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SOILS OF THE EASTERN UNITED STATES AND THEIR USE—XIX.

THE WABASH CLAY.

BY

JAY A. BONSTEEL,
Scientist in Soil Survey.

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BUREAU OF SOILS.

MILTON WHITNEY, *Chief of Bureau.*
ALBERT G. RICE, *Chief Clerk.*

SCIENTIFIC STAFF.

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OSWALD SCHREINER, in charge of Fertility Investigations.

SOILS OF THE EASTERN UNITED STATES AND THEIR USE—XIX.

THE WABASH CLAY.

GEOGRAPHICAL DISTRIBUTION.

The Wabash clay is a widely distributed type of soil found in the alluvial bottom lands of the Mississippi River and of its principal tributaries. In the narrow bottom lands of the smaller streams the individual areas of the type are usually small, but in the broad bottoms of the Mississippi itself, and of its greater confluents, considerable areas of the Wabash clay are frequently encountered in single bodies. Areas of the type have been mapped in 23 different soil-survey areas found in nine different States, and aggregating a total of 419,915 acres.

Wherever the dark upland prairie soils are carried down into the drainage channels of the principal rivers they are sorted out and their coarsest particles deposited to form the loams and silt loams of the bottoms. There will also be found areas where the silt, and particularly the clay particles, have accumulated to constitute the Wabash clay. Such areas may be encountered along all of the major streams in the central prairie region and for long distances to the southward along the lines of deposition, particularly of the Mississippi River. Thus areas of the Wabash clay are encountered as far east as Ohio, as far west as Nebraska, and from these regions southward toward the Gulf of Mexico.

CHARACTERISTICS OF SOIL AND SUBSOIL.

The surface soil of the Wabash clay is a drab, dark-brown, or black, heavy clay loam, having an average depth of about 6 inches, although not infrequently extending to a depth of 12 inches or more. When wet this surface soil is a stiff, sticky, plastic clay, which adheres to the moldboard of the plow or to other tillage implements. This surface soil will crack and granulate as the water evaporates, forming large or small crevices, which sometimes have a depth of 4 or 5 inches and a width of one-fourth inch or more. In the areas in which the content of finely divided organic matter is high, and where

there is also present a small but appreciable quantity of very fine sand, the larger blocks and irregular masses of the surface soil are cross checked during the process of evaporation, so that innumerable small granular fragments are formed, which are frequently known as "buckshot." This has given the popular name "buckshot land" to large areas of the type in the more southern portions of the region of its development. Where an abundance of finely divided organic matter is lacking, and particularly where the surface soil consists almost entirely of silt and clay, the sun cracking only proceeds to the point of forming the larger irregular blocks, or at least only forms a thin granulated layer at the surface. In the more northern areas this land is known as "gumbo," while in the more southern areas it is frequently called "beeswax" land. Both of these terms are also applied to similar conditions in other soil types, but are more generally applied to the stiffer, more waxy areas of the Wabash clay.

The subsoil to a great depth is usually a stiff plastic yellow or drab clay, which is very waxy when wet and which retains a large amount of moisture, owing to its texture and its low-lying position, during practically all of the summer season. In fact, it is not infrequently saturated with water at shallow depths. Usually there are evidences of stratification in the subsoil, and the partings between the layers of clay are then marked by thin sheets of very fine sand or silt. Wherever the soil and subsoil are thus laminated the formation of the "buckshot" is facilitated, since each thin layer forms cracks and crevices by itself which do not adhere strongly to the next underlying layer. Thus the sun cracking proceeds to considerable depths and subdivides the soil into the finer granules, which renders its cultivation much more easy and makes it more valuable for agriculture.

The Wabash clay may easily be distinguished from practically all other soil types through its position in the lower lying areas of the alluvial bottoms along the Mississippi River and its principal tributaries; through its dark to almost black surface soil; through its characteristic structure, giving rise either to the designation of "gumbo" or "buckshot" land; and through the fact that with possibly one exception it is the stiffest, most plastic, and most adhesive clay to be found in the alluvial bottoms. The only soil type with which it might be confused is the Trinity clay, occurring in the alluvial bottoms and upon the terraces along the principal rivers of eastern Texas, which is also a dark to black granular clay even more stiff and plastic when wet than the Wabash clay, but characterized in its deeper subsoil by the presence of calcareous nodules, and also through its derivation from the black Cretaceous prairie soils of that region as contrasted with the black, loessial upland soils from which the Wabash clay is principally derived.

SURFACE FEATURES AND DRAINAGE.

The Wabash clay occupies level or depressed areas within the broader alluvial bottom lands. The arable areas of the type, in general, are found in almost absolutely level tracts lying somewhat back from the front lands along the main stream channels, and usually somewhat above the level of the lowest depressions found in the bayous and hollows of the bottoms. In addition to this agriculturally available land included within the type, there are numerous long, narrow areas of the Wabash clay to be found within the beds of old bayous and in other depressions throughout the bottoms. These latter areas are usually flooded each season. They retain an excess of moisture until far into the summer and are consequently not well suited to agricultural purposes in their natural condition. It is within these latter areas that the characteristic "gumbo" soil is also most frequently encountered. Such areas constitute the region of deposition of the finest sediments carried by the overflow waters.

The range of the elevation of the surface of the Wabash clay varies from 5 or 6 feet above sea level in the extreme southern portion of the Mississippi Delta to altitudes of 800 or 1,000 feet or even more in the upper drainage tributaries of the Mississippi. The Wabash clay is usually from 5 to 15 feet above the normal level of the streams along which it lies, and the type is consequently subject to frequent overflow, unless artificially protected. Lying so near water level, it is also frequently poorly drained, and this characteristic is more marked because of the stiff, tenacious, impervious nature of the heavy clay subsoil. Thus the Wabash clay is difficult to bring under agricultural occupation, and the expense involved in reclamation is frequently heavy.

The Wabash clay is rarely subject to any form of erosion except through the change in direction of the channels of the main streams, which frequently erode their banks upon the convex curve to redeposit the materials at lower points in the flood plain. Erosion, however, is not a serious difficulty in connection with the tillage of the Wabash clay, except in a few localities where open ditches and water furrows are improperly constructed.

LIMITATIONS IN USE.

The stiff plastic character of the materials constituting the Wabash clay presents serious difficulties in its tillage. Only in such areas as granulate naturally while water is being evaporated from the surface soil is it easy to secure the proper breaking and preparation of the land. Even in such cases, and to a more marked degree in the dense "gumbo" or "beeswax" soils, extreme care must be taken in plowing the land to perform that operation when the ground is neither

too wet nor too dry. If the ground is plowed when there is too great a proportion of moisture present in the surface soil the furrow turns over in a long shining slice of compacted clay, which it is practically impossible to harrow and cultivate into condition for the seeding or planting of crops. Great difficulty is also experienced in turning over the soil in this condition, because of the adhesion of clay to the surface of the moldboard. On the other hand, if the surface soil is permitted to become too thoroughly dry before plowing is attempted, the surface is merely broken into a succession of hard, compacted lumps, which no harrowing or rolling is capable of crushing sufficiently to form a granular seed bed in good tilth for the planting of the crop. Between these two extremes, however, there is a considerable range of moisture content for the surface soil within which tillage operations are fairly easy and the results obtained are satisfactory for the planting of the crop. When properly plowed and prepared, the surface soil rolls over in a friable, well-granulated furrow, which requires little additional preparation. It is this characteristic granulation, natural in some cases, induced by proper handling in other cases, which gives the soil its popular name of "buckshot land" and which renders it particularly valuable when in this condition for the production of certain crops.

In addition to this textural and structural limitation upon the preparation and use of the soil, its utility for crop production is decidedly limited by the time and frequency of inundations. Even in areas which are thoroughly protected by levees along the principal streams, the freshet waters from included tributary streams not infrequently rise over the lower lying areas of the Wabash clay to a depth of 2 or 3 feet, remaining at such a stage long past the proper period for the planting of the crop.

Even after the overflow waters have subsided, some time is necessary to permit the proper drying out of the surface soil, for tillage operations must be undertaken when the soil contains the right quantity of moisture to render these easy and effective. Moreover, throughout a considerable proportion of the total area of the type the water table, or zone of permanent saturation of the subsoil, is near to the surface at all times throughout the growing season, and any taprooted crops are injured or their production is prevented by this condition.

Thus, through its inherent properties, through its liability to overflow, and through its defective subsoil drainage the agricultural occupation of the Wabash clay is restricted to such areas as are in the best natural mechanical condition, as are reasonably protected from unseasonable overflow, and as are provided either with natural or artificial subsoil drainage.

Very little attempt has been made in any of the areas where the Wabash clay has been encountered in the soil surveys to produce other than a few general farm crops. All tree fruits are eliminated because of drainage conditions and because of the depressed position of the Wabash clay, precluding also proper air drainage. The characteristic stiff clay is also poorly suited to the production of small fruits or early garden vegetables. Only the later market crops, such as cabbages, tomatoes, and eggplant, may be produced to advantage upon land of this nature. In consequence, the chief crops produced upon the Wabash clay are corn and, to a limited extent, wheat in the more northern areas, and cotton, rice, and sugar cane in all of the more southern areas sufficiently protected from inundation.

IMPROVEMENT IN SOIL EFFICIENCY.

Protection from inundation is the first requisite in the tillage of additional areas of the Wabash clay. This is easily possible in many instances through the construction of earth embankments or levees which shall inclose and protect considerable areas of bottom lands, including the Wabash clay and other valuable alluvial soils. Such embankments have been constructed, not only in building the levees which protect the Mississippi bottom lands from inundation, but also for the agricultural occupation of the smaller areas along tributary streams in the more northern States. In all instances the wonderful fertility of the Wabash clay where it is properly protected from overflow has marked this soil type as one of those best repaying the expense involved in the construction of such embankments. It is probable that only the Wabash silt loam, which is generally associated with the Wabash clay, will better repay the establishment of embankments and of drainage.

Frequently in providing protection for this and other alluvial soils, broad earth embankments are built within the alluvial bottom lands to such height as is required to exclude even the highest overflows. In the case of the smaller streams these embankments usually do not need to be particularly massive. The top of the embankments may be no more than 2 or 3 feet broad. In the case of the larger streams and of all subject to wide fluctuations in water level broader embankments are required, and in the case of the levees of the Mississippi and its major tributaries embankments 20 to 30 feet high are not infrequently built, sufficiently broad at the top to furnish an excellent roadway along the levee. In each particular instance the area of the land to be drained, its probable agricultural value when reclaimed, the cost of constructing and maintaining the levee, the interest charge upon the investment, and the proximity of the area either to transportation or to near-by markets must all be considered as economic factors which will influence the success or the failure

of the enterprise. When in addition to the agricultural value of such improvements their value to the health of the community through the drainage of swamps is considered and the aid to the navigation of rivers, thus restrained within their proper channels, is taken into account, the reclamation of lands of this character, through proper embankments and drainage, is seen to be very desirable. In the reclamation of such lands, however, each particular case must be studied both from an agricultural and from an engineering standpoint.

The complete drainage of areas of the Wabash clay, even in those localities where proper protection from overflow has been provided, is a serious problem. Very little effort has been made to install tile underdrains in such areas, but sufficient has been done to show that the stiff, plastic nature of the subsoil requires lines of tile laid at no great distance from each other and at a considerable depth, in order properly to lower the water table. In fact it is a general opinion among those who have attempted to drain soil of this character in connection with their farming operations that frequent open ditches are fully as effective in the removal of surface water and in the lowering of the subsoil water as the more expensive tile-drain systems. Thousands of acres of the Wabash clay have been drained with good results through the establishment of open ditches. Owing to the position of this soil somewhat below the level of the front lands, and usually intervening between these and the deeper sloughs to the rear, this surface drainage is not infrequently effected through open ditches which empty, not into the main stream, but into the sloughs or deeper depressions to the rear of the type. Through the adoption of this practice a gentle slope, which does not give rise to the erosion of the bottom or the sides of the ditches, is obtained, and any difficulty with culverts or carrying the ditches across main highways or with the outflow of these ditches through embankments or levees is obviated. In general, it is recommended that open ditches be used rather than tile drains, and that wherever possible the grade of these ditches be sufficiently low to prevent erosion, but sufficiently steep to give thorough surface soil drainage. It is frequently possible to dig these ditches in the form of broad, shallow excavations which will not interfere seriously with communication between the tilled areas separated by the depressions. Such ditch forms have two advantages over the steep-sided narrow open ditch frequently used. In the first place, less labor is required to keep the ditch open, since this can be done by horsepower and the use of a slip scraper. In the second place, little or no damage results from erosion of the banks and the caving in of soil to obstruct the flow of water. As an additional advantage, communication between different portions of the field is not interrupted, as has been noted.

In practically all areas where it occurs the surface soil of the Wabash clay is well provided with partly decayed and finely divided organic matter. In some areas this is not evident, principally through the fact that the surface soil has been waterlogged and sealed against the action of the atmosphere to such a degree that the organic matter has only passed through the first stages of decomposition and has not been thoroughly subdivided and disintegrated to be incorporated as an inherent part of the soil itself. In many instances the clearing away of rank vegetation, the opening of the surface soil to the sunlight, and the action of the atmosphere will change the drab or yellowish surface soil material to the brown or black loamy "buckshot land" after a few seasons of proper drainage and cultivation. Through this process of drainage and aeration the natural preparation of the surface soil for crop production is aided and the land is not infrequently changed from stiff waxy "gumbo" to granular, friable, tillable fields. Wherever difficulty is experienced in this transition the addition of coarse strawy manures, the plowing under of a rank growth of vegetation, or any other method which will aid in the loosening and granulating of the surface soil is desirable. In some instances the application of lime has been particularly effective in inducing the granulation necessary to the easy tillage of the type.

LIMITATIONS UPON SPECIAL CROPS.

The Wabash clay has been little used for the production of special crops. Wherever it is so situated that local markets are available, particularly in the more northern areas, the Wabash clay constitutes an excellent soil for the production of cabbage. The yields of large, firm heads are heavy, the crop is easily tended, and usually profitable. It is only upon well-drained areas protected from overflow that the production of this or any other late market-garden crop is possible. Because of textural and drainage peculiarities, the production of other special crops upon the Wabash clay is practically eliminated.

EXTENT OF OCCUPATION.

Only a small percentage of the total area of the Wabash clay has been cleared and brought under cultivation because of the difficulties experienced from poor drainage and from inundation. It is only in those areas where levee systems have been installed, most extensive in the Southern States, that large areas of the Wabash clay have been tilled. In these sections the construction of adequate levees to protect the bottom lands from overflow and to maintain navigation have rendered possible the cultivation of the type. Even in such areas only the higher lying portions, which are first uncovered by the receding of the waters, are annually tilled. Other additional areas are tilled in such seasons as are marked by the early

recession of the water or by unusually low stages in the overflow. In the more northern sections the area annually devoted to crop production is extremely variable, since the farmers can plant or sow their crops upon the Wabash clay only in favorable seasons. Thus the area of the Wabash clay occupied in any one season may be greatly increased or decreased, depending upon the flood-water stages of those rivers flowing through areas of the type. In general, however, attempts have been made at cultivation of probably 20 to 25 per cent of the total area of the type. The larger proportion of this arable land lies in the more southern States, particularly in Louisiana and in Mississippi, where the levee systems are most complete. It is in these States that the farm and plantation dwellings and the dwellings for the tenants and hands employed upon the plantations are built within the area of the alluvial bottoms. In practically all of the more northern areas the type is unoccupied as a place of residence, or even for the storage of crops, because of the danger from overflows. Even in the leveed districts occasional overflows drive the inhabitants to adjoining uplands until the waters have subsided.

Increased areas of the Wabash clay may be occupied for agricultural purposes through the formation of drainage or levee districts, or through the united efforts of those farmers who own property in any particular stretch of bottom land. It is usually only through some such cooperative method that particular areas of the type may be reclaimed. The heavy yields secured from this and the associated types of the alluvial bottoms frequently justify an expense for the establishment and maintenance of engineering works which would not be justified for the improvement of upland soils. Thus there remain thousands of acres of the Wabash clay and its chief associate, the Wabash silt loam, awaiting a sufficient demand for land and the proper organization and application of capital to become valuable agricultural territory.

CROP ADAPTATIONS.

The crop adaptations of the Wabash clay vary with the climatic conditions of the different areas. In all of the Northern States corn constitutes the staple crop upon those areas which are tilled. Wherever protection from overflow and proper drainage are obtained the corn yields are heavy. In certain areas yields ranging from 40 to 75 bushels per acre are reported as the customary crop in years when the corn fields are not destroyed or injured by overflow. In many such areas corn has been raised from 10 to 20 years in succession upon the same land without appreciable diminution in the yield except through accident. In nearly all areas where corn has been planted upon the type, minimum yields are reported in excess of 30 to 35 bushels, while maximum yields reach the unusually high figure of 60 to 75 bushels. Local drainage and the seasonal precipitation may cause wide variations between these extremes. It would be difficult

to establish a normal or average corn yield for the type even in the more northern States, since the Wabash clay, when properly protected and handled, is capable of producing yields in excess of 60 bushels per acre, and any yields falling much below that amount may be directly attributed to some accidental local or seasonal peculiarity.

In the Southern States corn is produced to a considerable extent upon the Wabash clay in association with the cotton crop. The yields obtained from this soil type frequently exceed those reported from any other soils in the Southern States. Throughout the Yazoo Delta, in Mississippi, and the alluvial bottom lands on the west bank of the Mississippi River, in Louisiana, corn yields of 40 to 50 bushels per acre are not infrequent, while the yields from upland soils range from 8 to 20 bushels. Thus, in all localities where it occurs and where it is properly protected, the Wabash clay is an extremely productive and very valuable corn soil.

In some of the northern areas, particularly those which have been artificially protected, wheat is sown, usually a spring crop. Yields vary greatly, but are normally heavy. The minimum yields stated in the various soil survey reports approximate 20 bushels per acre, while maximum yields of 40 bushels have been reported. The quality of the wheat is fair, with a strong tendency toward a rank growth of straw somewhat at the expense of the formation of grain. Undoubtedly, with proper protection and drainage, the Wabash clay would constitute a very valuable spring-wheat soil of limited extent throughout the Central States.

Oats are also raised, but only in small areas. The yields are good, ranging from 40 to 60 bushels. The crop has the same tendency as wheat toward straw development.

Considerable areas of the Wabash clay are devoted to the production of grass. Timothy and redtop make excellent growth, while upon all areas where the water table is 2 feet or more below the surface clover is grown successfully. Yields of timothy ranging from 2 to 3 tons per acre are reported. The type ranks as an excellent grass soil. In addition to the tame grasses sown in cultivated fields, considerable areas of the type are annually utilized for the cutting of marsh grass and other wild grasses, with excellent yields of 1½ to 2 tons per acre. Even the forested areas are utilized for summer pasture. In all of the open glades and throughout portions of the forest wild grasses make good growth and furnish a succulent and abundant pasturage. In the more southern States the switch cane grows luxuriantly, particularly near the sloughs and bayous, occupying some portion of the type. Cattle are grazed to a limited extent upon this forage during the fall and winter. The wild grasses are almost lacking in these areas.

It is in the Southern States, however, that the principal agricultural use is made of the Wabash clay. In Mississippi and in Loui-

siana every available acre of the Wabash clay not subject to unusual overflow is utilized for cotton production. Small acreages of corn are sometimes produced upon the type at the various plantations. With possibly one exception there is no other soil in the Southern States so well suited to the production of cotton as the Wabash clay. This one exception is the Trinity clay, which in many characteristics is similar to the Wabash clay. When the surface of the Wabash clay is first cleared from the dense hardwood forest and cotton is planted, the first year's crop produces an abundant growth of the plant and a feeble fruitage of cotton bolls. On account of the moist, shaded condition of the land very few of these bolls mature at a sufficiently early date to escape the autumn frosts and only limited amounts of cotton may actually be picked during the first season. With something of a diminution, the same is true of the second season, but usually by the third season of cultivation a fair to heavy cotton crop may be expected, which is maintained, except under accidental circumstances, for many succeeding years. Thus it is usually a matter of some two or three years to subdue and bring the areas of the Wabash clay to their most productive state.

After the Wabash clay has been properly brought under cultivation through the clearing of the land, the aeration of the surface soil, and the proper tillage of the type, it is capable of maintaining a strong producing capacity for the cotton crop. Yields of less than one-half bale per acre are abnormally low. Yields of three-fourths bale to 1 bale per acre are common, while yields as high as 2 to 2¼ bales per acre have been repeatedly reported. Moreover, upon many of the fields occupied by the Wabash clay cotton has been raised uninterruptedly for 50 years or more without any serious or even appreciable decrease in the crop returns and without any resort to the use of commercial fertilizers. There have been variations, of course, in the yields from year to year due to climatic causes and to the efficiency with which the crop has been worked, but in general, taking the record of the Wabash clay in the Southern States as a cotton producing soil, it may be said that the type is capable of producing annually, after it is first subdued, a crop of one-half bale per acre or more, and that this rate of production will be maintained, so far as any influence of the soil itself is concerned, through long periods of time without recourse to artificial fertilization.

There is one recent limitation upon the production of cotton on the Wabash clay which is causing some concern to the planters in Louisiana and Mississippi. This is the advent of the boll weevil. Owing to the fact that the cotton grown upon the Wabash clay requires a long season to attain maturity, the earlier maturing varieties are not so well suited to production upon this type as those of longer growing period. A considerable part of the effectiveness of the contest against the boll weevil upon all upland soils has

undoubtedly arisen from the fact that early maturing varieties of cotton could be grown which would produce at least some part of a crop before the cotton was seriously affected by the weevil. This expedient of growing early maturing varieties is not nearly so applicable in controlling the weevil on the alluvial bottom soils, and particularly upon the heavy clay types like the Wabash and the Trinity clay. In consequence, other methods of combating the weevil must be devised for this and similar soil types. It may be possible that, at least temporarily, considerable proportions of the acreage of the Wabash clay in the cotton-growing States may need to be devoted to other crops than cotton. For this purpose corn is suggested as one of the best crops. The yields are high, and if varieties suited to the climatic conditions are selected 40, 50, and even 60 bushels per acre may be anticipated where the crop is given proper tillage. With the prevailing high prices of corn in the almost exclusively cotton-growing regions, where this type occurs, the crop should become decidedly profitable and able to compete even with cotton as a great staple crop. Where irrigation facilities are available in these southern communities rice may be grown upon the Wabash clay to excellent advantage. The production of this crop would require some outlay for the proper embankment of the fields to provide for flooding, and in many instances would also require the establishment of pumping machinery to draw water from adjacent rivers or bayous for flooding the land. The existence of artesian wells of considerable capacity in many of the bottom-land areas should in certain localities provide a cheap and feasible method for the irrigation of the rice fields.

In the regions south of Baton Rouge, in the Mississippi Delta, the Wabash clay constitutes one of the best sugar cane soils of the section. The sugar cane yields from 25 to 30 tons per acre, and is even more valuable than cotton as a staple crop for production upon this type. Climatic limitations alone prevent the considerable extension of cane growing to the northward upon the Wabash clay.

In the vicinity of New Orleans large areas of the Wabash clay are used for the production of market-garden crops, particularly egg plant, tomatoes, and cabbages. Additional areas, somewhat more remote from the city, are utilized for the production of grass to support a flourishing dairy industry.

It has been abundantly proved through the efforts of individual planters, and particularly of the Louisiana Experiment Station at Baton Rouge, that the Wabash clay is well suited to the production of alfalfa. There is a very necessary limitation, however, upon the production of this crop. Alfalfa is a taprooted plant which sends the main root rapidly to considerable depths into the soil and subsoil wherever conditions are favorable. Consequently only those areas of the Wabash clay may be selected for alfalfa production where the

normal water level exists at a depth of 3 feet or more below the surface, and where, in addition, the surface of the type is not subject to inundation. It may be broadly stated that if other areas are chosen for seeding to alfalfa the crop will suffer damage and ultimate destruction through the rapid penetration of the taproot into the saturated subsoil, and that the stand of the field will be approximately one year for each foot in depth to the water table. Of course, there are variations and modifications of this generalization.

In addition to alfalfa, Bermuda grass, white clover, and lespedeza all grow luxuriantly upon this type and are excellent grasses, both to be cut for hay or to be grazed off by work stock or dairy animals. The crab grass which infests many of the cotton fields is also valuable for grazing purposes and may be cut for hay. It is usually considered a nuisance upon all cotton plantations, and its introduction into any area is not to be recommended. The other grasses are generally to be preferred either for the production of hay or for grazing.

It is thus seen that for certain staple crops and, to a limited extent, for market-garden crops the properly protected and drained areas of the Wabash clay are exceedingly valuable. Although the type is of somewhat limited extent, those areas which are under cultivation have established for themselves a high reputation for the production of corn, spring wheat, and grass in the northern areas, and for the production of cotton and sugar cane in the southern localities where they occur. In addition to the staple crops enumerated, grass grows luxuriantly upon the type in all of the areas where it occurs. Under certain restricted conditions, alfalfa, Bermuda grass, lespedeza, clover, timothy, and redtop all furnish remunerative hay yields. Thus the Wabash clay within its natural limitations is an extremely fertile and valuable type of soil. Its cash valuations vary widely from the $5 or $6 an acre, at which undrained and unprotected forest areas may be bought, to $100 or even $200 an acre, at which the thoroughly protected areas suitable for cotton and cane production are held.

SUMMARY.

The Wabash clay is an important and widely distributed alluvial soil found within the flood plains of the Mississippi River and of its major tributaries.

The surface soil is a black, waxy or granulated clay, the former being known as "gumbo" and the latter as "buckshot" land. The subsoil is a yellow or drab plastic clay, frequently laminated and universally very retentive of moisture.

The Wabash clay occupies level areas and slight depressions usually to the rear of the lands fronting along the main rivers. It is subject to frequent overflow in all areas except those protected by levees and even then the back-set waters from tributary drainages not infrequently submerge the surface of the type for considerable periods in the spring months.

Owing to its fine texture, its low-lying position, and lack of natural drainage only small areas of the Wabash clay are cultivated in the more northern States, while a larger proportion of the type is cultivated in the leveed districts, particularly in Mississippi and Louisiana. The remainder of the type is chiefly forested to hardwoods with an undergrowth of wild grasses in the Northern States and of switch cane and saw palmetto in the southern latitudes.

Corn is the principal crop produced upon the Wabash clay in all of the northern areas, yields ranging from 30 to 75 bushels per acre. Spring wheat is also grown wherever possible, with yields of from 20 to 40 bushels to the acre. Oats are produced to a limited extent and yield heavy crops.

In the Southern States the Wabash clay is one of the best of the alluvial bottom-land soils for the production of cotton, which averages yields in excess of one-half bale per acre, with not infrequent crops of 1 bale per acre over considerable areas. Yields of 2 bales per acre have occasionally been reported. These crops are produced without the use of commercial fertilizers. Only a small portion of the type is planted to corn in these localities, but where this crop is grown the returns range from 30 to 50 bushels per acre.

South of Baton Rouge sugar cane is the most important crop, yielding from 25 to 30 tons per acre. Rice is grown to a limited extent, and large areas of the type still unreclaimed may be developed into valuable rice soil by the erection of proper embankments and the installation of irrigation machinery.

The only improvement necessary to bring large additional areas under cultivation is the construction of proper embankments or levees, together with the establishment of adequate drainage, preferably through open-ditch systems. The cost of such reclamation is high, but the fertility of the soil and its excellent adaptation to the production of some of the most valuable staple crops will make such investment profitable.

The Wabash clay is an excellent grass soil in practically all of the localities where it occurs. In the northern regions timothy, redtop, and the clovers give large yields upon protected and well-drained areas, while in similar locations in the south alfalfa, white clover, Bermuda grass, and lespedeza prove valuable crops.

Probably not more than 25 per cent of the total extent of the Wabash clay is now reclaimed and under cultivation, and vast areas of this valuable type are yet to be developed.

Approved.

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *July 14, 1911.*

APPENDIX.

The following table shows the extent of the Wabash clay in the areas surveyed to the present time. In the first column appears the particular survey in which the soil was encountered; in the second column, its extent in acres; and in the third column, the volume of the Field Operations of the Bureau of Soils, in which the report upon the area may be found. Those desiring a detailed description of the soil, and of the general conditions which surround it in any particular area, may consult these volumes in almost any public library.

Areas of Wabash clay encountered in the soil survey.

Survey.	Area of soil.	Year of publication, Field Operations.
Illinois:	*Acres.*	
Clinton County [1]	5,376	1902
Johnson County [1]	1,664	1903
O'Fallon area, Mo. [1]	6,976	1904
St. Clair County [1]	26,944	1902
Tazewell County [1]	13,696	1902
Kansas:		
Allen County [2]	5,299	1904
Parsons area	31,808	1903
Louisiana:		
East and West Carroll Parishes	85,120	1908
East Baton Rouge Parish [1]	13,824	1905
New Orleans area [1]	18,368	1903
Tangipahoa Parish	8,896	1905
Mississippi:		
Holmes County	28,544	1908
Smedes area [1]	37,760	1902
Yazoo area [1]	45,080	1901
Missouri:		
Atchison County	14,272	1909
Cooper County	2,176	1909
O'Fallon area [1]	24,960	1904
Putnam County	1,728	1906
Saline County [1]	28,544	1904
Scotland County	4,672	1905
Nebraska:		
Sarpy County	3,648	1905
North Dakota:		
Carrington area	3,328	1905
Ohio:		
Wooster area	1,216	1904
Oklahoma:		
Tishomingo area	6,016	1906

[1] Mapped as Yazoo clay. [2] Mapped as Sharkey clay.