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sions of single twisted string in addition to the usual Woodland impressions. Arrowpoints are stemmed, showing this culture to be relatively old. Along the Mississippi River in southern Minnesota are some mounds formed to represent birds and animals. These are called effigy mounds. The center of the effigy mound complex is in south central Wisconsin. No effigy mounds have been excavated in Minnesota, but those that have been investigated in Wisconsin have been shown to be burial mounds of the Woodland Pattern. A cave excavated south of Winona near La Moille had very thick pottery with cord-wrapped paddle markings in the upper seven feet of fill, but had no pottery in the lower six feet. This probably represents a very old Woodland site.

Thus far only a beginning has been made of the study of the various archaeological complexes of Minnesota. The Cambria Aspect was not known to us until 1938, and not recognized as distinct from the Oneota Aspect until 1940. The Great Oasis Aspect was not known until 1941. It is probable that other Aspects now unknown to us will yet be found. One difficulty in reconstructing the prehistory of the state is the fact that so very many of the mounds have already been destroyed. Working with a mutilated mound is like trying to read a book with most of its pages torn out. The remaining mounds are now protected by state law. The village sites resist destruction better than the mounds and much of the future archaeological research will concern itself with village sites.

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## THE PRESENT STATUS OF THE SOIL SURVEY IN MINNESOTA<sup>1</sup>

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The soil survey is essentially an inventory of the soils of an area. It is a fundamental investigation of our soil resources on which all systems of agriculture must be based. The primary objective, therefore, of a soil survey is to classify and evaluate the land resources. This is of first importance for the state and federal agencies which are entrusted with the responsibility of seeing that this important natural resource is utilized to its greatest efficiency. Further, the soil survey provides information on which soil management and soil conservation activities on individual farms may be based.

In actual practice the work of the soil survey consists of field observations to determine the location, distribution, and general character of the various types of soil. The different soils are shown

<sup>1</sup> Paper No. 461, Miscellaneous Journal Series, Minnesota Agricultural Experiment Station.

on a map which is accompanied by a report giving a full description of the different soil types, their method of handling, their adaption for different crops, their fertilizer and lime requirements, and other subjects in connection with the ability of the soils for crop and animal production. After the completion of the survey representative samples of the various soils are collected for laboratory studies in order to assist in the interpretation of the observations made in the field. The field men employed on the survey have had special training in soils and are generally graduates of agricultural colleges. Many have been raised on a farm and have a practical understanding of the farmers' viewpoint. Such factors as soil texture, structure, color, fertility, stoniness, topography, native vegetation drainage conditions, and others affecting the utilization of the land for crop production are given careful consideration in the mapping procedure.

While the mapping of the soils of the United States has been underway since 1902, unfortunately less than half of the total area of the country has been surveyed. In Minnesota only about 40 per cent of the total area has been completed to date.

When we realize that the total area of continental United States is approximately 1,903,000,000 acres of which about one-half, or 987,000,000 acres, are included in farms we can appreciate the immense amount of work that has been expended in accomplishing what already has been done.

The work already accomplished by the soil survey has brought out some very interesting and important facts about our soil resources. A few years ago the Land Planning Committee of the National Resources Board, in making a study of the soil resources of the nation, grouped the soils of the country into five grades based on their natural productivity for crops. Grade 1 was described as excellent land for the staple crops climatically adapted to the region in which it lies; Grade 2, as good, Grade 3 as fair, Grade 4 as poor and Grade 5 as essentially incapable of tillage. According to their computations, Iowa has the largest acreage of excellent and good land—Grades 1 and 2. This amounts to nearly 33 million acres. Minnesota is second with a little more than 24 million acres of excellent and good land. Following Minnesota are Missouri and Illinois with 22½ and 22 million acres, respectively, of excellent and good land.

While Minnesota ranks close to the top in the proportion of high grade land the fact should not be lost sight of that these 24 million acres constitute less than half the total land area of the state.

It might be worth while at this juncture to see just what is included in the 52 million acres of land in this state. Originally 19 million acres were open grass land or prairie. Practically all these acres are crop land and include some of our best farms in the state. The

soils are characterized by having deep, dark-colored surface soils with fine textured subsoils. This prairie belt lies to the west of a line drawn from the northwestern part of the state, in central Kittson County, in a southerly direction to a point near Austin, in Mower County, in the southeastern part of the state. Within its boundaries lies the famous Red River Valley, an area occupying about  $4\frac{1}{2}$  million acres of highly productive soils.

Then there are approximately 20 million acres included in the so-called "cut-over" region in many parts of which at one time dense stands of white and red pine flourished. These lands lie in extensive tracts in the central, northern and northeastern parts of the state. In this cutover region we find a very complex variety of soils much of which is good agricultural land with well improved farms. A large proportion of it, however, has soils unsuitable for farming.

Scattered over the state in a somewhat intricate pattern, resembling a branching tree, are the nearly level sand plains which border many of the present streams. In glacial times many of these were the beds of streams fed by the waters from the melting ice but are now well above overflow. It is estimated that there are approximately 5 million acres of these light sandy soils. A large proportion of them has been brought under cultivation and farmed with varying degrees of success. Owing to their droughty nature crop yields are often disappointing.

In addition there are 2 million acres of strictly non-agricultural land lying almost entirely in a solid block in the extreme northeastern part of the state, north of Lake Superior. Here the bedrock rises close to the surface, even outcropping in many places. The soil is thin and the topography so rough and uneven that any attempt at farming is almost hopeless. In spite of its unsuitability for farming it is regarded as fair to good forest land. Much of it is included in the Superior National Forest.

Finally the remaining 6 million acres consist of peat—a soil made up largely of the remains of plants which have undergone partial decomposition and have been prevented from further decay by remaining saturated with water most of the time. The attempts that have been made in the past to convert these lands into productive acres have resulted in a long series of disappointments. Compared with mineral soils, peat soils suffer from serious handicaps. Most peat soils are naturally poorly drained, and in some areas it is difficult to provide satisfactory drainage. They are not well adapted for sensitive crops, like potatoes and corn, because of their susceptibility to late and early frosts. Grasses and clovers are practically immune to injury from such frosts and are the safest crops on peat soils. With but few exceptions, peat soils require annual applications of commercial fertilizer, either phosphate alone, potash alone, or, more commonly, both phosphate and potash.

Since the acreage figures quoted above can only be an approximation they are considered fairly reliable and it is to be hoped that before too long a time the soil survey will have become completed and complete data made available for a more accurate appraisal of our soil resources.

The first soil mapping in Minnesota was done about 1906 and the work has continued without interruption since that time. Progress has been as rapid as funds will permit.

Soil survey work is carried on by the Division of Soils of the Minnesota Agricultural Experiment Station under a co-operative arrangement with the Bureau of Plant Industry of the United States Department of Agriculture who publish and distribute the soil maps and soil survey reports.

During the last few years a great deal of attention has been directed towards the conservation of our soil. The depletion suffered by the nation's soil through erosion by both water and wind has already been recognized as a real menace. In parts of southeastern Minnesota much of the upland soil has been seriously damaged by washing and in some places in the western part, on the open prairies, some of the rich top soil has blown away.

In the United States it has been estimated that some 50 million acres of once fertile land have been ruined as productive land through the ravages of accelerated erosion. On other lands the loss is less severe but on the greater proportion of crop land in the United States the damage already done ranges from slight to very severe. In Minnesota much of the land now partially impaired can maintain its soil resources by following approved methods of farming.

The Congress of the United States recognizing the seriousness of soil losses through erosion made provision a few years ago for the creation of an organization in the U. S. Department of Agriculture to provide permanently for the security of the nation through the control of erosion. This organization is known as the Soil Conservation Service and, as a part of their program, they have inaugurated a plan of making Soil Conservation surveys. These combine a detailed soil map with information dealing with the degree and character of soil erosion, the slope of the land, and the existing cover. The purpose of these surveys is to supply complete and immediate information on which detailed cultural and soil management plans may be developed for establishing conservation practices on individual farms.

These conservation surveys are being made in many districts of the United States, including Minnesota. Winona County, Minnesota, was the first county in the nation to have maps of this kind published. The field work for Washington and Dakota counties has just been completed and is now awaiting publication.