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# **GEOLOGY OF TAYLOR COUNTY**

**BY**

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# GEOLOGY OF TAYLOR COUNTY

## INTRODUCTION

### SITUATION AND AREA

Taylor county is the third east of Missouri river in the south line of Iowa counties. It is bounded upon the east by Ringgold, upon the north by Adams and upon the west by Page county, while Worth and Nodaway counties in Missouri are upon its southern border. All of its sixteen civil townships are exactly conterminous with the corresponding congressional townships, but owing to corrections in the survey that fell within the limits of this county and to the fact that the state boundary upon the south does not coincide exactly with the section lines of a full township, seven of the townships have fractional section area of 540  $\frac{5}{8}$  square miles only, or 537 according to the Iowa Official Register for 1919-1920.

### PREVIOUS GEOLOGICAL WORK

Doubtless the earliest specific reference to Taylor county by any geologist is made by White<sup>1</sup>. He devotes a little more than three pages to the consideration of its drainage, geology and material resources. Brief reference also is here and there made to this county in the general discussion of the various topics of interest to the geologist, the most practical and interesting of which come up in allusion to the prospects of the occurrence of coal in the Upper Coal Measures, which immediately underlie the heavy drift deposits of the county. His statement that in this series only in the valley of the Nodaway may good coal be found and that only in a thin vein has not been confirmed wholly by later investigators.

In the present series of the Geological Survey of Iowa, Taylor county Coal and Coal Mining receive due attention in volumes II and XIX. Its clays are discussed in volume XIV, and the

<sup>1</sup>In the preparation of this report use was made of field notes of the late Doctor Calvin who spent several weeks in the study of the geology of Taylor county.

<sup>2</sup>Geology of Iowa, Vol. I, pp. 344-348.

Quarries and Quarry Products in Volume XVII in each case by Beyer and Williams, while Meinzer and Norton have treated the Underground Water Resources of the county in Volume XXI.

## PHYSIOGRAPHY

### Topography

The topography of Taylor county has been developed wholly in the drift excepting along the valley of the East Nodaway which for about seven miles cuts the northwest corner of the county. The great Kansan drift plain formed the original sur-

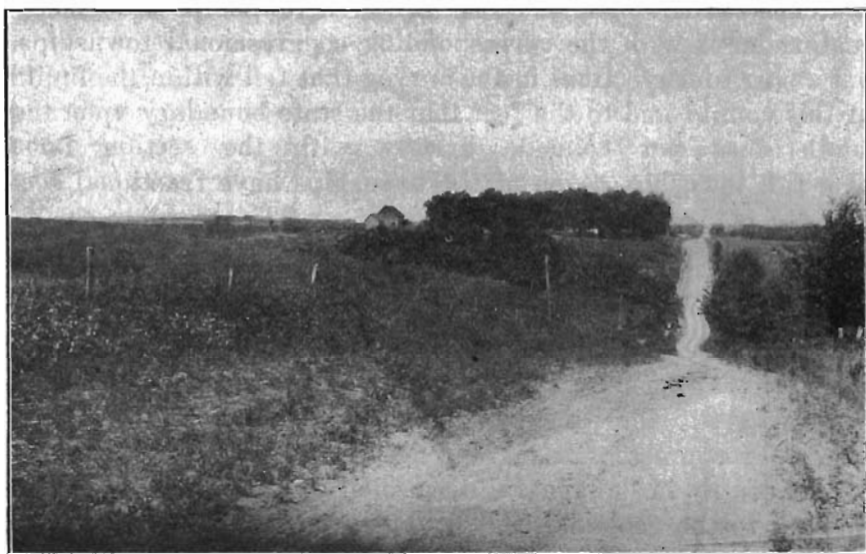


FIG. 7.—Rolling Kansan topography not uncommon in northern Taylor county. Photo by Calvin.

face which sloped gently a little to the west of south. In estimating approximately the slope of the general surface the altitude of Lenox, which is 1,293 feet according to one statement of Gannett, may be taken as very near the maximum for the county, since it is near its northern border and is situated on the uneroded Kansan plain. The altitude of Athelstan, which is 1,069 feet, may be considered as being not far from the minimum, it being near the southern border, south of Lenox in the valley of the Platte. The difference in altitude between the two

places is 224 feet. The relief at Athelstan is about 150 feet, leaving seventy-four feet to represent the slope in a distance of about twenty-two miles, or something over three feet to the mile. Today this plain at its southern border has been deeply dissected by a half dozen streams having the same general trend as the slope of the surface, dividing the drift into long, narrow, parallel blocks which have themselves been trenched and carved by the tributaries of the main streams and less deeply by secondary tributaries and only here and there are they crowned with small remnants of the original plain which through the long centuries that have passed since the retreat of the Kansan ice sheet have escaped all commonly recognized effects of erosion.

Naturally the south part of the county, where the streams have the greatest volume of water, has been most deeply eroded and it is in this part of the county that flat unchanged areas of the original plain are rarely to be found, though the interstream drift blocks are capped by numerous tracts that are but slightly

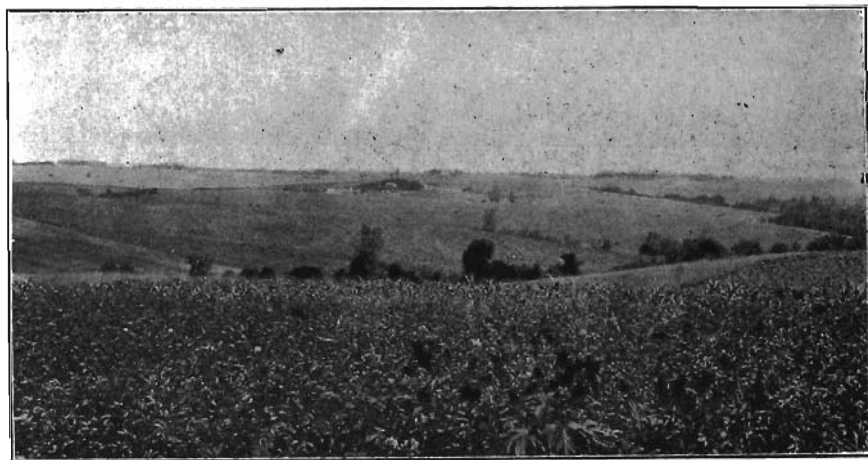


FIG. 8.—Kansan topography of northern Taylor county, showing the fairly even skyline. Photo by Calvin.

sculptured, or mildly dissected as yet. Further to the north these areas are larger in number and extent and where the headwaters of the smaller streams are found in the neighboring drift blocks, having lost their boundaries, coalesce, giving rise to a much less rugged topography, though where the larger streams enter the

county already carrying a considerable volume of water in the rainy periods, the topography of their valleys is well advanced, their flood plains being broad, and their valley sides being steep and well dissected. Where the tabular divides are unchanged by erosion, they are bordered by tracts that have been moderately sculptured, the succession of swells and depressions suggesting an Iowan drift landscape. The latter, however, presents a surface for the most part as it was left by the retreating ice, the erosional



FIG. 9.—Rolling Kansan topography in Taylor county showing the great width of the valleys. This view is suggestive of Iowan topography. Photo by Calvin.

changes being relatively slight, while the former is wholly the result of erosion. From this mild type of erosion are to be found all gradations to the somewhat mature forms of the south border.

The relief of different localities ranges from a few feet to 100 or 150 feet. In extreme cases it reaches 200 feet.

Platte township has more level area than any other, perhaps, since it is traversed by no large streams, the drainage being accomplished by headwater branches of East One Hundred and Two river. Its surface, even where it is most dissected, is capable of cultivation readily since the slopes are comparatively easy. Grant, Grove, Holt, Washington, Marshall and Gay townships have many considerable areas of a moderate erosional type, though all of them have deeply eroded stream valleys crossing



them. The other townships crossed by the lower courses of one or two of the larger streams have a higher per cent of rough land, though no inconsiderable part of their intervening territory with moderately sculptured surface affords much fine farm land.

The west tier of townships, Polk, Mason, Dallas and Nodaway, present the roughest topography, being traversed by the West Hundred and Two river which carries an unusual volume of water. Besides this strong erosional agent, Nodaway township is crossed by the vigorous East Branch of the Nodaway river and several tributary creeks some of which have cut completely through the drift and well into the shales and limestones of the Missouri, thus producing the maximum degree of ruggedness for the county. It is in these townships that the broadest flood plains and bottom lands occur, making compensation in part, at least, for that portion of their extent that has been marred by deep ravines and other forms of advanced erosion.

#### ALTITUDES.

The altitudes of the following places in the county are taken mostly from the later edition of Gannett's Dictionary of Altitudes:

LOCALITY	ALTITUDE	AUTHORITY
Athelstan .....	1069, C. G. W. R. R.....	Gannett
Bedford .....	1098, C. B. & Q. R. R.....	Gannett
Blockton .....	1081, C. G. W. R. R.....	Gannett
Clearfield .....	1250, C. B. & Q. R. R.....	Gannett
Conway .....	1140, C. B. & Q. R. R.....	Gannett
Conway Crossing .....	1158, C. B. & Q. R. R.....	Gannett
Gravity .....	1149, C. B. & Q. R. R.....	Gannett
Ladoga .....	1244, C. B. & Q. R. R.....	Gannett
Lenox .....	1293, C. B. & Q. R. R.....	Gannett
	1250, Weather Bureau .....	Gannett
New Market .....	1153, C. B. & Q. R. R.....	Gannett
Sharpsburg .....	1270, C. B. & Q. R. R.....	Gannett
State Line .....	1054, C. B. & Q. R. R.....	C. B. & Q. R. R.

#### Drainage

The drainage of the county is very nearly perfect. It is accomplished by branches of three small river systems. These rivers are tributaries of the Missouri, namely the Platte, One Hundred and Two and Nodaway. Platte river rises in Adair county, enters Taylor from Ringgold in section 15, Gay town-

ship, and leaves it near Athelstan, on the Missouri border, after a gently meandering course in a southwest direction through a beautiful flood plain. Just beyond the borders of the county the river turns abruptly to the west and in a course of six or seven miles receives as tributaries the West Branch and Honey creek, beyond which it flows south to its junction with the Missouri. Honey creek rises along the border of the tabular divide near Clearfield, and West Branch rises two or three miles farther south in Ringgold county not far from its western border. These two streams pursue a nearly parallel course at an average distance apart of about four and a half miles, at first in a southwest direction. The last third of their course through the county is southward. They have no perennial tributaries. Narrow flood plains more or less tree covered border them for nearly their whole length. The block of drift between them has a relief in the south of one hundred and fifty feet or more. This diminishes toward the north, disappearing entirely as the source of the head-water streams is reached. In Jackson township little, if any, of the original flat Kansan surface remains unchanged, but as one proceeds to the north, the relief lessens and rugged topography gives way to moderately sculptured interstream areas to be followed later by the tabular divides that have never suffered the ravages of erosion in any appreciable degree.

In the main there is little more to be said of the One Hundred and Two river system than has been said of the Platte system. East One Hundred and Two and Middle One Hundred and Two both rise within the limits of the county. The East One Hundred and Two is considerably larger than the other, having a course of about twenty-seven miles in the county and a drainage area of about one hundred and twenty-four square miles. Its course is southwest. Middle One Hundred and Two has little or no flood plain. Brushy creek is its largest branch. Having first united their waters, these two branches effect a junction five or six miles south of the Missouri border with the West Branch, which is really the main stream. The West One Hundred and Two rises in Adair county and its whole course in Taylor county is nearly due south. It has a fine flood plain

throughout the county, and also has the largest tributary of any of the streams of the county. The wretched system of nomenclature for the streams in some of the southwest counties of Iowa is well illustrated here, for according to the maps the West Hundred and Two river itself has a tributary on the east called the West Branch of One Hundred and Two river and it has another tributary on the east called the Middle Branch of One Hundred and Two river despite the fact that Middle One Hundred and Two river flows a little farther to the south in the same county. Though in the south half of its course the drainage basin of West One Hundred and Two river is not more than thirty square miles in extent, it is broader in the north half so that it has a total area of about two hundred and twenty square miles.

The East Branch of the Nodaway river, which in common with the Platte and West One Hundred and Two rivers rises in Adair county or very near its south border, passes in rather a meandering line through the west sections of Nodaway township and then in section 6 of Dallas township swerving to the west, enters Page county. It with its several small tributaries drains only about nine square miles of Taylor county. In its brief course it has cut through the glacial deposits and made several exposures of the Missouri shales and limestones.

It has been said that the drainage of Taylor is very nearly perfect. The exceptional cases are to be found in various portions of the county though more frequently in the northern than in the southern part, and consist of small areas of a swaley, boggy character for the most part on hillsides or in depressions between ridges in moderately sculptured regions. These places are due no doubt to rainfall entering the ground and soon reaching gumbotil, the impervious nature of which checks its downward progress, causing it to pass to the lowest part of the nearly flat area where a swampy patch will often be found, though sometimes it does not show itself at the surface, but in wet seasons manifests itself in damaged crops of corn or grain whose root system has thus been drowned out. Sometimes the

water reaches the eroded margin of the gumbotil on the bluffside where it slowly escapes by seepage, not in a single spot as a spring, but all along the hillside. Roadside cuts occasionally present the same phenomena.

In the country south of Ladoga the main depressions are swampy and on the slopes of the highlands the secondary depressions are too wet to produce good crops in wet seasons. Here the soil is moist and sticky, while, at the same time, in marked contrast the soil in sections 2, 3, 10 and 11, Bennington township, is granular, dry, easily crumbled and ideal for cultivation. Springlike seeps are found in the east half, northwest quarter of section 8, Mason township, in a sticky, tough, siltlike bluish deposit. In Marshall township there are small patches of very tough, siltlike, blue, sticky clay which makes seepy, miry places on the roads and more or less barren places in the fields. In Grove township there are flat sloughs between the rounded swells. An example may be noted in the northwest quarter of the northeast quarter of section 15. About the middle of the north line of section 23, Nodaway township, there is a broad slough, also another on the hillside in the northeast quarter of section 27, Nodaway township. Many other instances might be given. In each the association with gumbotil is such as to readily account for the conditions. See figure 17 for an illustration of this phenomenon.

### STRATIGRAPHY

While the Missouri immediately underlies the Pleistocene deposits everywhere in the county its exposures are very few. Aside from those already mentioned as being found along the East Nodaway and its small tributaries in the extreme northwest corner, a few others may be seen in and about Bedford along East One Hundred and Two river. Mantle rock belonging to the Pleistocene and the Recent is everywhere to be observed. It is quite varied in its manifestations and involves some of the most interesting present day problems that are engaging the attention of geologists, such as the origin of gumbo and some phases of loess.

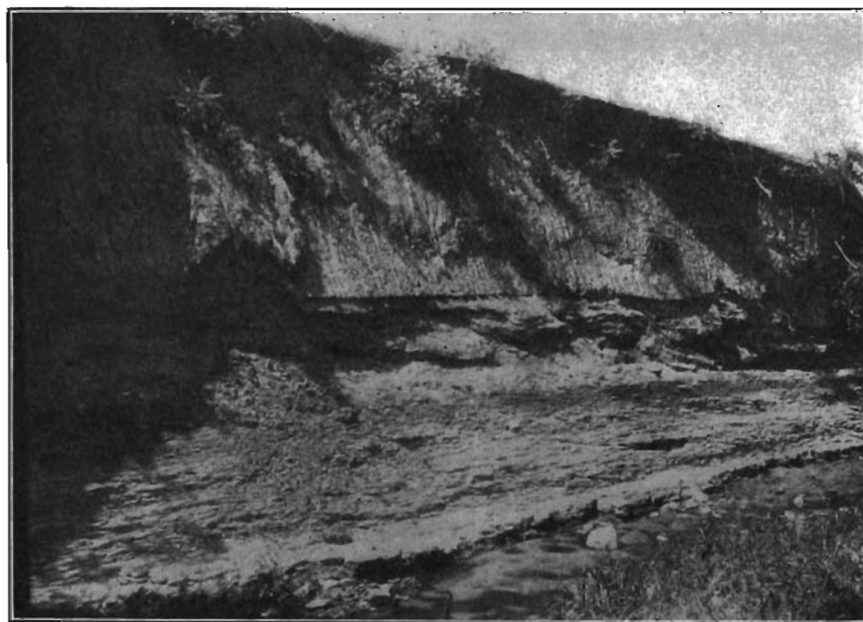


FIG. 10.—Missouri limestone overlain by loess; in the southwest quarter of the southwest quarter of section 7 of Dallas township, Taylor county. Photo by Calvin.

A table of the geological formations of Taylor county follows:

SYNOPTICAL TABLE.

GROUP	SYSTEM	SERIES	STAGE	CHARACTER OF ROCKS
Cenozoic	Quaternary	Recent		Soils Alluvium
			Yarmouth	Gumbotil (Kansan)
		Pleistocene	Kansan	Boulder clay, blue, jointed; pockets of sand and gravel
			Aftonian	Gumbotil (Nebraskan), forest beds, peat beds, soil beds, aqueous sands and gravels
			Nebraskan	Boulder clays, dark, friable
Paleozoic	Carboniferous	Pennsylvanian	Missouri	Shales and limestones

**CARBONIFEROUS SYSTEM****Pennsylvanian Series****MISSOURI STAGE.**

While the Missouri shales and limestones everywhere underlie the mantle rock, they outcrop in but two localities, near Bedford and in the valley of the East Nodaway in the northwest corner of the county. Limestone is exposed near the east end of the bridge east of the railway station at Bedford and again farther north near the river, where it formerly was quarried. This rock is referred by Calvin to the Forbes (Deer Creek) limestone.

There are exposures of the Missouri for half a mile along an unmapped tributary of the East Nodaway in the southeast quarter of section 29, Nodaway township. One of these is illustrated

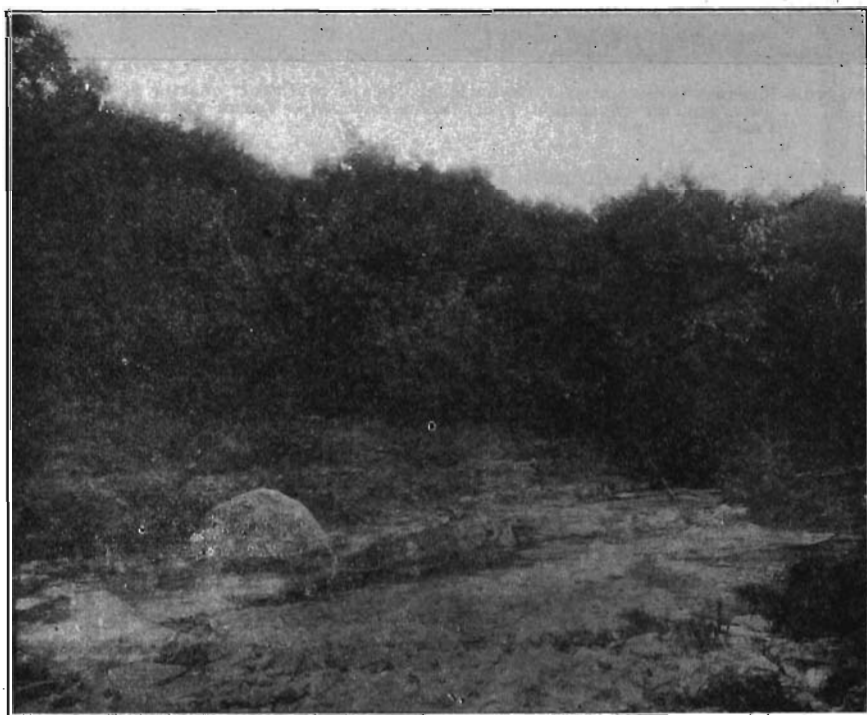


FIG. 11.—Exposure of cap rock with a big Kansan boulder; in the southeast quarter of section 29, Nodaway township, Taylor county, as it appeared in 1907. There are other exposures farther down the creek. Photo by Calvin.

by figure 11. Cap rock forms the platform on which the creek flows. In some places, however, it rises three and four feet above the usual water level, exposing below it two feet, more or less, of thin bedded shales and a foot of bastard rock very rich in fossils, *Ambocelia planoconvexa* especially abounding. Other exposures of the cap rock were observed in the northeast quarter of section 20 and in the north

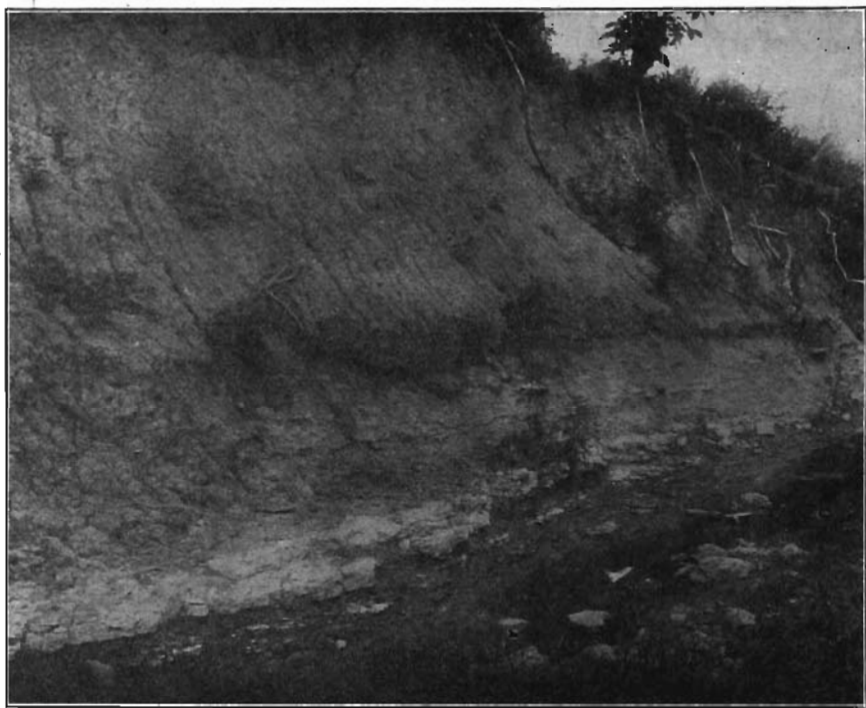


FIG. 12.—Exposure of Missouri limestone and shale overlain by gravel, "silt" and loess; southwest quarter of the southwest quarter of section 7, Dallas township, Taylor county. Photo by Calvin.

half of section 32, Nodaway township. Calvin gives the following section northeast of Hawleyville, Page county, along the west border of section 7, Dallas township. Figure 12 illustrates this outcrop.

	FEET
6. Loess .....	—
5. Blue silt .....	—
4. Gravel .....	—
3. Yellow weathered shale.....	4
2. Harder shaly limestone, containing <i>Chonetes granulifera</i> , <i>Fusulinas</i> and <i>Bryozoas</i> .....	1/2
1. Shaly limestone in the bed of the creek.....	2/3

The blue silt of Calvin mentioned above and elsewhere is undoubtedly the gumbotil of Kay<sup>3</sup>. Other exposures occur in this vicinity but aside from minor variations as to thickness and relative order of occurrence of the material further details are unnecessary.

According to Tilton the following beds must be represented here somewhere: Howard limestone, Severy shale (with its Nod-away coal seam), Topeka limestone, Calhoun shale, Deer Creek limestone.

#### THE BEDFORD WELL SECTION

*Missouri Stage*.—However, it should be of interest to note well the Missouri stage of the Bedford deep well section and so it is transcribed here from the section as given in the volume on the Underground Waters of Iowa<sup>4</sup>.

#### SECTION OF THE BEDFORD WELL.

DESCRIPTION OF STRATA	THICKNESS DEPTH	
	FEET	FEET
Pleistocene:		
Drift, no samples, no record.....	38	38
Carboniferous:		
Pennsylvanian—		
Missouri stage (722 feet thick; top 1,060 feet above sea level)		
Limestone, light gray, nonmagnesian, soft; earthy luster; permeated with minute ramifying smooth surfaced masses of calcite .....	6	44
Limestone, argillaceous, light gray, soft; earthy luster; and shale, plastic .....	6	50
Shale, drab, unctuous, noncalcareous; 8 samples.....	40	90
Shale, bluish drab, calcareous.....	5	95
Limestone, earthy, light blue-gray.....	5	100
Shale, drab, calcareous, 3 samples.....	15	115

<sup>3</sup>Kay, G. F., Gumbotil, a new term in Pleistocene Geology: Science, New Series, Vol. XLIV, Nov. 3, 1916.

<sup>4</sup>Iowa Geol. Surv., Vol. XXI, pp. 1183-1185, 1912.



## BEDFORD WELL SECTION

81

<i>Limestone</i> , light blue-gray, soft, argillaceous; with shale..	5	120.
<i>Shale</i> , drab, calcareous .....	5	125
<i>Limestone</i> and shale: limestone soft, whitish; rapid effervescence; numerous <i>Fusulina</i> ; encrinital, 5 samples...	25	150
<i>Limestone</i> , light gray, soft, earthy; a little chert.....	5	155
<i>Shale</i> , greenish drab; some limestone with crinoid stems..	10	165
<i>Shale</i> , as above; some black carbonaceous and a little blue-gray limestone .....	5	170
<i>Limestone</i> , light brown, white, gray, hard, compact; and greenish shale .....	5	175
<i>Limestone</i> , light blue-gray, argillaceous; and light yellow-gray with crinoid fragments; greenish shale.....	5	180
<i>Limestone</i> , yellow, gray, hard.....	5	185
<i>Shale</i> , dark brick-red, calcareous; 2 samples.....	10	195
<i>Shale</i> , greenish drab, calcareous, siliceous; and ocher-yellow, hard, siliceous, calcareous; 2 samples.....	10	205
<i>Shale</i> , hard, greenish drab; so highly siliceous with minute particles of quartz that it might be termed an argillaceous sandstone .....	5	210
<i>Shale</i> , greenish drab, plastic, pyritiferous; some hard, yellow fossiliferous limestone .....	15	225
<i>Shale</i> , blue-drab, soft, laminated; harder siliceous layers..	25	250
<i>Shale</i> , drab, laminated; 6 samples.....	30	280
<i>Shale</i> , drab, with some laminæ of black coaly shale.....	5	285
<i>Shale</i> , green, fossiliferous .....	5	290
<i>Shale</i> , green, fossiliferous; some drab limestone and chert.	5	295
<i>Shale</i> , hard, red; 2 samples.....	5	300
<i>Limestone</i> , hard, drab, with shale.....	10	310
<i>Shale</i> , drab, fossiliferous .....	10	320
<i>Limestone</i> , hard fine-grained, siliceous.....	5	325
<i>Limestone</i> , yellow-gray; and white, soft; earthy luster; 3 samples .....	15	340
<i>Shale</i> , green and black, carbonaceous.....	5	345
<i>Limestone</i> , soft, yellow, macrocrystalline.....	10	355
<i>Shale</i> , drab; 5 samples.....	25	380
<i>Shale</i> , drab; some drab limestone.....	5	385
<i>Shale</i> , drab; with sand of flinty drab limestone.....	5	390
<i>Shale</i> , reddish; with dark green-gray argillaceous limestone	5	395
<i>Shale</i> , red, a little brown siliceous limestone.....	10	405
<i>Shale</i> , drab, 4 samples.....	15	420
<i>Limestone</i> , light yellow-gray; crystalline in sand; 4 samples	20	440
<i>Shale</i> , greenish drab .....	10	450
<i>Limestone</i> , light yellow-gray; much shale.....	5	455
<i>Shale</i> , greenish; some drab limestone, flinty.....	10	465
<i>Limestone</i> , light yellow-gray .....	10	475
<i>Shale</i> , drab, 4 samples.....	20	495
<i>Limestone</i> , white; large fragments of shale.....	21	516
<i>Shale</i> , drab; some black at 516; with limestones at 525; 4 samples .....	19	535

<i>Limestone</i> , white and gray.....	15	550
<i>Shale</i> , black, fissile, combustible; and hard, gray limestone	5	555
<i>Shale</i> , dark drab .....	10	565
<i>Shale</i> , greenish; with white limestone in concreted powder	5	570
<i>Sandstone</i> , white, microscopic grains, calciferous; with shale .....	5	575
<i>Limestone</i> , white and light gray.....	10	585
<i>Shale</i> , dark drab .....	5	590
<i>Limestone</i> , hard, gray, siliceous; shale.....	5	595
<i>Shale</i> , dark drab .....	5	600
<i>Limestone</i> , yellow-gray, rather hard; much shale in large fragments .....	15	615
<i>Shale</i> , dark drab, nodules and masses of gray chert.....	15	630
<i>Shale</i> , light brown, calcareous.....	5	635
<i>Shale</i> , greenish; with gray limestone and chert.....	5	640
<i>Limestone</i> , gray; much shale.....	5	645
<i>Shale</i> , drab, black at 645; gritty at 650 and 655; with limestone at 670; sandy at 670, 675, 695, 700; coaly at 705..	65	710
<i>Sandstone</i> , fine, gray; 3 samples.....	15	725
<i>Shale</i> , dark drab; some black; fissile.....	10	735
<i>Limestone</i> , gray, finely arenaceous .....	10	745
<i>Shale</i> , dark, and reddish brown; 2 samples.....	10	755
<i>Limestone</i> , light gray .....	5	760

This is a typical section of the Missouri. There are in the 722 feet of thickness sixty-five strata as determined by the interpreters, Meinzer and Norton. Two of these are sandstone, twenty-four are limestone and thirty-nine are shales. The great majority of them range from five to ten feet only in thickness. Less than half the shales are simply argillaceous. Many of them are calcareous to a greater or less extent, or are thinly laminated with limestone. Others are carbonaceous up to the degree of being combustible or coaly. A few are siliceous, one being so much so as almost to warrant its being called an argillaceous sandstone. Only a few of the limestones are relatively pure. Some are shaly, or thinly laminated with shale. Others are cherty, flinty or otherwise siliceous. Fossiliferous beds are rare among both the shales and limestones. Shallow waters prevailed, but the depth and other conditions were constantly changing, now and then by comparatively abrupt diastrophic movements of the land or sea bottom or both, but for the most part by very gentle changes of level or of the relations of the land and water. Few of these individual strata are of wide extent, if we may judge from a consideration of other sections

of this stage, either partial or complete. In thinking of the conditions of the Missouri we are constantly reminded of the present day conditions of the northern margin of the Gulf of Mexico. There we find the extensive deposits forming shales, the small amount of sandstone area as at Ship Island and its vicinity and the limestones and shales of the Tortugas, etc.

*Des Moines Stage.*—Of the 580 feet of this stage the lower 180 feet are sandstone excepting two strata of shales five and fifteen feet thick interstratified with the two upper sandstone strata. The remaining upper 400 feet are wholly shales.

*The Mississippian Series.*—This series is 355 feet thick. At the very base are thirty feet of shales. Near the middle are two cherty strata. The rest of the section shows limestone exclusively.

*The Devonian System.*—In this section 130 feet belong to the Devonian system, of which 115 feet are limestone and fifteen feet are shale.

*Silurian System.*—Of the 575 feet belonging to the Silurian 120 feet are common limestone, 193 feet are dolomite, 130 feet are anhydrite marl, 30 feet are shale, 4 feet are marl and 20 feet are unknown.

#### THE MANTLE ROCK. THE QUATERNARY SYSTEM.

The Pleistocene contributions of Taylor county at once challenge the interested attention of the careful observer. The original materials of these contributions were doubtless very much like those of the same stages to be found in other counties where only the two oldest drift sheets have been laid down. But the changes wrought in them by the various agents of change during the immense intervals of the Pleistocene during which these agents have had free play, are unusually varied and somewhat confusing, but nevertheless of very great interest.

##### Pleistocene Series

##### NEBRASKAN STAGE

The material of this stage, the oldest of the glacial stages of Iowa, differs in its physical features so little from Kansan drift, that it is difficult to determine the age apart from certain materials which are associated with these drifts. When in southern

Iowa two drifts are found separated by gumbotil, a peat bed, or any other evidence of an interglacial epoch, the lower drift is assigned to the Nebraskan without much hesitation. Overlying the Nebraskan drift there is found, in many places in Taylor county and in other counties, a grayish, tenacious, thoroughly leached clay, which popularly is called gumbo, but which Kay has called specifically gumbotil<sup>5</sup>, and which Calvin, in doing field work in this county in 1910, frequently noted, giving it, for the sake of distinction, the name of blue silt. The comments in his note book upon the unusual occurrence of this material under the conditions in which he found it, show that he was becoming deeply interested in the problems it suggested and had he lived there is no doubt that he would have evolved a theory for its solution.

Some of the localities where the Nebraskan is exposed quite convincingly are given here. A few rods west of the northeast corner of section 16, Jefferson township, and also one-fourth mile west of the same corner a light blue siltlike material which occurs at intervals throughout the county seems to be overlain in the bank at the roadside by true drift and it is underlain toward the east by very red ferruginous till. Calvin thought this might be an inclusion of pebbleless Nebraskan in the Kansan. It may be, however, that the lower till is the weathered Nebraskan and the silt the overlying Nebraskan gumbotil.

In the west half of section 24, Clayton township, along the road passing through the middle of the section, exposures of Nebraskan gumbotil occur beneath Kansan drift. Similar exposures may be seen on both sides of Dougherty creek in Benton township. Along the south line of section 19, Benton township, near the southwest corner, Nebraskan gumbotil underlies residual gravel. A few rods north of the school house near the southeast corner of section 9, Benton township, an exposure presents the following section:

	FEET
3. Weathered Kansan with small pebbles, very red or brown...	2
2. Thin band of blue silt (or gumbotil).....	1/2
1. Weathered red till with much lime.....	2

<sup>5</sup>Kay, George F., Gumbotil, a New Term in Pleistocene Geology: Science, new series, Vol. XLIV, November 3, 1916.

Near the northeast corner of section 4, Benton township, a section shows weathered calcareous Kansan overlying a body of blue silt and apparently resting unconformably on it. This blue silt has many small pebbles in it. Nebraskan gumbotil occurs in a ravine north of Buchanan apparently below Kansan. One-eighth mile east of the southwest corner of section 9, Polk township, gumbotil appears below good Kansan. On a hill east of the center of the southeast quarter of section 15, Mason township, a section shows:

3. Typical calcareous Kansan.
2. Crumbly blue silt, Nebraskan gumbotil.
1. Kansan-like till (Nebraskan till).

It will be noted that the above cited instances are all in the townships of the south half of the county. This was to be expected since in the north half erosion is everywhere moderate except along Nodaway river.

#### AFTONIAN STAGE

The presence of Nebraskan gumbotil, at many places in Taylor county, separating the Nebraskan drift from the overlying Kansan drift, is the best evidence of the Aftonian age, which interval began with the retreat of the Nebraskan ice sheet and ended with the coming of the Kansan ice sheet. This Nebraskan gumbotil is, according to Kay, the result chiefly of the chemical weathering of Nebraskan drift during Aftonian time. Other materials, such as sand and gravel, peat, and vegetal matter, are included in the Aftonian. It is more than likely that sand and gravel in the bank of a small creek south of Adam's coal mine in the southwest quarter of the southeast quarter of section 24, Dallas township, is Aftonian, but sufficient determining data are not to be secured. Other similar cases might be cited. Frequent mention is made of meeting with wood and other forms of vegetal matter in putting down wells, but since most wells are relatively shallow, ending somewhere in the drift or just at the point of reaching rock it has not been thought worth while by the well digger to make and preserve the details of the changes in the character of the materials as they have been penetrated. The appearance of wood would impress the memory, but the depth and accompanying mineral materials would not be remem-

bered except in a very general way. A few instances where wood was found in sinking wells are here cited: The well at the Bedford schoolhouse; the well at the Fairgrounds; two wells in the southwest quarter of section 7, Ross township; two wells in the southeast quarter of the southeast quarter of section 13, Ross township; a well near the middle of the west line of section 2, Washington township; and in a mine shaft in the southeast quarter of section 34, Dallas township. In this instance the wood was encountered above a dark blue till believed to be Nebraskan. Even in the record of the deep well at Bedford, where all the details respecting the rock formations below the Pleistocene are given with the utmost particularity, nothing is given concerning the Pleistocene save its thickness, thirty-eight feet.

#### KANSAN STAGE.

The direct available knowledge of Taylor county as a portion of the earth's surface is confined almost wholly to the Kansan drift formation. It is dominant in thickness, in area, extent, in variety of phases in which it appears today, and, with the Nebraskan, in forming the basis in which the topography of the county has been wrought. Out of it has come the material prosperity of the people in the main. A restricted area in Nodaway and Dallas townships produces coal which comes from the Missouri. A few wells derive their water from the Aftonian, or Nebraskan, or even from the Missouri or still older rocks. Along the larger stream courses alluvial deposits of moderate extent are found. With these exceptions, it is the Kansan, Kansan everywhere upon which the people must depend for their substantial success.

The material of which it is composed was torn from the rocks of various kinds that lay in the pathway of the immense glacier that irresistibly ploughed its way from its central Canadian source south and southeastward, until it met its defeat in changed climatic conditions and was compelled to drop along the way of its retreat, its load of gathered rock substances now in large part reduced to a pulverized condition.

In its unaltered state Kansan till, like that of the others, is made up of argillaceous, calcareous, siliceous and ferruginous

matter in the main, the first named constituting by far the larger amount of its components. It is, then, a clay, dense, tough, not readily pervious, more or less plastic, of a dark bluish color, usually somewhat calcareous and with sand or gravel thoroughly intermingled, or in small pockets, streaks or bands of variable extent. Rock fragments of intermediate size are not uncommon, but bowlders are relatively not numerous. They are granitoids and greenstones mostly though quartzites, Cretaceous rock fragments and fossils are not infrequently found.

The lapse of time since the retreat of the Kansan ice sheet is variously estimated by geologists. Chamberlin and Salisbury offer as a minimum 300,000 years, as a maximum 1,020,000. The extent of this range indicates the degree of indefiniteness that attends all efforts to put estimates of Pleistocene time divisions into figures. But, when we consider the extent of the chemical changes that have been wrought in this ancient drift sheet and the erosional effects that may be observed in it wherever it has



FIG. 13.—Residual gravel exposed a few rods north of the middle of the east line of section 11, Marshall township, Taylor county. Photo by Calvin.

not been protected by later drift sheets, it is easy to conclude that the time under consideration was long, very long as we commonly estimate time.

The unweathered Kansan, of course, is found only in recent exposures such as the deeper road cuts, ravines and banks that have been eaten into by meandering streams. Overlying it usually is the weathered Kansan which has very much the same general makeup, although by oxidation, leaching and other forms of weathering, changes in color, compactness, toughness and perviousness have taken place; the degree of change varying with the distance from the surface, so that as a rule the weathered phase passes almost imperceptibly into the unweathered. In many places a thin layer of residual gravel overlies the weathered type. Figure 13 shows a good illustration of this feature. Practically all the gravel observed in the county has this position, which fact accounts for the small amount of



FIG. 14.—A road cut near the northwest corner of section 16, Jackson township, Taylor county, showing segregated lime plates and nodules near the surface of the old Kansan drift. Photo by Calvin.





FIG. 15.—A road cut near that shown in Figure 14 and showing similar lime plates and nodules near the surface of the old Kansan drift. Photo by Calvin.

available gravel to be found here. Exposures of Kansan drift occur under various conditions. Some instances have been noted in locating the Nebraskan. A striking fact about many of the exposures in this county is that calcareous material, in concretions of some form as a rule, is found, mostly in joints "even up to the grass roots". The weathered Kansan occurs almost everywhere in the county either directly at the surface or underlying loess and gumbotil and, perhaps, a layer of residual gravel. To designate localities, then, would be obviously unnecessary. Figures 14 and 15 are views of two such localities.

*Kansan Gumbotil.*—In some sections of the Mississippi valley a certain obnoxious type of clay has long been recognized popularly under the term "gumbo". In Iowa this material is found in the Kansan drift areas, and here it is limited to the tabular divides. The geologist busied with the many problems that have readily offered themselves for consideration, has almost wholly ignored this material until recently, so that geological

literature is signally void of more than incidental allusions to this specific product of the Pleistocene. Among the many contributions to the present series of the Iowa Geological Survey, direct or indirect references to gumbo are made only by Gordon, Bain, Keyes, Udden, Shimek and perhaps one or two others, so far as the present writer recalls and of these Udden and Shimek alone attempt to account for it genetically, though even then confessedly in a tentative way.

The term gumbo is sometimes applied to a mere surface prairie mud that, doubtless, needs no special consideration. Again it is applied to a tenacious clay found in alluvium, the origin of which may confidently be attributed to water deposition. A third type often found on the uplands of the counties in the southern part of Iowa has been regarded by several of the writers named above as a modified loess beneath which it is usually found and into which it appears to grade. So intimate seems the relationship that the term gumbo is seldom applied to it. It is regarded as a less porous and more thoroughly oxidized and leached loess that when dry resembles joint clay. Some have called it red clay for distinction's sake. In a few instances it has been called gumbo. Calvin in his unpublished notes upon Taylor county found this form of material so often thrust upon his attention that he became intensely interested in it and time and again so expressed himself as to convince the reader that it was a problem that would receive his strictest attention in writing up his report. The various names he gave to it indicated the doubts he had as to its genesis. The term he most often used, blue silt, seemed to imply that he thought it may have been in some way a water deposit. Many of these exposures in the southern townships which occur between distinct beds of till, we have referred in earlier pages of this report to the Nebraskan stage. The rest must be regarded as belonging to the Kansan.

Recently Kay, recognizing the chaotic condition of our knowledge of this whole subject and believing that the time was opportune for a more complete exposition of it than had been undertaken previously, availing himself of such data as were accessible, and after carefully examining the best known exposures of the material under consideration, has offered a theory

that seems to account for the upland phases of gumbo far better than any other that has fallen under our observation<sup>a</sup>. It may be noted that Bain<sup>7</sup> and others recognized the intimate relationship of what was sometimes called an altered loess, but which was the formation now under discussion unquestionably, with the loess above it. Kay reverses the order of genesis and makes the so-called loess or loesslike clay in these conditions the product of the weathering and concentration of the gumbo. The gumbo itself he regards as the result of the weathering during an exceedingly long time of the upper part of the Kansan drift, while erosion was inactive because the plain was not subject as now to surface drainage. This weathering was therefore chiefly chemical and resulted in the grayish, tenacious, thoroughly leached joint clay commonly known as gumbo, which has a thickness varying from a few feet to twenty feet or more. It grades downward into yellowish and chocolate-brown Kansan drift from three to seven feet in thickness below which is the unleached dark Kansan drift. All the gumbo observed in the county is to be accounted for under this theory more satisfactorily than under any other, excepting some of the alluvial type noticed in the flood plain of Platte river and which for the present may best be regarded as a fluvial deposit. To this upland gumbo for distinction's sake Kay has given the name gumbotil. Conditions being the same, gumbotil may have been developed in other interglacial stages and we have had occasion to refer to it as occurring in several of the southern townships as a phase of Nebraskan drift material.

A typical instance of the "blue silt" of Calvin is near the middle of the south line of section 15, Holt township, where it grades into loesslike clay above and into the weathered Kansan till below. This latter condition is so pronounced that Calvin's note reads: "This 'blue silt' is included in the drift and differs from loess." Again in describing a feature in the southeast quarter of section 27, Nodaway township, he speaks of "sloughy

<sup>a</sup>Kay, G. F., Some Features of the Kansan Drift in Southern Iowa: Bull. Geol. Soc. Amer., Vol. 27, pages 115-117; also Iowa Geol. Surv., Vol. XXV, pp. 612-615.

<sup>7</sup>Iowa Geol. Survey, Vol. IV, Keokuk County, p. 288 and elsewhere; also Iowa Geol. Survey, Vol. IV, Mahaska County, p. 243.



FIG. 16.—Marshy seeps on hillsides with dry land above and below. The land above the first belt of corn is too wet to plow. Southeast quarter of section 27, Nodaway township, Taylor county. Photo by Calvin.

ground well up on slopes, due apparently to deposits of 'blue silt' in the Kansan drift." In figure 16 one such locality is shown.

Similar exposures of the "blue silt" were noted in all the northern townships where erosion has cut through the upper portions of the drift only. As pointed out by Kay, "in the southwestern part of the state the Kansan gumbo which is in situ is found only where the divides, which are no longer distinctly tabular, retain the level of the former gumbo plain."

#### LOESS.

In the western part of Taylor county there is considerable typical yellowish loess of eolian origin, similar to the loess which is so prevalent in the counties nearer to Missouri river. This loess is well shown in the railroad cut at New Market, where the yellow loess in the upper part of the cut grades into gray loess below. Yellow loess is well shown in the numerous road cuts that have been made in recent years in connection with the improvement of the highways.

In the eastern part of the county there is little, if any, loess. There is, however, a loesslike clay, which is thought to be not of eolian origin but to be related more or less closely to the Kansan gumbotil. Such a relationship exists in the counties to the east of Taylor county\*. The explanation suggested by Kay for this loesslike clay is that it is the result of changes that have been going on at and near the surface of the gumbotil during the great length of time since the normal gumbotil was formed, and that, moreover, the loesslike clay, which is now found as a mantle on the Kansan drift on the slopes and divides that have been brought by erosion considerably below the level of the gumbotil plain, may be the product not primarily of wind action but chiefly the product of the weathering and concentration of gumbotil and related materials, and it may have been brought to its present position in connection with the development of the present topography by erosive processes.

#### The Recent Series

##### ALLUVIUM.

Wherever the topography is measurably mature, the larger streams for the most part are bordered with flat and fertile flood plains, ranging from one-fourth of a mile to more than a mile in



FIG. 17.—The broad bottom lands of Platte river above Blockton, Jefferson township Taylor county. Photo by Calvin.

\*Kay, George F. Some Features of the Kansan Drift in Southern Iowa: Bull. Geol. Soc. of Amer., Vol. 27, pp. 115-117. See also Iowa Geol. Survey, Vol. XXV, pp. 612-615.

width. The finest and largest of these, perhaps, are along Platte river. See figure 17. Formerly all these bottom lands were wooded and in many instances remain so up to the present time though their fertile character has tempted the farmer to convert them into cultivated fields to a large extent. Only in the case of the largest streams do these flood plains extend much into the northern half of the county, but along the Nodaway and the West Branch of One Hundred and Two river they are found well up to the north border of the county. Occasionally, as in section 10, Dallas township, no bottom land appears, erosion having failed to prepare the way for the Recent deposits. Superficially alluvium is a fine loamy silt, but in the deeper deposits sand, gravel and clay are to be found. The clay is usually tough and impervious and is commonly called gumbo. If the term gumbotil is to be used specifically for the siltlike weathered till as suggested by Kay, this alluvial silt may well retain the name gumbo as a distinctive term. In some instances in times of heavy rainfall the coarse elements of the till have washed down the steep hillsides and have covered the finer alluvium of the flood plain. This is the more likely to take place in the future as the slopes have become denuded of their natural protective covering of trees and bushes and the surface becomes loosened and roughened by grazing animals clambering over the steep slopes.

#### SOILS

Superficial mantle rock, whether of recent or long time exposure, commonly passes under the term soil and may vary greatly in composition, degree of disintegration, perviousness, etc., and consequently in its productive quality. Taylor county is dependent almost wholly upon agriculture for its prosperity. A large percentage of its surface, wherever the topography is not too rugged to admit of cultivation, is rich and productive. Loam, loamy loess, and alluvium constitute the varieties most highly valued. Clayey, sandy and gravelly soils are so insignificant in extent as to merit no more than the merest allusion. When gumbotil is near enough to the surface to constitute the

subsoil, it makes an ungenerous harborage for the roots of growing crops greatly to their detriment especially in wet seasons. Experience is demonstrating that even some gumbotil is amenable to wise treatment. It is no doubt true that sooner or later every portion of the county will prove to have its own unique method of response to the appeals of the skillful husbandman.

## ECONOMIC PRODUCTS

### Building Stones

In the early settlement of Bedford quarries were operated on the border of the town and quite a large amount of stone was taken out. The old school building and the old court house were built of local stone, but both of these buildings have been taken down, though a large pile of the stone is still to be seen near the creamery. It is a limestone of the usual Missouri type, yellow, clayey or earthy in part. Fossils are rare except as they are represented by comminuted fragments of *Fusulina cylindrica*. *Spiriferina kentuckiensis* was noted, also *S. limeata*, *Athyris subtilita* and *Lophophyllum profundum*. No quarrying has been done in this locality for many years. There is a natural exposure of this limestone at the southeast corner of the bridge east of the railway station.

*Boulders.*—In many counties of Iowa, especially those within the bounds of the Iowan drift, large, firm boulders of granite, granitoid and greenstone abound. These have been used freely for foundation walls and for other purposes where limestone is used ordinarily, but in Taylor county boulders and cobbles are so rare that their occurrence becomes at once a subject of remark. Many of them show evidences of weathering. On the south line of section 34, Mason township, is an unusually large bed of gravel in which were numerous small boulders and many cobbles, an exceptional case. An occasional boulder was seen in section 10, Dallas township. In the northwest quarter of section 13, Polk township, on the south side of the road a boulder two and one-half feet in diameter was noted. Residual gravel was on the other side of the road. Indeed the boulders seem to be associated with cobbles and residual gravel and sand of a residual nature. Sand and gravel, while frequently in

pockets, streaks or bands in the drift, or occurring in residual layers, are nowhere of such extent as to be of economic importance worthy of note. The largest bed of gravel seen was in section 34, Mason township.

#### **Roads and Road Materials**

Rough topography is so characteristic of the larger part of the county that hills, low or high, gently shaped or steep are the common feature of the roads. Skillful grading has already done much and will do much more to improve the roads over these hills. Gravel and crushed stone for road purposes are not obtainable to any notable extent within the bounds of the county. After grading and provisions for suitable drainage have accomplished their best for the roads, further improvements must come from the use of materials such as oil, gravel, crushed stone, and cement from without the bounds of the county.

#### **Clay Products**

Formerly brick yards were in operation in Lenox, Bedford, Blockton, Gravity and in the northwest quarter of section 30, Jackson township. In all these places excepting at Lenox the material used was an alluvial silt. The brick industry soon declined in most of these places, due in part to the fact that the demand for brick locally was never very great and also because the quality of the brick, while good, was not equal to the best and so brick was shipped in to a certain extent, thus still further restricting the market for the local product. At Lenox the manufacture of tile was added to that of brick and a flourishing business was done for several years. The plant was quite extensive in machinery and output, which in 1907 was about 600,000 brick. In 1910 nearly 400,000 tile were made. The material used was an upland siltlike clay. In the lowest two feet it is blue and sticky, quite like the blue silt that in this report has been called gumbotil. This is overlain by eight feet of a yellowish clay with ochery, ferruginous streaks running through it. The upper two feet is a dark loam. All these were used together. So far as can be learned this plant, too, has shut down, though the latest to do so.



### Coal and Coal Mines

Several natural outcrops of coal in the banks of the East Nodaway and its minor tributaries in Nodaway township led to the sinking of a shaft by J. R. Foster more than fifty years ago on the East Nodaway about two miles south of Henshaw. Coal of good quality was obtained. Mining developed slowly, however, for several years. It reached a maximum of about 24,000 tons in 1901. About thirty different mines have been opened in Nodaway and Dallas townships. Some of these shut down after a brief season of activity owing to difficulty in controlling water. The demand for the product of all mines not on the railroad is local and necessarily is limited in amount. Only five mines were operated during the winter of 1917-18. One of these, operated by the Pullens, about three-quarters of a mile east of New Market, has shipping facilities over the Chicago, Burlington and Quincy Railway. Its depth is 185 feet. Its product for the year was about 10,000 tons. A section follows:

	FEET
Soil .....	4
Yellow joint clay .....	20
Blue clay .....	6
Yellow clay .....	10
Black shale .....	100
Gray shale .....	35
Cap rock .....	5
Slate, variable .....	
Seam of coal.....	1½-2
Fire clay .....	—

In the southeast quarter of section 34, Dallas township, John Bean has a mine that was worked for a short time twenty years ago. Work was resumed in this mine in December of 1917 and continued through the winter months with four men employed. This coal sold for eighteen cents per bushel. It is Mr. Bean's intention to begin work again July 1, 1918. The shaft is seventy-five feet deep.

Near this mine is the Millison mine. The shaft, which is 125 feet deep, was put down in 1917. Six to eight men were employed during the winter of 1917. Water makes the operation of this mine somewhat difficult.

John Campbell operates the mine in section 32, Nodaway township, formerly owned by Nathan Wilcox. This mine was worked for seven months in 1917 employing four men at four dollars a day. The coal sold at twenty cents a bushel. The eighty foot shaft gives a section as follows:

	FEET
Clay .....	10-20
Gumbo .....	10
Yellow soapstone .....	20
Blue soapstone .....	10-15
Cap rock .....	4
Slate .....	3- 4
Coal vein .....	1½-1 2/3
Fire clay .....	3- 4

A little north and east of the Campbell mine is the McKinley mine, very much like the Campbell mine in most details, but it could not be operated much during 1917 on account of the water.

These mines, excepting the Pullen mine, attempt to meet only the local demand. Many mines well known for twenty years or more are shut down. A very common complaint is the scarcity of help. All the coal mined in this county is from the Nodaway seam which also supplies all the coal of Adams and Page counties. This seam is in the so-called Braddyville limestones (the part known as Severy shale), a part of the Shawnee division of the Missouri stage. There is no positive evidence that the coal-bearing strata of the older formations which are productive farther east and which are known to underlie the Missouri of Taylor county, contain veins of coal that could be profitably mined. Even if the veins are there they lie at such a depth as to preclude profitable mining under present conditions.

### Water and Water Supplies

Water supply conditions are in some particulars somewhat unique in Taylor county. An attempt was made at Bedford to secure an abundant supply of good water for the use of the city. With this intent a well was drilled to the depth of 2,400 feet. The only water of ample flow that was secured was salt, too salty to be fit for household or any other use. This expensive failure has checked and will check for many years any farther effort

of the kind in this county. The details concerning this well may be found in Volume XXI of the Iowa Geological Survey and will not be repeated here.

The present municipal supply at Bedford is taken from several large wells situated in the valley of East One Hundred and Two river which penetrate a heavy deposit of fine sand next to the limestone. The practical difficulty in securing a sufficient amount of water for the town lies in separating the very fine sand from the water. Fortunately, over the county at large water can very generally be secured by means of bored or dug wells of no very great depth. Should a larger supply be required, the need may be met usually by a cluster of such wells so related that a single pump serves all from the central well. Sinking a single well to a greater depth may serve the same purpose. For meeting the demands of the pasture, artificial ponds are resorted to quite effectively.

Few wells are reported reaching to the rock. More rarely do they enter it and no advantage seems to result. Most wells end in gravel or sand. Some end in the unmodified till, but such wells are not likely to be constant. Dug wells are giving place to bored wells which are sunk to a greater depth thus securing greater constancy. Wells on the flood plains are constant at a depth of twelve to twenty feet. The depth of a few wells in different localities is given. They will serve as good representatives of all the wells of the county.

At the creamery at Bedford rock is reached at twenty feet. In the southeast quarter of the southeast quarter of section 13, Polk township, rock was encountered at ninety-four feet, clay only being passed through in the drift. In the southwest quarter of section 7, Ross township, there are two good wells which extend seventy feet in the drift. In section 13, same township, two wells, one of ninety and one of one hundred thirty feet, are reported. Wood was found in each of these four wells indicating that they end near the base of the Kansan drift. Near the middle of the west line of section 2, Washington township, wood was encountered at the depth of seventy-seven feet, but no water was secured. Wells near Ladoga have reached a maximum depth of one hundred ten feet. At Clearfield water is secured at fifteen

to twenty feet. Around Guss wells average about forty-five feet, ending in blue clay. The public dug well at New Market ends in gravel at a depth of fifty-eight feet. Water stands fifteen feet below the surface quite constantly. Other wells here range in depth from thirty to sixty feet, depending measurably upon a difference in the superficial altitude of the individual well. About Gravity wells end in clay and range in depth from forty to forty-five feet but are not constant. Fifteen miles north wells of about the same depth, but ending in sand, are constant.

*Springs.*—Natural springs are not common enough to be relied upon very extensively. A few, however, of exceptional excellence occur. One is just east of the west line of section 34, Clayton township. Another is reported from the southwest quarter of section 21, Marshall township. Near the middle of section 9, Mason township, there are three and another is in the northeast quarter of section 10, same township. These springs have their origin in about the same conditions as the seepages spoken of in this report under the topic, Drainage. But in the case of the springs the conditions prevail over larger areas and the lay of the land brings the water to a single outlet rather than to many. Indeed some of the seepage places might be made to resemble at least temporary springs.

#### **Forests and Forestry**

Trees still occupy the flood plains of the streams in many places, though the fertility of the alluvium of these plains has led to their transformation from woodlands to tilled fields in perhaps a majority of cases. A fringe of trees along banks of the streams has been left not infrequently. This is particularly to be commended, since the tree roots help to prevent wash which, unrestrained, would result in meandering that ultimately would mean the removal of all the alluvium over most of the flood plains. The bluffsides that border the plains and the ravines that gash the bluffsides as well as other places where the topography is too rugged to be cultivated are more or less tree clad. But the stand of trees in all these places is of nature's own choosing and is wholly under nature's care. Usually these places are pastured and the best nature can do is greatly marred

and hindered, if not practically made valueless by the trampling and browsing of cattle. Too often the trees prevent good pasturage and the stock prevent profitable tree growth. It is hard to estimate the economic waste that ensues. It is certainly unfortunate that in such counties there is not at least one farmer that, amid the multiplicity of things to which the tillers of the soil have to give attention, does not see what an opportunity is here for the display of profitable effort in introducing an application of the principles of forestry. The general impression seems to prevail that only on a large scale can this be done by lumbering corporations, for instance, or by the state, or nation. As a matter of fact, however, the benefits of a judicious use of these principles might be experienced in hundreds of places in Taylor county. A piece of rough land could be fenced, set out with a choice selection of seedling trees, or planted with nuts and seeds. With less care than an ordinary crop would require, in a few years, it would become a wonderful object lesson to all beholders. The trimmings and thinmings would soon pay for the trouble in making them and at the same time the value of what remained would be enhanced by the operation. From being a profitless acre, it would become a part of the farm to be reckoned with, having a distinct and increasing value. Besides yielding fuel and wood material always in demand about the farm for a great variety of purposes and the ever more and more valuable stand of timber, it puts a check to the wash of hillsides and to the encroachments of the ravines by headward erosion into the tilled fields, a process that is reducing the remnants of the tabular divides more rapidly than is realized ordinarily. In many instances too, the product of such erosion, if unchecked is spread over the flood plains making waste land where before had been rich alluvium only. The birds, those tireless, but too often unappreciated friends of man, would find added encouragement and make inestimable returns for such encouragement. With a small increase of time and effort this area could be increased until all the unprofitable part of the farm could be converted into a remunerative tract competing with the better portions in economic efficiency.

By observing the kind of trees found growing naturally in the county, no mistake could be made in selecting species adapted to the local conditions of soil and climate, though other valuable species known to flourish elsewhere under quite similar conditions might be sparingly introduced by way of experiment. The following trees were noted in thrifty condition: *Juglans nigra* L., Black walnut; at home in all parts of the county; *Carya ovata* K. Koch, Shell-bark hickory; *Quercus alba* L., White oak; *Ulmus americana* L., White elm; *Tilia americana* L., Basswood; *Acer saccharinum* L., White maple. These are among the more valuable kinds more commonly seen. Butternut and pignut hickories, a half dozen other species of oak, the honey locust, the black cherry, two species of ash and several other kinds were not uncommon. A few specimens of the hard maple were seen along the streets of some of the towns. Its value in so many ways ought to make it a popular tree for general planting.

#### ACKNOWLEDGMENTS

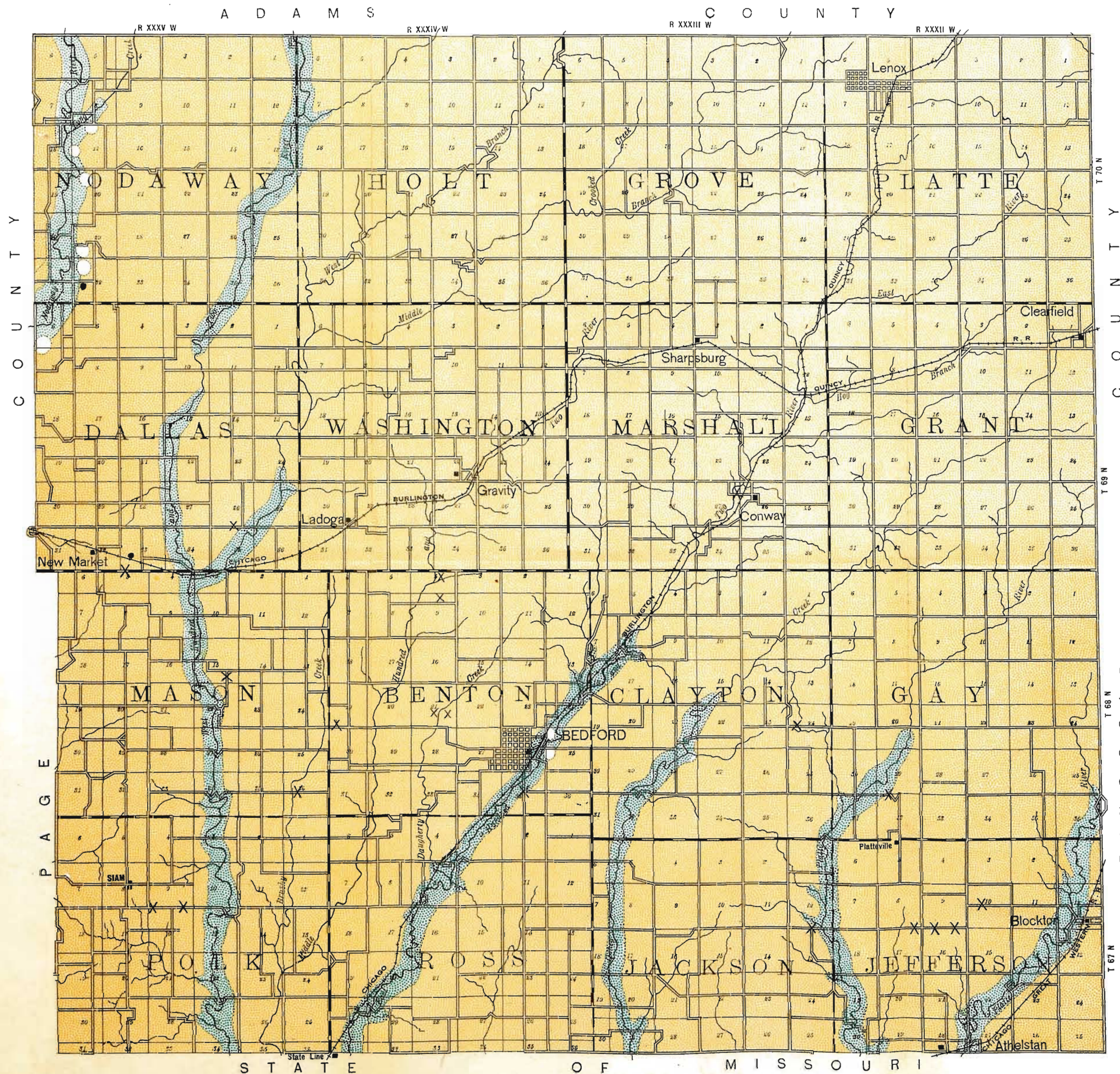
In August, 1907, the former State Geologist, Dr. Samuel Calvin, made a partial survey of Taylor county and in July, 1910, he completed the survey. His death in 1911 occurred before he had written the report. When his notes were placed in my hands with request that I prepare a report upon the county, I knew that so far as field work was concerned nothing was left for me but to go over the ground and recognize for my own sake the points of interest that he had noted. I desire now to express my very great indebtedness to him in the preparation of this report not only for the character and fulness of his notes, but also for his interpretation of their significance as it occurred to him while in the field. The details are remarkable. Nothing escaped the keen observation of this veteran investigator. Only a very small proportion of them need appear in the report, but they have been most useful in verifying and establishing general truths and principles. Nothing seemed to awaken his interest more than the frequent occurrence under very varied, but nevertheless related conditions, of what he usually called "blue silt", though sometimes he suggested that it might be gumbo, or Nebraskan till. It had plainly challenged his interest. His pur-

pose to give it the fullest consideration in the preparation of his contemplated report is everywhere manifest. I can only feebly express my obligation to my late esteemed friend for his part in this report.

The thanks of the writer are due to the present State Geologist, Dr. George F. Kay, for his helpful suggestions, especially in reference to his theory of the origin of the loesslike clay in Taylor county and of the immediately underlying gumbotil (the blue silt of Calvin), support for which theory is particularly abundant and convincing throughout the county. The uniform courtesy shown to the writer by all those to whom he has applied for information or other assistance is hereby cheerfully acknowledged.







IOWA GEOLOGICAL SURVEY

MAP OF THE  
SURFACE DEPOSITS  
OF  
**TAYLOR**  
COUNTY  
IOWA

BY  
M. F. AREY  
1916

Scale 1:25,000  
1 2 3 4 5 Miles  
1 2 3 4 5 Kilometers

LEGEND

GEOLOGICAL FORMATIONS

- ALLUVIUM
- KANSAN DRIFT IN PLACES  
OVERLAIN BY LOESS
- EXPOSURES OF NEBRASKAN  
TILL OR GUMBOTIL
- MISSOURI LIMESTONE

INDUSTRIES

- COAL MINES