GEOLOGY OF FRANKLIN COUNTY.

BY

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CONTENTS.

INTRODUCTION.

LOCATION AND AREA.

Franklin county stands fifth from the Mississippi and seventh from the Missouri river in the third tier of counties from the Minnesota line. The county lies between Cerro Gordo and Hardin counties to the north and south respectively; while Butler and Wright counties form the east and west boundaries. In outline it is square and contains sixteen standard sized townships. It has an area therefore of 576 square miles or, 368,640 acres.

The county was organized in 1855, prior to which time it had been under the judicial rule of Chickasaw and later of Hardin county. The name Franklin was given in honor of Benjamin Franklin; the first county seat, which was located two miles south of the present site of Hampton, being called Benjamin.

EARLIER GEOLOGICAL WORK.

The area under discussion was traversed previous to 1852 by parties under the direction of David Dale Owen* in tracing the boundary between the Devonian and Carboniferous systems.

Dr. C. A. White† states that the Kinderhook limestone outcrops along the Iowa River in Franklin county. Careful search at the present time failed to reveal any exposures of this formation along the Iowa in the county. In Volume II of White's report‡ published the same year, a general review of the geology and natural resources of Franklin county is given. All the indurated rocks exposed in the area were by this author referred to the Kinderhook. The present study indicates the presence of Devonian rocks in West Fork and Ingham townships. Exposures of shales and limestones may be frequently observed in the neighborhood of the West Fork of the Cedar River, which bear typical Devonian fossils, thus leaving no question as to their identity.

The course of the Altamont moraine in Iowa has been traced by Warren Upham and a detailed description of the position and nature of its most conspicuous ridges in Franklin county is given in the Ninth Annual Report of the Geology and Natural History Survey of Minnesota, page 303.

*Geological Survey, Iowa, Wisconsin and Minnesota, p. 105, 1852.
†Geology of Iowa, Vol. I, p. 194, 1870.
‡Geology of Iowa, Vol. II, p. 239 et seq. 1870.

Of the counties adjacent to Franklin, Cerro Gordo to the north and Hardin on the south have received attention by members of the present survey. * †

The clays of Franklin county are briefly treated in Volume XIV of the present series of reports‡. A section of the Lime Creek shales exposed in a clay pit one-half mile south of Sheffield is described in some detail as the only exposure of these shales then known in the county.

The peat deposits of the county are described and some estimates made of the quantity and availability of this class of fuel by T. E. Savage** in a Bulletin of this survey.

PHYSIOGRAPHY.

TOPOGRAPHY.

The surface features of Franklin county are such that it can primarily be separated into two fairly distinct districts. The boundaries of these districts have been determined by the deposition of glacial detritus from the two ice sheets last to invade the territory. Essentially the eastern tier of townships and the two upper members, Ross and Mott, of the second row, are included in the area of Iowan drift. The remainder of the county, approximately five-eighths of its total area, is covered with the more recent Wisconsin glacial till, and its topography is, as a result, characteristically immature.

The boundary line between these two provinces is somewhat irregular, but with few exceptions the differences in surface configuration are so marked that there arises no question as to its location. Its course across the county is in general from west of north to east of south. Entering two and a quarter miles from the east border of Richland, and passing one mile to the west of the city of Hampton, it divides Reeve township diagonally nearly into halves and detaching somewhat more than one and one-half square mile from the northeast corner of Grant, makes its exit into Hardin county two and one-quarter miles east of the western boundary of Osceola township. To the suspecting observer, who is already familiar with the trend

*S. Calvin, Geol. Cerro Gordo Co., Ann. Rep. Iowa Geol. Survey, Vol. VII, 1896.
†S. W. Beyer, Geol. Hardin Co., Ann. Rep. Iowa Geol. Survey, Vol. X, 1899.
‡Clay Industries of Iowa, Ann. Rep. Iowa Geol. Survey, Vol. XIV, p. 402, 1904.
**Iowa Geological Survey, Bulletin No. 2, pp. 13 and 20, 1905.

of this dividing line in the counties to the north and south, there is much of suggestion as to its probable course in Franklin county to be obtained from the ordinary civil map which shows only legal boundaries, railroads and streams. Perusal of such a map will show the prevailing courses of the streams within the Wisconsin area to be eastward. Just before breaking through the moraine these streams, without exception, assume a northeasterly direction, with many sharp turns and windings, as though seeking a vulnerable point of egress. Outside of the Wisconsin they at once assume the uniform south of easterly direction of flow.

On closer inspection of each of these two areas, it will be found that they again break up into more or less well defined districts according to, and depending on, the particular type of land form predominating. The Iowan drift area may be considered in two parts, first, that portion whose surface features are due to the materials of the Iowan drift; and second, that part whose topography depends on the earlier erosion of the limestones and shales of the older formations and later modifications by loess deposition. The Wisconsin drift area is separable into the Altamont moraine and the more level portion of the drift surface to be designated the drift plain.

IOWAN DRIFT AREA.

About three eighths of the county are covered with drift of Iowan age. But the materials of this sheet of drift are not alone responsible for the topographic features of more than one-third of this area. The Iowan till sheet is relatively thin wherever observed in the state, and it becomes more attenuated near its southern border, which crosses eastern Hardin county some nine miles south from the Franklin county line. The thickness of this deposit in Franklin county is, over considerable areas in Ross, West Fork, Reeve and Osceola townships, sufficient to disguise largely pre-existing features and to exert a ruling influence on the present topography. Away from the streams in the townships mentioned the land surface is in general level, often monotonously so for miles, the characteristic Iowan drift plain. This is especially true of portions of Ross and West Fork townships. The surface is occasionally broken by the trenching of the smaller

streams whose valleys are seldom cut to any considerable depth however, without exposing the underlying shales or limestones. The landscape is occasionally varied by the presence of the usual large fresh granite bowlders which characterize this drift.

In the vicinity of the larger streams and in fact over a good share of Mott, and especially in Ingham and Geneva townships, the land surface is more hilly and rugged. This would be expected as a result of the down-cutting of the streams no matter what the material in which they had to work; but here the relief is due very largely to the outcropping or barely covered ledges of Kinderhook limestone. Along the West Fork of the

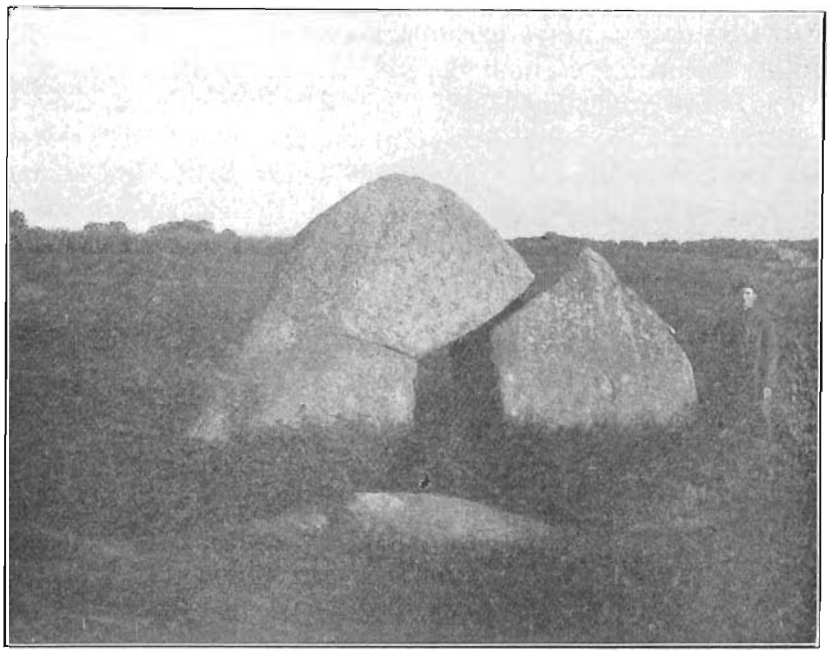

Fig. 52—Red granite bowlder of Iowan age, Southwest Section 25, Reeve township, on the farm of Mr. Jacob Kurtz.

Cedar river the Devonian strata are responsible for many of the prominent topographic features. East of this river hills of limestone underlain with shales form the bounding walls of the valley, and outcrops are common in the northwest part of West Fork township. The area westward from this stream to the border of the Carboniferous rocks has the characteristic mild

topography of the Lime Creek shales, somewhat modified by the Iowan drift and loess, and is in contrast with the more pronounced reliefs imparted by the Kinderhook limestone as will be later noted.

The practical absence of the earlier Kansan drift as a factor of topographic importance may be accounted for by erosion preceding the Iowan stage. The indurated rocks are therefore the chief determining factors, but these, while commonly outcropping on the hill slopes and along the borders of the river valleys, are universally capped with a thin layer of drift and a greater or less thickness of loess.

The occurrence of loess overlying Iowan drift has been recorded by Calvin in Mitchell county,* by Beyer in Marshall† and by Savage in Tama‡ and Fayette** counties, and is known at various other points in the Iowan drift area. It is usually but a thin veneer and seldom sufficient to exert a controlling influence on topography. In the portion of the Iowan drift area in Franklin county just outlined, however, the characteristics of typical loess topography are unmistakeable. While the Iowan is in most places in this county covered with a loess-like material, it is here only that its presence becomes conspicuously noticeable. A series of loess covered hills, growing in prominence northwestward, extends from the county line in east Ingham to the southeast corner of Ross township. The hills are supported by limestone and represent the extreme northeasterly outliers of the Kinderhook. The more prominent eminences rise frequently fifty to sixty feet above water in the streams. A similar series of hills extends across northern Geneva into the southern part of Mott township. They are also to be found south of Mayne Creek in Geneva and north Osceola townships. In general, the larger streams are skirted by loess-erosional hills of this type.

In some respects these land forms resemble the paha described by McGee§ as occurring in Delaware, Fayette, Bremer, Benton and other counties in this section of the state. The

*13th Ann. Rep. Iowa Geol. Survey, p. 329.
†7th " " " " " Drift Map.
‡13th " " " " " p. 242.
**15th " " " " " p. 330.
§Pleistocene History Northeastern Iowa, 11th Ann. Rept. U. S. G. S., Pt. I, pp. 404, 451 and 457.

nuclei of such elevations are of indurated rocks, they are always crowned with loess and stand at times considerably above the level of the surrounding drift plain. T. E. Savage* describes the paha of Benton county as being hills of Kansan drift which were surrounded by the Iowan ice but were not submerged. Neither this explanation nor that of McGee which considered

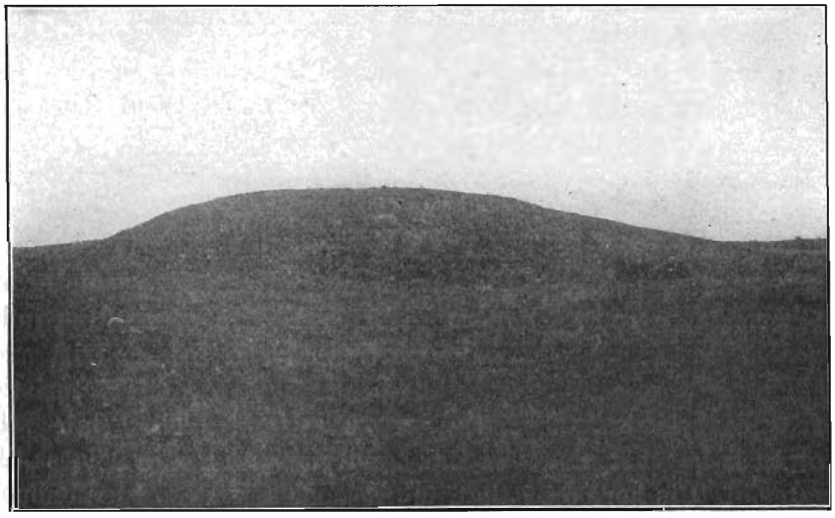

Fig. 53 An isolated knob of Kinderhook limestone in the valley of Mayne Creek, Section 18, Geneva township.

them due to glacial erosion of the drift or of the underlying indurated rocks appears to be applicable to the hills in Franklin county. Wherever observed in section, a moderately heavy mantle of loess rests on Iowan drift, which is usually thin, and reposes directly on the limestone of the Kinderhook. There is no evidence of ice moulding in the contours of the surface. The Iowan ice appears to have spread a thin stratum of detritus over hill and valley alike but not great enough in amount to conceal the irregularities of the pre-Iowan land surface. The nuclei of limestone, probably shaped to some extent by the movement of the ice upon them, and standing somewhat above the average level of the plain, were then objects or obstacles upon and around which the accumulation of the fine grained, wind drifted loess materials seems to have taken place.

*Iowa Geological Survey, Ann. Rep., Vol. XV, p. 142.

WISCONSIN DRIFT AREA.

Essentially five-eighths of the area of the county are included in the region occupied by the Wisconsin drift. This region displays two types of surface, the hilly, knobby tracts of the Altamont and Gary moraines and the relatively level drift plain.

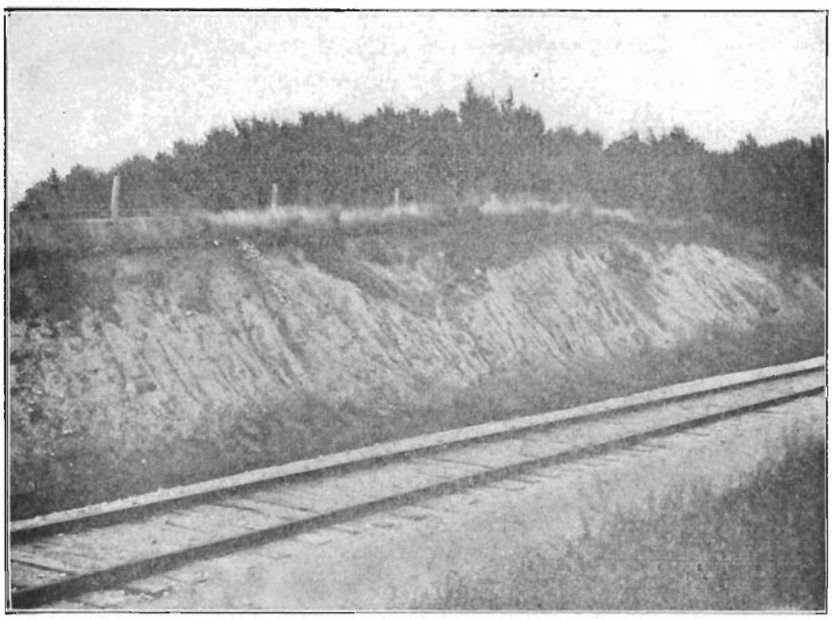

Fig. 54—Wisconsin drift showing gravel pockets, Chicago Great Western Railway cut two miles west of Hampton.

The Moraines.—The eastern border of the Wisconsin area is in general marked by a belt of hilly country varying in width from two to seven miles. In Richland and north Marion townships it has an average width of four to five miles, broadening southward so as to include practically the southern half of Marion and nearly three square miles in the southwest corner of Mott township. This outer zone of hills narrows in its course to the southeast across Reeve, and in Grant and Osceola townships is but two and a half to three miles wide.

The hills in this morainal area are not prominent, and the topography grows milder to the westward, gradually merging into the drift plain. This is especially true in Richland, Marion and Grant townships. Passing from the Iowan to the Wisconsin

drift there is a rise in elevation of from twenty to eighty or ninety feet, the most noticeable relief being in the northern part of Reeve township. Here the rise is rapid to the summits of conspicuous ridges of drift that were deposited close to the ice border, and beyond which a fairly high slope leads to the level of the drift plain in north Hamilton township. Throughout this morainal tract the surface is one of mounds and rounded hills, knob-like in places, composed mostly of gravelly drift, and interspersed with ponds and marshy depressions. In fact, the presence of the latter must in some localities, for example west of Hampton in southwest Mott township, be largely depended on to establish the position of the edge of the Wisconsin. Occasional kame-like hills are found in portions of the moraine which, where they have been dissected, prove to be composed of partially stratified gravel and sand. Such are common in southwest Marion township.

The belt just described may be termed the outer moraine in contrast to the more pronounced marginal topography in the southwest townships of the county, and marks the extreme limit of the eastward advance of this ice sheet. To the west, and occupying portions of Morgan, Oakland, Hamilton, Lee and Grant townships is a series of crescentic ranges of morainal hills which exhibit on a grand scale the features of a terminal moraine. Reference to the Pleistocene map will show the position of the principal ridges. They as a rule fade away into the general upland to the north and cannot be traced far in this direction.

From the main range, which enters the county at the middle of the west side of Morgan township and is two miles wide, spurs lead off into north central Morgan and into west Hamilton townships. A more or less connected series extends from northwest Grant into southern Hamilton township. The central range extends through southern Morgan, across the northeast corner of Oakland and then swings due eastward across central Lee township where it joins with the spur from the northwest already mentioned. A crescentic spur from the main chain extends southeastward into east Oakland, and a similar though more prominent one, through south central Lee and into Hardin county.

Warren Upham has the following regarding the nature of this portion of the moraine;* "This belt is very rough, with many hillocks and short ridges, generally trending in the same direction with the series, composed of till with abundant bowlers, and divided by depressions which often contain sloughs or lakelets. Its height is fifty to seventy-five feet above the smooth areas of till on each side, and about one hundred feet above the Iowa river." The series of hills comprising this inner moraine is conspicuous for miles when approached from the north and especially so where they cross Lee township. In the northern part of this township in an area five or six miles long by one mile wide known as the "Big Slough". A body of water of some size seems to have been confined here at some former time by the wall of high drift hills to the south. One of the headwaters of Mayne Creek now flows through this depression.

The morainal features just described undoubtedly mark the position of portions of the ice margin during extended halts in the recession of the Wisconsin glacier. There appears to be little of system in the arrangement of these ridges, but in general it may be noted that the spurs leading from the central belt are concave to the west and that as a rule the more abrupt slope is to the east. The inner moraine closely approaches the outer in Hamilton and Reeve townships, but southwestward it again departs in its course through western Hardin county. Traced southward, it can be connected with the concentric chains of hills in northern Story county, which are recognized as belonging to the Gary moraine†. The Gary moraine represents a stage in the melting of the ice when its southern point stood at Mineral Ridge in northern Boone county and the position of the east edge of the lobe at that time is marked by a more or less continuous series of hills and mounds paralleling the outer moraine, the Altamont, and at times merging with it.

In the northeast corner of Hancock county it separates from the maze of hills of the Altamont and the Antelope moraine of Upham, to approach the former again in southern Franklin county. From here the two distinct moraines again stretch southward to join once more in northeast Story county.

*9th Ann. Rept. Geol. and Nat. Hist. Surv. Minn., p. 303, 1881.
†See S. W. Beyer, Iowa Geol. Survey, Vol. X, p. 28 and Vol. IX, p. 161.

Wisconsin Drift Plain.—Outside of the morainal belts the surface of the drift is substantially a plain varied only by occasional low ridges of drift or knobs of sand and gravel and the usual numerous ponds and marshy places. Drainage is practically lacking, except in close proximity to the larger streams. Such is the topography of Wisner and Scott townships. Portions of Morgan, Hamilton, Oakland, Lee and Grant townships are to be included in the drift plain, but the relief is in general greater because of the more or less promiscuous disposition of the morainal hills in these townships. South of the Iowa river in Oakland township the surface is unusually level, and shallow ponds and 'sour' places in the land are common.

ALTITUDES.

In the following table is compiled a list of the elevations of some of the principal points of the county.

LOCALITY.	ALTITUDE A. T.	AUTHORITY.
N. Co. line, one mile E. of N. W. corner,	1256 feet	C. G. W. Ry.
Alexander	1261 "	I. C. Ry.
W. Co. line, C. G. W. Ry	1239 "	C. G. W. Ry.
Coulter	1239 "	" "
Hampton	1137 "	" "
Hampton	1151 "	I. C. Ry.
Hansell	1029 "	C. G. W. Ry.
E. Co. line, C. G. W. Ry	991 "	" "
Dows	1167 "	C. R. I. & P. Ry.
Popejoy	1176 "	" "
Burdette	1196 "	" "
Sheffield	1084 "	I. C. Ry.
Chapin	1165 "	" "
Geneva	1110 "	" "
Faulkner	1113 "	" "
Ackley	1103 "	" "

The localities in the above list which have the greatest altitude are in the west and northwest portions of the county. They are situated on the Wisconsin drift plain. The part of the county occupied by this newer drift averages 75 feet higher than the Iowan drift area. No elevations are given of the highest portions of the morainal areas. It is safe to say that numerous points could be found in the moraine in Reeve, Morgan and Lee townships with altitudes at least fifty feet greater than the highest figures given in the table.

DRAINAGE.

The drainage of the county may be considered with reference to the two drift sheets which occupy its territory. There is a marked difference in the development of the streams in these two provinces. With the exception of the Iowa river, all the streams of any considerable size are practically confined to the Iowan drift area. Some of these head in the ponds and marshes of the Wisconsin drift but the areas drained by such headwaters are very limited.

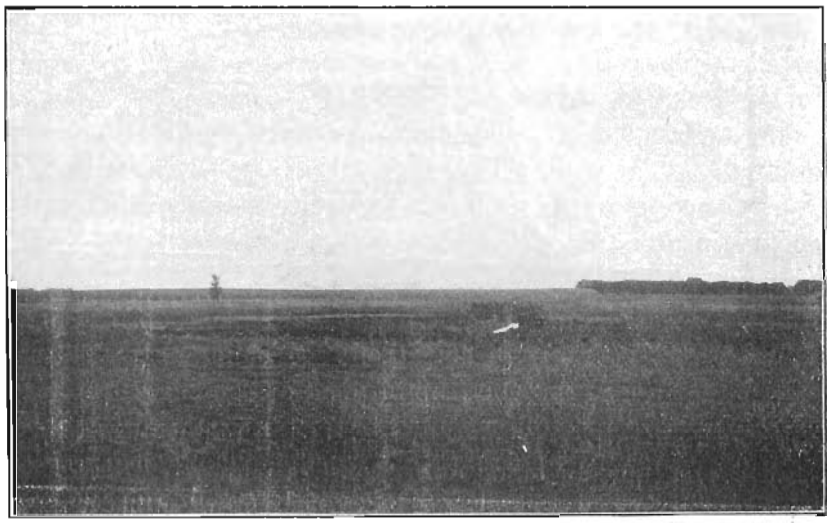

Fig. 55—The glacial pond and modern method of its elimination.

Viewed as a whole, the general direction of the streams indicates the slope of the country to be to the southeast. The figures given in the table likewise suggest an inclination in this same general direction. The maximum difference in elevation between any two points mentioned is two hundred seventy feet between Alexander and the county line at the east side of Ingham township, giving a gradient of approximately ten and one-half feet to the mile.

All the streams in the county, excepting the Iowa river, belong to the Cedar river system. The West Fork of the Cedar is the parent river and, while not the chief drainage way, is joined before it reaches the Cedar by Hartgrave and Mayne creeks,

the most important waterways in the county. Beaver, with its branches, which tap a small area in the southeast corner of the county, flows directly into the Cedar in Black Hawk county some distance below its confluence with the West Fork.

West Fork of Cedar River.—This river with its several small tributaries, of which Bailey Creek is the most important, drains West Fork and Ross townships. It is the largest stream in the Iowan drift area, and traverses a broad depression excavated in this drift and the shales of the Lime Creek formation. It has long since ceased down-cutting and is now widening its valley by a process of tortuous meandering. The stream is skirted in places by narrow belts of alluvium which is found to overlie stratified sand and gravel. Broad gravel terraces border the stream channel throughout its course in the county. At the north line of section two, Ross township, where West Fork enters the county, this terrace is twelve to fifteen feet above the flood plain and lies to the west of the stream. In section 18, West Fork township, it is ten feet and although it is in evidence in places as low ridges in the stream valley until the east county line is reached, it thins almost to disappearance.

Bailey creek enters the county near the northeast corner of Richland and, flowing southeastward across northern Ross, joins the West Fork of the Cedar in section 19 of West Fork township. It is normally a small stream and occupies a narrow alluvial valley, but it has the reputation of rising very rapidly at times without warning, and accomplishing considerable damage by its overflow. A level gravel terrace flanks this stream to the north. The town of Sheffield is situated on this terrace which is here over a mile in width. The gravels border Bailey creek to its union with West Fork, and the coalescence of the two gravel benches here forms a very level wedge shaped tract of considerable extent. Several smaller branches effect the drainage of southern Ross township and enter the West Fork below the confluence of Bailey creek in West Fork township.

Hartgrave creek.—Hartgrave creek is formed by the union of Otter, Spring and Squaw creeks in southwest Ingham township.

The headwaters of Otter creek come from the Wisconsin drift in the northwest part of the county. Within this area they are aimlessly meandering prairie streams which accomplish little more in the way of drainage than to connect a series of swales or marshes. Buffalo creek, which rises in southeast Wisner and flows across northern Marion township, is the most important branch. Outside of the moraine Otter creek is confined within valley walls of Kinderhook limestone, which is found outcropping at intervals along its entire course.

Spring creek takes its rise in southeast Scott and leaves the Altamont moraine in western Mott township. It has a flood plain of moderate width outside of the moraine through Mott and into Ingham townships and is rock-bound with frequently outcropping ledges of limestone.

The source of Squaw creek is in the morainal belt. It meanders amongst the limestone hills of southwest Mott township as though leisurely seeking a line of least resistance. This stream seems not to have been an important waterway during the melting of the Wisconsin ice nor to have been long established in its present position; for there is no sign of the usual gravel deposit, and its channel is immediately bounded by Iowan drift which, with a loess-covering overspreads the pre-glacial features of the Kinderhook.

Otter and Spring creeks, outside of the Wisconsin drift, occupy pre-Iowan depressions and their valleys are marked by the presence of Wisconsin gravel trains. As a general rule the gravel benches disappear at the Wisconsin border, but conspicuous terraces are to be observed along both Spring and Buffalo creeks in Marion township some distance within the border of this drift. It is to be noted also that the gravels grow finer and are more perfectly assorted as the distance eastward from the moraine increases. In sections 23 and 24 of Mott township a broad flat connects the valleys of these two creeks which here approach each other to within one mile. A spur of loess covered limestone hills along the east edge of section 24 intervenes and the streams separate to join some four miles beyond to the southeast.

Again in section 33, Ingham township, a broad flat leads southward from the valley of Hartgrave creek across sections 4 and 9 of Geneva township and merges with the valley of Mayne creek. This flat-bottomed depression is bounded by loess capped limestone hills. It lacks drainage, and ponds are so numerous that cultivation is for the most part impossible. The gravel terraces become broader and more conspicuous along Hartgrave creek proper in the southeastern part of Ingham township, but their height above the flood plain level of the creek diminishes to practically zero at its exit from the county. This stream occupies a very wide erosional depression, out of proportion, it would seem to its present volume and capacity to do work. This, the main stream, together with its two principal contributary branches, flows in an ancient valley which the deposition of detritus by the Iowan glacier failed to obliterate.

Mayne creek.—Mayne creek issues from the moraine in section 26 of Reeve township. It has two principal branches in the Wisconsin area which unite in section 29, Reeve township. These are prairie streams with their sources in the hills and ponds of the inner moraine. The course of Mayne creek through the Altamont moraine in Reeve township is somewhat sinuous. It has not only excavated its way through the hills of Wisconsin drift but has eroded deeply into the Kinderhook rocks of the Lower Carboniferous. The valley is densely wooded in this portion of its course. Outside of the moraine this stream flows in a wide depression and is skirted by gravel terraces. The latter fail in western Geneva township, and the trend of the valley is such as to lead into the large bayou depression already mentioned as extending northward in northern Geneva township to the valley of Hartgrave creek. The valley occupied by Mayne creek to this point is earlier than, and out of proportion to the size of the present stream. Through sections 10, 11 and 12, Mayne creek flows in a valley seldom over a third of a mile in width and one of which the stream is unquestionably the author.

It is plain that an adjustment in the drainage lines has taken place in this vicinity during glacial times. The lower part of the course of Mayne creek through eastern Geneva township is

not that followed by its pre-glacial ancestor. The main channel was then through the depression opening northward into Hartgrave creek; and Mayne creek through some exigency of glacial movement has been diverted from this ancient course. The diversion of Mayne creek will also aid to some extent in explaining the lack of harmony between the breadth of the valley of Hartgrave creek and the size of the stream. Doubtless a master stream occupied this wide valley prior to the Iowan ice and received tribute from an even larger tributary than the present Mayne creek.

Beaver creek.—The surplus waters in Osceola township are removed by Beaver creek and a number of small tributaries. The source of the Beaver is in Grant township where it effects a partial drainage of the eastern portion. The remainder of Grant township has no well developed drainage lines. Osceola township is but thinly covered with Iowan drift so that the stream courses outside of the Wisconsin are universally eroded in the limestone. Beaver creek itself is the only stream of appreciable size. In it the limestone is obscured by the loess and glacial gravels which skirt it eastward from the Wisconsin border. It has no flood plain of mapable width, but flows over a limestone bed in the lower part of its course in the county as do its tributaries to the north of it, which meet the Beaver in Butler county to the east.

Iowa River.—This river is itself the only representative of the Iowa river system in this county. From its random meanderings among the mounds and hills of the Gary moraine in Wright county, it enters Morgan township, Franklin county, two miles from its southern border and with a bold curve in the southwest corner of this township leaves it still one-half mile north of this same boundary. The town of Dows is situated in the curve to the west of the river, the main part of the corporation being in Wright county. With minor meanders along the county line on the west side of Oakland, the Iowa river angles across the southwest corner of the township from the middle point of its west boundary to an exit into Hardin county one mile west of the southeast corner. The Iowa river here is much diminished in size as compared with the same stream outside of the morainal

district. It has no confluents of any importance and flows in a shallow channel in the Wisconsin drift plain. In places some alluvium has been put down and at intervals along its course heavy deposits of gravel have been made use of for road materials. From the river the land gradually rises to the northeast to the morainal belt in notheast Oakland and Morgan townships; while to the south the level drift plain stretches beyond the limits of the county.

Briefly recapitulating, the sufficiency of the drainage in Franklin county is seen to bear a direct relation to the two till sheets that cover it. The Iowan drift area, including much of the east half of the county, has nearly perfect drainage. Instances of arrested stream development during glacial times have been noted and areas thus affected are today not well drained. Another exceptional case of this nature is to be observed in sections 24 and 25 of West Fork township, where low sand ridges bar the natural flow of the meteoric waters, and ponded open water in places stands barely separated from a moderate sized stream. Streams of importance are sparsely distributed in the Wisconsin drift area. Pre-Wisconsin drainage lines were obliterated by this ice sheet and those now present are, with possibly Iowa river excepted, superimposed and flow out to the east upon the Iowan drift plain. The western tier of townships practically lacks drainage, with the exception of the parts of Morgan and Oakland townships that lie on the slopes of the Iowa river depression.

STRATIGRAPHY.

General Relations.

The geological formations in the region under consideration belong to three distinctly separate ages, representing two of the major divisions, or eras, of geological time. The Devonian rocks which underlie the northeastern portion of the county and the Lower Carboniferous limestones occupying the remainder belong to the Paleozoic era. The region has been land surface since its elevation from the sea bottom at the close of the Carboniferous and no deposits are present representing the

enormous lapse of Mesozoic time. The till sheets which overspread all the older formations mark a period of recent dynamic activity. These glacial deposits were made in the later part, or Quaternary age, of the Cenezoic era, and belong to the geological time period in a later portion of which we now live.

In accordance with the general trend of the indurated rocks of Iowa, the members of the older series of rocks in Franklin county overlap each other with a gentle dip to the southwest and with a line of outcrop extending in a northwest-southeast direction. Exposures of these rocks are abundant along all the principal streams in the Iowan drift area and aside from their geological interest are of local economic importance.

A synopsis of the time periods and the corresponding rock formations that are represented in Franklin county is arranged in the subjoined table:

SYNOPTICAL TABLE.

GROUP.	SYSTEM.	SERIES.	STAGE.	FORMATION.
Cenozoic	Pleistocene	Recent		Alluvium Sand and gravel
		Glacial	Wisconsin	Drift
			Iowan	Loess Drift
Paleozoic	Carboniferous	Mississippian	Kinderhook	Limestone Shales
	Devonian	Upper Devonian	Lime Creek	Owen Limestone Shale Hackberry Shales
		Middle Devonian	Cedar Valley	Mason City Dolomite

The deep well at Hampton affords the only information obtainable regarding the strata older than the Devonian, that underlie the county. Professor W. H. Norton has kindly furnished the following record of the strata penetrated, with interpretation.

CITY WELL, HAMPTON, IOWA.

SAMPLE NO.		DEPTH OF SAMPLE, FEET.
65.	Till, pale yellow	20
64.	Sand, ocher-yellow, with ochreous clay	40
63.	Shale, blue	60
62.	Limestone, bluish-gray, subcrystalline, of rapid effervescence in cold dilute HCl; in coarse chips. Fragments of calc spar and sparry surfaces indicate that the rock is geodiferous. Platy fragments of drusy pyrite are found and in some the pyrite alternates with laminæ of black coaly shale	80
61.	Shale, blue; samples at 100, 120 and	140
60.	Limestone, dark greenish gray, earthy, of brisk effervescence, with argillaceous residue; in large chips, with some fragments of white finegrained crystalline limestone	160
59.	Limestone, dark drab, finegrained, crystalline, hard, residue black, moderately brisk effervescence, containing microscopic grains of crystalline quartz	180
58.	Limestone, white, compact, earthy luster, also gray and cream-colored, saccharoidal, in small chips and with much argillaceous admixture. Effervescence moderate, residue large, argillaceous and microscopically quartzose	200
57.	Shale, greenish, brisk effervescence	220
56.	Limestone, white, earthy, in fine sand, with some chips of shale	240
55.	Shale, greenish; samples at 260 and	280
54.	Limestone, white, brisk effervescence, crystalline, in fine sand masked by argillaceo-calcareous powder	300
53.	Limestone, vari-colored: dark bluish, saccharoidal, effervescence moderate, argillaceous residue; and buff, sub-crystalline, finegrained; compact, of brisk effervescence and little residue	320
52.	Limestone, light gray, fine-grained, subcrystalline, subtranslucent, of rapid effervescence, in large flakes	340
51.	Limestone, drab, much dark argillaceous residue, effervescence moderate	360
50.	Limestone, light gray, dense and fine grained, sub-crystalline, of brisk effervescence; with some chips of greenish, soft saccharoidal limestone	380
49.	Limestone, light buff, soft, compact, earthy, effervescence brisk	400
48.	Limestone, light bluish and light buff, of brisk effervescence, hard	420
47.	Limestone, light brownish, soft earthy, brisk effervescence, argillaceous residue	440
46.	Limestone, bluish gray, earthy luster, fine-grained and compact, brisk effervescence and dark argillaceous residue	460
45	Limestone, blue-gray, effervescence rather slow, large clayey residue; drillings contain also fragments of fossiliferous green shale	480
44.	Limestone, gray, sub-crystalline, in angular sand, effervescence brisk	500

SAMPLE NO.		DEPTH OF SAMPLE. FEET.
43.	Limestone, cream colored, very soft, earthy, effervescence moderate; some drab, argillaceous	520
42.	Limestone, light blue-gray, soft, rather large clayey residue, effervescence moderate	540
41.	Limestone as No. 42, but with chips of chert and siliceous limestone and of drab argillaceous limestone	560
40.	Limestone, white, soft, rapid effervescence, subtranslucent	580
39.	Shale, light chocolate-brown, calcareous	600
38.	Shale, reddish, no reaction for carbon or hydrocarbons in closed tube	620
37.	Shale, light greenish, calcareous	640
36.	Limestone, moderate effervescence, with much powder, argillaceous	660
35.	Shale, light buff, calcareous	680
34.	Drillings of gray chert, greenish shale and red calcareous shale, probably fallen from above	700
33.	Shale, greenish	720
32.	Sand, of vari-colored, briskly effervescent limestone with considerable shale, greenish	740
31.	Shale, dark greenish, calcareous	760
30.	Limestone, white, briskly effervescent; with much shale	780
29.	Shale, chocolate-brown; buff limestone; considerable yellow chert	800
28.	Limestone, gray and white, brisk effervescence; with much white chert and argillaceous powder, samples at 820 and	840
27.	Shale, green and brown, and gray chert	860
26.	Limestone, gray, briskly effervescent	880
25.	Limestone, cream colored, brisk effervescence, in fine sand with much argillaceous powder	900
24.	Limestone, light yellow, highly argillaceous; samples at 920 and	940
23.	Shale, light brownish, calcareous	960
22.	Limestone, light gray, some fossiliferous; cherty; brisk effervescence; in chips with much argillaceo-calcareous powder in some samples; samples at 980, 1000, 1020, 1040, 1060 and	1080
21.	Limestone, gray, of rapid effervescence, 1100, 1120 and	1130
20.	Green shale, with considerable fine chippings of gray limestone	1140
19.	Green shale in fine chips, indurated	1160
18.	Sandstone, white grains of clear quartz, well rounded, comparatively uniform in size, surfaces smooth; with some green shale probably from above; samples at 1180, 1200, 1220 and	1240
17.	Dolomite, gray, hard, cherty	1260
16.	Dolomite, gray, cherty, arenaceous	1280
15.	Sandstone, fine grained, white	1300
14.	Dolomite, light buff and gray, cherty, samples at 1320 and	1340
13.	Dolomite, light buff, arenaceous, considerable quartz sand in drillings	

SAMPLE No.		DEPTH OF SAMPLE FEET.
12.	Dolomite, gray, arenaceous, considerable sand in drillings	1380
11.	Dolomite, bluish gray	1400
10.	Dolomite, bluish gray; and sandstone, large part of drillings quartz sand	1420
9.	Dolomite, gray, with small fragments of arenaceous dolomite and quartz sand	1440
8.	Sandstone and dolomite, sandstone of St. Peter facies (No 18) dolomite, gray	1460
7.	Sandstone, white, fine grained, hard	1480
6.	Dolomite, gray and white, cherty; samples at 1500 and	1520
5.	Dolomite, gray, with residue of cryptocrystalline quartz	1540
4.	Dolomite, blue-gray, with residue as above	1560
3.	Dolomite, gray; samples at 1580, 1600 and	1620
2.	Sandstone, of clean, white, well rounded grains of pure quartz of moderate size; samples at 1640, 1660 and	1680
1.	Sandstone as No. 2, but somewhat harder as indicated by the larger proportion of fractured grains; samples at 1700 and 1709	

ASSIGNMENT OF STRATA.

NOS.	STAGE OR SUB-STAGE.	THICKNESS, FEET.	DEPTH, FEET.	ELEVATION OF BASE A. T., FEET.
65-61	Pleistocene	52	52	943
63-55	Mississippian	228	280	715
54-44	Devonian	240	520	475
43-40	Silurian-Devonian	78	598	397
39-35	Maquoketa	82	680	315
34-19	Galena-Trenton	500	1180	-185
18	St. Peter	68	1248	-253
17-11	Upper Oneota or Shakopee	152	1400	-405
10-7	New Richmond	80	1480	-485
6-3	Lower Oneota	155	1635	-640
2-1	Jordan	74	1709	-714

The record of the Ackley well, which is located in Hardin county within one and one-half mile of the southeast corner of Franklin county, is summarized by Beyer as follows*:

STAGE OR SUB-STAGE.	THICKNESS, FEET.	DEPTH, FEET.	ELEVATION OF BASE A. T., FEET
Pleistocene	100	100	1010
Kinderhook	207	307	803
Lime Creek	28	335	775
Devonian (unclassified)	300	635	475
Niagara	180	815	295
Maquoketa	160	975	135
Galena-Trenton	385	1360	-250
Saint Peter	85	1445	-335
Upper Oneota	120	1565	-455
New Richmond	70	1635	-525
Lower Oneota	185	1820	-710
Jordan	210	2023	-920

*Iowa Geol. Survey, Vol. X, p. 263.

DEVONIAN SYSTEM.

LIME CREEK STAGE.

Representatives of the Devonian system are the country rock in approximately one and one-half townships, including portions of Ross and Ingham, and nearly all of West Fork townships, in the northeast corner of the county. Only beds belonging to the Lime Creek stage of the Upper Devonian are present and these consist mostly of magnesian and calcareous shales and limestones, the latter likewise usually containing magnesium in varying quantities. Certain of the shales and limestones are highly fossiliferous.

The uncertainty as to the proper reference of bodies of shale which lie beneath the Kinderhook limestone will be noted when the rocks of that stage are considered. It should be said here, however, that on account of the similarity of the strata lithologically, it has been impossible to locate definitely the dividing line which marks the upper limit of the Devonian. Professor Calvin has emphasized this fact in mapping the border of the Kinderhook in Cerro Gordo county. Fossils alone must be largely depended on, and unless good exposures are abundant, difficulty is experienced in determining the exact position of the border line. Fossils were collected from available outcrops in Franklin county of the rocks belonging to both stages and the plotting of the limits of the areas was based chiefly on paleontological evidence, supported in some degree by topographic and lithologic factors.

Hackberry shale.—The Hackberry beds of the Lime Creek stage are the oldest formation exposed in the county. These shales lie immediately beneath the drift and postglacial deposits in a large portion of the Devonian area. Bordering the east side of the valley of the West Fork of the Cedar and particularly conspicuous in the northwest part of West Fork township, the limestone of the Owen beds rests upon the Hackberry shales. No exposures were examined in which the contact between these two formations was evident but sections of each were frequently seen in close proximity to each other.

The best exposures of the Hackberry beds are found along Bailey creek (called Beaver creek in Cerro Gordo county) in

Ross township. One-half mile south of Sheffield, near the center of section 9, is the brick and tile plant of Mr. E. P. Fox. The pit section shows the following strata:

		FEET.
3.	Buff to yellow shale, slightly magnesian, containing irregular concretions of lime carbonate and thin bands of limestone at top. Non-fossiliferous	3
2.	Yellow, pink to red plastic shale	6
1.	Non-fossiliferous, plastic blue shale with some carbonaceous matter and occasional thin seams of selenite	6

The base of the pit is near the level of the creek. A well drilling at this plant encounters firm limestone about twenty feet below the bottom of the pit.

In a road cut south of Bailey creek on the west side of section 10, Ross township, higher beds are exposed:

		FEET.
4.	Soil and iron stained limestone residuum	1½
3.	Shale, light blue, with thin limestone partings, grading downward into yellow, highly fossiliferous, magnesian shale	5
2.	Shale, uniform yellow in color, gritty, with limestone laminæ	5
1.	Shale, blue, plastic and lacking concretionary matter, to road bed	1

One hundred yards east of the wagon bridge at this point thirty feet of the plastic blue shales are exposed at a bend in the creek. These are a continuation of the section in the road just noted, making in all a thickness of more than forty feet of Hackberry shales that is open to view. The lower argillaceous member has occasional bands of limestone running two to three inches in thickness and is non-fossiliferous. This stratum corresponds to the blue shale made use of at the E. P. Fox clay plant south of Sheffield.

The Hackberry shales form a terrace south of Bailey creek extending through sections 9 and 10 of Ross township and are exposed at a few other points by the cutting of this stream. The above described exposure of this formation is the best observed in the county. The sequence is the same as that found by Professor Calvin in Cerro Gordo county,* although the aggregate thickness of the beds is somewhat less.

*Iowa Geol. Survey, Vol. VII, p. 162.

Owen beds.—The Owen beds outcrop at various points along the east side of the West Fork of the Cedar river in the northeast corner of Ross and throughout its course in West Fork township. In section 7, West Fork township, a small quarry is opened from which some rock has been removed. These beds furnish a supply of building material which has been utilized locally at many points.

The quarry opening just north of the road along the south side of section 7, West Fork township, affords the following section:

		FEET.
2.	Yellow magnesian shale, with chert nodules and, near the base, interbedded sub-crystalline limestone, apparently dolomite. In places, definite bands of chert permeated with brachiopod impressions. *Spirifer whitneyi* most abundant	3½
1.	Thinly bedded, fossiliferous, partially crystalline, brown dolomite. Much shattered at top and badly rifted throughout. Exposed	7

Many other species of brachiopods appear in this section. In the top yellow shale besides *Spirifer whitneyi* Hall, a large *Productella*—allied to *P. lachrymosa* Conrad,—and *Camarotoechia orbicularis* Hall, are frequently seen. In the limestone layer a species of Spirifer related to *S. disjuncta* Sowerby, occurs besides those mentioned above.

Below the wagon bridge over West Fork at the south side of this section, twelve to fifteen feet of calcareous, more or less plastic, yellow shales crop out in the bank of the stream. These shales here form a conspicuous terrace to the east of the river upon which, about twenty feet above the water, rest the beds of dolomitic limestone described above. They appear at intervals along the stream both north and south of this locality and are apparently the upper argillaceous shales of the Hackberry beds.

Beds of weathered magnesian limestone of the Owen formation are exposed in the road through the east part of section 1, Ross township. Near the east line of this section yellow, weathered shale appears bearing casts of *Naticopsis gigantea* H. & W., a large gastropod which characterizes the Owen limestone in Cerro Gordo county. Just east of the West Fork, on the south side of section 35, a surface of nodular weathered limestone is

exposed in the road gutter. Unidentifiable crinoid remains and casts of *Stropheodonta demissa* were noted. The same limestone occurs in the road east of the West Fork on the south side of section 1, Ingham township. It outcrops in the roadbed northward through the middle of this section, and the underlying beds are exposed for some distance along the stream in this vicinity. The limestone is compact, brown in color and rich in fossils, the common species being *Spirifer whitneyi*, *Atrypa reticularis*, *Naticopsis gigantea*. Ten to twelve feet of this rock are in view some thirty feet above the water in the river. The section is obscured to within ten feet of the water. Below this level along the bank of the stream four feet of marly to nodular, yellow, calcareous shale are exposed, rich in perfectly preserved fossils among which are: *Spirifer whitneyi* Hall, *S. orestes* H. & W., *S. Hungerfordi* Hall, *Atrypa reticularies* Linne., *A. aspera*, var. *hystrix* Hall var., *Orthis iowensis* Hall, *Stropheodonta arcuata* Hall, Orthoceras sp. This shale grades downwards into a nodular, argillaceous, dolomitic limestone containing similar species, and of which there are four and one-half feet. Above the water are two feet of yellow plastic clay. A large, never-failing spring flows out at this horizon. This section includes both Owen and Hackberry strata, the fossiliferous, calcareous shales being the equivalent of the upper member of the Hackberry section in Cerro Gordo county.*

The top limestone appears again on the county line near the southeast corner of section 1, Ingham township.

The exposures described outline in a general way the areas occupied by the two principal formations of the Lime Creek stage. Outside of the relatively narrow belt of country along the east side of the West Fork of the Cedar river the more resistant limestone beds of the Owen formation are believed to be absent. In the remaining portion of the Devonian area, as outlined on the map, the Hackberry shales are the country rock. A well drilling on the farm of Wm. Garber in section 2 of West Fork township, encountered solid rock, the Cedar Valley limestone, at eighty-five feet. A well near Aredale in the edge of

*S. Calvin, Iowa Geol. Survey, Vol. VII, p. 163.

Butler county reached the rock at eighty feet, passing through 'blue clay' to this depth. In the town of Sheffield, well sections indicate almost the entire absence of the Lime Creek shales, the terrace gravels, with a thickness of twenty to thirty feet, resting in some instances directly on the basement limestone. It is believed that the shales are not absent over any considerable area. They are lacking along Bailey creek on account of the early erosive work of this stream in excavating a wide valley which has later been in part filled by the deposition of gravels and alluvial materials.

It is of interest to note that well drillers in this part of the county invariably report a considerable thickness of 'soapstone' or blue clay after passing through an upper heavy stratum of limestone. In Sheffield, an approximate section is as follows: gravel, 28 feet; brown solid limestone, 27 feet; blue clay, 83 feet; rock, to 190 feet. At the well above mentioned in the northeast quarter of section 2, West Fork township: sand, 6 feet; blue clay, 79 feet; rock, 55 feet; clay, 78 feet; rock, to 260 feet. This bed of shale, interstratified with the limestone, appears to be equivalent to No. 6 in Professor Calvin's "Generalized Section of the Cedar Valley Limestone in Cerro Gordo and Adjacent Counties."* It does not appear as a distinctly argillaceous bed in the Hampton or Ackley well sections, and is somewhat anomalous in its occurrence. Professor Calvin has emphasized the extreme variability of this portion of the Cedar Valley section in the adjoining county to the north and it would seem probable that here is exemplified an extreme local variation in the conditions of sedimentary deposition in this period of Devonian times.

CARBONIFEROUS SYSTEM.

KINDERHOOK STAGE.

The Carboniferous rocks present in the county belong to the Kinderhook stage, the lowest member of the Mississippian Series. Although believed to be the country rock in the western part of the county, they are entirely obscured by the drift. To

*S. Calvin, Iowa Geol. Survey, Vol. VII, pp. 159 and 160.

the east, beyond the border of the Wisconsin, Kinderhook rocks are exposed along the channels of all the principal streams. As has already been intimated, the surface configuration of considerable areas in the Iowan drift is influenced in large measure by the underlying limestone.

The Kinderhook consists of limestones and shales, the former varying from soft, marly, argillaceous beds containing large quantities of chert, to compact, partially crystalline, fossiliferous or semi-oolitic dolomite. The shales range from magnesian and calcareous beds which in many instances represent the firmer limestones in a state of decay, to typical yellow or bluish plastic clays. Aside from certain thin interstratified beds of shale the limestone is in many places known to be supported by a greater or less thickness of similar beds. In the Hampton well, the lower eighty feet of the Kinderhook are highly argillaceous. Thirty feet of blue shales were encountered at this horizon in the Ackley deep well.* Below the limestone at Iowa Falls sixty feet of calcareous, gray-blue shales were referred by Professor Beyer to the Kinderhook. Shales are also recognized beneath the Le Grand beds in Marshall county where one hundred seventy-five feet of argillaceous beds are provisionally placed in the Kinderhook.†

These underlying shales outcrop at a few points in Franklin county but nowhere in any considerable thickness. They appear to be conformable with and, as in the deep well sections cited, a continuation of the Devonian shales below them. For this reason question arises as to the location of the lower limit of the Carboniferous rocks where the lower member or Louisiana limestone of the Kinderhook is absent. In well sections the formations cannot usually be differentiated and in the field where the exposures are available reliance must be placed on the fossil organic remains present to establish the line of demarkation.

The Hampton well section shows two beds of shale above this basal member, the upper but a few feet, and the lower some sixty feet in thickness. These beds occur at several points in the

*S. W. Beyer, Iowa Geol. Survey, Vol. X, p. 260.
†S. W. Beyer, Iowa Geol. Survey, Vol. VII, p. 212.
‡Iowa Geol. Survey, Vol. VI, p. 149.

eastern part of the county and where not in view are frequently indicated by the presence of a line of springs at the base of exposed limestone layers.

TYPICAL SECTIONS.

Bailey creek.—This stream flows in a valley cut in the Kinderhook strata for two and a half miles from where it enters the county in Richland township, and exposures are common in this vicinity. In the northwest quarter of section 1, Richland township, at the county line bridge, ten feet of soft, shaly, magnesian limestone are to be seen. One-fourth mile south on the west bank of the stream the same strata are exposed overlain by fifteen feet of heavy bedded magnesian limestone. The contact is marked by a line of bog springs. Professor Calvin has noted the occurrence of characteristic Kinderhook fossils in this limestone.* The shaly limestone crops out in road cuts along the west side of section 1 of Richland township where the usual mantle of drift is practically absent. It weathers into a yellow, calcareous clay.

The weathered limestone is to be observed in road cuts on the west side of section 8, Ross township. Near the northwest corner of this section five to six feet of weathered plastic shale, yellow to light blue, and enclosing bands of limestone, are exposed in the channel of a small stream but a few rods from an outcrop of limestone twenty feet higher in the hillside. Close to the stream on the west line of section 5, twelve feet of the underlying shales appear. They may also be seen near the stream at the west edge of section 6, Ross township. No fossils were found, and it is believed that this is the basal member of the Kinderhook stage.

Otter Creek.—Rock is exposed almost continuously in the valley of this creek from section 30 of Ross to its union with Hartgrave creek in Ingham township. One mile west of Chapin at the southwest corner of section 29, limestone is quarried.

The following section may be viewed:

		FEET.
3.	Thin drift soil	1
2.	Badly weathered and iron stained argillaceous limestone	7
1.	Regularly bedded blue-gray to sugary-brown dolomitic limestone containing Orthothetes, related to *O. inequalis* Hall, and Orthis(?). Exposed	8

*Geol. Survey, Vol. VII, p. 179

Ledges of this rock form the east boundary of Otter creek valley and appear for some distance both north and south on both sides of the stream. One-half mile south of the above quarry weathered beds containing many flint chips and nodules of chert and bearing casts of *Spirifer subrotundatus* Hall, crop out in the road. Similar outcrops are to be found in the vicinity of Buffalo creek in sections 36 and 31 of Richland and Ross respectively; along the west side of section 6, and across sections 5 and 4 of Mott township, where the bordering hills are all supported by the limestone which stands twenty-five feet above the stream. Throughout the remainder of its course in Mott and Ingham townships, Otter creek valley is bounded by limestone walls, and evidences of its presence are to be seen, aside from natural outcrops and hillside talus, on nearly every section line where the public highway crosses this creek. At the north edge of section 19, Ingham township, a few feet of weathered, yellow, non-fossiliferous limestone are exposed, while along the east side of this section, just north of Otter creek, there is a partially obscured exposure of twenty feet of yellow calcareous shales containing brachiopod impressions preserved in thin bands of chert, and covered with shelly layers of this same limestone. The upper members here are higher in the section than those observed in Ross and Richland townships and contain much chert, in bands and nodules, some of which is chalky white and even pulverulent.

Limestone is also found along Spring creek in sections 21 and 22 and along Squaw creek in the north part of the city of Hampton. The following section may be observed in a small quarry opening west of the Hampton cemetery:

		FEET.
3.	Earthy, shattered and iron stained limestone with numerous bands of chert	5
2.	Thin bedded, earthy limestone permeated with chert in both bands and concretions; somewhat cavernous; brachiopod impressions preserved in chert	6½
1.	Heavier beds (6-8 inches) and less chert; caverns lined with botryoidal calcite	7

These strata stand high in the hills to the eastward among which Squaw creek makes its way for the rest of its course. In

sections 1, of Reeve, 6 and 5 of Geneva and 32 of Ingham townships the slopes are angular and terraced, and the limestone crops out at many points.

There are innumerable exposures of the lower limestones and occasionally of the shaly beds not in the immediate vicinity of the streams, in the north central part of Ingham and in the corners of Mott and Ross townships, where the main features of the topography are expressed in these older rocks. In the northeast quarter of section 28, south of the railroad track, a small quarry is opened on the land of D. W. Mott. The sequence is:

		FEET.
3.	Soil and decayed limestone	4
2.	Plastic, light blue shale with very thin bands of limestone	2
1.	Fossiliferous, crystalline brown dolomitic limestone, exposed	8

The beds are much rifted horizontally and fractured by vertical joint planes.

Mayne creek.—The greatest thickness of beds is to be seen near the north side of section 21, Reeve township. The section is partially obscured by talus materials but it is approximately as follows:

		FEET.
8.	Drift	8
7.	Thinly bedded shattered limestone with much chert in oval nodules and more or less persistent bands	14
6.	Heavier bedded, arenaceous limestone carrying chert as above, and occasional caverns and calcite geodes	6
5.	Shaly limestone with bands of firmer rock	12
4.	Compact, resistant ledge of limestone	1
3.	Argillaceous limestone containing some chalky appearing chert nodules grading into No. 2	2
2.	Firmer but weathered and iron stained limestone	1½
1.	Compact, evenly bedded dolomitic limestone	3½

Judging from its lithologic character No. 1 appears to be equivalent to the rock quarried one mile west of Chapin.

Mayne creek has accomplished a considerable amount of erosive work since the close of the glacial period. Evidence of such work is found in sections 29 and 30 of Reeve township where thicknesses of twenty-five to thirty feet of Wisconsin drift overlying six to eight feet of shelly limestone may be observed at a number of points.

Across section 22 of Reeve township Mayne creek is bordered by a low terrace of shaly limestone similar to that exposed in section 21. Near the middle point of the north side of section 23 is an old quarry not now worked. Section:

		FEET.
3.	Shelly limestone containing chert bands	3
2.	Heavy bedded, subcrystalline and fossiliferous dolomitic limestone; stylolitic structure common	4
1.	Irregular and thin bedded, cavernous cherty limestone	5

This same stone is close to the surface in sections 14 and 13 of Reeve township, appearing in the road bed near the northeast corner and on the east side of the latter section. East of the road along the west side of section 18, Geneva township, is a conspicuous monadnock of the limestone. It stands thirty feet high in the valley of Mayne creek. West of the town of Geneva the limestone outcrops near the center of section 19.

In the southwest quarter of the northeast quarter of section 16, Geneva township, an artificial exposure shows six feet of badly weathered shaly limestone containing Orthothetes related to *O. inequalis* Hall, and a band of chert at the top. The rock is granular and earthy, but in fresh pieces it is brown, subcrystalline and fossiliferous. In the southwest quarter of the southeast quarter of section 10, Geneva township, just east of the wagon bridge over Mayne creek is a quarry belonging to Mr. Oren Benson of Geneva.

		FEET.
4.	Soil	1½
3.	Weathered magnesian limestone with abundant small flint nodules	5½
2.	Heavy bed showing no lines of separation; brown where weathered and fossiliferous (Productus bearing long spines being very abundant); interior of large blocks, light in color or mottled by pink interstitial calcite; distinctly oölitic in texture	10
1.	Calcareous shale resting on limestone	1

A few feet below the base of this quarry and eight feet above the water in the creek the top of the impervious shales is marked for some distance eastward along the south side of the valley by a line of springs. The drift covering is very thin and the limestone forms a ridge extending eastward into sections 11 and 14. In a quarry near the north boundary of section 14,

on the land of Mr. H. H. Andrews, the same succession of strata may be observed as noted above in section 10. The beds are here broken by vertical jointing which has produced open fissures six to eight inches in places. *Athyris proutii* and the spiny Productus sp. are abundant. *Productella concentrica* Hall, and an undetermined species of Spirifer also occur. Unweathered samples of the lower stratum show an abundance of crystals of iron pyrite. The limestone rests on yellow shale which is exposed in the trench cut by a small stream a few hundred yards from the quarry.

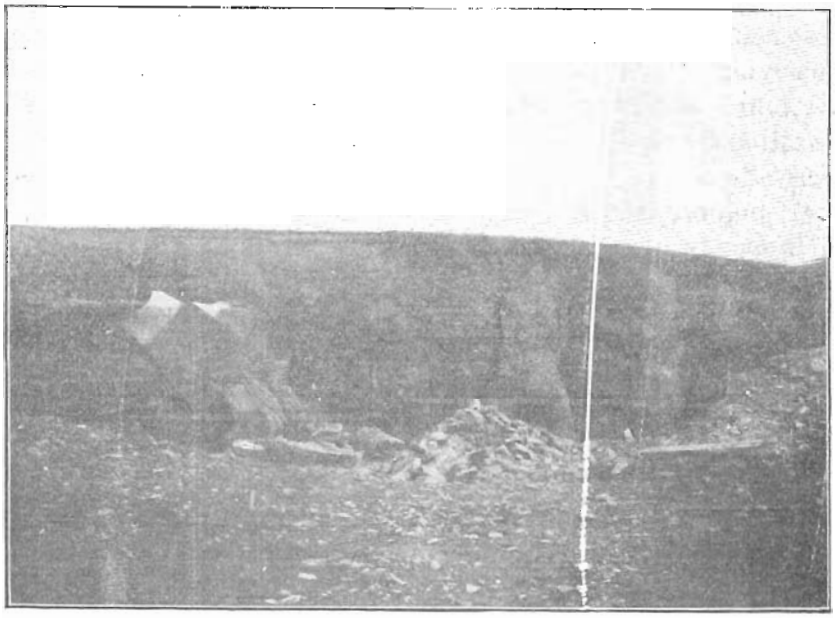

Fig. 56—Quarry in Kinderhook limestone, Section 11 Geneva township.

Nodular fossiliferous limestone outcrops in the road on the east edge of section 13, Geneva township. Water stands at this level which appears to be the top of the shale. All of the hills throughout east central Geneva township are capped with the limestone, and a spring line which is seen in many places indicates the contact between the two formations. Stratigraphically this shale seems to correspond in position to that encountered at 943 feet A. T., in the Hampton well.

The Kinderhook outcrops at various points in sections 35 and 36, Geneva township and in the east half of Osceola township, particularly along the branches of Beaver creek. A cherty limestone similar to that quarried at Hampton forms a conspicuous bench along a sharp draw leading from the east line of the county across the middle of section 12. Near the southeast corner of section 24 the limestone appears in the road south of the creek and is for the most part weathered to a marly, oolitic sand. Where freshly broken the stone is seen to be the same as that quarried in sections 10 and 14 of Geneva township. Large springs issue at the foot of the limestone escarpment near the water level in the creek and mark the top of the underlying shale. On the county line along the east side of section 25 of Osceola township, limestone appears in the road and in section 36 of a few rods west of the county line five feet of cherty limestone are exposed in the banks and bed of Beaver creek, ponding the stream and forming a rapids at this point. The upper two feet are weathered to a granular incoherent sand which is rich in branchiopod remains. Weathered limestone crops out at numerous other localities in the three eastern tiers of sections in Oceola townships. It appears in places as a shaly, chert impregnated limestone, and in others as an iron stained oolitic sand. As noted, however, both are frequently present, the former overlying the latter.

PLEISTOCENE SYSTEM.

KANSAN DRIFT.

Franklin county is included in the area which is believed to have been completely overspread with ice during the Kansan stage of glaciation. Deposits of the later, Iowan and Wisconsin, ice sheets have however entirely obscured any Kansan till that may be present. In the eastern part of the county the Iowan drift may be frequently observed resting directly on the Kinderhook and Devonian formations, so that practically all the material laid down by the Kansan glacier, however large or small in amount, has either been removed through erosive processes or was insufficient to exert any important influence.

All the older deposits in the western part of the region lie deeply buried beneath, presumably, a thin layer of Iowan, and a heavy mantle of the bowlder clay and sandy and gravelly materials deposited by the Wisconsin ice.

Buchanan gravels.—Although many of the country wells are sunk through the Pleistocene strata to 'rock', no records were obtained which had been kept with sufficient care to justify a differentiation of the different drift sheets. The most convincing evidence of an ice invasion earlier than the Iowan is found in the occasional presence in well sections of beds of gravel beneath till of Iowan age. At a few points in the central part of section 2 of Geneva township, outcrops of coarse, clayey and deeply iron stained gravels were observed, and they appear to underlie considerable areas. In the road running east and west through section 2, they are exposed near the east side of the section, and are covered by a few feet of loess. They may also be observed at various points in adjacent portions of Butler county. In appearance the gravels are relatively very old and this in conjunction with their stratigraphic position makes their reference to the Buchanan interglacial stage very probably correct.

IOWAN DRIFT.

The territory occupied superficially by materials belonging to the Iowan stage has been fully outlined under Topography. This area, which embraces approximately six and one-half townships in the eastern half of the county, bears evidence of having been quite generally covered by the Iowan glacier, but the amount of material put down appears to have been in many places very meager. An aggregate depth of over twenty feet of Iowan drift with its thin loess covering is rare, while throughout considerable portions of Ingham and Geneva townships, along the line of the Kinderhook escarpment, the latter formation reaches to the very grass roots.

Where observed in occasional road cuts and along the railroads in Mott and Ingham townships, the Iowan drift presents the usual characteristics. It is an unassorted, but slightly leached, yellow glacial till. Although in general well provided with the smaller bowlders of, principally, the lighter colored,

more acid varieties of igneous rocks, the large fresh granites which are a constant characteristic of this drift sheet elsewhere are of importance only locally. Sections 35 and 36 of Reeve, and 13 of Mott township are notable in this particular. The prevailing type is a coarse-grained pink granite, and some of the bowlders are of enormous size.

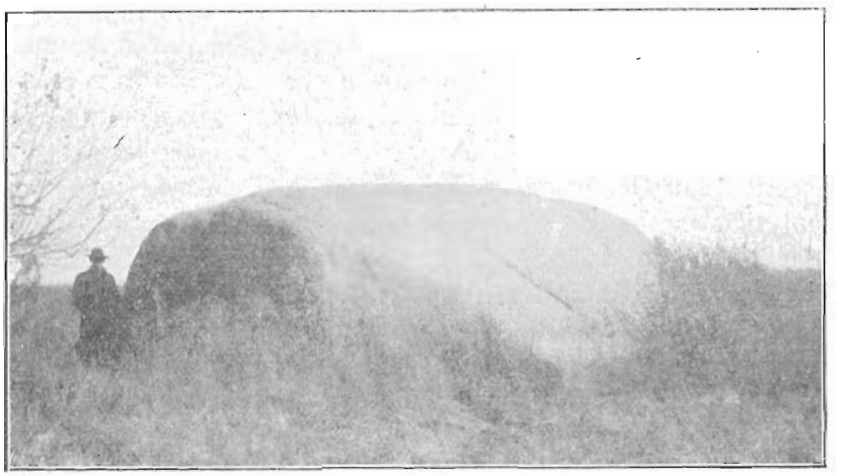

Fig. 57.—Iowan boulder in Section 13, Mott township. It is a coarse grained red granite. Dimensions, 24X36X19 feet above ground.

Loess has been deposited over a considerable portion of the surface of the Iowan drift. It is most conspicuous where it covers the outstanding hills and ridges of the Kinderhook limestone in Mott, Ingham and Geneva townships. These outliers of the indurated rocks, which of themselves stand somewhat above the general level, seem to have served as obstructions that excited accumulation of eolian materials around them. The loess may be seen at times resting immediately upon the eroded surface of the limestone or shales and again supported by a greater or less thickness of undoubted Iowan drift. The loess attains a thickness of fifteen or more feet. Good exposures may be examined in sections 6 and 5 of Mott township, and at various points throughout northern Ingham and Geneva townships, notably along the east side of section 5 of the latter township. Concretions of lime carbonate are abundant in the deposit, but casual inspection does not reveal the presence of the

R.XXIIW. R.XXIW. R.XXW. R.XIXW.

T.93 N. T.92 N. T.91 N. T.90 N.

WISNER RICHLAND ROSS WEST FORK

SCOTT MARION MOTT INGHAM

MORGAN HAMILTON REEVE GENEVA

OAKLAND GRANT LEE OSCEOLA

WASHINGTON

SHEFFIELD CLINTON CHAPIN ALEXANDER LATIMER COULTER HAMPTON HANSELL GENEVA POPEJOY OAKLANDIS BURDETTE FAULKNER ACKLEY

Baileys Creek, Otter Creek, Buffalo Creek, Spring Creek, Indgraves Creek, Squaw Creek, Haynes Creek, Iowa River, West Fork Cedar River, Dows Creek

Iowa Central, Iowa, Central, Chicago Great Western, Chicago Rock Island & Pacific, Dows Road

IOWA GEOLOGICAL SURVEY

MAP OF THE SUPERFICIAL DEPOSITS OF FRANKLIN COUNTY, IOWA.

BY

IRA A. WILLIAMS

1906

Scale 1/125,000

1 ½ 0 1 2 3 4 5 Miles

1 ½ 0 1 2 3 4 5 Kilometers

LEGEND

Iowan Drift

Wisconsin Drift

Altamont Moraine

INDUSTRIES

Clay Pits ▲

Quarries ⚒

Sand and Gravel +

Peat ■

TRI CITY PTG. CO. DAVENPORT, IA.

usual remains of land mollusks. The dividing line between the loess and the Iowan till is frequently poorly defined and is never marked by the distinct ferreto band so characteristic of the Kansan drift. In fact, in many instances the change in coloration is so slight that, except for the absence of the gravel pebbles in the loess above, there appears to be almost a gradation into the underlying typical drift. In other sections the line of separation is plain both because of the difference in the

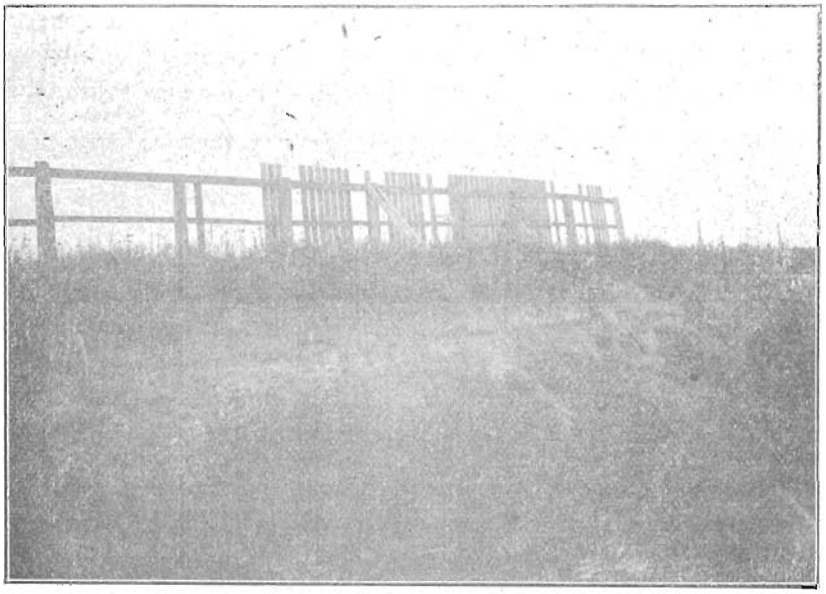

Fig 58—Loess overlying Iowan drift in railroad cut, Section 25, Mott township.

nature of the materials and of the slope angle maintained by them. Loess overlying the Iowan may be seen in a railroad cut near the east edge of section 25 of Mott township (Fig. 58). The absence of the oxidized zone and of other evidence of an extended time interval following the retreat of the Iowan ice and preceding the deposition of the loess, suggests at least immediate succession, if not contemporaneity of loess accumulation with the wasting of the glacier. The loess was placed upon the fresh and unmodified surface of the till before climatic conditions had sufficiently ameliorated so that plant growth could gain an important foothold, or the weathering processes bring about appreciable chemical alterations.

WISCONSIN DRIFT.

The Wisconsin drift in this county presents the ordinary characteristics that have been many times detailed in the earlier reports of this Survey. On account of its comparatively recent deposition the materials are unleached and vary in color from yellow near the surface to light blue in depths beyond the limits of oxidation. It is typically composed of an extremely calcareous and sandy clay matrix which is filled with promiscuously distributed pebbles and bowlders of a wide range of sizes and varieties. The bowlders are often scattered over the surface. and in localities where they have been undisturbed are interesting features of the landscape. Bowlder fields are common in

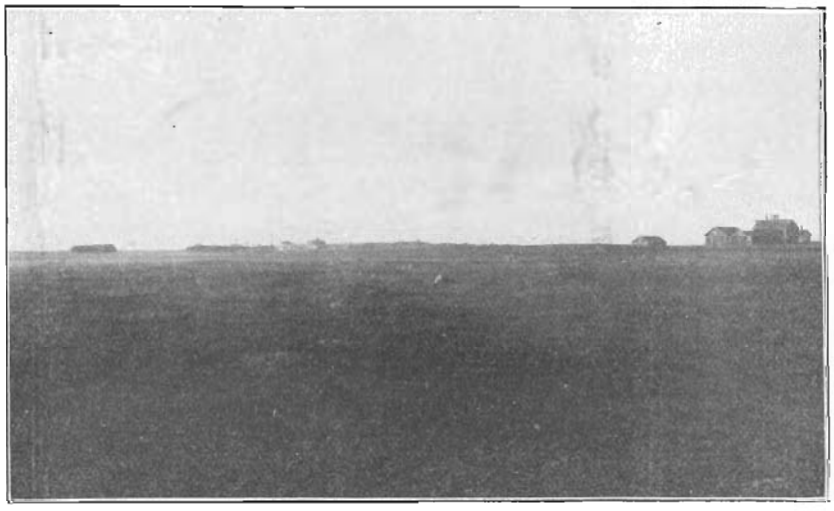

Fig. 59—Field of Wisconsin boulders in the southwest quarter of Section 27, Wisner township.

Wisner and Richland townships. Figure 59 shows such a field in the southwest quarter of section 27 of the former township. The varieties represented are mostly of the granite type although the gneisses and schists, some of them exhibiting beautiful contorted banding, are common. Occasional densely black "nigger heads" are observed.

From the typical bowlder clay the drift grades into clayey gravels, argillaceous sands, and in the morainal tracts where the action of water has been of greater importance, beds of

perfectly assorted sand and gravel occur. Wells sunk in the Wisconsin drift area penetrate from fifty to one hundred sixty feet of Pleistocene strata. From obtainable information and a study of the older drifts in the eastern part of the county it would seem that a large proportion of this depth should be referred to the Wisconsin. Wells in Wisner township go one hundred feet to rock; in southern Scott, one hundred to one hundred sixty feet; at Latimer, one hundred feet, which depth decreases rapidly in eastern Marion township; and in Dows, eighty feet to the indurated strata. Exposures of any thickness of the Wisconsin drift are rare, but its general character may be observed at innumerable points along the public roads in the western half of the county.

Gravel Trains and Terraces.—All of the streams that issue from the moraine are bordered by more or less continuous layers of gravel which usually appear as valley terraces in the Iowan drift area. The gravels are especially noticeable on Bailey, Otter and Buffalo creeks, along which they may be frequently seen within the borders of the Wisconsin drift. They occur also along Mayne creek in Reeve and Geneva townships The materials are well sorted as a rule and are products of the streams while they were flooded during the melting of the Wisconsin glacier. More or less sand is always present and cross-bedding is a prevailing feature, indicating deposition from rapidly flowing currents. The fineness of the pebbles composing the gravels increases with the distance from the Wisconsin border—as would be expected with the decrease in declivity and hence carrying power of the streams.

Where the West Fork of the Cedar enters the county it is skirted by a gravel bench, twelve to fifteen feet higher than the flood plain. This terrace unites in section 18 of West Fork township with the Bailey creek terrace, which forms a very conspicuous bench along the latter stream throughout its course in the county, and is here ten feet above the flood plain level. Beyond section 28, West Fork township, the gravels are not conspicuous. The terrace in places extends a mile back from the stream, the town of Sheffield being built on such a flat to the north of Bailey creek. The gravels in Sheffield are twenty

five to thirty feet thick. The gravels are also seen along Otter and Hartgrave creeks and vary in height above the water from fifteen feet at the moraine to disappearance in eastern Ingham township. The terrace on Mayne creek is not so conspicuous as are those along the other streams in the eastern part of the county and is not important beyond the eastern boundary of Reeve township. A gravel train flanks the Iowa river but does not occur as a bench, being seen only in road cuts and but little above the river. The gravel underlies the thin layer of alluvial silt that has been put down in places by this river.

Post-Glacial Deposits.

Under this caption should be mentioned the slowly accumulating alluvial materials that are even now being put down over the level bottoms in the stream valleys. Such deposition takes place during stages of high water when the overloaded streams are not confined to their channels but spread out covering areas of greater or less extent. The materials carried and deposited are usually the finer-grained soil particles that have been washed down from the slopes of the drainage basin of the stream. Although this process is unceasingly going on, none of the streams of Franklin county have flood plains of sufficient importance for mapping. It is true that all of the larger streams occupy depressions of considerable size, and some of them are in places bordered by broad flats which have been in the past undoubtedly many times flooded by sediment-carrying waters. But if, as seems advisable, we limit the application of the term flood plain to the area at present inundated during stages of high water, and alluvium to the sediment deposited outside of the channel during such inundation, these features are not of importance in the area under consideration. As mentioned, however, under Drainage, there are local areas of alluvium along the Iowa, the West Fork and, in fact, along all the major waterways that deserve notice.

Vegetable materials have been accumulating in the shape of peat beds in many of the upland ponds since the close of the glacial period. Thicknesses of ten to fifteen feet are at present found in some of these bogs. The accumulation takes place by the continuous growth of certain species of moss, and the plant

remains that are brought in from the surrounding hillsides. Water is essential to the growth of the deposit as upon it depends not only the life of the species of mosses that compose the bulk of the peat bed, but also the partial preservation of the remains of these plants as they die year after year. Hence we find all peat bogs either in shallow ponds or marshes or on the sites of formerly wet places. At present much is being done to eliminate all ponds and marshes to prepare the land for agriculture, and there is perhaps little accumulation of peat going on because of the all but universal advent of the ditch and the drain tile.

Soils.

Franklin is pre-eminently an agricultural county. Farming is the vocation of the rural population and there are no tracts of any size that have not been disturbed by the implements of the tiller of the soil. The marshy peat bogs as well as the glacial ponds are giving way to modern drainage methods, while productive soils are slowly replacing the peat, and growing crops the worthless waste of sedge, rush and water willow. The general fertility of the soils of the county is attested by the flourishing crops that are to be seen on every hand during the growing seasons.

The soils may be primarily classified as residual and transported soils. The latter is the prevailing type, and may be subdivided into the drift, loess, alluvium and terrace varieties.

The drift soils occupy areas corresponding to the two till sheets that superficially cover the county. The soils of the western portion of the county are relatively new as the time which has elapsed since the deposition of the Wisconsin drift has been short. Surface modification by weathering has progressed to but slight depth and as a result the soil has a yellow or light brown color and is still very limy. It is also less porous than the older soils, which lack of porosity prevents thorough aeration and the free circulation of the soil moisture. It is recognized that the typical Wisconsin bowlder clay soil requires more thorough and deeper tillage to obtain the most favorable results. As weathering progresses and plant growth loosens up

and alters the surface layer, many of the finer particles are carried down the slopes and accumulate in and around the marshes and ponds which, until recently have been very common. In this way have been produced the sticky, clayey, muck and impure peat soils that are well known in low undrained places. The so called 'sour' or alkaline spots are due to the impervious nature and undrained condition of such soils and these can be corrected only by the removal of the surplus moisture. In view of their origin it is evident that the marsh soils may vary from a fairly pure grade of peat to a mucky clay containing a greater or less amount of partially decayed organic matter. While not actually covered with water, such soils usually support a growth of uncultivated but nutritious grasses, but it often requires considerable patience, even after drainage is secured, to subdue them into perfect tractibility. This once accomplished, however, they become fertile and lasting because of the humus they contain.

The materials of the Iowan drift have been longer subjected to the action of the atmospheric agents, and a more perfect soil is the result. The Iowan drift soil, while still quite calcareous, is of darker color and more open texture than that of the Wisconsin drift, and is therefore better suited to tillage and to plant growth. As has been noted earlier, however, the Iowan is directly responsible for the soils of but limited portions of the area outside of the Wisconsin drift. It is for the most part buried by the silty, in places sandy, loess covering whose alteration forms the basis for most of the soil over the eastern part of the county. The loess is a clayey deposit of yellow to light brown color and entirely free from the gravel pebbles and coarse sand which permeate the drift clays. Rounded or irregular concretions of lime carbonate are abundant, but these are secondary and have been formed by the leaching action of water. It effervesces freely with acid, and microscopic examination shows a large proportion of angular particles which should perhaps be called very fine sand. Physically, the soil which is formed on the loess is permeable both to water and to the roots of plants. On account of the clay constituent and the readiness with which water both enters and dries from it, the loess soils are very apt to bake hard after wetting. For the same reasons they wash

readily, and from unprotected fields tons of the richest portions of the soil may be carried away during heavy rainfall or the melting of the winter's snows. Plowed fields exposed to the unhindered sweep of the winds are likewise denuded by the drifting of loose soil particles. The loess affords a fertile soil, and the cereal and legume crops grown upon it rival those produced on any other class of soil. It is usually found expedient however to take some precautions in the rotation of crops in order to avoid the necessity of leaving the uncovered fields open to the attack of winds and rain.

It has already been stated that at a few points along the principal streams of the county bodies of alluvium have been deposited. The materials have come from the upland soils, and this type is therefore one of great richness. Alluvial soils are usually sandy, of dark or black color, and where developed are the most productive of the region.

Covering the gravel terraces wherever they are developed in the county is a very productive soil. It is of the nature of alluvium, somewhat modified by later additions of rich loamy materials, and was undoubtedly spread over the surface of the gravel beds at a time following the close of the glacial period, while the streams were still of large volume and in a manner similar to the deposition of alluvium over the flood plains of today. The permeable gravels below afford perfect underdrainage. The terrace soils require seasons of more than the common amount of precipitation to produce the very best results. They are sandy, open textured and warm soils and appear best suited to the raising of corn, but in ordinary years even this crop does better on the less porous, more clayey soils.

The residual soils are of minor importance although at some points the weathered limestones and shales have contributed largely to the elements necessary for plant growth. In the southeast corner of Mott and the southwest two sections of Ingham township the Kinderhook limestone is very thinly covered, and in many places along the angular terraces which border Squaw creek the soil layer appears to be due almost entirely to the decomposition of the limestone. To the south of Mayne creek in sections 10 and 11 of Geneva township a similar state of

affairs obtains over small areas. In West Fork and Ross townships the Devonian shales have lent appreciably to soil formation in numerous localities. This is notably true along the west fork of the Cedar in section 7 of West Fork and section 1 of Ross township; and at various other points in Ross township south of Bailey creek. The presence near the surface of the shales is not so evident topographically as is the presence of the limestone. The characteristic yellow color and the marly nature of the shale soils are the distinguishing features. The limestone soils are highly impregnated with iron oxide and are therefore typically deep red to rust brown in color, and are found to grade downwards into the rotten and partially decayed limestone.

ECONOMIC PRODUCTS.

From the foregoing discussion it may be construed that Franklin county's most important asset is its fertile soil. On the soil the majority of its inhabitants depend and the products of the many prosperous farms are the chief articles of export. The county possesses besides, ample supplies of building stone, abundant clay resources from which are wrought most durable building material and drain tile which are at present so much in demand, and finally, a moderate supply of timber for fuel. In a way, therefore, it may be said that Franklin county is sufficient unto itself, and yet it depends, as do all other communities, for certain of the necessities, on neighboring fields having more abundant supplies that they are willing to exchange for articles which Franklin county is able to spare. Thus, coal must be shipped in, and lumber for building, while in return are sent out the bountiful products of the farm, the orchard and the dairy.

Building Stone.

Stone suitable for foundation walls and sidewalk flagging is quarried at a few points in the county. The best quality comes from the Kinderhook beds but a fair grade for rough work may be obtained at several localities from the Owen beds of the Devonian.

Kinderhook Beds.—A small quarry is worked by Mr. Wm. Low in the southwest corner of section 29 of Ross township. Considerable stone has been removed here and at a few other points along Otter creek in this vicinity. The quarry section has

been given on page 483. A quarry face eight to ten rods in length is open. The usable portion of the section is covered by six to eight feet of argillaceous weathered rock which must be removed by stripping. The lower beds are regular and the individual layers vary from six to eighteen inches in thickness. The stone is granular and fossiliferous and ranges from brown

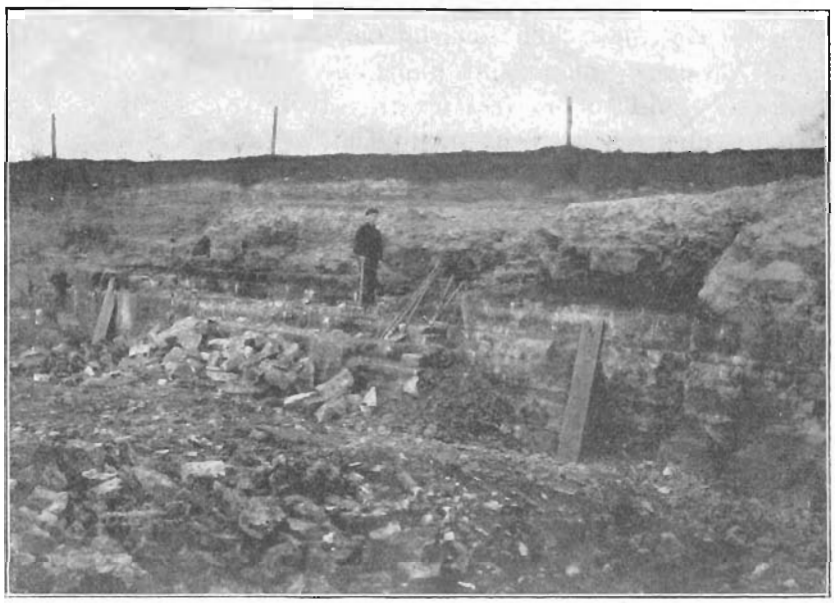

Fig. 60—Kinderhook limestone, one mile west of Chapin in section 29, Ross township.

to blue-gray in color. It yields readily to shaping for dimension work and affords the most durable building stone now produced in the county. A moderate local demand is supplied, none as yet being shipped.

Stone has long been quarried in the north part of the town of Hampton on Squaw creek. A poor grade of limestone is now being used from a new opening a few hundred yards west of the cemetery. The rock is weathered and contains intermittent bands of chert which cause it to break very irregularly. It is used for only the rougher masonry work and would not give satisfaction in exposed positions.

Although the Kinderhook limestone is removed for local use at a large number of points in Ingham, Geneva and Osceola

townships, at but two localities have quarry openings been made of sufficient extent that the nature of the unweathered rock could be observed. In the southwest quarter of the southeast quarter of section 10 and the northwest quarter of the northeast quarter of section 14, Geneva township, are small quarries in which are exposed essentially similar strata. The former is owned by Mr. O. Benson of Geneva and the latter is on the land of H. Andrews. The overburden here consists of five to eight feet of cherty magnesian limestone. This rests on a massive bed of eight to ten feet of gray to brown subcrystalline limestone which displays decidedly oolitic facies. Away from the weathered parts the rock is light in color and compact, and resembles in general appearance the Bedford stone. In natural outcrops this bed separates into numerous laminæ, each a few inches thick; but where newly exposed, slabs of almost any desired size can be obtained.

A small amount of stone is removed each year from these quarries. It is believed that continued development might open up unweathered portions of the bed which would furnish very good building stone. It seems likely also on account of the extreme thinness of the drift that prospecting along Mayne creek in this vicinity would discover places where it would be possible to obtain desirable stone that is not buried beneath so great a thickness of weathered residuum which must be removed.

Owen Beds.—These beds afford very little stone which is sufficiently coherent to have any extended use for structural work. As has been noted, however, the Owen limestone has been quarried at a few points along the east side of the West Fork of the Cedar where occurs a firmer phase of the usually argillaceous, marly magnesian strata of this formation. Some small amount of rock has been taken out in the southwest quarter of section 7, West Fork township. Three and one-half feet of yellow, magnesian, cherty shale overlie seven feet of moderately thin bedded crystalline brown magnesian limestone. Only the lower bed can be made use of, and, on account of its coarsely granular and partially weathered condition, is not a durable material. It has been used to a limited extent for sidewalk flagging and in walls, where it is fairly satisfactory.

Clay.

Franklin county is generously supplied with clays suitable for making all the common grades of wares. Those which are readily available are the loess and river clays and the clay shales of the Devonian. The loess, which overlies the Iowan drift in the eastern part of the county, is not utilized at any point. This material is employed over the state more than any other class of clays for brick and tile manufacture, and good substantial products are made from it.

River or alluvial clay is made use of at Dows in the Wilson Bros. Tile Works. The plant is situated southeast of town near the C. R. I. & P. tracks. The clay is taken from the river bottom below the plant. It is black soil at the surface grading downward into gray and yellowish plastic clay. Gravel underlies the clay, so the depth of the pit is limited to about four feet. The clay is spaded from the bank and hauled to the works in two-wheeled carts. The clay is shoveled on to an inclined belt which carries it to a pair of corrugated conical rolls. The rolls remove any contained gravel, after which the clay is lifted by a belt provided with metal pans to the pug mill. Only drain tile are made. A J. D. Fate and Company auger machine provided with a rotary tile cutter is used. With the exception of 11-inch tile, all sizes to one-half inch are made, from three and one-half to twelve inches in diameter. From the cutting table the green tile are wheeled to the dryers, being carried to the upper floors by chain elevators. The dryer buildings have slatted floors and are three stories high. Three buildings are connected by covered runways and include a total of over 96,000 square feet of drying space. Both exhaust and live steam are used for drying, but only after shrinkage in the drying tile has ceased, as too rapid expulsion of the water is apt to cause cracking. Three weeks are ordinarily required before the tile are ready for the kiln. The plant is equipped with six round downdraft kilns—one of which is eighteen feet; two, twenty feet; two, twenty-two feet; and one, twenty-three feet in diameter. Three stacks furnish draft for the six kilns. The tile require thirty-six hours to water-smoke and thirty-six hours to complete the burn. The product is of a high class and the local

demand is large. A considerable proportion of the output is also shipped into neighboring counties.

The Hackbery shales are utilized at the plant of Mr. E. P. Fox, one-half mile south of Sheffield. Both the yellow and the blue varieties of these shales are exposed in the pit. The upper two feet contain some limestone and calcareous concretions, but below this the clay is weathered and plastic and, excepting occasional blocks of friable magnesian limestone and some selenite scales, appears free from concretionary impurities. Approximately eight feet of the yellow, and three to four feet of the blue shales are removed for use. The clay is broken down and allowed to weather in the pit for six months or so. It is hauled by wagon and fed by hand into a "Little Wonder" auger machine made by the Wallace Mfg. Company. A single-wire hand cut-off is used for brick, tile and hollow block. All sizes of tile are made from three to eight inch inclusive, and this is the chief product. The ware is dried on racks under sheds having adjustable side walls for controlling the air circulation. Tile are safely dried in one week. The plant is equipped with one twenty-foot round down draft kiln. Power is supplied from a thirty horse power boiler and a twenty-four horse power Des Moines Iron Works engine. The ware produced is of fair quality. Incipient cracking sometimes ensues if the ware is too rapidly cooled in the kiln but the remedy for this is obvious. The presence of sulphates in the clay is evidenced in the finished product by a persistent scum or 'whitewash' which is often quite conspicuous by the finger marks produced in handling the green ware. This whitewash mars the appearance only, and in such materials as tile and brick that are well burned and are not to be used for outside work, should not diminish the value of the product.

These shales outcrop at various points along Bailey creek both above and below the town of Sheffield and in many places are practically free from overlying materials that would require removal. They constitute an inexhaustible supply of available raw material for the manufacture of the common clay wares.

Conditions appear especially favorable for drain tile manufacture on account of the location near the border of the Wisconsin drift—that great undrained stretch of country to the westward—where such an active campaign is now in progress to subdue the lakes, ponds and marshes of this new land surface. The demand for drain tile is strong and increasing and although railroad facilities are not the best, Franklin county raw materials are more accessibly situated than those of any competing area.

Sand and Gravel.

The terraces which skirt all of the larger streams in the eastern part of the county furnish excellent and abundant supplies of gravel and sand for road construction and concrete work. For road building the gravel beds are worked at many points where the public highways cross the stream valleys. Within

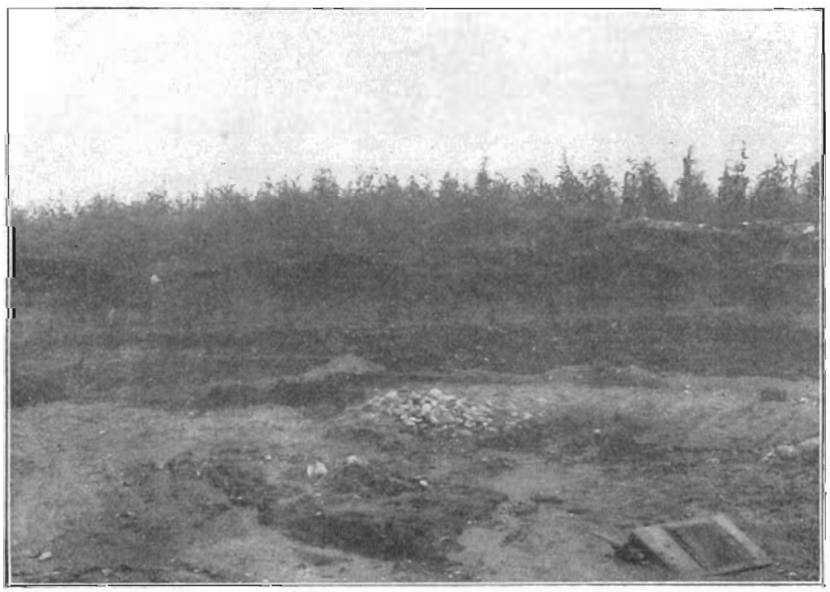

Fig. 61—Interstratified gravel and sand beneath partially assorted Wisconsin drift. Public highway between sections 5 and 6 of Reeve township.

the Wisconsin drift area extensive deposits are found along some of the streams and in the principal morainal belt in the southwest part of the county. On the road between sections 5 and 6 of Reeve township stratified sand and gravel occur

beneath a thin layer of partially assorted Wisconsin drift. Six to eight feet of the deposit have been opened up and large amounts removed from both sides of the roadway. Gravel and sand are hauled from this pit to Hampton for use in the manufacture of cement blocks, and for filling material in other lines of constructive work.

In the northwest quarter of section 19, Morgan township, is a series of morainal knobs. Near the northwest corner of the section one of these hills has been dissected. It is composed of nicely stratified clean sand, quite free from iron stain and other impurities. The strata are not horizontal nor continuous but interrupted and irregularly tilted at all angles. The pure condition of the sand renders it available for use in plaster and mortar mixtures. Sand is taken from here for making cement building blocks in Dows. No sifting is necessary, the requisite sorting and sizing of the sand having been accomplished by the natural agents which deposited it.

Peat.

The peat beds of Franklin county contain a large supply of low grade fuel that may at some future time be utilized. At present it is removed for use at but one locality. Peat has been taken out for a number of years on the land of Mr. E. H. Capellen in the south half of the northeast quarter of section 28, Morgan township, for local use. An area of sixty acres is said to be covered with eight to nine feet of usable peat. A plant of small capacity is installed by the Iowa Fuel and Brick Company of Dows, for briquetting the material. The equipments consists of a No. 66 Horton Mfg. Company Hercules six-mold soft mud brick machine, a small engine and drying sheds. The peat is hauled on a track in cars by a cable from the bog about one-quarter of a mile from the plant. In the brick machine the product is of necessity but very slightly compacted over its spongy condition in the bog, but the peat is put into convenient shape for handling, and the mechanically held water is largely dried from it. It is said to make a desirable domestic

fuel burning free from objectionable soot and clinkers. Some thirty tons have been produced in the past year. Following is a chemical analysis of an average sample dry peat brick.

	per cent.
Loss at 110°C	10 00
Volatile hydrocarbons	37 80
Fixed carbon	14 20
Ash	38.00

A calorimetric test of the same sample gives a fuel value of 4766 B. T. U., which means that one pound of the dry peat will produce enough heat in burning to raise the temperature of 4766 pounds of water one degree Fahrenheit.

Water Supply.

Ample supplies of good water are to be obtained from a number of different horizons in the geological formations that underlie this county. In the western part where the drift deposits are thick few wells are sunk below the base of the Pleistocene, and farm water supplies are frequently furnished by shallow wells, thirty to ninety feet in depth, which are fed from local sand pockets or intercalated beds of gravel, or by seepage from the bowlder clay itself. Such sources do not afford constant and unfailing supply, nor is the quality of the water the best. An abundance of water can usually be obtained at the base of the drift whose thickness runs from eighty to one hundred sixty feet. Gravel or quick sand, and in some instances hard pan, are found immediately over the Kinderhook limestone.

The town supply well of Latimer penetrates the rock one hundred feet, a porous member of the Kinderhook doubtless being the aquifer. The Dows well is eighty-four feet in depth and draws its water supply from gravel beds above the rock. Scattered over the south half of Morgan township are some fifteen flowing wells. They are obtained at thirty to eighty feet, and are said to all reach the solid rock. Some of these wells have a strong flow, while in others the water barely rises to the surface.

Outside of the Wisconsin drift area wells are quite universally sunk into the indurated strata of the Carboniferous and Devonian, although fairly dependable supplies can be obtained in places from the gravels and the alluvial deposits along the larger streams. In the vicinity of Sheffield and in general over the northeast part of the county it is necessary to go two hundred feet into the Devonian for water, and flows are sometimes to be had at this depth. In Ingham and Geneva townships the wells are frequently three hundred feet deep, and drillers report penetrating a bed of quick sand at about eighty, and another at three hundred feet.

The city of Hampton draws its supply of water chiefly from the deep well which penetrates seventy-four feet of the Jordan sandstone. The volume of water afforded by the Jordan is however not sufficient and is supplemented by that coming from the St. Peter sandstone. The water stands one hundred feet from the surface and is pumped from one hundred seventy feet. The mineral analysis of the deep well water is as follows:

Analysis Hampton City Well.

	Parts per million.
SiO_2	13.0
Fe	none
Al	2.1
Ca	80.7
Mg	33.4
Na	21.4
K	7.6
CO_3	180.0
HCO_2	
SO_4	59.0
Cl	5.0

Analyst, W. S. Hendrixson,
June 29, 1905.

The water is hard and is corrosive when used in boilers. It is however of fair quality for drinking purposes.

The water supply for Hampton was formerly taken from two large springs which flow from the limestone in the bank of Squaw creek. These springs now flow into a large cistern and this supplementary supply is drawn upon quite regularly during certain hours each day.

R.XXIII W. R.XXII W. R.XXI W. R.XX W. R.XIX W.

T.93 N. T.92 N. T.91 N. T.90 N.

WISNER SCOTT MARION RICHLAND CLINTON MOTT INGHAM ROSS WESTFORK

MORGAN OAKLAND HAMILTON LEE REEVE GRANT GENEVA OSCEOLA

SHEFFIELD CHAPIN ALEXANDER LATHER COULTER HAMPTON HANSELL WASHINGTON GENEVA FAULKNER ROPEJOY OAKLAND BURDETTE ACKLEY

Baileys Creek, Otter Creek, Buffalo Creek, Spring Creek, Maynes Creek, Indymves Creek, Squaw Creek, Cedar River, Iowa River, Beaver Creek

Iowa Central, Chicago Great Western, Chicago Rock Island & Pacific, Iowa Northern, Dows Road

IOWA GEOLOGICAL SURVEY

GEOLOGICAL MAP OF FRANKLIN COUNTY, IOWA.

BY
IRA A. WILLIAMS
1906

Scale 1/125,000
5 Miles
5 Kilometers

LEGEND
GEOLOGICAL FORMATIONS

Kinderhook	Mississippian
Lime Creek	Upper Devonian

TRI CITY LITHO CO. DAVENPORT, IA

Water Power.

None of the streams of Franklin county have been utilized for water power with the exception of Spring creek. This stream has been ponded in section 19 of Mott township and a small lake formed by an artificial dam of some length across its valley. This body of water is known as Beed lake, and water is run from it through a race to the flour mill one-half mile below the lake. The other streams of the county have neither a sufficiently constant flow nor volume great enough to afford economical water power. Iowa river would perhaps be the only possible exception so far as the flow of water is concerned, but favorable mill sites along this stream are very rare.

ACKNOWLEDGMENTS.

It is a pleasure to acknowledge the uniform courtesy and response to requests for information accorded the writer by many citizens of the county. Thanks are due also to other members of this Survey for counsel and aid during the progress of the work. The author is especially grateful to Professors Calvin and Savage for assistance in the identification of fossils and to Dr. S. W. Beyer for advice and substantial aid in some of the problems met in the field.