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VOLUME XXI

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PAPERS OF THE MICHIGAN ACADEMY OF SCIENCE ARTS AND LETTERS

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EUGENE S. MCCARTNEY
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VOLUME XXI

"Pusilla res mundus est nisi in illo
quod quaerat omnis mundus habeat."
—SENECA, *Naturales Quaestiones*

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THE USE OF BEVELED DISCOIDALS IN NORTHERN GEORGIA

WILLIAM B. COLBURN

THIS paper has to do with a method of bowling, practiced by the Cherokee Indians, in which the beveled discoidal had a very definite use previously unknown to, or at least unrecorded by, any anthropologist or historian.

During the first three months of 1932 I directed the partial excavation of a mound located on J. J. Greenwood's farm about one half of a mile northeast of Dillard in Georgia and one quarter of a mile east of the main highway between Franklin, North Carolina, and Clayton, Georgia. The mound was oval, roughly one hundred and thirty feet long by one hundred feet wide, with its long axis running nearly due north and south (Fig. 1).

My preparatory work, after clearing the mound of the brambles and cornstalks (see Pl. I, Fig. 1), was to choose, arbitrarily, a center of the mound, which I marked by a post, and from that point, with the efficient aid of Mr. Milky, a government surveyor from Franklin, to survey the mound and its immediate surroundings. I had learned from the owner that for at least three generations the plowing done each year over the mound had been from north to south, and so I decided to include in my excavation the fifty-foot strip lying due south of the mound proper, in order to recover any sherds or artifacts dragged down by the plows. I therefore enclosed the mound in a rectangle one hundred and ninety feet long by one hundred and thirty-five wide with posts driven into the ground at five-foot intervals, and with the northern and eastern lines only ten feet distant from the mound, as indicated in the floor plan (Fig. 1).

A preparatory trench five feet wide was then dug along the southern side of the rectangle, to a depth of two or three inches below the undisturbed earth; at the eastern end of the trench the required depth proved to be three feet and at the western end slightly over five feet. Owing to the absence of sherds and charcoal in either end of this test trench, it was decided to continue the excavation toward the mound on a sixty-foot front, thirty feet to either side of the center or zero line. During the excavation of the first two five-foot strips along this sixty-foot front fourteen discoidals were uncovered, two in the first and twelve in the second. Some are illustrated in Plate I, Figure 3.

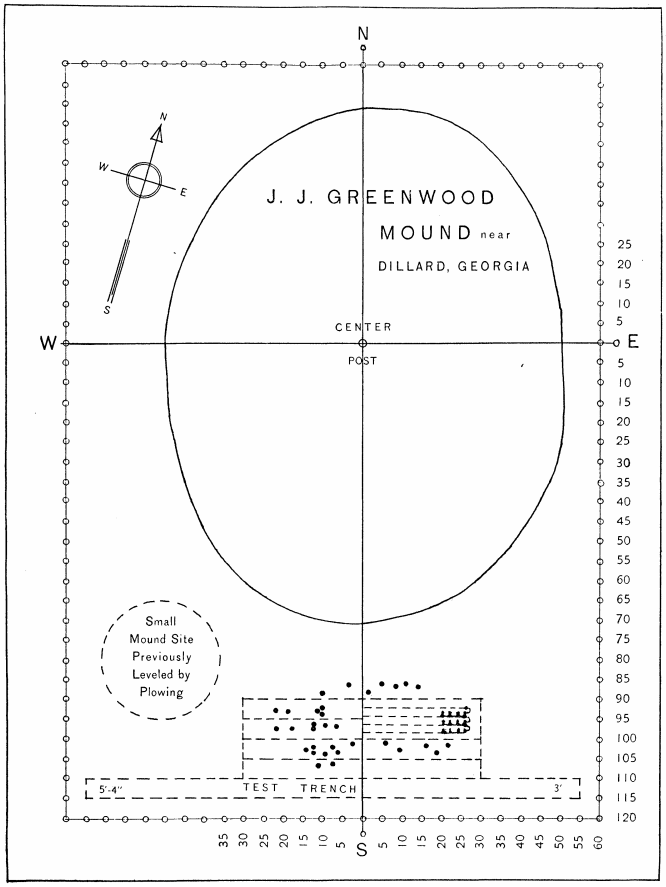


FIG. 1. Floor plan of the J. J. Greenwood mound, near Dillard, Georgia

When the south 100-foot profile wall had been shaved back a distance of two feet, a line of field rocks was encountered between east 20 and 30 on profile line south 98. At the same level, an average of three feet below the surface, a stratum of hard-baked clay extended about twenty feet to the west from the western end of the row of field stones. As the work of uncovering these features progressed, we discovered that the stones were arranged in three definite similar groups or patterns of four open squares, three with their open sides at right angles to the clay runways or alleys, and a smaller one directly facing the left-hand side of these runways.

The baked-clay floors were perfectly level and about two feet six inches in width; each strip uncovered as we worked north was about three inches higher than the one south of it. Opposite the openings to the three large squares rough-hewn or split sections of tree trunks had been embedded in the earth, evidently to hold in place the row of field rocks forming the back of the square of the next alley above, as well as serving as fenders. These extended approximately two feet to the west of the field rocks, and each terminated at a large rock forming the left-hand upper cornerstone of the small square in each alley. All these features are portrayed in Figure 2.

During the excavation of the remainder of the two five-foot strips in which these alleys were uncovered eleven more discoidals were found, and later seven others were unearthed in the five-foot strip to the north. In all, thirty-two discoidals were found in the immediate vicinity of these alleys, all lying upon the original humus line; seventeen, or more than half of them, were of the beveled type which, when bowled or rolled with the larger diameter to the left, would, upon loss of momentum, naturally curve to the right in the same manner in which the lawn-bowling ball of our day curves to whichever side is weighted. The Cherokee Indians made these discoidals with a beveled edge so that they might be curved into the hollow squares opening at right angles to these alleys. This form of bowling must have been known to and been practiced by the whole Cherokee nation, because discoidals of this type have been found commonly throughout their former domain.

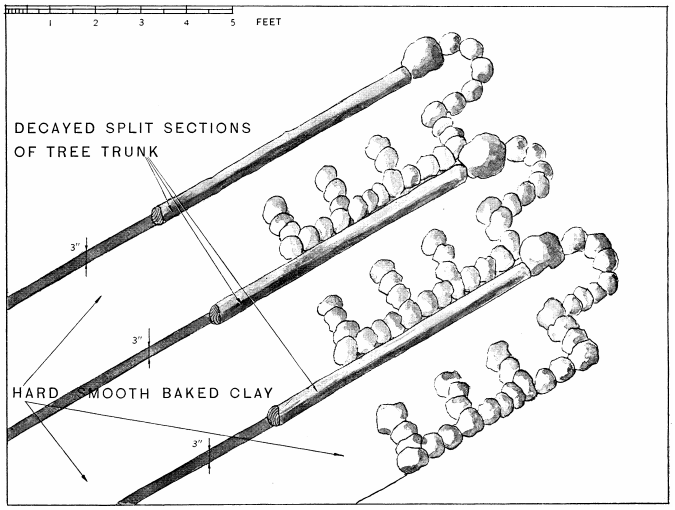


FIG. 2. The eastern end of the bowling alleys

During the last ten years we have obtained from Cherokee territory for the Cherokee collection of Burnham S. Colburn at Biltmore Forest, North Carolina, over two hundred discoidals of all types. These we have classified into four main divisions: first, barrel; second, doubly concave; third, beveled; and fourth, the straight or common variety. The first of these, the barrel type, named from its resemblance to a barrel, is by far the rarest; there are only five in the Biltmore Forest collection. It probably was not used for bowling, since many of them are too large and too heavy to be handled easily. The second type, which is the most beautifully finished, is rarely found in other than perfect condition and so is regarded as "ceremonial." The last two types, however, are more often chipped or nicked at the edges than in perfect shape, which leads me to believe that they were used in their various games and that the beveled discoidal was especially made for use on alleys such as those uncovered at the Greenwood mound.

One of the interesting finds made close to the bowling alley was a discoidal of the beveled-edge type, from which one large piece had been chipped off. This fragment was discovered three days later at a point some fifteen feet away. Upon being placed in position on the original stone it showed clearly that, after the chipping off of the piece, the discoidal had been reworked by its owner. Also several discoidals were made of mica schist. These, of course, were very roughly finished, but were interesting because of the sparkle of the mica.

PLATE I

FIG. 1. The J. J. Greenwood mound near Dillard, Georgia, before clearing. Note the brambles and the cornstalks

FIG. 2. Squares of river stones associated with the clay runways. From a photograph taken after a cloudburst

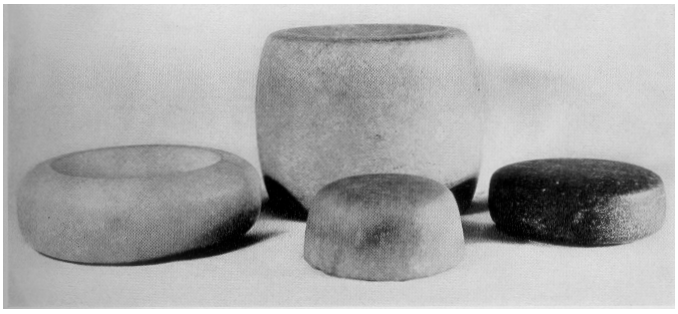


FIG. 3. Four types of discoidals

Before the bowling alleys, and especially the field rocks, had been completely uncovered and prepared for photographing a cloudburst caught us unaware. After the deluge we found that the symmetry of the squares has been largely destroyed, but, fortunately, I had drawn a sketch as the excavation progressed, and the photograph taken after the storm still gives an idea of the arrangement of the field stones and shows at least one of the decayed wooden borders (Pl. I, Fig. 2).

In American archaeology there are a great many artifacts of the Indians still classed as "problematical," owing to the fact that we do not definitely know to what use they were put. This is primarily due to the lack of

any written history by these early Americans and to the rapidity with which they lost their own arts and adopted those of the white man upon contact with him.

Only through the good fortune of finding evidence, such as these bowling alleys at the Greenwood mound, is it possible for archaeologists to reconstruct the life and habits of the Indians prior to the coming of the white man. In this case the evidence was undisturbed owing to two facts: first, the Indians had evidently covered up these alleys before undertaking some expedition or temporary migration from which they expected to return; and, second, the owners of the land had plowed over the mound year after year from north to south, burying deeper and protecting more surely this prehistoric playground.

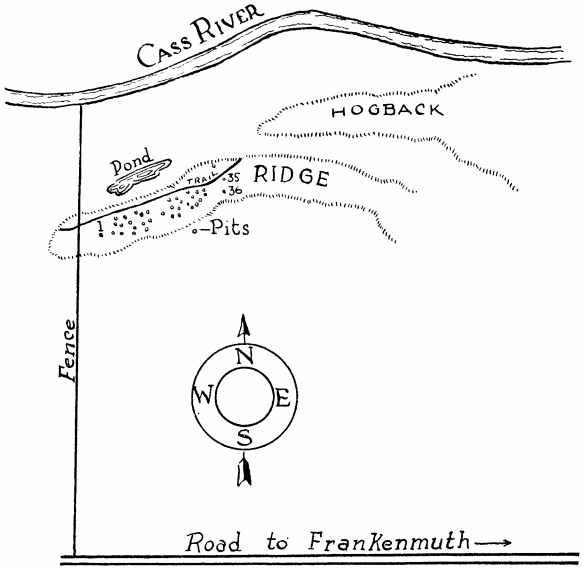
CRANBROOK INSTITUTE OF SCIENCE
BLOOMFIELD HILLS, MICHIGAN

PREHISTORIC STORAGE PITS IN SAGINAW COUNTY, MICHIGAN

FRED DUSTIN

AMONG the interesting remains of the American Indian mentioned or described by early writers we find storage pits, usually spoken of locally as "corn pits." Though the latter designation is quite applicable, corn was only one of several foodstuffs thus stored.

In our own State of Michigan these evidences of prehistoric life and culture were numerous, and perhaps no county in the state had more of them than Saginaw, for its rich bottom lands were ideal for the cultivation of corn, while the sandy knolls and ridges that abounded afforded the situations best adapted to underground storage as practiced by the aborigines. Saginaw County was a populous center,[1] and early settlers and local historians have frequently noted large cornfields; in fact, the former often planted their first crops on land cleared perhaps hundreds of years before a white man saw this continent. The plow of the settler soon left its furrows on this cleared land, but the storage pits, usually located on light, poor soil, often escaped cultivation for years, and in this manner a few of these relics have survived destruction. It is such a group, possibly the only one left undestroyed in this county, which I have surveyed and platted and which I shall describe. It is located in the northeast quarter of the southwest quarter of Section 29, Frankenmuth Township, forty rods south of the Cass River, which bisects the section (see Map 1). A fraction of this quarter-quarter section lies north of the river. Of the major portion south of the stream only a narrow strip on its western border has ever been cleared; although the greater part was lumbered many years ago, it was allowed to become forested again and is now covered by a mixed growth of hardwood, with a considerable number of small pines and a few larger ones. The original stand, which was mainly pine of good size and quality, formed beautiful groves on the higher grounds and river bluffs, ideal situations for aboriginal camps and villages, a fact attested by numbers of artifacts, pottery remains, and other relics of primitive days collected from several sites in the near vicinity.



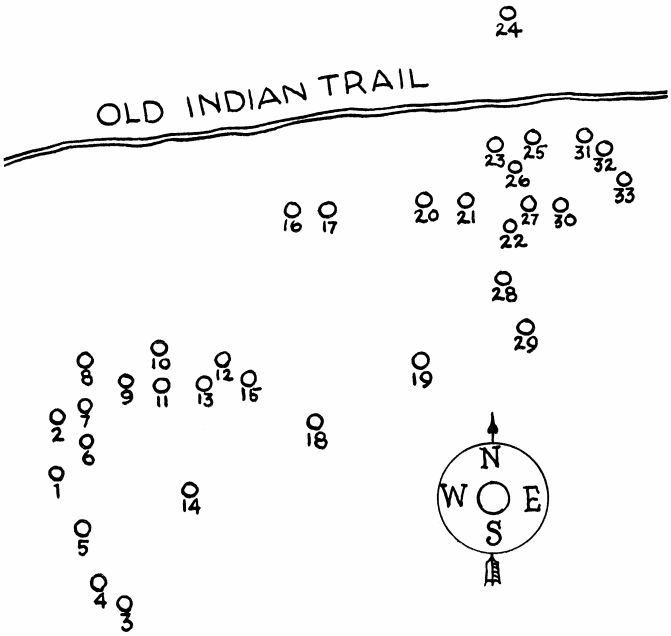
MAP 1. Location of storage pits (indicated by dots) in Section 29, Frankenmuth Township, Saginaw County, Michigan (see also Map 2)

On the eastern edge of the cleared land bordering this wooded tract a sand knoll rises abruptly from a little run (Pl. II, Fig. 1). Near the crest of this elevation a stump fence divides the cleared land from the woods. Crossing this fence from the westward, we find ourselves thirty or thirty-five feet above normal low water in the river, and twenty feet above the bottom land northward. The little hill we have climbed is the terminus of a narrow ridge extending northeast and southwest; at its foot on the left is an intermittent pond two or three acres in extent, once a favored haunt of wild ducks and other waterfowl. One hundred feet east of the fence is the pit marked "1" on the plat (Map 2), with pit 2 a few feet north. Near these two pits, aided by my assistant, Mr. Ralph Stroebel of Saginaw, I ran a line north and south by compass, from which measurements were made with pit 1 as an initial point.

For four or five hundred feet northeast the ridge at its base is about two hundred feet wide and is composed of yellow sand. Many woodchuck holes, both occupied and abandoned, with one hole freshly dug, showing a badger's tracks in the soil, were seen at the time of my survey, April 29, 1934. A pioneer settler who hunted and trapped hereabouts for forty years or more has told me he could usually find the tenement of a badger on this ridge or near it. In studying the pits care should be used not to confuse the funnel-shaped depressions formed by the sand settling around the mouths of these abandoned animal burrows with those made by human hands.

Nearly all the storage pits are found along the flat crest of the ridge, most of them in two groups, with four scattered between and others to right and left. Pits numbered 1, 2, 6, 7, 8, 9, 10, 11, 12, 13, and 15 form the westerly group; those numbered 20, 21, 22, 23, 25, 26,

27, 28, 30, 31, 32, and 33, the easterly. About eighty feet northeast of pit 33 is another prominent pit, numbered 34, and a hundred feet farther in the same direction are two others, numbered 35 and 36. These last three are not shown on the plat, but, including them, there are, on a space sixty feet by three hundred feet, thirty-six attributable to the Indians, with a possibility of several more, for when they were questionable, I gave the benefit of the doubt to badger or woodchuck. There are also two or three "blowdowns," hollows in the soil, usually with a gravelike mound on one side, caused by roots of trees lifting the earth as they were overturned by the wind. In time, the decaying of trunks and roots left the hollows and mounds.



MAP 2. The storage pits shown on and along the ridge on Map 1. Eighty feet to the north-east of pit 33 is another prominent pit, 34 (not indicated on the map); one hundred feet east of it are two others, 35 and 36 (see Map 1)

The Indian pits are shallow; the deepest are not over three feet after the leaves and the rubbish have been removed, for the sand has caved in and nearly filled the original excavations. They are circular in outline, although some have been marred by lumbering operations, as well as modified by natural causes and the treading feet of men and beasts. Mr. Stroebel removed leaves and debris from one or two, and I secured a fair picture of a typical depression; also a second photograph of it with Mr. Stroebel standing in it (Pl. II, Fig. 2). This pit is about two feet deep, but it is not possible to indicate depth with accuracy in such a view, so that it appears to be much shallower.

Owing to lack of time, we did not attempt to excavate any of the pits: if they are of the usual type, their depth would be five or six feet, and probably fragments of the bark linings would remain, with a possibility of securing some relic of stone, bone, or copper, for such articles were sometimes stored in these pits with other belongings.

PLATE II

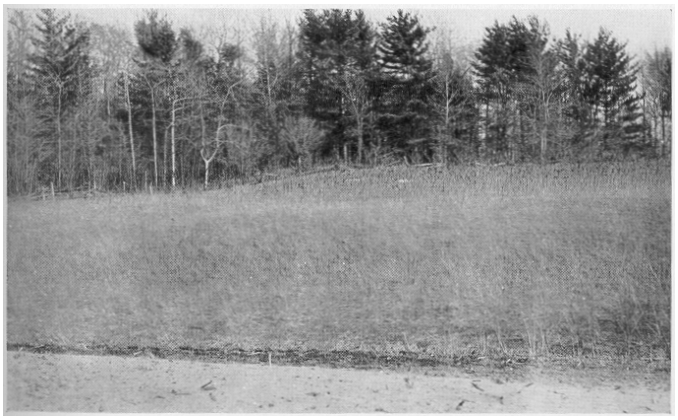


FIG. 1. Knoll forming western end of ridge on which are located a number of Indian storage pits. Section 29, Frankenmuth Township, Saginaw County, Michigan

FIG. 2. One of the storage pits (No. 10 as shown on Map 2)

On rising ground five hundred feet west of these corn pits I collected artifacts and potsherds from a small prehistoric village site, which is really the continuation of a larger one extending to this from the southwest, and designated "Dead Creek Village,"[2] formerly a very good collecting ground. Another interesting feature is a remnant of the old Indian trail on the ridge where the pits are located. In Plate II, Figure 1, at a third of the distance from the left, may be seen a small, forked, light-colored tree against a background of pines. A person who is walking up the river, either with purpose or aimlessly, naturally takes the easiest route, and therefore enters the woods near the forked tree. After traversing a hundred feet, he may realize that he has involuntarily followed the footsteps of the red man and is walking in his ancient path. In winter when the ground is covered with snow, or at a certain time in the spring, traces of this old trail are very perceptible, but with the abundance of summer vegetation is hardly noticeable. It ascends gradually to the crest of the ridge, where it is lost, but if we continue our journey northeastward, we come to a run separating the storage pit ridge from another which terminates ahead of us in a long, pointed “hogback,” with its extremity toward the west. The Indian trail crossed the run and followed up the hogback to higher ground beyond.

I have often traveled over this ground in the last twenty years, and have unconsciously followed the route of the primitive man who came before me, although my interest in the pits usually led me directly to the crest of the ridge. In the springtime a few years ago, while searching for the rare green-flowered trillium for a friend at the University of Michigan, I noted the faint old trail, some five feet below the summit of the ridge on its northerly side, and followed it each way until it was lost on the knoll or at the edge of the cleared field.

My attention was called to these storage pits in 1916 by Mr. Frank Satchell of Frankenmuth Township, who was the trapper and hunter mentioned on a previous page. To him and to Mr. Stroebel, who assisted me in the survey, I owe my thanks for information and help, and to Mr. John Kueffner for permission to enter upon his lands in doing the work.

SAGINAW, MICHIGAN

[1] Dustin, Fred, "Some Ancient Indian Village Sites in Saginaw County, Michigan," *Pap. Mich. Acad. Sci., Arts and Letters*, 12 (1929): 77. 1930.

[2] See article cited in note 1.

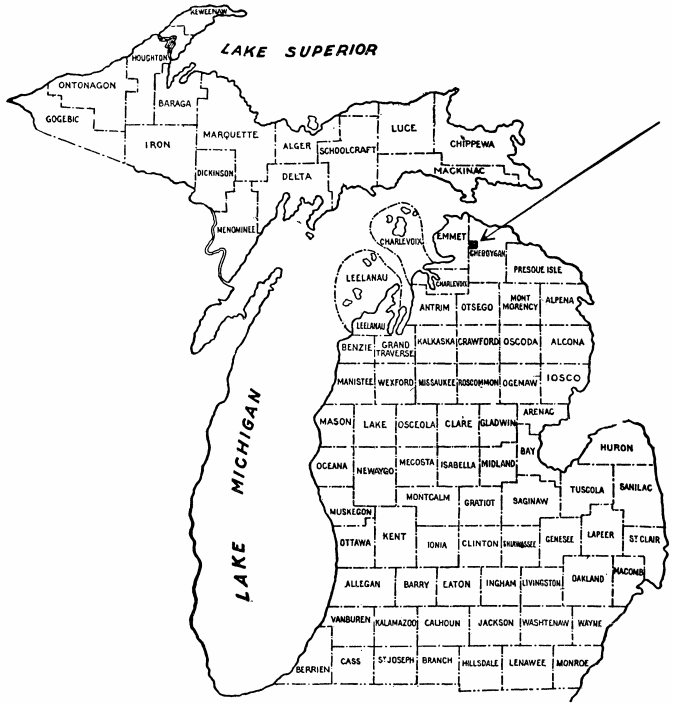
A FOREST SOIL STUDY OF THE UNIVERSITY OF MICHIGAN BIOLOGICAL TRACT

ROY L. DONAHUE

THE University of Michigan Biological Station tract lies in the central-western part of Cheboygan County between Burt and Douglas lakes (see Map 3).[1] Within its 3,910 acres is found a variety of natural conditions that readily lend themselves to a related study of forestry and soils.

The tract is characterized by a predominance of pine land that was logged in 1871-72. Repeated fires have destroyed nearly all remnants of the original stand, leaving large-toothed aspen, red oak, red maple, and pin cherry as the present forest cover.[2] In smaller bodies virgin hardwoods occupied the land to the exclusion of pines. After the logging of the original hardwoods in 1912 the fires that followed were almost as intense and numerous as on the pine land. Less permanent damage by fire was done, however, as is evidenced by the fact that the present cover on the hardwood land is almost identical in composition with that of the original growth, although the productivity may have been somewhat decreased by this burning. Swamp land, which is confined primarily to the area lying just to the north of Burt Lake, supports an abundance of white cedar and black spruce.

Profile features of the well-drained soils show (*a*) coarse organic matter on the surface, then (*b*) a leached (eluviated) gray layer over (*c*) a concentrated (illuviated) horizon, yellow brown to brown, overlying (*d*) parent material, usually of a sandy texture. This succession of layers indicates that the soils of the area belong to the Podzol Soil Region. The swamp soils are, in the main, dark brown to black, well decomposed, neutral to slightly acid in reaction, and underlain with white saturated sand at a depth of from three to five feet. The soil profile of the small ericaceous (muskeg) bogs that from a forestry standpoint are nonproductive exhibits a coarse, permanently wet, yellow peat in which the individual plant residues may be identified even to a depth of several feet.



MAP 3. Sketch map of Michigan showing the location of the University of Michigan Biological Station

The late Dr. J. W. Tourney (5) stated that, though climate is the most important influence in determining the range of a forest species, the character and the condition of the soil are often responsible for the limitation of that species. Also he wrote that the influence of the soils is most apparent in the local distribution of trees. Many attempts have been made to explain the occurrence and the form of vegetation without mention of the soil, and other works have sought to magnify pedology as the key to all life distribution. Probably greater truth may be found by a joint study of forests and soils, not in the sense of cause and effect particularly, but rather in the sense of their reciprocal relationships. Such a combined study has been given impetus recently by Professor J. O. Veatch (6-7) and by Professor R. H. Westveld (9).

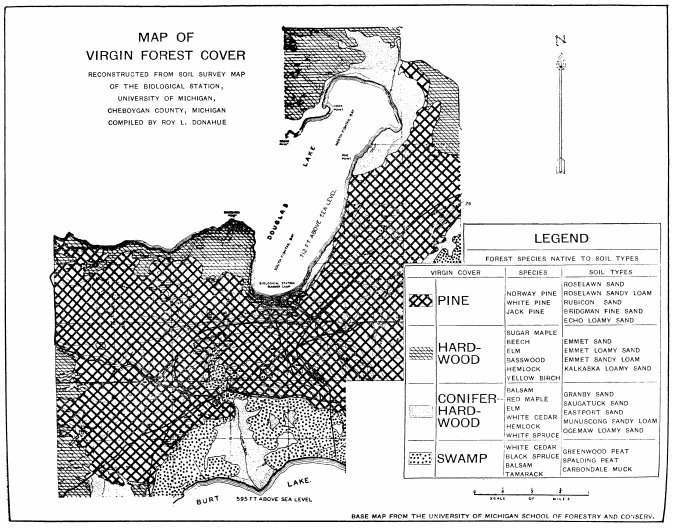
A discussion of the simultaneous occurrence of forests and soils on the Biological Station tract is here attempted, by way of observations on the kind of virgin cover (Map 4), the present greater vegetation, and brief notes on silvicultural practices that are intimately related to the character of the soil.[3]

A warning is sounded by Sampson (4) as to the use of the soil type as a basis for mapping vegetation types: "Biotic competition, rate of succession, habitat range, preoccupation by approximately ecological equivalents, biotic history, topographic and climatic factors may frequently be paramount over the differences in soil characteristics selected by the U. S. Bureau of Soils to delimit soil types." This observation discourages any attempt to correlate forests and soils. But in this study, with the soils mapped on a larger scale (5 inches = 1 mile) and in greater detail than specified by the U. S. Bureau of Chemistry and Soils, a much closer relationship is more likely to exist. Also, in this paper several soil types with closely related characteristics are grouped to facilitate their study. These special treatments bring about a detail in relationship that is not possible with the use of standard soil maps.[4]

For convenience of presentation the soil types are grouped on the basis of their original forest cover, such as: pine land, hardwood land, conifer-hardwood land, and swamp land.[5]

PINE LAND

Sixty-nine per cent of the tract is classified as land that originally supported mainly Norway pine and white pine, with a sparse mixture of red oak, and an occasional hemlock and jack pine. Clear-cutting and severe subsequent fires have combined to prevent the natural regeneration of the valuable pines on all except a few acres on the area.



MAP 4. The virgin forest cover as reconstructed from a detailed soil survey, supplemented with field observations on forest and soil relationships

Lack of uniformity in the present forest cover appears to be directly related to the frequency and intensity of fires, and to slight differences in soil textures. The cover on the loamier pine soils is similar in composition to that found on the more sandy soils, but differs in the more luxuriant and thrifty character of the former, owing to the presence of more silt and clay in the surface as well as to the existence of sandy clay lenses in the substratum (Pl. XL, Fig. 2). Repeated fires have exhausted the fertility of some areas to the point where they now support stunted oak sprouts (sometimes 15 or 20 to the stump), with few or no associated forest species, and seldom any ground cover save reindeer moss (lichen). On such places a high mortality of pine seedlings may be expected. By far the greater part of the pine land is covered with an abundance of large-toothed aspen, red maple, red oak, pin cherry, and an occasional trembling aspen (Pl. XL, Fig. 1). I am told by Professor Gates that, if left undisturbed after a damaging fire, pine land will again be dominated by species of the original stand in about 30 to 35 years, provided, of course, that adequate seed trees are present.

Any silvicultural practice on pine land should take cognizance of the fact that soil moisture is likely to be deficient, so that any treatment that tends to conserve this moisture will bring favorable results. Tree roots concentrate in the B layer (Pl. XL, Fig. 3). Below this layer is sandy material that is usually drier than the layer above, which encourages a fibrous feeder-root system at shallow depths, although in addition pines may develop a taproot.

The abundance of large-toothed aspen naturally calls to the forester's mind a possible utilization of this species for a continuous pulp or excelsior stand. Intensive examinations of the growth of aspens have brought to the foreground the information that the life of large-toothed aspen and trembling aspen on pine land seldom exceeds 35 years, with a maximum diameter of six inches (3). This fact, coupled with the usual inability of aspens to maintain themselves in a closed stand for more than about two generations, indicates that the successful management of an aspen stand is very doubtful.

Except in an experimental way only Norway pine, white pine, or jack pine should be artificially reëstablished on the pine land, if a continuous forest crop is to be expected.

HARDWOOD LAND

Soils grouped to form the pine land represented in Map 4 are, as a rule, yellow to yellow-brown in the B layer (Pl. XL, Fig. 3); those that make up the hardwood land (13 per cent of the tract) are dark brown (Pl. XLI, Fig. 3). An interesting possible explanation of this relationship may be seen in Plate XLI, Figure 2. Here is shown, at a depth of four feet, the substratum of a pine soil containing a limestone fragment that has turned the otherwise yellow sand into a dark umber brown. Thus the parent material of hardwood soils may have had a greater amount of limestone than the parent material of the pine soils.

Quantitative records of the difference in composition between the virgin and the present hardwood forest cover (Pl. XLI, Fig. 1) reveal the following conditions:

TABLE I

THE COMPOSITION OF A TYPICAL MAPLE-BEECH FOREST BEFORE AND AFTER LOGGING (10)

Forest species	Percentage of virgin stand	Percentage of second-growth stand
Sugar maple	35.9	67.3
American beech	21.2	6.8
Hemlock	14.6	2.7
Yellow birch	4.1	0.9
Red maple	3.7	1.7
American elm	2.9	1.5
Basswood	2.1	0.6
White pine	1.5	0.0
White birch	1.4	4.0
White ash	0.8	0.0
Red oak	0.7	0.0

It can readily be seen from the table that sugar maple is the only important forest tree that increases in abundance after the logging of the original stand. According to Professor Gates, this may be due to three things: (*a*) the stumps sprout rapidly after a fire; (*b*) the leaves are distasteful and mildly poisonous to livestock, owing to the presence of an alkaloid known as acerin; (*c*) the seedlings are tolerant and therefore able to establish themselves very readily under a closed canopy.

When the soils that comprise the hardwood land are a sandy loam, with sandy clay at shallow depths (Pl. XLI, Fig. 3), a denser and faster-growing stand of trees is associated. Soils of the sandier group support a less dense stand and tend to be more cemented into a hardpan, especially on ridge-tops or dry benches, where the profile is not kept young by geological erosion. When a continuous hardpan is present, wind throw is more likely to occur, thus making it necessary on such areas either to clear-cut or to use a light selective method of harvesting the timber.

In a conversation with Professor Gates I learned that, when a few seed trees remain, the length of time required for species of the original hardwoods to dominate hardwood land after a fire is about 20 to 25 years.

Artificial regeneration is seldom necessary on this type of land, owing to the rapid sprouting and natural seeding of the native hardwoods. But where valuable forest trees are absent, only the adapted hardwoods should be selected for planting. The establishing of Norway pine, white pine, white spruce, Norway spruce, and white cedar plantations on hardwood land is a questionable silvicultural practice because of the severe competition afforded by the former hardwoods.

CONIFER-HARDWOOD LAND

About 10 per cent of the tract is shown on Map 4 as a mixture of swamp conifers and lowland hardwoods. In virgin stands this land supported a very heterogeneous mixture and dense growth of balsam fir, American elm, white cedar, yellow birch, hemlock, and white spruce in varying proportions, along with red maple, white pine, black spruce, and black ash. Under present conditions the cover (Pl. XLII, Fig. 1) may contain, in addition to any one or all of the original species, a large percentage of white birch and trembling aspen. It is on this type of land that the trembling aspen grows up to 70 feet in height and attains a diameter of more than 13 inches and makes the harvesting of a stand for pulp or excelsior much more profitable than on the pine land where smaller trees are encountered. Even here, though, one or two crops are all that may be expected when fires are excluded.

Professor Gates states that 15 or 20 years after a fire these soils will be covered with a heavy stand of trembling aspen and white birch, with an understory of balsam fir, white spruce, and hemlock gradually dominating.

Soils of the conifer-hardwood land may be conveniently divided into (*a*) those that possess a brown layer, ofttimes cemented (Pl. XLII, Fig. 3), and (*b*) those that have no brown in the profile (Pl. XLII, Fig. 2). A slightly better drainage may exist in the former group, but both types are classed as poorly drained soils.

Because of a high water table or a hardpan in these soils, wind throw tends to be a serious factor in forest management. A wide variety of forest trees may be planted or managed, owing to the intermediate position of the soils in regard to their natural moisture content. On a few areas in the tract white spruce and white cedar have already been planted and have shown very high survival, as opposed to a poor survival on many of the soils of the pine land, where moisture is deficient.

SWAMP LAND

As shown on Map 4, about 8 per cent of the tract is swamp land. With the exception of a few ericaceous bogs throughout the area, the major part of the organic soils support a jungle-like stand of white cedar, black spruce, balsam fir, tamarack, and a small amount of — black ash (Pl. XLII, Fig. 4). Disturbance by man has not destroyed remnants of the virgin timber stand, so that the present growth indicates almost identical composition with that of the former forest.

Alder seeds in rapidly and grows densely on any area where the severe root competition has been decreased through either fire or logging, although, according to Professor Gates, in approximately 10 years the species of the former vegetation will again dominate the site.

Even in closed stands a high wind velocity does serious damage by blowing over these shallow rooted trees. A clear-cutting or a light selection cutting is necessary so as to minimize wind injury.

With only a small amount of expense one can maintain white cedar and black spruce in a productive condition on most of the swamp land because the soil is black, highly decomposed, fertile, and well supplied with moisture.

SUMMARY

1. The University of Michigan Biological Station tract comprises 3,910 acres on Douglas Lake, in central-western Cheboygan County, Michigan.

2. A study of the coexistence of forests and soils is here attempted.

3. The former forest cover may be divided into pines, hardwoods, a mixture of lowland conifers and hardwoods, and swamp conifers.

4. Soils of the area belong to the Podzol Soil Region.

5. After a fire the length of time required for the species of the virgin stand to dominate the cover again is as follows: pine land, 30 to 35 years; hardwood land, 20 to 25 years; conifer-hardwood land, 15 to 20 years; and swamp land, 10 years.

6. A high water table or a hardpan prevents deep root penetration, and thereby induces wind throw.

7. Aspen stand management on pine land is questionable because of the scrubby tree growth, but on conifer-hardwood land shows promise of success, owing to the more rapid growth and the greater ultimate size of the trees.

8. An explanation of the primary difference between a pine soil and a hardwood soil is suggested. This difference may be due to a greater abundance of limestone in the parent material of the hardwood land.

ACKNOWLEDGMENTS

The author is grateful to Dr. Frank C. Gates, professor of botany at Kansas State College, for his suggestions pertaining to the main forest soil problems on the tract; to Dr. C. E. Millar, professor of soils at Michigan State College, for his encouragement of the paper; and to Mr. R. H. Westveld, assistant professor of forestry at Michigan State College, for a critical review of the subject matter contained herein.

MICHIGAN STATE COLLEGE
EAST LANSING, MICHIGAN*

[1] The Biological Station tract is located in Townships 36-37 North, Range 3 West.

[2] See the Appendix for the scientific names of all species mentioned.

[3] For a discussion on the general subject of forests and soils see reference 2; and for a specific study of soil characteristics and forest growth see Westveld (9).

[4] For a description of the soil types encountered see Veatch (8).

[5] This classification scheme corresponds very closely to the system presented by Dr. Frank C. Gates (1), namely, Bog, Picea-Abies, Pine, and Beech-Maple.

* EDITOR'S NOTE — The author's present position is that of Associate Professor of Forest Soils, Mississippi State College, State College, Mississippi.

APPENDIX

COMMON AND SCIENTIFIC NAMES OF SPECIES MENTIONED

(The scientific names of the trees are those of Dr. C. P. Sargent; the names of the other vegetation, those of Dr. Asa Gray.)

Alder, Alnus incana
American beech, Fagus grandifolia
American elm, Ulmus americana
Balsam fir, Abies balsamea
Basswood, Tilia glabra
Black ash, Fraxinus nigra
Black spruce, Picea mariana
Hemlock, Tsuga canadensis
Jack pine, Pinus banksiana
Labrador tea, Ledum groenlandicum
Large-toothed aspen, Populus grandidentata
Leatherleaf, Chamaedaphne calyculata
Norway pine, Pinus resinosa
Norway spruce, Picea abies
Pin cherry, Primus pensylvanica
Red maple, Acer rubrum
Red oak, Quercus borealis
Reindeer moss (lichen), Cladonia sp.
Sphagnum moss, Sphagnum sp.
Sugar maple, Acer saccharum
Tamarack, Larix laricina
Trembling aspen, Populus tremuloides
White ash, Fraxinus americana
White birch, Betula papyrifera
White cedar, Thuja occidentalis
White pine, Pinus strobus
White spruce, Picea glauca
Yellow birch, Betula lutea

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PLATE XL

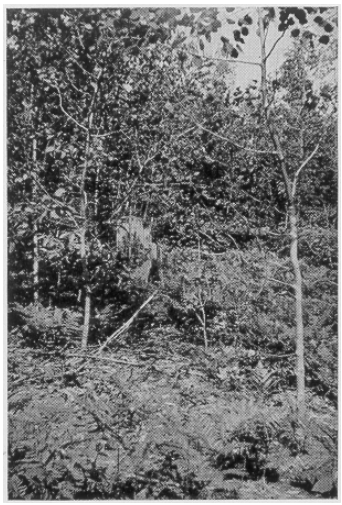


FIG. 1. Present forest cover on pine land which consists of large-toothed aspen, red maple, red oak, and pin cherry. A remnant pine stump is seen in the center background

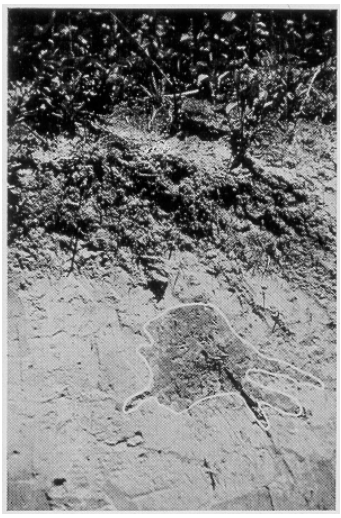


FIG. 2. A sandy clay lens in the substratum of a loamy pine soil, making for greater fertility

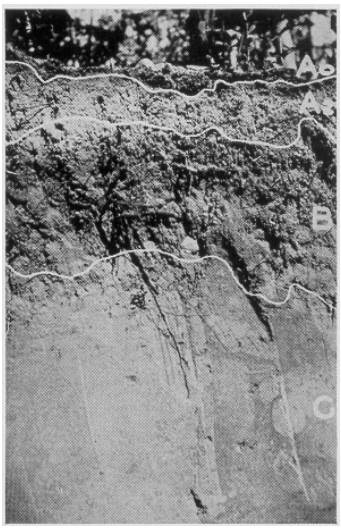


FIG. 3. Profile of a pine soil showing a concentration of roots in the B layer at a depth of 8 to 20 inches below the surface

PLATE XLI

FIG. 1. Present hardwood cover with numerous remnants of the original stand. Sugar maple, American beech, yellow birch, red maple, American elm, and basswood dominate the forest vegetation

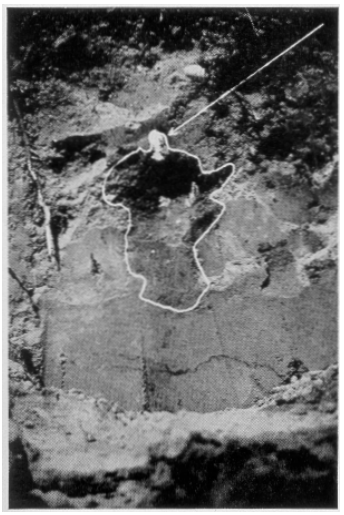


FIG. 2. Yellow substratum of a pine soil showing a darkened area around a limestone fragment. When this dark color exists as a continuous layer, hardwoods are usually associated

FIG. 3. Profile of a sandy loam hardwood soil with the natural soil horizon existing at variable depths. Note the dark B layer in which roots are concentrated

PLATE XLII

FIG. 1. Typical present cover on conifer-hardwood land consisting of trembling aspen, balsam fir, white birch, hemlock, and red maple

FIG. 2. Soil profile of conifer-hardwood land in which no distinct brown cemented layer is present. Note the 6-12-inch accumulation of organic matter

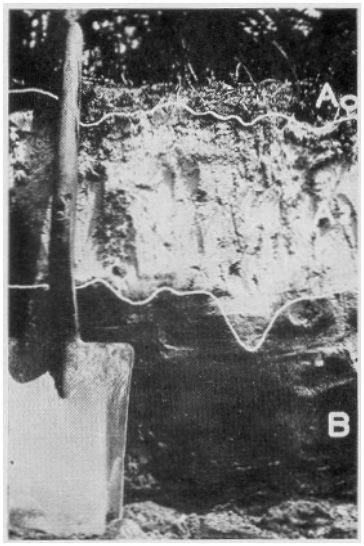


FIG. 3. A conifer-hardwood soil profile characterizing that group of soils having a brown cemented hardpan. Note the thick white A_2 layer

FIG. 4. A dense stand of white cedar, black spruce, balsam fir, and tamarack as the dominant forest cover on swamp land

THE HIGH PLAINS OF MICHIGAN

CHARLES M. DAVIS

I. INTRODUCTION

THE High Plains of the northern part of the Southern Peninsula of Michigan are formed by a skeleton of moraines filled with sandy outwashes. The moraines not only bound this area but also traverse its surface in a complicated yet quite orderly network of hills. Clay till plains of varying magnitude cling to the bases of these hills and extend out into the seas of sandy outwash which fill the interstices.

The surface features of this upland result from glacial deposition and, as yet, are little altered by erosion. The porous sandy soils absorb the rainfall, so that the few streams have little power. The pattern of the drainage is coarse in texture; streams are far apart and the interfluves are broad and dry. Lakes occupy some of the depressions and swamps border the streams. Over most of the surface the drainage through the soil is excessively rapid, but in some places it is so slow that broad expanses of swamp form the landscape.

Most of this surface is covered by forests of several associations, from the deep shade of beech and maple and the sunny thickets of oak and poplar to the open plains of jack pine and sedge. All these forests bear the scars of cutting and burning.

The present occupance of the area is concentrated on the heavier soils of the more loamy hills and the till plains or around the lakes. Here the houses, fields, and barns of continuous agriculture mark the landscape. Yet even here the land retains the aspect of a frontier; houses and barns made of logs, pastures and fields uncleared of stumps, and the forest sharply bordering on the cultivated land — these things and many others indicate that the occupance is not complete.

The landscapes which make up the High Plains are not static. Twenty thousand years ago, perhaps, they lay beneath the ice of the continental glacier. As the postglacial climates changed over the area the landscapes were altered accordingly. Then came man with the tools of his culture, which radically altered the aspect of the area. Everywhere in the High Plains one can see the marks of relict landscapes; forests of poplar and oak are thickset with stumps of pines, fields once cleared are now abandoned, mills have saws which are no longer turning, towns decay, and villages have disappeared. A new order has superseded the old; the rotting stumps are hidden by new forests, the cottage has replaced the lumber camp, the fisherman wades the streams where once the lumberjack drove his logs, and the motorcar crosses the sandy plains in the tracks made by the high-wheeled logging carts.

What we see in the High Plains today is but a phase in a process which changes visibly from decade to decade. In three quarters of a century, within the memory of men still alive, or the time in which a pine might have grown from a seedling to a tree, the hills and plains have endured many changes. They have been stripped of their timber, have been burned and reburned, have been settled, cultivated, and abandoned. Nature in her patient way has covered up the wreckage of each change and continues building the forests upon the pattern of the soil.

The position of the High Plains area on the patterns of the world distribution of geographic facts undoubtedly underlies the nature of its geography, but these larger patterns do not orient its internal differentiation.

On a world scale the High Plains lie close to the equatorward margin of the well-watered lands of severe winters. This equatorward position somewhat modifies the long cold winters and the short cool summers and permits the area to be reached at intervals in the winter by warm air masses of tropical origin which break up the unrelenting coldness of the lands farther north. The variations of temperature and rainfall within the area form a regional climatic pattern which apparently has little correlation in the landscape pattern; either the climatic differences are not critical or they are overshadowed by edaphic variations which are not climatically induced. Although the area lies entirely within the climatic limits of the deciduous forests, the edaphic conditions do not everywhere permit the growth of this kind of forest. The differentiation between deciduous and coniferous forests seems to be a function of varying texture and moisture content of the soils, which, themselves, in spite of their great diversity, are as a group transitional between the brown-forested soils of the central eastern United States and the podsols of the north.

The relation of the High Plains area to the world distribution of cultural forms is that of a rather sparsely populated region on the poleward margin of one of the central areas of Occidental culture. Its present occupance is the relict of a general withdrawal of population following the collapse of a settlement induced by exploitive lumbering. The agriculture by which this population survives is, in general, an unprosperous and declining portion of the Hay and Forage Region of northeastern United States and southeastern Canada.

These facts of distribution on a geographic scale[1] set broad limits to the nature of things in the High Plains. Within these limits, however, the internal differentiation of the area is oriented by the lineaments of a subordinate or a chorographic pattern the details of which obscure any effects of the larger or geographic pattern.

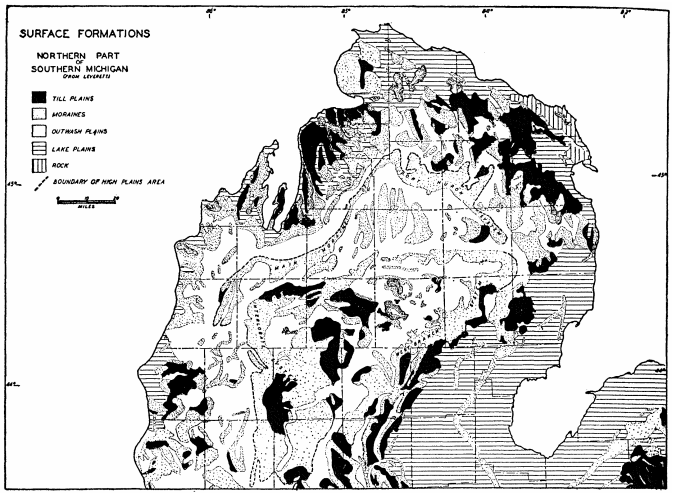
The principal natural landscape-forming elements, surface, drainage, and soil, and the resultant landscapes within the High Plains are arranged upon the lines of this chorographic pattern, the lineaments of which form the master lines of landscape distribution within the area. The form of this pattern is the shape taken by the glacial front at various stages in its melting and is preserved by

the surface features and soil materials laid down by the ice in its retreat. Upon this pattern are oriented the landscapes which collectively express the geographic aspect of the area. Where these are characterized by forests the lines of the fundamental pattern are clear, but where cultural forms are dominant the pattern is vague and obscured by an early stage of occupance not yet adjusted to its differences.

II. THE BASES OF THE LANDSCAPES

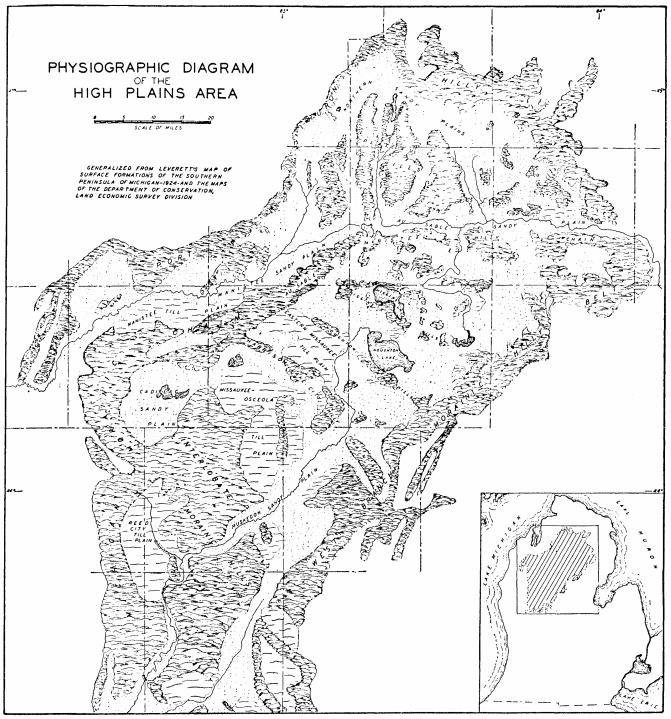
THE SURFACE PATTERN

The surface quality of the High Plains results from the interspersion of moraines, till plains, and outwashes in a pattern left by the retreating ice of the Wisconsin glaciation deeply underlain by previous sandy drift (Map 8). The depth of this underlying drift has been attributed to the interlobate accumulations of previous glaciations,[2] which the Wisconsin glaciation added to and reworked. The present distribution of surface forms may be explained by the way in which the lobes of the glacier moved across this upland of earlier deposition. From the ice basins, which are the present beds of the Great Lakes, the lobes moved inland, overrode the older drift and converged; the western ice, or the Michigan lobe, meeting the eastern ice, or the Saginaw lobe, and then moving on southward. At the time of the glacial melting these lobes separated over the High Plains area, forming first the rugged knob-and-basin stretch of the Interlobate moraine (Map 9) and then at the edges of the area the bordering moraines, the Michigan moraine[3] on the west, and the West Branch system on the east.



MAP 8

The gap between the Michigan and the Saginaw lobes was spanned by thinner ice, which melted rapidly, forming a recess toward the northeast. The progress of this retreat is marked by four chains of moraines which connect the Michigan with the West Branch system; between some of them lie broad till plains. The northeastern extent of this melting recess is marked by four large plateau-like morainic masses close to the northern corner of the High Plains area.



MAP 9

Continued melting removed the ice from the High Plains, but it made one more readvance, which carried the lobes as far as, but not into, the area. For a long time the melting edge of the glacier lay upon the sides of the upland and built up the Port Huron moraine, which forms the northwestern and northeastern boundary of the High Plains area from the Manistee River to the Au Sable.

Within this skeleton of moraines lie four principal and several smaller till plains, but most of the area is covered with sandy outwash laid down by the waters of the glacial melting. In some places these outwashes are wet and waterlogged, but ordinarily they are deep and dry. The depth and the porosity of the underlying material are strong factors in accounting for the aridity of most of the soils upon the plains.

The pattern made by the moraines, till plains, and outwashes in the High Plains area (Map 8) is the skeleton of the master lines upon which both the past and present landscapes have been distributed.

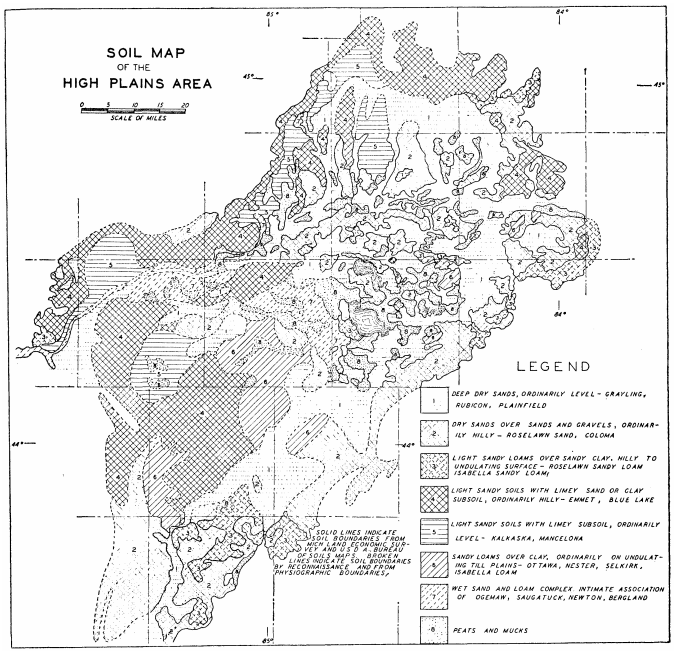
THE DRAINAGE PATTERN

The water from the glacial melting was carried away from the upland and to the lakes at the time of the glacial retreat. The courses of the glacial rivers were determined by the ice lobes, which were at the same time laying down the surface features. The present rivers flow in the old glacial channels as distinctly underfit streams, and the pattern which they make is one inherited from the glacial front. They appear to bend their courses around moraines (Map 9), but the cause-and-effect relationship cannot be inferred, since both are the simultaneous product of the same agent. They should not, therefore, be classed as simple consequent

streams, but as consequences of ice forms which no longer exist.

The knob-and-basin surface of the moraines, particularly on the western side of the High Plains, is dotted with numerous small lakes in all stages of the process of being filled in by vegetation (Pl. XLV, Fig. 4). The outwash areas are similarly pitted, but most of these pits are dry. In a few places large lakes, such as Higgins, Houghton, and Missaukee, have resulted from depressions on till plains or pits formed by large ice blocks left buried by the glacial retreat.

The patterns made by the lakes and streams are oriented upon the master lines traced by the surface. The streams and landforms are simultaneous phenomena of the same agent, and the lakes are subsequent features on the same pattern. The association of the poorly drained areas, of which swamps are the characteristic landscape expression, with the lines of the master pattern, is equally clear but somewhat more complicated.



MAP 10

The glacial ice in its retreat built the moraines and till plains, but the waters from its melting laid down the outwash. Consequently, the outwash may veneer heavier deposits with a thin mantle of sand, which causes slow drainage and a high water table. In the recess between the Michigan and the Saginaw lobes, the melting ice deposited heavier material in the form of till plains. Close to the high Interlobate moraine these have remained uncovered as the principal till plains in the area, but to the northeast this heavier material has been covered with a thin layer of outwashed sand, forming the great swampy district around Houghton and Higgins lakes.

THE SOIL PATTERN

The texture of the material which was deposited as a moraine, a till plain, or an outwash is generally characteristic of the particular landform. For this reason the pattern of the soils which result from the weathering of this material shows a general correspondence with the pattern of the surface (Map 10). Where this weathering took place under conditions of normal drainage, it has resulted in sandy soils of podsolic nature.[4] Where the drainage is slow the soil development proceeds in a manner different from that upon the well-drained material; vegetation is the chief instrument in building and the resultant soils are the organic group, peats and mucks (Map 10, No. 8). Intermediate between these two groups is another, which is formed by an intimate association of wet sands and loams found on somewhat poorly drained till plains and along streams (Map 10, No. 7).

The material deposited in the various classes of glacial landforms had characteristic texture. The heavier clayey and somewhat stony material of the till plains weathered into heavy sandy loams (Map 10, No. 6); the heterogeneous material of the moraines into light sandy loams and loamy sands (Map 10, Nos. 2-4); and the outwashes into light loamy sands and sands (Map 10, Nos. 1, 5). In addition to the texture differences, there seem to have been considerable differences in the composition of the material deposited in the western part of the area by the Michigan lobe and that deposited in the eastern part of the area by the Saginaw lobe. The former contained more limestone[5] and clay, which produced in weathering a cementation which has given these soils a somewhat higher moisture content than the similar soils from the material deposited by the Saginaw lobe. This difference in acidity and moisture content between the morainic soils of the western moraines (Map 10, No. 4) and the eastern morainic soils (Map 10, Nos. 2-3), and corresponding differences between the western and the eastern outwash soils (Map 10, Nos. 5 and 1, respectively) is not great, but apparently is ecologically critical, for the western soils bore broadleaf or mixed forests, while the eastern bore coniferous forests. In the present landscape quality of the High Plains area this difference is even more striking, for the western soils have been taken up as the agricultural districts, while the eastern soils have fallen into wild land and public ownership.

On the geographic scale[6] climatic forces are the primary agents in soil formation, but the diversity and the intimate association of the soils of the High Plains must be attributed to their recent origin from different kinds of glacial deposits. Although the soils of the western and the eastern parts of the area are different because of the lithologic differences of the materials brought in by the two lobes of the glacier, still the pattern of distribution of the soils in all parts of the High Plains area correlates strongly with the pattern of the surface features. Thus upon the chorographic mould is drawn the third of the master lines of the landscape-forming elements.

THE DEVELOPMENT OF THE ORIGINAL FOREST COVER

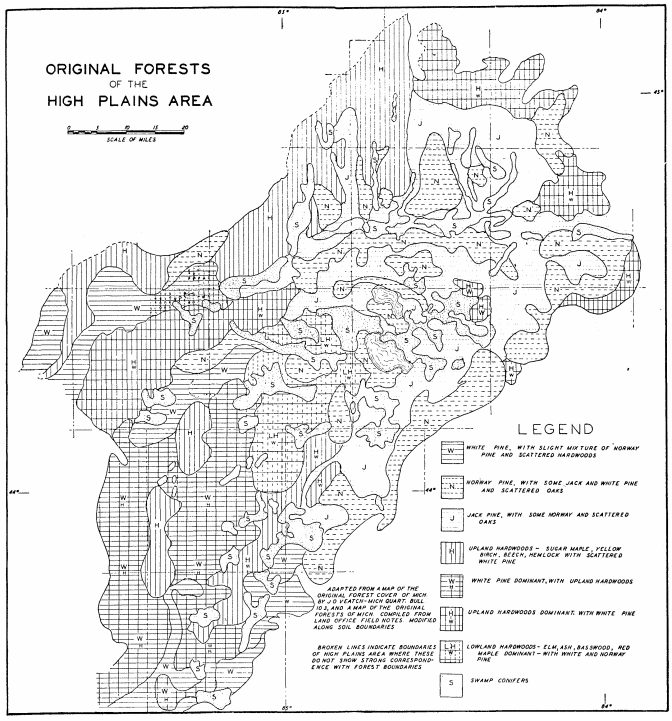
The history of the cover in the High Plains has been one of constant change. From the sterile sand laid down by the glacier ten or twenty thousand years ago there developed a succession of forests ending in that which the lumbermen cut away, and since then the hills and the plains have been more or less mantled with trees.

Vegetation is seldom in a static condition. Even without the interference of man a forest passes through a series of stages, each of which prepares the way for its successor, until the progression reaches the type most favorably suited to the climate. If the nature of the soil is such that the climatic climax cannot be supported, the succession cannot go on to its ultimate. Thus, in an area of diverse soils, several individual associations might be found, each of which represents an arrested step toward the climatic climax.

Upon the master lines of the surface, drainage, and soil the development of the forest cover proceeded, conditioned by three factors: normal forest succession, climatic change, and soil differences. Whitford,[7] without recognizing climatic change, traces the history of the forests of northern Michigan from the heath stage following glaciation through the spruce and the pine, and eventually to the broadleaf climax. Each association was succeeded by another after it had added humus and thus changed the condition of the soil. The study of fossil pollen in peat bogs has produced convincing evidence of postglacial climatic change. Sears,[8] in summarizing the results of American and European investigators, has postulated a series of five definite postglacial climates. The period immediately preceding the present is postulated as a warmer drier stage, which gave way to the cooler and more moist conditions of the present.

Whatever may have been the nature of the previous cover, the warm dry period, postulated above, must have induced a vegetation radically different from that which has existed in recent times. Most of the soils of the High Plains are droughty, and the small amount of moisture available to plants is one of the chief factors in limiting forest growth. Any considerable decrease in moisture from that which exists at present might prevent forest growth over much of the area and limit the heavier soils to the production of the more xeric trees. With the advent of cooler and more moist conditions, accompanied by increase in soil moisture, the forest succession toward the climatic climax began, from jack pine, through Norway pine and white pine, to the climax of the broadleaf associations. At the time of lumbering the forests of the High Plains represented all stages and mixtures of stages of such a progression which had been stopped or slowed down by the varying aridity of the soils (Map 11). The pattern of this original forest is oriented along the master lines of surface, drainage, and soil.

The drier eastern parts of the High Plains area were originally covered with pines. On the deep, dry sands of the outwash plains the forest succession had not progressed beyond the stage of an open stand of jack pines with a lighter or a heavier admixture of Norway pines and a few white pines indicating the direction of change. On the somewhat heavier soils of the morainic hills the forest succession had gone one step farther. Here the Norway pine was the dominant species, accompanied by a heavy mixture of white pines and a scattering of oaks. On a few of the more moist outwashes, particularly in plains along the Manistee and the Muskegon rivers, the white pines occurred as an almost pure stand.



MAP 11

In the western parts of the area the succession had gone forward to the stage of dominance of, or a heavy mixture of, the broadleaf trees. The genetic differences between the eastern and the western soils (see p. 310) were critical between the pines and the broadleaf trees at that stage in the succession. On the Interlobate and the southern part of the Michigan moraines the white pine was still the dominant tree, but the maple, birch, and beech were present as a heavy subdominant association. Here, apparently, the succession was somewhat slower than in the northwest, and the broadleaf trees had not yet supplanted the pines. Farther north, on the northward extension of the Michigan moraine (Map 11), the broadleaf trees had become the dominant association and the pines the subdominant. Still farther north, on the western limb of the Port Huron moraine and some of its outwashes, the broadleaf climax had been closely approached, since only relict white pines indicated the course of succession.

On the heavier soils of the till plains the succession had gone on to the broadleaf stage in all parts of the area, but in these situations there was a differentiation between the well-drained and the poorly drained till plains. Where the sag-and-swell surface was well developed and the drainage rapid, the forest cover was dominantly maple, birch, and beech, with a greater or a lesser admixture of white pine. In areas of flatter surface and heavier soils and slower drainage the broadleaf trees were represented by the lowland association, elm, ash, basswood, and red maple, mixed in varying degrees with white pine and Norway pine.

The succession of forest associations on the upland soils had apparently not been matched by a similar succession on the peats and mucks. The most common association on the organic soils is the cedar-spruce-tamarack forest, with the general association of the balsam (Pl. XLV, Fig. 4). It would appear that this is the most persistent of all the types in the High Plains through the vicissitudes of time and climatic change. Forest differentiation in the High Plains area, both areally and through time, is closely related to available moisture in the soils, and in this factor the waterlogged areas seem to have been fairly constant.

The distribution of the original forest cover of the High Plains area in such detail as it can now be reproduced oriented itself upon the pattern of the master lines drawn by the surface, drainage, and soils. In the eastern part the more porous soils formed from the material deposited by the Saginaw lobe were almost entirely covered with pine forests; the dry outwash sands, with jack pine; the more moist outwashes, with white pine; the sandy moraines, with Norway pine; and the till plains, with a mixed forest dominated by the broad-leaf trees. In the western part the more retentive soils resulting from the deposition of the Michigan lobe were almost everywhere covered with broadleaf trees or mixtures in which the broadleafs were dominant or becoming dominant. The swamp association was found everywhere throughout the area on the poorly drained soils.

SEQUENT OCCUPANCE

Into this slowly changing fundament of the High Plains came man; at first, primitive man, whose culture included only few and simple techniques for utilizing the resources of the land; and later, men of more advanced culture, with tools which changed the superficial aspect of the forest cover, but not the master lines upon which the distributions of phenomena are oriented.

It is not known with any degree of certainty at which point in its development this area came to be inhabited by the Indians. Except along a few of the larger lakes and rivers the Indians did not live in the pine woods of the eastern part of the High Plains.[9] The broadleaf forests of the western part of the area were more attractive, but even here the population was scanty in comparison with that along the shore of Lake Michigan and in the Saginaw Valley. For some thousand years or more the Indian lived in the forests of Michigan, but he made no significant changes in the fundamental landscapes and left no traces of his occupance in the present landscapes. His canoe routes, perhaps, marked the way for the communications of the fur traders, but, in the High Plains at least, there are today few landscape features which can be ascribed to the Indians.

In the seventeenth century the French voyageurs and the Jesuits joined the territory which is now Michigan with the great fur-trading empire which focused on Montreal. These first communications which connected northern Michigan with the rest of the world were largely by canoe and did not extend far inland. The French were interested in fur-bearing animals and Indian souls, and since there were few of either in the area of the High Plains, it remained unoccupied. The British had pushed into southern Michigan from New York and were in competition with the French for the fur trade when the territory became theirs as a result of the French and Indian War. The period of the British control was so short (1752-87) that it added little to the French settlements. It was not until the American settlers began to pour into southern Michigan that the forests were cleared and agriculture took over the land and permanent settlement approached the southern limits of the High Plains area.

The occupance of the High Plains by the lumbermen began with the advent of the "land-lookers," who, in the 1850's, were prospecting in the area for timberlands. The Land Office had surveyed the country and marked out the township and section lines; the land, including its timber, was on sale at $1.25 per acre.

There were two phases to the lumbering operations m the High Plains In the first of these, river logging, the timber was floated down the streams to the mills. The area which could be tapped by this type of operations was limited to that within easy reach of the main rivers and their principal tributaries. While river logging made roads and trails along the streams, there were not many permanent settlements in the cutting areas, and the mills were located downstream, usually close to the lakes. In the second or railroad, phase, which quickly followed river lumbering, the railroads replaced the streams as the main carriers, and, since logging branches could be built almost anywhere, this effectively cleaned up the rest of the timber (Pl. XLIII, Fig. 1). The mills were located along the main railroads close to the cutting areas, thus bringing settlements and, in many circumstances, the beginnings of agriculture into the forest lands.

The distribution of the occupance of the lumbermen was oriented along the three railroad lines which had made their way through the High Plains area in the early 70's. Every few miles as these railroads pushed toward Mackinaw, mills were set up to exploit the timber. Each of these was a nucleus for settlement; around some of them the cutover land was taken up for garden or crop agriculture. Most of these little settlements perished with

the passing of the lumbering, but some survived as the foci of the communications of the hopeful settlers who took over the land after lumbering.

It is not practicable here to describe the rapid rise and the equally rapid decline of the lumbering industry in the area of the High Plains. The operators bought the land, constructed their transportation, cut off the timber, and got out. The lumbering was done in the spirit of the expansion of the frontier. Whether or not it might have been done in some other manner to yield greater social and economic benefits is a matter of question. As a fact accomplished, it was the turning point in the development of the landscapes and the source to which may be traced many of their present characteristics.

THE FACTORS WHICH CONDITIONED THE LANDSCAPES AFTER LUMBERING

The lumbering operations had radically altered the superficial aspect of the original landscapes in the High Plains area. A new cover was to develop upon the master lines of distribution, conditioned not only by the character of the soil and the drainage, but also by new circumstances which remained from the occupance of the lumbermen. These new circumstances are loosely grouped under five heads: fires and their consequences, the development of the present forests, the beginnings of the system of communications, the economic consequences of lumbering, and the origin of the settlement. These, working collectively and often simultaneously on the old fundament, made the modern landscapes.

FIRES AND THEIR CONSEQUENCES

The conditions which were left behind by the lumbermen greatly increased the chances for fire on the land. The slash from the cutting operations was scattered on the ground, and after a year this became dry and made excellent fuel for a ground fire. It was expected that the debris from the lumbering would be burned when the country was taken up for farming; in fact, the trees were often felled so that the slash would make windrows to facilitate burning. The numerous men in the woods, logging railroads, mills, and settlers increased the agencies which might start fires. There was, furthermore, no equipment to combat fires in the woods; indeed, there was no desire to stop a fire which was "burning off the brush" unless it threatened standing timber or camps. The idea that the fires were burning out some of the humus in the soil or ruining the game cover was not yet widely recognized.

After the cessation of the lumbering operations and the collapse of most of the settlements which these had attracted, the pine-lands became almost deserted. The fire season began in the middle of the summer and lasted until the fall rains dampened the cover. The pungent odor of burning wood and the sight of reddened sunsets through smoky air were the everyday experiences of those who traveled through the wild lands. There was no organization to do anything about it. When fires approached settlements they were fought by backfires and plowing, while the clergy assisted with prayers for rain. Away from the towns, where new forests were growing to replace those cut away, the fires burned fiercely year after year, "clearing off the brush" (Pl. XLIII, Fig. 2).

The changes in the character of the cover which developed after lumbering must be attributed more to the fires than to the cutting. The lumbermen nowhere cut the land clear of timber; there were always young and "cripple" trees left, and these might have reproduced the forests except for the fires. Repeated burnings effectively destroyed the seed trees of certain species and introduced a new factor into the forest succession, for some trees survive fire better than others.

THE DEVELOPMENT OF THE PRESENT FORESTS

The first stage of the development of the forests in the High Plains area opened with the retreat of the glacier and had proceeded toward the development and distribution of climax and subclimax types roughly corresponding with the pattern of the soils. The progress of this phase was interrupted and terminated by lumbering and fires, and the stage was set for a new cycle under conditions somewhat different from the first.

On the dry sandy plains, which had formerly been covered with an open forest of jack pines and Norway pines, with a few white pines present, the jack pines alone returned in abundance and formed a heavy clumpy cover (Pl. XLV, Fig. 2). The jack pines are natural "fireweeds." The cones which enclose the seeds are tight resinous jackets, which neither rot nor open easily, but when a fire burns over these buried cones they pop open and the seeds sprout. The dominance of the jack pines on the plains today lies, perhaps, in this ability to withstand burnings and in the reduction of the Norway pines by fire until they were incapable of reseeding the plains in competition.

The dry, gravelly, sandy, morainic hills of the eastern part of the High Plains, which originally bore the forests dominated by Norway pines, are now covered by the oak association. The oaks also owe their prominence to fires. In the original forests of these hills the oaks were present, but were distinctly subdominant trees, which might be considered the forerunners of the broadleaf association. The fire-resisting qualities of the oaks result from their ability to sprout from undamaged roots after the rest of the tree has been killed by fire. Repeated burnings reduce the oaks to clumpy brush, but serve to kill out other trees and to emphasize the dominance of the oaks (Pl. XLV, Fig. 1).

On the soils which were somewhat more moist than those bearing the jack pines and the oaks and where agriculture did not immediately take up the land, the poplar-birch association, which had hitherto existed as a minor type, came swiftly into prominence and covered great areas of land. The widespread distribution of this

association may be accounted for by a combination of facts: the ease with which the seeds are spread by the wind, the rapidity of growth, and the wide range of tolerance of soils. The poplar-birch association also includes in some places the subdominant attachment of the fire cherry and the red maple, and the poplars themselves are found in almost all the other associations in the High Plains area. In spite of its wide areal distribution the poplar-birch is an ephemeral type. It rapidly occupies burned areas and develops a heavy forest growth, but, unless repeated fires occur, pines, oaks, or other trees force it out.

In the eastern part of the High Plains, the old pinelands, new cover associations, jack pine, oak, and poplar-birch have taken over the land. Although somewhat complicated by the ubiquity of the poplar-birch, the distribution of these new types (Map 12) follows closely the master lines of the surface, drainage, and soils which conditioned the distribution of the original forest types.

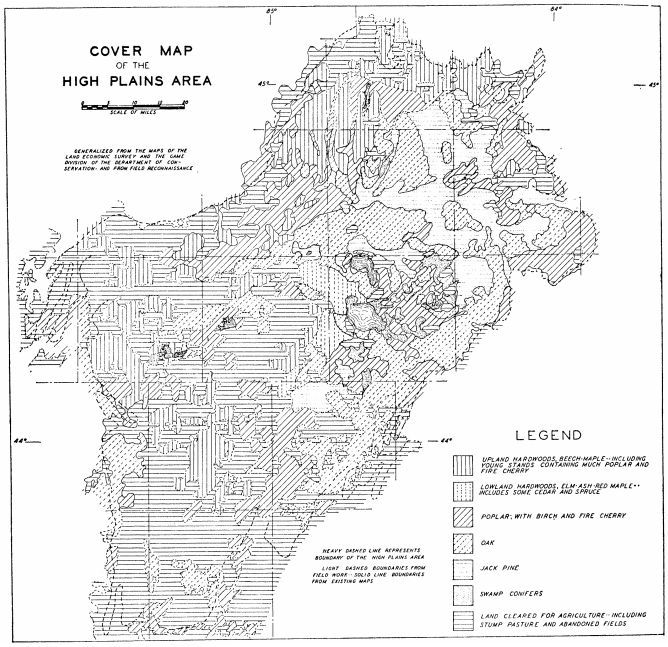
The cutting and burning which so radically altered the character of the forests in the eastern part of the High Plains did not so strongly change the western part. There the soils which bore the forests of mixed pines and broadleaf trees were appreciably more fertile, and the agriculture which followed in after the lumbering spread and took over much of the land. Those areas which were not so occupied have been slowly reproducing the original broadleaf cover, but without the relict pines. Where the land has not been heavily burned the seed trees of the maple, birch, and beech on the uplands and the elm, ash, and red maple on the lowlands are struggling to dominance against the quick-growing poplars (Pl. XLV, Fig. 3). On land which has been heavily burned, or where the soil is so poor as to make the growth of the broadleaf trees slow, the poplar has dominated the forest.

The pattern of the distribution of the new forests in the western part of the area is not nearly so clear as it is in the eastern part. The occupance is of an early stage, and is not yet adjusted to the lines of the soil pattern, and the soil-tolerant poplars further obscure the master lines of distribution.

The swamp forests were less affected than any others by the lumbering operations. The white cedar was the only tree for which there was much commercial demand. Where the swamps were heavily cut over and then burned, the land grew up in places into dense thickets of poplar, alder, and willow. In most of them, however, the landscape quality of the forest remained the same both before and after the lumbering period.

THE BEGINNINGS OF THE SYSTEM OF COMMUNICATION

Previous to the time of the lumbering the High Plains was an area almost isolated from the rest of the United States. The main lines of the railroads, which were built in part at least to facilitate the lumbering, provided these connections. The railroads and their many logging branches and the fine network of the lumbering roads and trails were primarily constructed for the purpose of getting the logs to the mills and the finished products to the market. The system was not laid out with the idea of its future utility to settlers who might take over the land. In spite of its origin the system of lumbering communications served the needs of the first settlers and still provides the cultural circulation through the unsettled parts of the area.



MAP 12

The lumbering roads enabled the settlers to get into the country and provided communications for a short while, but they were not very well suited to the circulation of an agricultural district. Where settlement endured they were replaced by a right-angled road pattern. Those parts of the original lumbering communications which still persist in the landscapes of the High Plains are relicts of an occupance which has passed. They are preserved because no other features have supplanted them or because they have become functional in the communications of the new occupance. The lumbering roads do not underlie the pattern of the present circulation, but they served the purpose until another way could be set up.

THE ECONOMIC CONSEQUENCES OF LUMBERING

The lumbermen regarded the pinelands as part of their stock in trade. They had purchased the land for a fraction of the stumpage value and, when the timber was gone, the land was a by-product to be disposed of at a profit, if possible, or discarded if necessary. Neither public nor private consciousness believed that the lumber industry owed anything to society for the harvest which it had reaped without sowing. The business of the lumberman was timber, not land, but the land remained. It was supposed, generally, that agriculture would follow

after lumbering and that a period of adjustment and tax delinquency in between was inevitable.

In the western parts of the High Plains this anticipation was realized, but in the east the scattered agricultural settlements collapsed with the withdrawal of the lumbering industry. In a few places this was bolstered up by land booms which served only to delay the process. Directly or indirectly, the land became tax-delinquent and was "bid to the state" at tax sales. By 1934 the state found itself in the landholding business to the extent of about three million acres, and had arrived at the conclusion that most of this land was unsuited to agricultural settlement. Wherever it was practicable, this land has been "blocked out" into state and national forests, state parks, game refuges, and public hunting grounds. The most important landscape quality which has resulted from this change to public ownership has been fire protection and reforestation, which has hastened the development of the new cover.[10]

There are still large areas of the cutover lands which are in private ownership. Some of this is in hunting and fishing clubs; some is used for other purposes, but much is held for speculation. A great share of the land in the second class seems destined for public ownership. In time, under protection, the wild lands will become forest lands, and the sandy soils will bear another crop of timber. In what manner this crop will be harvested may depend upon how time has changed public and official consciousness since the earlier harvest.

THE ORIGIN OF THE SETTLEMENT

The lumber industry moved into the High Plains without any preexisting structure of occupance on the land. The camps were far from the sources of supplies, and food for the men and forage for the animals were costly. Local produce found a ready market and a high price.

There were among the lumberjacks many who had been farm boys, who knew how to cultivate and who knew the difference between the light dry sands and the heavier soils. It is probable that the better spots of soil were taken up first, but proximity to the scene of lumbering operations and to railroads must have been of equal importance in guiding the choice of land for homesteading.

Where the soil was favorable to the crops which were planted, especially in the southwestern parts of the area, the settlements spread from these nuclei as the land was cleared by logging (Pl. XLIII, Fig. 3). Pioneer farmers came in over the railroads until most of this southwestern area is now occupied by agriculture and forms one of the landscape types which make up the present expression of the High Plains (Pl. XLIV, Fig. 1).

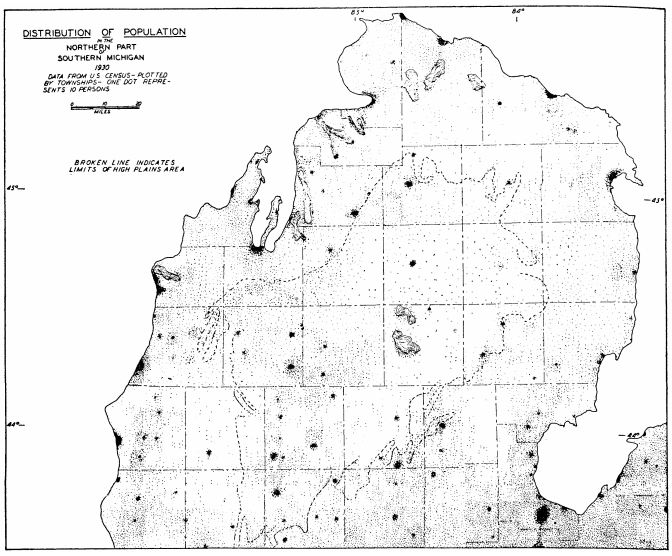
In the eastern parts of the area most of these "seeds of settlement" fell upon poorer soils and when the lumber camps with their high prices and ready markets moved away these settlements collapsed. There was a "wholesale abandonment of farms" in the pine country. In spite of "various intensive real-estate selling schemes" the land was not taken up, and it slowly reverted into wild land and into tax delinquency.

Wherever a mill was established along the railroads a nucleus of people grew up around it. From these agglomerations of the lumber industry can be traced the origins of almost all the towns in the High Plains. It was inevitable, perhaps, that most of these would disappear, since they were located with reference to available pine timber and to milling operations. The degree to which they have prospered and remained in the present landscapes of the High Plains probably is due to other, and then unforeseen, advantages of situation and to the concentration of supply function which they developed in the period of their existence as lumber towns. All of them have experienced a more or less rapid decline in population since the decade after the peak of lumber operations.

Many of these sawmill towns have been wrecked or burned and have vanished completely from the landscape. A great number exist as a few houses around a railroad station or a collection of weather-beaten shacks clustered around the foundations of a wrecked mill and surrounded by abandoned and unproductive fields. Even those towns and cities which grew to the greatest size and were the latest to decline ate definitely falling from their peak populations.

III. THE PEOPLE AND THEIR COMMUNICATIONS

Even in its most favorable locations the density of the population on the High Plains does not equal that of the agricultural lands of southern Michigan. The most peculiar aspect of the distribution of this population is the variations in the patterns which it forms. Spots which lack habitations are embedded in areas of relatively dense population, and there are wide expanses which are almost uninhabited.



MAP 13

THE POPULATION PATTERN

The pattern of the distribution of people in the northern part of the Southern Peninsula of Michigan is formed by the interspersion of areas of relatively dense population with areas of relatively sparse population (Map 13). Within this pattern there can be recognized in the most general way three relatively dense areas. The first of these is the northward extension of the agricultural area of southern Michigan, which reaches approximately to the latitude of Saginaw Bay. The second is the concentration in the fruit-growing and recreation district along the western shore. The third, which might be considered an extension of the first, is the agricultural districts of the south and west portions of the High Plains area.

This third division is in itself composed of two parts roughly divided by the Manistee River. South of this river the Michigan and the Interlobate moraines and their associated till plains are generally covered by agriculture (Pl. XLIV, Fig. 1). North of the river a narrow strip of population extends along the Port Huron moraine and some of its out washes. The rest of the High Plains area is sparsely populated by widely separated, small concentrations localized by spots of good soil or other factors of situation. The area between these concentrations is unoccupied except for single dwellings, which are ordinarily hunting or fishing camps.

These gross features of the population pattern when examined in detail are found to be composed of subordinate patterns similarly composed of a design of lighter and denser settlement. Wherever detailed soil maps are available, these lacunae in the population patterns can be seen to coincide with areas of drier and more sandy soils. In the northward extension of the belt of denser population along the Port Huron moraine the lacunae in the population pattern do not always correspond to the poor soil areas. Here the settlement is later and not so successful as in the southern parts of the area, and its uneven distribution represents, perhaps, a peopling which has not been carried on far enough to adjust itself to soil differences (Pl. XLIV, Fig. 2).

In its larger aspects the pattern of population concentrations correlates in general with that of the areas of heavier and more productive soils, but this correlation does not exist in all places or in detail. The causal relationship between the soil and the population densities can be advanced only in the sense that some of the soil types were more successful than others in supporting the agriculture which the settlers brought into the area.

THE COURSE OF SETTLEMENT

Prior to the lumbering operations the southwestern parts of the High Plains, which are today the most populous, were heavily forested. The area was without railroads, and the settlements were small and scattered. The inhabitants were probably part-time farmers and primarily engaged in trading and trapping and in the small-scale lumbering prior to 1865. Settlement followed quickly after railroads had been built into the area and lumbering operations had cleared much of the land. "The first settlers immigrated . . . from New York, Pennsylvania and Ohio, primarily to engage in lumbering and trading. Later as the country opened up many of them took up agricultural pursuits."[11] "(See Pl. XLIII, Fig. 3.) The new settlers came in on the railroads and probably tied their communications by the lumber roads to the focal points of the mill towns.

During the earlier time of the settlement of the area, hardwood lumbering helped to support the pioneer farmers, providing winter work or additional cash income from the sale of logs from the farm woodlots. The population increased slowly up to the decade of 1910-20, but through all this time, the areas of lighter soils have not been taken up by agriculture. These remain embedded in the rather even dissemination of the habitations as sharply marked lacunae where forests take the place of fields.

In the northern belt of settlement, which extends along the Port Huron moraine north of the Manistee River, the lumbering was on a much less grand scale than in the mixed forests farther south. Here the cutting moved more slowly through the area. Agriculture was encouraged by the markets provided by the many small lumber camps. Not only did those employed in the cutting operate part-time farms but also there was a "marked influx of settlers." From 1880 to 1910 there was a fairly continuous increase in the number of farms and in the acreage of land improved, and this served to hide, statistically, a smaller and local, but equally steady, abandonment of farms as the lumber camps moved away. By 1910 most of the cutting was over; the newly cleared lands were no longer taken up for farms and the abandonment went steadily on. Many of the farmers have remained, perhaps from inertia or the lack of means to go elsewhere, and the crop systems have been changed to provide a greater degree of self-sufficiency. The area remains in the landscapes of the High Plains as a district of going, if unremunerative, agriculture (Pl. XLIV, Fig. 2).

The correlation of the distribution of the population with the distribution of the other landscape-forming elements must be approached on a basis different from those which have earlier been stated as existing between the facts of the fundament. The facts of the fundament set broad limits to the forms of the occupance; certain environmental complexes are unsuited to the culture which people inherit, making certain types of occupance economically impossible or unprofitable and hence temporary. Within the limits of the economic possibility cultural forms are solely the results of human actions, and their distribution is a function of their history. The distribution of the population concentrations in the High Plains is the present aspect of human progress in settling the area.

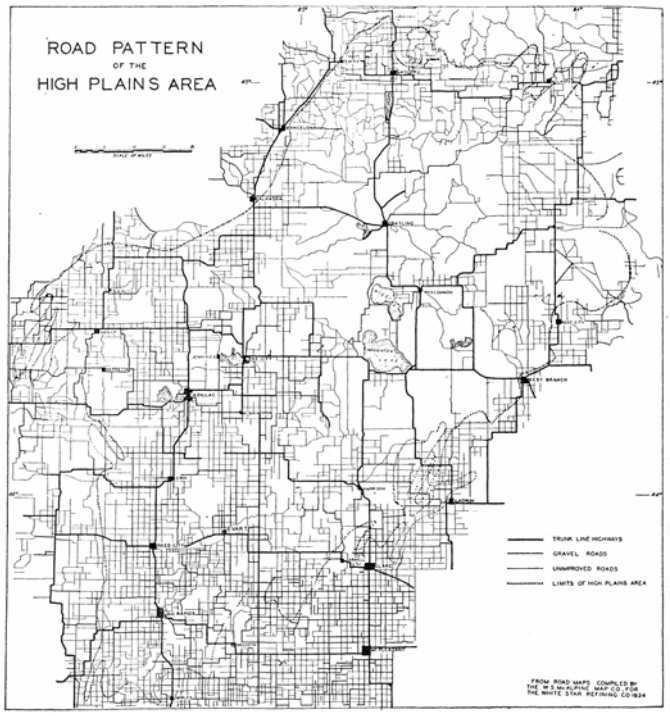
THE PATTERN OF CIRCULATION

The system of communication binds together the features of the cultural landscape. In an area of Occidental settlement every form which is functional has a path which connects it with the rest of the occupance. The lanes which connect the fields with the farmhouses, the rural roads which connect the farms with the towns, and the highways and railroads which connect the towns with the rest of the world are all aspects of the pattern of circulation. In the High Plains the evolution of the communication system parallels the sequence of occupance.

When the lumbering industry moved out of the High Plains it left behind the transportation system which it had built. The main railroads continued operations as through carriers and to serve the communities which had developed around the mills. The country away from the main lines was traversed by a network of logging roads and the grades of dismantled railroads, which were in excellent condition and which gave access to all parts of the area. Over the districts which were not at once taken up by agriculture, this road system was adequate for the horse-and-wagon transportation of the decades following lumbering, and is still the only way for communication over large tracts of the wild lands. Where traffic was somewhat heavier, parts of this system of lumber roads were taken over as "county roads" and improved by cutting back the brush and building more permanent bridges. On the map of road pattern (Map 14) these 'meandering ways can be seen leading through the unsettled northeastern parts of the High Plains.

Where agriculture took over the land, the lumber trails were speedily replaced by the familiar pattern of right-angled roads, which is a part of the culture of the people who occupied the land. A strip along each section line wide enough for a road was claimed by the township government, and it built the roads along this instead of acquiring other right-of-way. In districts where land has been abandoned or where settlement was planned but did not take root, this right-angled pattern remains as the skeleton of an occupance which failed, a straight, rutted, sandy trail enclosing the four sides of a square mile which differs not a bit from all the surrounding wild land.

The advent of automobile transportation introduced the highway into the system of communications. After twenty years of use the roads of the agricultural districts had become improved by widening and grading. A little surfacing solved the automobile problem in these areas. Along the old lumber trails in the wild lands, now somewhat overgrown by "fireweed" brush, it was a different story, and pioneer motorists still tell of their adventures of driving through this wilderness in the none too reliable cars of the early days. For each one of these roads which goes somewhere there are ten which go nowhere. They divide, cross, and unite in a maze which puzzles the strange motorist as it must have puzzled the driver of the high-wheeled cart fifty years ago. The traveler is never sure whether he is on the road or on one of its multitudinous branches or, indeed, on any trail at all. Until the time of the state trunk-line highway system such roads were the ways across the plains.



MAP 14

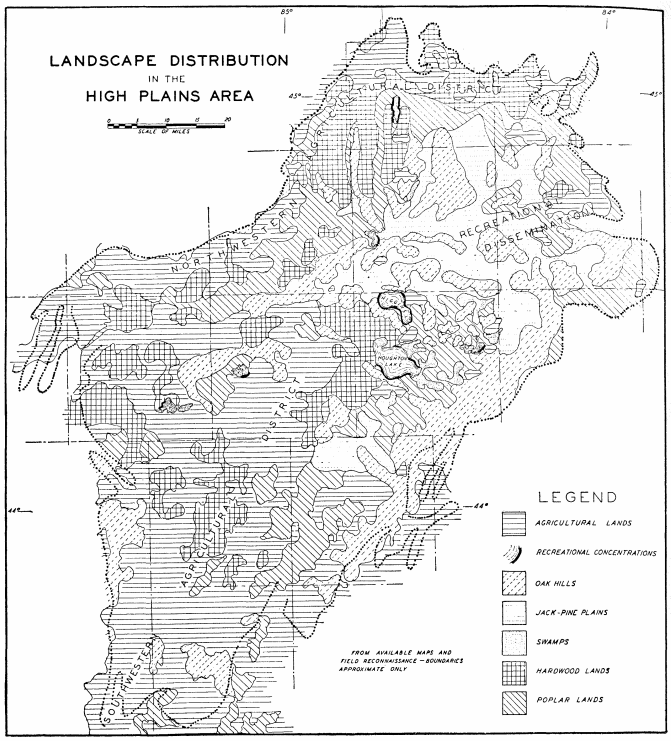
The trunk-line highway system is primarily intended to provide a means of getting from one place to another, not of facilitating the internal circulation of any particular area. It traverses the High Plains from north to south and from east to west with hard-surfaced roads in a large-scale replica of the right-angled pattern. In detail, however, the pattern is modified to provide for fast traffic; the sharp turns and corners are avoided by smooth curves made at the expense of acquiring a new right-of-way, and certain sections are entirely rebuilt to avoid other conditions.

The road pattern of the High Plains expresses the three modes of occupance which have marked its history: the windings of the lumber trails, the right angles of the agricultural districts, and the smooth, hard surfaces of the tourist highways.

IV. THE LANDSCAPES OF THE HIGH PLAINS

It might be expected from the diversity of the soils, surface forms, and drainage conditions of the High Plains that the landscapes which express the combination of these elements would be of endless diversification. However, such has not proved to be the fact; the elements combine into relatively few types of landscapes, and the complexity of the landscape pattern (Map 15) results from the interspersion rather than from the large number of these types. It is similar to a complicated mosaic made from a few kinds of tiles.

The landscapes of the High Plains fall into two general classes. The first is characterized by continuous human occupation, the agricultural, recreational, and urban landscapes; the second, by the areas unoccupied by men, which, for want of a better collective term, are here called the wild landscapes.



MAP 15

THE CULTURAL LANDSCAPES

The pattern of settlement in the High Plains is composed of three types of occupance. The first of these, the agricultural landscapes, is made up of the southwestern and the northwestern agricultural districts and the scattered agricultural settlements in the other parts of the area. The second, the recreational landscapes, is composed of the recreational agglomerations and the disseminated recreational occupance. The third, the urban landscapes, includes the cities, towns, and villages.

THE AGRICULTURAL LANDS

The distribution of the present agricultural lands in the High Plains corresponds in general with the distribution of the original broadleaf or mixed pine and broadleaf forests (Map 15). They occupy the well-drained till plains, the more loamy moraines, and some of the heavier outwashes of the western and southern parts of the area. The three entities which compose the agricultural lands, the southwestern district, the northwestern district, and the scattered agricultural settlements, axe differentiated not so much by the variations in character of the farms or the crop systems as by the nature of the distribution of the farms in relation to the district and to the High Plains as a whole.

THE SOUTHWESTERN AGRICULTURAL DISTRICT

From the Manistee River southward the Michigan and the Interlobate moraines and their associated till plains are generally covered by continuous agriculture (Map 15). Although a considerable portion of the land remains in second-growth woodlots, much is uncleared of stumps, and abandoned fields are common, still farm borders on farm and cultivated fields are the most characteristic expression of the landscape.

This area of continuous agriculture is bound together by a right-angled pattern of well-graveled roads, which mark almost every section line. From these the farmsteads are set back a little distance, generally shaded in a small grove of trees, above which a windmill and the top of a silo may stand out. The fields are laid out along the survey lines in precise rectangles of ten or twenty acres, giving the landscape an orderly appearance quite in contrast with the knob-and-basin surface of the moraine (Pl. XLIV, Fig. 1).

When examined in detail, this agricultural landscape is found to be made up of continuous small farms of 120 acres or less. Each of these farms is itself composed of three kinds of land: cropland, pasture land, and woodland, all bound together and connected as a functioning whole by the farm lanes to the nerve center of the farmyard with its buildings. Not every farm has all these kinds of land, but collectively they make up the agricultural landscape.

Ordinarily a third to a half of the farm land is used for crops. Of this, 5 to 15 per cent is in potatoes, 30 to 50 per cent in hay, and 30 to 40 per cent in grains.[12] From one to two thirds of the farm is in pasture, some of which is uncleared stump land, some wet land, and some abandoned fields. The pasture land, in general, composes that which appears unprofitable to put into crops, or which has been cropped and abandoned. The woodland is potential agricultural land which has been left in woods because of the value of the product in the economy of the farm. Commonly the woodlots are located on the crest of knolls or other steep slopes which would not make good cropland, but they are also seen on the intermediate slopes or level land. Perhaps in the evolution of the agricultural landscape the woodlots were left where the timber was the best and the fields and pastures where the clearing by lumbering was most complete. The nerve center of the farm is the farmyard. Here is the junction point between the lanes which connect the fields and the road system which ties the farm with the rest of the countryside.

The southwestern district is the most completely settled and agriculturally prosperous of the parts of the High Plains. The localization of this district must be attributed to the loaminess and the retentive character of the soil material derived from the Michigan lobe of the glacier. The soil itself did not induce the agriculture, but it was the kind of soil upon which the agricultural practices of the settlers produced enough returns to enable them to continue to cultivate it.

THE NORTHWESTERN AGRICULTURAL DISTRICT

North of the Manistee River the Port Huron moraine and some of its outwashes form a long narrow district of agricultural settlement reaching as far as Montmorency County on the east side of the High Plains (Map 15). Within this district the individual farms and their practices are much like those of the southwestern area, but the pattern of these farms in the landscape is different. Instead of a continuous area of farm bordering on farm, the northwestern district is composed of areas of farm land separated by areas of uncultivated land (Pl. XLIV, Fig. 2).

The unsettled parts of the northwestern district cannot be correlated with poor soil distribution, as in the southwestern district. The agricultural settlement of the northwestern district followed after the later lumbering of the broadleaf forests and ceased to expand to newly cleared areas when the lumbering declined between 1910 and 1920. The result was the impression on the land of an early pattern of settlement, arrested in expansion and adjustment by the collapse of the economic support of lumbering.

THE ISOLATED AGRICULTURAL SETTLEMENTS

Scattered over the eastern and central parts of the High Plains are small patches of heavier soils, in some cases small till plains, in others, heavier clayey places in the moraines. Many of these bear isolated agricultural settlements.

Some of these, undoubtedly, were settled to supply the lumber camps with products, others by the hopeful immigrants of the "land-boom" days. Once pioneers of the advancing agricultural front, these settlements have become relicts by the abandonment which has gone on around them. Their size is limited by the extent of the arable soil and, because of small population, the cost of community functions and connections with the rest of the world is high. They persist in the landscape, however, probably in a slowly declining status.

THE RECREATIONAL LANDSCAPES

The cultural landscapes of the second type are those which result from recreational occupance. Though the recreational population is seasonal, the forms which it makes are permanent, and these are a significant addition to the cultural landscapes.

Just as the agricultural landscapes are distributed in accordance with parts of the soil pattern, so the recreational landscapes are associated with parts of the drainage pattern. The values which are usually paramount in the selection of recreational locations are the presence of woods and waters, but the presence of established facilities, congenial neighbors, and ease of access also represent attractions.

The landscape quality which results from recreational occupance varies with the type of recreation sought for. In general, two classes can be recognized: the resort type or agglomerated recreational occupance, and the hunting and fishing type or the disseminated recreational occupance. The first of these occupies little total area, but produces such conspicuous forms as summer hotels, cottage villages, and golf courses. The second occupies much larger areas, but produces inconspicuous forms; the cabin and the clubhouse are lost in their surrounding wild land, and the persons who inhabit them seek seclusion rather than company (Pl. XLIV, Fig. 3).

In the High Plains there are three areas of recreational agglomeration at the three largest lakes, Houghton, Higgins, and Otsego, and several smaller areas on lesser lakes (Map 15). The disseminated recreational occupance is scattered over the northeastern parts of the area, where the lack of agriculture and the abundance of wild land furnish the necessary basic conditions, and where land values are so low that both public and private agencies may own tracts of land large enough for recreational use.

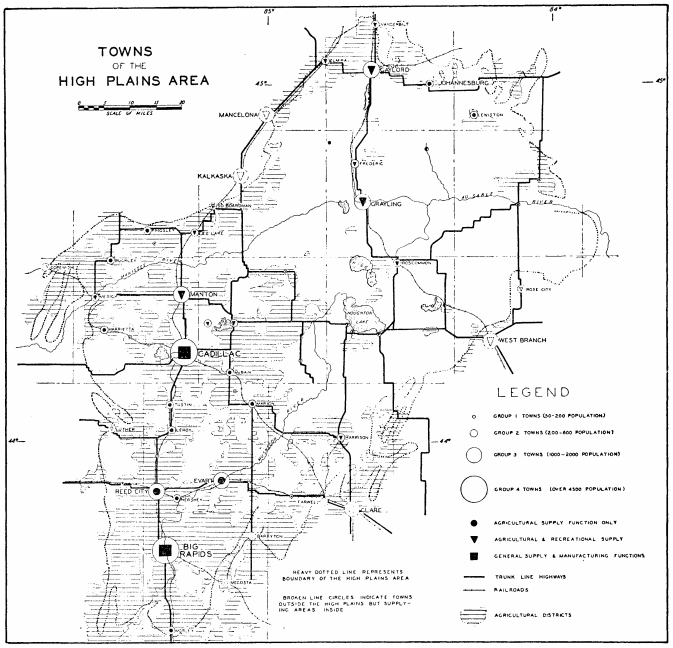
THE URBAN LANDSCAPES

As stated earlier, the urban agglomerations of the High Plains had their origin in the mill towns of the lumbering times. More or less rapidly all of them reached a peak of population from which they are now declining. A few of the larger cities developed wood-using industries, which extended their functional importance beyond the limits of their Immediate trade territories and prolonged their period of growth almost up to the present.

From the viewpoint of distribution, those towns which survive in a functional sense are those in situations which contained advantages beyond the presence of timber and mills. Of the forty-three towns which are here considered functional, twenty-two are in the southwestern agricultural district, eleven in the northwestern agricultural district, seven on lakes and streams serving recreational concentrations, and the remaining three on main trunk-line highways and close to scattered farming districts (Map 16). Approximately 30,000 town dwellers live in the agricultural districts, 700 in the resort villages, and 2,800 in the three trunk-line towns.

The scope of this paper does not permit descriptions of the morphology and the history of the towns of the area. In general, all of them originated from economic conditions no longer present, and the number of towns and the town population seem overlarge for the agricultural and industrial position of the area. This is apparent not only from the present condition of most of the towns, but also from their history. Of those which once existed more than half have disappeared completely or have been reduced to functional insignificance. Those which do survive are in various stages of a course of decadence, which, from the viewpoint of the present, will result in the extinction of many and the reduction of the rest till their populations

are only sufficient to take care of supplying what will remain of a shrinking agricultural umland.



MAP 16

THE WILD LANDSCAPES

The landscapes so far described have been characterized by cultural forms. They have their principal distribution in the western and southern parts of the High Plains. The second group of landscapes lack the cultural forms; these are the wild landscapes which have their principal distribution in the northeastern part of the area. They are named after the cover type, which is the most easily recognizable feature of the landscape, but they should be regarded as representing the combination of soil, surface, and cover as a distinctive landscape complex.

THE OAK HILLS

The surface of the sandy morainic uplands of the east and central parts of the High Plains area consists of a few forms endlessly repeated (Pl. XLV, Fig. 1). Smooth, rounded slopes are surmounted by low knolls and separated by flat-floored, sand-filled, streamless valleys. The diversification of the surface is offset by the uniformity of the vegetation, for the low, clumpy growth of oak covers the knobs and basins, valleys, and slopes in a mantle of dusty green. Through the oak one may catch a glimpse of the white trunks of birches and the lighter green of a grove of poplars and, here and there, a single maple or fire cherry, but these serve only to emphasize the dominance of the oak. The sandy soil beneath this forest is thinly covered with a brown-green carpet of bracken, sweet fern, and low blueberry bushes thickset with the stumps of pine now charred and rotting. In some places the straight, clean trunk of a single pine stretches up through the foliage of the oaks to support its crown above the ceiling of the common forest.

At some places the straight concrete roads of the trunk-line highway system cut through the hills, but more commonly the meandering double sandy trails of the old lumber roads are the only means of communication. Along these roads one may see widely separated old farmsteads, many of which are abandoned and a few reoccupied. The forlorn houses with gaping windows and sagging doors stand as relicts of agricultural settlement which failed upon the soil of the hills (Pl. XLIII, Fig. 4).

The passing seasons bring one brief period of brilliant beauty to the oak hills. The sharp frosts of the first weeks of October change the green mantle to a coat of many colors which, when seen from a short distance, belittles an attempt to describe it. Against the heather-colored background of the bracken, the oaks hang the scarlet of their leaves. Interspersed in the setting are the flaming reds and crimsons of the fire cherries and the maples. The brilliant flickering yellow of the poplar leaves as they twinkle in the sun add a shimmer to the colorful landscape. This brilliancy lasts but a few days; the oak leaves turn to a dull, dry brown and cling stubbornly to the trees; the others fall and are covered by the first snows, which presage the long, cold winter.

The oak hill landscapes are distributed along the moraines which form the eastern boundary of the High Plains and on the moraines which connect the Michigan with the West Branch chains (Map 15).

THE JACK-PINE PLAINS

An almost imperceptible descent leads from the oak hills to the jack-pine plains. The smooth slopes from the knobby surface flatten out into a level, sandy plain covered with a somewhat open forest of ungraceful jack pines (Pl. XLV, Fig. 2). In some places the trees are in dense clumps, but ordinarily the forest is parklike; the vision penetrates for two or three hundred yards until it is finally stopped by the trunks. The floor of this open forest is covered with a dull brown growth of bracken, sedges, and sweet fern lying thinly over sand strewn with pine needles. Almost everywhere are the marks of past fires; splintered stubs, still firmly rooted, point a single, blackened finger upward; others, slowly rotting, lie half buried in the sand. The soil beneath the needles is a grayish yellow sand, dry and infertile, with whatever humus it had accumulated in ten thousand years of forest growth burned out in a few decades of fires.

Except for the network of the old lumber trails, cultural forms are almost lacking in the jack-pine landscape. After fifty years of disuse these trails still are visible and are the only communications which lead, or mislead, the rare traveler over the plains.

The jack-pine plains bloom but once a year. The water from the melting snow is absorbed by the porous sand, and for a few weeks the soil is moist. Then the quick-growing flowers of the plains make their brief appearance. Among the clumps of grass and stalks of fern the varying blues of the birdfoot violets tint the

ground. Delicate anemones dot the needle-strewn soil, and the spikes of the early-blooming toadflax rise among the taller shrubs. With the hot days of late June the plains are again dry. The flowers and the grasses shrivel, and only the bracken and the fern remain on the forest floor as a carpet for the jack pines which, with their unchanging green and ungainly form, dominate this landscape from season to season.

The jack-pine plains are distributed over most of the dry sandy outwashes in the central and the northeastern parts of the High Plains (Map 15). They are complementary to the oak hills in occupying the poorer soils formed from the material deposited by the Saginaw lobe of the glacier.

THE HARDWOOD LANDS

In contrast to the sunny oak and jack-pine woods, the forests of the broadleaf trees are shady and damp. Through the canopy of the foliage the sun reaches the forest floor only in single beams which flicker as the wind stirs the leaves. The forest panorama is one of rather widely and evenly spaced trunks rising from a floor covered with seedlings and reaching upward to a ceiling in which the foliage of the individual trees is almost indistinguishably blended into the general canopy.

From this description of a virgin wood of broadleaf trees the landscape group here called the hardwood lands varies widely. If the forest has been thinned by cutting, it has a more open and ragged appearance and the sun shines through, lighting up the forest floor strewn with the litter from the cutting. If the lumbering operations have been extensively carried out, the forest is gone, and in its place has grown up a low, heavy, brushy growth of the reproduction of the original species mixed with poplars and fire cherries (Pl. XLV, Fig. 3), above which remain the few trees of the original stand left by the lumbermen. The original forests were in various stages of progression from the pines toward the broadleaf trees and were also edaphically differentiated between the beech-maple type on the drier soils and the elm-ash-red maple on the more moist soils. This fact, combined with the addition of the quick-growing trees which have come in since lumbering, have made the hardwood lands anything but a homogeneous landscape type. In a more detailed study the variations of this type would necessarily be recognized, but for the sake of clarity they are here lumped together, in spite of the very apparent differences which do exist.

The patchy distribution of the hardwood lands (Map 15) must be regarded as the remnants of a much larger distribution which once occupied most of the western part of the High Plains. The agricultural landscapes and the hardwood lands occupy the heavier and more retentive soils formed from the material deposited by the Michigan lobe of the glacier.

SWAMPS

From a distance there is a great deal of symmetry and grace to a swamp. This aspect is gained from the compact conical shape of the smaller spruces and the spirelike tops of the taller ones (Pl. XLV, Fig. 4). Inside the swamp this grace and symmetry are lost. The forest floor is littered with fallen trunks, mossy and covered with fungus, and from it comes the heavy, damp odor of decaying vegetation. On this floor the trees are thickly set with their crowns forming a cover so dense that the swamp is always gloomy. Trees uprooted from the soil have fallen and lodged against others and, as the wind blows through the swamp, these creak ominously.

At the edge of the woods is a narrow fringe of alders and willows between the forest and the grass marsh in its center. Here the sharp-edged sedge grows upon a floating bog which springs at every step. If one ventures out too far he may be in the water before he reaches the pond. Where the swamps have been cut over and burned the alder-willow brush has grown into dense thickets, forming almost impassable tangles.

The distribution of the swamps is in reference to the detailed, not the chorographical, order of things in the High Plains. They are found along river channels, but not along all river channels. Their place in the major lineaments of the area is sporadic, not invariable, as are those of the oak hills and the jack-pine plains. Oak hills are where they ought to be in accordance with the pattern of the surface and the soils; swamps are where one finds them.

THE POPLAR LANDS

A poplar thicket is a bright and pleasant spot. The light color of the bark of the trees and the fresh green of their leaves, together with the slender, graceful symmetry of the trunks, make an attractive contrast with the dusty oaks and the harsh, dry pines. Even if the trees are close together the foliage is seldom dense enough to shut out the sunlight. On the forest floor is a thick carpet of dry brown leaves which crackle underfoot and over which the foliage casts a changing pattern of light and shadow as they twist and turn in the slightest breeze.

The most cosmopolitan of all the trees in the High Plains is the poplar, with its companion, the birch. These two form an association which perhaps covers as much area as any other, and, furthermore, the poplar is ubiquitous in almost every one of the other forest types. The poplar seeds are blown widely by the wind, and the broad tolerance of soils and the quick-growing quality of the tree have enabled it to gain a foothold and outstrip the reproduction of the broadleaf trees and the pines. Nevertheless it is a poor competitor, and in three or four decades the other growth forces out the poplar and becomes the dominant tree. The poplar is the pioneer which rushes into new areas left by clearing or burning, but when the land becomes more settled, so to speak, by more persistent trees, the poplar dies away, to be found again on another frontier.

It is not possible to characterize any particular part of the large area dominated by the poplars as a poplar landscape in the same sense as the landscapes which have been previously described. These latter are permanent combinations of characteristic soil and surface as well as cover, while the poplars are a temporary or transitional vegetation, a scab tissue which covers the wounds of cutting and burning until the permanent cover developing underneath forces them out.

The regions of the most extensive distribution of the poplar lands in the High Plains are the more moist outwash sands of the eastern parts, where they are being supplanted by the jack pines, and the areas of recent hardwood lumbering, where they shade the reproduction of the original species which will eventually take their place in the landscape.

THE PATTERN OF THE LANDSCAPES

The pattern formed by the distribution of the various landscapes which collectively make up the geographic expression of the High Plains is shaped by the same master lines which can be seen in the distribution of the elements of surface, drainage, and soil (Map 15). In general, those areas originating from the material deposited by the western lobe of the glacier are characterized by the cultural landscapes and the hardwood lands; those from material laid down by the eastern lobe, by the wild landscapes: the oak hills, the jack-pine plains, and the swamps. To this generalization there are many specific exceptions, landscapes which are not where they should be according to the scheme of things.

V. CONCLUSION

The position of the High Plains upon the patterns of the world distributions of climate, vegetation, and population undoubtedly underlies the broader facts of its geography, but these larger distributions neither mark the regionality of the area nor orient its internal differentiation. As the study presented here has attempted to show: *The distribution of the landscape-forming elements and the resulting landscapes follow in general a fundamental pattern based upon a distribution of the surface features and soil materials which were laid down by the retreating ice of the latest glaciation.*

Upon this original fundament the weathering of the glacial material into soils and the development of the cover types proceeded in a direction consistent with the existing climate. Until the time of the occupance of the lumbermen this process of landscape development had gone ahead almost to the harmonious codistribution of cover associations and soil types. Thus far the activities of man had not altered the nature of things in the High Plains to any significant degree, but a new occupance took over the area, changed the cover, introduced new elements into the course of development, and initiated the modern landscapes.

Into the slow and orderly process of the evolution of the natural landscapes were thrust new cultural factors: clearing, fire, and agriculture. The result was an almost complete change in the cover associations and the introduction of new types in one way or another suited to survive in the new regime. The basic framework of the soil and the surface remained practically unaltered.

From the debris of this overturn the modern landscapes are taking form. Slowly they can be seen to emerge as an image develops upon a photographic plate. Although their outlines are not yet sharp and their details are obscured by the "fireweed" associations and by the ebb and flow of human adjustment, nevertheless their distribution is apparent and it is seen to follow the same fundamental pattern of the surface and the soil.

UNIVERSITY OF MICHIGAN

[1] "Geographic scale" in the sense of world distribution as contrasted with "chorographic" and "topographic" scales denoting increasing degrees of detail, as advanced by P. E. James in "The Terminology of Regional Description," Ann. Assn. Am. Geog., 24 (2): 85. 1934.

[2] Leverett, Frank, *Surface Geology and Agricultural Conditions of Michigan, Mich. Geol. and Biol. Surv*., Publ. 25, Geol. Series 21, p. 114. Lansing, 1917.

[3] For lack of a name in existing literature, this first moraine of the Michigan lobe in the High Plains area is called "the Michigan moraine" in this paper.

[4] Veatch, J. O., Schoenmann, Lee Roy A., and others, *Soil Survey of Kal-kaska County, Michigan*, U. S. Dept. Agric., Bur. Chem. and Soils, Series 1927, No. 28, p. 32. 1931.

[5] Leverett, Frank, and Taylor, Frank B., *The Pleistocene of Indiana and Michigan and the History of the Great Lakes, U. S. Geol. Surv., Mon. 53*, p. 224. Washington, 1915.

[6] See note 1.

[7] "Genetic Development of Forests," *Bot. Gaz*., 31: 289-325. 1901.

[8] "Climatic Change as a Factor in Forest Succession," *Journ. For*., 31: 934-942. 1933.

[9] Hinsdale, W. B., *Distribution of the Aboriginal Population of Michigan*, Occas. Contrib. from the Mus. of Anthropol., Univ. of Mich., No. 2, p. 7. 1932.

[10] From the inventory of some of these lands made by the Land Economic Survey of the Michigan Department of Conservation much of the basic material of this paper has been drawn.

[11] Wildermuth, R., and Fonder, J. F, *Soil Survey of Mecosta County, Michigan*, U. S. Dept. Agric., Bur. Chem. and Soils, Series 1927, No. 18, p. 2.

[12] Hill, E. B., Riddell, F. T., and Elliott, F. F., *Types of Farming in Michigan*, Agricultural Experiment Station, Michigan State College, Spec. Bull. No. 206, p. 69. Lansing, 1930.

PLATE XLIII

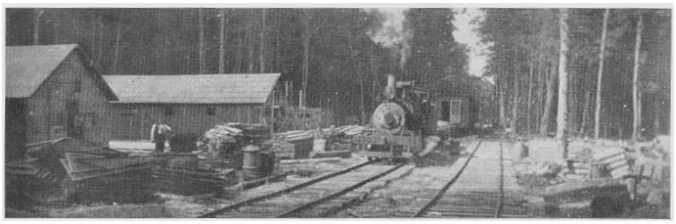


FIG. 1. A lumbering railroad

FIG. 2. Landscape after burning

FIG. 3. A pioneer farm

FIG. 4. An abandoned farm

Photographs by the Michigan Department of Conservation

PLATE XLIV

FIG. 1. The southwestern agricultural district

FIG. 2. The northwestern agricultural district

FIG. 3. A fishing cabin

FIG. 4. A town which survived from the lumbering days

Photographs by the Michigan Department of Conservation

PLATE XLV

FIG. 1. The oak hills

FIG. 2. The jack-pine plains

FIG. 3. The hardwood lands

FIG. 4. A swamp

Photographs by the Michigan Department of Conservation

THE KANKAKEE "MARSH" OF NORTHERN INDIANA AND ILLINOIS

ALFRED H. MEYER

TOPICAL OUTLINE

INTRODUCTION

SYSTEMATIC studies in land utilization, such as have been undertaken in recent years by the Federal Departments of Agriculture and of the Interior, by the Michigan Land Economic Survey and other state departments, together with the researches conducted by various public and private agencies as reported in the bulletins of the New York Social Science Research Council, all reflect the need for a scientific analysis of the land-utilization problems of the United States.

Regions which at one time or another have experienced competing and conflicting claims to land use generally furnish excellent material for land-utilization studies. The Kankakee marsh reclaimed area of northern Indiana and Illinois is such an area. Here clashed the interests of the hunter-sportsman-conservationist group with those of the organized land companies and of individuals interested in the reclamation of the wet lands for agricultural use. The author's interest in the region was aroused several years ago as a result of public propaganda and a petition to the Federal Government by a group of the Izaak Walton League to restore at least a part of the original marsh-swamp, once nationally famous for its wild life, particularly wild fowl. Studies of this type especially recommend them selves today in connection with the nation's agricultural and conservational readjustment policies.

The Kankakee country represents essentially an intermorainal marsh reclaimed valley extending from South Bend, Indiana south-westward to Momence, Illinois. Down the wide, flat-floored valley coursed the original meandering Kankakee River, now a series of straight ditches. Rising in the east within a few miles of the fat. Joseph River, tributary to Lake Michigan, and itself forming a headwater branch of the Illinois River to the west, the Kankakee, with the St. Joseph portage, provided a strategic connecting link in the Great Lakes-Mississippi route of the early French explorers, fur traders, and missionaries.

Serving successively in its native state the Pottawatomie hunter, the pioneer trapper, the marsh-hay ranger, and the professional sportsman, the modern Kankakee, dredged, ditched, and drained, has added over a half-million acres to the famous drift farming section of the Central Plains.

The Kankakee is located in the more favorable humid section east of the Mississippi. Its summer isothermal position places it within the "a" subdivision of the Df climatic type of the Köppen system, and fairly well within the northern border of the Corn Belt (Map 19).

Demographical relations are no less significant. Rimmed by a score of towns, the marsh at the eastern end is terminated by the industrial city of South Bend, while its western extremity is within 45 miles from the second metropolis of the country — Chicago (Map 20). Less than 150 miles from the center of population of the United States, its valley is "within 3-24 hours by express or 5-36 hours by freight of at least half the population of the United States" (1, p. 34).

THE FUNDAMENT — THE "NATURAL" KANKAKEE

Marsh prairies of aquatic sedges and grasses, potential grazing areas; wild-rice sloughs, scenes of countless wild geese and ducks; flag ponds, lined with muskrat

houses; a narrow but almost uninterrupted swamp forest, full of game, rimming a meandering river teeming with fish; the wet prairies, made humanly habitable by the interspersion of sandy island oak barrens surmounting the highest flood waters — such in brief is the physical setup which attracted the squatter pioneer from the East, who sought contentment in the solitude and seclusion of a marsh wilderness.

In the eyes of the reclamationist a half century later this same general scene reinterprets itself as an open prairie, practically unencumbered by a forest cover, with a flat valley floor, a high water table, and a presumably rich alluvial river bottom soil, located within 50-100 miles of the greatest stock and grain market in the world.

The cultural subtractions and additions incident to the drainage operations have modified almost beyond recognition the general areal picture of the prereclamation period. Yet certain elements of the natural landscape and their influences on human culture persist in general outlines to this very day. Many of the marsh dunal islands, particularly the unoccupied ones, and much of the original "meander lands" along the Kankakee River are still marked as of old by timber growth of upland and swamp species respectively.

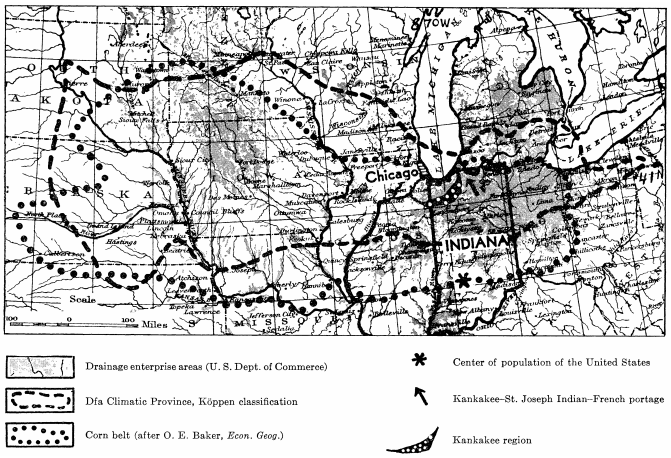
The "islands" presently encompassed by dry land continue to be the preferred sites of regional settlement.

GEOMORPHOLOGY

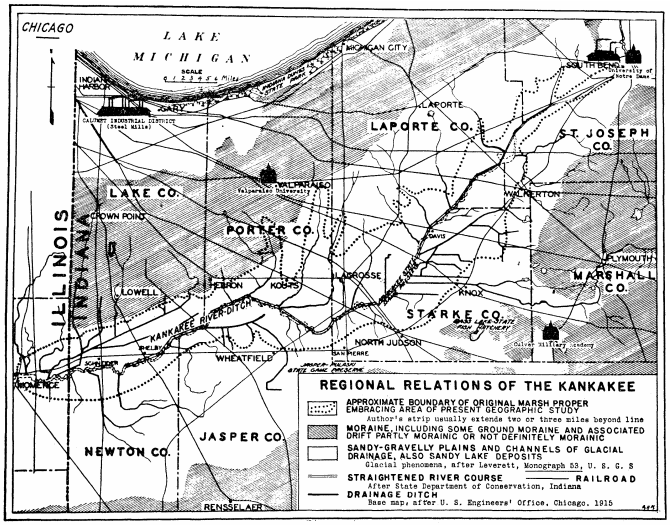
The conditions of the surrounding terrain in relation to the agricultural economy are as significant as the "islands" in respect to the human habitat. The latter, rising conspicuously in the form of sand dunes, were recognized at the outset as "barrens" and as generally unsuited to cultivation. But the soil conditions of the flattish marsh areas appear, for the most part, to have been known only superficially and classified categorically with the common types of river bottom and marsh lands. Whatever typical surficial lowland characteristics they may otherwise exhibit, the subsoil and "islands" of the Kankakee are structurally unique. Sand, with local lenses of gravel or clay, constitutes the basic structural material of the valley, while mounds and ridges of typical wind-blown sand here and there commonly attain heights of from ten to fifteen feet, surmounting the . seas of water-laid sand.

Reference to their hypothetical origin may help one to understand the situation. Occupying an intermorainal position, with the Valparaiso moraine on the north and the Maxinkuckee moraine on the east and southeast, these clastic deposits have been classed by Chamberlin (11, pp. 330-331) and Leverett (18, p. 338) as mostly outwash.[1] Part of the valley fill has been attributed to the postulated Kankakee outlet for the glacial waters escaping from the Saginaw lobe by way of the St. Joseph channel at South Bend (18, p. 338; 20; 21, pp. 12-14). Bradley attaches great depositional significance to the former lake waters occupying the basin which he denominates the "Old Lake Kankakee" (6, pp. 226-229).

Since many of the sand mounds and ridges are elevated above the highest possible level of the postulated lake or of the actually known marsh waters, which must have been shallow in either case, the sand of the higher elevated spots are clearly aeolian in origin, as is attested by their form and characteristic dune structure.



MAP 19. Areal location and classification of the Kankakee (base map after *Census of the United States*, No. 15, U. S. Dept. of Commerce, Bureau of the Census, 1930)



MAP 20

HYDROGRAPHY

For some eight or nine months of the year water from one to four feet in depth covered an area from three to five miles wide on each side of the river (1; 12). The area thus assumed the characteristics of a lacustral river rather than of an ordinary marsh. Especially was this true at the time of the winter ice jams and spring freshets. Having an elevation of approximately 720 feet at its source at South Bend, the Kankakee River trailed its way tortuously along the very slightly sloping and much oversized valley to a point near Momence. Here, at an elevation of 615 feet, it encountered a natural dam of Silurian limestone outcropping in the river bed. Within the small drop, then, of a little over 100 feet the river, totaling a meandering distance of some 250 miles,