A SOIL SURVEY OF VANDERBURGH, GIBSON AND PIKE, AND PARTS OF WARRICK AND SPENCER COUNTIES, INDIANA.

BY

CHAS. W. SHANNON.

Soil Survey of Vanderburgh, Gibson and Pike, and Parts of Warrick and Spencer Counties, Indiana.

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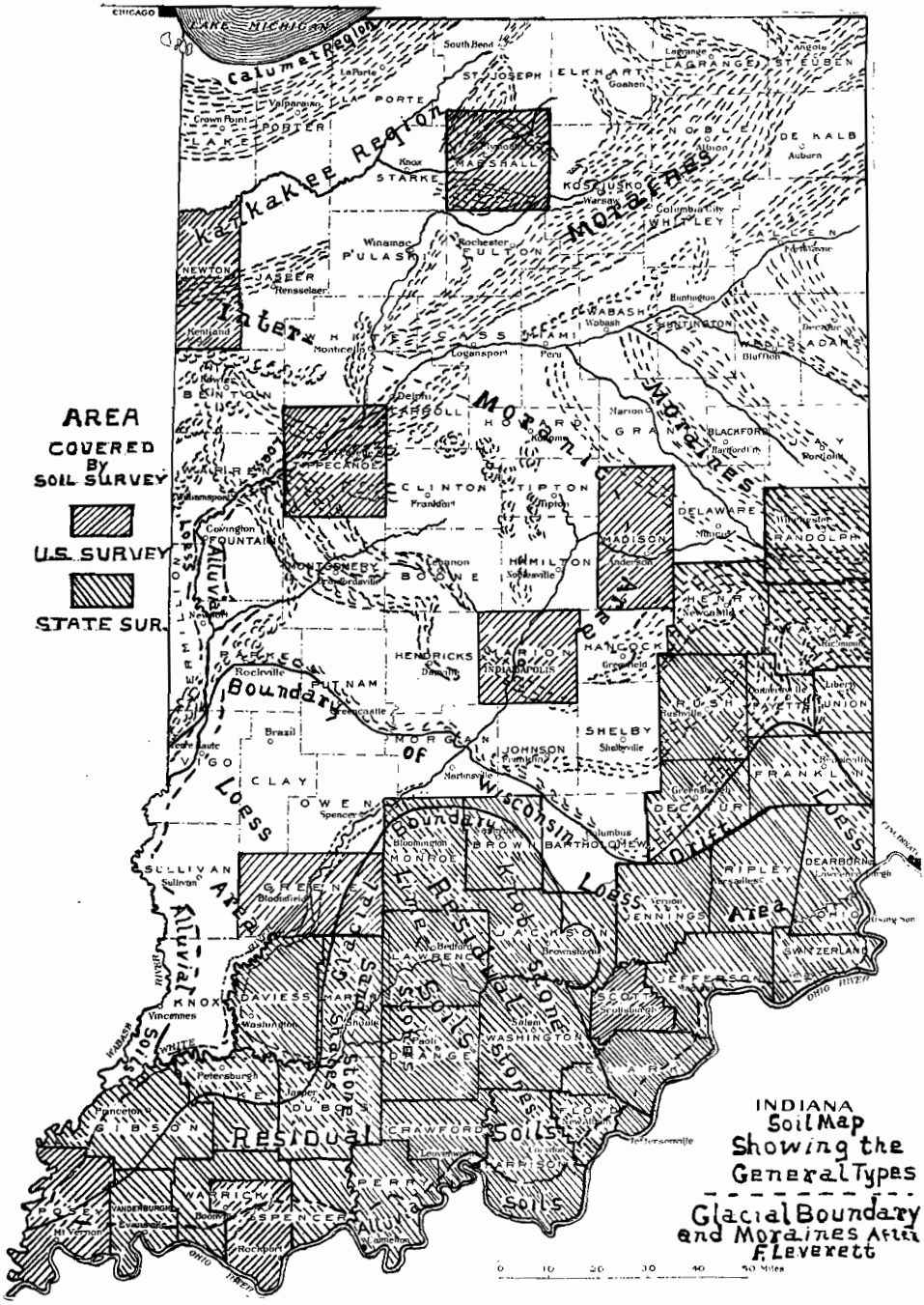
The counties included in this survey are situated in the southwestern corner of Indiana, and occupy an area of about 1,865 square miles. Posey County, in the corner of the State, and a part of Warrick and Spencer counties, known as the Boonville area, have been surveyed by the United States Bureau of Soils, and the counties adjoining on the north and east, with the exception of Knox, have been covered by former soil surveys made by the State.

This part of the State is an important one from several standpoints. The natural resources consist of clay for brick and tile, stone for macadam, coal, oil and gas in abundance, and various types of soil of great fertility. The area has a good water supply for domestic and manufacturing purposes, and several streams, including the Ohio, Wabash, White and Patoka rivers, are capable of furnishing great water power, and may also be made navigable for many miles.

The city of Evansville as a manufacturing and commercial center, together with the other county seats, and numerous villages, with their various enterprises, furnish a rather high percentage of town population. The average population, both town and country, for the entire area, is ninety-five per square mile, and taking out the town and city population, which amounts to about 104,800, the rural population is about forty per square mile.


CHICAGO
LAKE MICHIGAN
Calumet Region
Kankakee Region
Moraines
Lake
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Boundary
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AREA
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SOIL SURVEY
U.S. SURVEY
STATE SUR.
INDIANA
Soil Map
Showing the
General Types
Glacial Boundary
and Moraines After
F. Leverett
0 10 20 30 40 50 Miles

THE POCKET.

The counties of Gibson, Vanderburgh and Posey are located in the part of the State which is commonly known as the "Pocket." There is a general impression throughout this State and adjoining states, among people who have not visited this section of Indiana, that the county is very poor and in a backward condition. The stories about "Hooppole Township, Posey County," are responsible for the false impression which has gone out concerning this part of the State. It is an error which should be corrected in the minds of the people. There is no better land in the State than much of Posey, Gibson and southern Vanderburgh counties. The soils are fertile, the improvements are good and the crop production takes the lead in the State in several cases. The following paragraph will explain the prevalent story:

"In the early days men who went from Indiana to California, when in answer to the question, 'Where are you from?' said 'Indiana,' the reply would be 'A Hoosier from Posey County, Hooppole Township.' Much of such slang was originated by the Pittsburg coal boatmen. 'Hooppole Township' came to be used in this way. In the early boating days of this county Mt. Vernon was a head center for the gathering of flatboat crews. At one time a large coal flat had landed at that point from Pittsburg, and a large number of the boatmen had gone up into the town and filled up on fighting whisky. They soon raised a disturbance and started out to clear out the town. At that time there were some large cooper shops in the lower edge of the village next the river, and some twenty-five or thirty coopers were working there. As the boatmen and the citizens were having the battle these coopers, with stout hooppoles, went to the relief of the officers who were trying to quell the disturbance, and with their formidable weapons gave the Pittsburg boatmen a chastising which they remembered for all time afterwards. Hence the name of 'Hooppole Township, Posey County.'"*

PHYSIOGRAPHY AND GEOLOGY.

The area of this survey brings in many physiographic features and geological workings which have not been met with in other parts of the State covered by the soil survey. The entire surface area, with the exception of the eastern part of Spencer County, has been influenced, directly or indirectly, by glaciation. The sur-

*"Wm. M. Cockrum's Pioneer History of Indiana." Page 409.

face deposits then are of three classes, glacial, interglacial and post glacial or recent. At least three ice sheets have added material to this area. The Illinoian Sheet, however, is the only one which has actually advanced over the area. The Iowan sent down by its waters a large amount of fine material which was scattered over the surface, by the work of water and wind, and forms the loess which covers almost the entire area. The Later Wisconsin sheet did not reach the area, but the streams leading out from its edge carried large amounts of material which have been deposited in low flat plains, low terraces and dunes of sand and fine gravel. Long preglacial and interglacial periods of weathering and erosion chiefly made the topography of the region.

The surface rocks over the entire area are those of the Coal Measures. The following sections of a few feet will show the depth of the surface deposits and the nature of the immediate underlying formation:

Section of Well Near Oakland City.

		Feet.	*Inches.*
1.	Surface	4	0
2.	Sandstone	19	0
3.	Coal VII	1	6
4.	Sandstone	125	0
5.	Coal V	4	4

Section of Drilling at Owensville.

		Feet.	*Inches.*
1.	Surface, clay	8	0
2.	Sandstone	2	0
3.	Coal	0	2
4.	Clay parting	0	10
5.	Black shale	2	6
6.	Gray shale	8	6

North Part of Area Gibson and Pike County Line.

		Feet.	*Inches.*
1.	Loess and river sand	20	0
2.	Pebbly fluviated drift	8	0
3.	Soft white and yellow sandstone	30	0
4.	Soft laminated sandstone	22	0

Stimpson's Spring, Four Miles West of Evansville.

		Feet.	*Inches.*
1.	Loess and soil	3	0
2.	Merom rock	6	0
3.	Siliceous shale, with nodules	13	0
4.	Upper hard blue limestone	3	2

The physiography and geology of the area have been fully worked out by the United States Geological Survey and the material published in the Patoka and Ditney folios of the Geological Atlas of the United States. The geological history of the surface deposits and the physiographic relations are discussed in the parts quoted from these folios in the following pages.

The parts of Indiana included in the Patoka Quadrangle comprises almost the whole of Vanderburgh, Posey and Gibson counties and the southern part of Knox County. The Ditney Quadrangle includes nearly the whole of Pike County and parts of Gibson and Vanderburgh and the principal part of Warrick and Spencer counties and a part of the western side of Dubois and the western margin of Perry.

PLEISTOCENE DEPOSITS.

"The deposits which in North America characterize the Pleistocene period as a whole are of three classes and embrace (1) those whose deposition was associated, either directly or indirectly, with the presence of the great ice sheets which at several stages during the period covered large portions of the northern half of the continent, (2) those which are deposited through the ordinary influences of wind and water in the intervals between the stages of glacial invasion, and (3) those which have been deposited by similar agencies since the disappearance of the ice of the latest advance. The first are known as Glacial, the second as Interglacial, and the third as Postglacial or recent deposits. The materials of these deposits cannot always be referred to a single definite class, however, for in many instances the deposition has continued through more than a single stage.

GLACIAL AND INTERGLACIAL DEPOSITS.

"*Definitions.*—The glacial deposits consist of materials which have been picked up or dragged along on the bottom of the ice sheet during its southward movement or transported by its associated streams. The material has all been moved from its original location, and is therefore known under the name of drift. This drift was frequently deposited directly by the ice, being either set free by the melting of the portion into which it had been frozen, or simply left behind as a sheet beneath the ice, as the friction between it and the overridden surface became so great as to cause lagging and lodgment. The drift liberated by either of these meth-

ods usually consist of a heterogenous mixture of the grades of material ranging from clay to large boulders, and is known as till. Drift which was not deposited directly from the ice sheet, but which was taken up and transported by glacial streams and finally deposited in more or less stratified masses, is known as stratified or modified drift.

"*Glacial Stages.*—While not usually apparent from superficial study of the drift, a detailed examination of its structure and its general distribution and associations shows that instead of there being a single sheet formed by one ice advance there are in reality several distinct drift sheets, each of which represents a separate ice advance. The intervals of deglaciation or disappearance of ice between the advances are made apparent by the presence of soils, by beds of peat and marl, by the weathering of certain zones now buried in the midst of the drift deposits. The sheets themselves differ markedly in extent, and often in color, composition and other physical properties, and these differences, together with the morainal ridges marking the various positions of the ice margins, form the basis for the subdivision of the glacial period in North America into nine divisions, as follows:

Outline of Glacial Stages.

1. Pre-Kansan or sub-Aftonian glaciation.
2. Aftonian deglaciation.
3. Kansan glaciation.
4. Yarmouth deglaciation.
5. Illinoian glaciation.
6. Sangamon deglaciation.
7. Iowan glaciation.
8. Peorian deglaciation.
9. Wisconsin glaciation (latest stage).

"Of the drift sheets of the different stages described, only one, the Illinoian, has been proved to occur within the area of the Ditney quadrangle, though the existence of the earlier one is suspected. A soil zone older than the Illinoian till, the weathered zone of the Sangamon stage, the silt deposits (loess) of the Iowan, and the early part of the immediately following stages, and the terraces and dunes of stratified materials of the Wisconsin stage are, however, well represented in the area.

PRE-ILLINOIAN DEPOSITS.

"*Pre-Illinoian Soils.*—Logs, more or less carbonized on the exterior, coal streaks (lignite), zones of black muck, etc., have been deposited in wells, at considerable distances below the surface, at a number of points. Among these wells may be mentioned (1) one occurring just north of the east-west road at the point where it crosses the line separating sections 31 and 32, T. 1 N., R. 8 W. (three miles west and one and a half miles south of Petersburg); (2) wells along the main road leading north from Oakland City to Dongola, and about one mile north of the former; and (3) a deep well near the center of the western border of section 31, T. 1 S., R. 9 W. (three and a half miles north and one mile west of Francisco). The records are given below.

Record of Well (1), Southwest of Petersburg.

	Feet.
Blue mud	0–61
Logs of wood, lumps of coal (lignite), etc	61–62
Gravel (giving abundant but muddy water)	62–63
Soft clay (no pebbles reported)	63–98
Sandstone (water abundant on top, but tastes of ferrous sulphate)	98

RECORD OF WELLS OF GROUP (2) NORTH OF OAKLAND CITY.

Wells are from 23 to 45 feet deep and strike "black muck" at about the level of the Patoka flats. They do not go into this, however, and none have encountered rock.

Record of Well (3), Northwest of Francisco.

	Feet.
Dirt and sand	0– 12
"Ash loam"	12– 16
Blue clay	16– 76
Quicksand	76–106
Coal (lignite), 4 inches	.....
Gravel (with water)	.....

"The coaly or more probably lignitic material of the last well, occurring as it does over 100 feet below the present flood-plain of the Patoka River, points to an origin at a time when the land stood at a higher level than at present, presumably not long before the first of the Pleistocene ice invasion. The logs and lignites of the first well clearly occur under a thick filling of till, and their occurrence at the level of the present White River flats, and about

35 feet above the rock bottom, suggests that the till may have been deposited over a river flat standing at an elevation not far from the level of the present flood-plain. The conditions north of Oakland City appear to be similar. After penetrating 20 to 45 feet of probable drift the wells enter black muck at about the level of the Patoka flats. It is recognized, however, that in either case it is also possible to suppose that the lignite and muck zones simply mark time intervals in a compound drift sheet.

"*Possibly Pre-Illinoian Drift.*—At a number of points south of the known limits of the Illinoian till, there are shown on the Areal Geology map deposits of highly oxidized sands and gravels containing round pebbles of quartz and fragments of flint and jasper, supposedly derived from the older limestones to the east and north. Crystalline rock fragments of Canadian origin, though rare, are occasionally found. The material is clearly stratified and is prevailingly sandy, the pebbles forming a relatively small proportion of the mass. The color of the upper beds is usually a deep red, but lower down in the sections the red colors give place to browns. The materials are partially cemented. Some of the pebbles are coated with a bronze-colored film of iron oxide, but the coating is generally lacking on a considerable number of the pebbles, being in this respect in contrast with the universal staining exhibited by the pebbles of the supposed Tertiary gravels which cap some of the hilltops near Shoals, to the northeast of the quadrangle, near Tell City and Cannelton to its southeast, near Princeton to the west of the quadrangle, and at points in Illinois and Kentucky.

"The gravels generally appear to be only a few feet thick, and are exposed only on the tops or sides of the hills. They reach a considerable thickness on the south slope on the hill southeast of Littles, between it and the Patoka River, however, and appear to constitute nearly the entire mass of the high hill on the south side of the Patoka valley two miles southwest of Wheeling, the hill, in fact, exhibiting many of the features of kame moraine. A section in a small ravine just east of the road at the crest of the hill showed nearly 30 feet of partially cemented stratified sands and gravels under a 10-foot coating of loess, while minor exposures are to be seen on each of the roads leading to the crest. The gravel and sand is red at the top, but downward grades through brown to a yellowish-buff color. The stratification at the exposures in the ravine is nearly horizontal, but along the road on the

northeast side of the hill and the sands show a delta structure, with pitch to the south.

"Though the gravels are nowhere exposed, it seems likely that they constitute a portion of the filling, shown by the wells to be at least 50 feet deep, and possibly nearly 100 feet in places, which separate the valley of the South Fork of the Patoka River from Hurricane Creek just north of Oakland City. Single weathered pebbles and small boulders of northern derivation have been found at a number of points along the roadsides nearly as far south as Boonville, but though suggestive of glacial origin their significance is not established.

"The gravels occur at all levels, from near that of the stream beds, or perhaps even below, up to the crests of the hills having elevations of 500 feet or more, and they are found over considerable areas in the quadrangle. Their arrangement and distribution are such that it seems impossible to explain them through the ordinary processes of stream deposition and there appears to be no conclusive evidence of the existence of ponded waters during their deposition. On the other hand, the occurrence is in harmony with the conditions of deposition along the margin of an ice sheet, and at least a portion of the deposits, which in character seem to be a unit throughout the area, appears to be of the nature of a kame moraine.

"Accepting the view that the gravels are glacial in origin, their age remains to be determined. Their color and general weathered aspect give them an appearance much older than the ordinary Illinoian drift, but this may be due to the fact that their material is mainly sandy, a composition which in this region seems to be associated with high oxidation. Careful search was made for exposures that would show the relations to the Illinoian till, but no case was noted where a highly colored soil till or gravel rested below one of less advanced oxidation. Drift exposures showing deep red colors at the top are common, but the color is present only in the sandier varieties, and grade off, both downward and laterally, into the unoxidated portions. An examination of the pebbles seems to show that there was no great difference in the degree of weathering of the two types of drift. The general absence of the gravels on the top of the Illinoian till would seem to have more weight than their absence from beneath it, as gravels in the latter position would naturally suffer extensive erosion if not complete removal, becoming incorporated in the mass of the later till sheet

laid down by the overriding ice. An the other hand, tills often thin out, and in places practically disappear as the outer limits reached by the ice sheets are approached, the deposits at the outer margin sometimes consisting mainly, if not wholly, of stratified materials. The evidence, therefore, must be regarded as indecisive, but it seems probable on the whole that the date of origin of the gravels is earlier than that of the till, though both may belong to the same general invasion. The limits of the supposed glacial gravels are shown on the Areal Geology map, and their southern border is regarded provisionally as marking the limits of the farthest ice advance, though the possibility of a transient advance nearly as far as Boonville is suggested by the finding of the isolated northern fragments previously mentioned.

"*Possibly Pre-Illinoian Loess.*—In a section afforded by the banks of the Old Wabash and Erie Canal at the divide, one mile southwest of Francisco, some of the features are suggestive of a loess of a period earlier than at least a portion of the Illinoian stage. The section is as follows:

Section of Bank of Wabash and Erie Canal, Southwest of Francisco.

	Feet.
Light colored, loess-like clay	4
Yellow sand, very fine and distinctly though irregularly stratified	1
Black clay (gumbo)	1
Dark clay (stained by vegetable matter)	3
Light clay (like loess)	6
Disintegrated shaly sandstone	7

"The question whether the yellow sand may not represent the pumpings of a hydraulic dredge has presented itself, but the present condition of the exposure is such that this question could not be decided with certainty, and the long period which has elapsed since the cutting of the canal makes it possible to obtain trustworthy information in regard to its construction. The irregularities in the stratification are suggestive of dredgings, but the general occurrence and apparent relations to the other beds make it probable that the sand is a natural deposit laid down by the overflow of glacial waters during a late stage of the Illinoian invasion. If so, the loess beneath it is distinctively older than that particular stage of the invasion, and if the gumbo is an indication of a long time interval it is much older; but whether it is to be regarded as belonging to an earlier stage of the same invasion or to an earlier invasion is not clear.

"At a point some five miles west of Wheeling, and outside the limits of the quadrangle, a clay with abundant pebbles of the type characterizing the Illinoian drift was found overlying a true loess carrying the common loess fossils, which in turn rested on an oxidized drift sheet. It could not be determined, however, whether both of the supposed drifts, together with the included loess, are to be regarded as Illinoian, or whether the lower belongs to an earlier stage of glacial occupation.

ILLINOIAN DRIFT.

"*Till Sheet.*—The only deposits known to have been laid down by the direct action of the ice within the area of the Ditney quadrangle during the Illinoian invasion are those belonging to the till sheet deposited beneath the ice of that invasion by the melting of the basal debris-laden layer, or by the lodgment of debris, as previously explained.

"The matrix, or the body of the till, thus deposited consists, in the region under consideration, of a more or less sandy clay, which was derived partly from old soils or earlier drift sheets and partly from grinding and pulverizing of fragments of sandstones, shales, limestones, etc., which had been torn from the parent ledges by the action of the overriding ice. In this clayey matrix are imbedded angular or moderately well-rounded fragments of rock varying from mere chips to large pebbles, and even to boulders several feet in diameter. Rock fragments showing surfaces that are smoothly polished or striated by friction with overridden rocks are much less common than in many glaciated areas, especially those of harder rocks, but a considerable number have been observed within the limits of the quadrangle. The fragments were generally much less than an inch in diameter, and were mainly of hard rocks, such as outcrop at points far to the east, northeast or north, many having been derived even from beyond the Great Lakes. Many varieties of rock are represented, the more common being granite, diorite, quartzite, quartz, flint and jasper, the first three, and possibly the fourth, being derived from the Great Lakes region or beyond, and the remainder probably mainly from Silurian and Carboniferous limestones to the northeast.

"The soft sandstones and shales underlying the till in this region, and probably furnishing the larger part of the materials of the finer portions of the till, are not commonly represented by pebbles or boulders, though a few fragments of somewhat massive sandstone and of limestone have been noted. The pebbles known

to have been derived from the Great Lakes region or beyond are almost universally well rounded, but the flinty pebbles from the limestone areas, though they have lost their sharp edges, still present a rather angular appearance. The local boulders, being of relatively soft and friable materials, generally exhibit considerable rounding. The weathering of the granite and diorite pebbles and boulders varies greatly, some hardly being stained even on the exterior, while others are almost completely disintegrated. A weathered zone reaching an eighth or a quarter of an inch inward from the surface is perhaps a fair average. It seems probable that the variation in the extent of weathering is due largely to differences in composition or to the stage to which incipient weathering had advanced at the time of the removal of the fragments from their parent ledges.

"The texture of the finer portions of the till varies greatly, depending upon the nature of the rock from which it was principally derived. Where shale appears to have furnished the larger part of the material the till is generally very clayey and is of a gray or blueish-gray color in its unoxidized portion. Where the sandstones have furnished much of the material the till is sandy and varies in color from a very deep buff in the moderately oxidized portions to a deep red in the upper and the more strongly weathered parts. The limestones in the Ditney area appear to have been of too limited development to have had a marked influence upon either the color or the composition of the till. The till within the quadrangle is usually oxidized to a depth of 7 to 10 feet, or even more, the oxidized portions being rarely seen, except in unusually deep cuts. In the oxidized portions the color is ordinarily deep buff to brown, but reddish tints are very common in the sandier varieties. The red type of till frequently gave evidence of incipient cementation by iron oxide, but the solidification was usually less marked than in the stratified sandy layer formed as an original deposit by the glacial streams or from the reworking, by water, of the red till.

"Sections giving acute measurements of the thickness of the till are uncommon, and are generally so located as to give only minimum thicknesses. Wells have afforded data of great value as to depth to the rock, but usually little information can be obtained as to the exact nature of the materials penetrated. In general the thickness, though showing great variation, may be said to be considerable. Broad, plateau-like plains standing from 60

to 70 feet or more above the river flats occur along the south side of the White River Valley, in the northern portion of the quadrangle. The surface is in places almost absolutely flat over considerable areas, but is in general broken from place to place by rock hills and knolls which rise like islands above it, or by sharp ravines that have been cut into its mass by the streams since its completion. A somewhat broken plain of nearly the same elevation is found on the north side of the White River, indicating in all probability that the great drift plain was originally continuous across the present valley of White River, and continued for several miles northward. Its thickness along White River probably reached 150 feet or more, for records of wells dug several miles back from the river on the south show in cases no rock down to a depth of 100 feet. In general, however, the thickness of the till of the drift plains is less than 50 feet, though it shows marked and somewhat sudden variations, due to the existence of a rather rugged rock topography beneath the accumulation of till. The material composing the plain is usually till, but deep sections reveal the presence of considerable quantities of stratified materials in places, especially along the bluffs bordering the White River Valley in the extreme northwestern portion of the quadrangle.

"As the boundary marking the limits of the Illinoian till is approached the till plain is seen to be less perfectly developed. Rock begins to show through it with greater frequency, and it finally diminishes to a relatively thin mantle, which conforms to the contour of the rock surfaces. In general the till appears to continue with a thickness of several feet almost if not quite to the outer limits of its occurrence, though occasional areas of rather small size are found some distance back from the margin where no till appears to have been deposited. No prominent hills of till, such as are known to occur a few miles to the west of the quadrangle, have been noted within its area, though occasional low swells, apparently of till, have been observed at several points.

"*Outwash Gravels, Sands and Silts.*—Since more or less water was continually being set free by the melting of the ice sheet, and on flowing from its margin carried with it a considerable portion of the detritus previously held by the ice, the sands and gravels deposited by these waters are commonly found in more or less intimate association with the tills along the ice margin and for considerable distances down the valleys leading away from it. It is possible that some of the lower deposits and gravels described as

occurring outside the limits of the Illinoian till sheet may have been deposited when the ice stood in the position indicated by the boundary of the till sheet, but those deposits which occur as cappings to hills that themselves constitute pronounced elevations were apparently deposited in connection with an ice advance extending well beyond the limits of the till sheet. The principal overwash deposits are doubtless usually confined to the lower portions of the valley, where they are now frequently hidden beneath later silts. They are known to reach a considerable thickness in the lower portion of the valley of Little Pigeon Creek, where they have completely buried a rock topography of considerable irregularity. The deposits here, as in other places removed from the influence of strong currents, appear to be largely composed of bluish silt, but near the ice margin, as along the Patoka Valley, they are often, according to well records, sandy and even pebbly.

"*Deposits of Glacial Lake Patoka.*—During the maximum development of the Illinoian ice sheet its margin lay across the Patoka River, in the central part of the Ditney quadrangle, probably in the region between Dongola and Winslow. From here the margin extended, with a number of irregularities, northeastward to the vicinity of Otwell, crossing East White River not far from the northeast corner of the quadrangle. The waters draining into the preglacial Lower Patoka Valley being deprived of their outlet, accumulated as a glacial lake in this valley and its tributaries. To this the name of Lake Patoka has been applied. Into it flowed the silt-laden streams issuing from the ice front, and in it were deposited many feet of glacial sediments. Their thickness at the lowlands bordering Flat Creek is 75 to 120 feet or more. At Otwell a boring sunk by Dr. W. M. DeMotte to a depth of 119 feet failed, it is said, to reach rock. Another boring made by William Bell between Flat Creek and the headwaters of Mud Creek, six miles west of Otwell, is stated to have reached rock at a depth of 78 feet, while several others at short distances to the north and east are reported to have reached it at depths of 75 to 80 feet. The surface deposits of the Lake Patoka area, like those of the surrounding regions, consist of from 5 to 10 feet of loess. Below this in most sections in this portion of the lake is considerable thickness of sand, while below the sand and continuing to the hard rock is what is commonly called a blue mud. In the portion of the Patoka Valley in the western third of the quadrangle, which became covered by the waters of the lake as the ice retreated, few deep

wells have been sunk. A well 70 feet deep in the eastern half of Sec. 33, T. 1 S., R. 9 W. (one and a half miles south of Oatsville), however, gave the following section:

Section Shown by Record of Well Near Oatsville.

	Feet.
Surface	6
Soft yellow sand	3
Easy drilling (probably sandy clay)	47
Very tough clay	10
Easy drilling (probably sandy clay)	4
(Rock was not reached).	
Total	70

"The record already given in the discussion of the pre-Illinoian soils of the well northwest of Francisco shows an even greater depth of sediment. In the enlargement of Lake Patoka, which occurs in the northeastern portion of the quadrangle, the deposits seem to have built up to an elevation of about 500 feet.

"The deposits of the lake stand, as has been stated, at an altitude of about 500 feet above sea, and the outlets should therefore be found at that height. Divides of approximately that elevation do, in fact, occur at a number of points south and southwest of Oakland City, the lowest (apparently about 495 feet) being one mile north of Somerville, along the railroad. Like the Francisco divide, they have few features suggestive of outflowing streams. Whether the supply, and therefore the outflow, of the Patoka waters was slight, whether the outflow occurred at a number of points of the same elevation, and therefore had little effect at any single one of them, whether there was a general submergence of the region to about the 500-foot level, or whether the waters, as Mr. Leverett has suggested, escaped beneath the ice is not established.

"Lower than any of these divides, however, is that on the line of the abandoned Wabash and Erie Canal, one mile southwest of Francisco. This divide is at an altitude of 460 feet, or about 40 feet lower than the waters of Lake Patoka are known to have stood. The presence of yellow sand in the section at this point, previously described, would seem to indicate a temporary outlet of glacial waters across the col at the point. As there is, however, no indication of any marked westward slope of the surface of the Patoka deposits, and no evidence in the shape of deposition or erosion features, either in the lake or at the divide, or of any strong currents, such a difference of level of 40 feet in the width of a quadrangle

would demand, it seems clear that the Francisco divide was not the site of the outlet, except, perhaps, in the closing stages, when the ice had retreated westward from the point at which it had previously rested, supposedly between Dongola and Winslow.

"*Deposits of Glacial Lake Pigeon.*—From the point at which the ice margin crossed the Patoka it continued southwestward to the limits of the quadrangle, and then southward, parallel with but just outside of the border. A little west of the center of the western boundary it crossed the valley then occupied by waters flowing from the region now drained by Big Creek, Smith Fork, and the eastern headwaters of Pigeon Creek, in the west-central portion of the area. The result was the formation of a lake similar to, but smaller, than Lake Patoka, in which deposits of similar nature were laid down.

"In the case of Lake Pigeon the water rose until it formed an outlet over a divide two miles east of Elberfeld. This divide was probably at first somewhat reduced, through the agency of the overflowing waters, but to what extent has not been determined. Its original level must, however, have been less than 435 feet, which is the elevation of the present rock divide between Pigeon and Bluegrass creeks, otherwise the overflow would have been in the valley of the Bluegrass Creek. The col east of Elberfeld is now buried beneath an unknown thickness of silts which gradually accumulated and filled up the glacial lake nearly or quite to the level of its waters, and which extended down its outlet as far as the Ohio. The silt of the lake, taken in connection with a somewhat marked drift barrier formed along the ice margin to the westward, had the effect of permanently diverting the waters of Big Creek, Smith Fork and Pigeon Creek from their old western outlet into the channel beginning east of Elberfeld and leading southward to the Ohio.

"*Stream Deposits.*—In this region deposits of the Illinoian streams are mostly covered by recent alluvium. Near the western border of the quadrangle, however, there are remnants of low terrace, consisting of silt 10 to 15 feet or more above the recent alluvium of the Patoka River bottom. These become more prominent to the westward, and are there believed to be of late Illinoian age. Deposits of similar nature, and probably belonging to the same category, occur at a few feet elevation above the alluvial bottoms at other points in the quadrangle, but they are too indefinite to admit of mapping.

SANGAMON DEPOSITS AND WEATHERED ZONE.

"*Erosion and Local Deposition.*—Studies of the erosion features of the Sangamon stage in other regions have shown that the streams were broad and sluggish, with only shallow and rather poorly defined channels, and that the deposition was very slight in amount. In the Ditney region, however, the erosion was locally of considerable importance, probably removing 80 to 100 feet of Illinoian till from the valley of the White River and possibly even greater amounts of material along the Ohio River. Deposition during the Sangamon stage was probably limited to a few unimportant secondary deposits, produced by the reworking of the Illinoian drift by the agency of the streams. It is thought that some of the gravel possibly on the borders of the valleys may be of this type, but the evidence is not conclusive. In many localities in Iowa and Illinois, and to less extent in Indiana, peaty beds of black muck which were deposited in this interglacial stage have been noted and described, but with the exception of the gumbo, of doubtful significance, at the Francisco divide nothing of that sort was seen in the quadrangle. However, a black soil, possibly belonging to the Sangamon stage, occurs, it is reported in Sec. 15, T. 1 S., R. 5 W., three miles south of Jasper and just east of the limits of the quadrangle.

"*Weathered Zone.*—Though important deposits of the Sangamon stage are lacking, the interval between ice advances is nevertheless well represented by the Sangamon weathered zone. This zone marks the top of the Illinoian drift, and is recognized by the leached and the weathered character of that portion of the deposits. Where the overlying loess is of considerable thickness its lower part is usually but little oxidized and its appearance is in somewhat marked contrast with that of the weathered zone upon which it rests.

IOWAN LOESS.

"Following the formation of the weathered zone soils, and possibly silts, of the Sangamon stage, a considerable thickness of fine, almost structureless silt, known as loess, was deposited as a mantle over nearly the entire surface of Iowa, Illinois and Indiana, and in portions of many other states to the east, south and west. This loess has been traced as far back as the edge of the drift sheet of the Iowan ice invasion in northern Illinois, but stops at or near its border, apparently indicating that the deposition took place during the stage of glacial occupancy.

"Its composition varies considerably at different points, but the loess is generally characterized by about 70 per cent. of silica, largely quartz, and a considerable amount of feldspathic material, in addition to the calcareous portion. Two analyses of loess from near Terre Haute, some distance north of Ditney area, and a third of loess from near Princeton, just west of the quadrangle, are given below.

"The first sample (No. 1) is from a point 10 inches, the second (No. 2), from a point 22 inches, and the third (No. 3, from Princeton) from a point at least 30 inches below the surface. The analyses were made for the Indiana geological survey and first appeared in its Twentieth and Twenty-first Annual Reports.

ANALYSES OF IOWA SILT FROM NEAR TERRE HAUTE AND PRINCETON, IND.

[Nos. 1 and 2 by Prof. W. A. Noyes; No. 3 by Prof. Robert Lyons.]

Constituent.	No. 1.	No. 2.	No 3.
	Per Cent.	*Per Cent.*	*Per Cent.*
SiO_2	79.77	72.87	71.20
Al_2O_3	9.95	11.25	18.56
Fe_2O_3	3.39	6.75	1.34
FeO	.....	.....	.15
TiO_2	.70	.95	.88
CaO	.67	.69	.14
MgO	.26	1.06	.52
Na_2O	1.08	.39	1.26
K_2O	2.05	2.26	.32
H_2O	2.55	4.24	6.30
Total	100.42	100.46	100.67

"The amount of calcium carbonate ($CaCO_3$) present depends largely upon the amount of weathering to which the loess has been subjected, and consequently the calcium carbonate is present in minimum amounts near the surface. In the determinations of the CO_2 of the $CaCO_3$ at New Harmony, a few miles west of the limits of the quadrangle, a sample taken 2 feet below the surface is reported to have given but 0.229 per cent. CO_2, while one taken 10 feet below the surface gave 6.032 per cent. The Terre Haute and Princeton samples are of the leached type.

"In texture this loess is clayey, but the presence of fine grit is easily detected. The following mechanical analyses, made by Prof. Milton Whitney, of the Department of Agriculture, gives some idea of the size of the grains of the surface loess in eastern Illinois, and probably present fairly well the composition of the loess of the Ditney area. Where the grains exceed 0.1 mm. they are usually concretions of iron oxide or of lime. These concretions frequently

reach a diameter of an inch or more, and are all shapes, tubular types, however, being especially common among the iron-oxide variety.

MECHANICAL ANALYSES OF THE IOWAN SILT IN EASTERN ILLINOIS.

Diameter in Millimeters.	Conventional Name.	Galatia; 1–18 Inches from Surface.	Near Greenup; 2–15 In. from Surface.	Moweaqua; 2–18 Inches from Surface.
		Per Cent.	*Per Cent.*	*Per Cent.*
2 – 1	Fine gravel	0.00	0.30	0.00
1 – .5	Coarse sand	0.00	1.05	0.08
.5 – .25	Medium sand	0.02	3.42	0.77
.25 – .1	Fine sand	0.30	3.30	0.11
.1 – .05	Very fine sand	5.21	6.47	4.88
.05 – .01	Silt	57.75	55.48	52.50
.01 – .005	Fine silt	12.78	11.70	12.15
.005 – .0001	Clay	20.36	14.90	22.10
	Total mineral matter	96.42	96.62	92.59
	Organic matter, water loss	3.58	3.38	6.61
	Loss by direct ignition	6.01	3.11	5.73

"In color the loess is ordinarily buff or brown, but gray, yellow, and red are common colors. Mottling is very common. The gray colors are usually found some distance below the surface, but are sometimes within a foot or two of the top of the ground. In the Ditney area loess fossils have been discovered only in this type of loess. In one case, just outside the limits of the area to the west, fossils were found in gray loess within 3 feet of the surface, showing the clay to be very impervious to water and extremely resistant to both leaching and oxidation.

"In the Ditney region the loess of a bright-red type occurs, as a rule, only outside the limits of the Illinoian drift sheet. The color is most markedly red at the bottom, but gradually becomes lighter upward, frequently in the thicker exposure being the ordinary brown or buff of the top. The red color is most common where the loess rests on sandstone, but red loess has also been noted, upon both shale and limestone. In some localities there appears to be a gradual transition from sandstone through disintegrated sandstone into red loess, and also from till into loess, but in such instances it is probable that the loess, or more properly loess-like silt, is either a secondary deposit or has been partly reworked or modified through the action of the roots of trees and shrubs penetrating to the partly decomposed rocks or till beneath.

"The large pebbles of northern material found outside the recognized drift border may possibly have been derived from the loess itself, being dropped, it may be supposed, by floating ice dur-

ing a period of submergence, when the waters would have reached an elevation of at least 500 feet. There is other evidence, in the shape of divides silted with loess-like material and of elevated flats of similar silts, that there may have been standing water up to this elevation during the deposition of the loess, but sufficient evidence has not yet been obtained to establish this fact.

"An indistinct banding frequently occurs in the loess because of the greater amount of moisture held by certain portions, but no sandy or pebbly layers, or in fact any reliable evidences of stratification, were seen in the area.

"The thickness of the loess is extremely variable, but the amounts appear on the whole to be greater in the vicinity of prominent streams, in which places the loess sheet sometimes reaches a thickness of 10 or 12 feet or more. The mantle on the upland plains is generally 5 to 8 feet thick. On the slopes and on some hilltops it is much thinner, and in some places is wanting.

Wisconsin Deposits.

"The ice sheet of the Wisconsin stage did not reach the Ditney area, and there are therefore no deposits of this stage covering the general surface of the region. Every stream, however, which led either directly outward from the ice margin or was fed by tributaries heading at the ice front carried considerable amounts of glacially derived materials, which were deposited as broad, flat plains of sand or fine gravel. Of the streams in the vicinity of the Ditney quadrangle, only the Wabash and White Rivers head in the region occupied by the ice, though the Ohio received the drainage of a number of other streams heading near the ice front and bringing down quantities of glacial sediments, which were deposited as broad flats on either side of the river. The Wabash River was also the outlet of a large glacial lake in the region of the Great Lakes.

"In the Ditney area the Wisconsin sediments seem to be confined to the flats deposited by the White River along the northern edge of the quadrangle just west of Petersburg, and to a narrow strip belonging to the Ohio flats west of Midway, in the southeastern part of the area. They are entirely free from loess. The deposits west of Petersburg consist mainly of fine sand, and are in the form of a terrace standing about 10 feet above the flood-plain which has been cut out of the river since Wisconsin times. The top and more especially the inner margins of the terrace are marked by sand dunes formed by the action of the winds before vegetation has

covered the surface. With the exception of this area, the flats along the White River are composed of recent-alluvium. The deposits west and south of Midway include both sands and gravels and appear to reach considerable thickness. As in the case of deposits along White River, they are in the form of a wide, ill-drained plain or terrace, which stretches to the Ohio, about ten miles to the south, and which also stands a number of feet above the adjacent flood-plain. The plain is several feet lower than the earlier and high alluvial deposits of the valley of Little Pigeon Creek, from which it is separated by an escarpment about 15 feet high.

Recent Deposits.

"Under Recent Deposits are included those which have accumulated since the disappearance of the last, or Wisconsin, ice sheet. The time since this ice retreat has been relatively short, and but little work has been accomplished in the Ditney region. In the smaller valleys there have probably been more or less additions to the glacial fillings through the downward creeping or wash of the loess from the hillsides. In the larger valleys the streams have been busy in cutting out flood plains a few feet below the level of the glacial stream fillings, but these are still too small to accommodate the waters at the time of excessive floods, and the second bottoms are still overflowed at times and doubtless receive more or less silt from the overflowing waters.

"The flats along White River, on the northern border of the quadrangle, are composed chiefly of recent alluvium. The low terrace just west of Petersburg is an exception, and is a remnant of the gravels of the Wisconsin stage. There has been probably no change in the altitude of the land since Wisconsin time, and the process of deposition appears to have been essentially continuous, though occasional deposits at a slightly higher level than those now forming have been noted.

Relief.

"The Ditney quadrangle exhibits four rather distinct types of topography: (1) Rugged uplands, (2) rolling uplands, (3) upland plains, and (4) river flats. The last two resulted from accumulation of unconsolidated material in relatively recent geologic times, while the first two, which embrace by far the greater part of the area, have resulted from the action of stream erosion upon the hard rocks. The resistance of these rocks to erosion has been very

nearly the same throughout the quadrangle, the resulting relief depending, therefore, upon the relations of the surface to the drainage lines.

"The general rule that the larger the stream the more will the surface of the adjoining areas suffer reduction to low and rounded forms holds good within the quadrangle, except where alterations were effected in the drainage system through the influence of the Pleistocene ice invasion. Among exceptions of this nature is the broad, open valley near Otwell, evidently formed by a large stream, but now occupied by a small creek. The Patoka River from east of Velpen to beyond Winslow, on the other hand, occupies a narrow, steep-sided valley altogether disproportionate to the large size of the stream. The explanation of both lies in the deflection, through the indirect agency of the ice, of the large stream formerly occupying the Otwell Valley into the bed of a smaller stream heading not far from Velpen. Similar disproportions between the sizes of the streams and their valleys, likewise due to the influence of the ice invasion, exist in Pigeon and Bluegrass creeks in Greer and Campbell townships, the former, the larger, flowing in a narrow valley, while the latter flows in one which is broad and open.

"*Rugged Uplands.*—In the group designated rugged uplands are included the highest hills and ridges of the quadrangle. The type is best developed in the eastern half of the area, especially in the region between Flat Creek on the north and the valley of Pigeon Creek on the south, but is represented in the western half of the area by a number of more or less isolated peaks rising a hundred feet or so above the level of the surrounding regions. The hills are characterized by relatively sharp summits and the ridges by long, even crests sometimes extending for distances of two to seven miles with change of elevation of only 20 to 40 feet, a feature that is more noticeable because of the fact that the ridges, as a rule, are sharp and narrow and are characterized by steep slopes, which are cultivated only with difficulty. The minor channels, which are exceedingly numerous, are more or less V-shaped and are separated from one another by equally sharp divides. They exhibit steep descents in their upper courses.

"The elevation to which the higher points of the uplands rise is nearly uniform throughout the area of the quadrangle, and appears to indicate that they are but the remnants of an old surface, almost a plain in character, which once extended over the whole of the Ditney area. Within the limits of this area the highest por-

tion of the upland level is in a region a little to the east and northeast of the center, near the point from which the drainage diverges, and where a considerable number of the crests stand at elevations of from 600 to 640 feet above sea level. Isolated hills of similar elevation, however, are found at various points throughout the quadrangle. Among these may be mentioned McGregor and other hills about three miles west and one mile north of Somerville (elevation 600 feet); Kennedy Knob, one mile northwest of Somerville (600 feet); the hill one and one-half miles southeast of Somerville (620 feet); Snake Knob and several other hills to the northeast, north, and northwest of Lynnville (620 to 640 feet); Big Ditney Hill, three miles north and one and one-half miles east of Millersburg (660 feet); and Little Ditney Hill, about three miles northwest of the same village (600 feet).

"The level now represented by the upland crests appears, as stated, to have been a part of a broad, flat, or gently undulating plain of the kind known to geologists as a peneplain, which was developed over a large portion of the Mississippi Basin at a period when the land stood much nearer sea level than at present, and which was subsequently raised to its present level and eroded by streams until only the scattered remnants mentioned are left. Its development is considered in greater detail under the heading, "Physiographic Developments," p. 6. In addition to the high upland level just described, there appear to be other remnants in the shape of long, even crests or of land surfaces at lower levels, for there are a number of rather extensive crests or flats shown by rock hills at an elevation of about 500 feet, while ridges and hills of intermediate elevations are common. Though the evidence is not conclusive, it seems probable that subsequent to the formation of the first a second peneplain was developed at an elevation of from 100 to 150 feet below the former. It was probably much less perfectly developed, however, and it seems likely that in this region it was generally confined to the areas bordering the main drainage lines.

"*Rolling Uplands.*—In this class are included the lower and less rugged upland surfaces. The hills are generally much smaller than in the previous group. Their altitudes seldom exceeds 550 feet, and they usually exhibit smooth, gently rounded forms. The valleys are broad, relatively shallow, and are characterized by gently curving cross-sections, by the low pitch of their streams, and by broad, flat divides. The rolling uplands are best developed in the

vicinity of the older drainage lines, especially in the southern and western portions of the quadrangle, the time since the ice invasion being far too short for the development of rounded topography by erosion in the regions bordering streams that were forced into new channels at that time.

"A rolling upland surface appears to exist between the White and Patoka Rivers, in the northwestern portion of the quadrangle, but it is largely buried by deposits laid down during the ice invasion, and is now represented mainly by low, rounded hills projecting here and there through the deposits mentioned.

"*Upland Plains.*—The upland plains consist of broad, flat, or gently undulating surfaces standing at an elevation of about 500 feet and composed of deposits which accumulated during the period of the ice invasion. These deposits are of two distinct types. Those of the first type, including those forming the broad, flat uplands in the vicinity of Flat Creek, in the northeastern portion of the quadrangle, where laid down as stratified clays, sands, and gravels by streams issuing from the ice sheet into a broad lake, known as glacial lake Patoka, which then existed in this region. The deposits thus laid down constitute in places an almost featureless plain, above which the bordering uplands or occasional hills rise like bluffs or islands from a sea. Deposits of the second type, known as till, are composed of a heterogeneous mass of clay and sand with some pebbles, which are formed beneath the ice sheet during its occupancy of the region. These are best developed along the south side of the White River flats, in the northwestern portion of the area. The plain extends southward for several miles, but is more or less broken by rock hills which project above its surface, and by streams which have eroded deep channels in its mass.

"*River Flats.*—All of the rivers and large streams, and also many of the minor streams, flow through broad, flat plains of silt or very fine sand, which are generally overflowed every spring. Wells sunk for water show that the silts are often of considerable thickness, varying from a few feet in the minor valleys up to 100 feet or more in some of the larger ones. The river flats are widest in those streams which still occupy their original valleys, and are narrowest in those which are forced into new channels during the ice invasion. The flats bordering the principal streams vary but little in elevation throughout the quadrangle, being in general between 380 and 400 feet above sea level. Between the elevation of the flats of Pigeon Creek at the southern border of the quadrangle

(390 feet), distant ten miles or less from the Ohio, and the elevation of the Patoka flats (400 feet) north of Oakland City and seventy-five miles or more from the Ohio, there is a difference of only 10 feet. The meanders of the stream are exceedingly pronounced, and by their resistance to the free flow of the water give rise to annual overflows which cover the adjacent flats to depths of several feet. These conditions are very favorable to changes in the courses of streams, and bayous and abandoned channels are common."*

The above description shows well the physiographic and geological features not only of the Ditney quadrangle, which covers the eastern half of this survey, but also that of the western half in general. Points concerning the western part not included above, will be given at various places throughout the report from the description of the Patoka quadrangle.

DRAINAGE.

The drainage from the entire area finds its way into the Ohio. In the eastern part Anderson River, Crooked Creek and Little Pigeon Creek flow directly into the Ohio, also Pigeon Creek in Vanderburgh County, and numerous smaller streams. The Wabash forming a part of the western boundary of the area and also of the State in this part, is the second largest river and is of much importance as a drainage way for the western and northern parts of the area. White River forms the northern boundary across the eastern half of Gibson and western Pike, where the two forks join and the east fork forms the boundary over the eastern half of Pike. The river receives no large tributaries in this part of its course. The Patoka flows entirely through the northern part of the area, it has no tributaries and is a very meandering stream, with a valley varying in width from four or five miles, to narrows where the bluffs extend down to the river on each side, as at Patoka. The and the material carried by the streams from the ice front. Good artificial drainage systems are being worked out in the river flats.

The water supply in the low lands is obtained at moderate depths, the uplands often have a deficiency of water during the summer months. The sources of supply are streams, springs, wells, artificial ponds and cisterns. Springs are numerous in the sand hills bordering the Wabash Valley. The drift hills between the

*"Description of Ditney Quadrangle" in Ditney Folio.

White and Patoka rivers also furnish some springs. A few artesian wells with weak flow have been put down. In many places the people use cisterns to obtain water for domestic use. Artificial ponds in the compact loess also furnish water for stock.

CLIMATE.

The southwestern part of the State is not subject to severe winters or excessive heat in summer. There are no marked peculiarities in the climatic conditions, and the rainfall is usually well distributed throughout the year. The records from the stations at Evansville, Mt. Vernon, Princeton and Marengo will furnish data of value concerning temperature, precipitation and frosts.

The climatic conditions for the part of the area surrounding Princeton, Gbson County, Indiana, was furnished by Elisha Jones, who has acted as Signal Service Reporter for twenty-six years.

The coldest weather recorded at Princeton was on January 5, 1884, with 24° below zero. The highest temperature recorded was 120°. The greatest amount of snowfall in one year was 5 feet 7 inches during the winter of 1880-1881.

The Patoka hills north of Princeton, with an average elevation of about 640 feet, are well supplied with fruit trees, and they seldom fail to produce a crop because of weather conditions. The average time for the first wheat cutting in the county for twenty-six years was June 14, and the earliest was June 2d. And in the summer of 1910 it was June 20th. The greatest yearly rainfall in twenty-six years was 58 inches, the least yearly rainfall was 27 inches. and the greatest amount of rainfall reported for 24 hours was 10½ inches.

It will be noted from the following table that the average temperature for December, 1909, was much lower than for December, 1908.

	Dec. 1908.	Dec. 1909.	Year 1908.	Year 1909.
Highest Temperature	67°	62°	98°	102°
Lowest Temperature	14°	—4°	5°	—4°
Average Temperature	35°	26°	56°	58°
Rainfall and Melted Snow	1.5 in.	3.7 in.	40.5 in.	39.5 in.
Snowfall	2. in.	6 in.	14 in.	.....

December, 1909, was the coldest December for many years, the first snow was on the 7th. The first to cover the ground in 1908 was on Christmas Eve.

The tables of records from the Mt. Vernon Station, just to the southwest of the area of the present survey, was prepared by Chas. M. Spencer, Co-operative Observer, Mt. Vernon, Indiana.

MEAN MONTHLY TEMPERATURE, MT. VERNON, INDIANA, 1901 TO 1909 INCLUSIVE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.
1901	35.2	30.7	40.	51.	63.7	77.	84.6	77.6	70.	57.8	41.7	29.4	54.8
1902	31.7	26.1	46.2	55.2	73.5	76.	83.6	77.1	66.9	59.4	54.7	34.4	58.3
1903	33.	33.3	49.5	58.8	68.7	67.3	80.1	79.3	70.4	58.1	43.2	30.1	36.1
1904	28.2	28.2	46.1	36.	66.3	74.4	76.6	77.4	52.2	55.2	43.4	34.2	57.3
1905	24.9	22.7	50.1	55.1	70.	79.9	75.5	80.	72.5	57.9	46.7	35.4	64.2
1906	37.	31.8	34.9	59.5	67.	75.9	77.6	80.3	75.4	77.8	45.3	37.8	58.4
1907	39.7	34.2	54.1	47.2	63.7	71.5	81.7	81.9	70.5	56.6	44.8	37.4	57.
1908	33.4	33.7	49.7	55.9	69.3	76.7	77.5	79.6	73.6	57.6	48.	38.9	57.4
1909	33.	39.3	45.1	54.2	63.6	75.4	75.9	79.6	67.4	56.	59.9	28.2	56.8
Mean	33.1	31.	46.	52.5	67.3	75.	79.1	79.3	68.7	59.6	37.5	36.	.....

MAXIMUM TEMPERATURE (MONTHLY), MT. VERNON, INDIANA, 1901 TO 1909 INCLUSIVE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1901	66	68	80	51	84	102	109	98	98	84	76	64
1902	61	53	76	87	96	100	104	100	91	81	81	62
1903	65	69	78	90	92	92	100	100	99	83	77	51
1904	55	57	75	73	96	96	96	96	96	82	69	60
1905	74	52	84	87	95	100	95	99	93	89	75	57
1906	69	72	60	91	93	97	97	98	96	89	75	71
1907	66	69	86	83	86	93	101	100	97	88	68	64
1908	57	62	78	86	96	100	98	101	98	87	74	69
1909	72	69	65	84	88	93	96	103	94	96	81	78

MONTHLY PRECIPITATION, MT. VERNON, INDIANA, 1901 TO 1909, INCLUSIVE.

	Januray.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1901	1.39	.80	3.74	2.79	.88	3.71	1.56	2.39	.91	2.28	1.78	4.07	27.63
1902	2.63	.82	2.91	2.23	2.24	4.27	1.73	1.48	2.46	2.87	4.90	6.02	34.56
1903	2.90	5.19	4.47	4.67	3.72	4.02	2.06	7.17	.74	1.05	.51	.61	38.13
1904	3.37	1.25	8.76	4.61	4.63	4.10	4.36	1.36	4.64	.10	.60	4.25	41.99
1905	3.75	.70	3.18	4.14	4.20	3.21	10.64	2.14	3.22	8.14	4.50	3.72	51.54
1906	6.75	1.75	8.22	2.92	.57	3.05	6.05	3.49	9.08	2.95	6.30	6.70	57.33
1907	9.26	1.63	4.20	3.20	5.02	3.72	5.83	10.04	3.32	3.38	4.82	4.57	58.99
1908	1.52	8.32	3.63	6.46	5.52	1.54	2.18	1.38	.82	T	2.76	2.12	36.25
1909	3.60	6.45	3.93	4.38	3.75	2.95	10.25	.14	2.63	4.09	3.56	3.12	49.85

MINIMUM TEMPERATURE (MONTHLY), MT. VERNON, INDIANA, 1901 TO 1909, INCLUSIVE.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1901	13	10	14	30	38	51	56	57	36	59	16	—8
1902	5	4	14	31	39	48	51	52	36	33	33	7
1903	2	—4	24	27	31	41	56	54	39	30	13	3
1904	—9	5	27	23	47	57	56	59	44	26	22	9
1905	—7	—13	28	28	51	56	95	99	93	29	22	14
1906	6	—4	5	36	40	53	58	55	56	29	39	12
1907	3	6	27	25	39	49	57	56	43	29	20	19
1908	11	7	28	26	39	50	58	60	40	50	21	15
1909	0	2	22	27	34	55	56	53	38	27	25	—2

NORMAL MONTHLY AND ANNUAL TEMPERATURE AND PRECIPITATION.

Month.	Evansville.		Princeton.		Marengo.	
	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.
	°F.	*Inches.*	°F.	*Inches.*	°F.	*Inches.*
January	35.4	3.41	30.7	2.96	33	4.9
February	32.3	2.98	32.9	3.23	35	6.5
March	44.6	4.84	42.3	4.33	44	5.3
April	57.0	3.55	54.7	3.37	56	5.4
May	67.0	4.38	64.1	3.67	65	5.2
June	76.3	4.67	74.6	4.35	74	5.4
July	79.6	3.54	76.9	2.83	77	4.0
August	78.4	2.09	75.1	2.64	75	4.2
September	71.9	2.48	68.2	3.16	69	4.0
October	59.2	2.87	55.4	2.16	57	3.1
November	45.0	3.67	42.9	3.82	45	5.4
December	35.8	3.02	35.3	3.15	36	4.2
Year	56.8	41.50	54.4	39.67	56	57.6

The frost records kept by the station at Mt. Vernon are more complete. The occurrences of the last killing frost in spring and first in fall during nine years are given in the following table:

DATES OF KILLING FROSTS.

Year.	Mount Vernon.		Year.	Mount Vernon.	
	Last in spring.	First in fall.		Last in spring.	First in fall.
1893	Mar. 29	Oct. 29	1899	Apr. 10	Sept. 27
1894	May 19	.....	1900	Apr. 12	Nov. 8
1895	May 14	Oct. 1	1901	Apr. 21	Oct. 17
1896	Apr. 4	Oct. 19			
1897	Apr. 20	Oct. 29	Average date	Apr. 17	Oct. 20
1898	Apr. 7	Oct. 27			

From the above table it appears that, at least along the Ohio River, there is an average period of one hundred and eighty-six days during which tender vegetation is safe from damage by freezing. This period is probably subject to local variation, due to differences of elevation or other physiographic features. There is usually adequate rainfall for the crops grown, and injury from drought is very uncommon, even to crops maturing late in the year.

SOILS.

The area presents a very great variety of soil types. The general descriptions given below will show the origin, texture, and character of the various soil types. The types will be fully discussed under the various counties in which they occur, and the most complete descriptions being given in the report of the county where drainage features have been much modified by the glacial sheet the type is best developed.

The soils of the area may be divided into the following groups: (1) Soils of the River Bottoms; (2) Soils of the Terraces or Second Bottoms; (3) Loess Soils; (4) Till or Boulder Drift; (5) Sand Hill Soils; (6) Lake Plain Soils; (7) Residual Soils.

SOILS OF PATOKA QUADRANGLE.

Descriptive Terms Used in This Folio.	Soil Names Used by H. W. Marean, Bureau of Soils (Ms. of report for 1902).	Geologic Equivalents.
Residual soils.		Steep slopes of Carboniferous deposits.
Drift soils.		Steep slopes of morainal deposits.
Common loess soils.	Miami silt loam.	Common loess.
Marl-loess soils.		Marl-loess.
Sand-hill soils.	Miami sand.	Earlier and later dune sands and Wisconsin terrace deposits (in part).
River sands and gravels.	Miami sandy loam. Yazoo sandy loam (in part).	Wisconsin terrace deposits (in part) and upper and lower flood-plain deposits (in part). Natural levees.
River silts.	Yazoo sandy loam (in part). Yazoo loam. Yazoo clay.	Upper and lower flood-plain deposits (in part).
Lake and subordinate stream silts.	Memphis silt loam (stream)	Older stream silts.
	Waverly silt loam (lake or swamp).	Glacial lake deposits (in part)
Swamp deposits.	Griffin clay.	Abandoned channel deposits. Swamp deposits.

"The soils of the Patoka quadrangle may be divided into nine very distinct classes, shown in the first column of the accompanying table, which gives the types recognized by the United States Geological Survey. By the refined methods of physical and chemical analyses some of these soils may be still further subdivided. These subdivisions, which are the results of detailed studies by Mr. H. W. Marean of the Bureau of Soils of the United States Department of Agriculture, are given in the second column. The third column states briefly their occurrence in relation to the geologic formations and surface deposits shown on the accompanying geologic map. The mechanical analyses and many of the details in the following description as to the productiveness are the results of the careful examination by the Bureau of Soils.

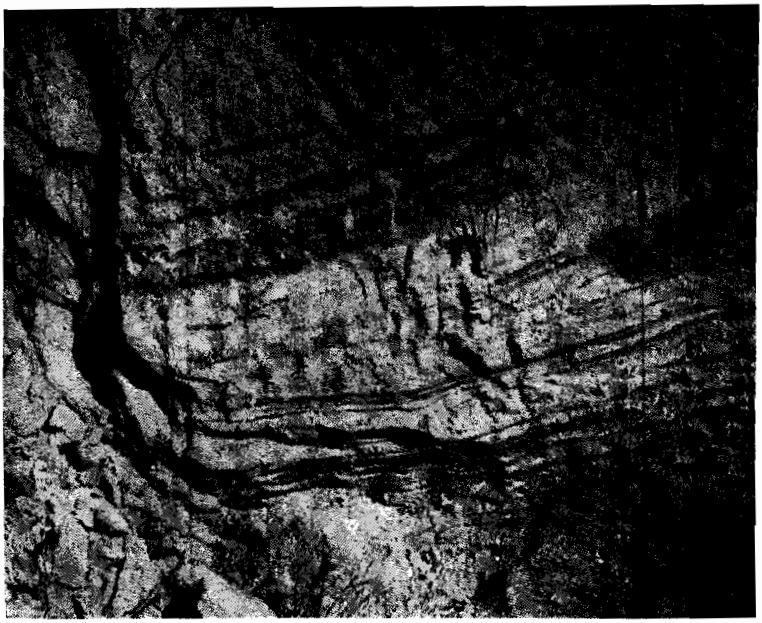
"*Residual Soils.*—Although the rock underlies the loess and drift at very moderate depths over the larger part of the uplands, it has been removed only on the steep bluffs and the sides of the sharper ravines. The soils of this type are usually stony, sandstone fragments predominating, though occasional shale soils were noted. The slopes on which they occur are generally too steep for cultivation and are covered with moderate growths of timber.

"*Drift Soils.*—As in the case of the residuary soils, it is only where the slope of the land is so steep that the coating of loess has been removed that the drift soils are found at the surface. The soils are generally sandy or even gravelly, but clayey types are not uncommon. Because of their limitation to steep bluffs and the sides of ravines they are never cultivated, but are generally timbered.

MECHANICAL ANALYSES OF LOESS SOILS FROM A POINT 1 MILE NORTH OF MOUNT VERNON, POSEY COUNTY, IND.

Diameter in Millimeters.	Conventional Name.	0–8 Inches from Surface.	8–36 Inches from Surface.
.0001– .005	Clay	13.68	9.10
.005 – .05	Silt	81.82	84.16
.05 – .1	Very fine sand	3.86	5.92
.1 – .25	Fine sand	.36	.50
.25 – .5	Medium sand	.08	.12
.5 –1.	Coarse sand	.14	.10
Total mineral matter		99.94	99.90
Organic matter, water		2.47	.34

"*Common Loess Soils.*—The common loess forms the immediate surface over the entire quadrangle, except on the river and stream flats and over the narrow belts of sand and marl-loess hills along the



U. S. Geological Survey.

Stratification in fossiliferous marl loess, near New Harmony, Indiana.

U. S. Geological Survey.

Stratification in the later sand dunes, near Mount Carmel, Ill.

borders of the Wabash Valley. It is generally of a light-buff to reddish-brown color, though becoming pale at times. The upper 9 inches is usually fairly open, but below the limit it is more plastic, tenacious and clayey. Under cultivation it becomes ashy gray in color. The materials of the loess were originally derived from diverse materials that were scattered over wide areas and it thus contains all the essential ingredients of an unusually fertile soil. It gives good yields of corn, wheat, clover, timothy, and would probably make good tobacco land. Fruit, especially apples, and some garden vegetables are raised. The average yield of wheat is said to be about twenty bushels and of corn from thirty-five to forty bushels per acre. The accompanying mechanical analyses by the Bureau of Soils indicate the physical character of the soil.

"*Marl-loess Soils.*—The marl-loess soils lie in two belts, one on each side of the Wabash Valley. They do not occur over the entire area mapped as marl-loess, but only along the edges of the belts next the river, the remaining portions being covered with common loess. In color the marl-loess is a pale yellow or straw color. It is also in somewhat marked contrast with the loess of the common type in composition, frequently carrying 5 per cent. or more of $CaCO_3$, while the latter generally contains less than 1 per cent. It weathers to a deep reddish brown and frequently shows abundant lime, even at the immediate surface, while in the common type the lime is rarely present at the surface. Its soil is superior to that of the common loess, with which it is sometimes mixed as a fertilizer, with some success. The following analysis, taken from the Thirteenth Annual Report of the Indiana Geological Survey (p. 46), gives a fair idea of its character:

CHEMICAL ANALYSIS OF LOESS, POSEY COUNTY, IND.

Constituent.	Amount.
Combined moisture	1.35
Soluble organic matter	.30
Insoluble silicates	73.30
Carbonic acid	10.00
Lime	6.80
Magnesia	3.78
Alumina and peroxide of iron	2.80
Chlorine	.12
Loess and alkalies	1.55
Total	100.00

"*Sand-hill Soils.*—The sand hills of the quadrangle are of two types, the first including the relatively fine white sands extending

from Keensburg westward to Bonpas Creek, and the second embracing the wider interrupted belt of coarse sands extending along the eastern border of the Wabash flats from near Hazelton to the southwestern limits of the quadrangle. In general these sand hills are so porous and are so well drained that they are poorly adapted to general farm crops, but large quantities of watermelons are grown, 500 to 1,000 car loads being shipped annually from Posey County. Stock peas are raised in small amounts, and wheat does well if it follows melons in rotation. Mr. H. W. Marean, of the Bureau of Soils, believes that alfalfa might profitably be introduced.

"*River Sands and Gravels.*—In this class are included the areas of coarser materials of both the lower and upper levels of the Wabash and White River flats. These areas, being limited to original depositional elevations, are of slight extent as compared with the areas of fine silts filling the intermediate depressions. In general the soils consist of buff sandy or gravelly loams which nearly always contain considerable quantities of fine silts and in places are mixed with considerable quantities of vegetable matter, giving almost black colors. In general the sandy soils are most common near the immediate banks of the rivers, where additions are constantly being made by overflow or through the action of wind.

"The higher portions of the sand and gravel flats will yield an average of twenty-five bushels of wheat per acre, and will afford good crops of clover or timothy. About forty bushels of corn per acre may be obtained. The sandier upper portions in places yield good crops of melons.

"*River Silts.*—By the term river silts is meant those finer deposits which have been mentioned as occupying the original depressions of the Wabash and White River flats. The material is largely what may be termed a coarse silt. While much finer than the sand of the preceding class of soils, it is coarser than the clayey silts of the smaller streams. These silts appear to be composed of particles which, as compared with those of the clay soils, are only moderately weathered. They constitute, next to the loess, the most important soils of the quadrangle, comprising the larger portion of the Wabash and White River flood-plains. Owing to the very recent drainage of much of the area of the flats, large tracts are still timbered. The cleared areas produce large crops of corn, averaging forty-five bushels per acre. The lower portions, next the river, are subject to annual overflow and are never troubled with drought. They include some of the best corn lands in Indiana and Illinois.

"An analysis of the river silts near Mount Vernon shows 2.42 per cent. of organic matter, 66.70 per cent. of silt from .05 to .005 millimeters, and 28.42 per cent. from .005 to .001 millimeters in diameter. This soil is frequently underlain by a gravel layer which is of great assistance in draining.

"*Lake and Subordinate Stream Silts.*—This class embraces the silt deposits of all streams except the Wabash and White Rivers and the broad drift flats marking the old lake beds. Most of the material is derived from the erosion and redeposition of the loess and is therefore exceedingly fine and clayey. The material is generally strongly weathered and leached of its lime. The stream silts are generally overflowed annually and are frequently wet throughout the year in places. Where artificial drainage has not been established the old lake flats are also very wet. Corn is the best crop, yielding fifty bushels per acre in places. Good crops of grass can also be grown.

"In the class of subordinate stream silts may also be included the clayey soils of some of the low terraces bordering many of the streams of the quadrangle, especially in the southern half.

"*Swamp Deposits.*—In this class are included the black silts, mucks, and peaty deposits that occur in the various depressions of the flood-plains and on the broad drift flats. The depressions of the flood-plains are of two types, the broad, shallow depressions, representing incomplete upbuilding of the plains, and the relatively narrow bayous and other abandoned stream channels. The broader depressions are usually filled by the slow accumulation of ordinary river silts, which are washed in at times of flood, and which are mixed with accumulations of leaf mold, etc., giving a black color to the whole. Occasional cypress ponds and swamps, in which the accumulations are almost entirely of vegetable matter, are found on the Wabash flats, especially northeast of Mount Carmel, on the Indiana side of the Wabash. The bayous are generally filled with silts mixed with large quantities of leaves, logs, etc.

"Many depressions in the surface of the drift flats marking the beds of the old glacial lakes have been occupied by shallow water bodies even up to within the memory of many of the present inhabitants. The soil of these portions consists of a black muck containing more or less silt washed in from the surrounding areas. The soil is very fertile and after drainage yields as high as fifty bushels of corn, twenty-five bushels of wheat, one and one-half to two tons of clover, or one and one-half tons of timothy to the acre.

The higher portions of the flats are characterized by the redeposited loess soils of the previous class."—Patoka Folio.

"*Soils of the River Bottoms.*—In this group is included the soils of the lowest portion of the bottom lands, or those subject to at least annual overflow. In the quadrangle they are best developed along the Patoka River, where they reach a breadth of several miles in places. Similar flats also border Pigeon, Little Pigeon, Blue Grass, Cypress Creeks and other streams. The soils generally consist of clay or almost impalpably fine sands, are whitish in color and 'cold,' being saturated with water in the winter and spring months and parched by drought in summer. Although portions of the bottom lands have long been under cultivation, large areas still remain forested, the most common timber being elm, red maple and gum; but where a considerable portion of sand is present beech, sugar-maple, overcup oak, and tulip trees also occur. Within the last few years somewhat extensive areas have been reclaimed for agricultural purposes by drainage ditches."

"*Soils of the Terraces or Second Bottoms.*—The soils of this group are limited principally to a narrow belt along the south side of White River west of Petersburg. They are composed of medium grained sand deposited by the river during the Wisconsin stage of the glacial invasions. They are much coarser in texture than the soils of the river bottoms, and not being subject to overflow are not so wet and cold as the former. The dune sands southwest of Petersburg may be placed in this group. Wheat seems to be the principal crop."—Ditney Folio.

VANDERBURGH COUNTY.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Vanderburgh County was organized in 1818, and named in honor of Henry Vanderburgh, a Captain in the Revolution and a man of prominence in the early history of the Northwest Territory and a judge of the first court formed in the Indiana Territory. In 1814 parts of Gibson and Warrick counties were taken to form Posey County, and then, later, parts of the three counties were taken to form the present area of Vanderburgh County.

The civil townships are: Pigeon, Knight, Scott, Armstrong, Perry, Union, Center and German.

Evansville, the county seat, was first settled in 1816 by Hugh McGary, and was named after Gen. R. M. Evans, one of the first inhabitants. It is located on the Ohio River. It is about 180 miles southwest of Indianapolis and about 200 miles from Louisville, by river. In 1850 the population was 5,000, in 1900, 59,000, and at the present time about 70,000, the second largest city in the State. The railroad facilities are good, six steam roads and four interurban lines and about thirty miles of street railway. The river traffic also keeps the city in touch with many important points. The following paragraphs from the Report of the Department of Statistics for 1907-1908, will show the class of business enterprises and the opportunities for development in Evansville:

"Through the Evansville business organization the city has secured some of its 275 factories, which include twenty-one furniture factories, eight foundries, three pottery, terra cotta and fire-clay products, eight brush and broom, three mattress and bed springs, four stove and furnace plants, six agricultural implement manufacturing establishments, four automobile, seven brick and tile, six wholesale meat packing houses, four awnings, tents and sails, one canning factory, eighteen carriage and wagon factories, four carpet, three leather belting and hose, six harness factories, six men's clothing, nine women's clothing, eight box factories, wooden and paper, and six railroad repair and car shops, and employ 9,500 men with an estimated pay roll of $30,000 weekly.

"Beneath Evansville and its surrounding country is a fine vein of coal, which is too deep, however, to be profitably mined, when it can be bought for sixty cents per ton. The Business Men's Association is ready to encourage any metal, wood or textile manufac-

turing establishment, and a factory site will be given free. Evansville claims to have the three essentials of a successfully conducted industrial enterprise which are as follows: an abundance of low-priced fuel, plenty of good labor and a location which assures quick transportation and low rates."

Howell, a suburb of Evansville, to the southwest, has a population of 2,000. The L. H. & St. L. and L. & N. railroads pass through the town and twelve passenger trains daily. The industries are the L. & N. repair shops and two chair factories. The town has three miles of street railway and other improvements which should enlarge growth in this place.

Staser (50), Englefield (200) and Erskine are stations north of Evansville on the E. & T. H. Railroad. Oakdam (25), Green River Road, Inglehart, McCutchensville, St. George, Straightline Jc., and Belt Yard are stations along the E. & I. Railroad northeast of Evansville. Martin, Armstrong (75), (creamery located here), Wilcox and Hillside are stations on the line of the Illinois Central, in the northwestern part of the county. North Howell and Belknap are on the L. & N. west line, and Cypress, a lumber station, Vaughn and Rahm are stops and switches along the south line of L. & N. St. Joseph (40) and Kasson (100) in the west side of the county, Zipp (120) in the central part, and Earle (45) in the central eastern part, are villages located some distance from the railroads and furnish trading centers for the surrounding population.

General.—In 1830 the population of Vanderburgh County was 2,610; in 1840, 12,000; and at the present time is estimated to be about 82,000; of this number Evansville is estimated to have about 70,000, and the town and village population is about 2,600, and the rural population would then be about 9,400. The area of the county is 236 square miles. The total population gives the number per square mile 348. The rural population allows six square miles for area occupied by cities, towns and villages, is about forty-two persons to the square mile. The greatest length of the county is nearly twenty-four miles and the greatest width a little less than fourteen miles. The total farm area, 142,287 acres, of which 120,619 acres are improved; the assessed value of farm lands and improvements is $5,560,140; and the total value of taxable property in the county is $41,988,810. Land varies in price from $35 in the rough parts to $150 per acre in the Ohio bottoms.

The county produces annually about 800,000 bushels of corn, an average of thirty to forty bushels per acre; wheat 450,000

bushels, an average yield of fourteen bushels per acre; oats, 25,000 to 50,000, yielding from ten to twenty-five bushels per acre; timothy, 11,250 tons or about one and one-third tons per acre; alfalfa is increasing in acreage, in 1908 over 100 acres being grown; clover, 9,000 tons, a yield of one and one-quarter to one and one-half tons per acre, and produces about 500 bushels of seed.

From 650 to 750 acres of potatoes are grown, yielding from fifty to eighty bushels per acre; tomatoes, only a very small area, from fifty to sixty-five acres yielding from fifty to 110 bushels per acre; peas, 300 to 500 acres; apples, from 3,000 to 4,500 bushels; and in 1908 the county ranked seventh in the number of pear trees, having 11,855; only five or six acres of tobacco are grown; no melons for the market, and a very limited amount of truck farming is carried on, considering the opportunities for good market and excellent transportation.

Transportation Facilities.—The transportation facilities for all parts of the county are excellent. The railroads leading out from Evansville are the E. & T. H., E. & I., the Peoria Division of Illinois Central, the St. Louis Division of the Southern, the Ohio Valley, the L. & N. and the St. Louis Division of the L. & N.; the Evansville and Princeton Traction Line, the E. & Mt. V., the E. & S. & N. to Newburg and Boonville, the E. & E. to Rockport and Newburg Suburban Line. The river traffic is of great importance to the county.

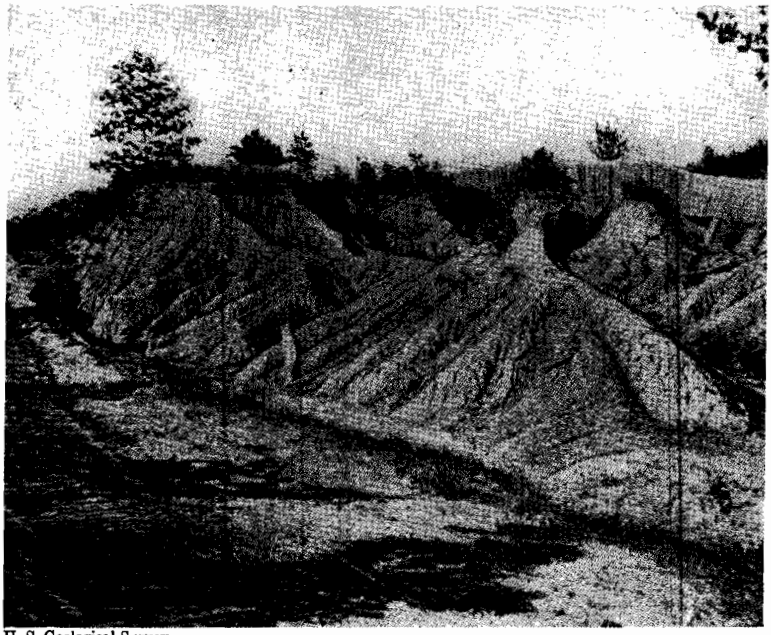
There are in the county 600 miles of public roads, with about 140 miles improved. The material used is limestone from the road metal quarry at Milltown, and from small local quarries and from the Ohio River gravel.

PHYSIOGRAPHY AND GEOLOGY.

In general the topography of the county is that of a fairly level tableland crossing the northern part, the Ohio River bottoms from two to five miles wide along the south and the wide bottoms of Pigeon and other creeks, with intervening upland somewhat broken. The upland is from 150 to 350 feet above low water on the Ohio. Evansville is 378 feet above sea level; and the low water mark is 326 feet; Erskine's, 381 feet 6 inches; Inglefield, 466 feet; Elliot. 410. The surface rocks are chiefly of the upper or Barren Coal Measures. The surface everywhere, except for a few small outcropping areas, is covered with the upland loess and alluvial deposits. In the upland the covering over the surface rock varies from a few inches to fifty feet.

U. S. Geological Survey.

Exposure of the Inglefield sandstone, near Inglefield Station, Ind.



U. S. Geological Survey.

Characteristic recent erosion topography in Till.

SOILS.

The soils of the county are divided into the two general groups, the upland and the bottom land. These groups comprise five distinct types.

The following table shows the extent of the various types:

	Square miles.
Loess—Miami silt loam	135
Reworked loess—lake plain	6
Alluvial—	
(1) Lower Ohio bottoms	45
(2) Smaller stream deposits	15
(3) Older stream silts	35
Total	236

1. Common Loess Soils. (Miami Silt Loam.)

This type is the most extensive soil in the county, covering all the uplands. In general the surface of the area upon which it occurs is gently rolling, but in places becomes considerably broken, and on the steeper slopes the loess has been washed away. The soil varies in color from gray to reddish yellow. The subsoil is more clayey and has a yellow to red color. The soil is principally a silt loam, with the silt as the principal constituent throughout the depth. Some fine sand is present and a small percentage of clay.

The soil is very uniform throughout the county, and has a high degree of fertility. Wheat yields from fifteen to twenty bushels per acre; corn, thirty to forty. The area is well adapted to fruit growing and several pear orchards have been planted, and apples and small fruits are now receiving attention. The area would be a most valuable one in which to engage in fruit growing.

The following table shows the results of mechanical analysis:

MECHANICAL ANALYSES.

Locality.	Description.	Organic Matter and Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt and Clay.
Near Bauer's.	Surface.....	1.50	.50	.30	1.20	3.50	92+
	Subsoil.....	2.20	.40	.15	.80	4.10	93
2 Miles E. Staser	Surface.....	1.20	.55	.40	2.50	4.10	90
	Subsoil.....	2.00	.50	.25	1.15	4.35	92+
West of Inglefield.	Surface.....	1.85	.40	.50	2.10	3.45	91+
	Subsoil.....	1.95	.50	1.50	3.00	5.30	88+

Chemical Analysis of Surface of Loess.

Laboratory number	43
Reaction to litmus	V. F. acid
Moisture at 105° C.	2.17
Total soil nitrogen	.104
Carbon dioxide	.....

Analysis of Fine Earth Dried 105° C.

Volatile and organic matter	3.035
Insoluble in (1.115 sp. gr.) HCL	88.456
Soluble silica	.010
Ferric oxide (FE_2O_3)	2.542
Alumina (Al_2O_3)	4.735
Phosphoric acid anhydride (P_2O_5)	.164
Calcium oxide (CaO)	.247
Magnesium oxide (MgO)	.493
Sulphuric acid anhydride (SO_3)	.022
Potassium oxide (K_2O)	.236
Sodium oxide (Na_2O)	.205
Total	100.145

Chemical Analysis of Subsoil of Loess.

Laboratory number	44
Reaction to litmus	V. F. acid
Moisture at 105° C.	3.09
Total soil nitrogen	.059
Carbon dioxide	.887

Analysis of Fine Earth Dried at 105° C.

Volatile and organic matter	3.563
Insoluble in (1.115 sp. gr.) HCL	84.405
Soluble silica	.012
Ferric oxide (FE_2O_3)	4.153
Alumina (Al_2O_3)	4.706
Phosphoric acid anhydride (P_2O_5)	.174
Calcium oxide (CaO)	1.372
Magnesium oxide (MgO)	.949
Sulphuric acid anhydride (SO_3)	.021
Potassium oxide (K_2O_3)	.296
Sodium oxide (Na_2O)	.201
Total	99.852

2. Lake Plain Soil.

This type covers an area of about ten square miles in the northern part of the county, being divided into two principal areas—that lying in the northwest corner, along Flat Creek, and a smaller area lying about Staser. The surface is generally level. This soil is also of loess origin and is composed of silts, sand and fine gravel

Farm view in edge of Ohio River valley, southwest of Howell, Vanderburgh County.

Melon field in sand dune area, West Owensville, Gibson County.

with a very small amount of clay. Most of the residual is very fine, having been eroded and redeposited from the loess. In most parts there is a high organic content, and the soil is of very dark color, is loamy and easily tilled. Corn is the principal crop, but in the better drained parts the wheat crop gives good yields. Hay is also grown to a considerable extent. See description of this type under Gibson County.

3. The Alluvial Soils.

The alluvial soils consist of three types: (1) That of the lower Ohio bottoms (Yazoo Clay and Miami Sandy Loam); (2) the smaller stream deposits; (3) older stream silts.

Soils of the Ohio Bottoms.—The principal soil is the same type as that found in a large area of the Ohio bottoms in Posey County, and has been designated as the "Yazoo Clay" in the soil survey of that county by the U. S. Bureau of Soils.

The soil is entirely an alluvial soil, and since the area is subject to overflows much material is added from year to year. The surface soil is a brown clay loam of great fertility and very easily cultivated. A small amount of organic material is contained in the soil and gives a good condition to the soil. The subsoil is more compact and at a depth of a few feet grades into a sandy clay or sand. This type of soil occupies all the great bend of the Ohio southwest of Evansville north to Bayou Creek and the greater part of the lower bottoms southeast of Evansville. The land is owned chiefly by farmers living in the uplands or by persons in Evansville and is rented, usually cash rent, ranging from $5 to $15 per acre, or in a few instances demanding even a higher price in some areas of the best parts of the great bend. Corn is grown almost exclusively and yields from 40 to 100 bushels per acre. Wheat grows well but is an uncertain crop because of the danger from overflows. Timothy and clover yield well. Land sells at prices ranging from $60 to $150 per acre, but there is little changing hands at any price. There is but very little timber land left and all the ponds and low lying tracts are being drained. The farms have but few permanent residents, and there are no towns within the area. The surface is level, with a gradual slope to the uplands, but the line is usually marked by a decided change in elevation. Near the upland the soil is more clayey, and this part is apt to be wet, and often contains bayous and swamps, but when drained out and put under cultivation it has a good state of tilth.

In the eastern part of the county the clay loam is separated

from the river by a narrow strip of sandy loam termed the "Miami Sandy Loam." In color and general appearance this type very closely resembles the former, but upon examination it will be found that the sand content is high, and, although the drainage conditions are good and a large amount of organic matter is present, the productiveness varies considerably. Corn and wheat are the principal crops. The area is small, but might be made to give good returns on special crops.

The following table shows the results of mechanical analysis:

Locality.	Description.	Organic Matter and Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt and Clay.
"Yazoo Clay." From U. S. Survey. One Mile E. Mt. Vernon.	Surface.....	2.60	.02	.02	.06	1.50	99
	Subsoil.....	2.27	.01	.02	.14	3.06	96.76
"Yazoo Clay." Five Miles S. W. Howell.	Surface.....	2.20	.10	.20	.15	1.70	98
	Subsoil.....	2.05	.10	.40	.20	3.50	96
Miami Sandy Loam. 4 Miles S. E. Evansville.	Surface.....	1.50	2.00	7.50	40.00	15.00	34
	Subsoil.....	1.55	1.60	10.40	42.50	12.00	22

Smaller Stream Deposits.—These soils occupy the valley of the smaller streams and are composed of silt and sands, with level, gently undulating surfaces and subject to overflows. The soil, while containing a limited area, is of great agricultural value. The surface soil varies in color from light yellow to brown, and has a varying amount of organic matter. The subsoil contains a larger amount of clay than the surface and becomes somewhat mottled in appearance, but still retains its silty character.

The soil is derived from material washed in from the uplands and mixed with decaying vegetable matter; this process is going on continually and the soil is thus kept in a good, fertile condition. The soils slope gradually to the stream but some artificial drainage is usually needed to secure the best results.

Corn yields about fifty bushels to the acre, wheat twelve to eighteen bushels, and grass makes an excellent growth. Some sorghum and a little tobacco are grown.

Older Stream Silts.—These soils are composed chiefly of fine silts containing a small percentage of fine sand and some clay. They occupy the upper valleys of some of the streams in the western side of the county, chiefly the tributaries of the South Fork of Big Creek and a large area north and east of Evansville and extending to the north along the eastern part of the county. The surface is comparatively level. Artificial drainage is required to obtain the best results. The soil is very fertile and gives good yields—corn fifty bushels, wheat twelve to twenty-five bushels,

clover and timothy one and a half to two tons per acre. Some truck farming is carried on in this region.

The material of which these soils is formed is supposed to be largely of pre-Wisconsin age, but mixed with material of more recent date. The larger areas are but slightly influenced by material from the uplands at the present time. The deposits show the work of overloaded streams in building up their beds. They consist largely of reworked loess with a marked clayey texture, but in places sandy and gravelly streaks occur.

SUMMARY.

Vanderburgh County is a prosperous agricultural region. The past few years have made marked developments, especially in the central and northern parts of the county. Good, substantial farm improvements have been made, and the increased demand for products by the growth of Evansville has stimulated an interest in intensive farming.

Farms range in size from 20 to 2,000 acres, but the average is from sixty to eighty acres. There is considerable variation in price, but all classes are on the increase. In parts where the land is farmed by the owners, improvements are good and prices high.

The river floods are rarely late enough to injure the corn crop. The regions about the bayous and swamps are often flooded until late in the year. These places are difficult to drain, but it is gradually being accomplished. In the higher parts of the bottoms some excellent improvements are found.

Corn is grown almost exclusively in the bottoms, but in the uplands various crops are grown and attention given to crop rotation. The most common is wheat followed by clover, which is used for hay and pasture for two or three years, and then followed by corn, and then wheat drilled in the corn, although some fall plowing is done for wheat. Stable manure and straw are well applied to the soils and the use of commercial fertilizers is not extensive.

There is excellent opportunity within the county for the establishment of manufacturing industries, creameries, canning factories, flour mills, etc., outside the city of Evansville, within easy reach of the raw material and still have good transportation facilities.

The soils have good natural fertility and are able to withstand drouth, and crop failures would not be expected except locally in unusual seasons.

Patoka River at Patoka, Ind., showing rock exposures and mill dam. The river valley, several miles wide in places, narrows here, the bluffs coming down to the stream on both sides.

Patoka River and railroad bridge near Gibson and Pike County line, north of Oakland City, Indiana. Showing wide valley.

GIBSON COUNTY.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Gibson County was organized in March, 1813. The territory had been previously included in the County of Knox. Since the first organization portions of Gibson County have been taken off, and have assisted in forming the counties of Posey, Vanderburgh, Pike, Warrick and Dubois.

The county was named in honor of General John Gibson, a soldier of the French and Indian and Revolutionary wars. He was secretary of the treasury from 1801-1816, and on numerous occasions was acting-Governor in the absence of Governor Harrison.

At the first division of the county into civil townships five were formed. The present townships are White River, Patoka, Montgomery, Wabash, Johnson, Barton, Columbia and Center.

The seat of justice was located February 14, 1814. The commissioners drew lots for the privilege of naming the county seat, and Captain William Prince was the lucky person.

Princeton, the county seat, is located a little north of the center of the county, twenty-seven miles north of Evansville. It has a population of about 8,000. In 1850 the population was about 800. Two railroads and an interurban line furnish the means of transportation. The Southern Railroad shops are located here. Sawmills, flour mills, machine shops, metal sewer works, a canning factory, glass factory and coal mining make up the principal industries. The town is making good progress and the improvements are good. The water supply comes from the Patoka River. The good agricultural community surrounding Princeton adds much to the business of the town. Financial assistance and free sites will be given industries seeking location.

Oakland City is situated near the eastern edge of the county, fourteen miles east of Princeton, and has a population of 2,100. Two railroads cross here, giving good transportation facilities to the town and surrounding country; there are fourteen passenger trains daily. The oil field recently developed in the locality has added much to the business of the town. There is an unlimited supply of coal and gas, and free factory sites will be given. A brick plant, planing mill, bent wood and heading factories are the principal industries. The water supply is from an artificial lake.

Fort Branch, on the main line of E. & T. H. and on Mt. Vernon branch of E. & T. H., also on Southern Indiana traction line, seven and one-half miles south of Princeton, has a population of 1,350. It is twenty miles north of Evansville and has fourteen passenger trains daily, and hourly interurban service. The present industries are a foundry and bridge works, a brick and tile factory and concrete works. The city is near the center of the county. The town is willing to assist in securing business enterprises. Clay works, canning factories and creameries would find a good location here.

Owensville, with a population of 1,300, is situated on the Mt. Vernon branch of the E. & T. H. Railway, eleven miles southwest of Princeton and in the center of the county. It is the center of the melon industry, ranking next to Decker, in Knox County. The present industries are sawmills, tile factories and flour mills.

Patoka, the oldest town in the county, is situated on the banks of the Patoka River, three miles north of Princeton. The town was formerly called Smithfield, and was platted in 1813 as Columbia, but was later given the name Patoka. In 1813-1814 the "black plague" swept over the town and greatly depleted the population, causing the defeat of the town for the county seat. The hotel and stage station for the stage line from Evansville to Vincennes was located here. The town now has a population of 700. The town is on the E. & T. H. Railway and has ten trains daily. It is the present terminal of the Southern Indiana traction line. The Patoka bluffs afford noted picnic grounds for neighboring towns and the surrounding country.

Hazleton, situated on the south bank of White River, six miles north of Patoka, has a population of 700. The second settlement in the county was made here, also the second ferry was established here and was a noted stage station in early days. It has ten passenger trains daily.

Francisco, on the Southern Railway, eight miles east of Princeton, has a population of 400. It is one of the towns which flourished during the time when the Wabash and Erie Canal was in operation, but has outlived most of the towns which sprung up at that time. Dongola, situated on the south bank of the Patoka, was another canal town which gave substantial growth, but ceased with the canal. The present industries of Francisco are two tile factories and a creamery. The town bids fair to grow, and some good opportunities may be had here by business enterprises.

Fetters is a lumber station and shipping point. Passenger trains do not stop here. A ferry crosses the Wabash giving good connection with Mt. Carmel, which is the chief trading place for the western part of the county.

St. James village is situated about a quarter of a mile west of station of same name. It has a population of 850.

Haubstadt, three miles south of Ft. Branch on the line of E. & T. H., and also on the line of the Traction Company, has a population of 300. It was formerly known as Haub's Station and was an old stage stand.

King's, three miles south of Princeton, has a population of about 150. The traction station is one-half mile west of the E. & T. H. Railway station. It affords a shipping point for timber brought in from the east part of the county and for grain and stock from the excellent surrounding agricultural community.

McGary, Mount, and Knowles, are stations and shipping points in the Mt. Vernon Branch of the E. & T. H. Railroad.

Somerville, in the southeastern part of the county on the E. & T. H. Railroad, has a population of about 100. It is the only town of importance in Barton Township and good roads lead out in all directions and large quantities of corn, wheat, oats, etc., are marketed here. Mackey and Buckskin are other stations south of Somerville.

The place known as Buenavista, on the river northeast of Hazleton, was laid out as a town in 1848, but ceased when Hazleton was founded. A ferry was established here about 1800, and was known as Decker's Ferry.

The Pioneers.—The pioneers of Gibson County will not be forgotten. Their labors have been crowned with success, even more than could have been anticipated. The honor of being the first white settler within the present limits of Gibson County belongs to John Severn, Sr., a native of Wales, who came to America several years before the Revolution. He located in Virginia. He had done considerable surveying and assisted the government surveyors in Maryland and Kentucky. About 1789-1790 he penetrated the wilderness of the Northwest Territory and settled on the south of the Patoka, near the place now known as Severn's Bridge. They lived for a few years after their arrival in a cave dug out of the side of the bluffs.

Next followed the Hazletons, who established a ferry on White River, where the town of Hazleton is now located. Daniel Robb,

a noble of Ireland, settled near the same place in 1800. The Hargroves, McClures, Montgomerys, Smiths, McGarys, Cockrums, Ralstons, Neeleys, Mounts, Woods and many others added much to the pioneer history of the county. Gen. Robert M. Evans was one of the most conspicuous men in the early history of the county. The Woods and Montgomery families were the largest families coming into the county. It is related that at early elections in the county these two families could elect any officer by their combined vote.

In 1816 Gibson County had a population of 5,330. In 1880 22,742, composed of persons of English, Scotch, Irish, German and French descent, with a considerable colored population. The present population is more than 30,000.

Military Donations, Locations and Surveys.—A portion of the land south of White River, in the north part of the county, was divided by the general government into militia donations, locations and surveys. These surveys were made between the years 1794-1802. These donations were originally made to a company of 128 militia men, of 100 acres each to the man, laid off in 100-acre plots. These lands were given for services rendered in one of the Indian wars. The persons were allowed to locate in the land or dispose of same in any way they cared. There were other locations which were given for various purposes to parties holding claims against the general government. William Rector was surveyor-general of the United States Survey, and under his supervision a portion of the county was laid out in sections, between 1801-05, and the balance at a later period.

The greatest length of the county from east to west is forty-eight and one-half miles, and north to south the greatest distance is about twenty miles. It has a total area of 490 square miles.

Transportation Facilities.—In the early days the stage line from Evansville to Vincennes carried many passengers. The first means for the transportation of surplus production were rafts and flatboats on the Wabash and up White and Patoka rivers. From 1832 to 1856 river traffic was quite active. The portion of the Erie Wabash Canal within the eastern part of the county also furnished a way of transportation for much of the county's products. But with the coming of the railroad the canal boat and stage coach gave way to better methods.

Patoka River, though not now a navigable stream, had its day of steam-boating. During high waters boats of small tonnage ran up as far as the town of Patoka and two small boats built on the

river above Patoka, one for steam trade, the other for moving flats and barges, operated for some time.

At the present time the county has fairly good transportation facilities. The main line of the Evansville and Terre Haute Railroad runs north and south through the county. The Evansville and Indianapolis line, crossing the southeastern side, is also operated by the E. & T. H. This line was built in 1854-56, and was known as the "Straight Line." The main line of the E. & T. H. was built in 1849-53. The Mt. Vernon branch across the southwestern, south of the county, was built in 1882. The St. Louis division of the Southern was built across the county from east to west about 1875. This line intersects the E. & T. H. at Princeton and E. & I. line at Oakland City. The Peoria division of the Illinois Central also touches the southwestern corner of the county. The Evansville and Southern Indiana interurban line, extending from Evansville to Patoka, adds much to the accommodations of the traveling public, and in the marketing of vegetables, fruits and melons from agricultural communities along the line.

The county has 1,350 miles of public road, with about 150 miles improved. The gravels of the terraces and flood-plains of the Wabash and along the bluffs of the Patoka are used as road metal. The greater part of the road material, however, is limestone shipped over the Southern from Milltown, Ind. In the northern part of the county near Hazleton, some river gravel is used. The first improved roads were built in 1899, and the county is making rapid progress in that line, and the people are well pleased with the investments in improved roads. In the sandy area in the western part of the county the roads are improved by addition of straw, hay, twigs and clay, otherwise they often preclude economic hauling because of the loose sand.

Agricultural Societies.—The Gibson County Horticultural and Agricultural Society was organized September 19, 1857. In 1852 a fair was gotten up by the merchants and farmers and the first fair was held about the Court House Square. No admission was charged and the premiums amounted to $30. The second fair was held in 1853 and $70 were paid as premiums. In 1856 the third fair was held, with 410 entries and premiums amounting to $225.

In 1857 the fair grounds were purchased and a fair held; there were 700 entries, with premiums amounting to $850, receipts $1,500. Fairs have been held every September since. The grounds are located at the northwestern limits of the city and contain twenty-

three acres, several halls for exhibits, and several hundred stalls for stock are on the grounds. The agricultural and horticultural exhibits are good, the number of stock shown each year is large and the good of the county is materially advanced each year by the fair, which is considered the best in the State from an agricultural standpoint.

General.—The total taxable property of the county amounts to $18,818,155, and the farm lands and improvements to $8,844,105. The total farm area comprises 278,830 acres, of which 242,145 acres are improved. The average price of land is about $65 per acre. The mineral resources are coal, clay, gas and oil.

The county produces annually, according to the statistics of 1907 and 1908, 2,000,000 bushels of corn, an average yield per acre of about thirty-five bushels; wheat, 750,000 bushels, with an average yield of twelve bushels per acre, and ranking second in the State in 1908 as the total average of wheat, having 60,000 acres, and ranking sixth in the total yields; oats, 150,000 bushels, an average yield of about eighteen bushels per acre; a large acreage of timothy is grown each year, and yields about one and one-third tons per acre; alfalfa growing is beginning to receive attention, and about 300 acres were grown in 1908. The clover crop ranks among the leading counties of the State, with an average of 10,000 to 12,000 acres, yielding from one and one-half to two tons per acre and producing 500 to 1,500 bushels of clover seed.

Large crops of cow-peas are grown, especially in the sandy acres. They make very rank growth and are the principal source of stock food. From 20,000 to 50,000 bushels of potatoes are grown annually, but that is a small amount, considering the adaptability of the soils and the ready market for potatoes. The average yield is about fifty bushels per acre. About 100 acres of tomatoes are grown, yielding about 100 bushels per acre. The county ranks among the first in the growing of peas, watermelons and cantaloupes. About 1,200 acres of peas are grown annually. From 1,500 to 1,800 acres of watermelons and from 500 to 800 acres of cantaloupes, ranking first in the State in the production of both. A few acres of onions are grown and give a good yield. No tobacco is grown for the market. In 1908 the county produced about 10,000 bushels of apples. Considerable attention is being given to the growing of pears, there being about 25,000 trees at the present time.

The number of live stock raised is rapidly on the increase. The value of pure bred stock is beginning to be realized.

Erosion in loess and under drift down to residual materials. Southeast of Princeton.

Another view of same as above.

Dairying is beginning to be a paying business. Butter making by the farmers is the chief use of the milk at the present time. Francisco has the only creamery within the county. Some milk is shipped to Evansville.

The rapid growth and development within the county in the past few years has placed the county among the leading counties of the State. The growth of the county is shown by the increase of population from 5,417 in 1830, and 11,000 in 1850, to more than 30,000 at the present time. During the last twenty-five years the corn crop has been doubled. Large areas formerly too wet for cultivation are being reclaimed and the wide range in the adaptability of the soils make all crops give good returns. Considerable attention is given to crop rotation and crop fertilization, and as a result most of the land is in good condition. The yield per acre of wheat has declined considerably since the years 1879-85. This is no doubt due to the increased acreage, and the attempt of some farmers to grow wheat for a number of years on the same land without proper fertilization, and also due to the low yields of wheat which come from run-down rented lands. The wheat yield at the present time, while not so high as some other counties, is pretty regular from year to year.

In the areas of the best soil types the land is owned chiefly by those who live upon it, and most of the settlers are considered well-to-do. The thrift of the farmers is shown in the economy of the land, the permanent improvements and general rural advantages.

PHYSIOGRAPHY AND GEOLOGY.

In general the topography may be said to be broken in the eastern part, with deep ravines, and elevated tracts with level surface areas and other places rolling and hilly. The central part is fairly level, or gently undulating, and the west and north sides have a very large area of bottom land. The entire surface is covered with the loess deposits reworked into many soil types. The underlying formations everywhere are the coal measures. The drainage is by Patoka, White and Wabash Rivers and Pigeon Creek in the southeastern part, and Black River in the southwestern part. The natural resources are coal, oil, limestone for road metal, and loess clays.

The various types of topography are given under the following heads: (1) Rugged Uplands, (2) Rolling Uplands, (3) Upland Plains, and (4) River Flats. The first two types have been pro-

duced by the action of stream erosion upon the hard rocks of the geological formations, and the results of erosion have been about the same throughout the county. The third and fourth types have been formed by the accumulation of loose material in recent geological times.

"*Rugged Uplands.*—In the group designated rugged uplands are included the highest hills and ridges of the quadrangle. The type is developed on both the drift and the rock hills, the former being most conspicuous in the region north of Patoka and the latter in the region north, northeast, and east of Princeton and in the area between Big Creek and the eastern edge of the quadrangle. In the latter area ridges several miles long, with moderately uniform crests, are numerous. As a rule, they are sharp and narrow and are characterized by steep slopes, which are cultivable only with difficulty. The minor channels, which are exceedingly numerous, are usually more or less V-shaped and are separated from one another by equally sharp divides. In their upper courses they exhibit steep descents.

"In the Ditney quadrangle, which is immediately east of the Patoka, the higher points of the uplands rise to nearly uniform elevations of from 600 to 640 feet, and are believed to be the remnants of an old surface, almost a plain in character, which once extended over the whole of this region. In the Patoka quadrangle, however, owing to the greater maturity of the drainage, the reduction is more complete, only an occasional peak rising to the 600-foot level. The hills on which the Princeton standpipe is built rise to 610 feet, those on the Petersburg road, two miles north of the same city, to 645 feet, those north of Maxams station, southeast of Princeton, to 625 feet, and that northeast of St. Joseph to 605 feet.

"*Rolling Uplands.*—In this class are included the lower and less rugged upland surfaces. The hills are generally much smaller than in the previous group. Their altitude seldom exceeds 550 feet, and they usually exhibit smooth, gently rounded forms. The valleys are broad and relatively shallow, showing gentle curves in cross-section, and are characterized by the low pitch of their streams, and by broad, flat divides. The rolling uplands are best developed in the vicinity of the older drainage lines, especially in the region west of the Wabash River. The Claypole, Gordon, Mumford, Foots Pond, and other hills projecting above the Wabash flats are to be classed in this type in part, although the flatter portions of their tops belong to the group next to be described. The sand hills

along the eastern border of the Wabash flats, the rock hills southeast of Hazleton, around Owensville, and along Big Creek, and the morainal ridges between Princeton and Fort Branch, southeast of Owensville, and near Poseyville and Cynthiana belong in the main to the rolling uplands, though the steeper portions approach the previous class in ruggedness.

"*Upland Plains.*—The upland plains consist of broad, flat, or gently sloping surfaces standing at an elevation of 500 feet or less and composed of deposits that accumulated during the period of the ice invasion or of loess or marl-loess deposited at a later period. The drift deposits are limited to the sloping drift plains east of the Princeton-Fort Branch moraine, the similar drift plains southwest of Fort Branch, and a few flat hilltops of the Mount Carmel quadrangle, where the rock is at no place far from the surface.

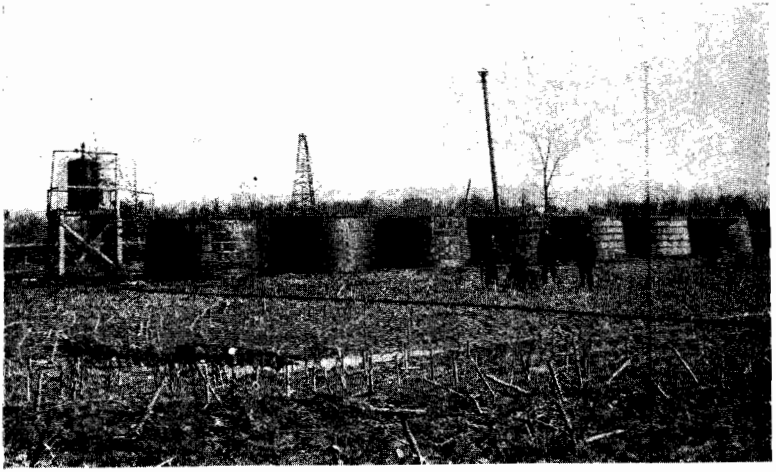
"The most conspicuous of the upland plains are the broad level or gently sloping marl-loess flats along the east side of the Wabash Valley south of the Black River and the smaller flats of the same material southwest of Mount Carmel, on Mumford, Foots Pond, and Claypole hills, and at points near Owensville and Hazleton. These marl-loess flats lie at a maximum elevation of 500 feet above sea level or about 120 feet above the Wabash bottoms. They frequently exhibit floor-like flats at this altitude, although sloping terraces, as in the Mumford Hills and along the north side of Big Creek, are more common.

"*River Flats.*—All of the rivers and large streams, and also many of the minor streams, flow through broad, flat plains of silt or of sand and gravel, which are generally overflowed, at least in part, each spring. Wells sunk for water show that the thickness of these silts and sands ranges from a few feet in the minor valleys to 150 feet or more in the valleys of the Patoka and Bonpas Creek. No deep wells are known in the portion of the Wabash or White River flats lying within the quadrangle, but the thickness of the deposits is probably 200 feet or more. In the process of the upbuilding of this considerable thickness of sediments the minor hills and valleys have been entirely obliterated, only the higher prominences rising as 'islands' above the flats. The general level of these flats is very uniform, being a little over 400 feet above the sea in the higher portions of the Wabash flats at the northern edge of the quadrangle, and about the same in the White and Patoka river bottoms. There is, however, a gentle slope southward to a 370-foot level at the southwest corner of the quadrangle. The low rate of fall has led to the development of meanders, which, because

of their resistance to the free flow, cooperate with it in giving rise to annual overflows that cover all but the higher portions of the adjacent flats to depths of several feet. This frequent overflow leads to many changes in the courses of streams, and bayous and abandoned channels are common." *

*Description of Ditney quadrangle.

View in oil field, showing tanks and pumping station, and the general topography of the land.



View in oil field, as above, near Oakland City, Indiana.

SOILS.

Gibson County has a great variety of soil types, with a wide range in adaptability. All the ordinary crops are grown, many special crops, truck farming and fruit growing, and each finds a soil specially suited to its needs—the loess soils of the uplands for wheat, sand hills for melons—corn along the stream bottoms and river flats and on the lake plains. The soils all have a marked degree of natural fertility. Fertilizers are not used extensively except on the areas where special crops are produced.

The following table will give the area of the various types:

	Square miles.
Miami silt loam—	
Common loess	302
Marl loess	10
Lake plain	27
Sand dunes and ridges	30
Alluvial—	
Upper flood plains	75
Lower flood plains	42
Swamp deposits	4

COMMON LOESS. (MIAMI SILT LOAM).

The common loess soil cover the greater part of the county, and has but little relation to the character of the topography. It varies greatly in depth, but is usually from 5 to 10 feet thick. This soil is a fine, silty material containing considerable clay. It varies in color from brown, or reddish to gray and is often mottled on fresh surfaces. The lime content is usually much lower than in the Marl-loess. Lime concretions are rare, while small iron concretions are abundant in places; there are but few ordinary pebbles found in the loess in its natural condition. The great mass of the loess is supposed to be of wind origin, the material having been derived from the Marl-loess deposits of the Wabash valley.

In their natural position the loess soils are usually of a buff color, but when exposed to the air in cultivation the color becomes ashy gray and in texture becomes more compact. All crops grow well upon the loess soils. The rolling upland topography of the common loess area permits of good drainage conditions and the soil is kept in good condition.

For further information concerning common loess soils, see Vanderburgh county and description of Boonville area.

Soil samples Nos. 45 and 46 were made up of equal samples from several locations of the loess area, thoroughly mixed and part taken

for chemical analyses and part for mechanical analyses. The sample No. 50 was taken near Princeton. The chemical analyses were made by Dr. R. E. Lyons, Bloomington, Indiana.

The Marl-loess occurs along the immediate border of the Wabash valley and does not extend far back except at a few points. The soil is usually of a light yellowish color, easily tilled and is productive. This type has been more fully described in the foregoing pages of the report.

Mechanical Analyses of Common Loess.

Locality.	Description.	Organic Matter.	Gravel.	Coarse Sand.	Medium. Sand.	Fine Sand.	Very Fine Sand.	Clay and Si t.
No. 45. Mixed Samples. No. 46.	Surface....	1.50	.0	.50	.75	.95	4.10	92+
	Subsoil....	.60	.50	.75	.60	1.05	4.85	91+
Clay Pit South Side Princeton.	Surface....	2.10	.10	.20	.50	.75	6.00	90
	Subsoil....	.50	.25	.50	.80	1.10	7.50	89

Chemical Analysis of Surface of Loess.

Laboratory number	45
Reaction to litmus	V. F. acid
Moisture at 105° C	2.41
Total soil nitrogen	.125
Carbon dioxide	.....

Analysis of Fine Earth Dried at 105° C.

Volatile and organic matter	3.655
Insoluble in (1.115 sp. gr.) HCl	88.395
Soluble silica	.031
Ferric oxide (FE_2O_3)	3.211
Alumina (Al_2O_3)	3.391
Phosphoric acid (P_2O_5)	.156
Calcium oxide (CaO)	.279
Magnesium oxide anhydride (MgO)	.398
Sulphuric acid anhydride (SO_3)	.036
Potassium oxide (K_2O)	.245
Sodium oxide (Na_2O)	.254
Total	100.051

Chemical Analysis of Subsoil of Loess.

Laboratory number	46
Reaction to litmus	Acid
Moisture at 105° C	3.54
Total soil nitrogen	.074
Carbon dioxide	.....

Analysis of Fine Earth Dried at 105° C.

Volatile and organic matter	3.398
Insoluble in (1.115 sp. gr.) HCl	84.721
Soluble silica	.073
Ferric oxide (FE_2O_3)	4.641
Alumina (Al_2O_3)	5.283
Phosphoric acid (P_2O_5)	.145
Calcium oxide (CaO)	.231
Magnesium oxide anhydride (MgO)	.477
Sulphuric acid anhydride (SO_3)	.029
Potassium oxide (K_2O)	.372
Sodium oxide (Na_2O)	.192
Total	99.562

	No. 50. Common Loess.	No. 1. Princeton.
SiO_2		71.20
Al_2O_3		18.56
Fe_2O_3		1.34
Fe		.15
CaO		.14
CO_2		.....
TiO_2		.88
MgO		.52
Na_2O		1.26
K_2O		.32
H_2O		6.30
Total		100.67

Chemical Analysis of Surface Marl Loess.

Laboratory number	47
Reaction to litmus	Acid
Moisture at 105° C	1.21
Total soil nitrogen	.074
Carbon dioxide	.....

Analysis of Fine Earth Dried at 105° C.

Volatile and organic matter	1.882
Insoluble in (1.115 sp. gr.) HCl	92.086
Soluble silica	.022
Ferric oxide (FE_2O_3)	2.202
Alumina (Al_2O_3)	2.314
Phosphoric acid anhydride (P_2O_5)	.139
Calcium oxide (CaO)	.334
Magnesium oxide (MgO)	.333
Sulphuric acid anhydride (SO_3)	.017
Potassium oxide (K_2O)	.159
Sodium oxide (Na_2O)	.208
Total	99.696

Chemical Analysis of Subsoil Marl Loess.

Laboratory number	48
Reaction to litmus	V. F. acid
Moisture at 105° C	3.66
Total soil nitrogen	.071
Carbon dioxide	2.137

Analysis of Fine Earth Dried at 105° C.

Volatile and organic matter	4.718
Insoluble in (1.115 sp. gr.) HCl	79.856
Soluble silica	.083
Ferric oxide (FE_2O_3)	4.612
Alumina (Al_2O_3)	6.864
Phosphoric acid anhydride (P_2O_5)	.128
Calcium oxide (CaO)	1.901
Magnesium oxide (MgO)	.683
Sulphuric acid anhydride (SO_3)	.022
Potassium oxide (K_2O)	.382
Sodium oxide (Na_2O)	.242
Total	99.491

Lake Plains.

For the origin and nature of the Lake Plains Soils, see descriptions of Lake Plains in preceding pages and also following in descriptions of Patoka Lake Plain in Pike county. The lake plain soils in Gibson county are more fertile than that of the Patoka Lake plain.

Miami Sand.

The above term is applied to the dune sands and parts of the terrace deposits extending along the eastern border of the Wabash flats, from near Hazleton, in a southwestern direction to the Posey County line near which the type reaches its maximum width. The area varies in width from about one-fourth of a mile to almost four miles, and is almost continuous across the county, and extends into Posey County, varying in width from one-fourth of a mile to a mile to a distance of several miles below New Harmony.

The soil varies from a medium to coarse sand, of a dark reddish brown on freshly exposed surfaces and becomes light color on leached areas. Small percentages of silt and clay are found in the soil and in places becomes quite loamy and grades gradually into the silt loams of the uplands; the clay content increases with depth. The coarse sand is in some places interbedded with fine or marly sand, very similar in texture to the marl loess, and where vertical

faces have been exposed shows traces of stratification, but never the perfect stratification of the marl loess.

The sand hills have a typical dune topography, somewhat influenced by surface agencies and the original forest growth. The sand has a maximum thickness of about one hundred feet. Some variation in texture and color occur with depth. The material is chiefly a quartz sand with rounded grains, carrying also some silt clay and imperfect fragments of shells.

With the exception of some large kettle-like depressions the area is well drained. In fact the sand hills are so porous and perfectly drained as to be poorly adapted to general farm crops, but large quantities of watermelons and cantaloupes are grown. Formerly the sand areas were considered of little value, but the good profits derived from melon cultivation has made the price of land take a big advance. In 1908 Gibson County ranked first in the production of watermelons and cantaloupes, having an area of 2,500 acres devoted to their growing, lying chiefly within the sand areas adjacent to the Wabash bottoms. Considerable acreage of cow-peas as a forage crop and garden peas for canning factories are grown. Some wheat is grown, and it is stated that it does well where it follows melons in rotation; but corn, on account of late maturing, suffers from drought. Clover is grown on a very limited area, and alfalfa culture is being introduced.

The origin of the sands of this area is difficult to determine. It may have been transported to its present position as the loess soils of the uplands. The roundness of the quartz grains and the traces of stratification in the subsoil would lead to the conclusion that the material was deposited in water. Others believe it to be wind blown sand of a later geological age than the loess.

The following paragraph from the "Patoka Folio," U. S. G. S., gives some information as to the origin and formation: "The upper flood-plains are bordered by broad and originally forested dune belts, apparently composed of sands derived from the surface of the flats. The muck and a part of the surface silts are undoubtedly of recent origin, but as important dunes are nowhere forming under the conditions now existing in this region, it is thought that they represent an accumulation at a period of greater depositional activity, when broad, bare flats, possibly extending over the greater part of the present width of the valley, were exposed to the sweep of the winds, and when the rate of dune accumulation probably precluded the existence of a vegetable mantle. These conditions

are believed to have characterized the latter part of the Wisconsin Stage and possibly extended into Recent time. It is thought, however, that the covering of the flood plain and dunes with vegetation probably took place immediately upon the subsidence of the floods that are supposed to have attended the Wisconsin ice retreat, but it is considered safer to class both the flood-plain and dune deposits as transitional rather than with either the Wisconsin or Recent stages."

The following table shows the results of mechanical analysis of the Miami sand:

MECHANICAL ANALYSES OF MIAMI SAND.

No.	Locality.	Description.	Organic Matter.	Gravel, 2 to 1 mm.	Coarse Sand, 1 to 0.5 mm.	Medium Sand, 0.5 to 0.25 mm.	Fine Sand, 0.25 to 0.1 mm.	Very Fine Sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
7128	3 miles northwest of Poseyville.	Medium sand, 0 to 8 inches.	1.08	0.00	2.34	23.04	52.60	8.60	8.88	3.68
7126	4 miles west of Mount Vernon.	Medium sandy loam, 0 to 7 inches.	.60	.00	2.54	20.50	61.54	4.78	6.82	4.12
7127	Subsoil of 7126.....	Medium sand, 7 to 36 inches.	.22	.00	2.04	25.70	50.54	3.78	13.78	4.10
7129	Subsoil of 7128.....	Medium sand, 8 to 36 inches.	.52	.14	2.74	21.32	54.70	7.36	8.84	4.74

U. S. SOIL SURVEY, POSEY COUNTY, IND.

No.	Locality.	Description.	Organic Matter.	Gravel, 2 to 1 m m.	Coarse Sand, 1 to 0.5 mm.	Medium Sand, 0.5 to 0.25 mm.	Fine Sand, 0.25 to 0.1 mm.	Very Fine Sand, 0.1 to 0.05 mm.	Clay and Silt.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.* *P. ct.*
60	2½ miles west of Princeton. Surface.	Medium sand, 0 to 6 inches.	.80	.00	3.00	27.00	50.00	10.00	9.10
61	2½ miles west of Princeton. Subsoil.	Medium sand, 6 to 36 inches.	.00	.00	2.5	30.00	47.5	7.5	12.2
62	4 miles southwest of Owensville. Surface.	Medium sand, 0 to 6.	.50	.50	2.8	30.00	45.00	8.5	12.5
63	4 miles southwest of Owensville. Subsoil.	6 to 36.....	.00	.50	2.8	28.00	48.5	6.5	13.50

Watermelon field in sand area east of Hazelion near Pike County line.

Preparing cantaloupes for market, east of Hazelton, Ind.

Swamp Deposits.

Several areas of this type are found in the county, with a total area of about 2,500 acres. These include the soils of the low situations of the flood-plains and the beds of the old glacial lakes of the broad drift flats. In these areas there is little or no natural drainage and the soils are always more or less saturated with water. The material contained in these deposits consist of the silts, mucks and peat. The broader depressions are usually filled by the slow accumulation of river silts washed in at times of floods, and are mixed with large amounts of vegetable matter consisting of roots, leaves, etc., giving a black color to the deposit. The bayous and abandoned stream channels are filled with silts containing a very large percentage of leaves, grass, logs, mosses, etc., in various stages of decomposition, and the addition of mineral matter brought in by the waters of high elevation.

On the flood-plains the soil, with its mass of partly decayed vegetable matter mixed with silt and clay, forms a spongy incoherent mass of varying depth. The amount of organic matter diminishes over the edges of the deposit, and the surface is thus almost level. Most of these areas have recently been drained by artificial ditches, and are being placed under cultivation. Such soils do not as a rule yield good crops of corn under continuous cropping, but the best value would probably be derived from the growing of timothy, millet and other forage crops, with an occasional crop of corn.

In the depressions of the drift flats, many of which have been filled with water until recently the soil consists of a black muck containing more or less silt washed in from surrounding areas. The soil is said to be very fertile and after drainage yields as high as fifty bushels of corn, twenty-five bushels of wheat, one and one-half to two tons of clover, or one and one-half tons of timothy to the acre.

Reclamation of Bottom Lands.

"*Ditches.*—One of the notable features of the surface of the quadrangle is the existence of numerous wide flats bordering the present rivers and larger creeks and also occupying areas that are supposed to have once contained the larger lakes, such as those north of the Patoka River, southwest of Princeton, east of Cynthiana, and about Poseyville. The flats of both types originally included extensive undrained areas, shallow lakes of considerable size

remaining in the depressions throughout the year, even within the memory of many of the present inhabitants. Within the last forty years, however, and especially during the last decade, numerous ditches have been dug and the lake areas have been drained, and some of the finest crops of the region are raised where the waters formerly stood. Even now, however, though large areas, especially on the Wabash flats, have been drained by the McCarty, Blair, Stunkle and other large ditches built by county aid, many square miles of bottom land within the quadrangle are yet to be reclaimed for agricultural purposes. These undrained areas support a heavy growth of timber, which is now being rapidly cut off, both by lumbermen and farmers.

"*Dikes.*—The lowlands along the Wabash and White rivers are protected in some places from the scour of the overflowing waters in times of flood by systems of dikes or levees. The most important of these are located near Grayville, one on each side of the river. The one on the south extends along the neck inclosed by the sharp loop of the river on which Grayville is located and has doubtless been of importance in delaying the formation of a cut-off at this point. The second dike extends along the west bank of the river from a point about a mile south of Cowling to the southern portion of the area in the southward loop east of Grayville.

Summary.

Gibson County is in a prosperous agricultural condition. The county is large, has great wealth, and the farming population, for the most part, are progressive people, as is evidenced by the appearance of the homes, farms and general conditions throughout the county. All crops are grown successfully. The melon industry, however, has made the county famous. A superior quality of melons is grown on the sandy soils, and find ready markets in St. Louis, Louisville, Indianapolis, Chicago, Pittsburg and other large markets. The sand areas were formerly considered of little value, but at the present time but little can be bought for less than $100 per acre, and there is little desire to sell at any price. Three varieties of cantaloupes are grown, chiefly nutmegs, netted Rocky-fords and large netted. There is a good sale for all these varieties. They are marketed in baskets, which hold on the average about eighteen melons, and the yield is from 200-400 baskets per acre. The cantaloupe season begins about July 15, and they bring about 50 cents per basket to the grower; later in the season the price

drops to 20 and 25 cents per basket, according to season and quality. The baskets cost the growers about 4 or 5 cents. Some shipments are made loose in the car, also sometimes hauled loose in wagons to surrounding markets, but the price obtained is usually lower, and there is considerable loss from rough handling. In hauling to the cars the growers haul from 85 to 150 baskets. Cantaloupes average about $60 per acre to the grower.

Watermelon shipments begin about August 1. They are hauled in wagons to the market and about 100-125 is the usual load. The first cars shipped bring the grower about 22 cents each. In shipping early cars the melons are graded and the light weights are rejected. The sizes ranging from 15 pounds to 30 pounds make up the best shipments. Watermelons yield on the average 200 to 300 per acre, with an occasional yield of 800 to 1,000 or a carload per acre. The principal fertilizer used is well rotted stable manure. The melon crop is usually plowed three or four times in cultivation and additional care is used in keeping down the weeds and grass. Large numbers of refuse melons are fed to hogs.

In the Wabash flats it is plainly noticeable that drainage is the essential thing to secure good crops. Along the public roads where grading has been done and a ditch has been left at each side, the corn growing next to the road is a good color, makes excellent growth and would appear to yield 60-75 bushels per acre, but going from three to four rods from the roadside the corn dwindles to no value. Furrowing through the fields every eight or ten rods would be very beneficial to yield well. The soil seems to be very fertile and with a proper system of ditches and tile drainage the value of the land will be greatly increased. Large areas from which all salable timber has formerly been removed has been allowed to grow up in very dense second growth, not so much as yielding pasture except it be for goats and sheep. Marsh grasses of several varieties are very abundant, but none of these are of much value as forage or pasture. Blackberries are abundant and are gathered and marketed by many people at prices ranging from 8 to 15 cents per gallon.

In the area lying between the wet lowlands and the sand dunes and ridges the soils are in good condition and yield good crops. Tile drainage has greatly benefited the area. Corn is the principal crop, and many farmers would prefer the corn crop rather than the oil leases where the pipes and cables have been placed over the fields in such a manner as to prohibit successful cultivation.

The county was formerly covered with a heavy forest growth. Some good timber yet remains, and considerable tracts of small growth are found in parts of the county. Practically all the trees of this region are of value as timber, and those which usually indicate a good quality of soil. Fifty or more species may be found in any wooded tract, and in some location one class of trees will predominate, and in other locations different species will take the lead.

The soil conditions of the county should be carefully studied and a series of investigations made as to their needs. The soil is naturally productive, but by the continual cropping, the soils are depleted unless the proper attention is given to the rotation of crops and the methods of cultivation.

PIKE COUNTY.

Pike County was organized in 1817. Prior to this time the territory was included in Gibson, Knox and Perry counties, and at the first organization of the county it was made to include much more than at the present time; it was later divided to form Dubois County, and the latter in 1820 gave part of its territory to help form Martin County.

The county was named in honor of Gen. S. M. Pike, who fell at the capture of York in 1813. Among the early settlers were the Brentons, McIntires, Stewarts, Meads, Cares, Finns and others whose names have a place in the history of the county.

The civil townships are Clay, Madison, Washington, Jefferson, Logan, Patoka, Marion, Monroe and Lockhart.

The first settlement made in the county was made at Oak Springs in 1800, by Woolsey Pride. The first postoffice in the county was kept at the Springs about 1811, by Hosea Smith. This location was on an old Indian "Trace" leading from Vincennes to Louisville. The first mill was built by Henry Miley in 1824. In 1828 a tanyard was started in Petersburg, with a capacity of $1,200 worth of leather annually; it continued in operation for fifty years or more.

Petersburg, the county seat, is situated in the northern side of the county one mile south of White River. It was laid out in 1817, and was named after Peter Brenton, who made the principal donation for the purpose of obtaining the county seat. The first court house was built in 1818, another in 1830 and another in 1868. The first business enterprises established were a horse mill and a carding machine. The present population is 2,250. The E. & T. H. Railway passes through the town. There are six passenger trains daily. Several rural routes go out from the postoffice to serve the surrounding county. A glass factory, brick factory, two flour mills, two sawmills, a pearl button factory and two grain elevators, employing about 300 men, make up the leading business enterprises.

The town has a good location on an elevated tract on the east side of Prides Creek, and is surrounded by fertile soil.

There are numerous opportunities for new establishments—canning factories, creameries, clay works, etc. New enterprises will be assisted, and cheap fuel is available. White River is the source of water supply.

Winslow, with a population of 1,100, is situated ten miles south-

east of Petersburg, and is on the line of the Southern Railroad, and has six passenger trains daily. The town is about one mile north of the railroad station. Six rural routes go out from the town. Two flour and feed mills are located here. There is considerable workable timber in the surrounding county, and workable deposits of clay are available, and steam coal may be had at a very moderate price. Natural gas has been found and some oil developments are being carried on at the present time.

Otwell, situated near the eastern edge of the county about twelve miles east of Petersburg, has a population of about 300. It is near the center of the Patoka Lake Plain, which forms a good agricultural region. It is a prosperous village, considering it has no transportation facilities. The road running from Jasper, in Dubois County, to Petersburg, passes through Otwell, and is a much traveled highway. A flour mill, sawmill and creamery are located here.

Velpen, seven miles east of Winslow on the Southern, has a population of 240. Several small industries are carried on here. It is a good shipping port for farm products and timber.

Ayrshire station is about one mile west of Winslow station, and has a population of 150.

Hartwell Junction is about four miles east of Winslow and has a population of about 200. The railroad here sends a branch line a few miles in length down to Cabel, which has a population of 125. Augusta, a little more than a mile to the west of Cabel, has a population of 260.

General.—In 1830 Pike County had a population of 2,464, in 1850 about 6,500, and at the present about 20,500.

The greatest length of the county is twenty-two miles from north to south, and the greatest width is twenty-one miles from east to west, with a total area of 336 square miles. The total farm area of the county is 200,724 acres, of which 172,700 acres are improved. The value of farm lands and improvements is estimated at $3,766,275, and the value of its taxable property is $7,265,880. Land varies in price from $15 to $80 per acre. The mineral resources are coal, clay, gas and oil.

The county produces annually, according to the latest statistics, about 1,000,000 bushels of corn, an average yield of about thirty bushels per acre; wheat, 275,000 bushels, with an average yield of ten to twelve bushels per acre; oats, 75,000 bushels, an average yield of about ten bushels per acre; timothy, 12,000 acres, with a yield of one and a half tons per acre; alfalfa grows well but has only been

tried since about 1905, but in 1909 about 125 acres were found in alfalfa meadow; clover is a good growing crop and about 4,000 acres are grown, with a yield of one and a half tons per acre and about 600 bushels of seed. A few acres of cow-peas are grown, and their cultivation has proven very beneficial to the upland soils.

Potatoes are grown only for local use, having an acreage of about 150 acres and yielding fifty bushels per acre. The yield is excellent under good conditions and many potatoes for the market might be raised in this county. Only a few tomatoes have been grown in the county and the yield was only fair, being about sixty bushels per acre. In the growing of peas the county ranks high, in 1907 holding seventh place in the State in acreage of peas grown, having at that time about 975 acres. From sixty to seventy-five acres of watermelons are grown each year; a few cantaloupes are grown in some parts of the county, but so far they have received but little attention. Some tobacco is grown for the market, the yield is good and the acreage from seventy-five to 200 acres.

In 1908 the county ranked ninth in the State in the acreage of tobacco, having in that year 206 acres. The county yields from 3,000 to 10,000 bushels of apples each year and ranks tenth in the State in the number of peach trees, having at the present time about 30,000 trees.

Recently more attention is being given to stock raising. In the eastern part dairying is receiving considerable attention. Hog raising is now becoming an important occupation, and the number of sheep kept is gradually increasing. Large tracts of the rough upland soil is practically unused and would afford excellent grazing.

Transportation Facilities.—Two railroads cross the county, the E. & I. from north to south, and the St. Louis division of the Southern from east to west. There are at present twelve passenger trains daily on these roads. The northeastern corner and the southern part of the county are shut out from railroad transportation, and all produce to be shipped must be hauled twelve to fifteen miles to the railway stations.

There are 1,200 miles of public roads in the county, with about forty miles improved. Good road material is very scarce, and the first improvement was made in 1902. Improvement has been made chiefly with limestone with a top dressing of gravel from the sand bars of White River, northeast of Petersburg. Many of the roads which have not been improved with stone or gravel are well graded and kept in good condition.

PHYSIOGRAPHY AND GEOLOGY.

Pike County in the northwestern part is fairly level or rolling. East from Petersburg, the divide between White and Patoka rivers, is made up of rather broken parts to the south, fairly level to the north and includes the Patoka Lake Plain in the eastern part. After passing the flat areas of the Patoka bottom the land becomes very hilly and continues to increase in roughness to the southern boundary. The area is covered with the loess material, except for some small till areas, terraces and sand hills along the northern edge of the county, residual areas in the southwestern part, along the steep hills and ravines, and the alluvial soils which are in part derived from the loess.

White River forms the northern boundary of the county and its main tributaries from the county are Harbin's, Conger, Beech, Pride's, Mud and Bear Creeks. The Patoka, a muddy and sluggish stream, flows across the center of the county from east to west. The principal tributaries are Flat, Stone, Coal and Sugar Creeks from the north; Rock, Cup and Barren Creeks and South Patoka River, with its tributaries, on the south.

SOILS.

The soils of Pike County consist of seven distinct types, the area of each being shown as follows:

	Square miles.
Miami silt loam (loess)	265
Patoka lake plain	20
Sand dunes	1
Till and terrace	5
Residual	5
Alluvial—	
White River	15
Patoka River	25

Patoka Lake Plain.

The Patoka Lake Plain occupys an area in eastern Pike County of about twenty square miles and extends over into Dubois County, where a large area is covered in the northwestern part of the county. The soils consist of modified loess containing a large percentage of silt, sand and rarely fine gravel. The soil to a depth of 8 to 12 inches is a loose loamy material, varying in color from light gray to light brown, and becomes lighter in color in the subsoil, but often with a mottled appearance due to a brown stain of iron oxide.

The soils were formerly very wet, but they have been sufficiently drained that practically the entire area is under cultivation. The soil in the western part of the plain is not so good as that part lying in Dubois County, but for the most part is of great agricultural value.

Wheat is extensively grown and yields from ten to thirty bushels per acre; corn yields from thirty to seventy-five bushels; oats, rye, clover and timothy make good growths. Land sells for from $50 to $100 per acre. Fruit growing is engaged in in a limited way. Hogs and cattle are the principal stock raised. Dairying is engaged in and a good creamery is established at Otwell, the principal town of the area.

There are no railroads through the area. The public roads are well graded and in good condition most of the year, although but a very small part have been improved with gravel or stone.

MECHANICAL ANALYSIS OF PATOKA LAKE PLAIN SOILS.

Number.	Locality.	Description.	Gravel.	Coarse Sand.	Medium Sand.	Fine Sand.	Very Fine Sand.	Silt and Clay.
26	Two miles northwest Ireland..	White soil..	.0	1.0	.0	3.0	15.0	81.0
25	One-half mile " " ..	Brown soil..	.0	1.5	.1	2.5	12.0	83+
41 & 42	W. Otwell	White.....	1.5	1.0	.5	2.8	14.0	80+

Chemical Analysis of Brown Soil, Patoka Lake Plain.

Laboratory number	25
Reaction to litmus.....	Acid
Moisture at 105° C.....	1.51
Total soil nitrogen.....	.103

Analysis of Fine Earth Dried at 105° C.

Volatile and organic matter.....	3.451
Insoluble in (1.115 sp. gr.) HCL.....	89.299
Soluble silica	.013
Ferric oxide (FE_2O_3)	2.691
Alumina (Al_2O_3)	3.111
Phosphoric acid anhydride (P_2O_5)	.178
Calcium oxide (CaO).....	.358
Magnesium oxide (MgO).....	.525
Sulphuric acid anhydride (SO_3)	.045
Potassium oxide (K_2O)	.331
Sodium oxide (Na_2O)	.409
Total	100.411

Chemical Analysis of White Soil, Patoka Lake Plain.

Laboratory number	26
Reaction to litmus	Acid
Moisture at 105° C	1.33
Total soil nitrogen	.089

Analysis of Fine Earth Dried at 105° C.

Volatile and organic matter	2.819
Insoluble in (1.115 sp. gr.) HCL	91.961
Soluble silica	.083
Ferric oxide (FE_2O_3)	1.415
Alumina (Al_2O_3)	2.447
Phosphoric acid anhydride (P_2O_5)	.093
Calcium oxide (CaO)	.508
Magnesium oxide (MgO)	.440
Sulphuric acid anhydride (SO_3)	.052
Potassium oxide (K_2O)	.213
Sodium oxide (Na_2O)	.305
Total	100.336

Chemical Analysis of Surface Patoka Lake Plain.

Laboratory number	41
Reaction to litmus	Acid
Moisture at 105° C	1.51
Total soil nitrogen	.119

Analysis of Fine Earth Dried at 105° C.

Volatile and organic matter	2.872
Insoluble in (1.115) HCL	90.931
Soluble silica	.112
Ferric oxide (FE_2O_3)	2.208
Alumina (Al_2O_3)	2.158
Phosphoric acid anhydride (P_2O_5)	.099
Calcium oxide (CaO)	.287
Magnesium oxide (MgO)	.329
Sulphuric acid anhydride (SO_3)	.046
Potassium oxide (K_2O)	.165
Sodium oxide (Na_2O)	.266
Total	99.473

Chemical Analysis of Subsoil Patoka Lake Plain.

Laboratory number	42
Reaction to litmus	Acid
Moisture at 105° C	2.88
Total soil nitrogen	.064

Analysis of Fine Earth Dried at 105° C.

Volatile and organic matter	2.922
Insoluble in (1.115) HCL	86.799
Soluble silica	.072
Ferric oxide (FE_2O_3)	3.687
Alumina (Al_2O_3)	5.136
Phosphoric acid anhydride (P_2O_5)	.076
Calcium oxide (CaO)	.260
Magnesium oxide (MgO)	.522
Sulphuric acid anhydride (SO_3)	.028
Potassium oxide (K_2O)	.182
Sodium oxide (Na_2O)	.289
Total	99.973

Till and Terrace.

Till.—Along the edge of the White River Valley west of Petersburg to the county line are deposits of glacial till, exposed in part and partly covered with the loess soils. The underlying formations seem to have had some part in the formation of the material. The texture of the till varies greatly, depending on the nature of the material from which it was derived. Where the surface is rough enough for the till to be exposed the land is covered with timber growth.

Terraces.—The terrace deposits are of small area, occurring along the edge of the White River bottom west of Petersburg. They are composed of medium sands, have good drainage and are fairly productive; wheat and corn are grown.

Sand Dunes.

Sand.—A limited area of about one square mile, just west of Petersburg is covered with sand. The sand is rather coarse, and is used to some extent for economic purposes. The area is too small to be considered from an agricultural standpoint, although some crops are grown.

Residual.

Residual.—In the southeastern art of the county some small areas in the rough topography present some residual soil. This is derived from the coal measure formation and is confined chiefly to hillsides too steep for cultivation. The soil is a sandy clay loam, with numerous iron ore concretions. Much of the soil of this part of the county is made up in part from residual material and does not maintain as high a degree of fertility as the uplands entirely of loess origin.

The Alluvial Soils.

(1) *White River Bottoms.*—White River proper and the East Fork form the entire northern boundary of the county, and with their tributaries on the south have a bottom area of about fifteen square miles, varying in width from a few feet to more than a mile. The soil is a sandy loam, containing considerable clay and silt. The color grades from a light yellow to black. The subsoil contains a greater amount of clay and in some places is very tenacious.

The area is not subject to overflow except after excessive rainfall, but when there are heavy spring floods and dry summer the soil often becomes baked and difficult to cultivate, otherwise the soil is in a good state of tilth. In general the natural drainage is good. The principal crops are corn and hay. Corn produces from forty to seventy-five bushels per acre. Clover and timothy yield from one to two tons per acre. Some wheat is grown on the better drained parts and gives good results. Large tracts are wooded, chiefly with second growth timber.

There are but few farm houses in the area, these being located on the uplands. The improvements are poor, but are growing to be of a better class.

(2) The Patoka and its tributaries constitute the drainage system for the southern half of the county. These streams have a large area of bottom land, varying in width from a few rods to one and a half miles. The Patoka is a very sluggish stream. The slight fall and meandering course produces much ponding in the wet seasons. The bottoms along the Patoka are known as the "flats." The soils are whitish in color and are cold, being saturated with water during the winter and spring months and hardened by drouth in summer. Natural drainage is poor and artificial drainage is difficult, but extensive areas have been recently reclaimed. Corn grows fairly well but gives a low yield. Small fields of wheat are grown in the upper parts. Hay makes a rank growth, but is sometimes rather coarse. Although portions of the soil have been under cultivation for many years, large areas still remain forested with elm, red maple, gum, water beech, birch, sugar maple, oaks and tulip poplars. In places of small areas sloughs and bayous are common and are grown over with cat-tails, water-lilies, willows, etc. When partially cleared the bottoms furnish good pasturage. The South Fork of the stream affords a better agricultural region than that along the main stream. The soils along the entire system have been largely leached of their natural plant foods and such cultivation as will restore organic matter to the soil will be of benefit.

WARRICK AND SPENCER COUNTIES.

In the summer of 1904 the United States Bureau of Soils, through A. W. Mangum and N. P. Neill, worked out a soil survey of part of Warrick and Spencer counties, known as the *Boonville Area.* The boundaries of this area are defined as follows:

"The Boonville area is located in the southwestern part of Indiana, bordering on the Ohio River. It is bounded on the east by the meridian of 87° west longitude and the Ohio River; on the north by a line drawn east and west through Tennyson; on the west by a line running ten and three-quarter miles north from the Ohio River to one and three-quarter miles east of the village of Hatfield, thence west for a distance of four and three-quarter miles, and then north to the northern boundary; and on the south by the Ohio River. This territory includes parts of Warrick and Spencer counties, and embraces 169,216 acres, or approximately 264 square miles."

The report on the survey, along with a good lithographic map of the area, has been published and a copy of same may be secured by any person sending his request to the Bureau of Soils, Department of Agriculture, Washington, D. C.

In completing the soil survey of the south and southwestern part of the State, the remaining parts of Warrick and Spencer counties were surveyed by the State and the information obtained is given in the following report, accompanied by that part of the United States report which deals with the physiography of the region, the description of the soil types, and the agricultural condition of the area.

WARRICK COUNTY.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Warrick County was organized in 1813, and was named in honor of Capt. Jacob Warrick, a soldier who fell at the head of his company in the battle of Tippecanoe. The first settlers were known as "Squatters," as the county was not surveyed until 1805, and the lands were not put up for sale by the government until several years after that time. Among the first settlers was John Sprinkle, who crossed the Ohio River from Kentucky and settled at Newburg in 1803; several other families soon followed and settled in the same locality. Four years later the town of Rockport was established by Daniel Grass, and rapid growth followed, since supplies for the settlement could readily be obtained from Owensboro, Kentucky.

The civil townships are: Boone, Ohio, Anderson, Skelton, Pigeon, Owen, Lane, Hart, Greer and Campbell.

The part of the county bordering on the river made the best progress, since the river was the only outlet for products until the building of the railroad through the county in 1873.

Boonville, the county seat, was settled in 1817, and was named after Ratliff Boone, an early citizen of the place. It is located near the center of the county on an elevated tract of land; it is about eleven miles from Newburg, on the Ohio, and about eighteen miles from Evansville. The population in 1850 was 300, and the population at the present time is about 4,800. Fourteen rural routes lead out to all parts of the county. The St. Louis division of the Southern Railroad passes through the town, giving six passenger trains daily; also the S. & N. traction line to Evansville.

The town has good macadamized streets, water-works and a good sewerage system is being constructed. The present industries are tobacco twist factories, flour mills and lumber yards. The Business Men's Club will give a free site and bonus to any industry desiring to locate here. A new court house was erected in 1906.

Newburg is located in the southwestern part of the county on the Ohio River. The town was formerly known as Sprinklesburg. The present population is about 1,750. Five rural routes lead out from here. Two traction lines, the E. S. & N. and Evansville Terminal Traction between Rockport and Mt. Vernon, furnish the

principal transportation. Steam freights are run on both lines. The river traffic is also of considerable importance. The industries are tobacco factories, brick and tile works, a canning factory and a glove factory. Later developments of the resources surrounding the town may soon be a means of bringing in new enterprises and building up the town.

Elberfeld is situated in the northwestern part of the county and has a population of about 850. Five rural routes go out from here. It is on the line of the E. & I. Railway and has four passenger trains daily. A flouring mill is the only industry of importance within the town. One of the largest coal mines in the county is located about one half mile south of the town, and coal is available for all industries at low cost. The town is a trading and shipping point for a very large area of surrounding country. There are good opportunities here for canning factories and creameries, and free sites will be given.

Tennyson, located in the east central part of the county has a population of 500. The Southern Railway affords six passenger trains daily. Three rural routes lead out from the town. The town is dependent chiefly on the surrounding country, there being no industries of importance in the town. There are opportunities for creameries and canning factories. The improvements are good for a place of such size.

Lynnville, located in the northern side of the county about ten miles from Boonville, has a population of 470. It is about ten miles distant from the nearest railroad station. It is a good trading center for a large area of the surrounding country.

Yankeetown, in the southeastern part of the county, six miles from Newburg, has a population of 209. It is on the Rockport line of the interurban.

Stevenson (60), Folsomville (160), Canal (130), Chandler (160), DeForest (61), Eby (50), are little country villages affording marketing places for the surrounding population.

General.—The population of the county in 1830 was 2,973; in 1840, 6,321; in 1850, 10,000, and at the present time about 22,400. The county is very irregular in shape and has an area of 397 square miles. The total farm area is 236,357 acres, of which 202,705 acres are improved. The assessed value of farm lands and assessed value of taxable property in the county is $9,060,985. Fifty years ago 100,000 acres within the county still belonged to the government and was considered worthless, but those lands have since become

some of the best within the county. The average selling price of farm land is now from $75 to $85 per acre.

The county produces annually about 800,000 bushels of corn, an average of about thirty bushels per acre; almost the entire crop is sold to the distilleries at Owensboro, Kentucky; wheat, 400,000 bushels, with an average yield of about eleven bushels per acre; oats, 25,000 to 80,000 bushels, ranging in yield from seven bushels to fifteen bushels per acre; timothy, about 15,000 tons, or about one and a quarter tons per acre; alfalfa, about fifty acres; clover, 8,000 to 10,000 tons, yielding from one to two tons per acre, and producing about 700 bushels of seed.

From 250 to 450 acres of potatoes are grown and yield from forty to seventy bushels per acre. About 150 acres of tomatoes have been grown the past few years, yielding about 150 bushels per acre. In the growing of tobacco Warrick County stands among the first. In 1907-1908 it ranked third in the acreage of tobacco, having over 2,000 acres each year; in 1907 the county ranked third in the total yield, producing 1,589,500 pounds; in 1908 it took second place in the total production, having 1,751,200 pounds, Spencer County heading the list with 2,090,000 pounds, and Switzerland taking third place with 1,128,200 pounds.

The dark export type, such varieties as the Pryor and Onesucker, is chiefly grown, since a heavy growth is always secured in the heavier soils, while the Burley is grown to some extent on the lighter soils. Most of the tobacco grown here is shipped to foreign markets, where the dark heavy type is preferred.

Stock raising has not received much attention. Very few farmers are engaged in stock raising as a business. Hog raising has received the most attention, about 15,000 being marketed during the year of 1908.

Transportation Facilities.—The railway facilities are only fair. The Evansville branch of the Southern crosses the south part of the county from east to west; the E. & I. crosses the northwest corner of the county. A suburban railway runs from Newburg to Evansville and a branch of the S. & N. interurban runs out from Evansville to Boonville, and another branch across the county to Rockport from Evansville. Small steamers on the Ohio carry the farm products direct to Louisville, Owensboro and other markets.

The northern half of the county has practically no transportation facilities, except that some of the principal public roads are being improved and permit of more economic hauling to and from

the distant railway stations. The interurban lines have done much for the smaller towns along their lines, and for the farmers in giving them opportunity to market their produce in much better condition. Some vegetable farming is now engaged in along these lines and dairying is receiving attention.

The county has 750 miles of public roads, with about forty miles improved. The improvement has been principally with crushed stone, at a cost of about $1,800 per mile. Road improvement did not begin until 1899, but the farmers are well satisfied with their investment on improved roads. Most of the stone used has been shipped from the road-metal quarry at Marengo, but there are some exposures of good stone in the county which should receive attention in further road building.

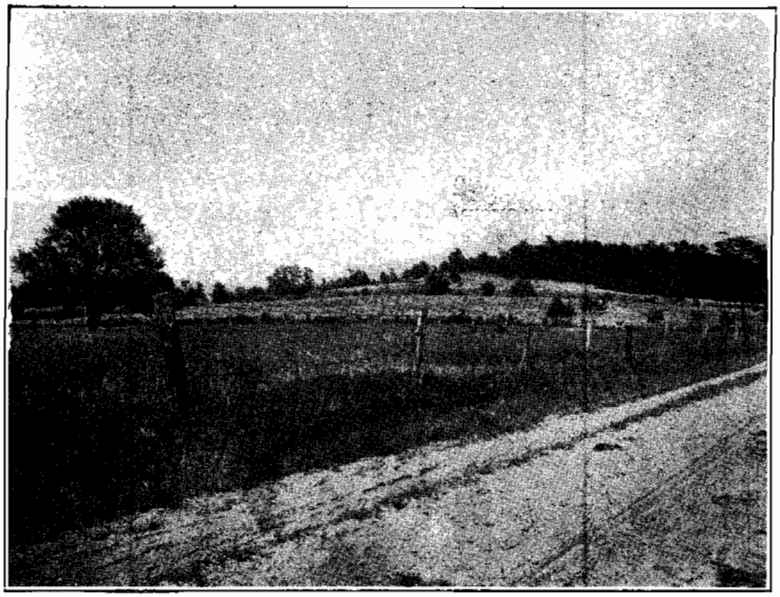
Agricultural Societies.—A county fair is being held each year at Boonville. The farmers' institutes are well attended and local agricultural societies have been organized. The farmers are a thrifty class of people and the greater percentage of the farmers own their farms and the county shows progress in the agricultural condition.

SOILS.

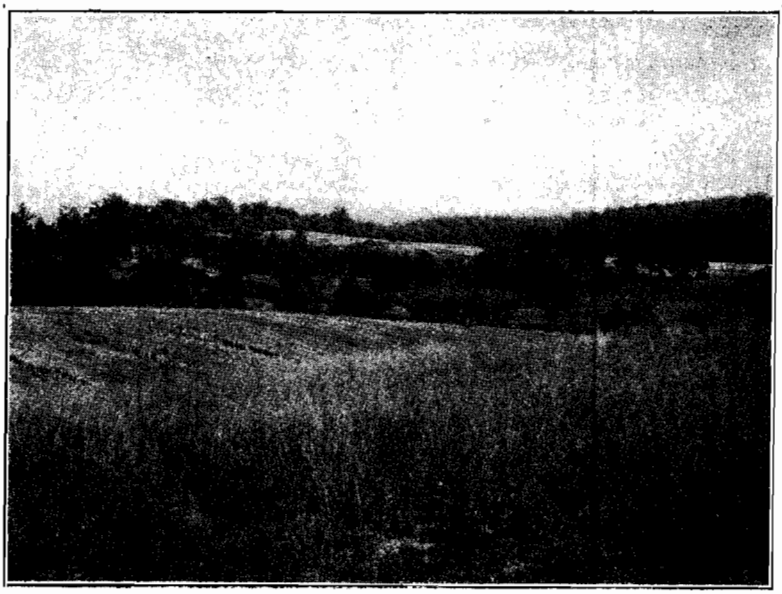
The soils of the county are divided into two general groups, the upland and the bottom land. These groups comprise six distinct types. Of these the upland type (Miami silt loam) derived from the loess of glacial origin is the most extensive. This type is a silt loam, varying in color from light ashy gray to light brown, and in its natural state has a large amount of organic matter. The area of this type has a good drainage condition and its adaptability to the various crops and its natural productiveness make it the most valuable soil in the county for general farming. It comprises an area of about 330 square miles. This type will be discussed in the following pages under the head of Miami silt loess of the Boonville area.

Waverly Clay Loam.

The second type is a clay loam, derived from the same loess material as the silt loam of the uplands, but because of its low lying position just above the streams, it has been reworked until it is made into a distinct type. The soil is of a light color and contains small iron concretions, which have been formed by the action of stagnant waters. The drainage conditions are bad. Under the best conditions average crops are produced. In general this type is not



Little Ditney hills as viewed from the west.



Little Ditney hills as viewed from the north end.

good for general farming purposes. The hay crop is the principal crop, but is rather coarse. Considerable coarse tobacco is grown; corn, wheat and oats in favorable seasons give fair yields.

Waverly Silt Loam.

This type is found along the smaller streams and is of considerable value for the production of most of the farm crops. Corn has been the principal crop, and large yields are obtained. Tobacco is now grown extensively and produces heavy crops of good quality. Wheat, oats, clover and timothy are all good growing crops.

The origin of the soil is from the bordering uplands, but the material has undergone considerable change and is mixed with a large amount of vegetable matter. Drainage conditions are good and artificial drainage systems are well worked out. The soil has good depth and is easily cultivated.

Waverly Clay.

This is a type of alluvial clay found in rather limited areas in the low bottom lands bordering the Ohio River. This type is separated from the river along most of its course by the sand ridges (Waverly fine, sandy loam), which represent the work done by the river before the channel had been cut down to the present level.

The sand ridges are of sufficient height to stand above the ordinary high water level while the waters are backed up through the smaller streams and flood the basin like depressions between the ridges and the main uplands.

Corn is the principal crop grown on the Waverly clay, and good yields are usually secured. In favorable seasons wheat is a good crop. The grasses grow well and give good pasturage and heavy yields of hay. On the sand ridges the season is sometimes too dry for good yields of the ordinary crops, but corn gives fair production, and wheat and oats are both profitably grown. Cowpeas and navy beans are grown extensively, and alfalfa and clover give heavy yields.

Miami Fine Sandy Loam.

This type is found in small areas along the western side of Little Pigeon Creek near the Ohio. The type covers a large area in southwestern Spencer County. The soil is of a light to dark brown, fine sandy loam from 6 to 8 inches in depth. The sand content decreases with depth and the subsoil grades into a silt or clay loam.

For more complete description of this type see under Spencer County and under description of soil types from "Soil Survey of the Boonville Area" in the following pages of the report.

The following table gives the relative extent of the soil types:

	Square miles.
Miami silt loam	330
Waverly clay loam	23
Waverly silt loam	40
Waverly clay	2
Waverly fine sandy loam	1
Miami fine sandy loam	1
Total	397

SPENCER COUNTY.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Spencer County was organized in 1818 and named in honor of Capt. Spier Spencer of Harrison County, who was killed in the battle of Tippecanoe. In 1807 the town of Rockport was established by Daniel Crass. The settlement could readily secure supplies from Owensboro, Kentucky, and the population rapidly increased, many settlers coming in from Kentucky, Tennessee, Georgia, Virginia and the Carolinas. Corn, tobacco, wheat, barley and oats soon began to be cultivated, and the settlers were no longer dependent on other sources of supplies. The growing of tobacco soon became of importance and has continued to increase until Spencer County still holds first place in the State in tobacco production.

The civil townships are Luce, Ohio, Grass, Jackson, Hammond, Huff, Harrison and Carter.

Rockport, the county seat, is situated on a high bluff on the Ohio River 50 miles above Evansville and 150 miles below Louisville. It derived its name from the hanging rock, known to boatmen of early days as the "Lady Washington Rock." The population in 1850 was 600, at the present time 3,300. The Southern Railroad comes into the town from the north with six passenger trains daily. The E. & E. traction line gives direct route to Evansville and Mt. Vernon. It is one of the chief river ports for steamers between Evansville and Louisville, and motor boats give passenger service to Grandview, Tell City and Cannelton. The water supply comes from deep wells, and good fire protection is afforded. The principal industries are pearl button factories, box board, paper and egg case filler factories, a foundry, a brick plant and flour, lumber and planing mills. Coal can be procured at a very low cost per ton, and inducements will be offered to enterprises seeking a location.

Chrisney, ten miles north of Rockport, has a population of 800. It is on the Southern Railroad and has four passenger trains daily. The town is in a progressive condition and there is opportunity for works in clay and lumber. The Commercial Club will give valuable aid to factories and mills desiring to come into the town.

The present industries are a broom factory, canning factory, creamery and wagon works.

Grandview, about six miles up the river from Rockport, has a population of about 900. There is no railroad, and the transportation is by the Louisville and Evansville steamers and motor boats to Rockport. The present industries are a flouring mill and creamery. Many other works are needed and would receive assistance, and the location would be a valuable one to many concerns.

Dale, in the northwestern part of the county, has a population of 750. It is on the Evansville division of the Southern Railroad, with six passenger trains daily. It has connection with Boonville, Evansville, Rockport, Tell City and Cannelton. The present industries are two planing mills, flour mill, creamery and two tobacco leaf houses. Brick and drain tile industries would find a good location here.

Gentryville, located on the western edge of the county, is on the Evansville division of the Southern Railroad, with six passenger trains daily. It has a population of about 500. A small tobacco factory and flour mill are the chief industries.

St. Meinrad, in the northeastern part of the county, is about ten miles from Dale, the nearest railroad station. The population is about 525. The St. Meinrad Abbey, a parochial school, is located here. The school has an attendance of about 400 students and is well equipped. The present industries of the town are a flour mill, planing mill, brick and tile factory and creamery.

Other towns and villages of small size are: Mariah Hill (125), three miles east of Dale, flour, meal and feed; Lincoln City (140), junction of Evansville and Cannelton branches of Southern Railroad; Rockport Junction, junction of Rockport and Evansville division of Southern Railroad; Bradley, Miller, Ritchie and Rock Hill, country stations along Southern between Rockport and Rockport Junction; Hatfield (110), in the southwestern corner of the county, is on the E. S. & N. traction line; Lake (310), about four miles northeast of Hatfield, has a brick and tile works, and a spur from the traction line has been extended from Hatfield. The town is a good trading center and will now give a good outlet for this part of the county's produce; Eureka (200), about two miles southeast of Hatfield, is also benefited by the traction line, although it does not touch the town; Enterprise (60), is a river port southeast of Eureka; Pueblo (60) and Patronsville (60) are situated in the pocket southwest of Rockport; Grass, 3½ miles northwest of

Chrisney, and Midway (80), about five miles west, are trading points; Pigeon (48) is just west of Gentryville on Little Pigeon Creek; Buffaloville (140), Kennedy (20), Lamar (40) and Evanston (20) are stations on the Cannelton branch of the Southern between Lincoln City and Troy; Huff (70), Schley (25), Huffman (110), Newtonsville (240), five miles northeast of Grandview, Liberal (50), Fulda (148) and Santa Clause are villages of importance as trading centers for the surrounding country.

General.—The total population of the towns and villages of the county is about 8,900. The population of the county in 1830 was 3,187; in 1840, 6,305; in 1850, 9,000, and at the present time 22,500.

The county has river boundary with the exception of the north side and about five miles of the west side to the north. Little Pigeon Creek forms the western boundary, Anderson River the east and the Ohio the southern. The county has an area of 406 square miles. The total farm area is about 246,978 acres, of which 202,799 acres are improved. The total value of the taxable property amounts to $8,029,820 and the farm land and improvements amount to $4,262,360. Until within the past fifty years the rough lands of the northeastern part of the county and the low river flats were considered worthless, but these are rapidly being improved and are of much value to the county. In the poorer parts of the county land sells at $25 to $60 per acre, in the best agricultural parts at prices varying from $75 to $100 per acre.

The county produces annually about 850,000 bushels of corn, an average of 25 to 30 bushels per acre; wheat 450,000 bushels, a yield of about 12 to 15 bushels per acre, ranking seventh in the State in 1907 and ninth in 1908; oats 50,000 to 100,000 bushels, averaging from 10 to 12 bushels per acre; timothy 12,000 to 15,000 tons, about 1¼ tons per acre; clover 7,000 to 10,000 tons, a yield of 1 to 1½ tons per acre and producing about 1,800 bushels of seed; a good acreage of alfalfa is grown, about 120 acres being grown for each year 1907-1908.

From 500 to 600 acres of potatoes are grown annually and yield from 40 to 60 bushels per acre; 60 to 70 acres of tomatoes, yielding from 75 to 110 bushels per acre; peas from 2,000 to 2,500 acres; apple yield in 1907 was about 2,000 bushels, in 1908 5,750 bushels; a few acres of melons are grown and a few vegetables are grown for the market. The canning factory at Chrisney is the only one within the county, but there is excellent opportunity for others to be located in other towns of the county. Spencer County stands

at the head of the list in the State in tobacco production, having an acreage of more than 2,000 acres each year and an annual production of about 2,250,500 pounds.

Transportation Facilities.—The transportation facilities are fair. The Southern is the only steam railroad in the county, but there are three divisions of this road, the Evansville division, the Cannelton branch and the Rockport branch, hence no part of the county is far removed from a railroad station. The E. S. & N. traction line extends through the southern part of the county to Rockport and has a spur from Hatfield, near the southwestern corner of the county, to Lake, about four miles farther north. The traction line opens up direct connection with Evansville and Mt. Vernon. Motor boats run between Rockport and Cannelton, and the Louisville and Evansville steamers carry much of the produce of the county. Much of the grain, especially corn, is sold to Owensboro, Kentucky, and the Louisville, Henderson and St. Louis Railroad on the Kentucky side also aids the transportation of products from the county.

Good public roads lead out from all the principal towns. There are 1,008 miles of public road, with 35 miles improved. The improvement is chiefly with limestone, which has been shipped in from Marengo and Milltown. The county is very poor in its supply of good road material. A small quantity of river bar gravel is found and has been used considerably on the streets of Grandview.

Agricultural Societies.—Two agricultural societies, one at Rockport and one at Boonville, were organized about 1836 for the purpose of creating an interest in stock raising and general farming. A county fair is held each year at Rockport. Farmers' institutes are well attended, and the farmers are desirous to learn the best farming methods. Fertilizer tests are being tried on the different soil types, especially as to the needs of wheat and tobacco.

SOILS.

The soils of this county are divided into two general groups, the uplands and the bottom lands. The former comprises an area of about 304 square miles, the bottoms about 102 square miles. These two groups include seven distinct types, the area of each being shown in the following table:

	Square miles.
Loess Soils—	
Miami silt loam	229
Miami fine sandy loam	35
Waverly clay loam	30
Waverly silt loam	20
Waverly clay	12
Waverly fine sandy loam	5
Residual Soils—	
Derived from the coal measure	75
Total	406

Loess Soils.

Miami Silt Loam.

This is the principal soil of the uplands, covering every part of the uplands except that designated by the residual soils. This soil is very uniform wherever found over the entire area of this survey, some slight changes, however, being due to the physical features of the area. The surface soil varies in color from a light gray to light brown or reddish yellow; considerable very fine sand is present, but coarse sand and clay constitute a very low percentage. The soil is very easily tilled, being very friable and crumbles into a loamy mass.

The subsoil is red or reddish yellow in color and usually contains a higher percentage of clay than the surface, giving it a more plastic nature, and is termed a "heavy, silty loam." The origin of the loess soils has been fully discussed in the preceding part of the report. Being of glacial origin, it would naturally be a soil of great fertility, having been derived from so wide a source. All the staple crops yield well upon this soil, and special crops, such as garden vegetables and small fruit. Apples and pears are also well adapted to this soil, and a large number of trees have been planted during the past few years.

Miami Fine Sandy Loam.

This type comprises an area of about 40 square miles. The largest area lies in the southwestern part of the county to the east of the Waverly clay loam. Beginning near Midway, it extends in irregular patches about two and one-half miles south and then widens into a compact body from three to four miles in width, and extends in a southwestern direction within one mile of the Ohio River. Other smaller areas and irregular patches lie to the north-

west of Rockport and surrounding Grandview, and extending somewhat to the east and in narrow strips and patches along Anderson River.

The soil varies from a light brown to reddish brown sandy loam with a varying clay content. The sand content decreases greatly with depth. The soils of this type are low lying, but slope gradually toward the streams and usually have good natural drainage. The general surface is slightly undulating. In some places there are low hills with slight depressions intervening. The origin of this soil is a combination of alluvial materials with removed loess material of the higher elevations. The soil seems well adapted to all crops. The growing of small fruit and truck farming should find proper soil conditions here, and the fact that the new traction line crosses the southern half of the largest area of this type and the spur of the road reaches lengthwise through the area from Hatfield to Lake gives ample opportunity for undertaking such work.

Waverly Clay Loam.

This is a light ashy color. Its origin is due to the same source as the Miami silt loam. It is somewhat hard and compact, but contains a large amount of silt. The loess material has been reworked and mixed with a large amount of alluvial material. The principal areas are along Little Pigeon Creek, and to some extent along the lower part of Anderson River, and an area of a few square miles lying between Rockport and Grandview. The soil is low lying and wet except where artificial drainage has been carried out. Corn and wheat give low yields; clover and timothy grow well, especially in the parts that have been under cultivation for some time. In very favorable seasons some good yields of wheat are secured.

Waverly Silt Loam.

This type is the soil of the small stream bottoms and of parts of the old lake beds. The soil is black in color, due to the large amount of vegetable matter contained. The origin is from the loess deposits, but the areas have been subjected to stagnant waters with heavy growths of vegetation, which decayed, adding a large amount of humus to the soil. Silt carried in from the uplands by running water caused a continual mixing of soil and vegetation, and accounts for the great depth of the black surface soil. The subsoil at considerable depth is a yellowish color, more plastic than the surface soil.

The most extensive area is the Willow Pond tract five miles west of Rockport. The area contains about three square miles. The Willow Pond tract has just been drained and is not yet in the best state of cultivation but promises to be one of the best soils of the county. The traction line passes through this region and will give a good chance for development here. The area would be an exceptionally good one for truck farming, and the products could find a ready market.

The second largest area of the type is the Lake Mills area, beginning about three miles northwest of Rockport and extending to the north in a strip a half mile wide for about three miles. The area has been well drained and the cultivation is bringing good results.

All the crops grow well. Corn yields from 40 to 60 bushels per acre; wheat 15 to 25 bushels; clover and timothy give from 1½ to 2 tons per acre. Tobacco makes a good growth but is rather coarse; and the entire area seems well adapted to the growing of vegetables.

Waverly Clay.

This type occurs extensively in the great bend of the Ohio River southwest of Rockport. The surface soil is a brownish clay loam containing a high percentage of clay and silt and a small percentage of sand. The subsoil is more compact and somewhat tenacious, and is usually mottled in appearance. This soil is overflowed annually and some low depressions are usually very wet throughout the year. Iron concretions occur in many places in the soil, due to the leaching action of stagnant water.

The soil is distinctly an alluvial type. An additional deposit of sediment is left each year, and the fertility is thus kept up to a good standard. The soil often cakes and cracks after the overflows, but it is not difficult to get in a good state of cultivation. Corn is the principal crop grown, the danger from overflow making the wheat crop too uncertain; timothy and clover grow well.

A large part of the area is difficult to drain, but several ditches have been constructed and the small streams opened up, and tile draining in some places has been done with good results.

Waverly Fine Sandy Loam.

This type consists of a light brown to yellowish sandy loam with a varying percentage of clay. The soil occurs in low ridges, varying in width from a few rods to a half mile, and immediately

bordering upon the Ohio River the entire length of its course along the county except where the hills extend entirely to the river. The soils are usually higher than the adjoining types and has good drainage. Practically all of this type is under cultivation, and good crops are grown except where the soil is a loose, incoherent sand and scarcely any vegetation grows upon it. This type is purely of alluvial origin, being laid down during overflows. The slope next the river is steepest, the other sloping off very gradually to the clay loam types. The occurrence of these ridges is accounted for by the fact that during flood time, the sand being the heaviest sediment in the waters, is deposited first and the clays and fine silts are carried farther inland.

Residual.

Coal Measures.—The residual soils derived from the formations of the coal measures occupy the part of the county lying between the eastern boundary at the Anderson River and Crooked Creek, as far north as Santa Fe, then to the northwest along a line running about one mile west of Mariah Hill and extending from that point across the northern edge of the county. The residual soil proper occupies about 75 square miles. To the west of the line designated the soil gradually becomes intermingled with the loess material and grades into the typical Miami silt loam, although in many places the underlying formations have had much to do with the character of the soil. This eastern part of the county is of very rough topography—high hills and sharp, winding ridges with narrow valleys, intervening. The hills rise from 180 to 250 feet above the level of the principal streams. The highest elevations reach heights of about 650 feet above sea level. The soil is a sandy clay loam, having been derived chiefly from the shale and sandstones of the lower coal measures, and along the eastern border the Mansfield sandstone has entered to a slight extent into the making of the soils. The area is not very inviting from an agricultural point of view. However, there are some well improved farms and good results are obtained from the careful cultivation of the soils. The area is well adopted to fruit growing, and tobacco is successfully grown. Land may be bought at prices ranging from $10 to $60 per acre. There are no transportation facilities for the eastern part, and the roads are too hilly to allow economic hauling.

DESCRIPTION OF THE BOONVILLE AREA.

PHYSIOGRAPHY AND GEOLOGY.

"The physicgraphic features of the area are quite marked, varying from rolling uplands and small valleys to bottom lands or river flats. The rolling uplands vary considerably in height, but rarely exceed 500 feet above sea level. The coal knobs, located 3½ miles northwest of Rockport, have an elevation of 600 feet and are the highest hills in the area. The hilliest portions are found in the vicinity of Boonville, in the northwestern corner of the sheet, around Chrisney, in the northern and eastern portions of the area, and to the south and west of Rockport.

"The hills in only few instances have very steep slopes, but as a rule are characterized by their smooth, gently rounded forms, with intervening shallow depressions. At Rockport, where the hills extend to the river, they have a steep, precipitous bluff 75 to 100 feet above the level of the river for about two miles to the south of the town. Where the surface is undulating or less hilly the soil does not erode to any extent. It is only on the steep sides of some of the higher hills that erosion is very great.

"The principal valleys of the area occur along the Cypress Creek ditch and Little Pigeon Creek, which still flow in the same channels they occupied prior to the glacial period.

"The valley formed by the Cypress Creek ditch has an average width of one mile and extends across the area from north to south immediately west of Boonville. The Little Pigeon Valley Creek traverses the area in a northeast and southeast direction and occupies the territory between the Boonville hills on the west and Chrisney hills on the east. It has an average width of four miles and is the largest valley in the area. Numerous other small valleys occur, especially in the hills, where small streams have cut their way through, but they are not of sufficient importance to warrant separate discussion. The streams usually overflow after heavy rains or long wet periods, and the soils found in the valleys are of a silty or clayey character.

"The surface of bottom lands or river flats in the southern part of the area along the Ohio River presents a flood-plain cut by numerous small streams, old stream channels and bayous. These lands are flooded annually by overflow of the river, and each year

new channels and bayous are formed. A few small ridges occur over these bottoms and have an elevation of 3 to 4 feet above the surrounding surface. The elevation of this flood-plain is from 340 to 360 feet above sea level.

"Following the course of the Ohio River and bordering it is a sand ridge averaging one-half mile in width, which is somewhat higher than the lands immediately back of it and is rarely overflowed. The soils found in the bottoms are of a stiff clayey character, and owing to their low-lying position are exceedingly difficult to drain.

"All the drainage of the Boonville area finds its way into the Ohio River, the streams flowing in a southerly direction and emptying directly into the river. The largest is Little Pigeon Creek, which drains over three-fourths of the area. It enters the area two miles east of Tennyson, flows in a southwesterly direction and passes out about five miles west of Richland City. The Cypress Creek ditch, which flows in a southerly direction through the extreme western portion of the area, drains the territory around Boonville and to the west of it. The remainder of the area is drained by smaller streams which have their sources within the area and flow directly into the Ohio River.

"The rocks forming the basal structure of the area belong to the carboniferous system. The rocks of this system have played an important part in the economic geology of the area, and at present quite extensive coal mines are being developed. The rocks belonging to this period which are more commonly exposed consist of sandstone, shale and shaly sandstone. Exposures may be seen in different parts of the area, especially in deep road cuts.

"Inasmuch as the underlying rocks are everywhere covered by a thick mantle of loess they have played only a minor part in the formation of the soils of the area. During the early Quaternary times great ice sheets extended across Indiana some distance north of the area. As the ice melted and the glaciers began to recede it is believed that a part of the material which later formed the soils of the area was released and carried still farther south and deposited over broad flats by streams then issuing from the glacial front. It was later picked up by the winds and generally redeposited in the form of loess over the surface of the uplands, covering all older geological formations. The soils of the uplands are of recent alluvial origin, being made up of reworked loess material and very fine sand, and are generally underlain by alluvium of the glacial age."

SOILS.

"The soils of the area are divided naturally into two general groups—upland and bottom land. The several soils in their typical occurrence are quite distinct, each possessing its own physical peculiarities. Six types have been recognized in the area, the Miami silt loam and Miami fine sandy loam being found in the upland division, the Waverly fine sandy loam in the bottom land division of the area.

"The following table shows the actual and relative extent of each of the different types found in the area:

AREAS OF DIFFERENT SOILS.

Soil.	Acres	Soil.	Acres.	Per Cent.
Miami silt loam	86,656	Waverly clay	8,320	4.9
Waverly clay loam	30,208	Wavery fine sandy loam	3,904	2.3
Miami fine sandy loam	22,848			
Waverly silt loam	17,280	Total	169,216	

Miami Silt Loam.

"The Miami silt loam is the most extensive type in the area surveyed. Its topographic features, ability to withstand drought, adaptability to a great diversity of crops, and its natural productiveness make it the most valuable soil in the area for general farming purposes.

"The soil is a silt loam averaging from 8 to 10 inches in depth and varying in color from a light ashy gray to light brown, according to the amount of organic matter present. It contains in its typical form a small percentage of fine sand, and when recently put under cultivation or in its virgin state carries a large amount of organic matter.

"The subsoil, from 9 to 36 inches, consists of a silt loam containing a small proportion of very fine sand in the first few inches. It varies in color from dark red to yellow, and becomes heavier as the depth increases. At a depth of 4 or 5 feet the clay content is much larger and a very heavy silt loam occurs, which is usually of lighter color than that immediately underlying the soil. The material is very compact at a depth from 25 to 36 inches, making a subsoil very retentive of moisture, while the fine silty texture of the soil prevents the surface from becoming baked, sun cracked or difficult to cultivate.

"The Miami silt loam, covering 51 per cent. of the entire survey, occurs in the uplands in all parts of the area. The largest unbroken body occurs in the northeastern part of the area and extends from near Rockport to the extreme northern boundary. Small tracts occupy the low ridges in the vicinity of the flat river bottoms. These differ slightly from the typical Miami silt loam in that the soil is slightly heavier and the underlying subsoil has a larger clay content. These small areas have undoubtedly been submerged at times, and the soil has been slightly altered by material deposited by water, as well as by what washed down from the neighboring uplands.

"The topography of the country occupied by this type is rolling. The hills are low and rounded, with gently sloping sides, and the intervening valleys are broad and shallow. This insures good drainage, and with proper attention the land is subject to but little injury from erosion. Artificial drainage is seldom necessary and is practiced in but few localities, the rolling topography being usually sufficient to drain the excess water into the numerous small streams.

"The loess from which the soil is derived is of glacial origin. The material, which is supposed to have been transported by wind and water, was deposited as a mantle over the entire country to the southward. It shows no stratification, and has an average depth of from 8 to 10 feet in the more hilly section, although it often reaches a greater depth in the valleys or more level areas. The loess overlies beds of sandstone and shaly sandstone belonging to the Carboniferous system. These rocks, however, have not entered into the composition of the soil except on an occasional steep slope where a thin layer of sandy shales has been exposed through the process of erosion, in which case they weather rapidly, and, becoming mixed with the silty material, cause a larger percentage of fine sand in the soil of the immediate vicinity.

"Great care is necessary to keep the Miami silt loam in a high state of productiveness, and a rotation of crops is very essential in order to secure the best results. Where the soil is in a loose and thorough state of cultivation, as is necessary when the crop is corn or potatoes, it suffers greatly from the effects of erosion, and large areas of the subsoil are exposed along the steeper slopes.

"The Miami silt loam is well adapted to most of the general farm products of the area. Wheat and oats do especially well, and large fields of clover, timothy and other grasses are always obtained.

Very little tobacco is cultivated on this type, as the other soils of this area are considered better suited to the variety grown in this section. Wheat averages 15 bushels, oats about 30 bushels and corn from 30 to 35 bushels per acre. Where the soil is well tilled and a good system of rotation practiced much larger yields are frequently realized without the aid of commercial fertilizers. Clover and timothy average from 1½ to 2 tons per acre, two or more cuttings often being obtained. Apples, peaches, plums and pears are all successfully grown in the most hilly sections. No attempt has been made to cultivate vegetables and truck crops except on limited scale for home use and for local markets, but excellent yields are generally realized from these crops.

"The following table gives the mechanical analyses of typical samples of the Miami silt loam:

MECHANICAL ANALYSES OF MIAMI SILT LOAM.

No.	Locality.	Description.	Gravel, 2 1 mm.	Coarse Sand, 1 to 0.5 mm.	Medium Sand, 0.5 to 0.25 mm.	Fine Sand, 0.25 to 0.1 mm.	Very Fine Sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10796	1 mile east of Pedigo Lake Mills.	Gray to brown silty loam, 0 to 12 inches.	0.1	0.3	0.2	0.5	4.0	84.2	10.7
10798	¾ miles south of Chrisney.	Yellow to brown silty loam, 0 to 10 inches.	.2	.8	.5	1.2	6.1	77.1	13.8
10797	Subsoil of 10796.....	Heavy silty loam, 12 to 36 inches.	.0	.2	.1	.3	8.7	68.2	22.4
10799	Subsoil of 10798.....	Yellow silty loam, 10 to 36 inches.	.2	.3	.4	.7	5.2	70.2	22.7

Miami Fine Sandy Loam.

"Third in extent and second in agricultural importance among the soil types of the Boonville area is the Miami fine sandy loam. The soil consists of a light to dark brown sandy fine loam, averaging about 8 inches in depth. This sandy loam varies from fine to medium in texture, with the coarser material usually occurring in the upper portions of the soil. The sandy content rapidly decreases with depth, and below 8 to 14 inches the subsoil is a heavy, fine sandy loam whose color varies from light red to yellow, generally becoming lighter in the deeper layers. The subsoil found from 20 to 36 inches below the surface is a light silt or clay loam, there being only a small percentage of sand present.

"The type is practically uniform throughout the area with the exception of a few minor variations in local spots. Of some of the higher elevations a sandy phase occurs which consists of a very sandy loam in which the percentage of sand continues to be quite large throughout the entire 3-foot profile. At a lower depth, however, the sand content decreases rapidly, and at 4 or 5 feet below the surface the subsoil is the same as that found underlying the typical soil. The sandy loam of this phase for a depth of from 20 to 30 inches is somewhat coarser than that of the typical soil, but grades rapidly into a sandy loam of finer texture at lower depths.

"In low positions a somewhat heavier phase of the type is encountered which has been slightly modified by the action of the water. The soil in this case is a fine sandy loam to a depth averaging 8 inches, mixed with varying quantities of organic matter. The underlying subsoil is a heavy, fine sandy loam which grades into a clay loam at about 15 to 20 inches below the surface. The color of both soil and subsoil varies from gray to brown, depending upon the amount of organic matter present. These variations occur only in limited areas over the main soil type, and are not of sufficient extent to be shown on a map of the scale used.

"The Miami fine sandy loam occurs in one extensive body, reaching from the central part to the southwestern corner of the area. It embraces all the territory from a short distance south of Midway southwest to within three-fourths of a mile of the Ohio River. The eastern boundary of this is formed by the rolling uplands of the Miami silt loam and the western by the bottoms of Little Pigeon Creek. Two small patches of this type are found a few miles northwest of Rockport, bordering the bottom lands of Lake Drain Creek. In the extreme western part of the area northwest of Hatfield two small areas are also found.

"The topography of this soil is generally level or slightly undulating. Some portions, however, consist of low hills with shallow depressions intervening. The small hills or ridges trend in a northeast-southwest direction, the general slope being to the south and west.

"Many small streams and drains flow across this type in a southwesterly direction, emptying either into Little Pigeon Creek or the Ohio River. In a few instances the streams have cut out wide depressions, and a heavier type of soil is usually found occurring along them. The type possesses good natural drainage. The

streams which flow through it afford excellent outlets for all the drainage waters, and only in a few instances has it been necessary to construct artificial ditches. Occasionally, however, it has been found advisable to widen and deepen the streams in order to increase their capacity for carrying off the surplus water during times of heavy rains or long wet periods.

"In addition to the good natural drainage which this soil type possesses, it also has the power to retain moisture, the underlying silt or clay loam subsoil forming an excellent medium for storage of the soil water, so that with the aid of proper cultivation crops suffer but little from the effects of drought.

"Over the more elevated portions of the type, and where the sand content of the soil is above the average, natural drainage is apt to be too thorough for most crops. In this case great care should be exercised in the methods of cultivating, particular attention being paid to the preservation of a surface mulch in order to carry the crops safely through the dry season of July and August. The lower lying portions of this soil type require artificial drainage to secure the best crops. Ditching and tiling greatly improve the productivity of such areas, and a large part of these is being artificially drained at the present time.

"The Miami fine sandy loam is of alluvial and glacial origin. The underlying silt and clay loam is undoubtedly reworked loess material washed down from the uplands, while part of the sand which goes to make up the sandy loam was deposited at an early date during times of exceptionally high water. The sand underlying the Miami silt loam bordering this type on the east has been washed over the surface of this soil and has entered into its composition.

"The type is well adapted to almost all kinds of crops that will grow in this latitude, with the possible exception of timothy, which requires more moisture than this soil can retain during the dry season. Ordinarily wheat averages 20 bushels per acre. The yield of corn on the cob varies from 40 to 80 bushels per acre, depending upon the manner in which it is cultivated, and of oats only from 25 to 30 bushels, owing to the lack of sufficient moisture fully to mature the crop. Early potatoes yield from 75 to 175 bushels, while the late varieties produce from 100 to 125 bushels per acre.

"The Miami fine sandy loam is one of the best soils in the area for the production of tobacco. It produces usually from 700 to

1,000 pounds per acre, although a much higher yield is often obtained. Tobacco is considered a sure crop, and often does well when corn, wheat and other crops are a failure.

"Apples and peaches are grown to some extent, but the apples do not keep as well as those grown on heavier types. Small fruits are cultivated to a limited extent, the quantity produced being scarcely sufficient for home consumption. The soil is well adapted to truck crops, but its distance from good markets render their production unprofitable at the present time.

"The following table gives mechanical analyses of typical samples of this type of soil:

MECHANICAL ANALYSES OF MIAMI FINE SANDY LOAM.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse Sand, 1 to 0.5 mm.	Medium Sand, 0.5 to 0.25 mm.	Fine Sand, 0.25 to 0.1 mm.	Very Fine Sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P ct.*	*P. ct.*
10790	2 miles east of Hatfield..	Brown fine sandy loam, 0 to 14 inches.	0.0	1.7	10.0	28.6	19.2	32.1	8.3
10788	1 mile east of Richland City.	Brown to gray fine sandy loam, 0 to 12 inches.	.2	1.7	6.4	27.1	18.6	34.9	11.1
10791	Subsoil of 10790.....	Heavy fine sandy 14 to 36 inches.	.1	1.2	7.7	26.1	10.7	39.7	14.2
10789	Subsoil of 10788.....	Yellow loam, 12 to 36 inches.	.1	.8	3.0	17.3	14.2	40.3	24.4

Waverly Silt Loam.

"The Waverly silt loam covers a very limited part of the area surveyed, but agriculturally it is one of the most valuable soils. The soil has a depth of from 12 to 18 inches. It is a silt loam, slightly plastic when wet, gradually becoming heavier as the depth increases, and varying in color from gray to dark brown, according to the amount of organic matter present.

"The subsoil is a light yellow silt loam containing a larger percentage of clay than the soil and becoming heavier at a depth of 25 or 30 inches. In places the subsoil is a mottled, heavy, drab silt loam of a much stiffer nature than the soil, but still retaining its silty character.

"The Waverly silt loam occurs as narrow strips bordering most of the small streams in all sections of the area, but seldom extends back more than a quarter of a mile from the streams. The largest

area, which lies along the Cypress Creek ditch west of Boonville, has an average width of one mile. A second extensive area occurs at the head of the Willow Pond ditch, northwest of Rockport, where the soil contains a very large amount of organic matter and is of a much darker color than the greater proportion of the type. The Willow Pond area has only recently been drained and put under cultivation, and both soil and subsoil are of a slightly heavier nature than the typical Waverly silt loam.

"In topography the type is level, with a gentle slope toward the small streams. It occupies the low depressions near the source of streams and the narrow valleys between the rolling hills. The streams have usually cut their channels down several feet below the lands bordering them, but are generally insufficient to drain thoroughly the larger areas without artificial means. The soil is easily drained by straightening and deepening the small stream courses and cutting lateral ditches at frequent intervals through the wet areas. Tiles are used with excellent results, and at present the greater part of the soil is drained well. When ditched and tiled thoroughly it is very productive, and in several localities its value has been increased from $10 to $50 an acre by the installation of a good drainage system.

"The Waverly silt loam is derived from material washed from the uplands at times of heavy rains and deposited in the depressions and shallow valleys, mixed with decaying vegetable matter. The remains of decomposed logs and other organic matter have been found in the soil at a depth of from 6 to 10 feet below the surface, indicating that the now shallow valleys have been gradually built up to this present level by the steady accumulation of material from uplands.

"Where the soil is well drained corn averages from 50 to 70 bushels; wheat, 20 bushels; oats, 40 bushels; clover and timothy, about 2 tons, and tobacco from 1,000 to 1,200 pounds per acre. Large yields of potatoes and other vegetables are obtained. The soil seems best adapted to corn and tobacco. The corn crop is never a failure, and when well cultivated gives larger yields per acre, and as quantity rather than quality is what the growers strive for, much of this soil is devoted to its production.

"The following table gives the mechanical analyses of typical samples of the Waverly silt loam:

MECHANICAL ANALYSES OF WAVERLY SILT LOAM.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse Sand, 1 to 0.5 mm.	Medium Sand, 0.5 to 0.25 mm.	Fine Sand, 0.25 to 0.1 mm.	Very Fine Sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
10806	4 miles north of Rockport.	Brown to yellow silty loam, 0 to 10 inches.	0.2	0.5	0.5	3.6	10.4	74.8	10.1
10804	2 miles east of Boonville.	Yellow fine silty loam, 0 to 12 inches.	.2	.2	.1	.5	5.8	82.1	11.1
10805	Subsoil of 10804.....	Yellow silty loam, 12 to 36 inches.	.3	.5	.3	.4	5.7	77.8	15.1
10807	Subsoil of 10806.....	Yellow heavy silty loam, 10 to 36 inches.	.2	.5	.5	3.5	10.7	67.5	16.7

Waverly Clay Loam.

"The soil of the Waverly clay loam consists of about 6 inches of heavy, light brown to gray silt loam, often containing small iron concretions scattered over the surface and through the soil. The soil becomes heavier with depth and grades into a very heavy silt loam containing a large percentage of clay. At a depth of from 12 to 20 inches the subsoil is a sticky, mottled clay, usually containing small iron concretions. It becomes stiffer and more tenacious as the depth increases, making the soil difficult to drain. When plowed and exposed to the air the subsoil often becomes whitish in color and dries into hard crusts or clods very difficult to pulverize. There is apparently little organic matter in the soil except in small swampy areas, and no attempt has been made to drain these areas or to put them under cultivation. In such places the soil is known locally as "glade" or "crawfish" land, and is of little agricultural value.

"The Waverly clay loam occupies small areas adjacent to many of the small streams, but in the north central part of the area there is one body of considerable extent. This occupies the low, flat country which extends along Little Pigeon Creek and other streams from near Tennyson to where Little Pigeon Creek leaves the area. There are a few ridges and shallow depressions in this area, but the greater part of the land is almost level. It is drained with great difficulty on account of the compact nature of the soil, the level topography and the slight elevation above the level of the streams.

"Where this soil is ditched and tiled and a complete system of artificial drainage established the least productive phases have been

made to produce average crops. Where no system of drainage is practiced these lands are either covered with a growth of scrub oak or are used exclusively for pasture.

"A small area of the type situated about two and one-half miles north of Rockport deserves special mention. It occupies an old terrace of the Ohio River, and has a more rolling topography than the typical areas. This, together with its elevation and nearness to the river, gives it better drainage and a higher crop value than this soil usually possesses. This area is of too small extent, and the soil occurring between the low ridges is too typical of the Waverly clay loam to classify it as a separate soil type.

"The Waverly clay loam is derived from the same loess material as the Miami silt loam of the uplands, but its position in the low, flat valleys, only a few feet above the present level of the streams, has caused this material to undergo considerable change. The poor drainage, the addition to finer material washed down from the uplands, the effect of water which collects and spreads over the low areas in wet seasons, and the material deposited over these sections by former inundations, all combine to make this soil much heavier than that formed from the loess on the well-drained uplands.

"The yields of the various crops cultivated on this soil depend to a great extent on the thoroughness of the drainage and cultivation. With the methods usually practiced corn will average from 10 to 15 bushels and wheat from 10 to 12 bushels per acre. Wheat often gives larger yields in a favorable season if preceded by clover. Very little oats is grown on this type, and a yield of from 15 to 20 bushels per acre is estimated as an average crop.

"Tobacco is grown quite extensively on this soil, a heavy, coarse textured leaf being produced. This tobacco does not command so high a price as that grown on the more sandy soils, but the plants are larger and larger yields are obtained, the average being 1,000 to 1,200 pounds per acre.

"The soil seems best adapted to clover, timothy and redtop, and a large amount of hay is harvested yearly from it. The hay crop averages from two to three tons per acre for each cutting, and the facilities for shipping this product to southern cities make it a profitable industry.

"The Waverly clay loam varies considerably in agricultural value according to its position, topography and the methods used in its management. The greater part of it is considered a very poor soil for general farming purposes, but where it occupies the

low ridges a few feet above the more level areas and is well drained very fair crop yields are usually obtained. Small areas frequently appear only a few rods apart where, on account of the local influences of topography and the natural drainage, fair yields are produced on one field, while on an adjacent one which is too wet and poorly drained nothing except clover and grass can be successfully grown.

"The following table gives the mechanical analyses of this type:

MECHANICAL ANALYSES OF WAVERLY CLAY LOAM.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse Sand, 1 to 0.5 mm.	Medium Sand, 0.5 to 0.25 mm.	Fine Sand, 0.25 to 0.1 mm.	Very Fine Sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10786	1½ miles northeast of Richland City.	Heavy silty loam, 0 to 6 inches.	0.3	1.0	1.4	395	8.9	56.3	28.6
10784	3½ miles east of Boonville.	Clay, 0 to 6 inches....	.3	1.0	.7	1.0	1.8	59.0	36.1
10787	Subsoil of 10786.....	Gray clay, 6 to 36 inches.	.4	1.3	1.6	3.7	8.6	53.2	31.0
10785	Subsoil of 10784.....	Yellow to gray heavy clay, 6 to 36 inches.	.2	.4	.3	.3	1.1	53.9	43.7

Waverly Clay.

"The Waverly clay is an alluvial soil found in the low bottom lands bordering the Ohio River. It extends uniformly over that section of the area which is subject to annual inundation during the spring floods.

"The soil to a depth of from 8 to 10 inches consists of a light brown clay loam, often containing a small amount of sand. The percentage of silt and clay is very large, the soil rapidly becomes stiffer and more tenacious with depth, grading into a heavy, tenacious clay subsoil of a brown or drab color, which is often mottled in the lower depressions. A few small iron concretions are frequently seen in the more swampy areas, both in the soil and the subsoil.

"This type of soil is overflowed annually, and when the water recedes the lands on drying become baked and sun cracked, making its cultivation difficult.

"The Waverly clay occurs in a large area in the extreme southern part of Spencer County and embraces a greater part of the lands lying within the great bend of the Ohio River southwest of

Rockport. It also extends in narrow strips a short distance up the valleys of some of the small streams which flow through this section of the area. These lands are comparatively level, but are traversed by numerous narrow sloughs and shallow, swampy depressions with low ridges intervening.

"The type as a whole occupies a basin-like depression surrounded on three sides by the sand ridge which extends along the banks of the Ohio River, and on the north by the rolling uplands. The small streams which flow through it have cut their channels several feet below the surface of the greater portion of the area, and as soon as the floods subside the water covering the lowlands finds its way back to the river through these outlets. Drainage is difficult over a large proportion of the type, but ditching and tiling greatly increase its agricultural value.

"The material from which this soil is formed is brought down by the Ohio River at times of high water and is deposited over the areas flooded. During the annual spring floods the river water backs up through the openings which the small streams have cut in the sandy ridge and spreads out over the low, flat country of the interior. The fine particles of silt and clay held in suspension are gradually deposited over the bottom lands, while the sand and coarser particles are deposited nearer the main current of the stream. This annual addition of new material to the soil tends to maintain its productiveness, and when the crops are not damaged by overflow large yields are obtained. Along some of the narrow depressions where the current of the stream is strongest during the overflow the surface soil has been eroded and the stiff clay subsoil exposed. Crops planted in such places are either a total failure or give very low yields.

"The Waverly clay is cultivated almost exclusively to corn, which averages about forty bushels per acre. During favorable seasons and where the land is well drained and cultivated as much as sixty bushels per acre is often produced. Wheat yields from eighteen to twenty bushels per acre, although the crop is sometimes destroyed or greatly damaged by the floods. It is estimated that about one wheat crop from three is harvested from this soil. Wheat is often sown in the fall, and if the crop is destroyed by the overflow it is followed by corn planted in the late spring. Oats are grown to a very small extent, as they suffer from the same disadvantages as wheat; but when not damaged by floods forty bushels per acre may be produced. Tobacco is grown to a limited extent,

and about the same grade of the dark export type is obtained as that grown on the Waverly clay loam. The yield is about 1,000 pounds per acre. Clover, timothy and other grasses give yields of from two to three tons per acre.

"This type, however, is best adapted to the production of corn. The soil is usually in condition to cultivate by the latter part of April and often at an earlier date, and as the corn is planted in May it is very seldom damaged by overflow, and large and profitable yields are thus almost always assured.

"The following table gives mechanical analyses of typical samples of the Waverly clay:

MECHANICAL ANALYSES OF WAVERLY CLAY.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse Sand, 1 to 0.5 mm.	Medium Sand, 0.5 to 0.25 mm.	Fine Sand, 0.25 to 0.1 mm.	Very Fine Sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10808	7½ miles southwest of Rockport.	Heavy Clay loam, 0 to 8 inches.	0.3	1.1	0.7	1.8	3.0	58.2	34.8
10810	7½ miles southwest of Rockport	Brown heavy clay loam, 0 to 10 inches.	.1	.2	.3	1.1	1.5	55.5	41.2
10809	Subsoil of 10808.....	Stiff clay, 8 to 36 inches.	.7	2.2	1.2	2.9	4.7	51.6	36.6
10811	Subsoil of 10810.....	Brown to gray heavy clay, 10 to 36 inches.	.1	.3	.5	1.5	1.8	46.8	49.0

Waverly Fine Sandy Loam.

"The Waverly fine sandy loam is a type of minor importance in the area on account of its limited extent. It is well adapted to a variety of crops, and, owing to its elevation above the flood-plain, the crops are seldom seriously injured by the overflow of the Ohio River.

"The soil to a depth of 15 inches is a light brown to gray, fine sandy loam, the sand content being usually large and of finer grades. As the depth increases the soil becomes heavier, and at from 15 to 20 inches passes into a brown, fine sandy loam containing a larger percentage of clay. The sand content, depth of soil and size of the sand particles often vary according to location. That portion of the type lying nearest the river is of a coarser texture and is often deeper than that immediately bordering the Waverly clay.

"The Waverly fine sandy loam occupies a narrow ridge extending along the whole course of the Ohio River, where it forms the

southern boundary of the area except where the Rockport hills reach to the water's edge. This ridge slopes gently toward the low inland basin occupied by the Waverly clay, but its slope toward the river is more abrupt and ends in the steep banks which extend to the water's edge. Its elevation above the river and the neighboring lowlands, together with the sandy nature of the soil itself, gives to this type excellent drainage. Ditching and tiling are never necessary, as only a very small proportion of the type is subject to overflow.

"This sandy ridge was formed before the river had cut its channel down to its present level. During times of overflow the water, spreading over the more level sections, deposited the coarser material near the banks of the river. The coarser sands are deposited near the main current, while the finer grades were carried farther inland and laid down near the deposits of silt and clay. As the river gradually deepened its channel, and as more material was annually deposited along its banks, a natural levee was soon formed, consisting of a sand ridge several feet above the flood-plain of the river. Small quantities of silt, clay and organic matter, becoming mixed with the sand, formed a soil which is not only productive but easily cultivated.

"During a very dry season the crop yields are very small, but with an average amount of rainfall large yields of oats, corn, wheat, potatoes, melons and navy beans are secured. Corn averages from 40 to 50 bushels, wheat from 15 to 20 bushels, oats from 25 to 30 bushels per acre. Tobacco is also grown on this soil and averages about 700 pounds per acre. The yield is not so large as obtained on the heavier soils, but the leaf grown on this soil usually brings a higher price. All vegetables do well on this soil. A large acreage is devoted to navy beans. It is also excellently adapted to alfalfa, while a large yield of clover is always obtained. The type is best adapted to corn, melons, alfalfa and early vegetables, the latter being grown for local markets.

"The following table gives mechanical analyses of typical samples of the Waverly fine sandy loam:

MECHANICAL ANALYSES OF WAVERLY FINE SANDY LOAM.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse Sand, 1 to 0.5 mm.	Medium Sand, 0.5 to 0.25 mm.	Fine Sand, 0.25 to 0.1 mm.	Very Fine Sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
10802	3 miles south of Rockport.	Brown fine sandy loam, 0 to 12 inches.	0.1	0.4	0.6	23.1	34.7	31.0	9.9
10800	6 miles south of Rockport.	Gray to brown sandy heavy fine loam, 0 to 5 inches.	.1	.3	.3	9.7	37.6	38.9	13.1
10803	Subsoil of 10802.....	Heavy fine sandy loam, 12 to 36 inches.	.1	.1	.4	18.0	32.8	32.4	16.0
10801	Subsoil of 10800.....	Brown loam, 15 to 36 inches.	.1	.2	.2	8.0	32.9	41.2	17.5

Agricultural Methods.

"To obtain the best results on the soils of the area very careful methods of cultivation are necessary.

"When the Miami silt loam is constantly kept in the loose condition required for the successful cultivation of corn the upper soil soon becomes eroded and its productivity is greatly lessened. The underlying subsoil becomes exposed on the surface and the land often fails to give sufficient yields to make its cultivation profitable. The usual method used to restore these lands to their former state of productiveness is to seed them down to clover. A fair stand of clover is usually obtained except on a few small areas where erosion has been greatest. The lands are heavily fertilized with stable manure or commercial fertilizer, and the fields are pastured to sheep or other live stock. By this means much of the wornout land in the area has been restored and profitably cultivated to all crops adapted to the soil.

"Where a rotation of crops is practiced the upland soils suffer very little from erosion, and profitable yields are continuously obtained without the aid of commercial fertilizers. Some system of crop rotation is in use in all sections of the area and on all soil types with the exception of the Waverly clay, but crop rotation is of the greatest importance on the Miami silt loam and the Miami fine sandy loam. The soils occupying the river flats and low upland valleys are not so easily eroded, and are annually enriched by the addition of new material washed down from the surrounding uplands or deposited by water.

"Drainage is the most important factor in the management of the soils occupying the lower and more level sections of the area.

The agricultural value of a large proportion of the Waverly silt loam and of the Miami fine sandy loam has been greatly increased where a system of artificial drainage has been established. The Waverly clay loam, on account of its level topography and slight elevation above the level of the streams, is the most difficult soil of the area to drain, but where ditching and tiling are practicable good results are always obtained. Where tile drainage is used the tiles are laid at a depth of 2½ to 3 feet and are placed 30 to 35 yards apart. These open into a main drainage ditch which leads to the neighboring stream. This system is adequate to drain the greater part of the upland valleys and low depressions occupied by the Waverly clay loam, but the topography of some of the small swampy areas occupied by the latter makes thorough drainage almost impossible.

"When preparing the soil for the cultivation of wheat the field is plowed about the 1st of August. It is then dragged, harrowed and rolled three or four times. The wheat is usually drilled in during the first week in September and is harvested early in July. The preparation of the land for oats is about the same as for wheat, except that the land is seldom worked more than twice before the crop is drilled in. Oats are sown during March and April, and the crop is harvested during the latter part of July.

"For corn the soil is plowed in the early part of April or as soon as the season permits. It is then dragged or harrowed until it is in a loose and thoroughly cultivated condition. The crop is planted from the 10th to the 20th of May, and should be cultivated once each week until it becomes too large.

"Tobacco seeds are first sown in beds located on the sunny hillsides, which afford them a natural protection. The tobacco beds are covered with a thin canvas or cheese cloth. The plants are set out during the latter part of June and the crop matures in September. It is then cut and hung on low scaffolds in the fields until the leaves begin to turn yellow. Great care is taken to protect it during rainy weather while in the field. After a short interval of time it is removed to open, well ventilated barns, stripped from the stalks and suspended from scaffolds. It is alternately dried and softened as the climatic conditions vary from dry to damp, and when thoroughly cured it is assorted and put on the market. No curing by means of artificial heat in especially constructed barns is practiced at present in the area.

AGRICULTURAL CONDITIONS.

"The agricultural interests of the area are centered in the production of corn, wheat and tobacco. A limited acreage is devoted to the production of oats, hay and vegetables, but the climatic conditions, soils and facilities for marketing all tend to make the area particularly well adapted to the three staples first named. The farmers of the area are intelligent and energetic, and the majority of them are prosperous and free from debt. Large yields of all crops grown, together with the prevailing good prices, have placed the farmers in all sections of the area in excellent financial condition. Great interest is manifested in farmers' institutes, agricultural societies and all kinds of local organizations which tend to advance the interests of the rural population.

"The average farm dwelling consists of a neatly painted two-story frame building, while the barns and other outbuildings are modern and well kept. These are always large enough to store the crops, to shelter the small number of stock which each farmer invariably owns and to protect the farm machinery during the winter months.

"About three-fourths of the farmers own the lands they cultivate, the remainder being tenants on the farms of larger landholders. Lands are usually rented on a share basis, but a few tenants in the upland sections pay cash. When rented on shares the landowner receives from one-fourth to one-third of the crop produced. The tenant furnishes the seed, work animals, farm machinery, fertilizers and labor, receiving from two-thirds to three-fourths of the crop made. From $3 to $4 an acre is the usual cash rent for farms in the Miami silt loam or Miami fine sandy loam, but a higher rate is obtained for well drained lands in the Waverly silt loam. The Waverly clay loam and Waverly clay types of soil are never rented for cash, the uncertainty of a profitable yield on account of the liability of crops on these areas to damage or destruction by floods, droughts or unfavorable seasons causing the share system to be preferred by the tenant.

"The largest farms in the area are situated along the Ohio River on the low, flat areas of Waverly clay. They average from 150 to 300 acres each, and, owing to the annual flooding of this section during the early spring months, they are cultivated almost exclusively to corn. There are comparatively few dwellings or farm buildings in this part of the area, as the farmers cultivating these lands live on the neighboring uplands or on the sandy ridge border-

ing the river. On the Miami silt loam of the uplands and the Miami fine sandy loam the farms have an average size of from 100 to 125 acres, and a very large proportion of the land is under cultivation. No large tracts are being cultivated on the Waverly clay loam. Although some farmers own from 150 to 200 acres of this type, much of it is either used for pasturage or is covered with a growth of hardwood timber.

"The average tenant in the area farms from forty to seventy-five acres. As a general rule farm labor is plentiful throughout the year, the supply often exceeding the demand, so that many of the farm laborers are compelled at certain seasons to seek employment in the towns or neighboring counties. During harvest there is always a demand for experienced farm hands at good prices, and it is often difficult to obtain them at this season. The labor employed in the area is of a very efficient character. When hired by the month from $14 to $20, including board, is paid for farm hands, but during harvest from 75 cents to $1 a day is the usual rate.

"Corn, wheat and tobacco are the principal products, each being grown on every variety of soil found in the area. A failure of the corn crop on many of the soil types is very rare, and during a favorable season an excellent crop is always obtained. This crop cannot be grown continuously on the rolling uplands without involving damage to the soil from erosion. As the soil becomes loose and friable when frequently cultivated, much of it is washed from the surface of the rolling hills to the neighboring valleys. However, when a rotation of crops is practiced large yields are continuously obtained and the general productiveness of the soil remains unchanged.

"A number of varieties of wheat are grown in the area, the most important being the Pool, the Red Wonder, the Russian Red and the New Columbia. The Pool is the variety most widely grown, but the Red Wonder seems better adapted to the more sandy soils.

"The greater part of the tobacco produced in the area is of the dark export type, but on some of the lighter soils a small amount of Burley is grown. The Pryor and One Sucker are the varieties of dark tobacco most widely cultivated, and a vigorous growth of these is always obtained on the heavier soils. The leaf is heavy and oily, varying in color from a light brown to a dark reddish brown. While a comparatively small quantity of Burley tobacco has been grown in the area, the present good prices are causing the production of this variety to increase rapidly. When the differ-

ence in the market prices is not very great the farmers prefer to grow the dark export type, as larger yields per acre are produced and it requires much less attention both while the crop is in the field and when being cured. Only a small part of the tobacco grown in the area is consumed in the United States, the greater proportion being exported to foreign markets where the dark, heavy types of this product are in greater demand.

"In connection with the foregoing discussion of the agricultural products of the area it seems advisable to point out again the relation between these products and the several soils. The Waverly clay and the Waverly fine sandy loam are well adapted to corn. The Waverly silt loam is also excellently adapted to this crop, and when well drained it produces larger yields than any other type in the area. The Miami silt loam is best adapted to wheat. Large yields of wheat are also harvested annually from the Miami fine sandy loam, and while there is no great difference between these types in the yield per acre, that produced on the silt loam of the uplands is of a higher grade, and as a rule commands better prices on the markets. Large yields of wheat are obtained on the Waverly clay when the crop is not destroyed by floods. The Waverly clay loam when properly drained is well adapted to the production of the dark-leaf tobacco, and yields of from 1,000 to 1,200 pounds per acre are realized. This soil, however, is best adapted to clover and timothy, a large part of the hay produced in the area being grown on it.

"The Waverly fine sandy loam and the Miami fine sandy loam are well adapted to melons, and the heavier, poorly drained phases of these types produce large yields of oats. Burley tobacco is also grown on these sandy loams, and with proper care in its cultivation, cutting and curing, a very fair grade is often obtained. Tomatoes, small fruits and early vegetables are well suited to these sandy soils, and limited experiments have demonstrated that alfalfa does well, especially on the Waverly fine sandy loam which borders the Ohio River.

"The transportation facilities of the area are excellent. Two branches of the Southern Railroad traverse the area, one of which terminates at Rockport, an important local shipping point on the Ohio River. The facilities afforded by both the river and the railroad cause Rockport to receive a large amount of produce from the surrounding country on the way to more distant markets.

"A large number of well kept county roads connect Boonville, Rockport, Chrisney and other smaller towns with all sections of the surrounding country. The streams are all well bridged, and the more important county roads are macadamized for some miles out from the leading towns.

"Several landings are situated at short intervals along the Ohio River where products of the neighboring farms are loaded on the small river steamers and transported direct to Louisville, Owensboro or other large markets. An electric car line is now being constructed to connect some of the smaller towns with Evansville, Rockport and other important local markets. This will greatly facilitate traffic and will enable the farmers in certain sections of the area to market their produce with more dispatch and at much less expense than at present.

"Owensboro, Ky., is the market for almost the entire corn crop of the area. The large distilleries located there create a constant demand for this product. The greater part of the wheat and tobacco is shipped to Louisville, Ky. A small proportion of the tobacco crop is marketed at Owensboro, and a still smaller proportion is shipped direct from the area to foreign markets. Very few farmers own more than a few head of stock. No cattle are raised for other than the local markets, but a large number of hogs are raised and marketed at Louisville and Cincinnati. A few farmers in the area have made a specialty of this industry, and as good prices are obtained it has proved very profitable.

"The diversity of crops grown, the natural productiveness of the land, the transportation facilities afforded by the river and railroads, and the nearness to large markets all tend to make the area surveyed one of the most prosperous sections of the State."

SUMMARY.

The counties of Warrick and Spencer are becoming prosperous agricultural communities. The people are progressive. Many good, substantial farm improvements are being made, good houses, well built barns and shelters for stock and machinery.

All the staple crops are grown—corn, wheat, oats, timothy, clover, alfalfa, cow-peas, tobacco and melons. Vegetable farming meets with success. All kinds of fruit grow well, and a large number of apples, pears and peaches have recently been planted.

At the present time there is but one canning factory in each county. It has been well demonstrated that the soils are well adapted to the growing of tomatoes, peas, sweet corn, etc., and excellent advantages are afforded for canning factories.

The increased transportation facilities should give impetus to fruit growing and truck farming, since all such produce could be handled in excellent condition and find a ready market in Evansville and other more distant points.

Large areas of the more rugged parts of the land could be devoted to grazing, and dairying would become a paying occupation. More creameries are needed, and inducements will be offered for their establishment.

Corn and tobacco are the leading products. A tobacco market was established at Rockport in 1855. The high prices from 1860 to 1870 caused a large acreage to be grown, almost to the exclusion of other crops. Spencer County alone is said to have produced 10,000,000 pounds a year. The production has greatly decreased, but Spencer County still takes the lead in the State, and the production is on the increase in both counties.

Road improvement has not progressed very rapidly, but the farmers are well pleased with their investment in road improvement. Good road metal is not very abundant and many of the best exposures of limestone well suited for this purpose are far removed from the railroads, but could be economically utilized by the use of portable crushers.

Considerable fertilizer is used, especially on wheat and tobacco, but in all the best farming localities wheat and oats straw is kept on the farm and the part not used as food for the stock is hauled out in manure spreaders and scattered over the fields. All stable manure is carefully utilized. Clover and cow-peas are also grown for green manure, and some attention is now being given to the growing of alfalfa.

The area is well adapted to agriculture, which, together with the developments of the natural resources, coal and clay, should cause the counties to hold a high rank in the State.

TABLE SHOWING THE RESULTS OF CHEMICAL ANALYSES.

Collector and Description of Soil Sample.	Shannon. Surface Patoka Lake Plain. 95.	Shannon. Subsoil Patoka Lake Plain. 90.	Shannon. Surface of Loess. 74.	Shannon. Subsoil of Loess. 75.	Shannon. Surface of Loess. 50.	Shannon. Subsoil of Loess. 55.	Shannon. Surface Marl Loess. 60.	Shannon. Subsoil Marl Loess. 61.
Laboratory No.	47.	42.	43.	44.	45.	46.	47.	48.
Reaction to litmus.	ac.	ac.	v. f. ac.	v. f. ac.	v. f. ac.	ac.	ac.	v. f ac.
Moisture at 105° C.	1.51	2.88	2.17	3.09	2.41	3.54	1.21	3.66
Total soil nitrogen.	.118	.064	.104	.059	.125	.074	.074	.071
Carbon dioxide.	.....	.....	.....	.887	.....	.....	.....	2.137

ANALYSES OF FINE EARTH DRIED AT 105° C.

Volatile and organic.	2.872	2.922	3.035	3.563	3.655	3.398	1.882	4.718
Insol. in 1.115 HCl_2.	90.931	86.799	88.456	84.405	88.395	84.721	92.086	79.856
Soluble silica.	.112	.072	.010	.012	.031	.073	.022	.83
Fe_2O_3.	2.208	3.687	2.542	4.153	3.211	4.641	2.202	4.012
Al_2O_3.	2.158	5.136	4.735	4.706	3.391	5.283	2.314	6.864
P_2O_5.	.099	.076	.164	.174	.156	.145	.139	.128
CaO.	.287	.260	.247	1.372	.279	.231	.334	1.901
MgO.	.329	.522	.493	.949	.398	.477	.333	.683
SO_3.	.046	.028	.022	.021	.036	.029	.017	.022
K_2O.	.165	.182	.236	.296	.245	.372	.159	.382
Na_2O.	.266	.289	.205	.201	.254	.192	.208	.241
Total.	99.473	99.973	100.145	99.852	100.051	99.562	99.696	99.491

These soil analyses were made by Dr. R. E. Lyons, of Indiana University, the same methods being used as in former analyses and described in the 32d Annual Report, Dept. of Geology 47–55.

SPECIAL TOPICS.

The area described in this report has a large number of soil types with an exceedingly wide range of adaptability. Some areas are of the most fertile soils, with apparently no cause to ever be replenished; others become depleted and yield inferior crops unless kept up by fertilizers; others already exhausted and abandoned; small tracts with no degree of natural fertility. Thousands of acres have, however, been reclaimed; good drainage systems are being established until acre by acre the most worthless lowland will become of agricultural value.

The farmers' and scientists' investigations are finding crops adapted to all soils, and if the soil naturally be so poor that it can scarcely do more for a plant than give it firm support, plant foods are added in various ways and good returns secured.

The sand hills, a few years ago considered without value, are now yielding enormous crops of watermelons and cantaloupes, and luxuriant growths of cow-peas, and selling for $60 to $100 per acre. The hills and ridges of the eastern part, which were once abandoned as soon as the timber was cut away, are well adapted to special crops and fruit growing.

The following pages devoted to brief reports on various subjects may not only be of value to the farmers of the areas included in southwestern Indiana but to the farmers of the entire State.

The growing of leguminous crops is rapidly growing in importance, and it is a common belief that they improve the soil, but the benefits derived by the soil depend entirely on the manner of disposition of the crops grown. Clover failure is very common, but how few farmers stop to consider the cause.

The annual wheat crop for the State of Indiana is about 2,100,500 acres, yielding 33,500,000 bushels. The five counties of this report grow about 202,500 acres of this crop, yielding about 2,300,000 bushels, a comparatively high acreage and yield for the size of the area, yet the yield per acre for any part of the area is not up to the highest. The production no doubt can be increased from one to five bushels per acre with proper understanding of the soil requirements.

Special crops, such as tobacco, watermelons and cantaloupes, and crops raised for canning purposes have a marked adaptability for this region, and their growth becomes a most important industry.

Parts suited for truck farming are made accessible by the building of traction lines, and the branch of agriculture promises to occupy a high place in the growth of these counties.

A brief discussion of the following subjects may be of priceless value:

1. Plant Foods.—Leguminous Crops and Commercial Fertilizer.
2. Increased Wheat Production.
3. Special Crops.
4. Truck Farming.

(1) LEGUMINOUS CROPS AND COMMERCIAL FERTILIZER.

By leguminous crops are meant such as clover, alfalfa, cow-peas and soy-beans—plants which have the power of extracting nitrogen directly from the free air through the soil. The ordinary grain crops do not have this power of securing nitrogen. To use leguminous crops profitably they must be well supplied with potash and phosphoric acid and the crop either turned under as green manure or used as forage and returned to the soil as farmyard manure. Clover if so used improves the soil, but if the hay crop is removed from the farm it is found that for each ton of hay removed from the soil per acre about 184 pounds of potash, 152 of phosphoric acid and 212 of nitrogen is taken, and the soil is just that much poorer. The second crop and the roots and stubble must, however, be taken into consideration, but the gain is in nitrogen only. The cow-pea is a wonderful grower and will as a rule make better growth than any other plant under unfavorable conditions of soil, and even when other crops have failed; however, no crops thrive better and more amply repay on rich land, but it is a mistake to suppose that the cow-pea itself needs no fertilizer. The cow-pea must get its potash and phosphoric acid the same as any other plant, and if these are deficient they must be supplied. Cow-peas may be planted at any time from early spring up until two or three weeks before fall frosts are expected. The harvesting for hay should not be too early, but is best when the earliest pods have begun to ripen. The cow-pea crop always benefits the soil chemically and mechanically. The methods for using the crop to benefit the soil are:

1. Plowing under the entire crop while green.
2. Allowing the crop to remain and decay on the surface of the ground during the winter and plowing it under in the spring.

3. Pasturing the field and then turning under the stubble, roots and manure from the stock.

4. Mowing the field for hay and plowing under the remainder of the crop.

Alfalfa thrives best on a light, sandy loam with a loose subsoil and good drainage. It is often a difficult crop to make a good stand, but if care is exercised the first year good results will be obtained. The hay crop may be cut from two to four times per year. Alfalfa is a heavy user of potash and should be thoroughly fertilized, and especially must this be done each year if it is expected to hold the crop for a number of years.

Clover, cow-peas and alfalfa all grow and yield good returns on many types of Indiana soils, and their growth should be more extended both for green manuring and for hay.

The following paragraphs will show the growth in the use of commercial fertilizer and the value to the farmer in securing the proper brand and in the right application of the material to his crops:

"The consumption of commercial plant foods in the United States has reached approximately 5,000,000 tons, and the cost to the consumer is nearly equal to the sum which we formerly paid for imported sugar, and which became the slogan in the campaign to establish the beet sugar industry of America—$100,000,000

"The industry is established but by no means stationary. It has increased at least 50 per cent. during the past five years, a very high rate considering the magnitude of the business.

"In the manufacture and control of these products there is employed a large number of chemists, and the Association of Official Agricultural Chemists, now over a quarter of a century old, was originally formed for devising suitable methods of analysis for these products. Thirty-three states have special laws for fertilizer inspection. The American Chemical Society recently organized a division of fertilizer chemists, and most of our agricultural colleges and experiment stations devote a considerable amount of attention to the subject.

"The farmer wants to know the facts about commercial plant foods, and all officialdom from the bureau chiefs of the National Department of Agriculture to the local speaker at the township farmers' institute undertakes to enlighten him.

"In those sections of the country where fertilizers have been longest used—along the Atlantic, the eastern gulf coast and the

upper Ohio Valleys—the experiment stations and control officials appreciate the magnitude and importance of the industry and understand its vital relation to crop productions. In marked contrast to this is the state of affairs in the greater part of the great area drained by the Mississippi, where most of our corn, wheat and oats are produced. Here we find also the curious combination of land rapidly increasing in money value and at the same time declining in productiveness, while the cost of farm labor is increasing. These circumstances cause the farmer to inquire how his crops may be increased and whether commercial plant foods may be profitable in this connection.

"Some thirty-five years ago the winter wheat growers of the Ohio Valley began to use fertilizers, most of the material being the side products of the packing houses, mainly bone meal; very profitable results were secured and the trade rapidly increased. In time, acidulated goods were introduced, often being mixtures of equal parts of acid phosphate and bone. Later came the 'complete' fertilizer, being ammonia 2, available phosphoric acid 8, and potash 2 per cent. This is still the so-called basal formula, that is the one used as a starting point in calculating the trade value of goods with different formulas. About two-thirds of the fertilizer used in that section consists of complete fertilizer, the use of bone and ammoniated phosphate is declining and the use of mixtures of acid phosphate and potash is rapidly increasing. Common applications for wheat are from one to two hundred pounds per acre, and it is almost invariably applied with a fertilzer attachment at the same time the seed is sown. The efficiency of the fertilizer in securing a stand of clover, the seed of which is sown before the wheat starts its spring growth, is a point to which the farmers attach considerable importance, and the increase in clover production may in part account for the reduction in the amount of nitrogen in the fertilizers now used as compared with that used at an earlier period.

"The use of fertilizers gradually extended to other crops, but fully two-thirds of the fertilizer sold in the Ohio Valley is used on winter wheat. The general tendency in composition has been to reduce nitrogen and increase potash, while the phosphoric acid has remained practically unchanged. Ready mixed brands are the rule, home mixing the rare exception.

"It is, however, unnecessary to state that much of this plant food has been used in a most haphazard way and that both buyer

and local seller knew little about the composition of the goods sold or their fitness for the crop or soil on which they were to be used.

"The one thing which stood out very clearly was that they paid; that by their use good crops of wheat could be secured where unprofitable crops grew before; and that a stand of clover or grass could be secured, a suitable rotation of crops established and maintained, and that the cost of the fertilizer was returned many fold in the increase of wheat grain alone—ten pounds of fertilizer, costing from ten to fifteen cents, producing on the average an increase of a bushel of wheat. This condition exists over much of the winter wheat belt, extending from Kansas east, and comprising an area of probably 200,000 square miles. These facts have existed too long and cover too much territory to be ascribed to local peculiarities of soil or season. The wheat grower knows that fertilizers pay. But as brands multiplied, the question arose which is the more profitable, and many made simple tests of different brands in which the popularity of the local agent received more consideration than the amount and kind of plant food in the goods; they obtained the confusing results that might be expected under these conditions.

"The chemical industries supplying plant foods and the purchaser of these products would both be greatly benefited by the inauguration at our expermient stations in the grain growing section of experiments properly planned to solve the question of the most profitable method of supplementing the plant food resources of the farm. Both farmer and fertilizer manufacturer need the help of the educational institutions in the direction of securing facts relative to the most profitable methods of utilizing plant foods in the production of our great cereal crops—facts that will help and not discourage.*

(2) Increased Wheat Productions.

"The first fertilizer used on wheat in the Central West consisted of bone and of tankage from the packing houses and the rendering plants. In a short time the collection of buffalo bones from the plains became quite an industry, and the buffalo bone was so highly esteemed that the name remained in the trade long after the supply was exhausted. Bone tankage seems to have been sold for wheat fertilizer in the West as early as 1875, but very little is known about the amounts or grades used during the first

*H. A. Huston.—From material submitted at request concerning Fertilizer Materials and Experiments on Wheat.

ten years. During the early eighties legislatures began to pass laws regulating the sales of fertilizers, and from that time we have a fair knowledge of the trade.

"One may say that in a certain sense the use of fertilizer in the section under consideration is little more than an experiment, but one whose extent deserves more attention than its quality. While there has been a rapid increase in the quantity of wheat fertilizer used and of the area to which it is applied, there has been little systematic study of the best methods of applying them.

"The high esteem in which bone is held as a wheat fertilizer is doubtless due to the fact that the typical wheat land of the Ohio Valley was a rather heavy clay whose scanty original supply of phosphoric acid had been much reduced by a bad system of cropping. In many places the soil had become acid, and phosphoric acid was the element that limited the crop; under these circumstances the nitrogen was not very heavily drawn upon and the inert potash of the soil became available a little more rapidly than it was used by the limited wheat crops, thus permitting an accumulation of available potash sufficient to last several years.

"Of course these conditions were not understood by those who began the use of bone. The one thing that appealed to them was that by drilling in with the seed 100 to 200 pounds of 'bone dust,' as mostly all fertilizer was then called, they could bring up the yield of wheat from six or eight bushels per acre to twenty or thirty bushels, at a cost of about fifteen cents per bushel.

"It is not strange that under these circumstances the farmer should believe that in the bone dust he had found the secret of successful and profitable wheat culture on land which a few years before appeared to have lost its value for wheat production. Indeed, many farmers thought that 'dust' could be used as a substitute for manure or crop rotation, and there was a tendency to neglect the utilization of the manural resources of the farm.

"Before a generation had passed, the farmers began to complain that bone was not as good as at first and failed to produce such striking results. As a matter of fact, the bone had improved in quality.

"Then came the introduction of the so-called 'half and half,' which consisted of a mixture of equal parts of acid phosphate and bone meal. At this time farmers were learning of the value of legumes as nitrogen gatherers and introducing them into their rotations more freely. Thus the phosphate and nitrogen supplies were reasonably maintained. The gypsum in the acid phosphate

released some of the less resistant of the soil potash, and for a time this system of 'half and half' and clover seemed to have won the day.

"But presently the crops failed to respond and clover did not catch well. Attention was then given to the question of potash, and the reign of the so-called 'complete fertilizer' began. In the past fifteen years the use of the ammoniated phosphate mixture has almost disappeared, the sale of ground bone has increased but slowly, while the complete fertilizers and the mixtures containing only phosphate and potash have been in rapidly increasing amounts.

"The complete fertilizer and 'bone and potash' mixtures at first contained only one or two per cent. of potash, but have gradually changed until now from six to eight per cent. is not unusual, and many farmers use high-grade potash salts to increase the potash content to ten or twelve per cent.

"If one looks up the records of tests by the experiment stations he will find that many experiments on wheat are reported unprofitable. An examination of the details of such experiments at once reveals the cause. Such excessive amounts of nitrogen have been used in the mixtures that the cost has been too high and often the amount of phosphoric acid used was not sufficient to permit the nitrogen and potash to be fully utilized.

"One of the oldest of the wheat experiments used plant food equivalent to 500 pounds per acre annually of a fertilizer containing nitrogen 10 per cent., phosphoric acid 5 per cent. and potash 6 per cent.

"As contrasted with this is the fact that wheat growers find that fertilizers of the 2-8-6 or 3-10-6 type used at the rate of 100 to 300 pounds per acre pay, even when we consider only the increase in the yield of grain and neglect the value of the straw increase or the efficiency of the fertilizer in securing a good stand of clover.

"So conspicuous is the effcet of phosphoric acid on the usual wheat soil of the winter wheat belt that many doubt whether the nitrogen or potash are effective or profitable in the mixtures.

"On a typical worn clay wheat land an experiment was undertaken on the basis of 300 pounds per acre of a goods containing nitrogen 3 per cent., available phosphoric acid 10 per cent. and potash 6 per cent., each element being omitted in turn the usual way."

The following results were obtained:

GRANT COUNTY, IND.

Fertilizer Applied Equal to	Yield Bushels.	Reduction from, Omitting				
		Nitrogen.	Phos. Acid.	Potash.	All.	
300 lbs. 3-10-6	33.8					
300 lbs. 0-10-6	29.1	4.7				
300 lbs. 3- 0-6	7.6		26.2			
300 lbs. 3-10-0	25.0			8.8		
None	6.5				27.3	

The nitrogen in the fertilizer cost	$1.80
The phosphoric acid cost	1.50
The potash cost	1.10
The complete fertilizer cost	$4.40

"The nitrogen increased the crop 4.7 bushels at a cost of $1.80, the phosphoric acid increased it 26.2 bushels at a cost of $1.50, while the potash increased it 8.8 bushels at a cost of $1.10. As wheat sold at 90 cents per bushel it will be seen at a glance that all the plant foods were used at a profit although, of course, we are not in a position to show that the combination is the one most profitable, nor do we know that this was the most profitable amount. We do know that it was very profitable, even neglecting the value of the increase in straw and the very striking effect on the clover which followed the wheat.

"The experiment is a typical one, for soils in the winter wheat belt and numerous others could be given, showing results of just the same character and even more striking in profits.

"The figures show how the lack of phosphoric acid limited the crop, and they serve to explain why bone gave such increases on these soils that for nearly a generation it was considered the only profitable thing to use.

"In another set, where the grower was of the opinion that less potash would be just as effective, the experiment was conducted along the same line, but the formula was 3-10-5, used at the ratio of 300 pounds per acre."

The following results were obtained:

SCOTT COUNTY.

Fertilizer Applied Equal to per Acre.	Yield Bushels.	Reductions from, Omitting				
		Nitrogen.	Phos. Acid.	One-half Potash.	Whole Potash.	All Foods.
300 lbs. 3-10-5	30.8					
300 to 0-10-5	22.6	8.2				
300 lbs. 3-0-5	9.5		21.3			
300 lbs. 3-10-2.5	24.8			6.0		
300 lbs. 3-10-0	21.3				9.7	
No fertilizer	4.2					26.6

"This experiment shows clearly enough the fact that with only a partial supply of potash the vegetable part of the plant uses it at the expense of the seed; the full ration of potash giving much more than double the increase of the half ration.

"Of course, we are still far from knowing the most profitable amounts or formulas for wheat growing in the Central West, but we have at least progressed far enough to know that the kinds and amounts that are practicable in ordinary use can be profitably used and more progress will be made when we have fuller experiments established which will take into consideration the kind of material to use, the right methods of application, the question of the most profitable amounts, and finally, the rational interpretation of the results secured."

Results of experiment by A. G. Mace, Lexington, Indiana, Scott County, showing stand of wheat on fertilized and unfertilized plots. Crawfish soil. Season 1907. See Photograph No. 1.

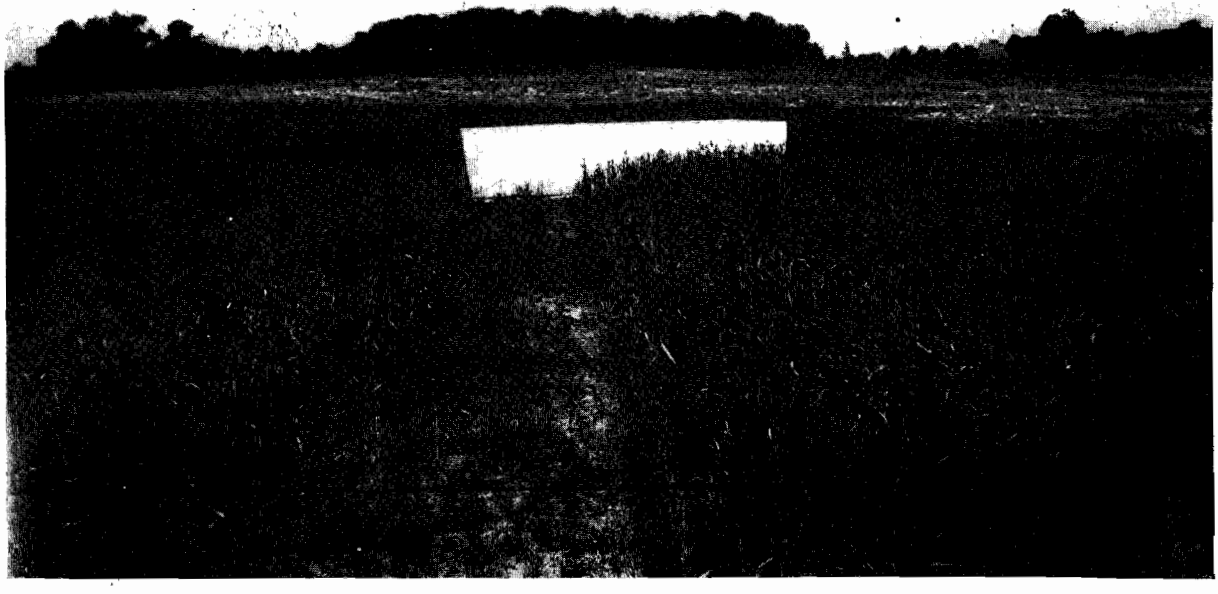
FERTILIZER PER ACRE IN POUNDS.

Plot.	17	1
Blood	0	120
Banner Bone Flour	0	172
Muriate of Potash	0	207
YIELD PER ACRE.		
Bushels	2	11.4

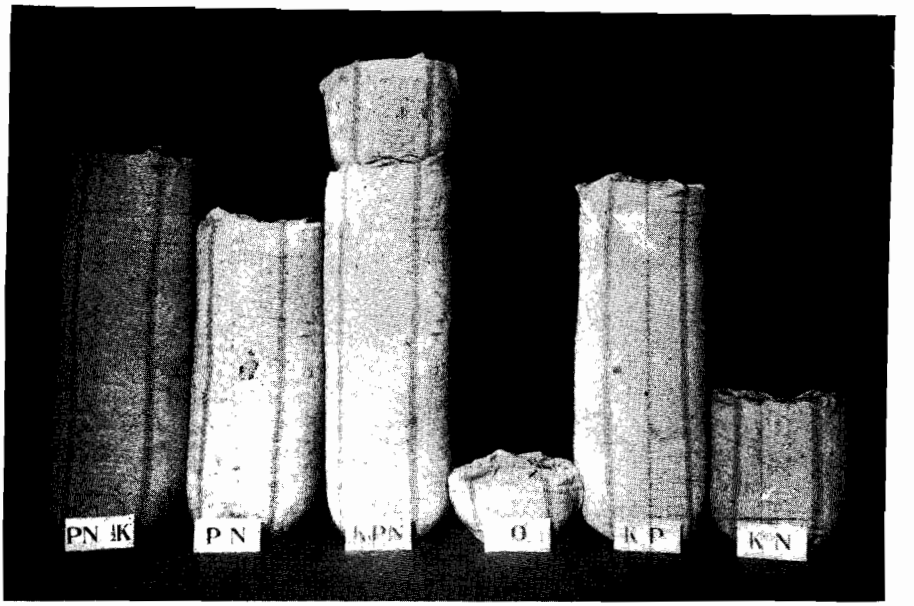
Results of experiment by A. G. Mace, Lexington, Scott, County, Indiana, showing the yield of wheat from 1-10 acre plots. Crawfish soil. Season 1904. Results also shown in Photograph No. 2.

FERTILIZER PER ACRE IN LBS.

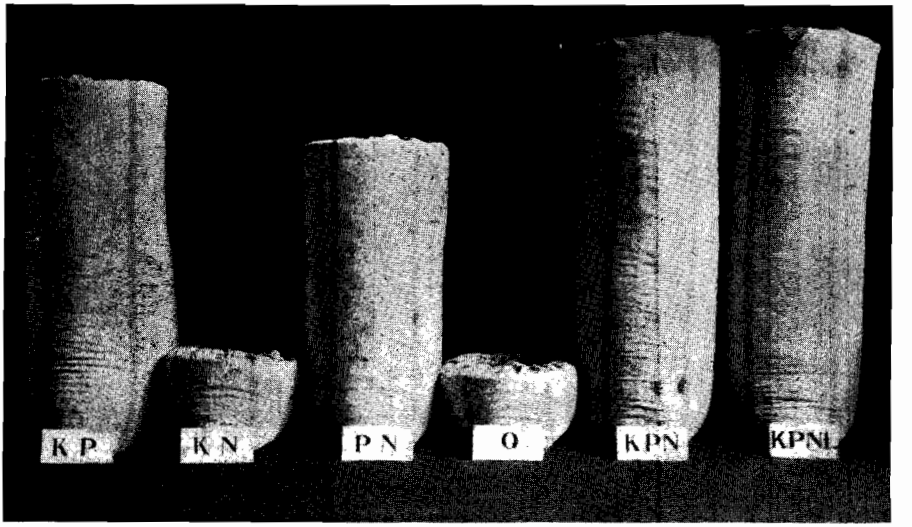
PLOT.	1	2	3	4	5	6
Acid Phosphate	200	200	200	0	200	...
Blood	60	60	60	0	...	60
Muriate of Potash	15	...	30	0	30	30
YIELD PER ACRE.						
Bushels	24.8	21.3	30.8	4.2	22.6	9.5



No. 1. Showing stand of wheat on fertilized and unfertilized plots. A. G. Mace, Scott County.



No. 2. Shows wheat yield from $\frac{1}{10}$-acre plots. A. G. Mace, Scott County.



No. 3. Shows wheat yield from $\frac{1}{5}$-acre plots. P. R. Edgerton, Grant County.

Results of experiment by P. R. Edgerton, Marion, Grant County, Indiana, showing the yield of wheat from 1-15 acre plots clay loam. Yellow clay subsoil. Season 1907. Results also shown in Photograph No. 3.

FERTILIZER PER ACRE IN LBS.

PLOT.	1	2	3	4	5	6	7
Blood	0	...	70	70	70	70	0
Banner Bone Flour	0	100	...	100	100	100	0
Muriate of Potash	0	35	35	...	35	35	0
Lime	.....	.....	.....	.....	.....	10 bbls.	.....

YIELD PER ACRE.

Bushels	6.5	29.1	7.6	25	33.8	34.1	6.5

Results of experiments by Ernest P. Welborn, Cynthiana, Posey County, Indiana, showing the comparative yield of wheat per acre on clay soil. Experiment in season 1907. Results also shown in Photograph No. 4.

FERTILIZER PER ACRE IN POUNDS.

PLOT.	1	2	3	4	5	6	7	8	9
Banner Bone Flour	0	125	.....	125	.....	125	125	.....	0
Acid Phosphate	0	.....	300	.....	300	.....	.....	.....	0
Muriate of Potash	0	.....	.....	60	60	30	120	60	0

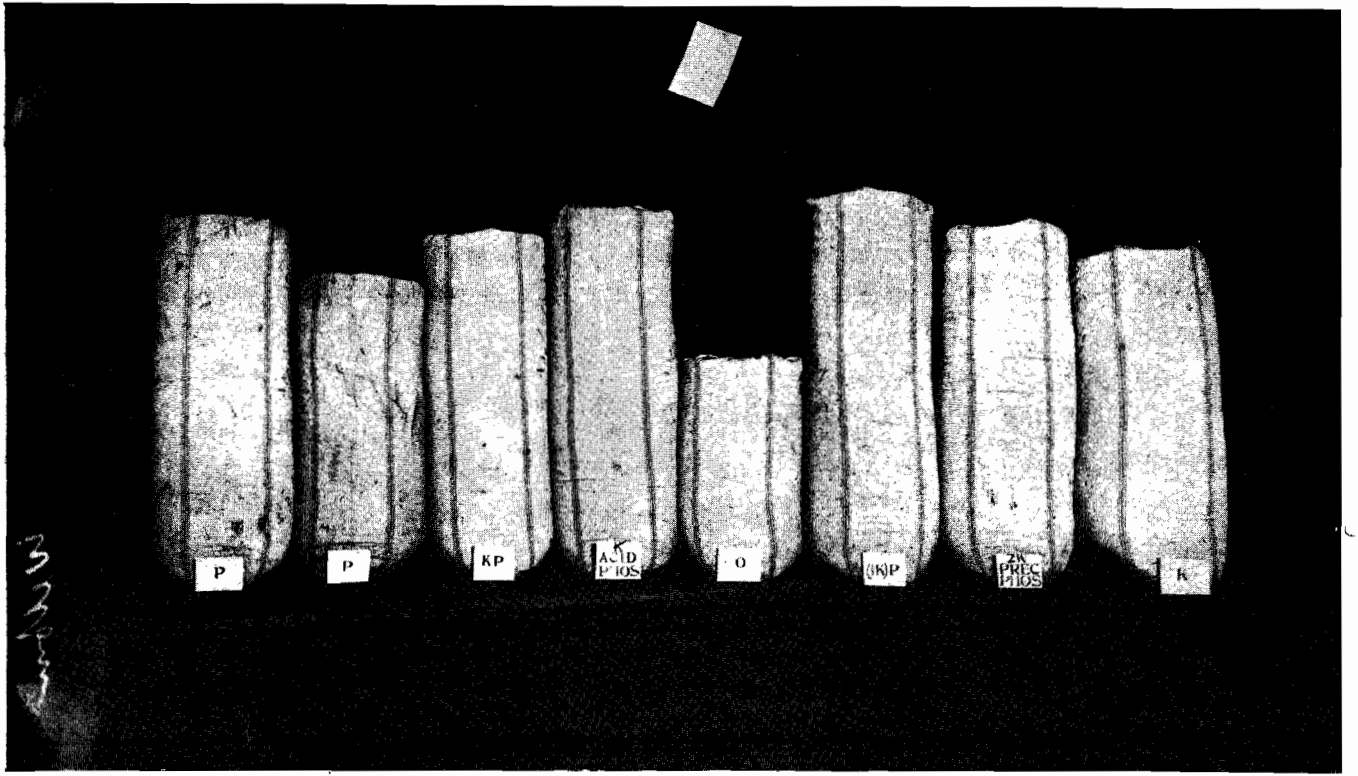
YIELD PER ACRE.

Bushels Wheat	19.83	34.37	28.66	33.33	36.08	37.08	34.0	31.58	21.5
Pounds Straw	2740	3367	3570	3810	3855	4245	3880	3535	3430
Pounds per Struck Bus.	55	57	57	59	59	58	59	57	56

(3) SPECIAL CROPS.

At present more than 700,000 acres of land are planted each year in this country with tobacco, and the average annual crop amounts to over 600,000,000 pounds and the value of the manufactured products from tobacco is estimated at $200,000,000, or nearly half the value of our flouring mill products. Of the amount produced Indiana grows an annual yield of about 10,000,000 pounds of tobacco.

Four chief classes are known in the trade: (1) Cigar leaf, (2) Export types, (3) Bright leaf manufacturing, (4) Perique.



No. 4. Showing comparative wheat yield from one acre. Ernest P. Welborn, Posey County.

The export types and the Burley tobacco belonging to the third class are the class chiefly grown in Indiana.

The State grows about 8,000 acres of watermelons, and 2,500 acres of cantaloupes, and the counties of the southwestern part of the State are the big growers, Gibson, Knox and Sullivan taking the lead, with Jackson in the central southern, striving for fourth or fifth place in the production of watermelons, and second in the acreage of cantaloupes. A light, rich, sandy loam is best for these crops, and good yields can never be secured on a wet, heavy soil. Farmyard manure is useful in growing melons. Commercial fertilizer should contain nitrogen 3 per cent., potash 8 per cent., and available phosphoric acid 8 per cent.

There are excellent opportunities in Southern Indiana for canning factories. Tomatoes, peas, sweet corn, pumpkins, etc., can be grown very profitably, and a number of localities are anxious to secure canning factories.

(4) Truck Farming and Fruit Growing.

The successful farmer does nothing but farm. He invests his money as fast as made in a way to improve the farm. He informs himself by books, magazines and farm journals as to the best methods, so he can do his work intelligently. No dilapidated buildings, tumble-down fence, tall weeds, neglected implements, nor unsheltered stock are to be found upon such a farm, but everything is attended to with the purpose of making everything count.

He is a poor farmer, indeed, who does not know how to produce a crop of grain, or fatten a carload of cattle, or care for his dairy herd that his milk may be the most wholesome on the market; he is a poor market gardener who cannot turn off a sound lot of potatoes, or celery, or onions; the fruit grower has missed his calling who cannot make his vines and trees yield liberal quantities of attractive fruits.

The chief object of every truck farmer is to make money. But in truck farming as in every other business, the most successful are usually those who have the most experience. There is, however, some difference between truck farming and general farming. Thus in most cases the truck farmer, who grows a great variety of garden crops, must show more knowledge, care and attention than does the general farmer who raises only the staple crops. A most successful farmer who turns his attention to truck farming may fail because he does not understand the "intensive" farming which he is trying to do on general farming principles.

Markets and Marketing.—No particular discredit must be attached to one engaged in any branch of agriculture who is not fully posted on all the ins and outs of marketing farm products. In these days of sharp competition it is of prime importance that the agriculturist should not only know how to raise a crop, but should know how to dispose of it so as to get the most profit from his money and his labor.

Until recently the large truck farms were generally located near the big cities. But today, with the splendid transportation facilities, low rates and the improved methods of handling fruits and vegetables, it is not necessary to be very near the large cities, where the prices of truck land are sure to be high. Thus the "out of town" gardener, if he has these transportation facilities, can compete on almost equal terms with his rivals near the large cities.

Among the simplest methods of marketing produce is peddling it direct from wagon to the doors of consumers in villages, towns and cities. While this method is one much employed by small farmers, gardeners and fruit growers, it can at the same time be profitably carried on to a considerable extent if the business is thoroughly developed, even though from a small beginning. Innumerable families in all of our towns, who are entirely dependent upon purchases for food supplies, are very glad to secure an important part direct from producers. They demand strictly fresh and sound produce, however, and for such are willing to pay full market prices. In many instances families will be willing to pay a little more for something especially nice, rather than buy something a little less desirable at the store even at a lower rate.

This suggests that the farmer's wagon must be first-class in every respect, attractive in appearance and the produce must be sound and of the best quality. It is a mistake to presume that the average housekeeper will pay a bonus to get fresh country produce; she is willing to pay a full price, but that is all. In securing this, the producer should be satisfied, because he saves all the middlemen's charges, and it is usually a quick trade with immediate and profitable returns. A second method of disposing of farm produce is to sell to a local grocer or marketman. This has some advantages, but like the first named can only be carried on in a limited way. Frequently, however, the local retailer with an established trade can handle the product of the small farmer and gardener to mutual advantage.

In producing on a large scale the farmer can sell his grain, live stock, poultry, eggs, fruit, vegetables, etc., direct to local buyers,

who in turn has his established outlet at distant large points of consumption and distribution, and often accumulating a carload or more from various farmers, ships as market conditions warrant. One thing in favor of this plan is the securing of a known price for the produce without fear of loss through dishonest agents and the expense of transportation rates. But a positive drawback is that the local middleman must take out a considerable profit to himself in order to protect against shrinkage, loss and decline in prices. A fourth method is shipping produce direct to consumers at distant points, previously secured by working up a trade from a small beginning. This is often a favorite and successful method, where the farmer has taken pains to establish a reputation for his goods and honest pack and count. The fifth method is selling through the commercial merchant, who handles by far the greater part of the farmer's supplies. This is true of perishable products, such as fruits and vegetables, but less true of poultry, eggs, hay, etc. As for grain, live stock, etc., they are frequently sold by the farmer to the local country buyers who trade through the hands of commission merchants in large cities. Thus to a great extent the commission merchant is the agent of the producers and shippers, standing for their best interests, and for his compensation in a way of common charges endeavors to do for the producer and shipper what he could not do for himself.

Whatever plan of selling the producer selects, the market must be big enough to take care of any usual supply of perishable goods, and, to be absolutely profitable, must be large enough to take care of a supply which for a time is even greater than usual.