SOIL SURVEY OF BOONE COUNTY, MISSOURI

General Nature of the County

BOONE COUNTY is in central Missouri (fig. 1). It is bordered on the east by Callaway County and Audrain County, on the north by Audrain County and Randolph County, and on the northwest by Howard County. The Missouri River forms the southwest border.

The county has a land area of 442,259 acres, or about 691 square miles. It includes parts of two major land use areas. The Central Claypan Area covers the northeastern and east-

central parts of the county. The rest of the county is in the area classified as Central Mississippi Valley Wooded Slopes.

The main campus of the University of Missouri is in Columbia, along with Stephen's College and Columbia College. Other towns in the county are Centralia, Sturgeon, and Harrisburg in the north, Rocheport in the west, and Ashland and Hartsburg in the south.

The lowest elevation in the county is about 540 feet above sea level where the Missouri River leaves the county at its southern tip. The highest elevation, about 940 feet above sea level, is on a broad ridge just north of the headwaters of Little Cedar Creek, on the drainage divide between Hinkson and Cedar Creeks. Local relief ranges from an elevation change of 320 feet in less than a quarter mile at the southern end of the county to a change of less than 10 feet in about 1mile in the area just west of Centralia.

In the northeast corner of the county, about 6 percent of the land area drains into tributaries that flow north and northeast toward the Salt River in Audrain County. The Salt River flows eastward to the Mississippi River. Surface water in the rest of the county drains into the Missouri River through a number of tributaries, including Bonne Femme, Cedar, Little Cedar, Hinkson, Jemerson, and Perche Creeks.

The other major drainage feature in the county is a system of karst topography west and south of Columbia. In this area, numerous sinkholes, some filled with water, overlie a complex network of caves and springs.

Population

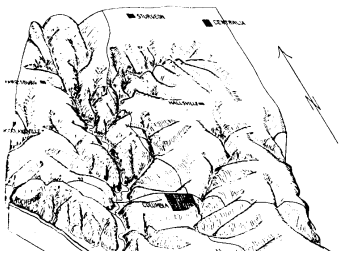
In 1990, the population of Boone County was 112,379. Columbia, the county seat, is the largest city in central Missouri. It had a population of 69,101.

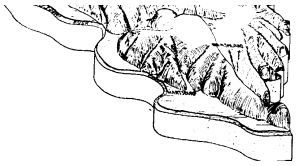
Figure 1. —Location of Boone County in Missouri.

Physiography and Relief

The central part of the county is rolling, and there are steep slopes along the larger streams. Columbia is at an elevation of about 750 feet above sea level.

During the Kansan glacial stage of Pleistocene time, almost the entire county was covered by glacial material. This material ranges in thickness from a few feet to more than 100 feet. The thickest material occurs in the northern and eastern two-thirds of the county. The glacial till consists of yellowish clay mixed and small pebbles.





At a later time following glaciations, loess (windblown-silt) was deposited over the entire county. It is thickest on the bluffs along the Missouri River and gradually becomes thinner with distance from the river. Over large areas, especially in the northwestern and eastern parts of the county, the cover of loess has been removed by erosion and the underlying glacial till forms the present land surface.

Boone County is in the transitional zone between the forest region to the east and the prairie region to the north and west. Approximately 20 percent of the county was originally covered with prairie grasses. The prairie cover was most extensive on the level area in the northeastern part of the county. Relief, parent materials, and vegetation were important soil-forming factors in the county. The relation of all the soil-forming factors is discussed more fully in the section "Genesis, Classification, and Morphology of the Soils."

Water Supply

Both surface and underground water are abundant in Boone County. With minor exceptions, the soils retain moisture well. The average annual precipitation is about 38 inches. There are about 100 miles of perennial streams.

Many ponds supply water for domestic use. Approximately 700 ponds were constructed between 1949 and because they contain much clay, the soils are especially suitable for ponds. Underground water of good quality is abundant. Large amounts occur at a depth of 1,000 or more feet.

Mineral Resources

Boone County has an abundance of limestone that is suitable for agricultural lime. The entire southwestern part of the county is underlain by high-grade limestone, mainly of Mississippian age. The limestone is covered with a thick mantle of till and loess, but there are many exposures suitable for quarry sites. Large quarries are located near Columbia and elsewhere in the county. More than 20,000 tons of agricultural limestone have been applied annually to soils in the county for many years.

An area about 10 miles wide, extending, southeastward from Harrisburg to a point east of Columbia, is under lain by coal of possible commercial quality and quantity. Pit mining has been discontinued, but some strip mining is done. The larger strip areas, which are shown on the detailed soil map, are about 3 miles southeast of Harrisburg and about 3 miles northeast of Columbia.

Climate

The climate of Boone County is characterized by warm summers and cool winters. Precipitation is fairly evenly distributed throughout the year, but large amounts of rainfall occur in summer and fall, particularly in June and September.

In winter, the average temperature is 29.6 degrees F and the average daily minimum temperature is 19.8 degrees. The lowest temperature on record, which occurred on January 18, 1930, is -22 degrees. In summer, the average temperature is 74.7 degrees and the average daily maximum temperature is 85.9 degrees. The highest recorded temperature, which occurred on July 15, 1954, is 116 degrees.

The total annual precipitation is 38.94 inches. Of this, 26.8 inches, or about 69 percent, usually falls in April through September. The growing season for most crops falls within this period. The heaviest recorded 1-day rainfall was 5.37 inches on August 12, 1993. Thunderstorms occur on about 52 days each year, and most occur from May to August.

The average seasonal snowfall is 22.4 inches. The greatest snow depth at any one time was 14 inches recorded on January 20, 1995. On the average, 26 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year. The heaviest 1-day snowfall during the period of record was 11 inches on December 31, 1973.

The average relative humidity in mid-afternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 83 percent. The sun shines 66 percent of the time possible in summer and 49 percent in winter. The prevailing wind is from the southwest. Average wind speed is highest, 12 miles per hour, in March.

The average date of the first frost is October 19. The average date of the last frost in spring is April 10. Boone County has an average growing season of 192 days.

Agriculture

Of the total land area in Boone County, approximately 135,000 acres is used for row crops and 100,000 acres is used for pasture. About 40 percent of the cropland and 50 percent of the pastureland is under some form of soil conservation management. In 1991, only 16,967 acres had been set-aside in the Conservation Reserve Program of the Natural Resources Conservation Service.

The large percentage of pasture is attributed to the extensive areas of soils that are not well suited to cultivation. From 1949 to 1954, there was an increase of 8 percent in -total land pastured. This shift has been due to the marginal quality of some of the land formerly cultivated, to low fertility, and to the hazard of erosion on cultivated soils.

Livestock

In Boone County the acreage in pasture has always been large, and livestock has been a main source of income.

Crops

The major row crops grown in the county are corn, soybeans, wheat, and grain sorghum. Other row crops include tobacco, canola, popcorn, and sunflowers. Some small areas are devoted to vegetables and orchard crops, including pumpkins, watermelons, tomatoes, sweet corn, and squash and strawberries, apples, peaches, and pecans. Grapes are also produced in the survey area, and some of the grapes are marketed to a winery near Rocheport.

Soybeans are the most extensively grown crop. Between 1975 and 1990, the harvest area of soybeans averaged about 45,000 acres. In that same time period, the average harvest area of wheat was about 19,000 acres; corn, about 13,600 acres; and grain sorghum, about 4,800 acres. The total acreage of crops and pasture has been declining in recent years, partly because the rapid growth and expansion of Columbia has resulted in the extensive conversion of land to urban uses.

Corn was grown on about 20 percent of the total cropland in 1954. It was being grown in all parts of the county but most extensively-7on" soils of the bottomlands and the uplands in prairie areas. About 12 percent of the total cropland was used for hay, about 31 percent was pastured, about 10 percent was not harvested or pastured, and about 24 percent was used for wheat, oats, and soybeans.

Since 1929 the acreage in corn has decreased about 20 percent; most of this acreage has been diverted to pasture. Average yields of corn are increasing, however. Soybeans are increasing in importance. They grow well on some of the nearly level soils that have slow internal drainage. The total acreage in hay has not changed significantly, but the acreage in the major kinds of hay has shifted through the -years.

Minor crops that are important in certain localities are tobacco and fruit. These are grown mainly on Menfro and Winfield soils of the river hills. In 1954 there were 52 acres in tobacco and 465 acres in orchards. The Salix, Sharon, and Ray soils on the bottomlands are well suited to growing vegetables.

Agricultural practices

Practically all of the creek and river bottomlands are subject to occasional flooding. This has no significant effect on land use. Some of the bottomlands of the Missouri River are protected from low floods by levees.

Descriptions of the Soils

The soil scientists who made this survey went over lie area at appropriate intervals and examined the soils by digging with a spade or auger. In each boring they examined the different layers, which soils men call horizons, and they compared the different borings. By such comparisons, they determined the different kinds of soils in the area.

They described the various soils and drew boundaries in aerial photographs to show the extent of them. The oils are described in approximate alphabetic order in lie following pages. Their acreage and proportionate extent are shown in table 4, and their location can be seen on the detailed map that accompanies this report.

Soils are classified by series, types, and phases. A soil series is given a place name; for example, the Mexico soils are so named because they were first mapped near Mexico, Mo. The soils of a series resemble each other in any ways but may differ somewhat in texture of the surface, soil. A soil type is named by adding texture of surface soil to the series name; for example, Mexico silt loam. Most of the soil-mapping units are phases of soil types. These soil phases are named by adding information about slope, degree of erosion, or other details to the name of the soil type.

An important part of each soil description is the soil profile, a record of what the soil scientist saw and learned when he dug into the -round. All soils of one type have essentially the same kind of profile, and soil types of the same series differ only in the texture of the surface layer. Thus, it is not necessary to describe, in detail, the profile of each soil shown on the map.

Following the name of each soil, there is a set of symbols in parentheses. These symbols identify the soil on the detailed map. The capability unit is given for each mapping unit, and these units are described in the section "Use and Management of the Soils."

In describing the soils, the scientist frequently assigns symbol, for example "A1," to the various layers. These symbols have a special meaning that concerns scientists and others who desire to make a special study of soils. Most readers will need to remember only that all symbols beginning with "A" indicate surface soil and subsurface soil; those beginning with "B" indicate subsoil; those beginning with "C" indicate substratum, or parent material; and those beginning with "D" indicate any layer under the "C" that does not consist of material from which the soil formed.

In some soils of the bottomlands, it is difficult to determine whether the soil layers are surface soil, subsoil, or parent material. For these soils, the layers are numbered consecutively and are not assigned a symbol.

The texture of the soil refers to the content of sand, silt, and clay. It is determined by the way the soil feels when rubbed between the fingers, and it is later checked by laboratory analyses. Each mapping unit is identified by a textural name, such as "fine sandy loam." This refers to the texture of the surface soil.

Structure is indicated by the way the individual soil particles are arranged in larger grains, or aggregates, and the amount of pore space between the grains. The structure of the soil is determined by the strength or grade, the size, and the shape of the aggregates.

Genesis, Classification, and Morphology of the Soils

In this section the factors of soil formation that affect the development of the soils in Boone County are discussed. In addition, the soil series in the county are classified by higher categories, the morphology of the soils is discussed, and laboratory data are given for some of them.

Factors of Soil Formation

Soil is formed by weathering and other processes that act on parent material. The, characteristics of the soil at any given point depend upon (1) the climate, (2) the plant and animal life, (3) the physical and mineralogical composition of the parent materials, (4) the relief- or lay of the land, and (5) time. The effect of climate on soil and plants is modified by the characteristics of the soil and by relief. Relief, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

Climate

Boone County has a climate that is marked by extremes in temperature. The average annual precipitation is about 38 inches; a considerable part of this occurs during, the growing season. The average annual snowfall is about 16 inches. The climate is fairly uniform through out the county, and no major differences exist among the soils because of it.

Living organisms

Plants and animals are active in the soil-forming processes. The nature of the changes they bring about
Depends, among other things, upon the kind of life processes peculiar to each. The kinds of plants and animals that live on and in the soil are determined by the climate, parent material, relief, and age of the soil, and by other organisms.

Most of the soils in the county have developed under a deciduous forest. The principal kinds of trees were oak, hickory, maple, walnut, and elm, but there were several other less important species. Some soils in the county had a native vegetation of tall prairie grasses, and soils that are transitional between those of the timbered areas and those of the prairie areas occur in places. The transitional soils were originally covered by tall prairie grasses and later by forests, and, consequently, they have some of the characteristics of both Gray-Brown Podzolic soils and Brunizems.

The vegetation has roots that go moderately deep to feed on the plant nutrients in the soil.

Most of the trees and shrubs shed their leaves each year. The content of plant nutrients in the leaves varies considerably. Generally, however, deciduous trees return larger amounts of bases and phosphorus to the soil in their leaves than coniferous trees. In this way plant nutrients are returned to the upper part of the soil from the lower part and partly replace nutrients that are leached out by percolating water.

Organic material is added to soils formed under forest by the decay of leaves, twigs, roots, and entire plants. Most of it accumulates on the surface, where it is acted on by microorganisms, earthworms, and other forms of life and by direct chemical reactions. The plant food released by this decomposition is available for new growth of plants.

Prairie grasses have a dense fibrous root system that contains a greater number of finer roots than trees and shrubs. The finer roots take less time to decay, and they add more organic matter to the soil than those of forest vegetation. Consequently, the Brunizem soils, which formed under grasses, have darker, thicker surface layers than the soils formed under forest.

As organic material decays, it releases organic acids that hasten the leaching and translocation of inorganic materials. The rate of decomposition is strongly influenced by temperature and by the amount of moisture present.

Parent materials

The parent materials probably have been the most significant soil-forming factor in Boone County. In this county they consist of (1) materials weathered from rock in place, (2) materials transported by glacial action, (3) transported by wind (loess), and (4) materials transported by water or gravity (alluvium or colluvium).

The basic geological structure of Boone County consists of limestone of 'Mississippian age and shale and sandstone of Pennsylvanian age. After the beds of limestone, shale, and sandstone were laid down, they were exposed to weathering for millions of years. Hills and valleys were formed, and apparently a large stream followed about the present course of the Missouri River.

Weathering of the rock formations produced soil material. The silty shale and sandstone produced similar soil material because the shale contained a lot of silt and the sandstone contained appreciable amounts of finer material. The calcareous clay shale and limestone produced heavy-textured (clayey) soils. The soils of Boone County that formed in these residual materials are those of the Dennis, Gosport, Mandeville, Snead, and Union series. Steep stony land also formed from residual materials.

During Pleistocene time, Boone County was almost completely covered by a glacier of the Kansan glacial age. This huge sheet of ice deposited large amounts of ground-up rock material called glacial till. The deposit was thickest in the northern part of the county; it thinned out to the south near the Missouri River. Borings for wells have indicated a thickness, in places, of more than 100 feet, but in most of the county, the thickness ranges from 10 to 20 feet. The till was derived largely from shale material mixed with some sand

and gravel. The material had a high clay content but contained little limestone; it is therefore not so highly calcareous as the till much of the northern part of the State. As time passed the till was subject to erosion, leaching and weathering. The soils of Boone County that formed primarily in the till are those of the Gamma, Gara, Lindley, and Sapp series.

After the Kansan glacial age there were two more major glacial ages-first the Illinoian and then the Wisconsin. The farthest extent of their ice sheets was many miles from Boone County. During the melting of the last ice sheet of the Wisconsin glacial age, large amounts of water flowed down the Missouri River and deposited much finely ground rock material on the flood plains. During the colder spells in winter, when the melting of the ice sheet was checked, the flood plains became dry mudflats. Windstorms then picked up dust from these flats and deposited the larger particles close by, and the finer particles farther away on the uplands. The silty deposits are called loess, which is the material in which most soils of the uplands of Boone County have developed.

The loess was deposited during two or more periods, separated by many years. The lower deposit that is recognized in Boone County is named Loveland loess because it was first recognized near Loveland, Iowa. In only a few places does the Loveland loess occur at the surface is the soil-forming material. Most of the loess that forms the land surface is considered to be Peorian loess. The loess is thickest on the river bluffs and thins out with increasing distance from the bluffs. In places on the bluffs, the loess is more than 30 feet thick, but, over most of the county, it is 5 to 10 feet thick. Where the loess is thick, it covers the entire land surface. Where it thins out, it has been removed from most slopes of 6 percent or more. In intermediate areas, where the loess is generally 5 to 10 feet thick, it does not occur oil most of the steeper slopes.

The soils of Boone County that have formed in loess are members of the Hatton, Marion, Menfro, Mexico, Pershing, Putnam, Seymour, Weldon, and Winfield series.

Alluvium was the parent material of many of the soils in the county. The soft loess material of the uplands is very erodible and has been removed from large areas, especially in the northwestern and central parts of Boone County. In some places the eroded material has accumulated at the base of slopes and in narrow drainage ways. The soils of the Chauncey series have formed in a mixture of alluvial and colluvial material that was moved mainly by gravity and has accumulated in smaller drainage ways in the uplands.

The alluvium in Boone County varies more in texture and color than either the loess or glacial till. Deposits from fast-flowing, waters are normally coarse, and those front slow-moving or stagnant waters are fine. It is to be expected that the coarser material will be nearer stream channels, or in small first bottoms, and that, the fine-textured material, or gumbo, will be in the larger bottoms, or terraces, generally some distance from the stream channels.

The soils of Boone County that have formed in alluvium are those of the Carlow,

Freeburg, Moniteou, Onawa, Racoon, Ray, Salix, Sarpy, Sharon, Stet, Wabash, and Westerville series.

Relief

Relief is important in soil formation because of its influence oil drainage, runoff, and infiltration, and other related factors including accelerated erosion. In Boone County it ranges from nearly level to very steep. On some steep areas where a large amount of water runs off the surface, erosion is rapid and keeps an almost even pace with rock weathering, and soil formation. Some of the soils on steep slopes have shallow profiles, and there are rock outcrops in places. In these areas the soil materials are being constantly removed by erosion. The soils do not remain in place long enough to form horizons.

Drainage is also an important factor that causes differences in soils. The Putnam soils, for example, are in broad, nearly level, prairie areas where drainage is slow. Consequently, they have a, highly leached subsurface horizon and dense subsoil. The Winfield soils, however, are rolling to hilly, have good internal drainage and are only moderately weathered.

Time

Time is necessary for development of soils from parent materials. Some of the soils in Boone County are old. They have formed in residual soil materials, in glacial till, or in loess, and they have been in place long enough for well-defined horizons to develop. Other soils are young. They are forming near streams where fresh deposits are added from time to time, and they have not been in place long enough for distinct horizons to develop. Some soils are young because they occupy steep slopes, and the soil materials wash away before distinct horizons have had time to form.