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

THE KNOX SILT LOAM.

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THE KNOX SILT LOAM.

GEOGRAPHICAL DISTRIBUTION.

The Knox silt loam has been encountered in 17 different soil survey areas located in 7 States, and the total area mapped in these localities aggregates 1,881,024 acres.

The type occurs chiefly along the greater stream drainage systems of central and southern Indiana, western and southwestern Illinois, and the extreme southwestern portion of Wisconsin; in the eastern and southern portions of Iowa; in northern Missouri and eastern Nebraska. Like the Marshall silt loam, this type is derived from the loess which overlies the areas of several glacial subdivisions, and also mantles the unglaciated rock surfaces in some portions of southern Indiana, of Kentucky, and of southern Illinois.

CHARACTERISTICS OF THE SOIL AND SUBSOIL.

The surface soil to an average depth of 10 or 12 inches is a light-brown, ashy gray, or nearly white silt loam. In the better drained areas, where erosion has not been excessive, this surface material may have a depth of 14 to 16 inches, and the typical color is then brown or yellow. On the other hand, in areas which are to the least degree deficient in drainage, and also in areas where the organic matter of the surface soil has been largely exhausted, the color is more nearly gray. The subsoil is a compact light-brown or pale-yellow silt loam, sometimes becoming more stiff and clayey at greater depths. Both soil and subsoil are normally stone free, and very little sand is found in any except local areas, where other materials have been mingled through erosion processes with the materials of the Knox silt loam. The fine silt or silty clay, known as the loess, has given rise to both the soil and subsoil of this type. The depth of this material varies from 40 or 50 feet along the bluffs of such rivers as the Mississippi, the Illinois, and the Missouri to layers only 5 or 6 feet thick along the Ohio River and its northern tributaries.

The Knox silt loam differs from the soils of the Marshall series in two essential respects. In the first instance its surface soil is a much lighter brown or even a pale gray, sharply contrasted with the deep brown or black surface soil of the members of the Marshall series, particularly the silt loam. In the second case, the Knox silt loam is distinctly a timbered region soil throughout the entire extent of its occurrence, as contrasted with the Marshall silt loam, which occupies only the prairie areas in the same general region. It differs decidedly from the soils of the Marion series, particularly the silt loam, in the darker color of the surface soil and in the timbered nature of the type, as contrasted with the prairie condition of the latter. It is not liable to be confused with any of the other soils of the glacial and loessial region.

SURFACE FEATURES AND DRAINAGE.

The Knox silt loam is developed in two distinctive topographic phases. Throughout northern and central Illinois and the north-central portion of Indiana it occupies the rolling to broken areas and the bluffs along the courses of the principal streams. The crests of these hills and bluffs rise from 50 to 150 feet above the bottom lands which they adjoin, and the general belt of the Knox silt loam frequently borders both banks of the stream for long stretches and extends back toward the rolling upland for a distance of 2 to 5 or 6 miles. Such areas are most frequently cut by deep V-shaped tributary valleys, giving a very sloping and somewhat eroded surface for the type in such locations. Practically all such areas have been allowed to remain in timber since the first occupation of the country for agricultural purposes, and in many counties in central Indiana and Illinois the principal woodlots and timbered areas still remain upon this type. All such areas are also grown up to native pasture grasses, among which the Canada bluegrass dominates.

In southern Indiana and in the Ohio River counties of Kentucky where the type occurs, as well as in southwestern Wisconsin and eastern Iowa, the Knox silt loam most frequently occupies undulating to gently rolling upland areas, bordered only by the steeper slopes and eroded portions such as dominate the type in the localities mentioned in the preceding paragraph. In these areas it is extensively used for agricultural purposes and not infrequently dominates the agriculture of the counties where it is found.

In Missouri and eastern Nebraska both types of development are found, and it is not infrequently the case that the cultivated fields of the gently rolling upland are bordered by the steep slopes of eroded and dissected margins along the stream courses and the major rivers. In Missouri the hilly portions are timbered. In Nebraska they are

chiefly covered by native pasture grasses or, more recently, by seeding to the cultivated grasses in the regions where this portion of the type is agriculturally occupied.

There is a wide range in the altitudes at which the Knox silt loam is found. Along the Ohio River and along the Mississippi, near the mouth of the Missouri, the altitude of its surface ranges from 500 to 650 feet above tide, or from 50 to 150 feet above adjoining river bottoms. In central Indiana and Illinois its altitude is usually from 750 to 900 feet above tide level, with the same general relationship to the streams as already described. In Wisconsin, Iowa, and Nebraska, as well as in western Missouri, its altitude ranges from 1,000 to 1,300 feet above tide level, and from 100 to 150 feet above the major streams.

The type is found in the temperate region of the United States extending from about 37° north latitude to 44° north latitude in the Mississippi River region and along its principal tributaries. The range in climatic surroundings, from its most southern occurrence in Union County, Ky., to the most northern region where it has been mapped in the Viroqua area, Wisconsin, is considerable, and has its effect upon the crop adaptation and the common uses of the soil. The limitation from north to south is principally one of temperature. There is a corresponding variation in the rainfall conditions attendant upon the type from a rainfall of nearly 40 inches in the Indiana and Illinois sections to a rainfall of about 25 inches in eastern Nebraska. This also effects the crop adaptations of the type, and somewhat varies the farm practice over its cultivated area.

In general, the drainage of the type is adequate, especially upon all of the more rolling and hilly portions of its development. There are areas, however, in the gently rolling upland where minor depressions, to some extent, lack adequate natural drainage, and in such depressions the crops are normally below the average for the type and for the region, indicating the necessity for supplementing the natural conditions with artificial drainage systems.

Erosion, however, is the principal difficulty to be experienced in the management of this soil. In all those areas where it occurs, principally, along the river bluffs and in the adjoining rolling to hilly territory it is most desirable to leave the type in timber or to establish natural pasturage over areas which have already been cleared. Even in the regions of low rainfall where the Knox silt loam occurs, it is decidedly susceptible to erosion when its surface is left exposed, especially after planting to the intertilled crops. In general, it would be better to omit cultivation over all such areas, using them for forestry and pasturage purposes and confining cultivation to the more level portion of the type or to other soils upon the upland.

LIMITATIONS IN USE.

On account of its silty texture and of the rather dense structure of the subsoil the Knox silt loam is not particularly well suited to the production of any except the general farming crops, including corn, the small grains, and grass. In some local areas potatoes have been found to give excellent yields over the small areas planted to that crop, and it is probable that any special crop adaptation for this type should follow the line of its development for the production of such crops as potatoes, cabbages, and the later truck crops, including sugar corn and green peas for canning purposes rather than its development for the earlier and lighter truck crops.

The amount of organic matter in the surface soil, either under natural conditions or after a considerable period of tillage, is too low to constitute the Knox silt loam a first-class corn soil, especially if it be compared with such types, occurring in the same general region, as the Marshall silt loam or the Carrington loam. In addition, its dense subsoil frequently interferes with the deep penetration of the corn roots and tends to diminish the yield because of drought conditions frequently to be encountered in the latter part of the growing season of the corn. It is thus better suited to the small grains than to corn or to special crops.

Locally, even winter wheat is injured and the yields of this crop are reduced through lack of surface and subsoil drainage in depressed or unusually level areas of the type.

In all of the more steeply sloping portions of the type, and these comprise practically its entire development in several of the areas where it has been encountered, difficulties arising from the rapid erosion of the soil make it inadvisable to raise either corn or the small grains upon it or even to grow grass to be cut for hay.

In the more southern regions where the Knox silt loam occurs, particularly along the Ohio River in Indiana and Kentucky, the climate is somewhat too warm to admit of the best results in corn growing upon this type. As a consequence this crop becomes subordinate to winter wheat, although considerable areas of corn are grown. In the same region oats practically vanish from the cropping system and winter wheat is the only universal small grain crop grown. From this condition there is a gradual change northward to those Iowa and Wisconsin areas in which the Knox silt loam is encountered, where corn is an important crop, though subordinate in acreage to oats and grass in many localities. In these more northern regions winter wheat is grown to only a very limited extent and oats constitute the chief cereal crop. Like variation in crop production upon the Knox silt loam is experienced from east to west until the Missouri River is passed. In Nebraska, however, corn again becomes the preeminent

crop, while both wheat and oats are decidedly subordinate, and the tame grasses are only grown to a very limited degree. In their place the prairie grasses are utilized both for pasturage and the cutting of wild hay. In this latter region, also, emmer and alfalfa occupy a considerable acreage.

IMPROVEMENT IN SOIL EFFICIENCY.

The first limitation upon the efficient occupation of the Knox silt loam is that of a too rough topography for economic use in the rolling to hilly areas bordering the principal streams. These areas should not be considered for tillage purposes under any conditions. Omitting such areas from the consideration of the agricultural uses and efficiency of the type, it is probable that the greatest improvement in the yields of the crops now grown may be effected by the incorporation of organic matter into the surface soil, accompanying the establishment of rational and definite crop rotations.

For the restoration of organic matter to the surface soil of the Knox silt loam there is probably no better method in any area where it occurs than the growing of clover alone, or of mixed clover and timothy, at some point in the regular rotation to be adopted. The stand in grass should not be maintained under ordinary circumstances for more than two years, and the sod should be turned under in order that the stubble and roots of the grass crops may increase the organic matter content for the production of corn and small grains. Throughout the entire extent of territory within which the Knox silt loam occurs this practice is not only possible, but is highly desirable. In the more western country along the Missouri River alfalfa may and should take the place of clover or of the mixed grasses for this purpose. In some portions of southern Indiana and of northern Kentucky the soil is reported to be "clover sick." In some instances this results from the ravages of a fungous disease, and there is practically no remedy except the abandonment of clover cultivation for a considerable period of time upon the affected fields. In other instances difficulty in the production of the clover crop arises either from a lack of the use of lime in connection with the seeding or from difficulty experienced with the "heaving out" of the clover during periods of repeated freezing and thawing in the winter and spring months. To meet the former condition lime should be applied to the soil at the rate of 1,500 to 2,000 pounds of the burned stone-lime, slaked to a fine powder and spread over each acre. If the powdered limestone is to be used in its place, two or three times the quantity per acre will be required. To remedy the difficulty with the heaving out of clover, adequate surface and subsoil drainage alone are required and will prove fully competent to meet this difficulty in all these cases.

The drainage of the Knox silt loam may usually be completed if medium-sized tile are laid through the lower portions of the poorly drained fields, following natural depressions and intersecting basins or hollows which have no natural surface outlet. Not nearly all of any single field is in need of drainage. In consequence, a material increase in the crop yields of this type may frequently be secured through the installation of supplementary tile drainage at a cost not to exceed $10 or $12 an acre for the land affected. There are some few instances where considerable areas would require the construction of open ditches into which extensive systems of tile drain should empty. These areas are usually indicated by an ashy-gray to almost white surface soil, by the presence of iron concretions locally known as "buckshot" within a foot or so of the surface, and by the light-gray or obscurely mottled condition of the compact and dense subsoil. Such areas, if of any extent, require complete drainage before they can be cultivated to advantage to the general farm crops.

The contrasts in slope within the area covered by the Knox silt loam are sharp. Either the surface of the type is nearly level, undulating, or gently rolling and capable of cultivation or, on the other hand, it is hilly and steep to such a degree that no one would be tempted to use it for the production of field crops. Consequently, while erosion is a serious problem in many areas along the steeper slopes, there is every incentive either to reestablish such slopes in forest or to secure a seeding of the native or tame grasses for pasturage purposes. Wherever erosion is active around the headwaters of the minor streams having their sources within this type, brush dams or other obstacles should be located in the gullies to prevent the extension of erosion, and grass seeding should be established as rapidly as possible. In no case should the intertilled crops be grown in such locations, and it is advisable even to omit the small grains which would require the plowing of the land and the breaking of any existing sod.

In very few instances, except in the production of tobacco, is fertilizer used to any extent upon the Knox silt loam. In some instances the stable manures are saved and applied to this type, producing excellent increases in the crop yields. In other instances various commercial fertilizers have been tried with some degree of success, particularly in connection with wheat growing, or for the production of tobacco. Usually only small amounts of commercial fertilizers are applied, not over 150 to 200 pounds per acre, and these fertilizers consist principally of some form of potash constituting 2 to 4 per cent of the total amount, with acid phosphate as the basis for the phosphoric-acid content of the fertilizer, amounting to 8 or 9 per cent. Very little nitrogen is used in any of these fertilizers. The amounts applied are entirely inadequate to produce any marked im-

provement in the soil itself, although temporary increases are obtained in the crop to which the material is applied. A far better method for the fertilization of the land would be the application of all possible organic manures, supplemented by the plowing under of green crops and of sod, with the application of some form of phosphatic fertilizer to be indicated by experimentation upon the land to be treated.

LIMITATIONS UPON SPECIAL CROPS.

Very few special crops are grown upon the Knox silt loam. In the Ohio River district of southern Indiana and western Kentucky a considerable acreage is devoted each year to the production of the heavy export tobacco. Whenever the economic conditions are such that there is an adequate demand for a greater quantity of this class of tobacco its cultivation might be extended over considerable areas of the Knox silt loam in southern Indiana and south-central Illinois. There is little incentive in the current prices for such an extension.

Apple orcharding has assumed an important place in the utilization of certain areas of this type. Only the better drained areas of the Knox silt loam, chiefly those occurring adjacent to the hilly and broken land along the major streams, should be selected for such plantings. Such a location is requisite, not only to secure adequate soil drainage, but also to secure air movement and air drainage to ward off unseasonable frosts. In certain of the Missouri areas extensive plantings of apples have been made upon the type, and the strong growth of the trees, the fact of their early bearing, and the fair to good quality of the fruit all indicate that in favorable situations, particularly in northern Missouri and in Iowa, Wisconsin, Illinois, and north-central Indiana, apple orcharding might become an important industry upon the Knox silt loam. In fact, in many of the prairie counties in this general location the Knox silt loam is the only soil type which is well enough drained and properly located with regard to air circulation for the planting of large commercial orchards. A considerable proportion of the more gentle slopes, which is now occupied by native timber, might well be cleared and planted to those varieties of apples suited to production upon the heavier soils of the central prairie region. These include Wealthy, Jonathan, Winesap, Ben Davis, Gano, and Red Astrachan. The total area of the Knox silt loam possessing both the requisite slope and drainage condition for orchard planting is somewhat limited, although many thousands of acres could thus be utilized.

EXTENT OF OCCUPATION.

Since the Knox silt loam is developed in certain localities as an undulating to gently rolling type, and in others as a hilly to even

steeply sloping soil, there is considerable variation in these different localities with regard to the extent to which it is occupied for agricultural purposes. In the former areas, as in Kentucky, southern Indiana, Iowa, Wisconsin, and some portions of Missouri, probably 80 per cent of the type has been cleared of its natural hardwood timber growth and occupied for the production of farm crops. In the cases where the type is only developed along the bluffs and steeper portions of the counties where it occurs, probably not more than 15 per cent of its extent has been cleared of forest and used for the production of tilled crops. The remainder of the type in such locations is used as the farm woodlot and to a considerable degree for pasturage purposes in the feeding of beef cattle and the grazing of dairy stock. There is thus considerable variation in the occupation of the type, dependent upon its topographic features.

There are some portions of the type at one time cleared and occupied for agricultural purposes which have latterly been allowed to revert to pasturage or to partly forested conditions because of the development of excessive erosion. These areas are localized in extent and are of no great size when compared with the total extent of the type in the States where it occurs. They merely mark the desire of certain communities to extend the areas of cultivated land beyond the natural limits set by the slope and rainfall conditions which control erosion. In Nebraska there are still considerable areas of the Knox silt loam possessing a gently rolling to slightly hilly surface configuration, which, owing to rainfall conditions, are occupied by native prairie grasses, either pastured off or cut as wild hay. These areas are rapidly being occupied for the production of Kafir corn, emmer, and alfalfa, and it is probable that within the next few years all of the areas of the Knox silt loam topographically suited for agricultural purposes will thus be occupied.

CROP ADAPTATIONS.

The texture, structure, and general physical characteristics of the Knox silt loam limit its crop adaptations to the production of corn, the small grains, and grass in all except very restricted areas.

Its climatic surroundings vary somewhat the selection of those crops which will best be suited to the conditions of temperature and of rainfall locally prevalent.

Thus corn constitutes the dominant crop upon the tilled areas of the Knox silt loam in both Illinois and Nebraska. The yields secured are high, ranging from 40 to 45 bushels per acre on the average. However, the acreage devoted to corn is limited, principally by topographic conditions, although in the more western localities the somewhat scanty rainfall not infrequently tends to decrease the

yields and the acreage planted to this crop. In Indiana and in Kentucky corn takes second rank in the total acreage of the Knox silt loam devoted to crop production, and the average yield of corn is about 33 bushels per acre, although in some instances from 35 to 38 bushels are secured through better tillage methods and the better natural drainage of the type. In Iowa and Wisconsin, although the corn yield is high, averaging 38 to 40 bushels per acre, the acreage devoted to this crop is secondary, being exceeded by either oats or grass or by both. In general, there is a wide variation in the yield of corn per acre, not only between the different areas where the soil type has been encountered, but also between different fields even in the same area. It is apparent from the investigations of the type that this difference in yield depends principally upon the amount of organic matter which is present in the surface soil. Those areas of the Knox silt loam which show the darker brown or the deeper gray color, as evidence of large amounts of organic matter in good condition, are always marked by the highest yields of corn, whereas the ashy gray or nearly white areas of surface soil show low yields when planted to corn, or else the crop makes absolute failure upon such tracts. The factor of the depth of surface soil, coupled with that of efficiency in the tillage of the soil, also exerts a strong influence upon the yields of corn. Where the surface soil has a depth of 12 or 14 inches, and where it is maintained in good tilth by frequent shallow cultivation, good yields are frequently secured even on those portions of the type which are somewhat deficient in organic matter. It is also apparent from the statistics of corn yield in the various areas where the Knox silt loam has been encountered that the warmer climate of the more southern latitudes and the smaller rainfall of the more western regions both exert an unfavorable influence upon the maturing of adequate yields of corn.

It may be broadly stated with regard to the Knox silt loam that, although efficient methods of management of the soil will result in the production of fairly satisfactory yields of corn, still the type as a whole may be considered as of only secondary importance as a corn-producing soil when compared with either the Marshall silt loam, the Carrington loam, or the Miami clay loam of the same general region.

In the more southern regions where the Knox silt loam is developed, winter wheat constitutes the crop most extensively grown. In southern Indiana and in Kentucky this crop usually dominates all others. It is not infrequently raised year after year upon the same field with little attention to crop rotation. As a result the average yields secured do not much exceed 11 bushels per acre, although in these same localities those farmers who have paid better attention to the management of their soils and to the rotation of crops secure

from 15 to 18 bushels of wheat per acre from the Knox silt loam. In this connection it is necessary to call attention to a rotation sometimes used upon this soil type, and one which has been effective also for the increase of grain yields upon similar types of soil in the central States. This rotation consists of the plowing down of sod with the production of either corn or tobacco upon the tilled area for the first year. Either or both of these crops may be followed by a seeding to wheat for the second year. In the third year wheat may again be seeded in the more southern locations, or oats may be seeded in the more northern latitudes. In either case a seeding to timothy and clover should be made and the grass should be cut for hay during the fourth and fifth year of the rotation. In this rotation it has generally been found advisable to use all of the stable manure available for the corn or the tobacco crop, and to use the commercial fertilizers with the small grains. In addition, it is sometimes necessary to apply lime preceding the final seeding to small grain and the accompanying seeding down to the mixed grasses. Where such a rotation has been adopted and persistently followed, the yields secured from the Knox silt loam have been materially increased over those portions of the type where neither rotation nor adequate fertilization has been attempted. It should be unnecessary to say that adequate surface and subsoil drainage should be provided in order to make this or any other rotation fully effective.

In the total area devoted to crop production on the Knox silt loam in Illinois, Iowa, and Nebraska, the oat crop is second only to corn in importance, while it constitutes the principal crop, so far as acreage is concerned, in Wisconsin. The yields of oats reported for the Knox silt loam are somewhat variable, averaging about 40 bushels per acre in Illinois, 35 bushels per acre in Iowa, and 32 bushels per acre in Wisconsin. Of course, the areas of this type which are most effectively handled in all three of these States produce considerably greater crops, amounting in each to 50 or 60 bushels per acre on the lands of the best farmers. In both Kentucky and southern Indiana the climate is somewhat too warm for effective oat production, and winter wheat replaces this crop. The acreage devoted to oats is, therefore, decidedly subordinate to that of any other agricultural crop adapted to the Knox silt loam. The yields of oats range from 20 to 25 bushels per acre, with an average of about 22 bushels.

In the more northern areas where the Knox silt loam is developed the acreage devoted to grass is second only to that devoted to oats or corn, as the case may be. Timothy and medium red clover are extensively sown, with smaller acreages of clover seeded alone. In all cases the yields are excellent, ranging from 1 to 2 tons per acre, with a general average of about 1⅓ tons. In Illinois, Indiana, and Ken-

tucky the area devoted to grass is third in rank, although the yields are fair to good, ranging from three-fourths to 1½ tons per acre, with an average of about 1¼ tons. Only a very limited acreage of these grasses is raised in Nebraska, but the yields are high, averaging 1½ tons per acre. Instead, the native prairie grasses are frequently cut for hay with an extremely variable yield, largely dependent upon rainfall. Within recent years alfalfa has been extensively seeded upon the Knox silt loam in eastern Nebraska, producing good yields, and leading to the more widespread occupation of the type for the production of this crop.

Barley is raised to a limited extent on the Knox silt loam in northern Illinois, southern Wisconsin, and eastern Iowa, giving yields of 20 to 25 bushels per acre. Rye is occasionally sown, both for pasturage and as a soiling crop and to a limited extent for the production of grain. Emmer has been sown to a limited degree in eastern Nebraska, chiefly as a forage crop.

In the counties bordering on the Ohio River, both in southern Indiana and in Kentucky, the Knox silt loam is quite extensively planted to the export tobacco. In fact, the crop largely takes the place of corn as a tilled crop in these localities, the yields varying from 1,000 to 1,500 pounds per acre, with an average in the neighborhood of 1,200 pounds. As before stated, the production of this grade of tobacco might well be extended in area at any time when the demand for this class of tobacco is sufficient to increase its price to a point where larger areas would be justified. In southwestern Wisconsin, also, the Knox silt loam is used for the production of cigar-binder tobacco, giving a yield of 1,000 to 1,200 pounds per acre of fair-quality binders. The percentage of wrapper leaves produced is rather low, however, and many tobacco growers prefer more sandy types of soil, where the percentage of wrapper leaves more nearly approaches the percentage of binders in the total crop. For the production of the binders the Knox silt loam is as well suited as any soil type occurring in that part of Wisconsin.

Irish potatoes are grown locally upon the Knox silt loam, producing from 100 to 250 bushels per acre. The potato crop is principally planted for home use, rather than on a commercial scale. The general characteristics of the Knox silt loam are such that it should prove an excellent potato soil in the more northern regions where it occurs. The soft, silty nature of the soil, its absorptive capacity for moisture, and its generally well-drained condition are essentials for the profitable production of Irish potatoes. The type is also stone free and easily maintained in good tilth, provided a little care is taken with the intertillage of the crop. Its tendency toward a slightly acid condition does not interfere with potato production, but is

rather favorable. It is believed that the commercial production of Irish potatoes upon this type in northern Illinois, southern Wisconsin, and eastern Iowa might well be extended.

Fruit crops.—Throughout the central prairie region in which the Knox silt loam is developed in rolling areas along the streams the type constitutes a valuable soil for the planting of apple orchards upon such areas as are not eliminated by too steep slopes or by excessive erosion. In central Missouri hundreds of acres of the type have been successfully planted to orchards, and in certain locations in Illinois large commercial orchards have also been set upon this soil. In all of these instances the growth of the trees themselves has been good, the orchards have come into bearing at an early date, and the quality of fruit produced has been good to excellent. Provided the proper varieties are selected for planting, and these will vary with the climatic conditions of any given locality, the Knox silt loam constitutes one of the best soils for apple orcharding to be found in the central prairie States. Those areas, however, which are flat, poorly drained, or of insufficient elevation to secure adequate air drainage should not be devoted to this purpose. Locally pears, plums, and peaches are also successfully grown upon the type, and they may be used for interplanting with apple trees as well as for independent planting throughout the areas where the type occurs east of the Missouri River.

FARM EQUIPMENT.

For its proper tillage the Knox silt loam requires the use of rather heavy teams and of the heavier types of power machinery. The thorough stirring of the surface soil to a considerable depth, the frequent tillage of the soil for the production of such crops as corn and tobacco, and the proper seeding and harvesting of large areas of the small grains all require a complete equipment of adequate teams and tools. The equipment of farm buildings and of accessory small machinery varies largely in the different areas where the Knox silt loam has been encountered. In the more northern areas where dairying and the production of corn, oats, and grass dominate the type, the equipment of farm buildings is more complete and the buildings themselves are usually larger than in the more southern wheat and tobacco growing areas. In the tobacco regions, in addition to the house and ordinary barns, the tobacco barn is also added to the equipment.

In northern Illinois, southern Wisconsin, and eastern Iowa a considerable proportion of the dairy business is based upon the crops grown upon the Knox silt loam and upon the pasturage afforded by its more sloping areas. The type is usually well watered, the crops adapted to it are well suited to animal feeding, and the climate is favorable to dairy operations. The crop-producing capacity of the

soil is also materially increased by the application of the stable manures, and in consequence the Knox silt loam is best farmed and is most effective, both for crop production and for profitable occupation, in the regions where dairying predominates. Locally, areas of the Knox silt loam in central Illinois and north central Indiana are used to a limited degree for the pasturing of dairy and other stock, although the limited extent of the type throughout this region does not constitute it an important dairying soil. Elsewhere dependence is placed upon the production and sale of grain or of tobacco.

SUMMARY.

The Knox silt loam is extensively developed from Indiana westward to Nebraska and from the Ohio River north to southern Wisconsin. It is the most extensive of the forested, silty soils derived from the loess.

In many areas the surface of the Knox silt loam is hilly to steep, and such areas remain in forest to be used for woodlot or pasturage purposes. In other areas the surface is undulating to rolling, and power machinery may be used over the entire area of the type.

The surface drainage of the type is generally adequate, although local areas require the assistance of tile underdrainage to improve subsoil drainage conditions.

The Knox silt loam is not infrequently somewhat deficient in organic matter and the increase of the yields of the general crops produced upon it is largely dependent upon the restoration of organic matter to this soil.

The Knox silt loam is a subordinate soil for the production of corn in the majority of areas where it is tilled, although fair average yields are secured by the best farmers.

It is one of the principal winter wheat soils of southern Indiana and adjoining territory, the yields ranging from 10 to 18 bushels per acre and averaging 11 to 12 bushels over considerable areas.

In more northern locations oats take the place of wheat as the small grain most generally raised on the Knox silt loam. The yields are good, ranging from 30 to 35 bushels or more per acre.

Grass is a subordinate crop in the more southern areas where the Knox silt loam is found, and the mixed grasses are little raised in its western extension. Elsewhere grass grown for hay constitutes a secondary or a leading crop, with yields ranging from 1 to 2 tons per acre and averaging about 1¼ tons for the entire extent of the type.

The Knox silt loam is also used for the production of export tobacco in Kentucky and southern Indiana and for cigar-binder tobacco in southern Wisconsin. Under present conditions the extension of tobacco production can scarcely be recommended.

Among fruits the Knox silt loam is best suited to the production of certain varieties of apples, and it is one of the best soils for the planting of commercial apple orchards to be found in the central prairie States, provided the more level areas of the type, having adequate air and water drainage, are selected. Pears, plums, and peaches may be planted in conjunction with the apple orchards or separately.

Potatoes are only raised to a limited extent and chiefly for home use, but the natural characteristics of the soil and its climatic surroundings are such that in the areas of its more northern and eastern development it should constitute an excellent soil for the commercial growing of Irish potatoes.

Locally tile drainage is requisite over some portions of the Knox silt loam.

Fully 80 per cent of the more level areas of the Knox silt loam has been occupied for agricultural purposes. The remainder of the level areas and practically all of the steep and hilly areas are occupied by forest, woodlot, and pasturage. In limited areas excessive erosion has caused the agricultural abandonment of a small proportion of the type.

The Knox silt loam ranks as a secondary corn soil, a secondary winter wheat soil, a fairly good soil for the production of oats, and in some localities as an excellent grass soil. Its agricultural rank and its efficiency are largely determined by the amount of organic matter maintained in the surface soil, by the depth to which that soil is developed, by the adoption of proper crop rotations, and by the adequate tillage of individual fields.

Dairying constitutes an important adjunct of the agricultural operations conducted on the Knox silt loam in northern Illinois, southern Wisconsin, and eastern Iowa, and in the dairying sections the crop-producing capacity of this soil has been increased beyond that of its efficiency in many other locations.

Approved.

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *May 27, 1911.*

APPENDIX.

The following table shows the extent of the Knox silt loam in the areas surveyed to this time.

In the first column is stated the particular soil survey in which the soil was encountered; in the second column, its extent of development 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.

Area of Knox silt loam encountered in the soil survey.

Survey.	Area of soil.	Year of publication, Field Operations.	Survey.	Area of soil.	Year of publication, Field Operations.
Illinois:	*Acres.*		Iowa:	*Acres.*	
Dubuque area, Iowa[1]	8,384	1902	Dubuque area[1]	168,512	1902
Knox County[1]	135,552	1903	Tama County[1]	76,224	1904
McLean County[1]	58,368	1903	Kentucky: Union County[1]	154,176	1902
O'Fallon area, Mo.[1]	24,000	1904	Missouri:		
Sangamon County[1]	92,416	1903	Cooper County	25,600	1909
Tazewell County[2]	224,960	1902	O'Fallon area[1]	30,656	1904
Winnebago County[1]	62,464	1903	Saline County[1]	43,776	1904
Indiana:			Nebraska: Sarpy County[1]	69,696	1905
Booneville area[1]	86,656	1904	Wisconsin: Viroqua area[2]	201,408	1903
Greene County[1]	224,512	1906			
Posey County[1]	149,376	1902			
Tippecanoe County[1]	44,288	1905			

[1] Mapped as Miami silt loam. [2] Mapped as Tazewell silt loam.