U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS.
IN COOPERATION WITH THE IOWA AGRICULTURAL EXPERIMENT STATION.

SOIL SURVEY OF PAGE COUNTY, IOWA.

BY

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[Advance Sheets—Field Operations of the Bureau of Soils, 1921.]

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[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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MAP.

Soil map, Page County, Iowa.

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By A. M. O'NEAL, JR., of the Iowa Agricultural Experiment Station, in Charge, and R. E. DEVEREUX, of the U. S. Department of Agriculture.

DESCRIPTION OF THE AREA.

Page County is situated in the southwestern part of the State of Iowa. One county separates it from the Missouri River and the State of Nebraska on the west, and it is in the first tier of counties north of the Missouri State line. Shenandoah, which is located on the western boundary, is approximately 59 miles from Omaha, Nebr. The county is rectangular, with dimensions of 24 miles east to west, and of 22½ miles north to south. It contains 16 townships, the southern 8 containing less than 36 square miles each. The county has a total area of 531 square miles, or 339,840 acres.

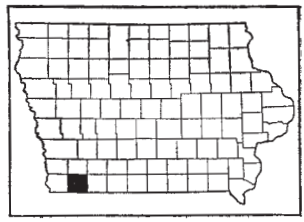

FIG. 15.—Sketch map showing location of the Page County area, Iowa.

The surface of Page County was originally a broad loess-covered plain. This has been modified and altered by the erosion of a complete drainage system. Two physiographic divisions exist—the uplands and the terraces and first bottoms along stream courses.

The uplands form by far the larger part of the area, and here the relief varies from gently rolling to strongly rolling, the former predominating. In most cases the hills are smooth and rounded and the slopes even and gentle. This is particularly the topography throughout Tarkio Township and the greater part of Pierce, Fremont, Morton, and Washington Townships. In that section of the county lying between the Nodaway and East Nodaway Rivers and in the southeastern part of Buchanan Township erosion has been more active, with the result that the hills are narrow, less rounded, and the slopes more abrupt. Similar relief is found along the west side of the Nodaway River in the vicinity of Hepburn, but the areas are narrow and only extend back one-quarter to one-half mile before merging with the more gently rolling uplands.

Second terraces occur throughout the bottoms of the East Nishnabotna, Nodaway, and East Nodaway Rivers, the largest development occurring in the vicinity of Essex and Porters Lake. The areas are rather disconnected and have a smooth to gently sloping surface. Along practically all the streams of the county first-bottom land is developed. The flood plains of the rivers are comparatively extensive, the width varying from 1 to 3 miles; the alluvial deposits along the smaller streams and intermittent drainage ways are often very narrow.

The prevailing slope of the county is toward the south. According to Gannett's Dictionary of Altitudes, the elevation above sea level at Clarinda is 1,009 feet, at Shenandoah 974 feet, at Essex 992 feet, at Coin 1,031 feet, at Hepburn 1,016 feet, at Braddyville 953 feet, at Northboro 1,074 feet, at Norwich 1,142 feet, and at Shambaugh 973 feet.

The drainage of the county is carried by the East Nishnabotna, Nodaway and East Nodaway Rivers and their tributaries. These streams cut across the county from north to south and meander through wide flood plains. The escarpment along the western side of the bottoms is more uniformly precipitous and abrupt than along the eastern side, and the valley floors lie from 100 to 200 feet below the general level of the uplands. Numerous small streams and intermittent drainage ways ramify all parts of the county. In the rougher sections drainage is inclined to be excessive and the hills are damaged by erosion. Formerly the first bottoms were all subject to frequent overflows, but since the rivers and larger creeks have been ditched and straightened only during periods of excessive floods are even the lower parts of the bottoms overflowed.

During the summer of 1841 the first white man immigrated from Missouri and settled in what is now section 27 of Buchanan Township. During the next few years settlement was slow, and even in 1848 the number of white families had only increased to 30. Page County was formed in 1851. The early pioneers were nearly all American born. Most of them came from Indiana, Ohio, Illinois, Kentucky, Missouri, and Tennessee.

The population of Page County in 1920, as reported by the United States census, was 14,371, a decrease of 823 during the preceding decade. The rural population, 74.9 per cent of the total, is well distributed over the county, averaging 27 persons to the square mile. In the northern part of the county the greater proportion of the population is of German descent.

The two most important towns of the county are Clarinda, the county seat, with a population of 4,511, situated in the eastern part, and Shenandoah, with a population of 5,255, situated on the western boundary. Essex, with a population of 797, Coin with 665, Blanchard with 422, Shambaugh with 298, Northboro with 209, Braddyville with 326, and Hepburn with 112 are other towns of importance. Norwich, Yorktown, Bingham, and Page Center are small villages enjoying railroad facilities. College Springs and Hawleyville are inland towns of some importance.

The transportation facilities of Page County are good, no point in it being more than 8 miles from a railroad shipping point. A branch of the Chicago, Burlington & Quincy Railroad runs east and west approximately across the center of the county, connecting Shenandoah and Clarinda with points east and west. The Red Oak–Nebraska City branch of the same system runs through Shenandoah, Essex, and the northwest corner. Another branch traverses the eastern part of the county, following closely the course of the Nodaway River, and still another leaves the line at Clarinda and runs southwest through Coin and Northboro. The Omaha–St. Louis branch of the Wabash Railway runs through Shenandoah and Coin, leaving the county at Blanchard.

The public road system is good. Throughout the greater part of the area the roads follow land lines and only in the rough sections where they wind along the lower slopes or follow crests of ridges do they deviate from this plan. A number of the main trunk highways have been brought to grade and concrete culverts put in, and during the year of the survey (1921) work was in progress on the Waubonsie Trail between Shenandoah and Clarinda. None of the roads are graveled or hard surfaced, but are kept in excellent condition by frequent dragging, especially after rains. The Waubonsie Trail enters the county at Shenandoah and runs through Clarinda and eastward into Taylor County.

The farmers of the county enjoy telephone service and rural free delivery. Schools are generally located at 2-mile intervals, but in a number of places have been consolidated. Where this is the case the small country schools are abandoned and central buildings erected in some town, the pupils being carried back and forth in school wagons. Graded public schools and high schools are found in all the larger towns.

The towns of the area furnish a market for most of the farm products. The principal outside markets are Chicago, Kansas City, and Omaha.

CLIMATE.

The climate of Page County is characterized by a wide range in temperature and a moderate and variable annual rainfall. The summers are comparatively short and hot; the winters cold and long. During June, July, and August the hottest weather is experienced, but as a rule the hot spells are of short duration. The mean for the summer months is 72.9° F. and the maximum for the same period is 113° F. The hot spells are sometimes accompanied by hot winds from the southwest, during which growing crops are often considerably damaged. While the mean winter temperature is 22.1° F. an extreme of −31° F. has been recorded during January. Blizzards occur frequently and cause great suffering to unprotected stock. The mean annual temperature is 50.1° F.

The rainfall is well distributed for the growing of crops. The mean annual precipitation is 32.83 inches, with 17.96 inches recorded for the driest year and 51.37 inches for the wettest. Late spring rains often interfere with plowing and with the planting of crops. The greatest precipitation occurs during the growing season; the fall months are somewhat drier, favoring the harvest of some of the crops. The precipitation of winter is less than for any other season. The summer rains are mostly in the form of thundershowers and are as a rule heavy and of short duration. Nevertheless, during the passage of a low-pressure area over this section rain may be general for several days. Snowstorms have been recorded as early as October and as late as April. The average annual snowfall is 31.6 inches.

The average date of the last killing frost in the spring is April 23, and the first in the fall October 11, which gives an average growing season of 171 days. The earliest killing fall frost recorded occurred on September 18 and the last in the spring on May 16.

The following table, compiled from records of the Weather Bureau station at Clarinda, gives the normal, seasonal, and annual temperature and precipitation for Page County:

Normal monthly, seasonal, and annual temperature and precipitation at Clarinda.

(Elevation, 1,009 feet.)

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1894).	Total amount for the wettest year (1902).	Snow, average depth.
	° *F.*	° *F.*	° *F.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	24.7	65	−19	1.17	0.99	2.53	6.2
January	19.7	67	−31	.95	.48	1.23	6.1
February	21.8	70	−29	1.07	1.40	.30	8.3
Winter	22.1	70	−31	3.19	2.87	4.06	20.6
March	34.9	92	−15	1.75	1.17	.92	7.1
April	49.6	96	7	2.83	2.06	1.79	1.2
May	60.8	99	21	5.13	1.37	7.18	T.
Spring	48.4	99	−15	9.71	4.60	9.89	8.3
June	70.0	104	38	4.82	4.02	11.64	.0
July	75.2	110	42	4.48	.39	8.02	.0
August	73.5	113	38	3.62	.23	6.76	.0
Summer	72.9	113	38	12.92	4.64	26.42	.0
September	64.6	106	26	2.99	2.53	4.72	.0
October	51.9	93	12	2.58	2.77	4.23	1.2
November	36.0	80	−7	1.44	.55	2.05	1.5
Fall	50.8	106	−7	7.01	5.85	11.00	2.7
Year	50.1	113	−31	32.83	17.96	51.37	31.6

AGRICULTURE.

Page County has been organized for nearly three-quarters of a century, and the first settlement antedated the building of railroads by some 30 years. From the beginning agriculture has been the chief resource. The early immigrants came from agricultural States to the east and south, bringing with them the experience and knowledge necessary to develop the fertile prairie and bottom lands of the region, but without adequate means of transportation progress was slow at first. During 1871 the first railroad was built through the county. This marked the beginning of a new era, and growth from this time on was rapid. Corn, spring wheat, and oats were the principal crops then as now, with corn occupying the largest acreage. Cattle and hogs were raised on most farms, and were the source of considerable income. These animals were pastured the greater part of the year on the prairies, which supplied excellent grazing, and only fed on corn a short time before shipping to market.

In the early days methods for improving and maintaining the fertility of the land were not considered. Rotations were not in use and commercial fertilizer or lime were never applied, but the natural richness of the soil and the considerable number of cattle pastured each year prevented the deterioration that might otherwise have taken place, and left the soils in their present productive condition.

The general trend of agriculture in the last 40 years is shown by the following table, which gives the number and size of farms and the acreage and production of the principal crops of Page County, as shown by the censuses of 1880, 1890, 1900, 1910, and 1920:

Acreage and production of principal crops, 1879 to 1919, as reported by the census.

Year.	Total number of farms.	Average size of farm.	Corn.		Wheat.		Oats.	
		Acres.	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*
1879	2,501	121	133,631	6,297,632	28,203	351,299	12,015	390,066
1889	2,436	134	112,591	5,384,405	9,526	117,813	23,867	878,679
1899	2,643	127.9	132,601	5,723,200	13,767	165,170	22,833	748,300
1909	2,341	140	109,725	4,228,209	15,682	263,383	17,070	459,584
1919	2,252	145.8	96,646	3,556,446	51,456	983,147	18,826	605,591

Year.	Rye.		Barley.		Hay and forage.		Potatoes.	
	Acres.	*Bushels.*	*Acres.*	*Bushels.*	*Acres.*	*Tons.*	*Acres.*	*Bushels.*
1879	3,093	55,864	3,064	54,405	21,604	27,301	.....	82,585
1889	2,179	39,376	84	2,317	41,566	61,600	1,383	133,582
1899	720	13,030	787	21,150	38,352	63,888	1,706	141,178
1909	205	3,319	1,442	29,813	40,720	68,508	1,070	95,414
1919	1,758	22,183	1,012	13,616	36,374	70,029	952	45,616

The total values of agricultural products in 1919, exclusive of animals sold and slaughtered, which item was not reported by the census, was the very considerable sum of $10,122,349. The value of the several classes of products making up this total is given in the following table:

Value of all agricultural products, by classes, census of 1920.

Product.	Value.	Product.	Value.
Cereals	$7,342,107	Livestock and products:	
Other grains and seeds	70,644	Dairy products, excluding home use	$359,459
Hay and forage	1,255,033	Poultry and eggs	625,547
Vegetables	276,047	Wool, mohair, and goat hair	23,634
Fruits and nuts	141,427		
All other crops	28,451	Total	10,122,349

At the present time the agriculture of Page County consists of the growing of corn and general farm crops for sale and for local use; the raising of hogs; the raising and feeding of beef cattle and to a small extent sheep; and dairying. The growing of fruit and garden truck is carried on to help supply the home demands.

The principal crops in the order of their importance are corn, wheat, oats, timothy, clover, and alfalfa. Some barley, rye, sweet clover, buckwheat, strawberries, melons, small fruits, sorgo, and all kinds of garden truck also are grown.

The principal agricultural interest of Page County consists of the production of corn, which was grown on 96,646 acres in 1919. The production for this year was 3,556,446 bushels, or an average of 36.7 bushels per acre. The two chief requisites are early maturity and good yields, and the farmers select their seed accordingly. Dent corn is grown entirely, and the most popular varieties are Reid Yellow Dent, Boone County White, Iowa Silvermine, and strains of these varieties. Practically all the crop is used on the farms in fattening beef cattle and hogs and in feeding the work stock and dairy cows. A small quantity is shipped from the northeastern part of the county to outside markets. The larger part of the crop is husked from the standing stalks, but a small percentage is cut and left in the shock

until feeding time. A small acreage is cut for silage, and where this is to be done soy beans are often planted between the rows. The acreage of corn has fallen off and the acreage of wheat increased in the last 20 years.

Wheat ranks second in importance, the production in 1919 being 983,147 bushels, the produce of 51,456 acres. Hard winter wheat is grown to the practical exclusion of spring wheat, as the yields of the latter are uncertain and the quality comparatively poor. Practically all the wheat is shipped, through the cooperative elevators located at Essex, Shenandoah, and Hepburn, to outside markets, and wheat constitutes the principal cash crop.

Oats are used in the rotation on practically every farm and the crop stands third in importance. The varieties best liked are the Kherson, Albion (Iowa 103), Richland (Iowa 105), and the Early Champion. Owing to climatic conditions, the likelihood of lack of moisture or the occurrence of too high temperatures at critical periods in the growth, the crop is rather uncertain and probably would not be grown extensively if it were not an excellent nurse crop for the clovers and alfalfa and one that fits well into the general rotation which is centered around the production of corn. The census of 1920 reports that in 1919, 605,591 bushels of oats were produced on 18,826 acres, an average of 32.6 bushels per acre. The greater part of the crop is threshed from the shock. Occasionally, when used as a nurse crop, oats are cut for hay. Practically all the oats are used in the county as feed for the work animals and young stock.

Hay occupied 36,374 acres, being the third crop in the county in point of acreage. The principal hay crops of the county are timothy, clover, and alfalfa. Timothy and clover are grown separately, as well as mixed. The largest acreage is in timothy and clover mixed, which in 1919 occupied 9,337 acres, from which 16,286 tons of hay was harvested. Timothy alone occupied 8,653, clover alone 3,653, and alfalfa 5,192 acres. The production of pure timothy hay amounted to 12,466 tons, of pure clover hay 5,216 tons, and of alfalfa hay 12,546 tons. It is to be noted that the production of alfalfa hay was greater than that of timothy hay, notwithstanding the great disparity in the acreage of the two crops. Hay is not a sale crop, being practically all consumed on the farms of the county.

The growing of clover is on the increase and should receive more attention, as it is not only a valuable soil builder that can be easily grown on the soils of the area, but is a valuable forage crop especially for dairy cattle. Red clover is most used, although alsike is often mixed with it, especially for sowing on the bottom-land soils where drainage is not well established. Hubam, annual sweet clover, is grown on a small scale by the seed houses of Shenandoah and Clarinda. The entire crop is threshed for seed. The biennial sweet clover volunteers along the roads and railroads, while clover appears in the bluegrass pastures. Red or red and alsike clover are commonly sown in the spring with small grain, at the rate of 10 to 15 pounds per acre. When seeded with oats or spring wheat the seed is generally drilled in with the grain, but in the case of winter wheat the seed is broadcasted in the early spring. The clover is pastured the first year and cut for hay the second. Occasionally the second cutting is harvested for the seed. Where the fields have been limed the yields are better than where no lime has been used.

The value of alfalfa as a forage crop and soil builder is recognized, and many small fields were noted during the survey, especially in the western part of the county. The crop is cut three or four times a year and yields an average of about 2½ tons per acre per season. Alfalfa yields well for a period of two to six years, when it is generally crowded out by weeds and bluegrass. When winterkilled the cause seems to be, not severity of the winters, but the poor condition of the plants at the beginning of cold weather. A few hogs are pastured in the alfalfa fields, and when the number of animals is not too great and pasturing not continued too long no damage to the stand results. All of the crop is cut for hay and used within the county for feeding the work stock and beef cattle.

Bluegrass grows naturally and is scarcely ever seeded. It thrives on the soils of the area and furnishes excellent pasturage during the summer months. Sudan grass is grown on a few farms, mostly as a catch crop. It furnishes good pasturage, and when planted early can be cut twice for hay.

Small apple orchards are found on most of the farms, but little care is given them, except in a few places where fruit is grown on a commercial scale. The quality is excellent and all the apples are sold within the county.

Potatoes, rye, buckwheat, watermelons, muskmelons, sorgo, soybeans, strawberries, and all kinds of garden truck are grown on a small scale to help supply the local demand.

The raising of hogs is the most important livestock industry. The 1920 Iowa Yearbook reports that on January 1, 1921, there were 105,671 hogs in the county, practically all raised in the county, although in some years a few are brought in for feeding. Cholera causes considerable loss; in 1920, 1,026 animals died from this disease. Preventive methods are being generally used and losses are steadily declining. The breeds most liked are the Poland-China, Duroc-Jersey, Chester White, Spotted Poland-China, and Hampshire. The raising of purebred Poland-China hogs for sale is also quite important. Some hogs are sold within the area to meet the local demand, but most of them are shipped to St. Joseph, Kansas City, and Omaha.

The feeding of beef cattle is important, especially in the southwestern part of the county. The industry, however, has recently suffered a slight decline, owing to the lack of adequate pastures, and according to the 1920 Iowa Yearbook there were only 34,863 head of cattle in the county, exclusive of those kept for milk, or an average of 11 per farm. In only a few cases do the farmers make a practice of raising purebred stock for sale. The breeds observed during the progress of the survey were the Shorthorn, Aberdeen-Angus, and Hereford, with no outstanding preference. The most general practice is to buy feeders in the St. Joseph, Kansas City, or Omaha market each fall. The animals are pastured till cold weather, when they are brought in and put on a heavy ration of corn and hay till sold in the late winter or early spring. Where young animals are bought they are kept at least a year before they are marketed.

There were 4,871 sheep shipped into the county during 1920, and on January 1, 1921, according to the Iowa Yearbook for 1920, the total number in the county was 7,364. Western sheep are used exclusively, as they seem to be hardier than those from other sections of the country. They are first turned into the cornfields or pastures

where they forage for themselves till cold weather, when they are brought in and put on a corn ration till shipping time. Most of the sheep are shipped out during the early winter. There were 44,998 pounds of wool clipped in 1920.

Dairying is an important side line and the revenue derived from the sale of all dairy products, excluding home use, amounted to $359,459 in 1919, as reported in the 1920 census. Only a few milk cows are kept, the average being two to the farm, although one large herd of Holstein cattle was noted on the farm of the State hospital at Clarinda. All dairy products are sold locally.

Practically every farm has its flock of chickens, and on many a very large number of fowls are carried. The value of poultry and eggs as reported in the census of 1920 amounted $625,547, a greater value than that of dairy products or vegetables. The chickens and eggs usually are sold to local produce houses and general stores, which, after supplying the local demand, ship to outside markets. A few farmers make a specialty of fancy stock for sale.

The Marshall silt loam, which is the most extensive and important soil type in the county, is considered the most valuable soil for the production of corn, wheat, oats, and hay. Since the straightening of the rivers and creeks and the resultant better drainage of the bottoms the Wabash silt loam has become a valuable, strong corn soil. Wheat now gives the best yields on the heavy, better drained bottom-land types. The Wabash silt loam (colluvial phase) and the Wabash clay, as well as the poorly drained areas of Wabash silt loam, are generally left in pasture, as cultivation is difficult and the luxuriant growth of natural grasses affords excellent grazing, and some hay. The Waukesha, Judson, and Bremer soils are considered well adapted to the growing of the general farm crops.

Corn usually is planted from three to four years on the same land before changing to small grain. Where corn follows corn the land is prepared by running a stalk cutter or disk harrow over the field, after which it is plowed, disked, and harrowed. Sometimes it is only plowed and disked, and in a few cases the stalk land is disked and harrowed without plowing. As a rule sod land to be used for corn is plowed in the late fall or early winter. Corn usually is planted in check rows in the upland and listed in the bottoms. The rows ordinarily are 3 feet 6 inches apart. Planting takes place between May 1 and May 15, and the crop is laid by about July 4. It receives either three or four cultivations, depending upon the season. In a few places soy beans are planted between the rows, especially where the corn is to be used for silage. Most of the corn is husked from the standing stalk; a small acreage is cut with a corn binder and stacked in the fields till feeding time. A very small acreage is hogged down.

Winter wheat, when planted between the corn, is sown about September 1 and when on sod about September 10 to October 1. In the first case it is drilled in with a one-row drill; in the latter an ordinary grain drill is used. Sod land, when prepared for wheat, is plowed deep early in the fall, disked, and harrowed. Clover and timothy are often grown with the wheat.

The growing of alfalfa is becoming more important, consequently improved cultural methods are employed to obtain better stands. There seems to be little preference between fall and spring seeding,

although it is said the former gives more certain results. In either case the land is broken deep and thoroughly disked and harrowed. Inoculation of the seed before planting and liming of the land insures better stands. Unless special care is exercised to keep down bluegrass and weeds, the alfalfa is choked out after a few years. The general practice is to leave the land in alfalfa from two to five years, after which it is returned to corn

The farmers of Page County recognize the value of manure, and the available supply is carefully conserved. When used on sod land it is scattered with a manure spreader in the fall before plowing, and on stubble land, to be used for corn, it is applied in the spring before disking. A small quantity of commercial fertilizer has been used in an experimental way and has proved beneficial. A number of carloads of lime were shipped in the year of the survey and scattered over the clover and alfalfa fields

The farm dwellings throughout the greater part of the county are large two-story houses, modern, substantial, and well kept. Many of them are of brick and stone construction. The barns are large and substantial, with ample space for the work stock and cattle, as well as room for the storage of a considerable quantity of grain and hay. A few silos and rat-proof corncribs were noted during the progress of the survey.

The farms of the area are generally well fenced. The fences are mostly of the hog-tight variety, consisting of 3 feet of closely woven wire with from two to four strands of barbed wire at the top. The use of concrete and iron fence posts is extending. The old mock orange hedges, which occupy so much land, are being removed rapidly.

Improved farm machinery is in general use. The equipment includes gang plows, riding and walking cultivators, disk plows, disk harrows, spike-toothed harrows, hayrakes, hay loaders, mowing machines, manure spreaders, and small-grain and corn binders. Tractors are also in use. Windmills and small gasoline engines are found on practically every farm, the former used for pumping water for the stock and the latter for doing work requiring light power. Some of the farms are equipped with individual electric-lighting plants. Throughout the county the threshing is done by cooperatively owned machines that travel from farm to farm in the fall.

The work stock consists of draft horses of medium and heavy weight. Mules also are popular.

Since corn is the principal crop all rotations center around its production. The one in general use consists of corn for three or four years, oats or wheat for one or two years, and timothy and clover for two or three years. The more progressive farmers, however, never plant corn more than three years before seeding to small grain, and pay attention to the growing and turning under of legumes. On the bottom-land soils corn is frequently grown on the same land for years without change.

Since the World War the labor problem has been a difficult one, but the situation is gradually adjusting itself. About two-thirds of the farms reported the use of labor in 1919, the census of 1920 reporting an expenditure of $690,608. This is $461.33 per farm reporting. Farm laborers as a rule are hired by the month, receiving from $60 to $70 and board. When the laborers are married a house

is supplied, together with firewood, a cow, and a garden. Much day labor is employed during harvest season, the rates of pay being much greater for these emergency helpers.

According to the census there were 2,252 farms in Page County in 1919, or 89 less than 10 years earlier. The farms range in size from 80 to 400 acres, with the average about 145 acres. Increasing numbers are leaving the farms and moving to the towns of the county, and in 1919 only 61.6 per cent of the farms were operated by owners. The number of tenants increased materially during the decade 1909–1919, the percentage in the earlier year being 34.1 and in the latter 37.2. Leases stipulating cash rent predominate, the rate per acre ranging from $12 to $20. Under the share system the owner generally receives half the produce. Special agreements are not uncommon. The owner, for instance, often specifies the acreage that is to be left in clover or grass. When feeders are bought the owner commonly furnishes half the money, and shares the profit equally with the tenant.

The value of land varies according to location, improvement, and topography. At present few farms are changing hands and the values given are based on the last transfers and on the price at which the present owners hold their farms. Near the principal towns the value of farm land is high, ranging from $300 to $400 an acre. The more rolling areas and slopelands away from the towns are held as low as $150 an acre. The average assessed value, according to the Federal census, is $237.69 an acre.

SOILS.

Page County is situated in that part of the United States where the climatic and other conditions have favored the development of prairies supporting a luxuriant growth of grass. This type of vegetation has held possession of most of the land for long periods, tree growth being confined to relatively small wooded areas, which have developed as the streams have worked their way into the original plains, giving sloping areas and better drainage. The soils of the area, including the alluvial soils, have therefore, for the most part, developed under prairie conditions, under which the growth and decay of grass vegetation has added large quantities of organic matter. The large quantity of organic constituents still retained by the soils is largely responsible for their prevailingly dark color at the present time. On the broader divides, where the run-off is gradual, material of dark color extends to depths of 18 to 22 inches, but in the rougher sections, i. e., where erosion has been more or less active, a thinning of the upper layer has brought lighter colored material nearer the surface.

These dark-colored soils may be grouped for convenience into two main divisions; first, those developed under conditions of poor drainage; and second, those developed where the more active movement of the drainage waters has been conducive to the better aeration and oxidation.

The first group includes the Wabash and Bremer series. These soils, developed from material washed from the dark-colored uplands and redeposited during times of overflow in the bottoms, are poorly

drained and in many cases the ground-water level remains near the surface. This condition has not favored leaching, aeration, or oxidation and dark-colored soils overlying mottled heavy subsoils have developed. The Bremer series, which is better drained, owing to its somewhat higher position, shows the effect to a slight degree of oxidation, and it is reasonable to believe that through this agency the color of the subsoils will gradually change.

The second main group can be divided into two subclasses—(*a*) partly leached soils and (*b*) thoroughly leached soils.

The first subclass embraces the entire upland area and includes the Marshall and Shelby soils. Here the rolling to strongly rolling topography has permitted a more active movement of the soil waters, resulting in better aëration and more thorough oxidation. This is apparent in road cuts, where it can be seen that weathering was extended to considerable depths. The Marshall silt loam is the most extensive soil of this group. Its typical profile consists of a dark-brown to very dark brown soil, underlain by a light-brown to yellowish-brown subsoil, friable and loose in structure, and slightly heavier than the surface soil. The Shelby soils are developed throughout the areas of strong relief. Consequently, the surface soils, while they resemble the Marshall soils in color, are much thinner, owing to the erosional action of the surface waters. The subsoils consist of a yellow, reddish-brown, or brown sticky sandy clay, containing in many places coarse sand and gravel, fragments of the original parent drift. As the lower subsoil is in many places impervious, the leaching has not been as active, and we occasionally find areas where sufficient lime is present to give effervescense when acid is applied.

The Waukesha and Judson types, which belong to the subclass of thoroughly leached soils, are developed on reworked material washed from loessial and silty drift soils and deposited on stream terraces that are now above overflow. The surface soils of both of these types are dark brown to very dark brown in color and of mellow, porous structure. The subsoil of the Waukesha silt loam is a yellowish-brown to light-brown silt loam to silty clay loam, while the subsoil of the Judson silt loam is little different in texture and structure from the surface soil. Drainage in both cases is excellent, and the free passage of the drainage waters has resulted in the thorough leaching of the subsoils to depths of more than 3 feet.

During a stage of the glacial period Page County was covered by a thick deposit of drift brought down and deposited by the sheet which formerly covered this general region. Subsequently this drift was blanketed by a deposit of silty material known as loess. Along many of the streams where erosion has been more active, the glacial drift is exposed, and these areas become more extensive toward the east, owing to the thinning of the loess covering. The unweathered loess, as observed in the deeper road cuts, is pale yellow to yellowish brown in color and has a uniform silty texture, while the glacial drift in its natural state is generally a bowlder clay. The classification of soils is now considered to depend more upon soil-forming processes, such as weathering, oxidation, the admixing of organic matter, and leaching, than upon the original characteristics of the parent material.

The soils of the area have been separated into series on the basis of color and the process of accumulation of the soil material. Further division into types is made on the basis of difference of texture.

The Marshall series is characterized by dark-brown to black soils and a light-brown to yellow or yellowish-brown subsoils. The subsoil is silty and ranges from a heavy silt loam to a silty clay loam. The soils are developed throughout that section of the county covered by the Missouri loess. The topography varies from gently rolling to sharply rolling. The Marshall silt loam is the only type of this series mapped in Page County.

The Shelby series comprises types with dark-brown to black soils underlain by a yellow, reddish-yellow, or light-brown sticky clay subsoil. The type is derived from the weathering of the sandy Kansan drift. The only type mapped in Page County is the Shelby silt loam.

The Waukesha series includes types with dark-brown to black surface soils and a brown to yellowish-brown subsoil. While the subsoil is heavier than the soil, it is not compact or impervious. The soils are developed on terraces and the topography varies from level to gently sloping. The Waukesha silt loam is the only type mapped in the present survey.

The surface soil of the types correlated with the Judson series is predominantly dark brown to almost black and the subsoil light brown. As developed in this county they represent colluvial slopes along the outer edge of the bottoms, and the color and texture may extend to 3 feet or more without change. One type, the Judson silt loam, is mapped.

The types in the Bremer series have black soils and a dark-gray, black or dark-drab subsoil, mottled in many areas with iron stains. The subsoil is generally heavy and impervious. The series is confined to terraces, and drainage is fairly well established. The silt loam is the only type of this series mapped in the county.

The Wabash series comprises types with dark-brown to black soils, underlain by a black, dark-drab, or very dark brown subsoil. The organic content of both soil and subsoil is high. The soils of this series are developed in the first bottoms and are subject to overflow. The Wabash silt loam, with a colluvial phase, the Wabash silty clay loam, and the Wabash clay are developed in the present survey.

Riverwash, as mapped in the county, includes small areas of sand, gravel, and silt immediately along the streams, where the material is shifted and changed with each overflow.

The following table gives the actual and relative extent of each of the soils developed in Page County. The distribution of the several types over the county is shown by means of distinctive colors on the accompanying map. In the following pages of this report the individual soils and their relation to agriculture will be discussed in detail.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall silt loam	205,440	60.5	Judson silt loam	3,328	1.0
Wabash silt loam	52,160	16.9	Riverwash	1,216	.4
Colluvial phase	5,504		Wabash clay	1,152	.3
Shelby silt loam	56,960	16.8	Bremer silt loam	832	.2
Wabash silty clay loam	7,552	2.2			
Waukesha silt loam	5,696	1.7	Total	339,840	

MARSHALL SILT LOAM

The Marshall silt loam consists of a dark-brown mellow silt loam with a depth of 15 to 18 inches, underlain to 36 inches by a yellowish-brown heavy silt loam to silty clay loam, slightly mottled with gray and iron stains below 24 inches. These faint gray mottlings, however, do not seem to be an indication of poor drainage. Throughout the more rolling areas a part of the organic matter has been removed and the color is not as dark as on the gentle rolling divides. These differences are, however, slight, and the type is remarkably uniform both in color and texture throughout the county.

In that section of the county lying between the Nishnabotna River and West Tarkio Creek the divide is broad and more level and the dark-brown soil extends in many places to 18 or 20 inches. Along the steeper part of the slopes of the eastern two-thirds of the county the type is predominantly a brown to dark-brown mellow silt loam12 to 15 inches deep, underlain by a yellowish-brown heavy silt loam which at 20 inches grades into a yellowish-brown silty clay loam mottled with gray and brown, the gray mottlings becoming more pronounced below 24 inches. Here iron concretions occurring in the lower part of the subsoil give the appearance of yellow mottlings. In Buchanan, East River, and Nebraska Townships the topography is prevailingly strongly rolling and erosion has been more active and has robbed the soil of some of its organic matter and surface covering. Consequently the soils are less dark in color and much thinner. This condition also exists along some of the larger creeks where drainage has been excessive. A few sandy areas too small to separate on the map are included with this type, the largest body of this description being found in the eastern part of section 22, T. 69 N., R. 36 W., and consisting of a dark-brown loamy fine sand, underlain at from 6 to 12 inches by a brown to a yellowish-brown fine sand.

The Marshall silt loam is the most extensive soil type of the county and is developed throughout all sections. The topography varies from gently rolling to strongly rolling, but the hills are rounded and the slopes smooth. Drainage is adequate. The subsoil is retentive of moisture and crops seldom suffer from want of water if the land is properly prepared, except in the rougher sections, where the run-off is rapid. The Marshall silt loam is considered a very valuable type and practically all of it is under cultivation or in pasture. The only natural tree growth consists of the few oaks, maples, hickories, and walnuts along some of the stream slopes. Groves of planted trees protect most of the farm dwellings and orchards from the cold north and west winds of winter. The trees used for this purpose are chiefly cottonwood, maple, elm, and hemlock.

Corn is the most important crop on this soil. Wheat, oats, and hay follow in the order named. The greater part of the corn crop is utilized to feed the work stock, beef cattle, and hogs on the farms and only a small amount is shipped. Wheat is probably the most important cash crop. Practically all the crop is delivered at the cooperative elevators located at Shenandoah, Essex, and Hepburn, whence it is shipped to outside markets. Oats are grown on all farms, as the crop fits well into the general rotation. In years when only a few cattle and hogs are fed a small amount is shipped out, but as

a rule the entire crop is used as feed on the farms of the area. Hay, which is the crop ranking fourth in importance, consists of timothy and clover, grown separately and together, and alfalfa. While the yields are good, the supply is not equal to the demand.

The raising and feeding of beef cattle and hogs are the principal livestock industries on this type, the latter being the most important. The 1920 Iowa Yearbook reports that the average number of hogs on the farms of the county in that year was 45. During the progress of the survey many farms on the Marshall silt loam were seen that had from 200 to 400 head. A few breeding herds of cattle are kept, but the more general practice is to buy feeders on the open market, preferably in the fall. A few dairy cows are kept on most of the farms to supply the home needs. A few small dairies are operated near Shenandoah and Clarinda to supply these towns. Some sheep are shipped in each year from the West and pastured. The raising of poultry, although a side line, is important. Sorgo occupies a small acreage. Most of the crop is made into sirup on the farms, but a considerable acreage is grown to supply a factory located at Shenandoah. A small acreage is devoted to the growing of rye, barley, and buckwheat.

Corn[1] yields from 35 to 80 bushels an acre, the average being 36.7 bushels; wheat, 15 to 40 bushels; oats, 15 to 50 bushels; and hay, 1 to 2 tons. Barley and rye yield on an average 12 bushels per acre.

Hubam clover is being grown by the seed houses of Shenandoah and Clarinda and a few farmers. The entire crop is harvested and threshed for the seed; the industry has proved quite profitable.

Apple orchards are found on most farms, but only in a few cases are the trees sprayed and otherwise well cared for. There are two or three commercial orchards in the eastern part of the county that have proved quite profitable. The entire product of these orchards is sold locally.

The Marshall silt loam, owing to its relatively light texture and friable structure, is easily cultivated. It can be plowed under varying moisture conditions without injury, and never bakes or checks on drying. The better farmers break the land from 6 to 8 inches deep, disking and harrowing afterwards to insure a good seed bed. Fall plowing is considered best, but in many years the farmers are unable to get to this work and the land lies in stubble or sod until spring.

The farmers recognize that through more thorough preparation of the seed bed and the use of crop rotations the yields are increased. While the rotation in many cases consists only of the growing of corn for a term of years and then seeding to grass, the more progressive are working out and using more definite and more efficient systems. The most popular consists of corn for two or three years, oats one year, wheat one year, and clover and timothy two or three years. When alfalfa is used in place of timothy or clover the field may remain in this crop four to six years before returning to corn. Soybeans are being grown between the corn, especially where the crop is to be used for silage or to be hogged down.

The growing of clover both for forage and for hay is on the increase, and in many cases it is turned under for green manure. Lime is profit-

[1] Yields on the various soil types, given in the report, are based upon the statements of farmers.

ably used and a number of carloads are shipped into the county each year.

Land of the Marshall silt loam is held at $200 to $400 an acre according to location with reference to the towns and railroads and the condition of improvements. Very little land of this type of soil changes hands.

This type is considered the most valuable one of the county, and where proper methods of management are employed its productiveness is not only being maintained but increased. The use of legumes in the rotations and the turning under of an occasional crop as green manure are recommended. In many cases the soil should be plowed deeper and the seed bed more thoroughly prepared. Deeper plowing will enable the soil to store more moisture and help to carry the crop through periods of drought, and more thorough seed bed preparation improves the stands and gives the seedlings the most favorable conditions for vigorous, healthy growth. On the steeper slopes, where erosion is relatively active, contour planting is recommended. The furrows should at least be run at right angles to the slopes to retard washing. The time may come when it will be necessary to terrace the steeper slopes to prevent the removal of the surface material. The use of lime should be extended. Experiments have been made with phosphorous and potash fertilizers and the results indicate that the use of them would, in some places, be profitable.

The success achieved in the two commercial orchards in the county suggest that the growing of apples might be extended. The varieties giving the best results in the county are the Jonathan, Grimes, Winesap, and Siberian Crab.

SHELBY SILT LOAM.

The Shelby silt loam is a brown silt loam, 7 to 10 inches deep grading abruptly into a yellowish-brown silty clay loam to silty clay mottled with rusty brown and yellow. The mottlings become more pronounced with depth, and indications of the unweathered parent till appear in many places below 20 inches. In some areas the first few inches of the subsoil is a brown friable silt to heavy silty loam or silty clay loam grading into the yellowish-brown layer within a few inches. Small bowlders occur on hillsides and in road cuts. It is not uncommon to find areas on the steeper slopes where the surface covering is entirely washed away, exposing the yellowish-brown subsoil. Along the steeper part of the slopes and on points where the surface soil has been thinned the plow often brings up gravel. In such areas the texture may approach a fine loam, and had they been large enough and of sufficient importance they would have been separated from the silt loam on the map.

The Shelby silt loam occurs as narrow strips bordering most of the streams of the county. While these bands are comparatively narrow in the western part, they become wider toward the east, the most extensive development being found in the southeast corner. Drainage is sufficient and in many places the run-off is rapid enough to cause erosion. The topography varies from rolling to strongly rolling or steep.

The greater part of the type is in cultivation or in pasture. Along the steeper slopes to the streams some forest areas appear, the growth consisting principally of bur oak, red oak, cottonwood, maple, walnut, and elm.

Land of this type is farmed in connection with the adjoining Marshall silt loam, and the principal crops grown are corn, wheat, oats, and hay, with the largest acreage in corn. All the products, except the wheat and a small percentage of the corn, are used on the farms as feed. Rye and barley also are grown on a small scale and watermelons and muskmelons do well in years of normal rainfall. Clover and timothy occupy a considerable acreage. Bluegrass makes a fairly good growth and furnishes excellent pasturage during the summer months. The general practice is to leave the steeper slopes in grass, as they wash and erode badly when cultivated. Small numbers of beef cattle and hogs are pastured each year on this type, and a few milk cows are kept to supply the needs of the home. The type is well adapted to the growing of apples and small fruits. Where the trees are pruned and sprayed apples of excellent quality are produced.

The Shelby silt loam is handled in practically the same way as the Marshall silt loam, with which it is closely associated. Cultivation, however, is not so easy in the case of the Shelby soil as the slopes are steeper. As the soil covering is much thinner than in the Marshall silt loam, the plow often turns up the heavier material of the subsoil. Too much of this material tends to reduce the yields.

This type is never sold separately, but always in conjunction with the adjoining upland or bottom-land types. It is not considered as valuable as the Marshall silt loam, and this estimation is reflected in the price.

The Shelby silt loam can be improved by the use of the methods suggested for the Marshall silt loam. As much damage is caused by erosion, it is best to leave the steeper slopes in natural pasture or in timber. Where cultivated the furrows should be run at right angles to the slope, or better still, should follow the contours. Terracing of all slopes would protect them against washing and prevent excessive leaching. Most of this type needs organic matter, and the growing of green manuring crops, as well as the application of stable manure, is even more essential to success than on the Marshall silt loam. It would prove advantageous to deepen the seed bed to 7 or 10 inches, provided this can be done without bringing up too much of the subsoil at one time. Deeper plowing would not only improve the physical condition of the seed bed but would enable the soil to absorb more of the rainfall and thereby reduce erosion. The steeper slopes should be seeded to bluegrass.

WAUKESHA SILT LOAM.

The surface soil of the Waukesha silt loam consists of a brown to dark-brown mellow silt loam 16 to 18 inches deep. The subsoil is a light-brown to yellowish-brown heavy friable silt loam which grades into a silty clay loam in the lower part of the 3-foot section. Faint gray mottlings appear in the subsoil, and below 24 inches iron stains occur in many places. The plowed fields, after rains, have a very dark brown to black appearance.

While the type is, in general, uniform, some variations occur. The most notable are developed north of Essex, in the northern part of section 11, T. 70 N., R. 39 W., and north of Braddyville in section 17, T. 67 N., R. 36 W. Here the surface is predominantly a brown to a dark-brown mellow silt loam 16 to 18 inches deep, and the upper subsoil a brown heavy silt loam that grades at about 24 inches into a yellowish-brown silty clay loam faintly mottled with gray. In a few places the surface soil approaches a loam in texture, but the areas are small and separation would have been difficult and of no practical importance.

The Waukesha silt loam, with one exception, is confined to the second terraces of the East Nishnabotna and Nodaway Rivers. Most of the bodies are inextensive and more or less isolated, the largest development occurring in the vicinity of Essex and Porters Lake. The areas lie approximately 14 to 22 feet above the normal level of the streams, and 5 to 8 feet above the first bottoms. Their surfaces are level to gently sloping and drainage is adequate. The subsoil is retentive of moisture and crops seldom suffer from drought.

The Waukesha silt loam is probably the most valuable of the terrace types, and all of it is in cultivation. The soil is well adapted to the growing of corn, and this crop occupies the largest acreage. Wheat, oats, and hay are other crops of importance, and small acreages are given to the production of barley and rye. All the grain, except the wheat and a small part of the corn, which are shipped out of the county, is fed on the farms. The hay is chiefly clover and timothy. A few fields of alfalfa were noted. The crop is generally cut for hay, although on some farms it is used as pasturage for hogs.

The raising of hogs and the feeding and pasturing of cattle are important interests. From some of the farms from 100 to 300 hogs are marketed each year. Most of the cattle are bought as feeders. Poultry is an important side line on most farms.

In productiveness the Waukesha silt loam compares favorably with the Marshall silt loam. Corn yields 35 to 75 bushels per acre; wheat, 15 to 35 bushels; oats, 15 to 50 bushels; and hay, 1 to 2 tons.

The Waukesha is handled in practically the same way as the Marshall silt loam. The deep mellow structure of the surface soil makes cultivation easy, and on most of the farms the fields are thoroughly prepared before planting. Fall plowing is the general rule. Much of the plowing is done with large gang plows drawn by tractors. The general rotation differs from that used in the uplands, in that wheat almost always follows oats.

Some lime is used on the farms on this type, and in most cases, manure is carefully saved and applied to the sod or stubble land with a spreader. Commercial fertilizers are not in general use.

Land of this type is highly valued for the production of general farm crops, and is held at from $250 to $400 an acre, according to location and improvements.

The Waukesha silt loam can be improved by the use of the methods recommended for the Marshall silt loam. The tiling of the more poorly drained areas would improve their physical condition and increase yields. The excellent results obtained from the use of certain fertilizers on experiment fields of this soil, both in this and other counties

of the State, suggest that their use may well be included in the management of the farms.

JUDSON SILT LOAM.

The surface soil of the Judson silt loam consists of a dark-brown to almost black mellow silt loam, 17 to 19 inches deep. The content of organic matter is high and after rains the surface appears black. The subsoil is predominantly a silt loam of lighter brown color than the soil, although in many places there is no change in color or texture from the surface to a depth of 3 feet or more. In a few borings the dark-brown silt loam is underlain at from 18 to 20 inches by a brown silt loam, grading at 24 to 30 inches into a lighter brown silty clay loam. Such areas were small and not important enough to justify separation on the map.

The Judson silt loam is developed mainly on the terraces of the East Nishnabotna and Nodaway Rivers, although one small area occurs along the west side of Middle Tarkio Creek, 7 miles south of the northern boundary and another along the west side of West Tarkio Creek. The type represents colluvial material washed mainly from the Marshall uplands and deposited, for the most part, along the outer edge of the bottoms.

The areas lie 2 to 4 feet above the first bottoms, and 10 to 15 feet above the level of the streams. The surface is level to gently sloping. Drainage conditions are generally good. The subsoil is retentive of moisture and crops seldom suffer during periods of drought.

The Judson silt loam, although of small extent, is a valuable agricultural soil, and all of it is in cultivation or pasture. The only tree growth consists of a few windbreaks planted to protect the farm dwellings from the cold north and west winds of winter. The trees used for this purpose are mostly elm, cottonwood, and maple.

Corn occupies the largest acreage, followed by wheat, oats, and hay in the order named. A small proportion of corn and all the wheat are sold; the rest of the grain is fed on the farms. The livestock consists of hogs and beef cattle. A few milk cows are kept to supply home needs. Alfalfa makes an excellent growth on this type. Occasionally the crop is lightly pastured, but the more general practice is to cut it for hay. Rye, barley, and garden truck are sometimes grown on a small scale. The yields are practically as good as on the Waukesha silt loam.

The methods of handling this soil are similar to those employed on the Marshall silt loam. Stable manure is never applied in as large quantities as on the upland types. In the vicinity of Shenandoah, where the type is used for growing nursery stock, the depth of plowing is 8 to 10 inches and the seed bed is very thoroughly prepared.

The Judson silt loam can be improved by the methods recommended for the upland types. As the soil is more or less acid, the application of lime will increase the yields. The excellent results obtained where soy beans are grown between the rows of corn indicates that the practice could well be extended. The use of rape as hog pasturage is often desirable. The crop can be grown with corn also.

The Judson silt loam is considered about equal to the Waukesha silt loam in value. The type is never sold separately, but always in connection with the adjoining upland or bottom-land soils.

BREMER SILT LOAM.

The surface soil of the Bremer silt loam consists of 14 to 16 inches of a very dark brown to black silt loam, high in organic matter. The subsoil is a lighter brown silty clay loam passing gradually at from 20 to 24 inches into a dark-drab or grayish-brown silty clay, mottled with shades of rusty brown. Where drainage is not so well developed the subsoil may have a drab, brownish-gray, or dark-slate color. The type is uniform throughout the area of its development, except in a few very small bodies where the surface soil approaches closely a loam or silty clay loam.

The Bremer silt loam is developed on the terraces of the Nodaway and East Nodaway Rivers, the most extensive areas lying along the east side of the East Nodaway, 3 miles northeast of Shambaugh. The topography is level to gently sloping. Drainage is not as well established as on the Waukesha and Judson types.

The Bremer silt loam is a strong agricultural soil and practically its entire area is in cultivated fields or pastures. The only tree growth consists of a few willows along old fence rows and the planted windbreaks of elm, maple, cottonwood, and evergreens. The principal crops in the order of their importance are corn, wheat, oats, hay, and barley. The pastures are especially good and a considerable area is used for this purpose.

Fields on this type are somewhat larger than on the Waukesha or Judson soils. Corn produces from 35 to 85 bushels per acre; wheat, 18 to 40 bushels; oats, 17 to 65 bushels; and barley, 12 to 20 bushels.

The methods of handling this type are similar to those employed on the adjoining Marshall and Waukesha soils, except that on many farms corn grows for a longer term of years without change to some other crop than on the Marshall silt loam.

Land of this type is nearly always sold in farms with the adjoining upland or bottom-land soils.[2] It is not considered quite as valuable as the Marshall silt loam, the price ranging from $200 to $350 an acre.

The Bremer silt loam can be improved by the methods suggested for the Marshall silt loam. Liming is necessary, especially where alfalfa and clovers are to be grown. The tiling of the more poorly drained areas is recommended.

WABASH SILT LOAM.

The Wabash silt loam is a dark-brown to very dark brown mellow silt loam 14 to 18 inches deep, underlain to 3 feet or more by a dark-drab, dark grayish brown, or black silty clay loam to silty clay, mottled with rusty-brown color in the lower depths. The content of organic matter is high, both in the soil and subsoil, and the surface has a black color after rains. Iron concretions appear in the lower part of the soil section of many areas.

The type, as is characteristic of most first-bottom soils, is subject to more or less change by fresh deposits and varies considerably from area to area. This is particularly true in the bottoms of the smaller streams. In the bottoms of the East Nishnabotna and Nodaway

[2] The land values are based on recent transfers and information obtained from the farmers as to the value at which land is held.

Rivers the type is more uniform, and large areas here show practically no variations in color, texture, or depth of surface soil. In depressed areas of poor drainage the surface soil is a black silt loam high in organic matter, underlain by a drab to brownish-gray plastic clay. Along the outer edge of some of the bottoms a layer of new material has often been deposited, varying in thickness from 1 to 3 inches. Also included with the type are a few very small areas of loam and silty clay loam, which can not be shown on a map of the scale of an inch to the mile.

The Wabash silt loam is most extensively developed along the Nishnabotna and Nodaway Rivers, where the first bottoms vary in width from 1 to 2½ miles. Along the smaller streams the areas are much narrower.

The surface of this type is prevailingly smooth, with a slight gradient toward the streams. It occupies a position 8 to 15 feet above the normal level of the rivers and 2 to 3 feet above that of the smaller streams. Formerly the greater part of the type was poorly drained and subject to floods, but the danger of overflow in areas along the rivers and larger creeks has been greatly reduced, in recent years, by straightening and deepening the channels of these streams. A few of the smaller streams still overflow their banks during periods of heavy rainfall, and here some damage to the growing crops occurs. Tile and open ditches are used to good advantage in many places. Drainage is sufficient during normal years, but crops suffer from excess of moisture in wet seasons.

The Wabash silt loam is a valuable agricultural soil, and much of the land has been reclaimed and brought under cultivation. Approximately 75 to 85 per cent is now devoted to the production of the general farm crops, and the rest, which is in forest or wild grasses, is utilized more or less completely for pasture. The forest areas are comparatively small and are fast disappearing. The tree growth consists principally of willow, cottonwood, ash, boxelder, and some walnut.

Corn occupies the greater part of the acreage devoted to cultivated crops on this soil. Practically all the production is used on the farms as feed. Winter wheat comes second and is the principal cash crop. This is shipped through cooperative elevators to points outside the county. The wheat is sometimes injured during the winter by heaving of the land and excess of water in the soil, but in ordinary years good yields are obtained. Oats are grown on all the farms. Practically all the product is used as feed for the work stock and hogs. Formerly much damage was done by lodging, a difficulty that has been overcome by the use of the Albion (Iowa 103) and Richland (Iowa 105) varieties adapted to rich moist soils. The oat straw is usually stacked in the field at threshing time and used as a feed for stock. Timothy and clover are grown, separately and mixed, for hay. Nurseries at Shenandoah, which rank among the largest of the country, grow much of their stock on this type of soil. It responds well to treatment and excellent results are obtained. Bluegrass and some native grasses make excellent growth on this type. In many places the native grasses are cut for hay. Rape is grown on a few farms for hog pasturage. The raising and feeding of hogs is the most important livestock industry and a large number are shipped to market annually. A few beef cattle are raised, but the general practice is to buy feeders

for fattening. Some apple orchards have been set out and these are producing good fruit, considering that the trees receive little care. A small acreage is devoted to the growing of sorgo for the manufacture of sirup.

Corn on this type yields 37 to 80 bushels per acre; wheat, 16 to 28 bushels; oats, 37 to 60 bushels; and hay, 1 to 2½ tons.

The handling of the Wabash silt loam differs little from the methods employed on the important upland soils. More care must be exercised in plowing this bottom-land soil, as it clods badly if turned when too wet or too dry. These clods are large and difficult to pulverize. Corn is grown for a longer time on the same ground before seeding to small grain or hay than in the uplands. When corn succeeds itself the land is always disked first to break up the stalks, then plowed, disked, and harrowed, while if oats are to follow the corn the soil is only disked and harrowed. Corn receives from three to four cultivations. The general practice in the bottoms is to list corn.

The yields on the Wabash silt loam can be increased by drainage, deeper plowing, liming, and green manuring. Tile drains are considered more effective than open ditches in improving the drainage conditions, although in many places the latter are used. As the subsoil is heavy and rather imperviods, the laterals should be placed at relatively close intervals.

Land of this type is valued at from $150 to $300 an acre, according to location and improvements.

Wabash silt loam, colluvial phase.—The surface soil of the colluvial phase of the Wabash silt loam consists of a brown to dark-brown mellow silt loam, 17 to 19 inches deep, which passes abruptly into a black silt loam to silty clay loam that extends to 3 feet or more without change. In some areas the immediate surface is formed by a layer of grayish-brown material a few inches thick. This represents recently deposited material that has not had sufficient time to accumulate organic matter. Some borings in the type show the dark-brown to almost black surface material extending to 3 feet or more without any appreciable change in color or texture.

This phase is developed along many of the smaller intermittent streams and is composed of colluvial material washed from the adjoining slopes. In many cases narrow ribbons of colluvial deposits appear along the same streams, and where this is the case only the predominant type is shown in the map. The areas have a level to gently sloping surface and lie 1 to 5 feet above the normal level of the streams. Drainage is insufficient.

The Wabash silt loam, colluvial phase, is seldom cultivated, but is left in pasture. It supports a luxuriant growth of grass. The only trees consist of a few willows along old fence rows. The part of the type cultivated consists of narrow strips included in fields of Marshall silt loam. No difference exists in the methods of handling or in the kinds of crops grown on the two soils.

WABASH SILTY CLAY LOAM.

The soil of the Wabash silty clay loam consists of 12 to 14 inches of very dark brown to black silty clay loam, high in organic matter.

The upper subsoil is a black heavy silty clay loam extending to 20 to 24 inches, where it passes into a drab or brownish-gray silty clay.

Iron concretions and a few rusty-brown mottlings appear in the lower part of the 3-foot section. The plowed fields have a strong black color after rains. Where drainage is poor the subsoil is more intensely mottled and the material in the lower part of the profile is generally a slate-colored or light-gray plastic clay. In the vicinity of Essex four areas are mapped in which the materials resemble closely those of the Lamoure series, especially in carrying lime concretions in the soil and subsoil. These areas, however, were too small to justify separation on the map.

The Wabash silty clay loam is developed throughout the first bottoms of the East Nishnabotna and Nodaway Rivers and West Tarkio Creek. In most places, except in the bottoms of the Nodaway north of Clarinda, where several of the areas are quite large, the bodies are small and isolated. The areas occupy a position slightly lower than the silt loam. The surface is flat or slopes gently toward the streams, and while not subject to frequent overflows, water stands on the land for some time after rains, the run-off being slow. Drainage in general is poor.

The greater part of the type is either under cultivation or used for pasture. The only tree growth consists of a few willows.

The heavy texture and poor drainage of this type make cultivation difficult, and during wet seasons it is generally left fallow and used for pasture. In drier years or where the excess water can be removed excellent crops of corn, wheat, and hay are grown. Corn is the principal crop. Where well drained the type is considered one of the most valuable wheat soils of the area. Natural grasses make excellent growth and are either cut for hay or pastured. In the vicinity of Essex a small acreage is devoted to the growing of alfalfa.

The soil is more difficult to handle than the Wabash silt loam and greater care must be exercised to plow it under proper moisture conditions. When too wet the land is turned up in large clods, which bake and are difficult to pulverize. Commercial fertilizers are never used. Lime has been applied with excellent results.

Deeper plowing and the incorporation of more organic matter would improve the condition of this soil materially. Drainage is very necessary and either tile or open ditches may be used, the laterals being placed closer together than on the lighter textured soil types. Crop rotations which provide a place for legumes are recommended.

The Wabash silty clay loam is not considered as valuable a soil as the Wabash silt loam.

WABASH CLAY.

The surface soil of the Wabash clay consists of a very dark brown to black silty clay to clay, crumbly and granular when dry and 6 to 10 inches deep. The subsoil is a black to very dark drab heavy clay slightly mottled with iron stains in the lower part of the 3-foot section. The type is uniform both in color and texture, the only variation being a few areas of the silty clay loam which were not mapped on account of their small total area.

The Wabash clay is a comparatively inextensive type and is developed only in the bottoms of the Nodaway River a few miles north of Clarinda. The areas are flat and occupy a position slightly lower than the adjoining silt loam and silty clay loam. Drainage is poor,

owing to the flat surface and low position of the type and the impervious nature of soil and subsoil.

A very small acreage is cultivated, the greater part being left in its natural state and used as pasture land. The only tree growth consists of a few willows.

The handling of this soil is quite difficult, which discourages the growing of farm crops. During the progress of the survey one small field of corn was noted. The excellent condition of the plants and the size of the ears in the field would indicate that the crop could be made profitable, provided the land were well drained. Wheat should also give good yields on land of this character where adequately drained. The natural grasses are sometimes cut for hay, but more generally left for pasture.

RIVERWASH.

Riverwash, as mapped in the county, includes small areas along the rivers and some of the creeks where the material is so mixed and variable that separation into different types was impossible. The material is recent alluvium and is composed mostly of sand and silt. In many places the layers are more or less stratified to 3 feet or more, in others the sand and silt are thoroughly mixed, and in others the first few inches is a dark-brown silt loam underlain by a mixture of sand and silt. The soil is subject to overflow and the surface is changing constantly. The vegetation consists of natural grasses, which make a very poor growth, and a few willow and scrub oak trees. The type has no agricultural value.

SUMMARY.

Page County is situated in southwest Iowa. It has an area of 531 square miles, or 339,840 acres.

The topography varies from flat or gently sloping, as in the first bottoms and terraces along streams, to rolling or strongly rolling, as in the uplands. In elevation above sea level the county lies between 950 and 1,200 feet.

The county is situated within the drainage basins of the East Nishnabotna and Nodaway Rivers. Creeks and smaller streams ramify all parts of the county.

Page County was organized in 1851. The population, according to the census of 1920, is 14,371. Of this, 59.5 per cent is classed as rural. Most of the inhabitants are native born.

The county is served by branches of the Chicago, Burlington & Quincy Railroad and the Wabash Railway, and no point in the county is more than 8 miles from the nearest line.

A network of earth roads covers the county. While none of these are hard surfaced or graveled, they are kept in excellent condition the greater part of the year. Schools and churches are located at convenient places throughout the county, the schools generally at 2-mile intervals. School districts have been consolidated in many places, and central buildings erected in the towns.

The climate is healthful and characterized by a wide range in temperature. The mean annual temperature is 50.1° F. The average growing season is 171 days. The rainfall is well distributed for the

growing and harvesting of crops, the mean annual precipitation being 32.83 inches.

Agriculture, from the beginning, has been based upon the production of corn. Wheat, oats, and hay are the next crops of importance. Barley, rye, sorgo, potatoes, and all kinds of garden truck and small fruits are grown on a small scale. Excepting wheat, which is a cash crop, and a small part of the corn practically all of the crops are used on the farms of the county.

The raising of hogs and the raising and feeding of beef cattle are the most important livestock industries. Dairying is confined to supplying home needs.

Large flocks of chickens are kept on practically every farm.

The farms are well fenced, the dwellings are large, substantial, and in most cases well kept, and the barns have ample storage space. Improved farm machinery is in general use. The work stock consists mostly of draft horses, although mules are well liked and are found on a number of farms.

Some form of crop rotation is commonly followed. This centers around the production of corn. All manure is saved and applied to the sod land or stubble fields before plowing. Commercial fertilizers have been used to a slight extent in an experimental way. Lime is being shipped into the county for agricultural use.

The farms vary in size from 80 to 400 acres, the average being 145.8 acres.

Somewhat over one-third of the farms are operated by tenants. Land is rented for cash or on shares. Where cash is paid, the value ranges from $12 to $20 an acre.

The price of agricultural land ranges from $150 to $400 an acre. The average assessed value, as reported in the 1920 census, is $237.69 an acre.

The soils of Page County can be grouped into two main divisions, (1) soils developed under conditions of poor drainage and (2) those developed where the more active movement of the drainage waters has given rise to better aeration and oxidation. The second division may be divided into two subgroups, (*a*) partly leached soils, and (*b*) thoroughly leached soils. The first main division includes the alluvial soils of the Wabash and Bremer series, the second division (subgroup *a*) the Marshall and Shelby soils, and (subgroup *b*) the Waukesha and Judson soils.

The Marshall silt loam is the most extensive soil in the county. It is a valuable agricultural soil, and practically all of it is in cultivated crops or pasture. Corn is the principal crop, followed by wheat, oats, and hay in the order named.

The Shelby silt loam is developed as narrow bands of soil bordering most of the streams of the county. While not as valuable as the Marshall, the greater part is under cultivation. It is devoted to the growing of corn, wheat, oats, and hay. The steeper slopes are generally left in pasture.

The Waukesha silt loam is developed on the terraces along the East Nishnabotna and Nodaway Rivers and Middle Tarkio Creek. The areas are inextensive and more or less isolated. This is a strong agricultural soil and all of it is devoted to the production of corn and the other general farm crops of this section.

The Judson silt loam is developed mainly on the terraces of the East Nishnabotna and Nodaway Rivers. It is of comparatively small extent. Practically all of it is used for the production of the general farm crops.

The Bremer silt loam represents old alluvium occupying second-terrace positions. The type occurs only along the rivers and the areas are small. The soil is considered somewhat stronger than the Waukesha. The largest acreage is in corn. Wheat, oats, and grass for hay each occupy a small area.

The Wabash silt loam is a first-bottom soil developed in all parts of the county, the most extensive areas lying along the rivers. It is subject to overflow, but conditions in this respect have been improved materially by straightening and deepening the channels of the rivers and larger creeks. Approximately 80 per cent of the type has been reclaimed and is now devoted to the production of the general farm crops, chiefly corn.

The Wabash silt loam, colluvial phase, differs from the main type in that it represents newer material that has been washed mostly from the adjoining slopes. It is of small extent, and is generally left in pasture.

The Wabash silty clay loam lies slightly lower than the silt loam. The natural drainage is insufficient to allow cultivation, except in dry seasons. When well drained the soils give good yields of corn and show little effect from continuous cropping. Wheat is grown to a small extent on the type.

The Wabash clay is of small extent. It is subject to overflow and water stands on the surface after rains. The greater part of the type is left in pasture.

Riverwash, as mapped in the county, represents an unassorted mixture of sand and silt that is constantly being changed by the action of flood waters. The type has no agricultural value.

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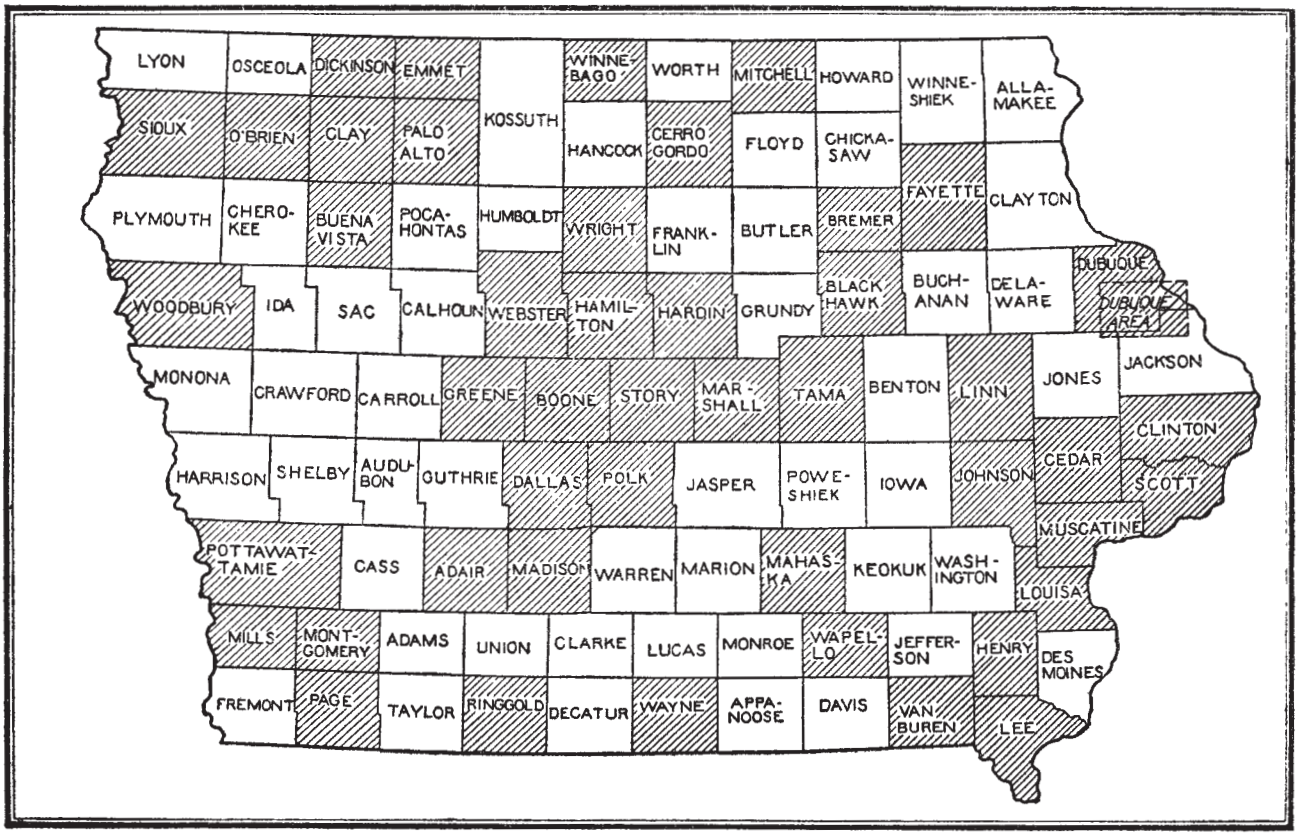

Areas surveyed in Iowa, shown by shading.

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