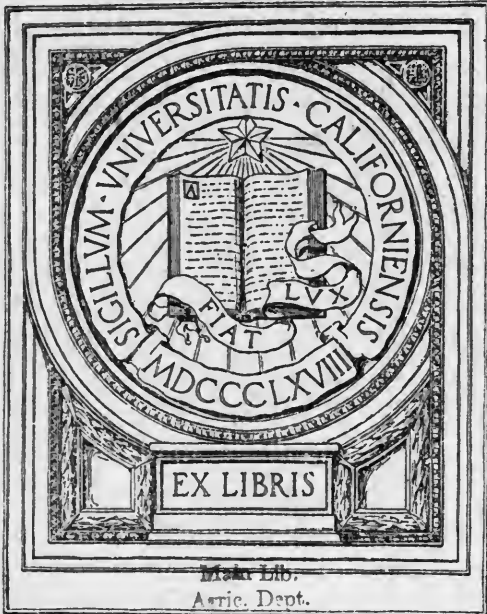


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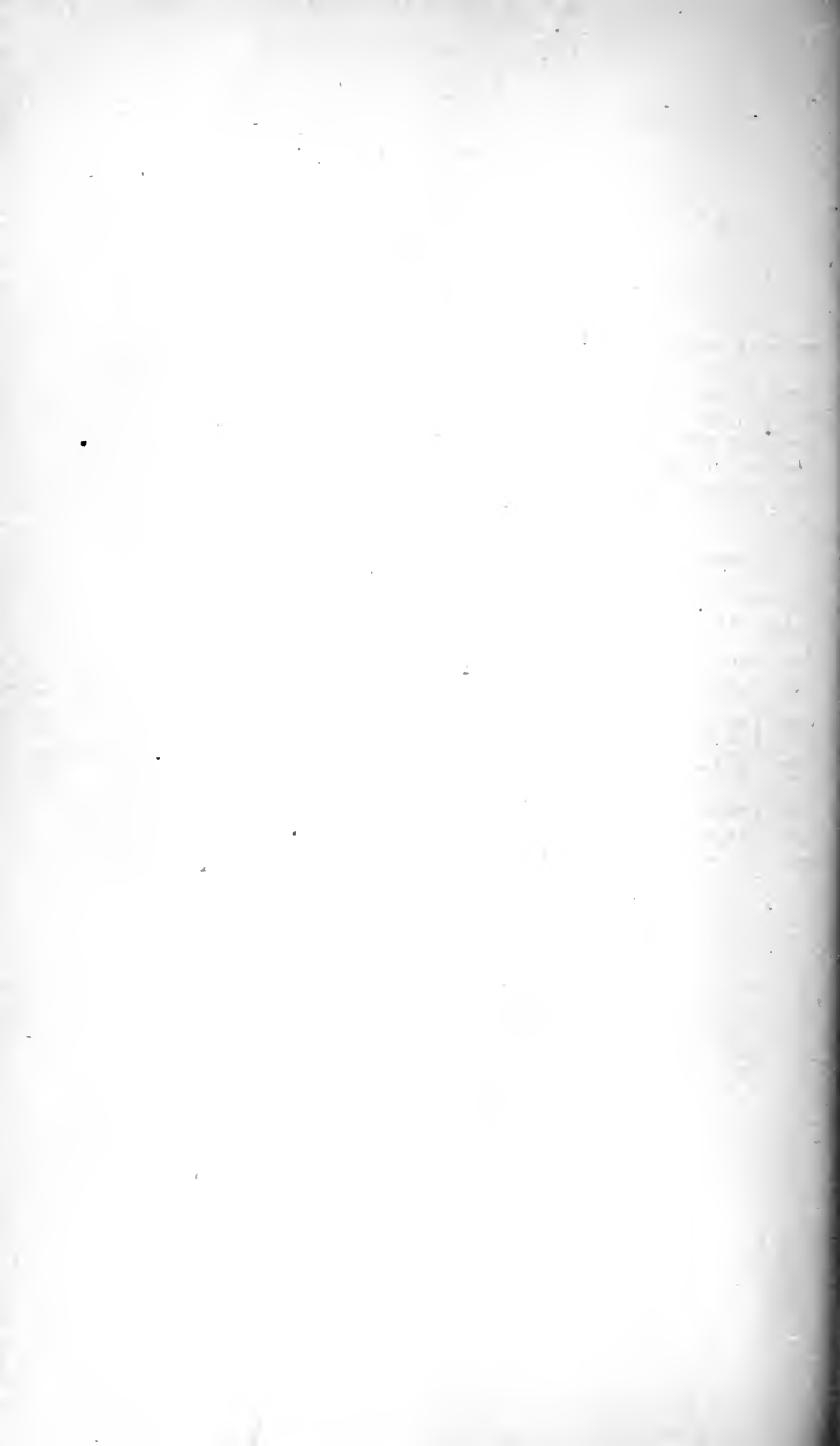
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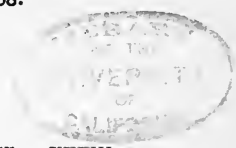
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MILTON WHITNEY, Chief of Bureau.

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

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THE CARRINGTON CLAY LOAM.

BY

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## SOILS OF THE EASTERN UNITED STATES AND THEIR USE—XXXIII.

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### THE CARRINGTON CLAY LOAM.

#### GEOGRAPHICAL DISTRIBUTION.

The Carrington clay loam is an extensive and valuable general farming soil found in the North Central States. It has been encountered in six different soil-survey areas in the States of North Dakota, Iowa, Minnesota, and Wisconsin and mapped to a total extent of 612,864 acres. The existence of considerable additional areas has been indicated by soil surveys already made, and it is probable that the type will eventually be found to cover an area in these States in excess of 6,000,000 acres.

#### CHARACTERISTICS OF SOIL AND SUBSOIL.

The Carrington clay loam, to an average depth of 12 or 14 inches, consists of a very dark-brown to black heavy loam or silty loam, grading at depths frequently in excess of 14 inches into a brown silty clay loam, which at about 24 inches becomes a yellow clay loam. The surface soil is almost universally high in organic matter, representing a long-continued accumulation of decomposed vegetation, which renders the soil more friable and easier to till than is commonly the case with such a heavy loam or clay soil. Stone or gravel are usually absent in the surface soil, but the deeper subsoil frequently contains both, with small local areas, in the more rolling portions of the type, where stone and boulders are abundant in both soil and subsoil.

In almost all areas where the type is found it is underlain by limestone rock at depths ranging from 10 to 50 feet, and a considerable amount of limestone fragments and gravel has been worked into the soil and subsoil. Even where the type rests upon other classes of rock the glacial till from which it is derived contains appreciable amounts of calcareous material, and the subsoil is universally marked by a rather high content of calcium carbonate.

Like the other members of the Carrington series, this soil is characterized by the dark color of the surface soil, the yellow or brownish-yellow color of the subsoil, and by its derivation from glacial till.

It is distinguished from the soils of the Marshall series by the presence of stone or gravel in the subsoil and from all other upland soils of the region by its very dark-colored surface soil.

#### SURFACE FEATURES AND DRAINAGE.

The typical areas of the Carrington clay loam occupy nearly level to undulating or rolling upland prairies in the North Central States. In North Dakota especially there are extensive tracts of the type which are almost absolutely level, while in Minnesota, Iowa, and southern Wisconsin the type is more varied in its surface configuration, and rolling to sloping surface features are more characteristic.

In all areas there is usually sufficient surface slope to make natural drainage conditions adequate for cropping, and only in the extremely level or depressed portions of the type, chiefly in small local areas, is artificial drainage required.

The absolute elevation of this soil above sea level varies with the slope of the low plateau country where it is found. In southern Wisconsin its altitude varies from 700 to 900 feet above tide level; in southern Minnesota and in north-central Iowa its altitude is about 1,000 feet above tide; while in eastern North Dakota it lies at altitudes ranging from 1,100 to 1,300 feet above the sea. This variation in altitude is due to differences in elevation of the underlying rock formations upon which the soil was deposited since it maintains a rather uniform depth of 10 to 30 feet of glacial till from which the soil type was formed. Low ridges, marking the presence of belts of glacial moraine, are found within the type with small depressions between, showing the presence of ponds and lakes now filled. There are also narrow sloughs and some deeper drainage ways within the areas of this soil. In general there are no serious topographic obstructions to the complete agricultural occupation of the type; stones are not usually present in sufficient quantity to hinder cultivation and only local areas require additional drainage facilities.

The Carrington clay loam is therefore naturally well fitted to sustain a prosperous agriculture.

#### LIMITATIONS IN USE.

The textural characteristics of the Carrington clay loam make it especially suited to grass and grain raising, particularly in the northern latitudes within which it occurs. The type is too dense and retentive of moisture, particularly in the subsoil, to constitute a special-purpose soil except under unusual conditions. It has, therefore, been developed properly as a general farming soil in all but a few localities where special market demands have given it a local value for the production of cabbage, onions, and sugar beets.

The type occurs under a fairly wide range of climatic conditions and the more northern areas, which possess a cooler climate, are also the more western ones, within which a smaller rainfall is experienced than those to the south and east where the type is developed. These differences in climatic environment, coupled with considerable differences in the length of time which the soil has been agriculturally occupied in the different areas give rise to variations in crop uses.

In all of the more southern and eastern areas the growing season is sufficiently long to produce the standard varieties of corn, while in the extreme northern areas only the short-seasoned varieties can be grown. Corn is therefore a standard and general crop for the Carrington clay loam in Wisconsin, southern Minnesota, and Iowa, while it is grown only to a limited extent in North Dakota. In Minnesota spring wheat is the great staple grain crop upon the Carrington clay loam and associated types, while oats are more generally grown upon it in Iowa and Wisconsin. In all of the areas, except in North Dakota, hay is recognized as especially fitted to this soil and considerable areas of it are in mowing land or pasture. In the newer communities wild grass may yet be cut upon the sloughs and marshes and there is a corresponding limitation of the acreage seeded to the tame grasses, although these are known to produce excellent yields.

Local selections of crops adapted to production upon the type are thus made to suit corresponding variations in climate or market requirements.

#### IMPROVEMENT IN SOIL EFFICIENCY.

The Carrington clay loam is an unusually fertile and lasting type of soil. It is well supplied with organic matter in its natural condition and the natural drainage is good over the greater portion of the type. Locally the laying of single lines of tile through sloughs or to afford drainage outlets for small depressed areas would increase the area of the type under tillage and would make the fields more uniform in their cropping capacities. In all of the older communities this improvement has been quite generally effected. In areas of cheaper lands many thousands of acres of this type should be so improved as intensity of cultivation increases.

In many of the newer communities pioneer crops are yet produced and the endeavor is to seed as many acres of this soil as possible to the small grains, especially spring wheat or durum wheat in the region of less rainfall. This one-crop system does not tend to maintain the high crop-producing power of the soil and necessitates fallowing with the alternative of decreased crop returns. The adoption of a regular crop rotation is, therefore, desirable and a tilled crop should be brought into the rotation to free the ground from weeds. Grass, including a legume, should also be grown after the

grain crop to assist in the preservation of the humus content of the surface soil. Such cropping systems have already been adopted in all of the older settled communities and the effect has been to maintain or even to increase the naturally high-producing power of the Carrington clay loam. This is notably the case in the dairying and stock-raising regions of Iowa and Wisconsin, where stable manure is carefully saved and applied to the ground as it is prepared for the corn crop. Applications of 10 to 12 loads of stable manure to the acre, once in five or six years, are adequate for its maintenance in an excellent condition of fertility.

The strong tendency to grow large areas of small grains has led to the shallow plowing of this soil in certain areas. The depth of plowing should be increased gradually from the present practice of plowing 4 or 5 inches deep until an average depth of 8 or 9 inches is attained. If the plowing is done in the fall and the ground is allowed to compact during the winter months, good results will follow. Spring plowing should usually be to a less depth and it is usually desirable to roll the ground in addition to the customary fitting with the plow and harrow. In all cases every effort should be made to secure a well fined and compacted seed bed.

#### LIMITATIONS UPON SPECIAL CROPS.

In southern Wisconsin, near to special city markets, considerable areas of the Carrington clay loam have come to be devoted to the production of cabbage as a late truck crop. The areas of the type best suited to this special crop are those lying at the lower altitudes and originally marked by somewhat deficient drainage and consequent accumulation of excessive amounts of organic matter in the surface soil. These areas, somewhat more mucky and moist than the general average of the type, are well suited to the growing of cabbage, onions, and even celery, where the local market permits of these special crops. The Danish Baldhead is the variety of cabbage chiefly grown for shipment to the city markets, while other varieties are grown for local use and for manufacture into sauerkraut. Yields of 12 to 15 tons per acre are secured and increasing acreages of this crop are being annually planted. Good artificial drainage of portions of the type rather more mucky than the average is necessary for success with this crop. The occasional liming of the land devoted to cabbage production is also to be recommended. Rotation of crops and fertilization with stable manures are even more essential than when the soil is given over to grain and grass growing.

Some of the more elevated and better drained areas of the Carrington clay loam have been used for the setting of home orchards with good results. Hardy apples, pears, and cherries succeed when thus planted, but the type can not be recommended as an orchard soil for commercial development.

## EXTENT OF OCCUPATION.

Practically the entire extent of the Carrington clay loam has been occupied for agricultural purposes, and only limited areas, where drainage is still defective or where the surface of the type is rough and sloping, remain unoccupied. Any additional utilization of this soil must take the form of extension of drainage and greater intensity of cultivation.

## CROP ADAPTATIONS.

The inherent physical characteristics, the level or gently undulating surface topography, and the high natural fertility of the Carrington clay loam render it a soil well suited for the production of the chief staple crops of the climatic regions in which it is developed. It takes high rank as a general farming soil.

In all of the more southern areas of its occurrence the type is highly prized as a corn soil. It is well supplied with organic matter, the surface soil is deep and fairly easily tilled, the natural drainage is adequate, and the surface slopes permit of the use of power machinery over the greater portion of the type. As a result, corn is extensively grown upon it in southern Wisconsin, Iowa, and southern Minnesota, the yields ranging from 25 to 60 bushels per acre, with a general average of about 40 bushels. The largest yields are secured in the more southern localities, where varieties requiring a long growing season may be planted. In the more northern areas the short-seasoned varieties give slightly smaller yields of grain. A considerable part of the corn crop is fed to dairy animals and used to fatten cattle. Corn silage is extensively grown for these purposes. In this connection statements made in the report of the soil survey of Ransom County, N. Dak., are significant. The writer says: "The shortness of the growing season has modified to some extent the desirability of this soil for corn, yet if carefully cultivated and planted as early as possible, using a variety adapted to the region, there is no doubt that a good yield can be secured in most seasons;" and "the need of some intertillage crop—as, for instance, corn—and of a rational crop rotation, while not marked at present, will sooner or later be realized by the farmers." The extension of the acreage devoted to corn growing is not only possible but highly desirable. It can best be accomplished through the introduction of short-season varieties and by the erection of silos, into which the crop can be harvested for the feeding of stock and of dairy cows.

In Iowa and Wisconsin oats are the chief small grain grown upon the type. The yields range from 35 to 50 bushels per acre and the crop is grown in regular rotation with corn and mixed grasses. In Minnesota and North Dakota spring wheat is the most

extensively grown small grain and the acreage devoted to it exceeds that given to the cultivation of all other crops. The yields secured vary considerably, depending somewhat upon the length of time which the soil has been under cultivation and somewhat upon the persistency with which wheat has been seeded to the exclusion of all other crops. Under the one-crop system the yields have decreased to 12 or 15 bushels per acre, but where any consistent attempt at crop rotation has been made they are maintained at 15 to 20 bushels per acre. In general, it may be said that the average yield for the type, under all circumstances, is in the vicinity of 15 bushels per acre. There are considerable variations, due to vicissitudes of climate, but the soil may be ranked as an excellent spring-wheat type.

Barley is an important crop upon the Carrington clay loam in Wisconsin and Minnesota and a subordinate crop in North Dakota. The yields obtained are heavy, ranging from 20 to 40 bushels per acre, with a general average above 28 bushels per acre. Rye is also grown to some extent.

A considerable area of the Carrington clay loam is given over to hay. The yields of mixed timothy and clover are unusually heavy, averaging better than  $1\frac{1}{2}$  tons per acre, and frequently reaching 3 tons. In the more southern areas the standard rotation of corn followed by oats, followed by the mixed grasses for two years devoted to hay production, with a year of pasturing, has been generally adopted, and the crops secured are fed on the farm to beef cattle or the dairy herd. With such management the yields are heavy and well sustained.

In North Dakota an increasing acreage of the Carrington clay loam is being devoted to the production of durum wheat. Under conditions of low rainfall this variety gives yields ranging from 25 to 40 per cent higher than the usual varieties of spring wheat, and the crop has proven profitable where others have experienced critical seasons from deficiency of precipitation.

Flax is grown for a single year at infrequent intervals in North Dakota upon this soil, giving yields of 8 to 15 bushels of seed per acre. Where grown continuously upon this or any other type of soil the yields decrease rapidly because of "flax wilt," and it has been found that an interval of five to eight years between flax crops is required to control this disease. The yields are higher upon new lands than upon those which have been cropped previously, either to flax or wheat.

Among the special crops, cabbage is the most important. In Racine County, Wis., the acreage to cabbage has steadily increased for the past decade, and thousands of acres are grown at present. The Danish Baldhead is the variety chiefly grown for shipping purposes, while other varieties are grown for the manufacture of sauer-

kraut and for local consumption. It is essential to have the soil well drained and in good tilth for the profitable production of this crop. The plants are set in the field between June 20 and July 10. Heavy applications of stable manure are made and the soil thoroughly pulverized. The yields obtained range from 12 to 15 tons per acre.

Sugar beets are well suited to this soil and where the local market is good are a profitable crop. The chief difficulty in the production of this crop arises from the large amount of hand labor required in the thinning, hoeing, and harvesting.

Alfalfa has been successfully grown upon the better-drained areas of the Carrington clay loam. The type is usually highly calcareous in the subsoil and its natural fertility is good. Where these advantages are coupled with good drainage, alfalfa may well become a very profitable crop for all of the areas lying within the more elevated portions of the type. Poor drainage must be avoided if alfalfa is to succeed.

While the Carrington clay loam is suited to the production of a fairly wide range of crops, the greatest success in its development has been attained where a regular rotation has been adopted comprising corn as the intertilled crop, spring wheat or oats as the small grain crop, and two or three years to grass production. When, in addition, the crops grown are chiefly fed to live stock upon the farm and the resulting stable manure is applied to the land, this soil has maintained a high producing capacity.

#### FARM EQUIPMENT.

The farm equipment of the Carrington clay loam varies with the class of agriculture which dominates the various areas where it occurs. In the dairy and live-stock districts it comprises barns, silos, and feeding sheds, while in the grain-raising regions it is more restricted. In all cases the type is well equipped with buildings, work stock, and machinery. Heavy draft animals are required for the proper tillage of the soil and improved machinery is also generally used.

#### SUMMARY.

The Carrington clay loam is an extensive general farming soil chiefly developed in southern Wisconsin, north-central Iowa, southern Minnesota, and eastern North Dakota.

The surface of the type varies from nearly level to undulating and gently rolling. Only limited areas are sloping or ridged. The natural surface drainage is good over the greater portion of the type. Small depressions and sloughs are improved by the installation of tile drains.

The type occurs through quite a range of climatic conditions, and consequently the important crops adapted to it vary in different localities. In the more southern and eastern areas corn, oats, and hay are the chief staple crops. Cabbages are raised as a special crop. Farther north spring wheat, barley, rye, and flax are grown, while in the most western areas of its occurrence durum wheat is coming to be an important and profitable crop.

The general adoption of rational crop rotations, together with the feeding of stock and the saving and use of stable manures, are the chief requirements for improving the efficiency of this type.

The Carrington clay loam is usually well equipped with the farm buildings, work stock, and tools required for the tillage of a heavy, fertile, general farming soil.

Approved.

JAMES WILSON,

*Secretary of Agriculture.*

WASHINGTON, D. C., *January 15, 1912.*



## APPENDIX.

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The following table shows the extent of the Carrington clay loam in the areas surveyed to this time.

In the first column is stated 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 the Carrington clay loam encountered in the soil survey.*

Survey.	Area of soil.	Date. <sup>1</sup>
Iowa:	<b>Acres.</b>	
Cerro Gordo County <sup>2</sup> .....	67,456	1903
Story County <sup>2</sup> .....	8,384	1903
Minnesota:		
Blue Earth County <sup>2</sup> .....	185,152	1906
Rice County.....	12,544	1909
North Dakota:		
Ransom County <sup>2</sup> .....	268,800	1906
Wisconsin:		
Racine County <sup>2</sup> .....	70,528	1906

<sup>1</sup> Year of publication, Field Operations.

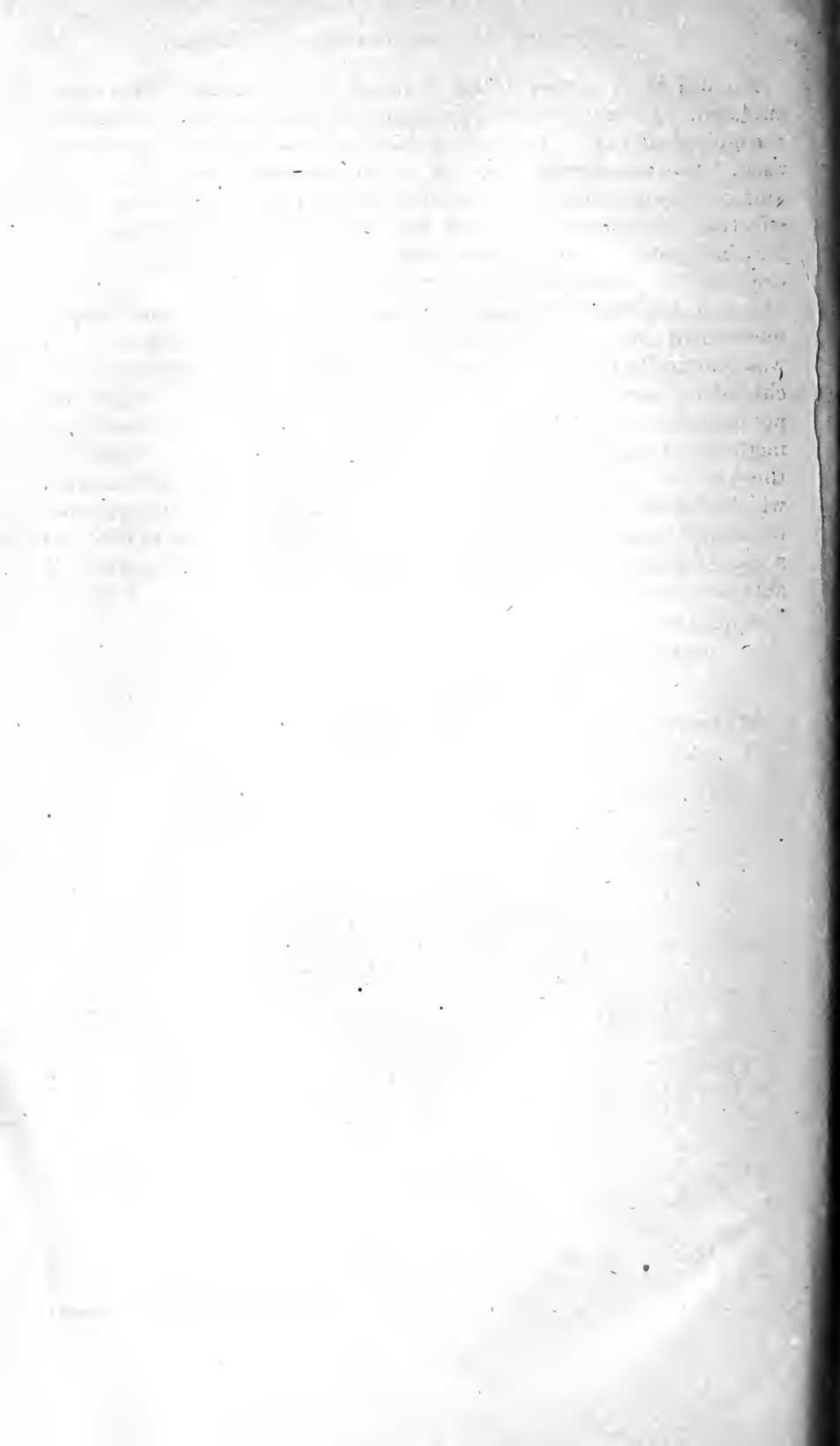
<sup>2</sup> Mapped as Marshall clay loam.

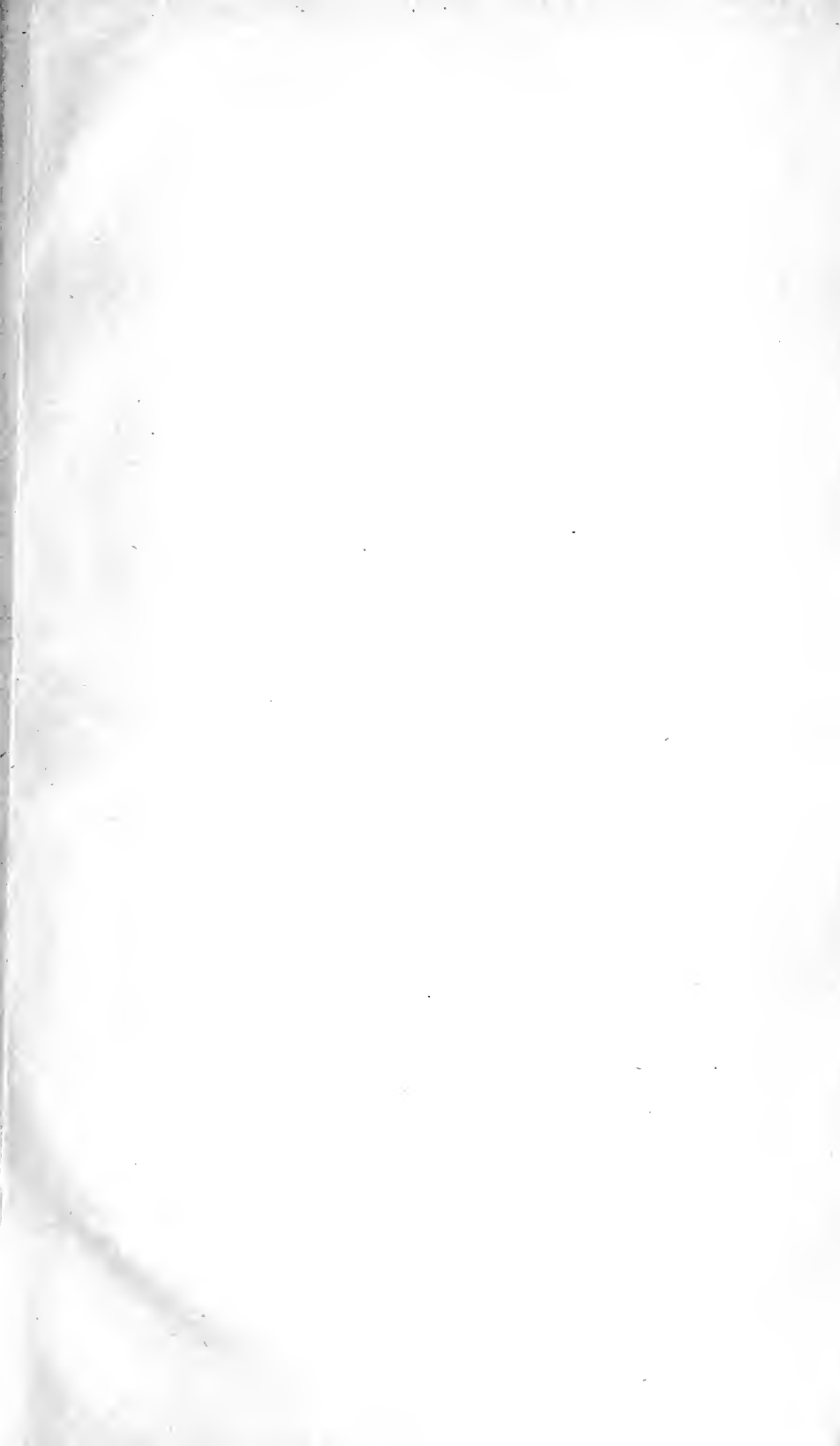
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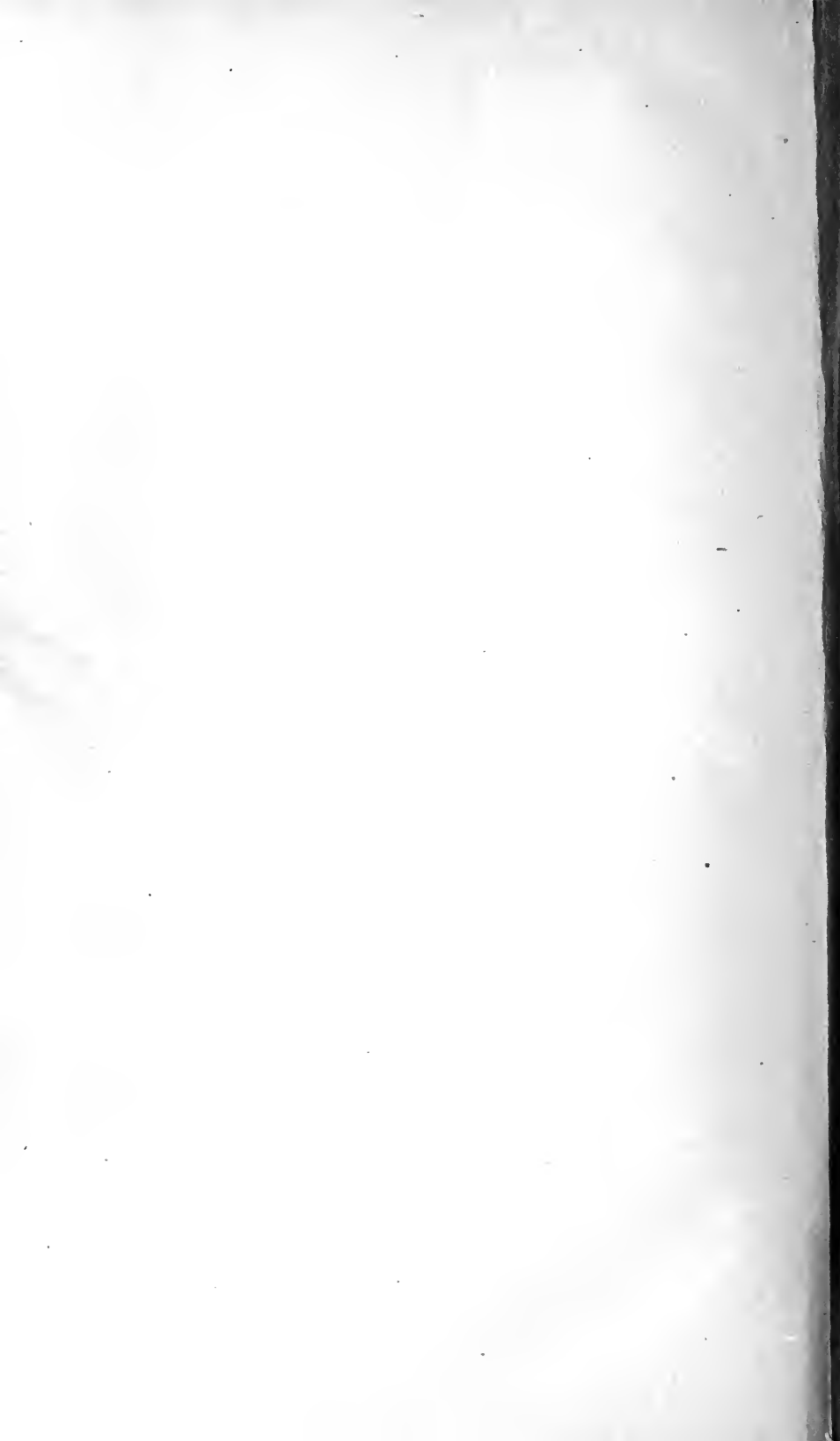
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