GEOLOGY OF

Kossuth, Hancock, and Winnebago Counties

BY

THOMAS H. MACBRIDE

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CONTENTS.

INTRODUCTION.

LOCATION.

The three counties of Iowa here discussed, Kossuth, Hancock, and Winnebago, constitute together an almost perfect square lying along the northern boundary of the State almost midway between the Mississippi and the Sioux. Kossuth is a double county in area, almost the largest county in the State. By our system of surveys the most northern townships and sections in any case bear the brunt of any definciency in land-division; and so it happened that our square is not exactly perfect but measures only about forty-one miles in north and south direction as against forty-eight from east to west.

These three counties are prairie counties, remote from rivers or mountains or any great terrestrial features popularly believed to determine topography, and it would naturally be supposed that all three are just alike, just like fifty other such political divisions to be selected anywhere within our valley-prairies. But such is by no means the case. Greater contrasts are not to be found, within the limits of a region not mountainous, than are to be seen within the square before us. We have plains wide extended, so level that for the passing traveler no inequality can be perceived; towns may hail towns across the unbroken fields and houses dot the distant landscapes like blocks upon a sheet of cardboard. We have precipitous hills rising like miniature mountains directly out of the plain, some of them in groups two or three hundred feet high enclosing lakes, like mountain lakes far above the general level, mantled in native forest and looming blue along the prairie horizon visible for miles and miles; we have townships of alternating marshes and knobby hills without any natural drainage whatever, and we have valleys with gently flowing streams bordered by softly rounded, sloping hillsides perfectly adapted to every phase of agricultural effort.

These are the facts of the problem, facts patent to every comer. The farmers attempt to adapt themselves to the motley situation. Lands suitable to their purposes have been long in use, while only recently the ever increasing demand for farms has impelled men to attempt the tillage of the less tractable hills and swamps. Explanation of the situation is the last thing thought of. Men go doggedly to work to make the best of a difficult problem finding satisfaction in a practical solution, a triumph over physical hindrance, and care only for the ultimate return in wealth or comfort.

Nevertheless there is a solution for our problem, an explanation of these strange conditions,—explanation so simple that anyone may understand it and may safely apply its terms even to the last square yard of all this most singular and anomalous topography.

PREVIOUS GEOLOGICAL STUDY.

It will not be supposed that such solution or explanation has always been at hand ready for each locality fitting thus to such varied local conditions. The facts which lend to our present story credibility have been coming rather rapidly to light during the last five and twenty years, not in Iowa only but in all parts of the northern world. The classification of these facts as set forth in these volumes is even more recent still. The earlier studies of the earth's surface were concerned in classifying the indurated rocky strata and discovering the history of organic life which these so clearly disclose. Inasmuch as our present field shows nowhere a trace of stratified rock in place these prairies were less attractive, indeed offered nothing to the elder students of the natural history of the State. David Owen about the middle of the last century was at work in this part of the world. He followed the Iowa River until the limestone exposures disappeared along its borders. Fifteen or twenty miles further on he encountered the topography known since his writing as the "knobby drift."* Owen was thus in Franklin county and within a few miles of the territory now discussed. Prof. James Hall, who came next in the order of time, does not mention our counties even by name. They did not fall within the limited scope of his inquiry. It

*Report of the Geological Survey of Wisconsin, Iowa, and Minnesota, David Owen, Phila. 1852, p. 104.

remained for Dr. Chas. A. White to introduce our territory to the world as he does in the second volume of his report.* Dr. White describes in some detail the peculiar topography of Kossuth and Hancock counties, and makes repeated reference to the oft-recurring beds of peat in slough and marsh. It was at that time the opinion of Dr. White and others that peat in the prairie counties would form a very important source of fuel supply. The surface deposits in White's report are simply referred to as drift and no attempt whatever is made to explain either their presence or configuration.

In 1881 the present phase of the geological study of this part of Iowa may be said to take origin in Upham's discussion of the series of morainic hills which all along our northern border extend from Minnesota into Iowa at greater or less length.† Mr. Upham's descriptions are generally accurate and his map as much so as may be expected on the scale to which it is drawn. The morainic field in our particular locality is really much wider than Mr. Upham's map indicates, as will be pointed out in the descriptions here following. In connection with our present study the reader should also consult Professor Calvin's report on Cerro Gordo county.‡

PHYSIOGRAPHY.

TOPOGRAPHY.

The topography of the area before us is, as already intimated extremely varied; nevertheless, it is not confused. To the careful observer it will appear that all the at first apparently endless variety is reducible to no more than three distinct types and these are after all quite definitely limited; with respect each to the other mutually exclusive in a remarkable degree. These three topographic types are, first, the type of the level plain, second, that of the knobby drift, the uneroded hills and swamps, and third the type of erosional flood plains and valleys.

The plain is that now familiar in all recent geological literature, the plain of the Wisconsin drift. It marks the bed or path of an

*Report of Geological Survey of the State of Iowa, Charles A. White, M. D., Des Moines, 1870, Vol. II, pp. 246-9

†See Ninth Annual Report of the Geographical and Natural History Survey of Minnesota, pp. 238-314, Minneapolis, 1881, and Plate VI.

‡Volume VII of the present series, pp. 119-193.

ancient extension of arctic ice and snow which at one time descended to our latitude and covered to large extent all the states of Wisconsin, Minnesota, Iowa and the Dakotas. The plain area in the three counties we describe is comparatively limited but its characteristics are as unmistakable as in that region where first this remarkable deposit found distinct recognition and a name. In the first place it is generally almost level. Certainly no one can traverse the southern half of Kossuth or Hancock county without being impressed with this topographic characteristic. Nearly all the western part of Hancock county also is a plain so flat that it seems to show no variation in level whatever. This is particularly the case about Hutchins, Kanawha, Corwith and Luverne. Algona, Wesley, Woden, are on a similar plain but on a different level. As the traveler approaches Woden from the south the village is visible for miles across an unbroken plateau. The valley of Prairie creek, say in Luverne township, is no valley to ordinary vision but an absolute plain stretching to the horizon's rim. These are typical illustrations. Sometimes the plain is marked by here and there a ridge or hill, merely a low swell in the landscape, sometimes a succession of low inequalities may be encountered; but these are recognizable only as one carefully traverses the country roads. Sometimes, as just intimated, the plain breaks from one level to another. This is well shown along a line from Irwington to St. Benedict. In the second place, consequent upon the first characteristic, we have in the plain topography a country without efficient drainage. There has been in many places almost no erosion whatever. The water streams along in sluggish current in some winding depression, sometimes as in case of Prairie Creek south of St. Benedict for considerable distance without any channel at all; sometimes we find a channel which is a mere ditch, tortuous, but only slightly eroded, as in the case of the tributaries of the Boone; sometimes the channel is deeper, a narrow valley has been formed and secondary streams break back in minor shallow receding swales and valleys approaching the erosional type. This is well illustrated by Lotts creek as seen in the township of same name and in Whittemore township both in Kossuth county. The Wisconsin plains have yet another characteristic; they are everywhere

spotted with "kettleholes", small depressions, wet places, an acre, less or more, undrained and grown up, where yet undisturbed by cultivation, to various forms of marsh vegetation, chiefly sedges and bulrushes whose dark colors contrast vividly with the paler vegetation of the surrounding prairie. In dry years the water disappears from most of these marshes and many of them are today lost in cornfields and meadows. But even after cultivation this remarkable surface peculiarity may still be traced. On the beaten pasture field after a summer shower "the rain also filleth the pools" and shines in little shimmering ponds over all the landscape, and for a little the kettle-holes all come back again.

The topography just described passes more or less directly to the north and east into a second type quite as distinct and no less remarkable. As we pass across the plain the horizon is suddenly broken by rounded contours of low mound-like hills, rising to various altitudes, twenty, thirty, seldom exceeding forty feet. As we ascend one of the highest and look about us the significance of Owen's original expression becomes vivid indeed. Here is the "knobby" drift. As far as eye can reach one knob succeeds another, hill after hill, at distances varying, without any relationship to each other or any regularity whatever. They rise out of the plain; they are not carved from it. The larger are apt to occur in groups, and where the sides are steep as is frequently the case, the summits are barren, rocky and gravelly, unfitted wholly for the plough. But if the knobs themselves are peculiar, no less so are the depressions between them. These, too, have little or no relation to each other. No streams run among hills like these; no radiating valleys acknowledge allegiance to these sloping sides. On the contrary, the streams of the country seem to be outside the hills altogether, and the depressions among the knobs are not valleys they are cisterns, lakes, marshes, swamps or pools. Here and there an imperfect drainage channel connects these nearly isolated swamps and we have a winding irregular slough as Mud creek in Kossuth County; sometimes, for reasons to be later on set forth, a considerable stream cuts through the ridges, hills and all, as Lime creek; but in general the depressions among these hills remain undrained or have waited the advent of the county ditch and the skill of the engineer. The accompanying

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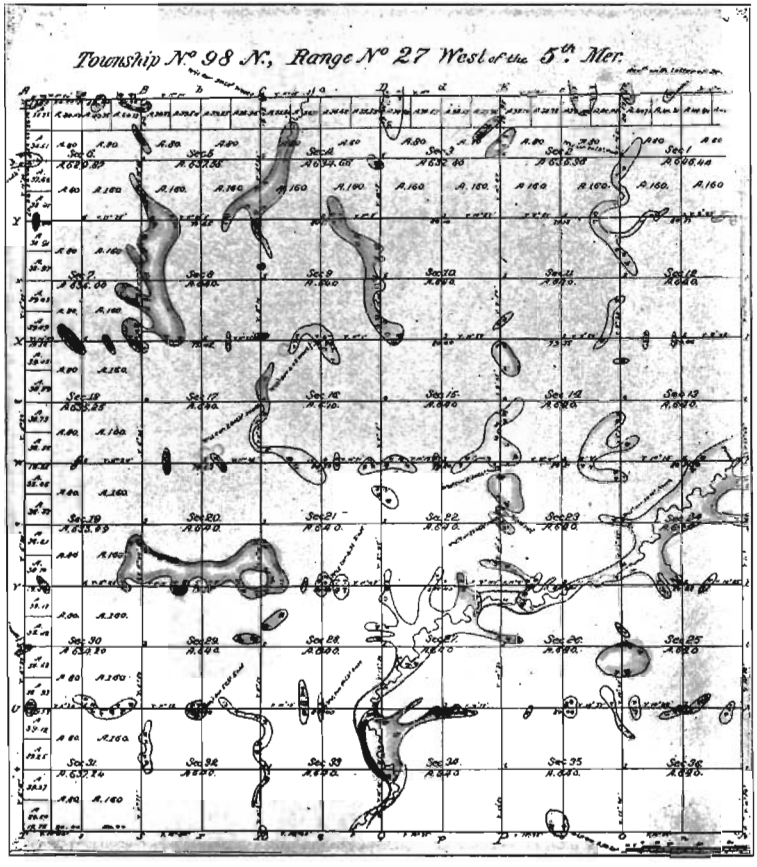


Plat of township 98 N., range 27 W.

illustration, Plate II, which is a photographic reproduction of the plat of one township as made by the original United States survey, will give some, though a most meager idea of the topography we have here attempted to describe.*

Such in general is the topographic character of all the eastern part of Hancock county, nearly all of Winnebago county and the northern half of Kossuth county. If the flat plain topography represents the bed of the old ice sheet, the knobby drifts marks for us the margin or limits of its occupancy. These hills are moraines, piles of material unspread when the movement of the glacier stopped. In some localities topography of this sort results in unusual features worthy of special description. Not infrequently the marshes are deepened into lakes and the knobs assume sometimes correspondingly commanding proportions. Thus there are lakes in all three of the counties we discuss. In Hancock county are found Twin lakes in the south and Crystal lake at the north and between them Eagle lake; all were at one time notable features of the prairie landscape. All seem to have been meandered and still preserve in large part their original identity. The Twin lakes are small, the larger, eastern, occupying not more than 200 hundred acres. The western lake was at the time of our visit dry, a pasture-field occupied by herds of cattle. Nevertheless there are many indications that it was once a permanent body of water of considerable depth. The banks were in many places high and show the erosion resultant from wave action; on the north these is a distinct sandy beach with recessional ridges, diminutive terraces, etc., all indicating a lengthened history. Nevertheless the history now seems forever closed. The eastern lake contains today the waters of both. In this rainy year of 1902, the waters are by no means deep, and, if one may judge by the extended growth of aquatic plants, bulrushes, sedges and cattails, the eastern lake is also passing and likely at no distant day to become a cultivated field.

Eagle lake is the largest body of water in the three counties. It is about two miles and a half long and half as wide and covers more than one thousand acres. This was at one time apparently

*For further illustration the curious reader may consult the road maps of any of the northern townships of Kossuth county as they lie in the courthouse at Algona. He will find not infrequently as many as six distinct marshes along one side of a given section, interfering with the public road. There are often more than thirty to the square mile.

much more attractive and lake-like than now. The greatest depth at present is said to be eight feet and the areas of open water are few and the greater part, as Twin lake, today grown up with rushes and sedges. Nevertheless there are good beaches here, and cottages have been erected on the western shore. Crystal lake is a permanent body of water beautifully surrounded by groves and hills. It is said to be twenty feet deep; at any rate the depth is sufficient to shut out rushes over the greater part and its clear surface invites the pleasure-seeker's boat.

The lakes of Winnebago county are less important. Rice lake, extending across the boundary and lying chiefly perhaps in Worth county, is a widespread shallow marsh stretching a mile or two in each direction but with only a limited area of open water. Its waters surround an island lifted fifteen or twenty feet above the ordinary level of the water. The island affords a pleasant beach on which cottages have been erected. The lakes of Kossuth county are best described as sloughs or marshes and will no doubt eventually all be drained.

But if the marshes are thus sometimes lakes, the knobs are occasionally no less like mountains. They everywhere surprise us by their abruptness and steepness and in Ellington township of Hancock county, are found two or more which so far transcend all others that they have long been famous. The highest of the group is Pilot Knob* which as the barometer reads is nearly 300 feet above the waters of Lime Creek at its base, 1450 feet above sea level. This is not only the finest morainic mound thus far described in Iowa, but is one of the finest in the whole country. Ocheydan mound is only half so high. The famous Lapham Mound, Wisconsin though more than 800 feet above the level of Lake Michigan is not so high above the basal plain as is our Pilot Knob. The visitor approaches Pilot Knob more easily from Forest City. The mound is visible from the streets of the town (Fig. 16) as indeed from the prairies almost anywhere for miles in any direction looming up dark and blue along the horizon. The highway climbs at first by easy ascent but at length ascends rather

*To the pioneer the boundless prairies of the Mississippi valley seem to have come ever with irresistible suggestion of the sea. The endless meadows of dark grasses driven in waves before the wind established a more vivid likeness and, for the pioneer, any natural object which aided the traveler to find his way across the unmarked plain became a "pilot." Hence Pilot Rock and Pilot Mound and Pilot Knob, over the whole western country.

FIG. 16. Pilot Knob is visible from the streets of Forest City.

abruptly to the western extension of the hill whence the Knob still looms above us nearly a mile further to the east. Between lie mountain meadows, as typically such as if the mountains really rose around us; sedgy bogs girt around by the white ranks of the aspen, walled in by impassable ridges. A tiny lake (Fig. 17) lies to the south 200 feet above Lime creek, fed by springs, cold and clear, in summer decked by water lilies and all forms of northern aquatic vegetation, but the knob is nearly a hundred feet above us still. Forests of oak and ash, linden and hickory spread all around diminishing as we ascend, until we reach the wind-swept summit, perfectly bare; a miniature mountain in every particular. The view from the summit is certainly the finest of its kind. The Knob is so isolated and so steep on almost every side that the prospect in every direction is limited only by the powers of distinct vision. On the plain below us covered, as we know, with hillocks and knobs, all inequalities vanish. The scene entire seems level where houses, groves and towns appear in varied

FIG. 17. Dead Man's lake. A tiny lake lies to the south.

colors to the far horizon's rim. Here is the natural park for the people of Forest City.

Having thus seen something of the nature of the topography with which we deal, we may now take a more comprehensive view and note its general arrangement. It is immediately apparent that there are no knobs to the south and west, and no plains to the north and east. The traveller on the Milwaukee railway approaching from the east meets the knobs at Clear Lake or near it: they keep him company to Britt and then disappear entirely. He has passed through the marginal, or Altamont moraine of the Wisconsin drift in this locality, a distance of some twenty-two miles. If the reader will consult the map of Cerro Gordo county published in this series of reports* he will discover that outwardly, that is, on the eastern side, the moraine terminates by a comparatively uniform front, the line of demarkation between the hill country and the succeeding plain is nearly straight, or at least not very irregular; the inner margin of the moraine is

*Report of the Iowa Geological Survey, Vol. VII, p. 180.

quite the reverse. The ice seems to have returned from north and west again and again as if loth to release its hold, but recession once begun the margin never quite reached again its farthest eastern out-push. By consulting the maps it will be noticed that the existent drainage system is in large measure correspondent to geological history as portrayed. It would seem as if the inner margin of the moraine was first correspondent in general with the eastern bank of Lime Creek and the east fork of the Iowa river. The first return gave us in the same way the west fork of the river and the series of lakes to which we have already alluded. Subsequent advances and retreats presented in each case a somewhat arcuate or V-shaped front extending mainly east and west and leaving as results of marginal drainage the peculiarily paired affluent streams which in Kossuth county especially form the head-waters of the upper Des Moines. It is probable that these later morainic fields will be found coincident with others in Palo Alto and Emmett county which will again unite with those already noted in Dickenson and Clay and so form a more or less continuous recessional moraine across the entire field of Wisconsin invasion in northern Iowa.

A peculiar feature in the topography of Kossuth county may be mentioned here. Extending from the north part of Portland township entirely across Ramsey township and into Ledyard is a deep, well-defined depression known as Union Slough. The banks are in most places precipitous, twenty or thirty feet high and evidently the result of some former erosion. We say former erosion because there is evidently no erosion now. The bottom is flat, a mile at least in average width, without present channel or even drainage; simply a sharply outlined morass or swamp a mile or more in width and ten miles long, shut in by high banks and hills. At present the whole surface is covered with water from one to three or four feet deep, so level that a stream escapes from each end, south into Buffalo creek, north into the Blue Earth river. This trough-like valley is no doubt a section of the channel of some preglacial stream, probably part of the stream now represented by the Des Moines, a part that in some way escaped obliteration, although cut off, especially at the south, by glacial detritus, piles of gravel and sand. It seems probable that Buffalo

creek itself, after passing the south end of the slough, may occupy for a little way, till it reaches the river, part of the same old channel, and possibly the Des Moines also does the same thing here and there in its course southward.

Another topographic feature that is at first sight rather anomalous is the Irvington ridge. A high plateau extends from the river east and north from about Irvington around by St. Benedict and Wesley and so northeast until it joins the morainic hills south and east of Woden. The most prominent margin of the plateau is along the south and follows almost exactly for several miles the section-line road one mile south of the middle of Irvington township. This plateau is only about twenty or twenty-five feet higher than the Hutchins-Britt-Corwith plain, but it is perfectly of forming a correct impression of our extremely level topography. Compare, for example, the Milwaukee line from Garnamed, as Prairie creek in the several branches, find at the plateau-margin a cutting point and erosion has worked back in rather unusual complexity from the crest. The topography looks much older than it really is, for there is no reason to suppose it earlier than the glacial epoch we are discussing. It seems probable that the plateau represents the margin of an advance of the ice sheet which immediately receded, stopping some miles to the north where the knobby-drift region may be first traced and that in this advance either no moraine was left at the south or it has been obliterated by erosion, at first exaggerated by the nearness of the ice-front. The drainage has, however, been always principally toward the Des Moines channel; there is a fall from the eastern crest toward the river of about four feet per mile.

The map accompanying sets forth sufficiently the topography of the region and in the light of what has been said further description seems unnecessary. The supposition that the ice at first moved south and east at the same time and later in a direction almost directly south will probably account for the general trend of the ridges and hills in different parts of the area here described.

On this map the altitude of the railway at the station is entered near the name of each town or village. A comparison of these

altitudes as reported will be very instructive to anyone desirous of forming a correct impression of our extremely level topography. Compare, for example, the Milwaukee line from Garner to Whittemore; or the Northwestern in Kossuth county.

DRAINAGE.

The drainage of the area before us instead of determining the topography is almost entirely determined by it. In some places the drainage is perfect or nearly so; in many places there is no drainage at all. There is however a general slope to the south or southeast and when natural drainage fails it is still possible by ditching to reach the end desired and some of the finest farms in the country border a brimming county ditch.

The naturally drained parts of these counties are in the main those immediately contiguous to the principal streams. Among the morainic hills there are, of course, many well drained fields; but these are often so situated as to make their cultivation difficult until the adjoining marshes are drained or tiled.

The principal streams of the three counties are: the Des Moines river and its tributaries, the Iowa river in two branches, and Lime creek, affecting principally the eastern side of Winnebago county. The Des Moines river, or rather the eastern fork of that stream, takes rise in southern Minnesota and enters Kossuth county from Emmet county some twelve miles south of the State line. The stream is of less importance until joined by its principal eastern tributary, Buffalo creek. From the point of this union some three miles south of the center of Kossuth county the river courses almost directly south through the middle of the county and emerges almost exactly at the center of its southern boundary. The river is a fine perennial stream. The valley of the river from its union with the Buffalo down to the Algona city limits follows apparently an old time channel. The flood plain is wide with much alluvium. At Algona the channel seems to have been pushed west by the drift. At any rate the valley is here new and narrow and is flanked by narrow choppy ravines. Below the city the valley widens again and at Irvington seems to have been at one time gorged with gravel, probably because of the sudden bend at this point to the west. The most remarkable

thing about the valley is its depth and the extent of erosion it displays. When, as evidenced by the topography, the glacier lay about Bancroft and Burt the marginal drainage was into the channel of the Des Moines especially by way of the Black Cat, Buffalo Fork and Linder's creek and these tributaries all show the same very marked erosive features. Indeed all the streams that converge immediately north of Algona are more or less deeply eroded and the drainage of this part of the county, south of a line passing through Lone Rock, is proportionally good. The stream channels cut thus deep in the prairie are here and there quite heavily bordered by native woods and the natural scenery is often beautiful.

The streams in the northern half of Kossuth county are all simply sloughs. Mud creek, the longest of them is well named: for the greater part of its course through several townships it has no eroded channel and waits the tardy aid of a county ditch. The Blue Earth river flowing north carries a strong current and seems to be the principal outlet of Union Slough and probably carries away most of the water from the public ditch which enters the upper end of the slough, draining Ledyard township.

The Iowa river is especially interesting because heading in the territory before us and so illustrating the beginnings of a characteristic or typical prairie stream.

The Iowa river drains the eastern half of Hancock county and flows southward in two perennial forks, both determined in course by the topography of the moraine, both, but especially the western, primarily a drainage channel for the inner margin of the Altamont. Neither gives evidence anywhere within our limits of any extended erosive power. Where the valley is large or wide its width is referable to the original position of the knobs or hills more than to any carving done by the stream. The east fork of the Iowa river takes origin in a series of marshes occupying the central sections of Madison township, Hancock county. Some of these swamps are within less than half a mile of the course of the west fork in this locality. Having gathered the waters of most of the sloughs in Madison township and the north part of Garfield township, winding about amid the morainic ridges and ever escaping southward where the hills have

left a convenient gap, the stream tends at length almost directly southward along the east line of Garfield township and so continues for some eighteen or twenty miles, leaving the county five miles from the southeast corner. The stream receives its principal tributaries from the high flat prairies of Ell and Avery townships, the moraine on the east side of the river holding a respectful distance, four or five miles or more away; on the east the valley is limited by morainic swells and ridges all the way; these are especially prominent in the vicinity of Goodell and Klemme. At the latter point the stream has cut through an eastward projecting spur. Near the old town of Amsterdam in Avery township the river has a wide alluvial sandy flood plain, but it emerges from the county with only a narrow slightly eroded valley. The west fork of the river in its rise and progress is more remarkable still. Crystal lake may be called the head of the Iowa river. Its outlet flows east or northeast and passing through a gap in the morainic ridge just south of school house number one in Crystal township, helped by a ditch, the stream turns southeast into Madison. It seems that the waters of Edwards lake at time of overflow, a rare occasion, also seek the same channel, although it is possible that in high water the lake might drain equally well into a marsh to the east. This latter has been ditched into communication with a branch of Lime creek, care being taken to avoid the upper ramifications of the east fork of the river. Such are the difficulties under which one of the principal rivers of Iowa is determined in its first outgoing.

Once started the river streams on from one swamp to another avoiding many and finally, as the east fork, on the bounds of Crystal township turns directly south passing Eagle lake one-half mile to the west, but draining it only indirectly and in most circuitous fashion, then on south, almost directly south, limited by moraines now on this side now on that but forming no valley for itself until it cuts through the moraine to the east at last in Winfield township and thenceforth occupies a channel distinctly erosional until it leaves the county within about three miles of the point of emergence of the east fork. The streams are thus seen to be nearly parallel. Their direction and proximity are equally remarkable. They are more than once within three or

four miles of each other. The phenomenon is explained only when we study the topography which they have not caused but by which they are from first to last conditioned. For this reason these streams, although perennial and of considerable importance are less efficient in conveying away the surplus water of the fields. Only at the last have the currents sufficient fall and force to excavate a channel. Hence only in the southern townships of the county are the valleys really serviceable. Erosion has nowhere affected the secondary streams, and ditches are the order of the day.

Another prairie stream which must be mentioned here is the Boone river. This also takes its rise in Hancock county and is likewise of minimum service as a drainage channel. As above remarked the general slope of the country is south and the Boone in most of its course simply creeps aimlessly about upon the surface. Erosion appears in the vicinity of Corwith and thence south, but the main stream and all its tributaries are simply wide low swales or depressions over which the waters spread in times of flood, but, except as aided by human device, produced no erosive change whatever. Paradoxical as it may seem, the valley of the Boone in Hancock county is an almost level plain; a depression unperceived by him who passes over it.

Lime creek is the third principal drainage channel of the territory now examined. This water rises in Minnesota and enters Winnebago county as a considerable stream about three miles east of the northeast corner of Norway township. The general course for many miles is almost directly south, the westing being only about four miles in Winnebago county. This stream also represents the original drainage of the inner margin of the Altamont. The whole of the three eastern townships of this county is morainic. In fact these townships have practically no drainage at all, for there are, strange enough, no tributaries to Lime creek from the east. Beaver creek in the southeast is of value to Mount Valley township; but although the whole country is hilly it is without natural drainage to a very large extent. On the other hand a considerable but very imperfect drainage enters Lime creek from the west. The county ditch following sloughs and swamps, some in natural connection and some not, now drains

all of Newton township, drains Lake Harmon in Logan township and even the east side of King township. The channel of Lime creek is generally wide but uneven, little eroded above Forest City. At Forest City the erosion is very marked. Forest City occupies part of a morainic ridge some seventy feet above the flood plain of the creek, so that the valley here is not only deep but remarkably narrow. There is every reason to believe that the creek has since the retreat of the ice cut through the moraine, which is indeed part of the Pilot Knob system, and so found its way into the much broader valley immidiately to the south. This valley, however, leads east; there are in places considerable flood plains and here and there a considerable deposit of gravel; but in general in Hancock county the creek simply winds about among the morainic hills showing only here and there evidence of efficient erosion. Immediately northwest of Forest City is a sandy plain including a number of the south-central sections of Forest township. This with the rather wide alluvial bottom land or flood plain of the creek from Leland south all tends to confirm our conclusion that at Forest City the narrow valley has only recently, as such things are esteemed, been cut down and through. If one examines the map and the general trend of the moraines there sketched, together with the course of the Lime creek as far as Forest City and that of the east fork of the Iowa, he can hardly resist the conclusion that these streams might really have been one but for the curious intervention of the successive morainic ridges which first damned up Lime creek altogether and then shunted it away off eastward and northeastward ere ever it made escape southward and eastward in accord with the general slope characteristic of this part of Iowa, and the general trend of Iowa streams.

All the streams here described are remarkable in that they take origin in simply wide-extended meadows, great marshes on which the water is generally nowhere deep enough to prevent luxuriant growth of sedgy vegetation, but which seeps away with such slowness as to become in fact a perennial fountain. The effect of man's interference has been in many cases,—by no means yet in all,—to hasten by ditching the escape of the marsh water and at length of the storm water, so that such rivers as the

Iowa are likely more and more to become tenuous and uncertain in dry weather, more and more impetuous, sudden, erosive torrents in time of protracted rain.

GEOLOGICAL FORMATIONS.

GENERAL DESCRIPTION.

The geological formations represented in these three counties are very few; in fact, but two, and these are no more than two superimposed sheets of till or drift with no indurated rocky strata exposed or even discoverable, except by the well-digger's drill, in the whole area. The geology is almost wholly surface geology and apart from the topography just described offers few themes for present discussion. There are no quarries, save the scattered bowlders of the prairie; sometimes so large that a single one constitutes for a time a local quarry, sometimes so abundant that a single farm may furnish building stone for the neighborhood and to spare. Here are named the only geological formations recognized:

GROUP.	SYSTEM.	SERIES.	STAGE.
Cenozoic.	Pleistocene.	Glacial.	Wisconsin. Iowan. (?) Kansan.

The Pleistocene System.

KANSAN DRIFT.

The Kansan drift is the name applied to the vast body of glacial detritus spread over nearly the whole area of Iowa and constituting still the superficial deposit of the larger portion of the State's area. Older than the other generally recognized drift sheets it lies beneath these and so, as in our present field is only here and there exposed, although everywhere discoverable. The farmer who sinks a well, or sometimes even the man who excavates a cellar, the road-maker who cuts the hills, the railway engineer who empties a pocket of gravel,—anyone who for any reason cuts through the common country clay is sure to encounter sooner or later what he calls a hard-pan of blue clay. This ex-

perience is so general that it is everywhere understood. The blue clay is a recognized sub-stratum of which everybody is sure, the only question being as to relative depth or position and its thickness. The student of surface deposits recognizes in this omnipresent sheet of blue clay a member of the Kansan drift. Whatever may be above it or below it this much over the whole state, with few minor exceptions, is fixed and constant. Now in the area here described the blue clay, so far as discovered, comes naturally nowhere to the surface. It is probably very near the surface in many places, covered by the black soil only; but its proximity to the surface even where so reported, could not be confirmed. The Kansan clay has however been uncovered in places not a few by artificial means and sometimes by erosion. Besides, the bottom of Union Slough and the beds of many of the lakes and sloughs are said to be blue clay. The bottom of the Irvington gravel pit seems to be blue clay, and road cuttings between Algona and Irvington, along the river, reveal the same peculiar, easily identified formation. Along the road that leads up from the river southwest in section 10 a peculiar jointed clay may be observed which represents an oxidized upper portion of this same blue clay horizon. The experienced traveller along the highway will catch many such glimpses, especially after heavy rains when erosion is everywhere unusually fresh and clean. It may be worthy of record that for such observation the summer of 1902 gave exceptional opportunity. But beyond all surface exposures, the record of every deep well in the whole country establishes the presence of the Kansan drift as the universal subjacent stratum over our entire area. Just above this hard-pan of blue clay there is often found in other parts of Iowa a deposit of hard compact brown or reddish gravel, and traces of this are also not lacking in the surface exposures referred to along the Des Moines river.

It was to be expected that traces of the Iowan drift had been discoverable here. This deposit in Cerro Gordo county and all the country east constitutes the surface and lies directly upon the Kansan or upon the country rock. It seems, however, that in this neighborhood the Iowan deposits are very thin, very scanty, represented in many places, as it appears, by trains of

bowlders only.* Besides the opportunities for observation, for tracing lines of contact in materials so easily displaced are not many. The country as already shown is flat save as covered by piles of the later drift, conditions entirely unfavorable to stratigraphic observation. It is difficult to say how much farther than present known limits the Iowan may have extended westward; its western moraine has been obliterated in this latitude, did such ever exist; nevertheless it is to be hoped that somewhere within the limits of the counties now before us, possibly in Hancock or Winnebago counties, probably not in Kossuth, which is too far west, some section more fortunate may one day reveal the sequence of all the Pleistocene deposits that here properly belong or may in good reason be assumed. There is evidence also in the report of well-diggers for this region, of the existence of still other, older, Pleistocene deposits beneath the Kansan. Everywhere come the usual reports of the finding of muck, twigs, sticks, etc., under the blue clay, with bad water from the black horizon. All this indicates, of course, that this blue clay bed covers an older surface, a surface once green with vegetation as is the present, though with a somewhat different vegetation as the twigs and sticks would show. Besides, after passing the blue clay the drill often goes through gravel, and other drift material for considerable distances before reaching limestone. Thus at Lake Mills the town well showed some twenty-five or thirty feet of such material, other wells are reported as showing even more. That is to say there is at least one other drift sheet under that here described as Kansan, but we have not yet sufficient data for its delimitation or definition.

In the same way in which we learn of this formation we come to a knowledge of the rocky floor which at greater or less depth underlies all this great body of drift gravels and sand and clay. The limestone that crops out in Cerro Gordo and Humboldt counties may guide us somewhat in determining the foundation limestones next the drift in Hancock and Kossuth. They represent possibly the Kinderhook stage of the Lower Carboniferous, or the Lime Creek stage of the Devonian, on the south, with the Cedar Valley stage of the same system in the north, especially in north-

*See, of the present series, Vol. VII, pp. 174-5.

ern Hancock and Winnebago county.* The limestone occurs at no great depth in any part of our field; thus at Lake Mills the depth is reported one hundred feet; at Thompson, nearly west, one hundred and eighty feet; at Germania, directly west of Thompson, only seventy feet. At Lone Rock and in that vicinity the limestone lies at from one hundred to one hundred and twenty feet beneath the surface; at Garner, at one hundred and ten to one hundred and twenty; at Britt, one hundred and twenty-five feet; at Algona, two hundred and thirty feet is the report. If this is true the well must have struck some earlier valley or depression, doubtless the earlier channel of the Des Moines. At West Bend, west side of Kossuth county, one hundred and sixty feet is the distance to the limestone. This reveals a remarkable uniformity in the rocky floor on which the drift has been in one deposit after another gradually laid down.

THE WISCONSIN DRIFT.

Without exception, so far as now known the entire surface of Winnebago, Hancock and Kossuth counties is covered by the deposit known in these reports as the Wisconsin drift. Often described in these pages it needs small discussion here. Where exposed by erosion or artificial cuttings it is the same whitish, sticky, pebbly calcareous mixture that we find everywhere as subsoil in all the northwest prairie. In this drift are abounding bowlders, none very large, predominantly of the type intersected by veins of trap and hence where weathered liable to assume fantastic shapes.† (Fig. 18). Occasionally the typical Wisconsin bowlder clay gives place to piles and beds of sand or gravel but this is unusual. Even Pilot Knob piled high as it is, appears to be made up throughout of naught but pebbly drift. The rains of centuries have washed, or course, all the finer earth from the summit of the hill and it now appears bare and gravel-capped, but the gravel is surely superficial only. On the other hand a mound one hundred feet lower exhibits on its western face a gravel pocket of considerable size now used as a source of road-material. Other rocky points appear here and there, as, for ex-

*See, of this series, Vol. IX, p. 122, and Vol. VII, p. 144, *et seq.*

†In Avery township on the farm of Emily Griggs a collection of these peculiar Wisconsin bowlders has been assembled and the stones have been placed in various fanciful postures to which peculiar erosion well adapts them.

FIG. 18. Bowlders liable to assume fantastic shapes.

ample, in sections 1 and 2 of King township, Winnebago county, but even the so-called "hog's back" in Norway township of the same county, a peculiar ridge, some twenty-five or forty feet above the general level, a mile or more in length and in places no more than a rod wide, is probably Wisconsin clay throughout. In the neighborhood of all the lakes there are banks and beds of sand affording not infrequently the luxury of a sandy beach; but such sand is often the result of a re-assortment of materials by the waters of the lake; the finer silt has been removed, the sand remaining on the wave-washed shore.

The Wisconsin Gravels—Under this caption may be discussed the few gravel deposits in the present area which seem to be due to the excessive wash incident to the melting and final disappearance of the assumed Wisconsin glacier. There are few or no such deposits along the Boone river, Prairie creek or the forks of the Iowa. Such as we have are to be seen along the Des Moines river below Algona. This indicates that the rapid drainage of the disappearing ice found principal exit by way of the

larger river. From a point about two miles south of Algona on to the limits of Kossuth county the Des Moines channel has been choked with gravel. This is especially notable at Irvington where from a bed of such material the Northwestern railway has taken out hundreds of carloads of gravel ballast. At Irvington the river shifts abruptly west for a couple of miles and the northern bank is an immense gravel train. So at Lime creek in Ellington township of Hancock county; the drainage before it cut through at Forest City must have gone over the ridge and found ready to hand south of Pilot Knob a considerable valley which it proceeded to fill up with gravel. The Burlington and Cedar Rapids railway has availed itself of part of this overwash found in the gravel-pit some two miles south of Forest City. In sections 15, 16 and 17 of Ellington township gravel trains are conspicuous along the north side of the creek. A well sunk on the Beadle farm, section 16, shows that the gravel is there more than forty feet in depth. These gravels are all referred to the close of the Wisconsin period. They are, when seen in section, fresh-looking, only slightly coherent or compacted, non-ferruginous; they contain many rotten bowlders, but these chiefly of the coarse-grained type whose elements were originally less intimately united. Water-laid beds of sand with abundant cross-bedding alternate with the layers of coarser gravel.

Finally, it is interesting in this connection to note the varying thickness of the surface drift. No doubt if all the data were in it would easily appear that the Wisconsin clay here as farther south, is relatively very thin; simply a veneer. No wonder old channels are sometimes all unfilled. In Kossuth county the blue clay is encountered often at a depth of five or six feet. About Bancroft the pebbly clay is said to be from ten to fifteen feet in thickness. In eastern Winnebago from six to thirty feet and so for other localities. At Algona the reported thickness is ten feet, along the river it is certainly more; at Whittemore ten to fifteen feet is the thickness reported. The knobs and mounds previously described where the deposit would seem much thicker are simply material undistributed resting on the old topography which, where the distribution of Wisconsin material has been accomplished, is often but slightly changed by the presence of this lat-

est surface sheet. Furthermore, if the testimony of farmers is reliable, and it probably is, there are as already stated many places where blue clay lies immediately under the black surface soil. In these places the newer drift is of course lacking altogether. These localities are generally low, and represent, probably, pre-Wisconsin depressions.

Soils.

The soils of these counties are in all respects similar to those of the neighboring counties west. Over all is the same rich mantle of black surface soil of apparently inexhaustible fertility. In the region affected by the knobby drift as described in the pages preceding, there are hilltops from which the black soil has been largely removed by erosion. These pass for gravel hilltops; but in the great majority of cases there is really very little gravel or sand. Even Pilot Knob, although at the summit covered with small stones and pebbles is not a gravel mound; the real gravel deposit appears on the hill immediately west. Nevertheless there is some difference in the soils of these different counties when studied in detail. We have the soil of the upland and the soil of the plain, both resting on a subsoil of pebbly clay. This includes by far the greater part of the entire area under consideration. In the lowlands these black soils are often very deep; reported sometimes as much as four feet; on the hillsides much thinner, as would naturally be the case, and often more serviceable for immediate cultivation since the flats contain at times considerable peat, or at least soil in which organic matter has only partially decayed. This seems to be nearly everywhere the situation where marshes of considerable extent have been lately drained. Such soils are really suffering from excess of richness, and improve rapidly under the ventilation they receive in cultivation. Sometimes these lowland soils lie immediately upon the blue clay and these suffer from lack of subsoil drainage but these cases are few. In not a few cases in the knobby drift region there is considerable sand in the subsoil and sometimes at the surface. This is noticeable in the eastern townships of Winnebago and Hancock counties particularly. There is a similar condition along the east side of Union slough in Kossuth county.

Where the sand is not in excess the soils are improved by its presence. In German township of Hancock county are some of the finest farms to be seen anywhere and the proportion of sand is much greater than in most other localities.

The farms along Lime creek have not infrequently a sand or gravel subsoil; along the Des Moines south of Irvington there is some alluvial soil resting on beds of gravel, and in a few other localities a gravel subsoil has been reported or observed, but in general the soils of these counties are very uniform, rich, and unfailingly productive. They are almost always so level that they will never lose by erosion, and as the drainage of the county becomes more and more perfect the whole country will gradually assume the appearance of a well tilled garden.

ECONOMIC PRODUCTS.

There is no petroleum, no coal, no lime rock in these counties. The limestone is buried under drift and from forty to one hundred and twenty feet below the surface; no coal has been reported by those who year by year send down their drills in every part of the country, and petroleum has seemingly not yet been thought of. The discovery of either coal or petroleum in this part of Iowa is, as we know, unlikely; the whole region is north of the known limits of the Iowa coal field.

Notwithstanding the lack of stratified rock in place the country is liberally supplied with building rock, suitable for foundation purposes, at least, in form of surface bowlders. These when large are broken up in the field. In any case the granite is sold by the cord. Fourteen tons are reckoned a cord, and in Kossuth county the price is quoted at ten dollars per cord. The farmer commonly finds on his own premises sufficient stone for all his needs. Sometimes, indeed, the bowlders are far too numerous. Hundreds lie along the fence rows. One farmer reported three hundred on forty acres, all taken to the fence-line in a single season.

There are for present report no exposures of valuable clays. Nevertheless, the manufacture of brick and tile has in many places been attempted. Mr. Pitkin has spent large sums of money and much time near Forest City in an attempt to manufacture

brick and tile. The clay is said to cap blue clay. The worked bed is five or six feet thick free from pebbles or other objectionable features and the product as shown by the specimens on the ground is certainly good; better than any so far noted on the Wisconsin drift region. Nevertheless, for some reason the enterprise seems to have been abandoned. The deposit is apparently an aqueous sediment, resembles loess. At Klemme, or near it, tile of fair quality is manufactured in limited amount. Near the river at Algona brick is manufactured from Wisconsin clay rather unusually free from pebbles. The brick and tile, however, show the usual fault; the lime pebbles that are present slack after burning and so make trouble. The brick are very soft, suitable it is said for inside work only.

At Britt, the Interstate Drainage Company began operations about July 15, 1902, and are even now (October) enlarging the plant. They have burned about 50,000 brick of fair quality and 60,000 tile. The demand, so far, is far in excess of the supply. The material is apparently Wisconsin clay of superior quality. The fuel is coal.

The gravel which occurs in great abundance here and there should not be overlooked in a resume such as this. This gravel makes the best of roads. In many parts of northern Iowa its value is appreciated to such extent that miles of country roads are paved with it. Unfortunately for road-making, gravel though widely is not evenly distributed in nature. It occurs sometimes where not needed, and again cannot be procured conveniently where needed most. All the marshes of Kossuth and Hancock counties have been bridged by so called grades; these are often of gravel and excellent. They must be made of something other than ordinary surface soil if they are to be permanent.

Water Supply.

The running waters of the counties here described are of considerable value. In Kossuth county particularly, good perennial streams are well distributed. The Des Moines river waters a large section of the country while its several tributaries, the Buffalo, Black Cat, Plum creek and Lott's creek are far-reaching

and presumably perennial streams. In Winnebago county Lime creek is the only stream of value or importance. It is probable that the county ditch may be of service not only in draining wide-extended marshes but also as a water supply for many farms in the township by which it passes. In Hancock county we have the two branches of the Iowa river, both valuable streams especially in the southern townships. The Boone river also affords water for stock in the southwest part of this meadow county. There are besides in all these counties abundant pools and small lakes that are often serviceable in the care of stock. Some have been artificially deepened and made permanent.

By far the greater number of farms have deep wells and wind-pumps, with reservoirs of various sorts. Water is obtainable at varying depths. Many of the wells seem to yield abundant water above the blue clay at the surprisingly shallow depth of fifteen to twenty feet. In Mount Valley township wells eighty feet deep have water within ten feet of the surface. Such go through the blue clay but not to rock. Forest City has a well located near Lime creek, north of the city and three hundred and two feet deep; the well is flowing at the level of the creek or a few feet higher. In the eastern part of our territory rock is reached at about 120 to 130 feet, occasionally much less, and the wells enter the rock for varying depths. In Kossuth county, northern half, the rock seems to be not more than seventy-five to one hundred feet below the surface and at Germania a flowing well is found only sixty feet deep. Other flowing wells are found about Ledyard and indeed on all the farms from Germania north and west. Flowing wells are common also along the Boone valley in Hancock county. So far as could be learned they are simply drift artesian wells; they do not in the cases reported reach the underlying limestone of the country at all and owe their peculiarity to the local topography, the intake being the morainic fields of southern Minnesota, of Winnebago and Kossuth or possibly of northern Hancock county. At Garner the town well is one hundred and twenty feet deep; about twenty feet to blue clay which is here some forty feet in thickness; "gravel and rock" make up the remaining sixty feet. The well at the Milwaukee railway station at Britt has been already quoted in these

reports.* This is over five hundred feet deep, but the town well a mile away finds abundant water at one hundred and twenty-five feet, ten of which are in limestone.

In general over the whole area here described water is reached at or near the surface of the limestone. The average depth of wells is not far from one hundred feet and the supply at this depth for all ordinary purposes is apparently inexhaustible. The water is generally reported good. Less complaint than usual is heard of bad water under the blue clay caused by slowly decomposing organic stuff. The deeper well at Britt, mentioned above, affords water which contains in solution an inconvenient amount of solids which tend to form incrustations and so choke up pipes.

ACKNOWLEDGMENTS.

In the prosecution of the work here recorded the author acknowledges his obligations to many citizens of the region, farmers especially, who were ever ready to aid in every possible way. To Supt. A. M. Deyoe, Mr. J. A. Treganza, Hon. Eugene Secor the Survey is indebted for special favors. In the preparation of the list of native trees following, the author would acknowledge his indebtedness to his colleague, Prof. B. Shimek, who in the interest of the United States Bureau of Forestry has made a special study of this particular part of Iowa.

FORESTRY NOTES FOR KOSSUTH, WINNEBAGO AND HANCOCK COUNTIES.

The forest area in these counties was originally, and has been until recently, rather larger than usual in prairie counties. Especially is this true of Hancock and Winnebago. In the latter the greater part of the eastern townships was originally covered with forest trees and until comparatively recent years the same region has been more densely and extensively occupied by young native forest, the so-called "second-growth." The same thing was true of a large part of Forest township and of Newton township, and there was native wood about Lake Harmon, and perhaps one or two other native groves were known to the pioneer. In Hancock county Ellington township, with the southern slopes

*See of this series Vol. VI, p. 195.

STATE OF MINNESOTA

IOWA GEOLOGICAL SURVEY

MAP OF THE SUPERFICIAL DEPOSITS OF KOSSUTH COUNTY IOWA.

BY T. H. MACBRIDE 1903.

Scale 1:250000

4 0 4 8 12 16 Miles

4 0 4 8 12 16 Kilometers

LEGEND

WISCONSIN DRIFT AFFECTED BY MORAINIC KNOBS.

WISCONSIN PLAIN

MORAINIC HILLS, RIDGES ETC. WEST HALF OF THE COUNTY TO MORAINE.

BORDER OF GLACIAL ADVANCE NOT CHARACTERIZED BY CONSPICUOUS MORAINIC DEPOSITS.

EAGLE GRANT SPRINGFIELD HEBRON

SWEA HARRISON LINCOLN LEDYARD

SENECA GREENWOOD RAMSEY GERMAN

FENTON HENRY PORTLAND BUFFALO

LOTTS CREEK UNION PLUM CREEK WESLEY

WHITTEMORE CRESCO IRVINGTON PRAIRIE

GARFIELD RIVERDALE SHERMAN LUVERNE

HUMBOLDT

T. 100 N. T. 99 N. T. 98 N. T. 97 N. T. 96 N. T. 95 N. T. 94 N.

R. XXX W. R. XXIX W. R. XXVIII W. R. XXVII W.

Drawn and Engraved by The Hachmeister Co. Davenport, Iowa

of Pilot Knob and the banks of Lime creek, were all extensively wooded country and native groves were found all along the Iowa river in Avery township and about Amsterdam. There is still a native grove at Twin lakes and one in section 11 of the township of the same name, and another at Crystal lake. The latter is now in part a park. In Kossuth county the native woods were limited pretty nearly to the valley and flood plain of the Des Moines river, particularly below the point where the tributaries, Black Cat and Plum creek, enter. The list of species represented in these native forest plantations includes the names of nearly all the arboreal forms found in eastern or especially northeastern Iowa. Along the Des Moines about Algona and along Lime creek east of Forest City and especially on Pilot Knob and on its attendant hills genuine forest conditions prevail. Undisturbed by fires the trees make luxuriant growth and add a beauty to these prairie landscapes otherwise unattainable. The presence of Pilot Knob and its wooded sides, seen like a blue wall from all the surrounding country for miles, has to this country and for it a real commercial value, and if the people who are so fortunate as to own farms and homes in the neighborhood of this piece of natural attractiveness are wise they will never suffer its beauty to be destroyed. Steps should be taken to make Pilot Knob with its woods, its lake and its meadows, its exhilarating heights, a park to be for the delight and enjoyment of the people for all time. Algona has also great natural advantages. Her wooded banks and woodland drives along the river and across it, attended by the rich variety of native groves, are certainly surprisingly beautiful and should belong to the city, some of them at least, for the benefit of coming generations.

Tree-planting in these counties has proceeded much as elsewhere for the purposes of shelter and fuel. Every farmer has a grove, and some of these are of fine proportions and show beautiful trees. Here as in other Iowa counties the species planted have been selected as rapidly growing, rather than for value when grown. Nevertheless there are plantations sufficient to show that all sorts of trees common to our northern nurseries may be successfully reared along these northern borders. Mr. Eugene Secor has hundreds of conifers to show how easily the farmers

of this region may provide themselves with timber, even for lumber. The primeval trees in all the forests named have nearly all long since disappeared. They were the product of centuries and were ripe for the harvest. Time has not elapsed for their successors to attain much value; but there is no doubt that the most valuable hard-wood trees of our northern forests will yet again find place upon the hills and by the streams of the counties to which they are native and in which history shows that they find congenial skies and soil. The observed species in the several localities discussed are named in the following list:

Tilia americana L. Linden. Basswood.

The linden is a valuable and beautiful tree not uncommon in all our northern forests. In Iowa the species is usually encountered on the hillside not far above the flood plain of some perennial stream. It is common along the Des Moines about Algona, along Lime creek about Pilot Knob, nor is it lacking to any of the native groves mentioned in the paragraphs immediately preceding. The stooling habit of the tree which often gives us two or three or more distinct trunks from the same stump prevents the otherwise rapid development of a large tree. Nevertheless basswood logs and lumber were familiar to the pioneer, and an occasional trunk two or three feet in thickness is yet to be found in our native woods. The tree grows well when transplanted, is clean and beautiful and forms a dense delightful shade. The bloom in midsummer is pleasantly fragrant, the delight of the bees and the source of our very finest variety of honey.

Celastrus scandens L. Climbing Bittersweet.

This singular forest plant is not infrequent in all the groves of northern Iowa. Its peculiar habit attracts the attention of the woodman who very frequently comes upon a young elm or even hickory entirely smothered, its trunk fairly strangled by the twining coils of its too affectionate neighbor. The effort of the afflicted tree to send down nutrition to its roots results sometimes in a curious swelling ridge which like a giant corkscrew affects the tree-trunk from bottom to top and remains a permanent disfigurement even after the assailant has entirely disappeared. Nevertheless the vine is a favorite cover for un-

sightly fences, and is sometimes planted for an arbor. In any situation its bursting, but long enduring, scarlet fruit is one of the cheerful sights of our western autumn.

Ceanothus americanus L. Jersey Tea. Red-root.

This little shrubby bush well deserves attention and preservation on account of its abundant and handsome bloom. It is found on the borders of dry woodlands everywhere and in summer contributes its share to the beauty of Pilot Knob. As an ornamental shrub certainly one of the finest native to our prairie state and worth a dozen imported but less hardy species.

Vitis riparia Michx. Wild grape.

This is the familiar wild grape of all the west. Native by every stream, climbing in every thicket, it quickly avails itself of the shelter afforded by planted groves and may be found on many a farm removed from its original habitat. The fruit, ripe after frost, is still much sought by those with whom still lingers the clean pure taste of the pioneer, the bloom is fragrant to an unusual degree, and hardy vigorous growth commends it as a valuable climbing shrub eminently fitted for the covering of objects unsightly in town or field.

Ampelopsis quinquefolia Michx. Five-leaved Ivy. Virginia Creeper.

The Virginia creeper is a universal favorite as a cover for the masonry of walls, for fences, etc. It has a great advantage over the grape in that its tendrils adapt themselves to various supports. They know well the roughened or weathered surface of various objects and spread adhering disks against the face of a tree stump or quarry wall. Hence the name five-leaved ivy. The plant very well supplies in this country the place of the English ivy. It will cover a stone building from top to bottom and adheres well to brick if not too much exposed to our burning summer sun. Five-leaved ivy bears no relation to the so-called "Poison ivy," is by no means poisonous. The foliage in autmun turns brilliant red, conspicuous in the autumn thicket. The fruit resembles that of the grape, but the cluster is open and the dark blue berries are few.

Acer saccharinum L. Soft Maple. White Maple.

The soft maple is the most familiar tree in Iowa. Universally planted on every prairie farm it is at once ornament and shelter and has transformed the landscape of the State. The tree is of surprisingly rapid growth, its wood makes excellent fuel and a quality of lumber much esteemed, especially in furniture-making. On the other hand the wood of the soft maple is brittle and in our latitude and climate the long branches not infrequently fall a prey to the sweeping wind or the gusts of summer storms. This is *A. dasycarpum* Ehr. of the books.

A. saccharum L. Sugar Maple. Hard Maple.

In this part of Iowa the sugar maple is rare. It was observed and noted in Forest township, Winnebago county only. The tree probably occurs in other places along Lime creek. It was not discovered in Hancock county nor in the valley of the Des Moines although to have been expected. The species is too well known to require much comment. It grows much more slowly than its relative the soft maple, but makes much better wood. When planted as an ornamental or shade tree the drought of an ordinary Iowa summer destroys its upper twigs and branches, so that all such trees sooner or later disappoint us, dying at the top. It seems probable that in any situation trees grown from seed do better than those whose roots have been disturbed and injured in the process of transplanting. In Iowa there were once large trees of this species, even groves of them, "sugar orchards," but these were uniformly found by rocky perennial streams, and in the shelter of other forest trees where the drought was less severe. This tree is called *A. saccharinum* L. in the more familiar literature of this subject.

Acer negundo L. Ash-leaved Maple. Box Elder.

The box elder is our universal tree. Native in all the eastern portion of the State it is now planted and naturalized in every county. As a shelter tree it rivals the willow and soft maple, especially in rapid growth, and makes a denser shade than either. Its habit is however very different from that of other maples. It tends to make crooked branches and a round dense head. Even in thick groves the trunk may rarely be induced to grow straight.

The tree is nevertheless valuable in every way, for shade, shelter, and fuel.

Rhus typhina L. Velvet Sumac. Staghorn Sumac.

A beautiful shrub is this; sometimes rising to the stature of a small tree, twenty to twenty-five feet in height; rare in northern Iowa. The only specimens noted were in the vicinity of Lake Mills, Winnebago county. Here it occurs commonly by the roadside. It is a most handsome ornamental hardy plant. It tends to form a thicket but is easily kept in check. The curious "velvet" of the young shoots and branches is unique in our forests; the leaves are soft and of delicate tints of green, changing in autumn; the flower clusters are large and showy and the fruit crimson and brilliant. We have nothing better that will endure our climate, probably nothing as good. It is not poisonous, as some are wont to believe, although the fruit is inedible, except by birds, and the peculiar resin of the branches protects the shrubs generally from cattle and horses.

The species ranges along our northern border and in eastern Iowa has been noted as far south as Monticello in Jones county.

Rhus glabra. Sumac. Smooth Sumac.

This is the species commonb throughout the State. Even in prairie counties where natural groves are none or few, the traveller often encounters on some dry hillside a plantation of sumac bushes, sometimes no more than one foot high. On the other hand in the eastern counties the sumac is sometimes a small tree fifteen or twenty feet high. Like the preceding it is one of our own ornamental shrubs and deserves well of every Iowan.

Rhus toxicodendron L. Poison Ivy; Three-leaved Ivy; Poison-vine; Poison Oak; Poison Sumac.

Resembling the preceding in none of its more obvious characters the poison sumac is yet able to lend its own ill repute to all other members of the family. This plant *is* poisonous, at least for many people though not for all. It is sometimes confused with the Virginia Creeper, because like that species it sometimes ascends tall trees, rooting fast to the bark of its host. In Iowa the *three-leaved* foliage is a sure distinction in the growing

season; later the *white dry fruit* will readily separate it not only from other species of sumac, but also from the purple fruited innocent Ampelopsis.

Robinia pseudacacia L. Locust. Black Locust.

Probably indigenous to southeastern Iowa, the locust tree has been very widely planted. For some time less popular because of the depredations of the locust-borer, it is now coming again into favor, being less afflicted. One of our most valuable hardwood trees; well worth planting for all purposes. Its flowers are beautiful and odorous; its foliage handsome and its wood heavy, strong, of unusual durability when in contact with the soil, hence of highest value for posts.

Spiræa salicifolia L. Wild Meadowsweet.

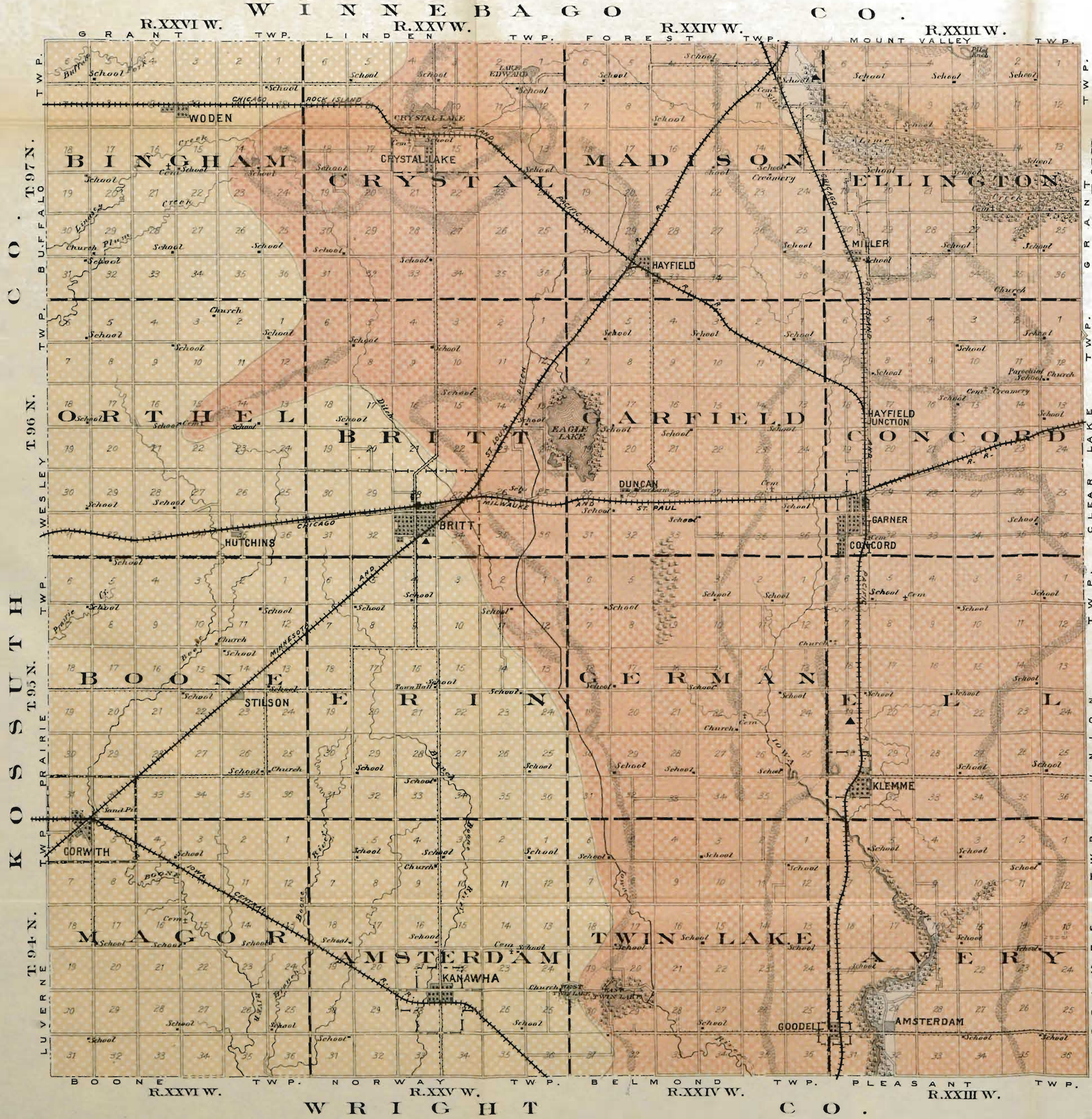
This is a beautiful little shrub with wand-like stems and branches tipped in summer with abundant, spicate, snowy bloom. Common in moist shades, on the flanks of Pilot Knob.

Pyrus iowensis Wood. Crab-apple. Wild Crab.

The crab-tree is common over all the prairie country forming small thickets around the borders of native groves and even on cool hillsides where there are no other forest trees. Its beautiful odorous bloom, the very glory of our early summer, should render this tree a favorite with our whole people and save it from threatened destruction. The agents of the nurseries offer our Iowa farmers long lists of cultivated and imported novelties in the way of flowering shrubs, but not one of them all will for a moment compare with the modest splendor of our Iowa crab, which everybody may have for the planting. It will bear transplanting and grow anywhere.

Cratægus mollis T. and G.; *C. crus-galli* L.; *C. punctata* Jacq.; *C. tomentosa* L. Hawthorn; White thorn; Thorn-apple.

These are first cousins of the crab apple, often, indeed generally, growing with the more familiar species, especially in wood borders or where the forest meets the prairie. Common on Pilot Knob, along Lime creek, and in the groves of Hancock county. Their white flowers contrast pleasantly with the rosy infloresence of the crab, although some are inclined to be mal-



IOWA GEOLOGICAL SURVEY

MAP OF THE SUPERFICIAL DEPOSITS OF

HANCOCK

COUNTY IOWA.

BY

T. H. MACBRIDE

1903.

Scale 1/125000

1 ½ 0 1 2 3 4 5 Miles

1 ½ 0 1 2 3 4 5 Kilometers

LEGEND

- ALLUVIAL DEPOSITS
- WISCONSIN MORAINIC DRIFT
- WISCONSIN DRIFT – PLAIN
- DRIFT MARGIN OR RANGE OF MORAINIC HILLS

INDUSTRIES.

- CLAY WORKS ▲

Drawn and Engraved by The Huebinger Co. Davenport, Iowa.

odorous. The first species is our favorite red haw whose large scarlet apples enrich the fence rows in autumn where the zeal of the road commissioner has not yet found the tree, or the barbarous vandalism of the "line-men" has not yet mutilated and destroyed it.

Amelanchier rotundifolia T. and G. Shad-bush; Service-berry; June-berry.

Recognizable on all our northern country by its fine snow-white blossoms covering the bush or tree in early spring. It blooms before the wild plum, before the leaves are out on anything—save perhaps the vanguard willows,—and marks the whole hillside with its white banners signalling the on-coming of the spring. The fruit is small but edible and in favor with many people so that the tree is often cultivated in country gardens. In habit and foliage variable, there is after all perhaps but a single species, the old *A. canadensis* L of which our round-leaved forms are but the western variety. Along the banks of the Des Moines; on Pilot Knob.

Cornus circinata L'Her; *C. paniculata* L'Her. Cornel-bush; Dogwood.

These are handsome ornamental shrubs. They bear white flat clusters of flowers in early summer and showy, round or flattened, berries in fall; the fruit in the first named blue, in the second white. *C. circinata* endures dry rocky places, even clings to rocky ledges; *C. paniculata* loves the river brink. Found n the thickets along wooded banks in all three counties.

Sambucus canadensis L. Elder-bush. Elder-berry.

The elder-berry is a plant everywhere familiar, often planted in gardens for the sake of its fruit, but now springing up as if native in the rich soil of farm-land and meadow. The abundant black-purple fruit is esteemed as fruit, and is certainly valuable as food for birds.

Viburnum lentago L.; V. *prunifolium* L.; V. *dentatum* L. Sheep-berry; Black haw; Arrow-wood.

Of the three Viburnums in this part of Iowa the first and last as here named are found in wet places or by streams; the

black haw is a small slender tree everywhere in native groves. *V. dentatum* on Pilot Knob only.

Symphoricarpus occidentalis Hook. Wolf-berry.

A handsome shrub is this, native to all the northern counties; abundant about the margins of the groves and so suggesting its proper use in plantations. The elegant little flowers are showy even in the flowery month of June, and the white fruit is in pleasing contrast to the dull tints of the autumn field.

Cephalanthus occidentalis L. Button-bush.

A common shrub in wet places on Pilot Knob; with handsome flowers, in its favorite habitat, but of little general use.

Fraxinus americana L. White Ash.

The ash is a tree of wide range and of universal usefulness. Its wood is excellent for lumber and makes fine fuel. As a shade tree it is clean and beautiful and of reasonably rapid growth. No other tree except the cottonwood and the maple is so extensively planted on prairie farms; nevertheless its value is hardly yet appreciated.

Fraxinus viridis Michx. Green Ash.

This species is not rare along wooded water courses and differs decidedly from the commonly planted species. It is a small, irregularly branched, but vigorous tree, valuable only for the excellent fuel it affords.

Ulmus americana L. American Elm. White Elm.

The white elm is the street-tree of North America. For planting in rows along our village and city streets nothing can match this. The tree is hardy, enduring all sorts of soil and much mistreatment; it grows rapidly and in selected individuals with a symmetry unequalled. Nor only along the highway and street is the elm a thing of beauty; out in the open field or by the prairie stream a single lone elm may often be noticed whose rich umbrageous foliage in summer, and elegant plumy outline in winter, are simply the crowing beauty of the landscape.

The elm is a rapid grower, makes first class lumber for many uses about the farm, and is valuable at last in no small degree as a source of excellent fuel.

Ulmus fulva Michx. Red Elm. Slippery Elm.

The slippery elm occures rarely in the groves of the counties we describe. It is a much less valuable tree than the preceding, although its wood is tough, unsplittable, highly prized for some purposes. The tree is easily distinguished by its extremely harsh, large and rough-surfaced leaves, the stiff rigid branching, and the large- clustered, almost orbicular, rough and venulose fruit.

Celtis occidentalis L. Hackberry.

Fine specimens of this tree were noticed near the old town of Amsterdam, and others in Winnebago county. It is indigenous to our northern counties generally and a delightful tree. It grows more slowly than its cousin, the elm, but makes a much denser shade. The top when left to itself is shapely, the foliage pale green. There is no finer ornamental tree and while its wood is less desirable for lumber it makes the best of fuel.

Juglans nigra L. Black Walnut. Walnut.

This is doubtless, commercially considered, the most valuable species in the whole list. Native to eastern Iowa, it grows well in stream valleys and on prairie plantations as far as the Missouri river. The walnut grove at Whiting in Monona county is famous the country over and there is another in Sac almost as fine. These are both the result of careful planting. In Hancock county there are fine thrifty trees in the groves around the old court-house at Concord. But the species is also represented by native trees at Amsterdam and on the land of Mr. Hathaway in Twin Lakes township. The pioneers seem to have found elegant walnut trees in Wnnebago county and there is still near Forest City, a walnut stump in witness more than four feet across the top. There is therefore no reason why farmers in these counties may not raise walnut timber. The crop is somewhat slow, but if cared for is much more rapid than some people suppose. There are many native walnuts along the Des Moines in Kossuth county but the larger trees have been long since cut away.

Juglans cinerea L. Butter-nut. White Walnut.

The butter-nut was noted in eastern Hancock and in Winnebago. This must be near the western limit of the species in this latitude. Not without value, the tree is nevertheless nothing like so worthy of cultivation as is the walnut. It is by nature a smaller form and although furnishing a fine-grained lumber has not been much in favor with our western people.

Carya alba. Nutt. Hickory; Shell-bark Hickory; Shell-bark.

This valuable species is apparently common in Winnebago county, but less so in the other counties. Only small young trees were observed. The old trees are probably all gone. The wood of the hickory is in great demand in the manufacture of wagons, buggies and other forms of vehicles. A forest of hickory today would be worth a fortune. As fuel the wood is equally famous, and the finest trees of our North American valley forests have been cut down to make winter fires. The hickory grows well and rapidly from seed, and it is to be hoped that within the range of its natural habitat it may be nowhere suffered to become extinct. The bitter nut, *C. amara* Nutt., is also found in our present field; it is a good tree for fuel but in the mill or factory possesses nothing like the value of its associate.

Corylus americana L. Hazel. Hazel-nut.

The hazel nut is so widely known as to require no more than mention here. It is the universal attendant of our native forest, the low, out-creeping border of the woods. It is astonishing how rapidly and easily the hazel extends its beneficent domain. The fruit is disseminated by our familiar birds. Blue-jays will attempt to carry two or three hazel-nuts at a time in their beaks, and will fly with a bunch of the fruit for long distances. In this way people are often surprised to find the hazel springing about the borders of our artificial groves. The birds are the planters and the hazel simply occupies its own.

Ostrya virginica. Willd. Ironwood. Horn-beam.

A valuable though small tree is this, not uncommon. The wood grows rapidly up to a certain age; afterwards very slowly; is tough and exceedingly hard; makes good tool handles and firewood.

Quercus. The Oaks.

More than any trees of the forest, the oaks appeal to every lover of the wood. On Pilot Knob five distinct species of oak occur, and three or four in other parts of our area. The universal species is of course the bur-oak, *Q. macrocarpa* Michx. This species occupies the very hardest and most unfavorable rocky or sandy hilltops, remote from all other arboreal vegitation. Next in frequency is the jack-oak, *Q.velutina* Lam., occupying the whole forest area already referred to, the whole Mississippi valley. On the slopes of Pilot Knob beautiful specimens of *Q. scheckii* Britt., the scarlet oak, adorn the roadsides and fields, their thin elegantly cleft leaves shining with unusual lustre in the summer sun. In similar localities and in the valleys of all the wooded streams occurs another common species *Q. rubra,* L. the red oak. The three last named all belong to the black oak series; all have dark-colored, furrowed bark, bristle-tipped leaves and fruit, and acorns that take two years to mature. The bur-oak, on the other hand, belongs to the white oak group. Its leaves have rounded lobes, are never bristly; the bark is pale and often flaky, though in old trees apt to furrow, over certain areas, and the nuts form and mature in a single season. The white oak, *Q. alba* L. is the finest and most valuable oak in our northern woods, and is fortunately not rare in Iowa. The writer noted, however, in the district covered by this report but very few, and these in Forest township of Winnebago county.

All sorts of oaks may be transplanted but they, like other forest species, grow best from seed. Acorns spring up readily if protected from animals and covered lightly with leaves. When cared for they grow with surprising rapidity, easily making two or three feet a year in height. There is no good reason why on the farms of northern Iowa oaks, ash trees, walnuts, pines may not begin to supplant the useful, but less valuable soft maple and box-elder.

Populus tremuloides, Michx. Quaking-asp.

A common little tree in all native groves. Of little value save as light fuel. Its nearest kin, *P. grandidentata* Michx., the large leaved aspen, or simply aspen, is much more valuable. It springs

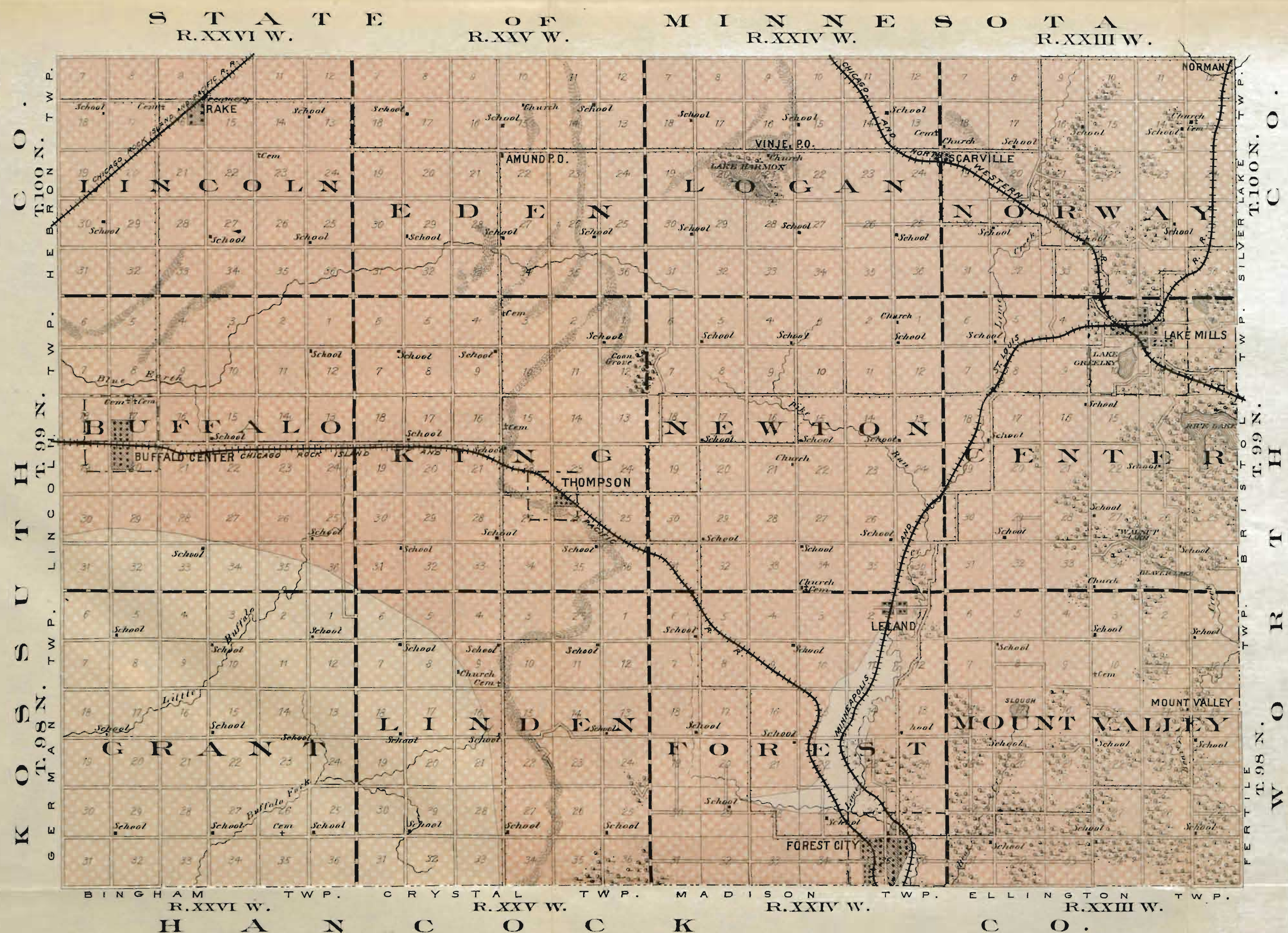
up quickly in clearings, grows in dense hillside groves and in a few years makes fine long straight poles, light and strong for use on the farm. Hundreds of these trees are found on the slopes leading up to Pilot Knob. The cotton-wood, *P. deltoidea* Marsh., has been extensively planted here as in all our western country. The cotton-wood makes good fuel and has been of service as a wind-break. Does not however, make good groves.

Salix species.

Of willows there are many in our region. Prof. Shimek furnishes me the following list: *S. discolor,* Muhl.; *S. amygdaloides* Anders., diamond willow; *S. cordata* Muhl., heart-leaved willow; *S. candida* Willd., hoary willow; *S. humilis* Marsh., prairie willow; *S. petiolaris* Smith, has no common name. In fact, the willows are for our people little distinguished. Most of those here listed are mere shrubs without economic value save as ornamental plants. The first two named are small trees.

Juniperus virginiana, L. Red Cedar.

This is the only representative of the conifers or pine family in this part of Iowa. The white pine seems not to come so far south and west. The little red cedar is said to be still not rare about the shores of Rice lake, Winnebago county and many are reported as taken thence for planting on the farms. All the conifers usually planted in Iowa have been successfully reared by the farmers of the counties here discussed. So much in genuine arboriculture has here been already wisely done that we have high hope for greater success in time to come, when to the other crops making Iowa the land of varied husbandry shall be added a perennial harvest of forest products from trees of all our noblest species.


STATE OF MINNESOTA
R.XXVI W.
R.XXV W.
R.XXIV W.
R.XXIII W.
KOSSUTH CO.
WORTH CO.
HANCOCK CO.
LINCOLN
EDEN
LOGAN
NORWAY
BUFFALO
KING
NEWTON
CENTER
GRANT
LINDEN
FOREST
MOUNT VALLEY
RAKE
AMUND P.O.
VINJE P.O.
SCARVILLE
NORMAN
LAKE MILLS
BUFFALO CENTER
THOMPSON
LELAND
FOREST CITY
MOUNT VALLEY
T.100 N.
T.99 N.
T.98 N.
HEBRON TWP.
LINCOLN TWP.
GERMAN TWP.
SILVER LAKE TWP.
BRISTOL TWP.
FERTILE TWP.
BINGHAM TWP.
CRYSTAL TWP.
MADISON TWP.
ELLINGTON TWP.

IOWA GEOLOGICAL SURVEY

MAP OF THE SUPERFICIAL DEPOSITS OF WINNEBAGO COUNTY IOWA.

BY T. H. MACBRIDE 1903.

Scale $\frac{1}{125000}$

1 ½ 0 1 2 3 4 5 Miles

1 ½ 0 1 2 3 4 5 Kilometers

LEGEND

ALLUVIAL DEPOSITS

MORAINIC WISCONSIN DRIFT

WISCONSIN DRIFT-PLAIN

DRIFT MARGIN OR RANGE OF MORAINIC HILLS

Drawn and Engraved by The Huebinger Co. Davenport, Iowa.