

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF BELL COUNTY,
TEXAS.

BY

WILLIAM T. CARTER, JR., IN CHARGE, H. G. LEWIS,
AND H. W. HAWKER.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1916.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1918.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., December 24, 1917.

SIR: A soil survey of Bell County, Texas, was undertaken and carried to completion during the field season of 1916.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1916, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Bell County sheet, Texas.

SOIL SURVEY OF BELL COUNTY, TEXAS.

By WILLIAM T. CARTER, Jr., In Charge, H. G. LEWIS, and H. W. HAWKER.—Area Inspected by HUGH H. BENNETT.

DESCRIPTION OF THE AREA.

Bell County lies in the east-central part of Texas, about 200 miles northwest of Galveston, 40 miles north of Austin, and 100 miles south of Fort Worth. It is bounded on the north by Coryell, McLennan, and Falls Counties, on the east by Falls and Milam Counties, on the south by Williamson County, and on the west by Burnet and Lampasas Counties. It has an area of 1,083 square miles, or 693,120 acres.

Bell County lies within the Black Prairie and Grand Prairie regions of Texas, which constitute a belt of undulating to rolling and hilly country, approximately 275 miles in length and averaging 65 miles in width, extending from southern Oklahoma southward



FIG. 1.—Sketch map showing location of the Bell County area, Texas.

to the Colorado River of Texas. In topography, soils, and agriculture the county is representative of about 17,000 square miles of land in Texas.

The line of separation between the Black Prairie and Grand Prairie divisions, consisting of a somewhat ill-defined eastward facing escarpment, passes approximately north and south through the county a few miles west of Pendleton, Temple, and Holland. The Black Prairie division, or approximately the eastern half of the county, is mainly undulating to gently rolling, with some rolling to hilly areas near the larger streams. In the vicinity of Rogers, in the southeastern part of the county, there are some high, rolling

hills, locally termed knobs. The Grand Prairie division, occupying the western half of the county, includes undulating to rolling uplands, deeply cut with stream valleys, which in many places have stony slopes and steep, rugged bluffs.

The lowlands along the Leon and Lampasas Rivers and Cowhouse and Noland Creeks have been cut deeply into nearly level, plateaulike table-lands, and are flanked by rough slopes leading down to the valleys and lower, smooth prairie areas. In some places where erosion has reduced nearly all the highland, small mesas stand 50 to 200 feet above the surrounding general surface. These are similar to the buttes and mesas occurring farther west, but are here termed "mountains" or "knobs," as are all the other rough lands. The Grand Prairie division of Bell County represents the eastern part of the so-called Lampasas Cut Plain, which is in general a rather hilly region.

In elevation above sea level Bell County ranges from about 450 feet in the southeastern part to about 1,200 feet in the extreme western part. The greater part of the county lies between 500 and 800 feet above seal level. The elevation at Temple is about 700 feet, at Holland about 550 feet, and at Killeen about 850 feet. The general surface slope is southeasterly.

Practically all of Bell County is drained by Little River, which empties into the Brazos River outside the county. Little River is formed in the central part of the county by the confluence of the Leon and Lampasas Rivers, and from this point to the southeastern boundary of the county, a distance of about 15 miles, has a fall of about 75 feet. The channel of Little River is deep, but only about 100 feet in width. Leon River drains the northwestern part of Bell County. From the point where it enters the county to its confluence with the Lampasas River, a direct distance of about 20 miles, this stream has a fall of about 100 feet. It follows a winding course, with frequent narrow gorges and steep-walled valleys, flanked by rough and stony slopes. Practically all the southwestern part of the county is drained by the Lampasas River. This stream in its course of about 28 miles has a fall of 300 feet. It also follows a winding course, and has carved a generally deep valley, bordered in places by rugged bluffs. The principal tributaries of Leon and Lampasas Rivers have cut rather deep valleys. They have swift currents, and cease to flow in protracted dry periods. The Black Prairie or eastern part of the county is drained by a number of creeks which flow in a southeasterly direction and empty into the Little or Brazos Rivers. As a rule they have cut only shallow valleys. They also are of intermittent flow.

Numerous small branches, practically all intermittent, reach into all parts of the upland. Some of the steeper slopes have been eroded, especially in the western part of the county. Mills for grinding grain are operated by water power on Salado Creek, and considerable water power remains to be developed along some of the larger streams. In the rougher areas in the western part of the county there are numerous small springs. The first-bottom lands along the larger streams are subject to occasional overflows, and those along the creeks and smaller streams are frequently overflowed in the winter and early spring for short periods of time.

Bell County was formed from Milam County in 1850. The early settlers located along the larger streams in the early thirties, coming from the longer settled parts of Texas and from the older southern States. The population of Bell County in 1910 is reported as 49,186. It consists largely of descendants of the original settlers and later immigrants from other parts of Texas and other southern States. Only about 4 per cent of the population is of foreign birth, mainly Austrian, German, and Mexicans. There are over 6,000 negroes in the county. Over 30,000 persons live in the country or in towns of less than 1,000 population. Agricultural settlement is most dense in the eastern part of the county, on the Black Prairie. The most sparsely settled sections are certain rough areas in the central and western parts. Agriculture is almost the only industry of the county.

Temple, situated in the east-central part of the county, with a population in 1910 of 10,993, is the largest town. Belton, the county seat, situated in the central part, had a population in 1910 of 4,164. Temple has varied manufacturing industries, including 2 oil mills, a flour mill, a cotton compress, and a foundry, and is a railroad division point. Killeen, Pendleton, Troy, Rogers, Heidenheimer, and Holland are small railroad towns. There are a number of villages throughout the county not on railroads.

Bell County in general has good transportation facilities, although considerable areas in the southwestern part are more than 10 miles from a railroad. The Missouri, Kansas & Texas and the Gulf, Colorado & Santa Fe Railways cross the eastern part of the county from north to south, passing through Temple. One branch of the Gulf, Colorado & Santa Fe extends westward from Temple through the central part of the county, passing through Belton and Killeen. A short branch of the Missouri, Kansas & Texas extends from near Temple to Belton. A proposed railroad, partly built, the Temple & Northwestern, extends in a northwesterly direction from Temple through the county. A short railroad line in Williamson County extends almost parallel to the southern border of Bell County at a distance of only a few miles from the county line. This furnishes transportation facilities for a considerable area in south and south-

west Bell County. An electric railway connects Belton and Temple, which are 8 miles apart. The railroads which pass through the county are main lines which make direct connection with Galveston, Houston, Dallas, Fort Worth, St. Louis, Kansas City, Chicago, and California points.

Most of the public roads are very good in dry weather, but after rains the heavy soil becomes very sticky, and many roads are almost impassable in places during long periods. Much interest has been taken recently in road improvement. The work is greatly facilitated by the abundance of gravel in various parts of the county. In the last two years over 200 miles of gravel-surfaced road has been built in certain bonded districts, and the roads are gradually being improved throughout the county. Most of the farming sections have good rural mail-delivery service and telephones are in general use in both the urban and rural districts. Good schools and churches are maintained in all sections.

Fort Worth, with large meat-packing establishments, constitutes the chief market for the live stock shipped from the county. Cotton is sold to buyers and shipped to various parts of the world. Corn, oats, and wheat are shipped in varying quantities to various parts of Texas and adjacent States. The larger towns within the county consume a considerable proportion of the agricultural products.

CLIMATE.

Bell County has a mild, healthful climate, with a comparatively long growing season and adequate rainfall for agriculture. The mean annual temperature is 65.6° F. The average date of the last killing frost in the spring is March 14, and that of the first in the fall, November 15. There is thus an average growing season 246 days in length. The latest recorded killing frost in the spring occurred April 30, and the earliest in the fall on October 22

The mean annual precipitation is 33.36 inches. In most years the rainfall is well distributed throughout the growing season, but occasionally periods of dry weather damage the corn crop, especially on the thin soils, and sometimes small grain is injured.

Owing to the mildness of the winters, fruit trees frequently begin to grow and blossom before the last spring frost, with consequent loss of the fruit crop. Occasionally a cold wave from the north and northwest reaches well into this part of Texas. These sudden cold snaps, locally called "northerns," last but a few days. They often bring freezing weather. Snow rarely falls, and melts in a few hours. The summers include some extremely hot days, but the heat is considerably modified by the almost constant breezes.

The table below, giving the normal monthly, seasonal, and annual temperature and precipitation is compiled from the records of the Weather Bureau station at Temple:

Normal monthly, seasonal, and annual temperature and precipitation at Temple.

| Month. | Temperature. | | | Precipitation. | | | |
|----------------|--------------|-------------------|-------------------|----------------|--|---|----------------------|
| | Mean. | Absolute maximum. | Absolute minimum. | Mean. | Total amount for the driest year (1901). | Total amount for the wettest year (1902). | Snow, average depth. |
| | ° F. | ° F. | ° F. | Inches. | Inches. | Inches. | Inches. |
| December..... | 47.7 | 90 | 9 | 2.93 | 2.08 | 3.22 | 0.8 |
| January..... | 46.7 | 81 | 5 | 2.10 | .75 | .30 | T. |
| February..... | 48.3 | 89 | - 4 | 2.17 | 2.49 | .99 | .4 |
| Winter..... | 47.6 | 90 | - 4 | 7.20 | 5.32 | 4.51 | 1.2 |
| March..... | 58.6 | 100 | 19 | 2.46 | 2.48 | 2.37 | T. |
| April..... | 66.3 | 100 | 30 | 3.88 | 1.52 | 2.89 | 0 |
| May..... | 72.9 | 99 | 39 | 4.33 | 2.66 | 5.67 | 0 |
| Spring..... | 65.9 | 100 | 19 | 10.67 | 6.66 | 10.93 | T. |
| June..... | 79.8 | 103 | 51 | 3.39 | 1.37 | 1.91 | 0 |
| July..... | 82.6 | 109 | 56 | 2.44 | .97 | 20.42 | 0 |
| August..... | 82.6 | 110 | 50 | 1.92 | .25 | 0 | 0 |
| Summer..... | 81.7 | 110 | 50 | 7.75 | 2.59 | 22.33 | 0 |
| September..... | 77.6 | 103 | 43 | 2.62 | 2.27 | 5.03 | 0 |
| October..... | 67.1 | 100 | 34 | 2.34 | 2.27 | 2.48 | 0 |
| November..... | 56.8 | 94 | 19 | 2.78 | 1.81 | 13.90 | 0 |
| Fall..... | 67.2 | 103 | 19 | 7.74 | 6.35 | 21.41 | 0 |
| Year..... | 65.6 | 110 | - 4 | 33.36 | 20.92 | 59.18 | 1.2 |

AGRICULTURE.

The first settlers in the territory now included in Bell County established homes on the timbered bottom lands along the larger streams, where water, fuel, and timber for fencing and building could be easily obtained. Small patches of bottom-land soils were cleared, and corn and vegetables were grown for home use. Agriculture in some form has always been practically the sole industry of the county. During the early period of settlement and for a considerable time thereafter the raising of cattle and horses was the principal occupation. Prior to the Civil War considerable corn and wheat and some cotton were grown in the southern part of the county along Little River. The river and creek bottom lands were cultivated first, as they were more easily tilled than the uplands, which at one time were considered worthless for farming and were used only for grazing. Oats also

were produced at an early date, and sorghum was grown for forage and for making sirup for home use. Water-power mills to grind corn and wheat were built on some of the streams at an early date. The surplus products consisted chiefly of flour, meal, hides, and cotton, which were hauled by ox teams to Houston or to other terminals of the Houston & Texas Central Railroad as it was built into central Texas. Cattle were sold to buyers who drove the animals to points in Louisiana on the Red River and shipped by boat to New Orleans, and in later years to Kansas City and other northern points.

After about 1870 the population of the county increased more rapidly. The prairie lands began to be settled and cultivated about this time, and were devoted principally to cotton, corn, oats, and wheat. The introduction of barbed-wire fencing in the latter part of this decade greatly facilitated the opening up of the prairie lands, and this gave further impetus to settlement of the prairies. In a few years much of the free range was fenced and ranching was gradually discontinued throughout the county.

The census of 1880 shows 40,475 acres in corn, producing 402,322 bushels, and 37,826 acres in cotton, with a production of 9,217 bales. Nearly 11,000 acres were devoted to wheat, with a production of 84,267 bushels, and 5,169 acres to oats, which produced 161,324 bushels. In this year there were 2,833 farms in the county, averaging in size 162 acres, of which an average of 71 acres was improved. Over 58 per cent of the farms were operated by owners.

The 1890 census reported 54,010 acres in corn, producing 1,521,681 bushels; 99,636 acres in cotton, producing 37,473 bales; and 9,184 acres in oats, producing 215,355 bushels. Over 2,300 acres were in wheat, which produced 20,936 bushels. There were 4,249 farms in the county, averaging 125 acres in size. About 47 per cent of the farms were operated by owners.

By 1899 the area in corn had increased to 83,120 acres, producing 2,359,360 bushels, and that in cotton to 145,784 acres, producing 56,560 bales. Wheat occupied 26,029 acres and oats 24,248 acres. The number of farms had increased to 5,059, with an average size of 111.3 acres, of which 64 acres consisted of improved land. Only 39.4 per cent of the farms were operated by owners. In 1899 there were \$334,087 worth of animals sold or slaughtered and \$94,265 worth of poultry raised. The value of all dairy products amounted to \$245,414.

At present the agriculture of Bell County consists mainly of the production of cotton, corn, oats, wheat, and forage crops, with some vegetables and fruits, principally peaches, for home and local use. Cattle raising and feeding is carried on to some extent in the western part of the county, and a few flocks of sheep and goats are kept. Dairying to supply the local markets is carried on inextensively, and

poultry raising is engaged in to some extent on every farm. Chickens, turkeys, and eggs are shipped from the county in large quantities.

Bell County is one of the leading agricultural counties of the State. According to the 1910 census, it ranks seventh in the State in cotton production, fifth in value of all farm property, and eighth in total value of all crops produced.

Cotton occupies a larger acreage than any other crop in the county, and is the principal money product. The census reports 190,217 acres in cotton in 1909, with a production of 58,050 bales. The production in 1910 was 58,006 bales; in 1911, 81,321 bales; in 1912, 87,213 bales; in 1913, 74,144 bales; in 1914, 72,081 bales; and in 1915, 44,346 bales.

Corn is the second crop in importance. It is grown by all farmers to some extent. The census reports 78,176 acres planted to corn in 1909, with a production of 1,153,364 bushels. Practically no corn is grown for ensilage. Much of the corn produced is used for feeding work stock and farm animals, mainly hogs and cows, but to some extent beef stock and sheep in certain parts of the county. Some corn is shipped out of the county each year, mainly for milling. In years of large production a considerable quantity is shipped to other parts of the State.

The third crop in importance is oats. This crop occupied 20,548 acres in 1909, producing 444,454 bushels. The acreage has increased considerably since that year, and the present area in oats is estimated by good authority as about 70,000 acres. Much of the oat crop is fed on the farm to work stock, sheep, and other farm animals, but a large proportion is shipped to various other parts of Texas or to other States. A considerable acreage of land in oats is pastured during the winter, and the crop is very valuable for this purpose.

Wheat is grown by many farmers, principally in the western part of the county. The area in wheat in 1909 was 1,507 acres, and the production 14,722 bushels. The acreage has doubtless increased considerably since 1909. Much wheat is ground in various mills within the county for local use, but a large part of the crop is shipped from the county.

Sorghum is the leading forage crop. Almost every farmer grows sorghum for dry forage or green feed. Part of the crop is used as ensilage for feeding beef and dairy animals. Many farmers manufacture sorghum sirup on the farm for home and local use.

Minor crops grown by some farmers in a small way for forage include millet, milo, kafir, feterita, and Sudan grass. In addition, barley and rye are seeded to some extent for pasturage. A number of farmers are experimenting with alfalfa on various soils, with some success. A small acreage of prairie hay is cut and baled annually.

Several varieties of vegetables are grown to supply the local markets. Irish potatoes, sweet potatoes, and melons are the more important crops of this class. Some of the vegetables produced for market are grown under irrigation. Fruit is not produced on a commercial scale regularly, but in years of good yields some is sold to the local markets. The principal fruit is the peach, followed by the plum and pear. Late spring frosts and freezes frequently destroy the fruit crops. Grapes, blackberries, strawberries, and dewberries succeed and are produced in a small way, for market and to supply the home.

Diarying is carried on to some extent near the larger towns. Some farmers make butter for sale in the towns, while others ship cream to the creamery at Belton or Temple. According to the census, the value of dairy products produced in Bell County in 1909, excluding those used in the home, was \$227,055. Most farmers keep a few good Jersey cows to supply milk and butter for home use.

In 1910 the total value of domestic animals on farms in Bell County was \$3,098,455. The total number of cattle of all kinds was 24,428, of which 9,570 were dairy animals. There were 10,097 horses, 10,683 mules, 17,990 hogs, 11,379 sheep, and 2,690 goats.

A considerable number of steers are shipped into the county from various parts of the State and grazed to produce stockers for market. Some steers are fed for the market. Cattle grazing and feeding are carried on in the western part of the county, and some beef cattle are raised here. The larger ranches carry several hundred head of cattle. They get their subsistence mainly by grazing, but are fed corn to some extent. The cattle may be kept a year or more before being fattened for market. Some stockmen use ensilage in feeding beef stock.

Most farmers raise hogs, at least in sufficient number to furnish meat for home use, and in the western part of the county many farmers raise and fatten hogs for the market, although in only a small way. A number of farmers throughout the county keep a flock of sheep for wool production and for clearing the land of weeds, and a few stockmen in the western part of the county have several hundred head. These are kept chiefly for the wool, but some are shipped for slaughtering. A number of herds of goats are kept in the western part of the county. The census reports the value of the wool, mohair, and goat hair produced in Bell County in 1909 as over \$20,000.

The farmers of Bell County recognize in a fairly definite way the adaptation of the different soils to certain crops. The Frio loam, clay, and silty clay loam and the Trinity clay are known to be better suited to corn and cotton than to small grain, and are selected for these staple crops where possible. The Houston black clay is recognized as better suited to cotton and corn than to oats and wheat, while the Houston clay is known to give better results with small grain than with corn. Some farmers report that the Houston clay,

shallow phase, is especially adapted to wheat and oats. The Crawford clay is considered an especially good soil for oats, wheat, and cotton, while the Crawford stony clay in its present condition is best suited for pasturage. It is well recognized that the Brackett stony clay, Brackett gravelly clay, and Rough stony land are adapted only to grazing. Their rougher and chalky slopes are of little value except for the grazing of goats, on account of the scant growth of grass. It is known that the Simmons clay and Bell clay are especially good corn, forage, and cotton soils, and they are also successfully used for small grain. The San Saba clay and its light-colored phase are also best suited to cotton, small grain, and corn where the soil is deep. The Abilene clay is especially suited to cotton, permitting early planting and consequent early maturity of the crop. Other crops also grow rapidly on this soil, but the type does not stand dry weather so well as some of the other soils. The Miles fine sandy loam is recognized as especially suited to fruits and vegetables. The Abilene clay, Frio loam, Frio clay, and Frio silty clay loam are also known to be good vegetable soils.

In growing cotton most farmers prepare the land by bedding and rebedding. A low bed is thrown up with large sweeps, and later is broken out with the sweeps, making beds where the original middles were. Some farmers bed only once. In some cases a small turning plow is used to throw up the beds. Corn land is usually prepared in the same way as cotton land. However, in growing corn and to some extent cotton many farmers are beginning to flat-break the land in the fall or winter. Turning plows are used and breaking is done to a depth of about 5 inches. The land is harrowed at intervals during the winter and spring to aid in the retention of moisture. Soil prepared in this way withstands droughts better than where bedded. Corn is usually planted early in March, and is generally cultivated about three times. Cotton is planted as early as April 1 and may produce a fair crop if put in as late as June. Cotton is cultivated 5 to 8 times, or by most farmers as frequently as possible. On cotton or corn land oats are drilled in, in the fall, without plowing, but where this crop follows oats or wheat the stubble land is flat broken in the summer. Wheat is sowed in the same way as oats. Both these crops are used to a considerable extent for pasture during the winter and early spring. Sorghum is usually sowed broadcast or drilled in like small grain and cut for hay. For ensilage it is planted in rows and cultivated like corn.

The farm dwellings range from small to good-sized wooden buildings. There are many very substantial houses on farms operated by the owners. As a usual thing the tenants live in small, unpainted houses. There are very few large barns in the county. As a rule the fences are good, being of barbed or woven wire. The work stock

consists of horses and mules. The former are usually of rather light type; the latter are good stock. The farm machinery in common use includes 3 and 4 horse turning plows and disk plows, harrows, cultivators, mowing machines, and harvesters, and as a rule is of the best type. Thrashing outfits travel from farm to farm after harvest.

No definite system of crop rotation is followed in Bell County, but many farmers change crops at irregular intervals. As a rule one crop is grown for years on the same land. Farming operations, especially in the eastern part of the county, are governed largely by the requirements of the cotton crop. No commercial fertilizer is used in this county, and little barnyard manure is applied to the soils.

Farm labor is usually plentiful. A large proportion of the farm hands are negroes or Mexicans. Much of the labor is hired by the day, \$1 being paid in winter and \$1.25 in summer, with a higher rate—\$1.50 a day and board—during harvest and cotton-chopping seasons. Where hired for periods longer than a day, ordinary labor is paid for at the rate of \$18 to \$25 a month, with board.

Farms in Bell County vary widely in size. According to the census the average size of farms in 1910 was 115.6 acres. The smaller farms are mainly in the eastern half of the county. In the western part some individual holdings of pasture land, including some tillable areas, comprise more than 1,000 acres.

According to the census, there were 4,915 farms in Bell County in 1910, with a combined area of 82 per cent of the entire area of the county. Over 61 per cent of the area of these farms was improved land. The average value of all farm property in Bell County in 1910 was \$7,311 per farm, 79 per cent of the total value being represented by the land, 9.5 per cent by buildings, 2.5 per cent by implements, and 9 per cent by domestic animals.

The percentage of farms operated by tenants has increased gradually from 41.9 in 1880 to 60.3 in 1900 and 60.5 in 1910. Under the prevailing system of rental the landowner receives one-third of the corn and one-fourth of the cotton produced.

Farm values vary according to the soil, the improvements, and the location with reference to transportation facilities. In the eastern part of the county land prices range from \$100 to \$200 an acre, the latter being asked for land near some of the larger towns. In the western part of the county good farm land is held at prices ranging from \$40 to \$125 an acre, or at even higher prices in especially favored situations. The pasture lands, or rougher, stony areas of the county, are priced at \$6 to \$25 an acre.

SOILS.¹

Bell County lies in a limestone region where the upland soils have been developed under prairie conditions from material accumulated by residual decay from calcareous rocks. The character of the soil depends mainly on the degree of consolidation of the rock, which ranges from practically unconsolidated marl and calcareous clays to indurated limestone, the former occurring in the eastern part of the county, the latter in the western part.

The region is practically treeless. In small areas there are patches of scrubby brush and small trees, but the color of the soil, as well as the size of the trees, indicates that the tree growth is recent.

The climatic conditions are essentially uniform over the whole county and with the exception just noted the native vegetation is essentially uniform.

The climate of the region is one under the influence of which the mature soil is dark reddish brown in color, with a red to reddish brown subsoil from which the carbonates have been leached. This stage of development has been reached in Bell County by the types of the Crawford series only. The rest of the soils are immature, and the degree of immaturity, expressed partly in the depth to the parent rock, but mainly in the degree of soil and subsoil oxidation, depends primarily on the rate at which the soil material is accumulated from the parent rock and the rate of surface erosion. Where surface erosion is slight and the rate of rock disintegration slow, the soil layer, at any given time, although it may be shallow, has reached a more advanced stage of development than where the rate of rock disintegration is rapid and more advanced also than where the rate of surface erosion is rapid.

The Crawford soils have reached an advanced stage of development in Bell County on account of their occurrence on the consolidated rocks where the rate of accumulation of the soil material is so slow that soil oxidation keeps pace with it. The soil has become well oxidized and leached of its surplus carbonates by the time the material has accumulated.

Where the accumulation of soil material is rapid, as is the case on the soft marls of the eastern part of the county, a thick layer of immaturity-developed soil with imperfectly oxidized aerated and leached subsoils is soon developed. The Houston black clay is a typical illustration of this phase of soil development. It is a young soil; it has not reached its final stage of development nor acquired the characteristics that will yet be imposed upon it by the climate in which it is developing. To be sure this change is slow, so slow that it

¹ The geological discussion in this report is based upon Part VII of the 21st Annual Report of the U. S. Geol. Surv., 1899-1900, entitled, *Geography and Geology of the Black and Grand Prairies of Texas*, by Robert T. Hill.

can not be seen within the short space of a historical age, but it is surely and slowly taking place.

The Houston black clay is, however, not the youngest upland soil in the county. The Houston clay and the Houston clay, shallow phase, are both younger and in about the same stage of development. The former is developed from rocks somewhat more consolidated than the latter and is a little darker in color. The Houston clay, shallow phase, is a soil in which the disintegration of the parent rock has not yet extended to a depth of 3 feet. The parent chalk, practically unmodified, is found at depths varying from 1 foot to 30 inches. The soil down to the parent rock seems to be in essentially the same stage of development as the Houston black clay. The Houston clay stands in a stage of development between the Houston black clay and the Houston clay, shallow phase.

The youngest upland soils in the county, soils that consist essentially of the parent rock with little modification by soil-making processes, are the various members of the Brackett series. There is usually a thin layer of a few inches of brownish to dark-brownish surface soil, underlain by the partially-disintegrated parent calcareous shale.

The San Saba soils are in essentially the same stage of development as the Houston clay, shallow phase, and are differentiated from the latter solely because of their derivation from a rock slightly younger than the Houston chalk, though the two formations are quite similar in their main characteristics. In San Saba County the soils of this series are derived from consolidated rocks, though it is shallow, and in the soil mapping in the future the San Saba series will be held to shallow soils, dark in color, derived from consolidated rocks and differing from the Crawford soils only in the degree of oxidation and aeration attained, while soils like the San Saba in Bell County will be placed in the Houston clay, shallow phase. The Simmons soils occur on flat areas in the central part of the county and have developed under conditions of imperfect drainage.

In stage of development the upland soils of the county may be arranged as follows, beginning with those least advanced: (1) Brackett, (2) San Saba, (3) Houston clay, shallow phase, (4) Houston clay, (5) Houston black clay, (6) Crawford.

The Simmons soils stand apart from the members of this group, since they were developed under conditions of imperfect drainage.

The terrace soils of the county vary also in their stage of development. The Bell soils are in about the same stage of development as the Houston black clay. They are young, high in percentage of organic matter, contain a good percentage of carbonates, but are not yet thoroughly oxidized and aerated in the subsoil. The Abilene soils, on the other hand, are well oxidized to a brown color with

brown subsoils, and aeration has extended to a considerable depth. They have gone even further in their development, in some respects, than the Crawford soils, having developed a calcareous horizon in the subsoil. This is due largely to their development on a smooth surface, but it is indicative of an advanced stage of development. The Miles soils are somewhat further advanced in this respect than the Abilene soils.

The alluvial soils are all young. In stage of development they are geological deposits, though they are fertile as crop growers.

As already stated, the formations which give rise to the residual soils range from calcareous clays and marls to chalks and hard limestones. They are in all cases calcareous and have weathered to depths ranging from a few inches to several feet. The calcareous clays and marls occur in the eastern part of the county and are composed almost entirely of soft strata which weather rapidly into deep black soils. These marls and clays are known geologically as the Taylor formation. The Austin chalk consists of beds of impure chalk interbedded with softer beds of marl. It occurs in a narrow belt extending across the central part of the county and comprising the western margin of the Black Prairie, of which the Taylor formation forms the principal part. The Austin chalk weathers into a shallow black soil.

The Georgetown (Fort Worth) limestone and Edwards limestone are the principal hard rocks of the western part of the county, where the soils are usually shallow and stony. There are also chalky beds and calcareous strata in the western part of the county, together with some shell agglomerate.

Large and small areas of alluvial soils are widely distributed throughout the county. They include second-bottom or terrace soils, occupying nearly level to undulating positions on the outer margins of the larger stream valleys, and representing old alluvium, and first-bottom soils, which are subject to overflow and receive fresh deposits of sediments at intervals. The second bottoms lie about 20 to 200 feet above the present first bottoms of the streams. They consist of material laid down on former flood plains.

The upland—i. e., residual—soils are classed in the Houston, Crawford, San Saba, Brackett, and Darnoc series, with nonagricultural areas mapped as Rough stony lands.

The soils derived from the weathering of the Taylor formation (calcareous clays and clay marls) and the Austin chalk are classed in the Houston series. This series is characterized by a dark-colored, calcareous surface soil, with a brownish to grayish subsoil. The Houston black clay is the most extensive soil of this series mapped. It covers the greater proportion of the eastern third of the

county. The Houston clay, shallow phase, is derived from the Austin chalk, in areas where the formation of a deep soil has been prevented by erosion. The typical Houston clay, which occurs in the more rolling areas, is derived to some extent from the weathering of the Taylor formation, in part from the Austin chalk, and over considerable areas from the Georgetown formation, a harder limestone.

The surface soils of the Crawford series are red to brown and are underlain by red or reddish-brown subsoils. These soils are derived from the weathering of the harder limestones, viz, the Edwards and the Georgetown (Fort Worth). Where derived from the Edwards limestone they frequently contain flint or chert fragments. In Bell County the Crawford stony clay and clay types are mapped.

The San Saba series includes the dark-colored calcareous soil developed in the western part of the county, principally on the rolling prairies, but to some extent over the high, timbered plateaus in close association with the Crawford soils. On the plateaus the series is derived from the Edwards limestone and to some extent from the chalky material of the Comanche Peak formation and from the Georgetown limestone, but the larger areas of the series are derived from the Walnut formation, which consists of beds of clay and limestone, calcareous laminated clays, and shell agglomerate. Only one type of this series, the San Saba clay, with a light-colored phase, is mapped in Bell County.

The Brackett series is characterized by gray to light-brown surface soils, with gray or whitish, chalky, highly calcareous subsoils. This series covers a considerable part of western Bell County. It is derived from the chalky formations and limestone (Edwards limestone) of the Comanche Peak formation, and from chalky strata, limestone, and shell agglomerate of the Walnut formation. Three types are mapped in this county—the stony clay, gravelly clay, and clay.

The Darnoc series includes brownish surface soils with yellowish-brown subsoils, both having a greenish tinge. Only the clay type occurs in this county. It is derived from the waxy clays and shales exposed by erosion in small strips in the central part of the county.

The terrace soils include the Simmons, Wilson, Bell, Abilene, and Miles series.

The Simmons series is characterized by very dark gray, calcareous surface soils, with black to dark bluish gray subsoils. The soil material has been transported principally from areas of calcareous soil farther west. The Simmons soils occur on high alluvial terraces, and are usually underlain at depths greater than 3 feet by beds of small, rounded gravel consisting of quartz and other rocks, sometimes cemented into a lime conglomerate known as "concrete." One type of this series, the clay, with a high phase, is mapped.

The Wilson series includes types with dark-brown to black, compact surface soils, and lighter colored, tough subsoils. This series is closely associated in occurrence with the high phase of the Simmons clay, occurring on the high alluvial terraces. Only the clay loam type of the series is mapped.

The surface soils and subsoils of the Bell series are black to dark bluish gray in color, and calcareous. This series is encountered on alluvial terraces, lying above overflow, along streams in the Black Prairie region. In places gravel beds underlie the soil. The soil material has been transported by water from adjacent or local areas of the Houston soils. Only one type of the Bell series, the clay, is mapped in this survey.

The surface soils of the Abilene series are brown to reddish brown, and the subsoil brown, reddish brown, or yellowish. This series occupies high alluvial terraces in some of the larger valleys. A characteristic of the Abilene series is the presence of gravel beds within or just below the 3-foot section. This gravel in most cases has been either firmly or weakly cemented with lime, and some of it is in the form of conglomerate. The only member of the Abilene series encountered in Bell County is the clay, with a colluvial phase.

The Miles series is characterized by reddish to brownish surface soils, with red or brownish-red subsoils. The Miles soils occur on the same kind of terraces as those of the Abilene series, and have a similar origin. They contain similar underlying beds of gravel or conglomerate. Their principal difference from the Abilene soils is in color. Two members of the Miles series are mapped, the gravelly sandy loam and fine sandy loam.

Two series include the soils derived from recent-alluvial material. The soils of the Frio series, characterized by calcareous, brownish to nearly black surface soils, with gray to brown, calcareous subsoils, occur along streams throughout the greater part of the county. The soil material has been washed from calcareous upland soils, such as those of the Brackett and San Saba series. Three types of this series are mapped, the loam, silty clay loam, and clay.

The Trinity series includes types with calcareous, black or dark-brown soils, composed of material washed principally from the Houston soils. One type, the Trinity clay, is mapped in this survey.

In following pages of this report the various soils are described in detail. Their distribution is shown on the accompanying map, and their actual and relative extent in the appended table:

Areas of different soils.

| Soil. | Acres. | Per cent. | Soil. | Acres. | Per cent. |
|--------------------------|---------|-----------|--------------------------------|---------|-----------|
| Houston black clay..... | 168,384 | 24.3 | Bell clay..... | 19,648 | 2.8 |
| Brackett stony clay..... | 61,824 | 8.9 | Trinity clay..... | 17,984 | 2.6 |
| Crawford stony clay..... | 58,368 | 8.4 | Brackett gravelly clay..... | 17,024 | 2.5 |
| Houston clay..... | 42,048 | 8.3 | Frio silty clay loam..... | 11,776 | 1.7 |
| Shallow phase..... | 15,424 | | Miles fine sandy loam..... | 8,512 | 1.2 |
| San Saba clay..... | 47,808 | 8.1 | Frio loam..... | 7,936 | 1.1 |
| Light-colored phase..... | 8,320 | | Brackett clay..... | 7,104 | 1.0 |
| Simmons clay..... | 16,256 | 6.3 | Miles gravelly sandy loam..... | 3,840 | .6 |
| High phase..... | 27,264 | | Wilson clay loam..... | 3,712 | .5 |
| Crawford clay..... | 41,024 | 5.9 | Darnoc clay..... | 2,112 | .3 |
| Rough stony land..... | 40,832 | 5.9 | | | |
| Frio clay..... | 35,776 | 5.2 | Total..... | 693,120 | |
| Abilene clay..... | 27,456 | 4.4 | | | |
| Colluvial phase..... | 2,688 | | | | |

HOUSTON BLACK CLAY.

The surface soil of the Houston black clay is a black or very dark bluish gray, heavy clay, averaging about 12 inches in depth. The subsoil is a heavy, dark bluish gray, brownish-gray, or yellowish-brown, waxy clay. In some areas the lower subsoil is a gray to white, chalky clay. Both surface soil and subsoil are highly calcareous and contain small lime concretions. Small shells and shell fragments are common. In some localities rounded chert fragments are scattered over the surface. The largest of these areas are shown on the map with gravel symbol. The gravel does not interfere greatly with cultivation, but it dulls tillage implements rapidly.

The surface soil when wet is very black and tenacious, giving rise to the local name "black waxy land," but upon drying the soil assumes a characteristic dark-ashy color on the surface, and crumbles to a desirable tilth, especially if cultivated when the moisture conditions are right. In its native untilled condition the dry soil bakes and cracks. As the cracks fill in they cause numerous shallow depressions and low elevations, and the type is sometimes called "hog-wallow land." These minor surface irregularities disappear with cultivation. In the larger areas of the Houston black clay there are included patches of typical Houston clay too small to map separately. Where these are most numerous the surface on drying has a rather spotted appearance.

The Houston black clay is a very extensive soil type, occupying the greater proportion of the eastern half of the county. This large body represents part of an extensive development of the type throughout the Black Prairie region of Texas.

The surface is undulating to gently rolling, becoming more rolling in the vicinity of streams. The surface drainage and underdrainage are in most places good, but water stands for some time after rains on occasional nearly level areas. In these places ditching has been done on a small scale, with good results. On drying out the soil retains moisture well if frequently cultivated, but crops as a rule suffer more in dry seasons than on the lighter types of the region.

The Houston black clay is the most important soil in Bell County. Practically all of it is in cultivation. Originally it was a prairie soil, with occasional small clumps of elm, mesquite, hackberry, or live oak. The native grass was mainly broom sedge. The type is highly esteemed as farming land. It supports the densest population in the county and has a higher selling price, as a rule, than any other soil. The most important crops are cotton, corn, oats, and wheat. Cotton is the chief cash crop. Corn is grown for feeding work animals and other stock on the farm, the surplus being sold locally or shipped away. Oats are mainly fed on the farm, but are sold in the local markets to some extent, or shipped outside the county. Wheat is grown in a small way by some farmers, for sale on the local markets. A small acreage is devoted to Sudan grass. Sorghum is grown by many farmers as feed for the farm stock. Hogs, horses, and cows are raised in a small way, and dairying is carried on inextensively. Some farmers devote little attention to other crops than cotton. Peach and plum trees do well, but few crops of fruit are obtained owing to injury to the bloom by spring frosts and freezes.

Crop yields on this soil vary considerably with the seasons and the methods employed. Cotton ordinarily yields from one-half to three-fourths bale, and occasionally over 1 bale per acre. Corn yields 35 to 40 bushels, oats 30 to 60 bushels, and wheat 15 to 20 bushels per acre. Sorghum yields 3 to 5 tons of hay per acre, and Sudan grass 3 or 4 tons. The gravelly areas apparently are about as productive as the typical soil.

For good results, the Houston black clay must be plowed when moisture conditions are the most favorable, that is, when the soil is moist enough to plow easily and yet not moist enough to stick to the plowshare. When the type is plowed under these conditions and cultivated frequently the surface is friable and mellow. Most of the land has been in cultivation for a long time, some of it for 40 years, without the use of fertilizers, but the soil continues to be very productive, especially where the crops have been changed from time to time. It appears to have deteriorated somewhat where cotton has been grown continuously for long periods. No systematic crop rotation is practiced, but many farmers change the crops as frequently as convenient.

Land of the Houston black clay sells for \$80 to \$150 an acre, the price depending on the location.

The Houston black clay is especially suited to cotton and corn. A number of farmers have tried alfalfa in a small way. This crop grows well and gives good yields of hay, but it suffers badly from the root rot, which also damages cotton and some other plants in places. No practical remedy for this disease is known, but it may be kept under control by changing crops frequently and by deep plowing. The better farmers state that bedding with the turning plow or flat breaking the land in the fall or winter results in better yields than the more common method of bedding the land in the spring with big sweeps.

HOUSTON CLAY.

The Houston clay consists of a brownish-gray to dark-grayish, calcareous clay, 10 or 12 inches deep, underlain by a light-brown to brownish-yellow clay which becomes lighter colored and more friable with depth. The lower subsoil is usually a yellowish and whitish, highly calcareous, chalky clay. When dry the soil has an ashy color. The yellow of the subsoil often has a greenish cast. Some small areas near Temple and Troy, where the white, chalky, calcareous material comes very near the surface or outcrops, are included with this type, being too inextensive to show separately. In places the soil consists of a brown or dark-brown clay overlying yellowish-brown to light-yellow clay.

When wet this soil is very sticky, but on drying it crumbles to a desirable tilth and is easy to plow.

The Houston clay occurs in a number of small bodies and in a few areas of several square miles extent. The largest of these are in the northeastern part of the county, in the vicinity of Temple and Pendleton.

In topography the Houston clay ranges from gently rolling to steeply sloping, the latter condition existing in only a few places. It usually occupies the highest Black Prairie uplands and the slopes of the larger stream valleys traversing them, otherwise covered by the Houston black clay. It occupies much of the high ridge extending northward a mile or two west of Temple. Drainage is very good, and in some places the run-off is so rapid that there is a tendency to wash.

The Houston clay is an important soil type in some sections of the county, but few farms are composed of this soil alone. Practically all the type is in cultivation. It is naturally a prairie soil, with a scattering of small mesquite trees in places.

The most important crops produced are cotton, corn, oats, wheat, and forage, principally sorghum. Practically the same crops are grown as on the Houston black clay, except that probably a smaller

percentage of the land is devoted to cotton, and a larger proportion is devoted to oats by many farmers. Crop yields for average seasons are about as follows: Cotton one-half bale per acre, corn 20 to 40 bushels, oats 30 to 60 bushels, and wheat 15 or 20 bushels. Sorghum gives good yields of hay.

Farms composed largely or entirely of this type sell for \$100 or more an acre.

The typical Houston clay is well suited to the crops commonly grown. The soil should be cultivated in such a way as to reduce erosion to a minimum, and on the steeper slopes furrows should be run on a level or as nearly so as practicable. In growing corn, especially, organic matter should be incorporated in the soil by plowing under vegetation. The soil is also improved by growing cowpeas or other legumes.

Houston clay, shallow phase.—The greater part of the Houston clay, shallow phase, represents eroded areas of the typical Houston clay. Generally small fragments of whitish limestone are scattered over the surface, frequently in sufficient abundance to give the cultivated fields a grayish appearance. On the average, whitish chalky material is reached at depths ranging from about 3 to 6 inches. The surface soil is similar to that of the typical Houston clay. Small patches of the Houston black clay and Houston chalk are scattered throughout the larger areas of this phase, the former soil occupying depressions and the latter some of the slight ridges and steeper slopes.

This phase occurs in a number of small areas which aggregate several square miles in extent. It is encountered in an irregular strip extending southwestward across the county. It occupies rolling, ridgelike areas, and some rather steep slopes occur. Drainage is thorough and erosion is injurious unless care is used to prevent it.

This soil is not very important in Bell County, owing to its limited extent. Probably 85 per cent of it is in cultivation, but not many farms are made up entirely of this soil. It is naturally a prairie type, but the native vegetation on uncultivated areas now comprises scattered small live oak, Spanish oak, elm, and hackberry trees.

The same crops are grown as on the Houston black clay, and on about the same relative acreage. Practically the same farming methods are followed. The soil appears rather thin, but it is said to produce good yields. For good returns it requires ample and timely rainfall. In seasons of heavy rainfall the phase is reported to be as productive as the Houston black clay. It is said to be best suited to wheat and oats. Yields in average seasons are reported about as follows: Corn 25 bushels, oats 30 to 60 bushels, and wheat 15 to 20 bushels. Cotton yields from one-fourth to three-fourths bale per acre. Sorghum and Sudan grass do well.

Land of this phase is sold in association with the surrounding Houston soils, and reduces the selling value of farms to some extent.

The productiveness of the Houston clay, shallow phase, varies with the depth of the weathered soil mass. In areas of shallow soil crops suffer more quickly from dry weather and yields, especially of corn and cotton, are correspondingly less. The land should be plowed deeply, as the chalk when turned up weathers into soil rapidly, especially where a good supply of organic matter is maintained. Care should be taken to prevent erosion. It would apparently be more profitable to grow small grain and forage crops on this soil than cotton or corn.

CRAWFORD STONY CLAY.

The surface soil of the Crawford stony clay is a brown, red, or reddish-brown, heavy clay, 6 or 8 inches deep. The subsoil is a red or reddish-brown, stiffer clay. Hard limestone or a chalky formation is reached within the 3-foot section, frequently at only a few inches below the surface. Scattered very abundantly through surface soil and subsoil are irregular fragments of chert or limestone. These are in many places so abundant or so large as to prevent cultivation until at least the largest have been removed. Locally the type is called "flint land," owing to the large numbers of chert fragments on the surface. Included with the Crawford stony clay are areas, too small to map, of Crawford clay, Brackett clay, and Rough stony land, as well as some areas where the surface soil is black and is underlain by a red clay or chalk subsoil.

The Crawford stony clay is a rather extensive soil. It occupies considerable areas throughout the central western part of the county, principally southwest of Salado and north and northwest of Belton. Other developments occur near the Lampasas County line.

In general the type occurs as flat-topped table-lands or plateaulike elevations in the higher sections of the county, bordered by the steep, rough slopes of Rough stony land and Brackett stony clay leading down to the valleys. These elevations are remnants of the Lampasas plain which have endured the erosive action that has lowered the surface over a large proportion of the high, level plains underlain by the hard limestones. The surface of the type is nearly level to gently undulating, and drainage is fairly good. It lies mainly at an elevation of 750 to 1,000 feet above sea level.

Probably less than 5 per cent of this soil is in cultivation, owing to its stoniness and inaccessibility. The principal crops are cotton and corn, with some sorghum. Areas from which the larger stones have been removed yield fairly well, the yields of corn, cotton, and sorghum approximating those obtained on the Crawford clay. Oats

and wheat do well, but are grown to only a small extent. The type is largely devoted to pasturage, but stock raising is not a well-developed industry.

A rather thick growth, consisting of small trees—principally live oak, Spanish oak, elm, post oak, some blackjack oak, hackberry, and cedar—covers most of the land. Cactus and prickly pear grow where the soil is very thin, as well as algerita and other thorny bushes. There is a good supply of cedar for posts, and large quantities of firewood. Much more of the type will probably be cultivated within the next few years, although clearing the land of timber and removing the larger rocks is laborious.

Much of this land could probably be purchased for \$10 to \$25 an acre, but land in farms brings a much higher price.

This soil is apparently well suited to cotton, corn, oats, wheat, and sorghum, the principal general-farm crops, but under present conditions it could probably best be used as pasture. Clearing the land of timber, at least in part, and seeding to some suitable grass would greatly increase the grazing value. Fruit trees grow well on the type and grapes should succeed.

CRAWFORD CLAY.

The Crawford clay consists of 6 to 10 inches of dull-red, reddish-brown, or dark-brown clay, underlain by red or reddish-brown, rather stiff clay which frequently rests on limestone or soft, chalky material at about 15 to 36 inches. In occasional small areas the surface soil is nearly black, and the subsoil red or reddish. In places the red clay subsoil rests at 18 to 24 inches on yellowish, friable clay, which in turn grades into whitish, chalky, mortar-bed material. The surface soil and subsoil in many places contain small, irregular chert and limestone fragments, giving rise to the local name of "flint land." More often, however, the type is called "red land." In places some limestone fragments are present. Over most of the type bedrock seems to occur within the 3-foot section, and in many patches the type consists of a few inches of soil overlying limestone.

Included with the Crawford clay as mapped are very small areas of Brackett clay and Crawford stony clay.

Some small and medium-sized areas of Crawford clay occur throughout the central part of Bell County in a belt several miles wide reaching from the northern border through the county in a general south-westerly direction. Good-sized areas occur near Belton, Salado, and Moffat. Smaller, widely separated bodies are encountered in the western part of the county.

The surface ranges from gently undulating to nearly level. Surface drainage is usually good. As a rule, the type occupies the nearly level table-land areas of the high plateaus or "mountains," and high

undulating to rolling prairie areas just west of the Black Prairie. The subsoil is retentive of moisture, but underdrainage is usually quite good. Where the hard or chalky limestone formation lies near the surface, however, crops suffer in dry seasons.

The Crawford clay is not so extensive as the Houston black clay, but it is an important soil. Probably 60 per cent of it is in cultivation, the remainder supporting a growth of small post oak, live oak, Spanish oak, elm, cedar, and other trees. Usually the type is surrounded by areas of Crawford stony clay or Rough stony land, and the stony character of these types tends to retard cultivation of the Crawford clay.

While cotton is a very important crop on this type, it does not dominate farming operations so decidedly as on the Houston black clay. Oats occupy a large acreage, and considerable wheat is grown. Sorghum is another important crop. Some of the areas more remote from railroads are used with other types as pasture land.

Crop yields depend very largely on the season. A number of farmers report average yields of cotton as one-third to one-half bale per acre, corn 25 to 40 bushels, oats 35 to 60 bushels, and wheat 15 to 25 bushels. Sorghum and Sudan grass grow well, yielding several tons of hay per acre.

The Crawford clay responds readily to cultivation. It is sticky when wet, but is inclined to crumble on drying. Crops make an early start in the spring, and if rainfall is not too light grow rapidly and yield well. No regular system of crop rotation is practised.

Good farms on the Crawford clay sell for about \$60 to \$100 an acre. Some unimproved areas associated with other types could be bought for less than \$50 an acre, but these are small and isolated.

The Crawford clay is a fairly productive soil, seemingly best adapted to oats and wheat. For corn the soil should have a good supply of organic matter, and the plowing under of green crops is especially beneficial. The growing of cowpeas and the turning under of the vines would improve corn yields considerably. Fruits most successfully grown on this type are peaches, plums, and to a less extent pears. Spring frosts and freezes make yields of fruit crops uncertain.

SAN SABA CLAY.

The surface soil of the San Saba clay is a black or very dark brown clay, 8 to 15 inches deep. The subsoil is a black to dark-brown or dark-gray, heavy, tough clay, containing some fine chert particles and small calcareous concretions. In places the subsoil, at depths ranging from 20 to 36 inches, grades into a pale-yellow, friable, chalky clay, containing white calcareous spots. In other places a

layer of hardened shell agglomerate, or "shell concrete," several inches thick, occurs in the subsoil. The subsoil is thus rather variable, consisting of dark-colored clay in the depressions, of pale-yellow, chalky clay in the higher areas, and of shell agglomerate in sloping areas. Occasional areas contain a scattering of rounded chert fragments ranging up to several inches in diameter. Adjacent to areas of Brackett gravelly clay a slight admixture of shells in some places occurs in the surface soil. The type closely resembles the Houston black clay on the surface.

The San Saba clay is rather extensive in the western part of the county. The largest areas are mapped around Killeen. The type occurs in a number of short valleys reaching back into precipitous areas of Rough stony land, locally called "coves." Here the surface material is in part colluvial. The type is also developed on the high plateaus in close association with the Crawford stony clay. It is gently rolling to undulating in topography, and generally has good surface drainage, but some depressions have been benefited by ditching. Where the shell agglomerate lies near the surface the land is rather wet and soggy just after rains, and in dry weather is droughty and crops suffer considerably. In its native condition the surface is "hog wallow."

The San Saba clay is a rather important type in the western part of the county. Probably 90 per cent of it is cultivated. It originally was prairie land, although small live-oak, hackberry, elm, and post-oak trees grow in places. It is said that the prairie grass was at one time broom sedge, which later gave way to an abundant growth of mesquite grass.

Cotton is the most important crop on this type, followed closely in area by corn and then by oats. A small acreage is devoted to wheat on some farms. Oats, corn, and sorghum are grown for feeding farm stock. There is usually a small surplus for sale. There is no important development of live-stock industries on the farms. Hogs are raised for home use and in a small way for market. Some cattle are fed for beef, and a few flocks of sheep are kept for wool production, being pastured mainly on soils less adapted to cultivation. Vegetables, peaches, and plums do well, but are grown only in a small way for home use. The fruit crop is uncertain, owing to late spring frosts.

Cotton yields an average of one-half bale or slightly less per acre. Corn is estimated to yield 25 to 35 bushels per acre, and oats 25 to 40 bushels. Wheat ordinarily yields 12 to 15 bushels.

This soil is quite sticky when wet, but in cultivated fields upon drying out it assumes a very loamy structure. Numerous fine surface cracks break in all directions, and the soil is very easily cultivated when worked properly. The type is apparently productive and very

durable. No systematic rotation is practiced, and frequently one crop is grown in the same field for a number of years. No commercial fertilizers are used and very little barnyard manure is applied. Green manuring is seldom practiced.

Improved farms on this type bring from \$40 to \$75 an acre, the price depending largely on the location.

Areas of San Saba clay shown on the map with stone symbols represent the San Saba stony clay. The surface soil of this type is a black or very dark brown, heavy clay, 6 to 15 inches deep, resting on a subsoil consisting usually of chalk or limestone. Limestone and hardened chalk fragments are scattered sparingly over the surface and throughout the soil mass. This soil represents shallow, stony areas of the San Saba clay. It is locally called "adobe" land, on account of the chalky subsoil material, which is called adobe. The San Saba stony clay occurs in a few patches widely scattered throughout the western part of the county. Its total extent is only a few hundred acres. It is closely associated with the Crawford stony clay, and numerous small patches are doubtless mapped with that type in the more inaccessible situations. The surface is nearly level, but this soil has good drainage. It is said to withstand droughts well. The same crops are grown as on the San Saba clay, and produce about the same yields. Owing to the very slight extent of the San Saba stony clay, it is of little importance. Much of the type remains in the natural growth of live-oak, cedar, elm, hackberry, and other trees.

San Saba clay, light-colored phase.—The surface soil of the San Saba clay, light-colored phase, is a brown to dark-brown, friable clay, 8 to 10 inches deep. It is usually free from stones, but in some places there is a scattering of chert fragments over the surface. The subsoil usually consists of a brown to yellowish-brown, friable clay, extending to depths of 36 inches or more in places and containing small white spots of chalky material in the lower subsoil. Frequently the subsoil below 15 to 20 inches is a pale-yellow or whitish, chalky silty clay, the upper portion of the chalky clay being often a hardened, cementlike layer 2 or 3 inches deep, and either solid or somewhat broken. In many places this hardened chalky layer gives way to a hard shell agglomerate several inches thick, which is similar to the shell agglomerate occurring in the typical San Saba clay.

This phase occurs in a number of small areas throughout the western part of the county. A large part of the prairie land around Killeen is occupied by the typical San Saba clay, interrupted by numerous small areas of this phase, which occurs largely on the gentle swells of the well-drained prairie. The phase also occurs on the narrow lower slopes of large areas of the Brackett soils. Its topography is gently rolling to gently sloping, and drainage is good

throughout. Erosion is usually not severe. The soil dries out readily after rains, and warms up quickly, so that crops grow rapidly. Where the shell agglomerate lies near the surface crops suffer in dry weather.

Probably 80 per cent of the type is cultivated. It is usually farmed in conjunction with large areas of the typical San Saba clay. It is likewise a prairie soil, but with a scattered growth of live oak, elm, hackberry, and shrubs in places.

The same crops are grown as on the typical San Saba clay, and the soil is handled in practically the same way. Yields are probably somewhat lower, but in seasons of adequate rainfall the better improved areas would produce equally good returns of oats and wheat. Ordinary yields are reported as follows: Cotton, one-third bale per acre; corn, 25 to 30 bushels; oats, 30 to 40 bushels; and wheat, 15 to 18 bushels. Sudan grass yields well, giving three cuttings a season. Small orchards of peaches and plums do well except for frost damage. Vegetables in home gardens produce good yields.

This soil seems better adapted to oats and wheat than to corn. It can be greatly improved by plowing under barnyard or green manures and by growing legumes.

In the following table are shown the results of mechanical analyses of samples of the soil and subsoil of the typical San Saba clay, and of the light-colored phase:

Mechanical analyses of San Saba clay.

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|----------------------|--------------------------------|----------------|----------------|----------------|----------------|-----------------|----------------|----------------|
| | | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i> |
| Typical soil: | | | | | | | | |
| 444309.... | Soil, 0 to 10 inches..... | 0.5 | 1.0 | 1.0 | 12.4 | 5.6 | 42.5 | 36.8 |
| 444310.... | Upper subsoil, 10 to 24 inches | .7 | 1.2 | 1.5 | 11.0 | 6.6 | 49.1 | 29.5 |
| 444311.... | Lower subsoil, 24 to 36 inches | .8 | 1.4 | 1.2 | 4.8 | 5.8 | 62.9 | 23.4 |
| Light colored phase: | | | | | | | | |
| 444314.... | Soil, 0 to 12 inches..... | 1.8 | 2.0 | .9 | 3.6 | 6.5 | 52.6 | 32.8 |
| 444315.... | Subsoil, 12 to 36 inches..... | .6 | 1.6 | 1.6 | 8.6 | 11.6 | 47.1 | 28.9 |

BRACKETT STONY CLAY.

The surface soil of the Brackett stony clay is a gray, heavy clay, several inches deep, resting on highly calcareous, gray or white clay or chalky material. Frequently limestone lies near the surface. Hardened chalk fragments or hard, flat limestone fragments are scattered over the surface and through the soil. On many slopes the type simply represents exposures of chalk and soft limestone, with a scattering of stones over the surface. On the smooth areas the soil material is relatively deep, but on most steep slopes there is little

soil, the material consisting of broken chalk and limestone fragments. In many places there is a thin covering of reddish Crawford soil.

Numerous very small areas of Crawford stony clay, San Saba stony clay, and Brackett clay and gravelly clay occur within areas of the Brackett stony clay, being too patchy and intricately associated with that type to map separately. Symbols are used on certain areas of the type to indicate rock outcrop or very narrow strips of Rough stony land.

The Brackett stony clay is rather widely distributed over the western part of the county. The largest areas occur in the southwestern part, around Youngsport and Maxdale. The surface is rolling to very rolling. In many places the type occupies slopes adjacent to areas of Rough stony land. Drainage is thorough, and erosion in many places has exposed the chalk foundation of the type.

There is a scattered growth of small live oak, Spanish oak, post oak, mesquite, and cedar on this soil. On the chalky slopes of much of the type there is little grass, but the large rolling areas in the southwestern part of the county support a rather good growth of mesquite and other prairie grasses. These are especially abundant in small depressions and narrow valleys, in which a deep layer of soil has accumulated.

Practically none of this type is cultivated and it is doubtful whether it is sufficiently productive to give very good yields, even after the removal of some of the stones. It is used principally for pasture. Considerable numbers of beef cattle, some sheep, and some goats and horses are grazed on the large areas in the southwestern part of the county, where individual holdings of this land frequently exceed 1,000 acres. On the chalky areas where there is little soil and only a scant growth of grass, goats are about the only animals that can subsist.

This type is of little value for crops, but it makes good pasture land and the better areas could profitably be seeded to some quick-growing grasses and made much more desirable for grazing.

In large areas the Brackett stony clay can be bought for \$8 to \$25 an acre.

BRACKETT GRAVELLY CLAY.

The Brackett gravelly clay consists of a light-brownish to gray, gravelly clay, grading at a few inches into pale-yellow and white, chalky clay. The chalky material increases with depth. Fossil shells and fragments of limestone, both highly calcareous, are distributed over the surface and through the soil section, being so abundant in places that it is impossible to penetrate the soil with an auger. In places beds of loose shells occur at the surface and again beds of cemented shells known as "concrete." Both surface soil

and subsoil are calcareous. Some areas mapped as this type consist of chalk exposures with fine fragments of hardened chalk and limestone distributed over the surface. A few bodies in the southern part of the county, several miles east of Salado and Prairie Dell, represent Houston chalk.

The Brackett gravelly clay is rather widely distributed in small areas over the western part of the county, principally south of Killeen. As mapped, it includes very small areas of Brackett clay and Brackett stony clay. The surface is rolling to gently rolling. The type occupies ridges and the borders of the higher slopes in areas where streams have cut below the shell and chalk beds, the lower slopes being occupied by the Brackett clay or San Saba clay. In places the gently rolling ridges are occupied by the Brackett gravelly clay, while the Brackett stony clay occurs on the steep slopes. Drainage is everywhere thorough. The run-off is excessive and rapid, and the formation of the type is, in fact, due to erosion, the soil material having been washed away, exposing the shell and chalk beds.

There is a rather thin cover of grass, with many weeds, on this type, and an occasional scrubby growth of live oak and cedar. In numerous small swales, where there has been an accumulation of brown soil, a good growth of mesquite grass occurs. Prickly pear, cactus, and Spanish dagger are characteristic plants. This type is cultivated to only a small extent, mainly as patches in fields composed principally of other soils. Oats and sorghum do better than any other crops, but the yields of even these are ordinarily low. In seasons of excessive rainfall it is said that oats sometimes give fair yields. The land is used principally for grazing sheep and cattle. It is held at a low price.

BRACKETT CLAY.

The Brackett clay consists of a grayish to pale-yellow or brownish clay underlain at 6 to 10 inches by a layer ranging from pale-yellow clay to whitish, calcareous chalky material. Often the whitish, chalky material is mottled with pale yellow. Frequently small, soft limestone fragments and shells occur on the surface and throughout the soil.

The Brackett clay is rather widely distributed throughout the western part of the county in small areas. It occurs usually on narrow slopes leading from the higher lying Brackett stony clay and Brackett gravelly clay. It also occupies numerous patches, usually too small to map, in areas of the Crawford and San Saba soils.

In general, the surface is gently undulating to gently rolling, but in places the slopes are sufficiently steep to cause severe erosion and gulying. Drainage is everywhere thorough. Only a small proportion of the type is cultivated. It supports a growth of mesquite

and other grasses, as well as scattered small mesquite, cedar, and live oak trees, and is largely used as pasture along with the other Brackett soils. For good yields it needs considerable rainfall and the addition of organic matter. Barnyard manure or green vegetation should be plowed under.

DARNOC CLAY.

The Darnoc clay consists of a brownish or greenish-brown clay underlain at 8 or 10 inches by greenish-brown or greenish-yellow, plastic clay. Large and small limestone fragments are generally scattered over the surface. Greenish and slate-colored shale occurs in the substratum. The soil is sticky when wet.

This type occurs in a few small, widely separated areas extending in a general way across the central part of the county from northeast to southwest. The largest developments occur a few miles east and south of Salado.

The type occupies rather steep slopes, and is more or less eroded and gullied. Probably less than 1 per cent of it is cultivated. It has little agricultural value and should be used as pasture and woodland. It supports a scattered growth of small mesquite and live-oak trees.

In the following table are given the results of mechanical analyses of samples of the soil and subsoil of the Darnoc clay:

Mechanical analyses of Darnoc clay.

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|-------------|-------------------------------|----------------|----------------|----------------|----------------|-----------------|----------------|----------------|
| | | <i>Per ct.</i> | <i>Per ct.</i> | <i>Per ct.</i> |
| 444340..... | Soil, 0 to 10 inches..... | 0.6 | 1.2 | 0.8 | 2.5 | 5.2 | 35.4 | 54.3 |
| 444341..... | Subsoil, 10 to 36 inches..... | .4 | 1.2 | .8 | 2.3 | 4.2 | 36.9 | 54.2 |

SIMMONS CLAY.

The Simmons clay consists of a black or very dark bluish gray clay which either shows little change within the 3-foot section or becomes somewhat lighter colored, dark drab or grayish brown, in the subsoil. Occasional small areas show a slightly brownish color on the surface. There is usually encountered in the substratum, at depths ranging from 3 to 10 feet, a whitish "mortar-bed" material. This consists of rounded limestone, quartz, chert, and other gravel, cemented with whitish calcium carbonate. In some places there is simply a solid gravel bed several feet thick. When wet this soil is black, and the type is locally called "black land," but upon drying the immediate surface layer has a dark-grayish cast. The soil pulverizes on drying, but is very sticky when wet. Both surface soil and subsoil are calcareous.

The Simmons clay is developed in a number of rather large areas near Little River, in the central part of the county. The largest developments occur around the town of Little River and near Sparks. A few smaller areas are mapped in the Leon and Lampasas River valleys, and one small area lies along South Noland Creek near Killen. Other small bodies occur along creeks in the western and southern parts of the county.

In topography the type ranges from nearly level to very gently undulating. It lies 10 to 30 feet higher than the bottom lands. Surface drainage is rather slow in some areas, but this does not prevent the use of the land for agriculture. The subsoil is retentive of moisture, and crops do not suffer quickly in dry weather. Some poorly drained areas have been improved by ditching. Where the soil has never been cultivated there occur slight hummocks alternating with irregularly distributed shallow depressions.

Although not extensive, the Simmons clay is an important soil agriculturally. A number of good farms are situated on this type, and practically all of it is in cultivation. The original growth consisted mainly of mesquite trees, with some elm, hackberry, and live oak.

The most important crop is cotton, and the crop next in acreage is corn. Oats and some wheat are grown, as well as forage crops, principally sorghum. This is a productive soil. Ordinary yields are reported as follows: Cotton, one-half to one bale per acre, averaging probably a little more than one-half bale; corn 25 to 40 bushels, oats 30 to 50 bushels, and wheat 15 to 25 bushels. Sorghum yields 3 to 4 tons of hay per acre. The yield of Sudan grass is large.

This soil does not dry out so quickly as some of the adjacent types, especially the Abilene clay, and is somewhat later in getting into condition for cultivation and planting in the spring. It is rather difficult to plow, and unless worked when in the best condition, as regards moisture, clods on drying. No systematic rotations are practiced on this soil.

Farms on the Simmons clay range in price from about \$75 to more than \$100 an acre. The principal areas of the type lie near lines of transportation.

Drainage would improve most of the level areas of this soil. In well-drained situations alfalfa should do well.

Simmons clay, high phase.—The surface soil of the Simmons clay, high phase, is a black or very dark bluish gray clay, 10 to 12 inches deep. On drying the surface soil becomes friable, and has an ashy-black or grayish appearance in the field. The subsoil to 36 inches is a black or dark-gray to bluish-gray, waxy clay, the lighter color increasing with depth. At 3 to 5 feet a white calcareous clay is

encountered. Beds of rounded quartz gravel occur at depths of 15 to 30 feet beneath the surface, the beds in places being thin and in others several feet in thickness. The gravel is embedded in the whitish, calcareous clay, and in places is hardened into a mass of so-called "concrete" a foot or two thick. In the more nearly level, poorly drained areas the soil does not effervesce with hydrochloric acid, but in most places, even in gently undulating situations, there is some reaction. This soil is locally referred to as "black mesquite land." Where the surface is undulating it has every appearance of the Houston black clay.

The phase occurs in several good-sized areas in the southern part of the county, the largest lying just southeast of Holland and around Bartlett. One small area lies just northwest, and another several miles south, of Belton, and a considerable body occurs just north of Holland. Since the phase lies as high as the Houston black clay, or higher in places, and resembles that type closely, it is possible to draw only approximate boundaries where these soils join.

The surface of the Simmons clay, high phase, is very nearly level over large areas, but in places is very gently undulating. In uncultivated areas the surface is marked by "hog wallows." Drainage is poor in the flatter areas, but this does not prevent crop production, although it hinders somewhat. The subsoil holds a good supply of moisture, and dry weather does not injure crops severely.

The greater part of the phase lies 500 to 650 feet above sea level, and 50 to 100 feet higher than the typical Simmons clay.

The Simmons clay, high phase, is naturally prairie, although there was originally a considerable growth of scattered mesquite trees. Practically all the phase is in cultivation; probably less than 1 per cent of it is used for pasture.

Cotton is the principal crop, followed by corn, sorghum for forage, oats, and wheat. According to the reports of a number of farmers, cotton in average seasons yields about one-half to three-fourths bale per acre, corn 25 to 40 bushels, and wheat 15 to 30 bushels. The ordinary yield of oats in favorable years is 40 to 60 bushels per acre, and a maximum yield of 90 bushels has been obtained. In unfavorable years the yield may be much less than 40 bushels. Sorghum yields 2 or 3 tons of hay, and Sudan grass, which is grown very inextensively, gives two cuttings of 1 to 2 tons each. Peaches, pears, plums, and other tree fruits succeed, but on account of the weather conditions the fruit crops are uncertain.

The surface soil of this phase is rather sticky when wet, but upon drying crumbles to a desirable tilth, like the Houston black clay. No systematic crop rotation is practiced, but there is some change of crops from time to time.

This phase is largely situated near good roads and the land has a relatively high price on this account. Probably little of it around Holland or Bartlett could be bought for less than \$125 to \$150 an acre, and some is held at even higher prices. The farms are in a good state of cultivation, and good farm buildings and other improvements give the section of the county where this phase is developed a very prosperous appearance.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Simmons clay:

Mechanical analyses of Simmons clay.

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|-------------|----------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 444324..... | Soil, 0 to 12 inches..... | <i>Per cent.</i> 0.8 | <i>Per cent.</i> 1.5 | <i>Per cent.</i> 1.8 | <i>Per cent.</i> 12.4 | <i>Per cent.</i> 13.0 | <i>Per cent.</i> 35.5 | <i>Per cent.</i> 35.1 |
| 444325..... | Subsoil, 12 to 36 inches.. | .4 | 1.3 | 1.8 | 12.9 | 11.5 | 37.3 | 34.4 |

WILSON CLAY LOAM.

The surface soil of the Wilson clay loam is a brown or light-brown to brownish-gray clay loam, about 6 to 10 inches deep. The subsoil consists of a light-brown to dark bluish gray, tough clay, underlain at about 20 to 30 inches by dark grayish brown to bluish-gray tough clay, constituting essentially a claypan. Occasionally there is an appreciable content of fine and medium sand and some rounded quartz gravel in the surface soil. When wet the soil is dark, but on drying out the immediate surface has a grayish or ashy color. Locally this type is called "pancake" land, owing to its peculiar property of baking after rains. If plowed or cultivated when wet the soil upon drying forms very hard clods which are broken down with difficulty, and if not worked until thoroughly dry it becomes too hard to cultivate. In places the subsoil effervesces with hydrochloric acid, but on the whole the material is not very calcareous.

As mapped in this county the Wilson clay loam is not true to type in all respects. It is lighter in color than the typical Wilson clay loam, which is black to very dark brown, while the soil in this area has a grayish shade. It differs also in its very heavy, plastic, tough clay layer in the subsoil. The typical Wilson clay loam has a heavy subsoil, but lacks the compact layer of clay. It also has a higher percentage of organic matter than the soil in this area, and does not bake so hard on drying.

The Wilson clay loam occurs in the extreme southeastern corner of the county. A fairly large body is mapped around Althea, and smaller ones occur near Vilas and two miles west of this place. The

surface ranges from nearly flat to very gently undulating. Under-drainage is slow, but the areas are reached by small, sluggish stream heads, and the removal of surface water is complete enough to make cultivation of all the type possible. The downward flow of water through the tough clay subsoil is very slow, and on level areas water may stand on the surface for several days after rains. Where the soil is cultivated properly crops do not suffer greatly from dry weather, but good yields generally may not be counted on in either very wet or very dry years.

Originally this land supported a considerable growth of small, scattered, mesquite trees and some post oak, with an undergrowth of mesquite grass and various less important prairie grasses. Practically all of the type is cultivated, but on account of its small extent it is of little importance in the agriculture of the county. The most important crops are cotton, corn, oats, and sorghum. Wheat is grown to a small extent. The type is generally planted to cotton, and it is said to be better adapted to this staple than to any other general-farm crop of the region. According to reports of farmers, the type yields, under good methods of cultivation, an average of one-half to three-fourths bale of cotton per acre, 20 to 40 bushels of corn, 25 to 50 bushels of oats, and 10 to 15 bushels of wheat.

The soil is not easily tilled except at the optimum stage of moisture content. It responds fairly well to good cultivation, but has to be handled with care to prevent baking and clodding. It is said that for best results it should be broken deeply with a turning plow in the fall or winter. Damage from the cotton wilt is said to be comparatively light on this soil.

Land of the Wilson clay loam in farms is sold for \$75 to \$100 or more an acre.

This soil can doubtless be improved by deep flat breaking, by plowing under vegetation, and by incorporating organic matter in the soil through the growing of cowpeas or other legumes and occasionally turning under the vines.

BELL CLAY.

The Bell clay consists of a black to very dark brown clay, underlain at any depth from about 12 to 30 inches by a black, dark bluish gray, or brown, rather plastic clay. The subsoil is usually calcareous. The substratum is a grayish, calcareous clay, frequently containing thin beds of limestone and chert gravel at varying depths. This type resembles the Simmons clay, and except in topography, it is similar to the Houston black clay. Only in occasional instances does it have the conglomerate or "concrete" layer that characteristically occurs in the Simmons soils. It is the second-bottom equivalent of the Trinity clay.

The Bell clay is widely distributed in long, narrow areas along many of the smaller streams in the eastern part of the county. The largest developments occur around Red Ranger and Blue School, and just north of Donahoe. The type occupies narrow, low terraces along small streams flowing through large areas of Houston black clay. It has a nearly level to very gently undulating surface, and lies about 5 to 15 feet above the associated first bottoms. Drainage is not everywhere perfect, but is sufficient to allow the successful cropping of the land. The soil conserves moisture well.

Originally this type supported a timber growth of elm, hackberry, pecan, and some varieties of oak; now practically all of it is in cultivation. The most important crop is cotton. Corn is also produced, and some sorghum, the latter for forage. Oats are grown to some extent, and wheat on a very small total area. In average seasons cotton yields one-half to three-fourths bale per acre, corn 25 to 50 bushels, oats 30 to 60 bushels, and wheat 12 to 30 bushels. Sorghum gives good yields of forage.

This soil has about the same texture and structure as the Simmons clay, and is handled in practically the same way. Alfalfa should do well on the better drained areas.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Bell clay:

Mechanical analyses of Bell clay.

| Number. | Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|------------------------|---------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| | | <i>Per cent.</i> |
| 444305, 444330 | Soil, 0 to 12 inches. | 0.8 | 1.0 | 1.2 | 6.5 | 16.0 | 37.6 | 36.8 |
| 444306, 444331 | Subsoil, 12 to 36 inches. | .4 | 1.1 | .8 | 5.2 | 12.0 | 40.0 | 40.2 |

ABILENE CLAY.

The surface soil of the Abilene clay is a brown to rather dark brown clay, having an average depth of about 10 inches. The subsoil is a brown, chocolate-brown, or light-brown, stiff clay, passing at any depth from 16 to 36 inches into more friable, brownish or salmon-colored clay. This contains spots of white, chalky, calcareous material, the proportion increasing with depth. This lower-subsoil material may continue to a depth of several feet, but generally a bed of rounded gravel, consisting of limestone, chert, quartz, and other rocks and usually cemented with lime, underlies the soil at 3 to 6 feet. Along the larger streams this gravel deposit may be several feet thick, but along the smaller creeks it often occurs in only thin layers. Where cemented, the gravel beds form a true lime conglomerate. In some places the gravel is only slightly cemented, while

sometimes only the white limy material, with little or no gravel, is encountered. In places the upper substratum, at least, consists of whitish or salmon-colored, highly calcareous, chalky material.

On some of the steeper slopes where the subsoil material and gravel outcrop or have only a shallow covering of soil the surface has a yellowish-brown or grayish color. On a few steep slopes where the conglomerate outcrops huge, blocky fragments lie on the lower slopes. In a few places where the type is associated with the Miles soils the surface soil and subsoil have a reddish color. In occasional areas there is a small content of rounded gravel or subangular chert fragments on the surface and throughout the soil and subsoil. The soil forms a good friable seed bed. Both soil and subsoil are calcareous. Locally the Abilene clay is referred to as "chocolate land" or "red land."

This type occurs in strips or larger areas along the Leon, Little, and Lampasas Rivers and adjacent to the bottom lands of Salado, Cowhouse, and Noland Creeks. One of the largest and most representative areas is mapped 2 or 3 miles west of Little River. Other areas ranging up to several hundred acres in extent occur in the valley of South Noland Creek several miles west of Belton and just east of Killeen.

In general the surface is very nearly level to gently undulating, and steep slopes occur only where the type adjoins the lower lying bottom lands. It lies 10 to 30 feet or more above the bottom lands, and 20 to 50 feet or more above the streams. Just south of the Lampasas River near Elm Grove School one area lies as high as the Simmons clay, high phase. Surface drainage is almost everywhere adequate. Only small areas are subject to serious erosion, and with careful methods of handling, washing is almost negligible. On some areas, usually sloping, where the gravel comes within a foot or two of the surface, the soil is wet and "seepy" after rains. Where the "concrete" or conglomerate occurs the soil becomes droughty in the summer and crops suffer in long periods of dry weather.

The Abilene clay is an important type. The soil dries out and warms up early in the spring, and crops grow more rapidly than on many other soils. Probably 90 per cent of it is in cultivation. Small areas remain in the native vegetation, consisting of a heavy carpet of wild grasses and a timber growth of pecan, elm, live oak, hackberry, ash, water oak, and other trees, with small mesquite in places.

Cotton and corn are the principal crops. Oats and wheat are grown to a smaller extent, and sorghum and Sudan grass are grown by some farmers. The surplus corn, oats, and wheat produced are sold. Small orchards of peaches, pears, and plums thrive on this soil, but frosts and freezes frequently kill the fruit. Cattle and hogs

are raised and fed to supply meat for home use and to some extent for sale. Cotton ordinarily yields about one-half bale per acre, corn 30 to 40 bushels, oats 30 to 50 bushels or more, and wheat 12 to 25 bushels. From 3 to 5 tons of sorghum hay per acre is obtained. Sudan grass gives three cuttings of 1 to 2 tons each.

This soil is easily tilled, and is durable and productive. No commercial fertilizers are used. On one well-improved farm a successful crop rotation has been worked out and followed for several years, corn, oats, and cotton being grown in a 3-year rotation. As soon as the crop can be gathered the cotton land is broken early in the fall with a turning plow to a depth of 5 to 8 inches, the cotton stalks being turned under. The land is harrowed after rains and corn is planted on the flat land. In the fall after the corn is harvested oats are drilled in, and the land is cross harrowed to kill grass and other vegetation. The following summer or fall the oat land is flat broken for cotton. A similar rotation might be used to advantage on many of the upland soils of the county. Barnyard manure is beneficial to this type, and crops withstand dry weather better where it has been applied.

Land of the Abilene clay is usually sold for \$40 to \$100 an acre. Higher prices may be asked for farms on the best areas near railroads or towns.

For best results with corn the soil should receive applications of organic matter, but the present organic content seems to be sufficient for cotton, oats, and wheat. Growing leguminous crops, such as clover, cowpeas, and alfalfa, greatly improves the soil. Alfalfa would probably do well under favorable conditions. The soil is well suited to certain vegetables. Irish potatoes would probably give very good results.

Abilene clay, colluvial phase.—The Abilene clay, colluvial phase, represents areas of the type occurring in narrow valleys on gentle slopes between the Brackett and Frio soils. The surface soil is a brown, friable clay, about 10 inches deep. The subsoil to 36 inches is a brown or yellowish-brown clay, containing white, chalky spots in the lower part and sometimes a thin lime-cemented gravel bed at depths of 2 to 4 feet. Frequently a layer of chalky, highly calcareous material is encountered at 15 to 30 inches.

The surface of this phase is gently sloping and drainage is good. It has about the same agricultural value as the typical Abilene clay, and it is farmed in practically the same way.

MILES GRAVELLY SANDY LOAM.

The Miles gravelly sandy loam consists of a light-brown to brown gravelly sandy loam, underlain at about 8 or 10 inches by reddish or brownish gravelly sandy loam which passes at about 10 to 15

inches into red, stiff gravelly clay. This is often quite waxy in the lower part and mottled with yellow. Small rounded gravel, mostly of chert and quartz, is abundant in the surface soil and usually occurs in the subsoil, but in some areas the subsoil consists of a mass of gravel intermixed with red clay, in places overlain by very little soil covering. At depths of 24 to 40 inches there is usually encountered a bed of gravel, consisting of rounded cobbles not over 2 or 3 inches in diameter, mainly of chert and quartz, with some sandstone and limestone. In places this bed occurs as a mass of gravel in a matrix of reddish-yellow and whitish calcareous material, the whole often being cemented into a conglomerate. This gravel is quarried for use in road surfacing.

The Miles gravelly sandy loam occurs in a number of narrow strips in the Leon and Little River Valleys. Some of the largest areas lie a few miles north and east of Holland. The natural growth consists of black-jack oak and post oak. Only a small proportion of the type is cultivated.

MILES FINE SANDY LOAM.

The surface soil of the Miles fine sandy loam is a brown to slightly reddish brown fine sandy loam or loamy fine sand, 8 to 20 inches deep. In some places the immediate surface material is grayish when very dry. The subsoil is a red, stiff, slightly sandy clay. On some eroded slopes the clay subsoil is exposed or lies very near the surface, giving rise to patches of reddish sandy clay loam, clay, and brownish clay loam. In a few places the soil contains small chert and quartz gravel, and in spots the texture is rather coarse. The substratum consists of whitish, calcareous, chalky material or beds of chert and flint gravel, frequently cemented with lime carbonate.

The Miles fine sandy loam is not extensive, but it is widely distributed throughout the eastern part of the county along the Leon and Little River Valleys. Some of the largest areas occur within a few miles of Belton, 1 mile and 4 miles north of Moffat, and at Tennessee Valley church. The type occupies terraces lying 20 to 100 feet above the stream bottoms. The surface is gently undulating, and the drainage is good.

Probably 85 per cent of this type is cultivated. The native vegetation consists of a rather heavy growth of blackjack and post oak. Cotton and corn are grown to some extent and give fair yields, but the type is used largely for market gardening. Many vegetables, including watermelons, give good yields. Peaches, plums, and pears, as well as various berries and grapes, are grown successfully and marketed with the vegetables.

This soil is easily cultivated and responds readily to good farming methods. In growing corn especially, a good supply of organic matter should be maintained by plowing under cowpea vines or other vegetation.

Improved land of this type favorably located with reference to markets sells for \$100 or more an acre.

In one or two small gently-undulating areas around the town of Little River, surrounded by bodies of Simmons clay, the soil mapped as Miles fine sandy loam, if more extensive, would be separated as the Riverton fine sandy loam. It consists of a brownish fine sandy loam, 12 to 15 inches deep, underlain by a waxy clay, mottled reddish and yellowish, passing into mottled red and grayish clay. Some small gravel occurs on the surface in places, and beds of rounded quartz and chert fragments are encountered at a depth of several feet. This soil is farmed in the same way and to the same crops, as the surrounding types. Owing to its sandy surface soil, it is well suited to vegetables. General farm crops also grow well and give good yields.

FRIO LOAM.

The Frio loam consists of a brown to dark-brown, friable loam passing at about 10 to 12 inches into brown or yellowish-brown loam or friable clay. Near stream banks some small areas of sandy loam are included.

This type occurs principally in narrow bottom-land areas along the Lampasas River in the western part of the county. Small bodies are mapped along the Leon River a few miles from Belton. The type has a nearly level surface, but it mainly lies 20 to 40 feet above the stream beds and the drainage is good, though the areas along the Lampasas River are occasionally overflowed.

Practically all of this type is cultivated, probably less than 1 per cent being in the native timber growth of pecan, elm, hackberry, bur oak, and other trees. The most important crops are cotton, corn, oats, wheat, and sorghum for forage. The crop yields depend largely on the season, though yields are lower in sandy areas than where the soil is heavier. In average seasons cotton yields one-half to three-fourths bale per acre, corn 30 to 50 bushels, oats 20 to 50 bushels, and wheat 15 to 20 bushels. Along some of the rivers vegetables and some other crops are irrigated in a small way. Vegetables give good yields and market gardening is engaged in quite successfully near good markets.

The Frio loam is very easily cultivated. Where it is very sandy the subsoil is too light for the best conservation of moisture. Systematic crop rotations are not employed.

Although this type occurs largely in small areas in farms including various other soils, it affects the selling price of the land considerably. Farms composed largely of this type can be bought for \$40 to \$100 an acre.

The Frio loam is naturally a productive soil, but it can be improved by deep plowing and supplying organic matter. This would be especially beneficial for corn. Alfalfa should grow well on this soil.

FRIO SILTY CLAY LOAM.

The Frio silty clay loam consists of a brown to dark-grayish, friable silty clay loam, underlain at 5 to 8 inches by dark-brown to nearly black silty clay which passes into lighter brownish, stiffer clay. The surface soil in some areas contains considerable sand, and is more friable than typical. The surface soil dries out to an ashy cast.

This type occurs principally in a number of small areas along Leon River and Cowhouse Creek, in the northern part of the county. A few small areas are mapped along the Little and Lampasas Rivers. The type occurs in bottom-land situations in close association with the Frio clay, and resembles that soil very closely in topography and drainage. The same crops are grown, under the same farming methods. Yields differ very little, except that corn gives slightly higher returns and oats somewhat lower. The soil is well suited to vegetables, which are grown largely near Belton. This soil is easier to cultivate than the Frio clay. It is a very desirable soil, suited to all the common general-farm crops and to peaches and plums. It is all under cultivation.

FRIO CLAY.

The Frio clay consists of a brown to dark-brown, and along some of the smaller streams nearly black, friable clay, underlain at 10 to 12 inches by brown or dark-brown clay which is moderately friable when dry and plastic when wet. Along some of the smaller streams the soil is nearly black.

The Frio clay is widely distributed throughout the western and southern parts of the county, where it occurs along practically all the streams. The largest areas are encountered along Little and Leon Rivers and the Noland Creeks. Only very small areas occur in the Lampasas Valley. Along the Little River in the southern part of the county some of the areas are more than 2 miles wide.

The surface is nearly level, but drainage is usually good. As a rule a narrow depression adjacent to the uplands catches most of the upland run-off. These strips remain wet longer than the other portion of the bottoms, but they are cultivated. The type lies about 15 to 30 feet above the river channels and about 4 to 12 feet

above the creeks. It is overflowed occasionally, part of the type nearly every year, but the overflows usually occur in the winter and spring and crops may be seeded afterward. Sometimes crops are ruined by late floods.

The Frio clay is an important soil in Bell County. Nearly all of it is in cultivation. The native vegetation consists of pecan, elm, hackberry, bur oak, ash, box elder, cottonwood, and other trees. The most important crops are cotton and corn. On some of the larger areas oats and wheat are also grown. Sorghum is produced to some extent for forage.

Crop yields on the Frio clay in average seasons are reported approximately as follows: Cotton one-half to 1 bale per acre, corn 35 to 60 bushels, and wheat 15 to 20 bushels. Sorghum yields several tons of forage per acre and Sudan grass gives excellent returns. Alfalfa has been grown very successfully in a few small fields, and the soil is evidently well adapted to this crop. Yields range from 1 to 2 tons of hay per cutting, and 3 or 4 cuttings may be made in a year. Some large fields are devoted to Johnson grass, which gives good yields of hay. In the western part of the county, along small streams, some of this land is irrigated in a small way and vegetables for market are produced very successfully.

The Frio clay is very friable and works into a good seed bed. The subsoil conserves moisture well. Oats and wheat sometimes grow too rank on this soil and lodge badly, but after these crops have been grown for several years on the same land this tendency is not so pronounced.

Farms composed entirely of this soil sell for \$50 to \$100 an acre.

The Frio clay is a very productive soil, especially adapted to corn, cotton, alfalfa, various forage crops, and grass.

TRINITY CLAY.

The surface soil of the Trinity clay is a black, bluish-gray or brownish, friable clay, about 12 inches deep. On drying the immediate surface material has an ashy cast and becomes crumbly. The subsoil is very similar to the surface soil, but somewhat lighter in color. Along the smaller streams the soil is darker in color than along the larger streams. Both surface soil and subsoil are calcareous.

The Trinity clay is confined to the Black Prairie region, in the eastern part of the county. It occupies narrow bottom-land areas along the creeks, the largest developments occurring along Big Elm Creek. It is mapped along every stream of any considerable size in the eastern part of the county.

The surface is very nearly level. The type usually lies 4 to 12 feet above the stream channel and is well enough drained to be used for farming. The type is subject to overflow, which occurs mostly in

the spring, and usually crops may be grown after the danger of overflows is past. The subsoil is very retentive of moisture.

The Trinity clay is an important though not an extensive soil type. Probably 90 per cent of it is cultivated. Part of the type supports a growth of pecan, hackberry, and oak. Cotton and corn are the principal crops. This soil is not used much for small grain, owing to the tendency of these crops to grow too rank, and lodge, and because of the danger of destruction or damage by flood. Sorghum is grown to some extent. An alfalfa field observed on this type in the course of the soil survey showed a very good stand and yield of that crop. Cotton yields about one-half to 1 bale per acre and corn 30 to 50 bushels.

The soil is easily tilled if plowed and cultivated when the moisture conditions are best, and it works up into a desirable tilth. No systematic crop rotation is practiced. The soil is especially suited to corn, forage crops, grasses, and alfalfa.

ROUGH STONY LAND.

Rough stony land comprises steep, rocky slopes as well as some rather gently rolling land containing massive limestone outcrops. On the steep slopes at the top large, broken limestone boulders and fragments occur over the surface, but the lower slopes contain fewer large limestone fragments and consist largely of steep chalk bluffs.

The largest areas of Rough stony land are mapped in the northern part of the county, just west of Moffat and north of Sparta. The type occurs in irregular, narrow, steep slopes in many places in the western part of the county. These rough areas, locally called mountains, are the slopes of high table-lands occupied by the Crawford soils, leading down to the broad, rolling areas of San Saba and Brackett soils. The rough areas occur largely within a few miles of the larger streams, and are most extensive along the valleys of Leon and Lampasas Rivers and Cowhouse and Noland Creeks. In the western part of the county the table-lands have been thoroughly dissected, and in places small flat-topped "buttes" or "mesas" stand up in the prairies. The steep slopes of Rough stony land extend 50 to 200 feet above the valleys and prairies.

This soil can not be cultivated, and it is used as pasture land or woodland. It supports a scattered to heavy growth of Spanish oak, cedar, live oak, and other trees. The cedar is valuable for posts and the other timber for firewood. There is a very scant grass growth. Goats could find pasturage on this land, but there is little subsistence for other stock.

Where the valuable cedar timber has been cut, much of this land is probably valued at not more than \$6 to \$15 an acre.

SUMMARY.

Bell County lies in central Texas, about midway between Dallas and San Antonio. It has an area of 1,083 square miles.

In topography the county ranges from gently undulating to hilly and rough. Some nearly level areas occur along streams. The greater part of the county is gently rolling. Its general slope is southeasterly. Elevations above sea level range from 450 to 1,200 feet, but the greater part of the county lies between 500 and 800 feet.

Drainage is good throughout the county. All of its area is drained into the Brazos River through the Little River, which is formed in the central part of the county by the confluence of the Leon and Lampasas Rivers.

Bell County in 1910 had a population of nearly 50,000. The principal towns are Temple, Belton, Bartlett, Rogers, Killeen, Holland, Pendleton, Troy, Heidenheimer, and Nolanville. Several railroads cross the county, and the transportation facilities are good in most sections. A number of good roads have been built through the county, but most of the highways are ordinary dirt roads. The county is well supplied with telephone lines and good schools and churches. Fort Worth is the principal market for live stock. The other farm products are marketed in various parts of the State or in other States.

The climate of Bell County is mild and healthful. The mean annual temperature as recorded at Temple is 65.6° F., and the mean annual precipitation 33.36 inches. There is an average growing season of 246 days.

Cotton growing is the principal agricultural industry in Bell County. According to the 1910 census, this county ranks fifth in the State in cotton production. Corn, oats, wheat, and forage crops are grown for home use and for sale. Cattle raising and feeding, hog raising, and sheep grazing are carried on to some extent.

Systematic crop rotations are not practiced, but some farmers change crops occasionally. No commercial fertilizer is used and little barnyard manure. Farm labor is usually abundant, at reasonable wages.

In general the farms range in size from 80 to 160 acres, but many are smaller and many larger. The price of agricultural land ranges ordinarily from \$30 to \$150 an acre. Near some of the larger towns higher prices are asked.

Bell County lies within the Black and Grand Prairie regions of Texas. The upland soils are residual, being derived from hard and soft calcareous strata ranging from calcareous clays and marls, through soft and hard chalks, to various hard limestones. These

formations have weathered into soils of the Houston, Crawford, Brackett, San Saba, and Darnoc series, and Rough stony land. Along the streams there are strips of alluvial deposits, giving rise to soils of the Frio and Trinity series in the first bottoms, or flood plains, and to soils of the Abilene, Simmons, Wilson, Bell, and Miles series on the older and higher lying second bottoms, or terraces.

The Houston black clay is the most extensive soil type mapped. It covers the greater part of the Black Prairie, in the eastern half of the county. This soil is used very extensively for cotton production. In the western part of the county the Crawford clay and San Saba clay are the principal farming soils, used for growing cotton, corn, oats, and wheat. Extensive areas of Brackett stony clay, Crawford stony clay, and Rough stony land occur in the western part of the county and are used as pasture and timber land. Practically all the alluvial soils are in cultivation, being devoted principally to the production of cotton, corn, and oats.



[PUBLIC RESOLUTION---No. 91.]

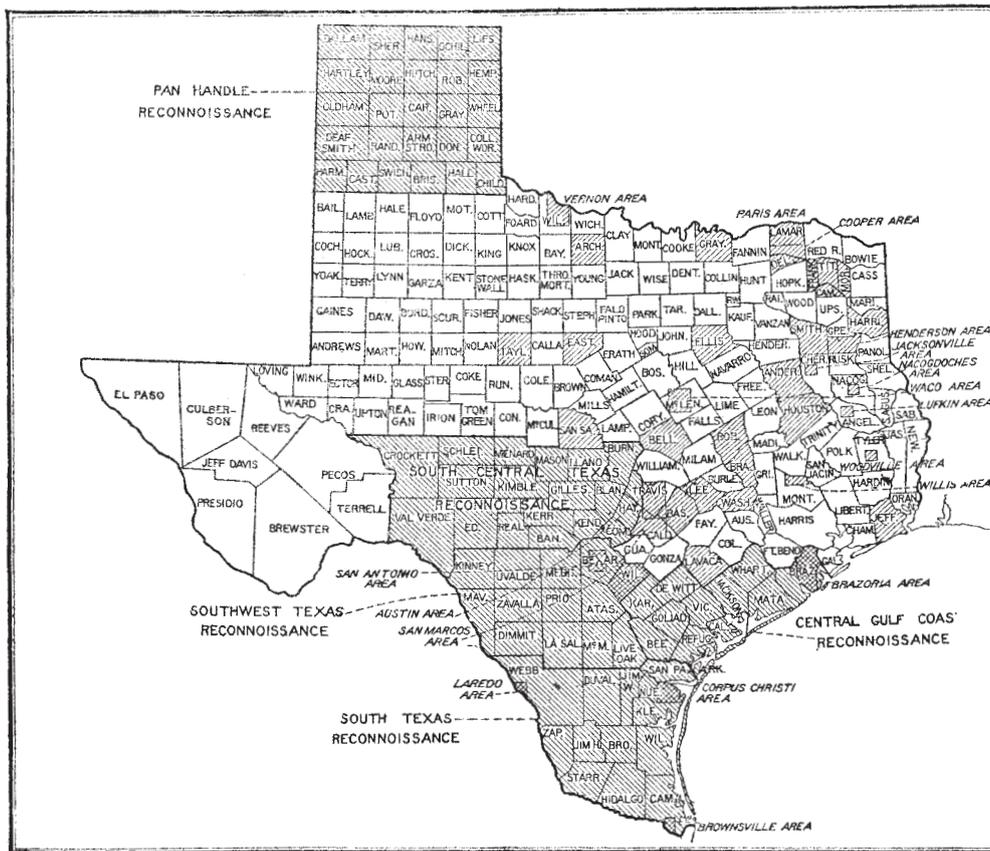
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Area surveyed in Texas.

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Washington, D.C. 20250-9410;
- (2) fax: (202) 690-7442; or
- (3) email: program.intake@usda.gov.

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