
GEOLOGY OF RINGGOLD COUNTY

BY

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GEOLOGY OF RINGGOLD COUNTY

INTRODUCTION

LOCATION AND AREA.

This county received its name in honor of a gallant young officer who lost his life at the battle of Palo Alto in the Mexican war, the memories of which were still fresh in the mind of the public at the time of the organization of the county in 1851. It is in the fourth tier of counties east of Missouri river along the Missouri border. It has Decatur county upon its eastern boundary, Taylor on the west and Union on the north. Twelve of its civil townships are exact equivalents of the corresponding congressional townships, but the four townships upon the south line are fractional. Sections 31, 32, 33, 34, 35 and 36 in each are entirely wanting and sections 25, 26, 27, 28, 29 and 30 lack a little more than one-fourth of a full area in Riley and Lots Creek townships and just about one-fourth in Middle Fork and Clinton townships. The slightly southward trend of the south boundary of the state in all the counties east of Ringgold ceases about midway of this county and thenceforward the boundary line pursues a due west course. The area of the county is therefore very nearly 542 miles.

PREVIOUS GEOLOGICAL WORK.

Ringgold was one of the fourteen counties in the southwestern part of the state whose geology received special attention by White¹ in his first volume. As but two minor outcrops of indurated rock were found, the three pages devoted to this county were mostly given to the character of the surface and the drainage. The great thickness of the drift and the deep drift-valleys through which the streams flow were particularly noted. These were regarded by White as "the deepest and largest purely drift valleys in the State", "being from one hundred fifty feet to more than two hundred feet deep, from the general level

¹Geology of Iowa, Charles A. White, M. D., Vol. I, pp. 328-330, 1870.

of the uplands of the county." Other mention of the county is confined to brief comments on the prospect of coal within its limits in volumes II and XIX of the present series of reports of the Survey and to annual tabulated statements concerning clay products in the same series.

PHYSIOGRAPHY

Topography

Simple as is the topography of many Iowa counties, it is doubtful if any one of them presents less complexity in its topographic details than does Ringgold county. The present surface configuration is the resultant of Pleistocene agencies. Such is the thickness of the drift deposits in all parts of the county that, whatever irregularities of surface may have been developed in the later Carboniferous formations during the period of their exposure to meteoric agencies, they contributed almost nothing to the existing topography beyond affording a substantial foundation for the heavy mass of glacial debris that rests upon them. The only decisive ground for qualifying the above statement exists in the valley of Thompsons Fork of Grand river which crosses the extreme northeast corner of the county. Here the river has cut through the drift and well into the Bethany limestone. It is true, however, that all this might have been accomplished under exceptional conditions within the limits of post-glacial time and so far as anything in this valley within the county is concerned there is insufficient evidence to warrant a conclusion that it did not so occur. But Bain² who studied the channel of this river throughout its course in Decatur county and, doubtless northward into Union county, finds apparently conclusive reasons for regarding that part of the valley of Thompsons Fork of Grand river which is south of Afton Junction as preglacial.

The following are the reasons given by him for his conclusions :

- "1. The Kansan drift is found undisturbed in this valley.
2. The size of the valley and the fact that much of it is cut in rock.
3. The distribution and character of its tributary drainage lines.
4. The advanced stage of the meander and rock cutting that has produced the great bend in the river in the northwest portion of Burrell township, Decatur county."

²Iowa Geol. Survey, Vol. VIII, p. 264, 1897.

The rock exposures in the valley of the East Fork of the Grand in sections 20 and 30, Lots Creek township, may be indicative of the preglacial existence of a channel there, but since this stream just above these localities and between them is still bedded in the drift, though very near its lower limit, it is much more probable that the channel of this river has been excavated wholly within post-Kansan time.

The larger streams have cut the original drift plain into approximately equal parallel blocks with a north and south trend and these in turn have been subdivided at their southern ends into similar smaller blocks by tributaries which make their junction with the larger streams beyond the limits of the county and state. Tributaries which lie wholly within the county have made numerous smaller triangular or subquadrangular lobes. Minor intermittent streams have continued the dissection almost indefinitely, until only relatively small areas of the original flat Kansan plain remain intact and those are confined almost wholly to the divides of the larger streams and especially in the northern half of the county.

Davis, Wayne and Ringgold counties have relatively small water courses which rise within their border, or but a short distance beyond, while the alternate counties Van Buren, Appanoose and Decatur, are traversed respectively by Des Moines and Chariton rivers and Thompsons Fork, with the results that the great drift plain common to them all has been modified in the later named counties in a much more pronounced way than in the first named. Broad undisturbed stretches of the flat Kansan plain constitute a prominent characteristic of the south two-thirds of Davis county. In Wayne county they are less noticeable, though still a marked feature of the landscape, while in Ringgold county they are to be remarked upon rather from their absence or diminution in size than from their occurrence. These areas are not only unmarked by stream channels, but are also wholly without the wide low sags that characterize the comparatively level stretches that occur in some parts of the regions of the Iowan drift.

The larger stream beds lie two hundred feet or more below the general level of the drift plain and where several streams

are in somewhat close proximity the country is exceptionally rugged. Such a locality is in the northeastern part of Union township where Sand creek parallels Thompsons Fork a mile or so away and some of its own tributaries come down to it from the southwest. An exceptionally rugged topography has developed



FIG. 1.—Erosional topography in Monroe township, Ringgold county.

among the upper forks of a small tributary of Thompson Fork in the eastern part of Monroe township. This unusual condition



FIG. 2.—Erosional topography shown in section 30, Athens township, Ringgold county. Belongs at right of figure 5.

among the minor branches near the headwaters of the streams is readily explained. Ordinarily the headwater streams are quite remote from the base levels at their junction with the master stream; thus their gradient is low and consequently their erosive effects are rather moderate near their sources. In the case of Holl Run, cited above, the descent to Thompsons Fork is made within nine or ten miles. With the consequent high gradient all the branches become raging torrents with every considerable rainstorm and the results of their ravages are manifest up to their very beginnings. Such streams make headward erosive progress rapidly and not unfrequently invade the drainage areas of other less precipitous streams, capturing their tributaries and thus still further increasing their own efficiency as agents of erosion. Figure 2 is an example of this process.

A section through the drift block between two large neighbor streams in the south part of the county would be represented

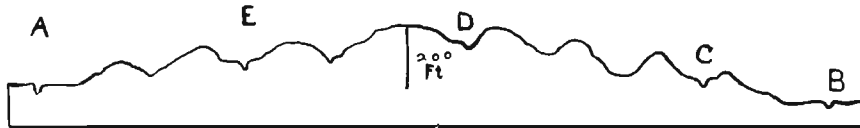


FIG. 3.—An ideal section through a drift block between two large streams in the southern part of Ringgold county.

ideally by the following diagram, figure 3, in which A and B locate the large streams, C, D and E locate the tributaries. The contour line is nowhere twice the same, of course. The altitude of the stream beds increases towards the north and consequently the height of the intervening ridge diminishes, while the number of the ridges usually increases since the blocks are subdivided by an increasing number of minor tributaries toward the headwaters of the main streams. A typical example of these blocks may be seen south of Maloy between the Platte and the West Fork of the Grand.

The flat Kansan areas (or tabular divides as they are called by Kay and others) already alluded to are found just beyond the sources of the headwater streams as in the south of Athens and the north of Riley townships, where there is an area not yet invaded by the initial streams of West Big creek, also in the sections of Athens township immediately south and west of Keller-

ton into which the head streams of East Big creek have failed as yet to penetrate. A similar region may also be cited about Tingley and beyond Lots Creek, south of Elston.



FIG. 4.—Portion of a tabular divide in section 21, Athens township, Ringgold county.

A region representative of an intermediate type of topography may be found south of Mount Ayr towards the East Fork of Grand river. It suggests an exaggerated Iowan drift topog-

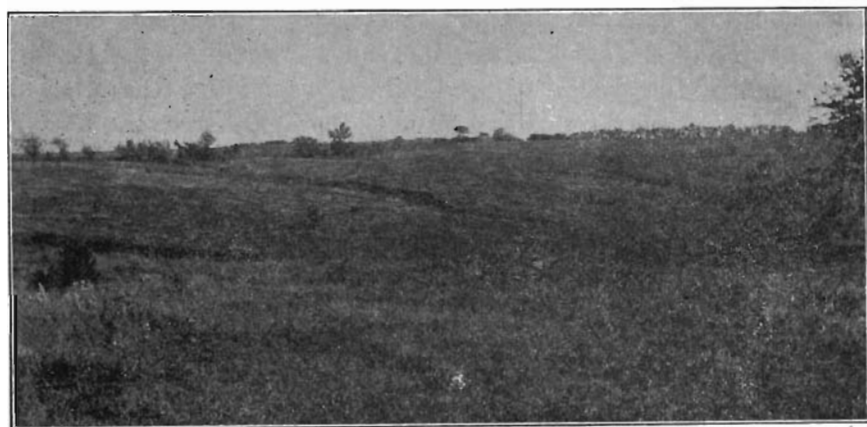


FIG. 5.—Erosional topography in section 30 of Athens township, Ringgold county. This view belongs at the left of figure 2.

raphy, a billowy surface, wherein irregularity is the rule, the trend, size and form of the ridges and hills varying indefinitely. From the top of even the highest hills the view is much restricted excepting where a stream valley chances to be in the line of vision.

In the southern part of the county most of the divides and hill crests are narrow, while towards the north they tend to widen and flatten. The Chicago, Burlington and Quincy railroad southwest of Mount Ayr follows the divide between the West Fork of the Grand and the Middle Grand. On both sides of the road the surface gently slopes away to the valleys beyond in a manner quite unique for this region.

Another intermediate type approaches the flat Kansan areas in general aspects, differing in having a moderately broken or dissected surface. The drainage and soil are good and but little or no waste land occurs. This phase may be found adjoining the flat Kansan areas and also in localities whose conditions approximate those of the flat Kansan.

The only remaining topographic phase is that of the river valley. The Platte, perhaps, affords the finest illustration of a river plain to be found within the county. It is comparatively wide and lies high enough to be safely cropped in ordinary seasons, at least. Some of the rivers either have no river plains or have them only at intervals along their courses.

ALTITUDES.

The following table gives the altitudes of points within the county, or just over its border in adjacent counties, as given in Gannett's Dictionary of Altitudes, Bulletin 274 of the U. S. Geological Survey.

LOCALITY	ALTITUDE	AUTHORITY
Beaconsfield	1209	C. B. & Q. R. R.
Benton	1059	C. G. W. R. R.
Blockton, Taylor county...	1081	C. G. W. R. R.
Clearfield, Taylor county...	1250	C. B. & Q. R. R.
Delphos	1140	C. B. & Q. R. R.
Diagonal	1089	C. G. W. R. R.
Ellston	1214	C. B. & Q. R. R.
Goshen	1180	C. B. & Q. R. R.
Kew	1109	C. B. & Q. R. R.
Kellerton	1197	C. B. & Q. R. R.
Knowlton	1102	C. G. W. R. R.
Maloy	1120	C. G. W. R. R.
Mount Ayr	1232	C. B. & Q. R. R.
Redding	1130	C. B. & Q. R. R.
Shannon City, Union county	1144	C. G. W. R. R.
Tingley	1151	C. B. & Q. R. R.

The points of maximum altitude in the county are on the uplands along the north border of Lincoln and Tingley townships and must be about 1,260 feet above sea level. The lowest point is probably in the valley of Thompsons Fork of Grand river in the northeast corner of the county and is estimated at about 1,020 feet above sea level, making a difference between these extremes of 240 feet, which is quite in accord with the observed depth of the larger river valleys below the adjoining upland levels, where the difference ranges from 150 to 200 feet.

Drainage

The entire surface of Ringgold is covered heavily with drift debris which, superficially at least, is represented by the Kansan, by far the oldest of the drift sheets that are exposed over any considerable portion of the state. The time since the Kansan was laid down may better be reckoned in milleniums than in centuries. The drainage of the county therefore has had ample time in which to develop and, since for two hundred feet or more in vertical extent there is no indurated rock to interpose the slightest obstacle, as complete a system of drainage has been developed as can be found anywhere in the state excepting possibly in the driftless area. Bogs or true swamps are unknown. An occasional small patch that is somewhat saturated with water for a part of the year may be found, perchance, but it scarcely amounts to a disadvantage to the owner of the land. Indeed, the sole disadvantage lies in the fact that in perfecting the system of drainage, the ever active and efficient agents of erosion have cut the channels too deep by far.

The drainage of Ringgold is effected by Platte river and the Grand river system. The Platte is the largest stream that has any considerable part of its course within the county. Its headwaters are in the northern part of Union county. About ninety square miles in Lincoln, Grant and Benton townships of Ringgold are drained by it. After nearly paralleling the course of the West Fork for sixteen miles or more it swerves to the west and enters Taylor county from section 31 of Benton township. It is a quiet stream and along the lower half, at least, of its course in Ringgold county there is a fine alluvial flat of moderate width. It has a series of short, pinnately arranged branches

upon the west side, but leaves the drainage upon the east to the West Fork with a single exception in Lincoln township.

Grand river is a tributary of the Missouri and in extent of its basin is comparable with the Cedar-Iowa system as two to three. In Iowa its basin comprises in whole or in part the counties of Wayne, Decatur, Ringgold, Clarke, Union and Adair. Its tributaries with one exception are from the north and have their rise in Iowa. The West Fork may well be regarded as the main stream to which all the rest are tributary as it takes its course southeastward to its master stream.

It may be pertinent to say something here about the confusion in the names of some of the rivers in southwestern Iowa and which is experienced specially in dealing with the various elements of the Grand. In this part of the state more than elsewhere the rivers have a tendency to branch dichotomously, a method that in many cases gives little distinction in size to the branches. Hence the branches are usually called forks and when they in turn divide, their divisions are called forks. Since the courses of all these streams are southward, the terms East and West Forks are very common designations for these secondary as well as for the primary branches, to the utter confusion of the stranger, if not of the resident. Then, too, as the long expression, such as Thompsons Fork of the Grand, is too cumbersome for daily use, it is abbreviated by dropping the terminal prepositional phrase or the initial descriptive part. Thus Thompsons Fork of the Grand is known in Iowa as *the Grand*. When a stream is known as the East Fork, or the West Fork, the stranger is left to wonder to what system the stream belongs.

Named in order from west to east the members of the Grand river system in Ringgold that independently cross its south border are West Fork, Middle Fork, Fletchrell branch, East Fork, Lots creek, West and East Big creeks. So far as they maintain their individuality, their courses are practically parallel. Their drainage basins with one exception are very narrow, scarcely averaging five miles. Most of them are bordered with trees below the point where their initial branches have united to form a perennial watercourse. Their tributaries are small as a rule and principally from the west side excepting in the case of the

West Fork. Bedded in the drift as they are they are muddy streams upon the slightest provocation.

Next to the Platte ranks the West Fork which we have already said should be regarded as the main line of the Grand. It rises in Union county and has in Ringgold a drainage area of about one hundred and seventy-five square miles, more than double that of any other stream except the Platte.

While most of its tributaries are small, Plum creek upon the west in Jefferson township and Squaw, Crooked and Walnut creeks upon the east are relatively large. Its basin has a maximum width of nearly twelve miles.

The headwaters of East Fork also are in Union county. Its course is quite direct. The branches that enter it within Ringgold county are few, but above the average in size. Fletchrell branch and Middle Fork become tributary beyond the state line. Middle Fork drains the territory southwest of Mount Ayr. The eastern border townships are in large part drained by the East and West Forks of Big creek and by Lots creek, all of which form a junction at a short distance beyond the state line. Grand river, or more exactly Thompsons Fork of the Grand, which in its passage from Union to Decatur county leaves merely a few acres of Ringgold county upon its eastern side, effects the drainage of about thirty-six square miles in Union and Monroe townships through its tributaries, Sand and Elk creeks.

STRATIGRAPHY

While Paleozoic formations are to be observed in but three small exposures within the county, there can be no question as to the series or stage to which the deposits immediately underlying the drift should be referred. In the first place Ringgold lies in the very midst of the area of the Missouri stage of the Pennsylvanian series. Then, too, the rocks of all the exposures in their own character as well as through the fossils which they bear testify unequivocally of the time in which they were laid down. Equally clear is the evidence that the superficial drift throughout the county belongs to the Kansan stage. The following table shows the relation of the various elements of the stratigraphy of the county.

TABLE OF FORMATIONS

GROUP	SYSTEM	SERIES	STAGE	CHARACTER OF ROCKS
Cenozoic	Quaternary	Recent		Alluvium
		Pleistocene		Loess
			Yarmouth	Gumbotil (Kansan)
			Kansan	Boulder Clay
			Aftonian	Sand, gravel, plant remains
			Nebraskan	Boulder clay, bluish gray
Paleozoic	Carboniferous	Pennsylvanian	Missouri Kansas City Division	Limestone

THE CARBONIFEROUS

Since the Carboniferous is almost universally deeply buried beneath the drift and since its uppermost formations belong to that portion of the system that is barren of coal, little interest economically or scientifically attaches to the oldest accessible rocks within the bounds of the county.

Pennsylvanian Series

MISSOURI STAGE.

Kansas City Division.—Neighboring counties, chiefly on the north and east, have numerous exposures of shales intermingled with which are several more or less important beds of limestone which by reason of their greater hardness have a prominence quite out of proportion to their thickness as compared with the shale beds. Sandstones occur, though they are but few. This entire aggregation of strata is a part of the *Kansas City division* and constitutes the basal portion of the Missouri stage³. In Keyes' general section of the Missouri in Iowa as published in Volume VII of the Proceedings of the Iowa Academy of Science, a thickness of 100 feet has been assigned to the Kansas City beds in Iowa. The report on Decatur⁴ and Madison⁵ counties present valuable contributions to our knowledge of the Kansas City division in the state. The exposures are quite numerous and are so distributed and related as to make the differentiation and

³See the report on Clarke county, this volume, page 117.

⁴Bain, Iowa Geol. Survey, Vol. VIII, 1897.

⁵Tilton and Bain, Iowa Geol. Survey, Vol. VII, 1896.

correlation of the several beds of the lowest portion of this division quite satisfactory.

The series of limestones belonging to the Kansas City division have been known by the following names.

The Westerville

The De Kalb (*Fusulina*)

The Winterset

The Bethany Falls (Earlham)*

The Hertha (Fragmental)

The Hertha is basal. Each of these substages usually consists of one heavy bed and one or more thin beds of limestone separated by shale beds of varying thickness and each separated from the other by heavy beds of shales with an occasional sandstone bed. Fossils abound in both the limestone and the shales in most localities.

Along Grand river (Thompsons Fork of the Grand, more exactly) in Union county, and near Westerville in Decatur county on Sand creek not far from its junction with Thompsons Fork, are found beds of limestone which Bain has called the Westerville limestone and which lie not far from the upper limits of the Kansas City division.

In section 1, Union township, Ringgold county, which is cut by Thompsons Fork, there is an exposure of shales and limestones along the south bank which belong undoubtedly to the Westerville limestone. A portion of the exposure was covered with drift debris washed from the steep bluffside above. A very imperfect section is given below.

3. An earthy blue limestone, fossiliferous and having the upper 3 or 4 inches very hard and separated from the softer lower portion by a very thin band of shale. The full thickness not determined.
2. A blue-gray nodular limestone, the nodular masses quite variable in size and in some cases in concentric layers; non-fossiliferous.
1. A dark blue fissile shale, 18 inches above the water's edge, the river being quite low at the time of observation.

The fossils observed in No. 3 were *Fusulina*, abundant only in places, *Rhombopora* sp. and several other Bryozoa, a *Productus*

*Tilton, John L., The Proper Use of the Geological Name "Bethany": Proc. Iowa Acad. Science, Vol. XX, pp. 207-211, 1913.

sp., *Rhipidomella pecosi*, *Chonetes* sp., and fragments of small crinoid stems.

A yellowish limestone, somewhat crystalline and thin bedded, occurs along the creek in section 20, Lots Creek township. *Fusulina*, *Bryozoa* and *Brachiopoda* fragments largely make up this stone. It is hard and has been used sparingly for foundations by the farmers in the vicinity.

In section 19, Lots Creek township, a similar rock was found. Some layers were much more crystalline, but less fossiliferous. The stone of these outcrops might be serviceable for foundations, etc., were it not that it would require extensive stripping of the overlying drift.

QUATERNARY SYSTEM

Pleistocene Series

Mantle rock practically everywhere covers the county. Its maximum depth is upwards of 280 feet, a little more than that having been penetrated in the Lewis Myers well in Athens township. It is probable that the basal part of this belongs to the Pennsylvanian series and that the driller did not carefully distinguish some of the upper shales and clays of the Missouri formation of that series. Along the immediate banks of the East Fork in Lots Creek township the thickness of the drift is reduced to a few feet. In fact in two places a broken limestone is exposed. The thickness of the glacial deposits over the upland regions averages about 200 feet, if we may judge from the few instances where the drift has been fully penetrated, as well as from the differences in altitudes of the deeper valleys and of the higher ridges. The great thickness of the drift deposits together with the fact that many thousands of years have intervened since the disappearance of the Kansan glacier, the later of the two ice sheets that left their debris over the area of the county, accounts for the unusually rugged topography of large portions of the county. These factors account also for the accompanying phenomena which are manifest everywhere and which are due immediately to the activity of the various weathering agents, included in which phenomena mention may be made of alluvial soils, sand and gravel deposits both superficial and

interglacial, reddened and yellowed beds of drift, lime concretions, decadent rock fragments, soil beds, etc.

THE NEBRASKAN STAGE.

Before geologists had directed their attention to the careful and thorough investigation of the abundant drift material found almost everywhere in the northern part of the United States, the Kansan was believed to be the oldest as well as the most extensive drift sheet, at least in the middle west. A more intensive study soon made it evident that a further differentiation must be made to meet the requirements of the accumulating data. The heavy deposits in the southern part of Iowa, for instance, that had been regarded as the product of a single ice sheet gave evidence of having been laid down at two different times. This evidence came from the character of the deposits themselves as well as from the presence of more or less stratified sands and gravels, of vegetal matter and of other interglacial phenomena in the midst of the drift deposits. Today there is practically unanimous agreement among geologists as to the existence of two distinct drift sheets where but one, the Kansan, had been recognized at first. The upper of these has retained the name Kansan. The lower has been known as the Jerseyan, the Albertan, the pre-Kansan, the sub-Aftonian and the Nebraskan. The last name has been suggested by Shimek as suitable and more in accord with the names of the other drift epochs, especially as the other terms are unsatisfactory for various reasons.

The distinctive features of the Kansan have been given so often that they need not be given here. Those of the Nebraskan as given by Shimek will bear quotation. "Throughout the western and southwestern parts of Iowa and southeastern Nebraska there are exposures of a dark blue-black drift which, as far as could be ascertained, rests directly upon the older rocks of the region. It consists chiefly of a dark, blue-black joint clay, sometimes more or less ferruginous, which when dry is hard and brittle and breaks up into very small angular blocks, resembling lumps of ordinary starch as has been suggested. It is almost impervious to water and when wet is very tough, tenacious, rubber-like and so difficult to work that it is the abomination of

well-diggers and road makers, being the most despised of the 'gumbos'.

Scattered through this joint clay are relatively few, usually dark colored, pebbles and small bowlders (larger bowlders are very rare) which frequently show sharp angles and fractures, or distinctly planed, striated faces, demonstrating that this is a true drift."

Other observers doubtless have found variations in the characteristics of the Nebraskan, as might be expected, but will agree in the main with the above description.

The grounds for the conviction that the Nebraskan occurs in Ringgold county are as follows: The known occurrence of the Nebraskan in Union and other neighboring counties and the almost inevitable necessity of the existence of like conditions in this county at the time the Nebraskan drift was laid down in these other counties; the evidence from the deeper wells; the occurrence of materials definitely referable to the Aftonian, below which are found in a few instances a till meeting the description by Shimek quoted above.

It is unfortunate that the available records of deep wells are so few and unsatisfactory. That they are so is easily to be accounted for, since water is looked for in the upper part of the drift and little interest is taken by the driller in its variations beyond recognizing them simply as sand, gravel, clay, etc. However, such as they are, some deep wells give warrant for regarding them as testifying to the existence of a drift sheet below the Kansan and distinct from it.

Then, too, it has long been understood that coal cannot be found in workable quantities in Ringgold county except at such depths as to preclude its profitable mining under existing conditions, so prospectors have done nothing that helps the geologist in solving his problems concerning the deeper Pleistocene deposits. Recent cuts, natural or artificial, rarely extend more than a few feet below the surface. Indeed so far as the writer's experience goes few, if any, counties of the state afford so little that is directly and positively helpful in determining the nature and relations of the materials constituting the basal part of the

¹Iowa Geol. Surv., Vol. XX, pp. 304-307.

mantle rock and so in differentiating it from the upper portions.

There are, however, exposures of till that are found near the rock exposures in Lots Creek township which are unquestionably Nebraskan. One of these is a short distance south of Watter-son. Others are found on the east and west road in section 20. It is likely that wherever in the south half of the county the mantle rock is thin, it is Nebraskan, though weathering has rendered it difficult of recognition by any distinctive features. Where Thompsons Fork of the Grand cuts the northeast corner of the county the bluffside gives in part a section as follows:

	FEET
5. A gray loesslike clay.....	2- 3
4. A dark gray till, slightly ferruginous above and almost pebbleless	15
3. A well reddened gravel.....	10
2. A blue-gray till	
1. Till much obscured by wash from above, but doubtless a continuation of No. 2. 1 and 2 together.....	12-15

It would seem that 1 and 2 are Nebraskan, No. 3 is Aftonian and Nos. 4 and 5 are Kansan, though the thickness seems slight.

THE AFTONIAN INTERGLACIAL STAGE.

While in some places the Kansan rests directly upon the Nebraskan with little to indicate exactly where the line of division between the two is, if indeed material from both is not indiscriminately mingled, in many places sand and gravel beds make a distinct plane of separation, more or less continuous. Soil and forest beds and various vegetal remains not only emphasize this line of division but show that there must have been a long time interval as well. The upper part of the Nebraskan is weathered manifestly in some cases though the passage of the Kansan ice in places removed all traces of this part of the Nebraskan, or thoroughly mixed it with its own debris.

Inquiries concerning upland wells in Ringgold county revealed the fact that the great majority of them end in sand or gravel at a surprisingly uniform altitude, differences in surface elevation being taken into consideration. All over the county the depths of these wells were reported to be from 30 to 80 feet. Just above these sand or gravel beds logs and other plant remains have been reported in several instances. It is not un-

likely that the old surface of the Nebraskan was eroded somewhat and this accounts in part for the varying depth of these wells.

It is concluded therefore that Ringgold county adds its testimony to the current belief among Pleistocene geologists that there was a notable interval of time between the two oldest glacial epochs.

THE KANSAN STAGE.

The melting of the Kansan ice sheet left its burden of incoherent material spread out over the county as an extended plain sloping southward. Only remnants of the original plain are to be found today. Its surface has been widely and deeply dissected and its superficial composition has been variously modified by weathering during the long period of time since it was laid down. Good illustrations of tabular divides, as these remnants are called, may be seen in Athens, Monroe and Tingley townships. In fact every township has representatives of the original Kansan surface undisturbed topographically, though in this county they are of meager extent as compared with those in the more eastern counties, among which Davis county is specially to be noted. Since the characteristics of the Kansan have been written up by so many on account of its wide extent and the interest it has always commanded and since it presents no unusual features in Ringgold county, it is not deemed necessary to discuss it further here.

GUMBOTIL.

The term gumbo has been applied popularly and by the earlier students of the Pleistocene to certain dense impervious clays, usually varying in color from gray to nearly black, very tough and sticky when saturated with water, but somewhat tractable when dry, and this term has been applied to clays under a great variety of conditions and relationships. For many years it received little serious consideration from geologists, who simply regarded it as being one of the many variations of clay and having no value in the record of changes that took place in the history of the Pleistocene. In recent years it has awakened the interest of some who have speculated as to its origin and rela-

tions without, however, pronounced satisfactory conclusions. Very recently Kay, believing that the time had come to thoroughly study the problem, has evolved a theory that very satisfactorily accounts for the character and relations of the gumbo of the Kansan tabular divides as well as of a gumbo that occurs in similar relations to the Nebraskan and the Illinoian.

A brief statement of that theory is pertinent here. After the retreat of the Kansan ice there was left as a result of its invasion an extensive drift plain with a gentle slope^s. "This drift plain was so situated topographically that weathering agents were very effective but erosion was slight. As a result of the weathering during an exceedingly long time a grayish, tenacious, thoroughly leached joint clay, which has been named gumbo, was developed to a thickness varying from about fifteen feet to twenty feet or more. This gumbo contains only a few pebbles, which are almost wholly siliceous, and grades down into yellowish and chocolate colored Kansan drift from three to seven feet in thickness, in many places with numerous pebbles, few, if any, of which are calcareous. This drift, in turn, merges into unleached drift, oxidized yellowish for several feet; below which is the normal unleached and unoxidized dark-grayish to bluish-black Kansan drift. The gumbo is believed, therefore, to be essentially the result of the thorough chemical weathering of the Kansan drift, but subordinately, other factors, such as the wind, freezing and thawing, burrowing of animals, etc., have undoubtedly contributed to its formation."

"After the gumbo plain had been developed by weathering processes from the Kansan drift plain, diastrophic movements seem to have occurred, the plain having been elevated to such an extent that erosion became effective, and valleys began to be cut into the gumbo plain. Erosion of the gumbo plain progressed to such an extent that some valleys were cut to a depth of more than a hundred and fifty feet before grade was reached, and a mature topography was developed. Only remnants of the original gumbo plain remain, the most conspicuous of these being flat, poorly drained areas, known as tabular divides. Such divides are more prevalent east of a line drawn north and south

^sKay, George F., Bull. Geol. Soc. America, Vol. 27, pp. 115-117.

through south-central Iowa than west of such a line. In the southwestern part of the state, the gumbo is found only where the divides, which are no longer distinctly tabular, retain the level of the former gumbo plain."

It has been announced that detailed chemical analyses of gumbo which have been made in the chemical laboratory of the University of Iowa by Dr. J. N. Pearce strengthen the interpretations given above from the field evidence.

The theory of Kay as set forth above accounts well for a class of phenomena observed by the writer in Ringgold and other counties in southern Iowa, though his observations had been made before the statements quoted had been seen. The writer regards the theory as a distinct and valuable contribution to the settlement of one of the problems that have been attracting more and more the attention of Pleistocene geologists.

Kay also suggests that in place of the term gumbo which has always had a loose and indefinite application the term "gumbotil" be given to the superdrift clays under consideration. His definition follows. "Gumbotil" is a gray to dark-colored, thoroughly leached, non-laminated, deoxidized clay, very sticky and breaking with a starch-like fracture when wet, very hard and tenacious when dry, and which is, chiefly, the result of weathering of drift. The name is intended to suggest the nature of the material and its origin."

"Field work has already established the fact in Iowa that there are three gumbotils, the Nebraskan gumbotil, the Kansan gumbotil, the Illinoian gumbotil."

The presence of the Kansan gumbotil in the tabular divides is a matter of common recognition among the farmers as an impervious clay subsoil which in wet seasons checks proper downward drainage of the soil, thus creating conditions more or less unfavorable to the growing crops. It was rarely seen in roadside, or other cuts, however. Two or three gumbolike exposures were noted near the crests of the narrow ridges south of Mount Ayr, but in most instances a yellowish till with lime concretions just below the soil was seen. The latter cases are at a less elevation

⁹Kay, George F., Gumbotil, a new term in Pleistocene Geology: Science, New series, Vol. XLIV, page 637-638; 1916.

than the former and evidently are below the elevation at which the gumbotil occurs. Conditions similar to the above with even less of the gumbotil to be noted are very generally prevalent over the county.

One mile west of Watterson there is a gully eight or ten feet deep, the lower two feet of which is cut in a much reddened till containing many lime concretions. Above this is a gumbotil overlain by a siltlike clay similar to that often mentioned by Calvin in his notes on Taylor county. The whole exposure is undoubtedly Nebraskan. On the east and west road in section 20, Lots Creek township, Nebraskan gumbotil was observed.

LOESS.

This material which overlies the gumbotil and drift in many localities is to be noted in Ringgold county much more frequently than the gumbotil, largely because the cuts that disclose the near-surface mantle rock are in most cases too shallow to reach the underlying gumbotil, while they reveal a part, at least, of the loess. Since Kay's theory of the origin of the loesslike clay overlying the gumbotil is almost a necessary adjunct of his theory of the origin of the gumbotil, it is quite essential that he be quoted here. "While there is in places, loess of eolian origin on the Kansan drift of southern Iowa, much of the material which has been described as loess is thought to be not of eolian origin, but to be related more or less closely to the gumbo. The upper few feet of the Kansan gumbo, which is now limited to the tabular divides and divides closely related to tabular divides, is a fine-grained, loess-like joint clay in which, if diligent search is made, it is possible to find a few very small siliceous pebbles similar to those in normal gumbo, and it is thought that this loess-like clay is the result of changes that have been going on at or near the surface of the gumbo during the great length of time since the normal gumbo was formed. The loess-like clay which is now found as a mantle on the Kansan drift on the slopes and divides that have been brought by erosion considerably below the level of the original gumbo plain is believed to be the product, not of wind action, although wind may have been a factor, but chiefly the product of the weathering and concentration

of the gumbo and to some extent the underlying Kansan drift, where erosion has not kept pace with the weathering."

This description of Kay had special reference to the loesslike clay which is prevalent in many counties which lie to the east of Ringgold county and not to the distinctive loess of eolian origin which is found so abundantly in counties which are west of Ringgold county.

In the northeast quarter of section 2, Poe township, the East Fork of Grand river has been cutting comparatively recently into its north and east bank where it turns from the east to the south and has thus exposed twenty feet or more of earth. The upper part of this exposure is loesslike and stands vertical, or nearly so. So well has it resisted erosion that in places it overhangs somewhat the underlying sand or gravel much as indurated rock may overhang the subjacent strata. The unusual thickness, six or eight feet, of this loess, its situation, and its relations to the coarser material next below, which is more or less stratified, would indicate that it is eolian in origin. On the other hand the loesslike clay seen on the top of the narrow ridges on the road from Mount Ayr to Benton and that noted in the east half of section 13, Grant township, and in numerous other localities, afford good illustrations of a material that well may have had its origin by weathering from gumbotil.

Recent Series

ALLUVIUM.

All the larger streams of the county, at least in their lower courses, are bordered with flood plains of varying extent, which by meandering they made for themselves centuries ago. In more recent times with every recurring flood they have deposited over these plains increment after increment of fine silt rich in organic matter. This deposit is alluvium. Fine illustrations of alluvial valleys may be seen along the Platte and the West Fork of the Grand, and these plains extend practically across the county, while along most of the other streams they do not extend beyond the central part of the county.

ECONOMIC PRODUCTS AND PROBLEMS

Soils

The soils of the county are classed as loess, Kansan drift and alluvium. Loess ranks among the best soils. It is porous, thus affording good root basis for plants, admitting ready drainage in wet times and allowing the rise of moisture from below by capillarity in seasons of drouth. Where it overlies gumbotil and is of itself of no great thickness, the impervious nature of the gumbotil causes the ground water to rise into the loess in wet times and thus creates conditions unfavorable to the crops. This drawback is abundantly offset in all ordinary seasons by the fact that over these divides there has never been any wastage by erosion either of the mineral constituents that contribute to plant growth, or of the organic accumulations throughout the years since plants first found congenial conditions on these broad drift plains.

Alluvium, being a wash from the surface of loess or drift soils is naturally a very productive and permanent soil. Because of its situation, however, it is subject to inundation after repeated heavy rainfalls. The same situation, however, gives it the advantage in dry seasons of being well supplied with moisture by capillarity.

Between the tabular divides on the one hand and the alluvial plains on the other is a rugged topography, wherein the mantle rock is a till, mostly Kansan. This area may be divided into two portions, one a region of mature topography about the lower courses of the main streams, wherein erosion is relatively slight, the other where the streams branch dendritically and these branches have their sources well up near the level of the tabular divides, and for no inconsiderable part of their courses are intermittent. In this region erosion is today very active, and gives to the soil little opportunity to accumulate the organic material that is its principal source of enrichment. Then too, there is not time for the mineral constituents of the soil to be set free and made available for the growing vegetation. In other words the soil is kept too thin to be at its best.

Clays

While the till contains much clay it is not of a quality to be serviceable in making tile or brick. For several years common brick were made at Diagonal, at Kellerton and at Redding. The material used was loess and the stiff mud process was employed. The style of kilns was of the down draft type mostly. The annual value of the production scarcely ever exceeded \$8,000. Work was abandoned ten or more years ago, since the material was neither abundant nor did it produce brick of the best quality.

Sand, Gravel and Bowlders

While sand and gravel are not uncommon in many of the exposures made along the roadsides, they are in few cases in such abundance as to make them of value for any purpose. They occur in places between Sand creek and Thompsons Fork in quantity sufficient for local road improvement. They also occur in a few slopes where the meander of some stream has eroded, the best examples of which are to be seen on the south bank of Thompsons Fork in the northeast corner of the county, where ten feet of gravel is exposed, and along the north and east bank of the East Fork in section 35, Liberty township. These gravels are abundant and would make good material for improving roads in the neighborhood, but they are overlain with so much other material as to render their use unprofitable even if they could be made accessible by teams. North of Kellerton occurs a sand which is suitable for use in making concrete walks and has been used to some extent for that purpose in Kellerton.

Bowlders are small and rare enough to be subject for remark when seen. They are mostly granites, granitoids or some type of quartz. Cobbles and pebbles of quartzite are fairly abundant. South of Mount Ayr a small limestone boulder was seen. It had been weathered white on the outside, but was grayish brown on a fresh fractured surface and was intersected by small crystalline veins. The largest boulder observed is nearly seven feet long.

Water Supply

WELLS

The supply of water is mostly from dug, bored or drilled wells wholly in the drift or alluvium. A few wells have been extended into the strata of the Pennsylvanian, but as a rule such wells are disappointing as to quantity and quality of the water. In some instances they have afforded a copious supply of fairly good water. Mr. Robert Hall has a well in the east half of the southeast quarter of section 24, Athens township, which is over 270 feet deep, yields 13 gallons per minute and has shown no lack of water for eighteen years. A six inch vein of coal was found at a depth of 208 feet. This well ends in a thick bed of coarse gravel above which was "a white sand as fine as gunpowder."

Mr. Lewis Myers has a well in the southwest quarter of the southwest quarter of section 28, Athens township, which is about 500 feet deep, and yields upon test three to four gallons per minute. Eight or nine feet of limestone was encountered at a depth of 282 feet.

Meinzer¹⁰ found by analysis that the water of these two wells "show a large content of mineral matter, especially of sodium sulphate." In the southwest one-half of section 35, Monroe township, on Mr. Lon Beede's place is a well 435 feet deep. Limestone was met at 240 feet. Further details were not secured except that a good supply of water was obtained. Mount Ayr attempted to secure a public supply of water, but a serious cave in at a depth variously reported from 200 to 400 feet discouraged both the driller and the city and the work was abandoned. A well in the northeast quarter of the northwest quarter of section 19, Tingley township, passes through repeated beds of shale, sand and limestone and three very thin seams of coal and ends in sand at a depth of 624 feet. It has a daily product of thirty to forty barrels of water.

Most of the drift wells on or near the tabular divides range in depth from thirty to eighty feet and almost invariably end in sand or gravel. Water is practically assured in wells on the uplands unless they are situated on the naturally drained slopes,

¹⁰Underground Water Resources of Iowa. Iowa Geol. Survey, Vol. XXI, pp. 932-936.

but it is often limited in quantity, especially in dry seasons. The well at the Porter House in Diagonal affords a good illustration. It is a bored well seventy feet deep and at the time of a prolonged drouth it supplied the premises somewhat scantily, being pumped dry every day. The water is hard. Kellerton is situated upon a tabular divide. Wells in and about Kellerton average thirty to thirty-five feet in depth and end in a reddish gravel. Wood is not uncommonly found just before the gravel is reached. The public well on the street at Kellerton is about thirty-eight feet deep and affords good water in abundance even in dry times. A gentleman in town informed the writer that the water in his well, which is thirty-five feet deep, rises within ten feet of the surface. A few flowing wells are reported in the county but no exact data were secured. A most striking circumstance is the remarkable uniformity in well conditions throughout the county. The instances given illustrate the range of variation very well.

Meinzer¹¹ suggests that where seepage is slow a system of cluster wells, which has proven advantageous in Davis and some other counties, be adopted. Several wells are sunk within a short distance of one another and connected by iron pipes with a centrally placed well which is a little deeper than the others and which alone has a pump. This well serves as a common reservoir and thus yields a relatively copious supply.

Oil.

Not infrequently certain local conditions awaken the suggestion with the people that a natural supply of oil lies somewhere beneath the surface. The writer's attention has been called to a peculiar scum that appeared upon the water of an artificial pond in the east half of the southeast quarter of section 25, Athens township. Some thirty years have elapsed since the excavation of the pond, but not until March, 1910, had the scum made its appearance. The substance seen by the writer was somewhat gelatinous with a slight oily taste and a little iridescent reflection. Quite naturally some of the residents in the vicinity had become interested. However, it may be said, that whatever

¹¹Underground Water Resources of Iowa: Iowa Geol. Surv., Vol. XXI, p. 985.

the origin of the scum, and it may be accounted for in several ways, it is practically certain that no reservoir of oil of commercial value underlies the locality in question. Thus far no oil bearing horizons have been found in the state. Since the subject has been quite fully treated by Calvin in volume XI of the reports of the Iowa Geological Survey, pages 22 to 27, and by Kay in volume XXIII, pages XXV to XLVII, and in volume XXV, pages XI to XIII, of the same series of reports it is not necessary to discuss it further here.

Forestry

Among the real evils resultant upon the settlement of this country is the indiscriminate removal of the natural growth of trees. The recognition of this fact is becoming quite general, however, and in many states where there are extensive tracts more or less tree clad today, but not suitable for ordinary tillage the conservation of the forest remnants and the planting and development of trees on areas unsuitable for productive tillage is regarded as of such importance by the owners that they are employing trained foresters to direct the restoration of these tracts in such a way as to make them remunerative again as fuel and timber producing areas. Nor does it require any such length



FIG. 6.—Reverted timber land in section 26, Poe township, Ringgold county. On the right hand is the first year clearing; in the center, two years after clearing; on the left hand, seven years after clearing.

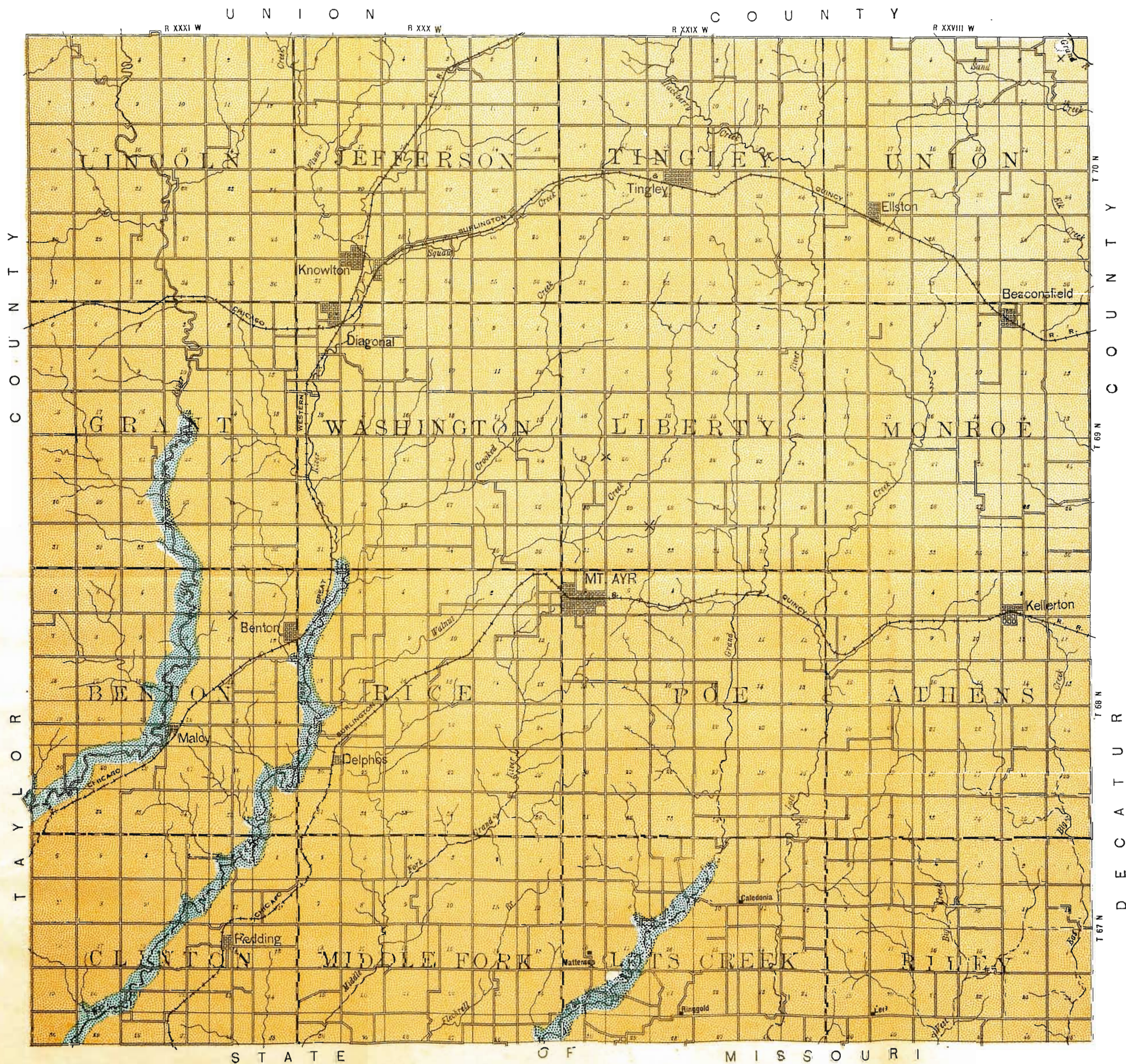
of time to bring this about as has been popularly thought necessary. Not only do owners find this commercially profitable, but they share with the general public substantial advantages growing out of the retention of a large part of the rainfall which is later given off slowly, thus preventing floods, rapid erosion and the covering of creek bottoms with gravel, sand and other forms of sterile deposits as well as making the run-off part of the rainfall available for the use of stock, mill owners, etc., for a much longer period of time. It has not been well understood as yet by owners of sections and quarter sections that even the waste nooks and corners on their farms can be profitably improved by applying to them the principles of forestry, which principles are neither so numerous nor so abstruse but that they may be made readily available by any one.

Not infrequently the papers, proud of Iowa's agricultural prosperity, declare that there is not an acre of waste land in the state. Nevertheless there are many acres that would be more remunerative growing trees, if a little care were given to the selection of the species of trees and to keeping them in good condition. Ringgold county has numerous areas of this kind, some of which, to be sure, are small, but are nevertheless worth as much attention as the other parts of the farm. That they are not now highly valued even for pasturage is evidenced by the fact that they are allowed to grow up slowly to volunteer trees and bushes, many of which are of the least desirable species and all are so browsed and broken up by the cattle as to destroy all likelihood of their ever becoming of material worth to the farmer.

At the borders of the tabular divides there are narrow, deep ravines of recent origin due to headward erosion in times of heavy storms that produce temporary torrential streams in these ravines. In this way many a fair field has been disfigured and rendered more difficult of ready access to all its parts by the constant and oftentimes rapid encroachment upon it of these ravines. Were the sides and upper ends of these ravines planted with judiciously selected shrubs and trees, erosion could be decidedly checked, if not wholly prevented.

ACKNOWLEDGMENTS

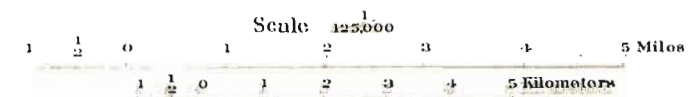
The writer is under special obligations to Professor Kay, the head of the State Geological Survey, for his personal presentation of his theory of the origin of gumbotil as well as for various other favors. During the field work every one to whom the writer looked for assistance in any way was most courteous and obliging. To all such his hearty thanks are gratefully extended.



IOWA GEOLOGICAL SURVEY

MAP OF THE
SURFACE DEPOSITS
OF
RINGGOLD
COUNTY
IOWA

BY
M. F. AREY
1916



LEGEND
GEOLOGICAL FORMATIONS

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