A63-217-10M

TEXAS AGRICULTURAL EXPERIMENT STATION

BULLETIN NO. 213 JANUARY, 1917

DIVISION OF CHEMISTRY

The Composition of the Soils of South Central Texas

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COLLEGE STATION, BRAZOS COUNTY, TEXAS

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

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*As of February 1, 1917.
**In cooperation with United States Department of Agriculture.

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THE COMPOSITION OF THE SOILS OF SOUTH CENTRAL TEXAS.

By G. S. Fraps, Chemist in Charge.

This bulletin deals with the chemical composition of samples of soil from nineteen counties in South Central Texas, and is the sixth of a series dealing with the chemical composition of typical Texas soils. The samples analyzed were sent us by the field agents of the Bureau of Soils of the United States Department of Agriculture.

A description of the soils and a map of this area has been published by the Bureau of Soils under the title of "A Reconnaissance Soil Survey of South Central Texas," by A. E. Kocher and party. These maps are on a scale of six miles to the inch. Requests for this report should be addressed to the Bureau of Soils, Washington, D. C.

MAINTENANCE OF FERTILITY.

The following are the chief essentials to the maintenance of soil fertility:

(1) Maintenance of vegetable matter and nitrogen, by growing legumes and turning these under or grazing them off.

(2) Correction of deficiency in phosphoric acid, if needed, by use of phosphates.

(3) Correction for acidity, if present, by use of ground limestone or lime.

(4) Correction for deficiency of potash, if needed, by use of potash fertilizers.

Vegetable Matter. The maintenance of the supply of vegetable matter in the soil is essential for the fertility of soils, though some soils produce well for a long time without additions of vegetable matter, through liberal use of fertilizers. Vegetable matter may be supplied in farm yard manure, which is sufficient if the quantity available is enough, but barnyard manure is usually not at hand in large enough quantities. Legume crops, in such case, should be grown in rotation with other crops, and either turned under or grazed off. Turning under a heavy green crop may sour the land; if the crop is heavy, it is best to allow it to become nearly mature before turning it under. The plant tissues are then harder, decay less rapidly, and are less likely to cause sourness. We are still more in favor of grazing off the crop, as in this case some of its feeding value is secured, while the droppings from the animal, together with the liquid excrement, contains the bulk of the plant food taken up by the crop. To make the crop into hay and save the manure from it is not such a good plan, as a large part of the fertility is lost in this way; and when the legume is made into hay, to be sold, the land gains practically nothing in fertility.

While other crops than legumes add vegetable matter to the soil when plowed under or grazed off, the legumes are the only plants which

can utilize the free nitrogen of the air. Hence the legumes are selected for the crop to be turned under or grazed off.

The maintenance of the nitrogen supply of the soil is more important than the maintenance of the vegetable matter. The only practical way to do this for farm crops is to secure the nitrogen from the air by growing legumes. Nitrogen costs too much for the planter to purchase enough of it to maintain the nitrogen content of the soil. The purchase of a small supplementary quantity may be profitable, but the main supply for cotton, corn, kafir, etc., must come from the soil, which then loses in fertility, unless it is first taken from the air by means of legumes.

It is not our intention to go into the matter of the kind of legumes to grow, except to say that corn grown in six-foot rows with cowpeas between, often produces as many bushels of corn the first year as corn grown in the usual way, and the second year, if the legumes are turned under or grazed off, it often produces eight to twelve bushels more. A cotton crop following the corn and cowpeas likewise is considerably larger.

(2) *Phosphoric Acid.* Soils are often deficient in phosphoric acid. The deficiencies of the soils discussed here will be shown later on. For discussion of the use of phosphates and other fertilizers, see Bulletin No. 167.

(3) *Acidity.* Some soils contain organic or inorganic acids, and are acid in character. Certain crops do not grow well in acid soils, especially clover, alfalfa, barley, rye, etc. There are other crops, such as cowpeas and watermelons, which do well on acid soils. Acidity may be corrected by adding lime, either slaked lime, quicklime, or ground limestone rock. The latter is usually the cheaper, and preferable in other respects. The acidity or non-acidity of the soils is shown in connection with the analyses. Many of the soils of the area contain an abundance of lime, and do not need further additions. Only one acid soil was found which was Crawford Clay of Burnet county, and its acidity was very small and would be corrected by an application of 200 pounds stone lime per acre.

(4) *Potash.* Soils as a rule contain an abundance of potash to produce good crops, though there is a variation in this respect. In general potash is least often needed of any fertilizer and often needlessly used in the South. The use of manure, the turning under of green crops, and the use of lime when needed, appear to assist the plants to secure potash from highly insoluble forms. The farmer should endeavor to secure the greatest benefit from his soil potash before undertaking to purchase fertilizer potash.

HOW TO USE THE ANALYSES.

Analyses of the soils are given in connection with the various types. The interpretation of the analyses is also given.

If the soil is well supplied with plant food, but does not give good yields, this indicates that its physical condition is poor, either in respect to cultivation, drainage, physical character, or in other respects.

If the soil is well supplied with total plant food, but low in active plant food, attempts should be made to increase the activity of soil agencies which make plant food available, by means of addition of manure, of green crops plowed under, or, if the soil is acid, by addition of lime or ground limestone.

If the crop yields are low and the plant food is deficient, the table shows the plant food that should be used first.

Suppose, for example, a farmer on Houston Clay of Comal county is securing a yield of one-fourth bale cotton per acre, what fertilizer should be used.

Table 6 shows that this soil furnishes enough active phosphoric acid for 6 bushels corn, enough potash for 157 bushels corn, enough nitrogen for 23 bushels corn, on an average, in pot experiments. Clearly, phosphoric acid is needed first, and most of all, and then nitrogen. The farmer then should apply acid phosphate, for the purpose of furnishing phosphoric acid, and cottonseed meal, for the purpose of furnishing nitrogen. These should increase the yields. But it would be still better for him to secure the nitrogen by growing legumes, and turning them under or grazing them off, and then using acid phosphate to supply the phosphoric acid. On this particular soil proper crop rotation with legumes is probably the first necessity.

As another example, take Yazoo Clay of Hays county (Table 6). If less than one-half bale cotton or 35 bushels corn are produced, the deficiency is probably not due to lack of plant food, but to bad physical condition, deficient rainfall, or otherwise. Crop rotation, with legumes to add vegetable matter, would here be clearly indicated.

PLANT FOOD REQUIREMENTS OF CROPS.

Table 1 shows the plant food taken from the soil by certain average Texas crops. The plant food in the crop sold is given, and also that in the by-products, which may be returned to the soil, either directly or with some loss in manure.

TABLE 1.

Plant Food Removnd by Crops in Pounds Per Acre.

	Phosphoric acid.	Nitrogen.	Potash.	Valuation per acre.
Corn, 40 bushels (in corn and cob)	19	38	13	$ 9.42
Corn, (in stalk and leaves)	6	22	29	6.50
Wheat, 25 bushels (in the grain)	13	29	8	7.06
Wheat (in the straw)	5	13	14	3.74
Oats, 40 bushels (in the grain)	10	25	7	6.51
Oats (in the straw)	4	10	21	3.50
Cotton (in 250 pounds lint)	0.1	0.8	0.7	.21
Cotton (in seed, 500 pounds)	7	16	8	4.10
Cotton (in stalk and leaves)	12	32	23	8.50
Potatoes, Irish (100 bushels, in the tuber)	10	20	36	6.76
Potatoes, Sweet (200 bushels, in the tuber)	20	28	72	11.12
Alfalfa, 4 tons	50	183*	143	48.18
Sorghum, 3 tons	29	84	134	26.58
Sugar cane, 20 tons	15	153	44	34.14
Onions, 30,000 pounds	37	72	72	20.94
Rice, 1,900 pounds (in the grain)	12	23	5	5.62
Rice (in 2,250 pounds straw)	3	14	37	5.20

*A part of this nitrogen comes from the air.

TABLE 2.

Pounds of Plant Food Per Acre to the Depth of Seven Inches.

Type.	County.	Total phosphoric acid.	Active phosphoric acid.	Total potash.	Acid soluble potash.	Active potash.	Total nitrogen.	Acid soluble lime.
Bastrop fine sandy loam	Travis	1,400	34	35,600	5,600	150	600	212,000
Blanco loam	Hays	2,400	72	19,600	1,000	298	2,200	658,200
Blanco silty loam	Comal	1,360	31	10,000	5,400	247	720	818,800
Brackett silty loam	Val Verde	1,140	21	36,000	6,400	395	1,960	540,000
Brackett stony clay loam	Val Verde	460	20	18,000	4,700	90	1,900	568,600
Brackett stony soil	Val Verde	200	.....	11,200	4,000	.....	600	5,400
Crawford clay	Burnet	3,720	326	28,000	.....	732	3,180	324,400
Crawford silty clay	Hays	2,100	768	40,200	15,600	282	3,600	31,600
Crawford silty clay	Kendall	600	13	13,200	8,600	158	2,600	542,800
Crawford silty clay	Kerr	1,780	217	37,800	28,400	2,110	2,960	23,400
Crawford silty clay	Bandera	4,000	.....	26,800	13,600	.....	3,360	32,600
Crawford silty clay (dark phase)	Comal	2,224	155	35,200	5,400	.....	3,500	134,000
Crawford stony clay	Hays	3,600	62	16,400	11,600	396	4,000	248,000
Crawford stony clay	Sutton	17,400	15	26,800	42,400	1,182	2,400	42,400
Frio silty clay loam	Menard	3,044	3,324	28,000	.....	1,092	2,140	370,000
Frio silty clay loam	Kimble	1,344	.....	19,200	7,600	.....	1,280	674,800
Frio silty clay loam	Kerr	960	40	36,400	.....	1,267	1,560	12,840
Frio silty clay loam	Edwards	2,000	59	29,800	19,200	670	3,360	412,800
Houston black clay	Hays	1,600	20	16,800	4,000	56	2,600	392,200
Houston black clay	Comal	1,160	313	13,600	13,800	1,155	2,020	102,400
Houston black clay	Travis	1,400	78	13,200	5,800	352	2,400	113,200
Houston clay	Comal	1,000	10	16,800	11,600	663	1,420	289,400
Houston clay	Hays	2,088	166	16,400	800	280	5,600	186,400
Houston gravelly clay	Comal	680	189	15,600	1,080	1,030	1,320	52,400
Houston loam	Hays	500	24	16,800	5,800	574	3,600	7,400
Lancaster sandy loam	Mason	694	30	37,000	2,400	265	620	2,800
Laredo silty loam	Val Verde	3,720	23	17,600	12,200	1,085	1,760	214,600
Miller fine sandy loam	Llano	2,040	240	32,400	8,300	.....	820	8,400
Miles soils (undifferentiated)	Crockett	2,400	87	36,400	18,600	833	3,400	294,400
Pedernales loam	Menard	740	27	31,600	11,400	815	1,360	6,600
Pedernales sandy loam	Gillespie	560	42	44,000	5,200	338	800	3,200
Pedernales sandy loam	Gillespie	320	16	24,400	2,000	292	400	2,600
Pedernales sandy loam	Gillespie	660	5	44,800	16,800	850	1,420	9,000
Pedernales stony fine sandy loam	Gillespie	2,240	794	31,200	6,000	598	1,660	17,200
Pedernales stony loam	Mason	1,178	97	36,600	6,400	.....	2,640	322,600
Pontotoc sandy loam	Mason	1,820	473	6,120	6,500	722	700	2,200
San Antonio silty clay loam	Kendall	760	57	25,200	16,000	1,047	2,440	57,600
San Antonio silty clay loam	Kerr	2,000	.....	20,800	11,000	.....	380	598,000
Susquehana fine sandy loam	Caldwell	800	14	20,000	6,800	424	2,000	1,400
Susquehana fine sandy loam	Travis	504	117	8,400	2,200	282	800	18,200
Tisho ningo fine sandy loam	Burnet	2,200	644	72,800	8,200	100	940	4,400

TABLE 2—Continued.

Pounds of Plant Food Per Acre to the Depth of Seven Inches.

Type.	County.	Total phosphoric acid	Active phosphoric acid.	Total potash.	Acid soluble potash.	Active potash.	Total nitrogen.	Acid soluble. lime.
Tishomingo gravelly sandy loam	Mason	932	64	92,400	3,800	470	1,220	4,400
Tishomingo loam	Llano	820	75	42,400	6,800	557	1,420	7,600
Tishomingo sandy loam	Llano	3,000	1,343	74,200	1,000	240	1,000	35,200
Tishomingo sandy loam	Llano	800	12	50,400	5,960	592	940	4,200
Tishomingo stony clay loam	Llano	1,000	20	56,800	1,210	1,225	1,440	17,200
Tishomingo stony sandy loam	Llano	1,680	19	70,400	6,600	485	1,000	3,800
Travis gravelly loam	Travis	800	25	32,000	10,400	416	2,600	29,400
Yazoo clay	Hays	1,772	194	22,000	8,200	280	2,600	197,200

Table 2 shows the quantity of plant food in the surface soil of the various samples examined, expressed as pounds per acre. The assumption is made that the soil weighs two million pounds to the depth of 7 inches, an assumption only approximately correct.

SOIL SERIES IN THE AREA.

The following is a brief description of the soil series found in this area: Table 3 shows the relation of the types to the county rocks.

Blanco Series. These soils are of alluvial origin, occupying terraces standing above overflow. They are gray to light brown soils with brownish subsoils, which contain heavy plastic material of a decidedly heavy brown color in the lower portions of the subsoil.

Brackett Series. These soils are derived through the weathering of limestone on the Edwards Plateau. They are gray, yellowish gray, or light brown surface soils with whitish or light brown or brown subsoils.

Crawford Series. These soils are derived from the weathering of indurated limestone, and occupy a large part of the Edwards Plateau. In the eastern part of the area these soils have dark brown to reddish brown surface soils, with reddish brown subsoils. In the cenera part, the red color of the surface soil is usually absent, and the surface soils are dark brown to black with reddish brown subsoils. In the western portion the soils are somewhat lighter in color.

Frio Series. These soils are found in limestone valleys, and are mainly alluvial in origin. They have dark brown to grayish brown surface soils with dark gray to dark brown subsoils.

Houston Series. These are derived from the weathering of limestone, and are one of the most extensive and valuable series of soil in the Gulf Coastal Plain, but only a small area is included in this survey. They have dark gray to black surface soils with lighter colored calcareous subsoils, and are prairie soils.

Katemcy Series. This soil is largely derived from the weathering of granite rocks, and lies in the northern part of Mason county. They have dark brown to black surface soils and a pale red subsoil.

Lancaster Series. These soils are usually formed from the weathering of a yellowish brown sandstone containing iron. They lie on the western edge of the crystalline rock in Mason and Llano counties. The surface soils are gray to reddish brown in color and the subsoils are yellow or mottled yellow and gray, and rest on sandstone at comparatively shallow depths.

Laredo Series. These soils are alluvial soils, being made up largely of material brought down from the calcareous and more arid part of Texas. They are seldom or never overflowed and occur as terraces

along streams in South Texas. They consist of gray to light brown calcareous soils with gray calcareous subsoils.

Miles Series. The Miles series are derived from the weathering of limestone. The surface soil is light grayish brown, or yellowish brown with a gray and brown or yellowish brown subsoil, having a pinkish cast, containing pinkish or white limestone gravel. Toward the northern boundary of the area the surface has a slightly pinkish color.

Miller Series. The Miller series is composed of soils washed down by the Colorado River, and consists of reddish colored alluvial soils.

Pedernales Series. These soils occur in basins of some of the streams of the area, and are derived from sandstone, limestone conglomerates, and limestone. They include red colored soils and subsoils, the whole lying on limestone at a depth of three feet or less.

Pontotoc Series. These soils are derived from the ferruginous red sandstone, and are bright red in color. The occupy only a small area.

Roswell Series. These soils are composed principally of alluvial material, and are found along the Pecos River. They have gray or grayish brown surface soils, with light brown or pinkish subsoils.

Rough Stony Land. This is not a soil type, properly speaking. It consists of land that is too rough and stony for tillage, and is adapted only to grazing. Considerable areas of this kind of land occur in the area surveyed. In many places the soil is very shallow, and in other places the rocks are exposed.

TABLE 3. RELATION OF SILS TO THE COUNTRY ROCKS (BUREAU OF SOILS).

Soil Group.	Origin.	Series.
Alluvial	Mixed derivation	Blanco Frio San Antonio Laredo Roswell Miller
Residue from unconsolidated rocks	Material of Cretaceous Age	Houston
Residue from limestone	Limestone ranging in age from Cretaceous to Cambrian	Miles Rough stony land Crawford Brackett Pedernales Katemcy
Residue from sandstone	Material of early Paleozic Age	Pontoc Lancaster
Residue from crystalline rocks	Material older than the Paleozic rocks of the region.	Tishomingo

San Antonio Series. The San Antonio series are derived from calcareous material of sedimentary origin. They have brown to chocolate brown surface soils and brownish red calcareous subsoils.

Tishomingo Series. These soils are derived mainly from the weathering of granites, schists, and gneisses, and to a much less extent from sandstone. They have reddish colored surface soils with red, yellow, brown, and mottled brown, and gray subsoils. They vary considerably in appearance and character.

Vernon Series. This series seems to be derived from the wind-blown material carried in from the Permian red beds, and are reddish colored in appearance.

DESCRIPTION OF SOIL TYPES.

We give below a detailed description of the soil types found in this area, condensed from the report of the Bureau of Soils referred to above. Table 4 shows the areas of the various soil types.

TABLE 4. CLASSIFICATION AND AREA OF SOILS (BUREAU OF SOILS).

Soil Groups and Types.	Acres.	Per cent.
Coastal Plain soils:—		
Upland soils:—		
Black soils:—		
Houston series:—		
Houston clay loam	16,128	0.1
Houston clay	18,432	.1
Houston black clay	5,760	.1
Houston gravelly clay	10,368	.1
Terrace and Stream Bottom Soils:—		
Gray soils:—		
Blanco series:—		
Blanco fine sandy and silt loam (undifferentiated)	19,584	.1
Blanco silty clay loam	32,256	.2
Laredo series:—		
Laredo silty loam	50,688	.3
Reddish brown soils:—		
Miller series:—		
Miller fine sandy loam	10,368	.1
San Antonio series:—		
San Antonio silty clay loam	149,760	1.0
Miscellaneous:—		
Gravelly soils (undifferentiated)	16,128	.1
Edward Plateau Soils:—		
Plateau proper:—		
Upland soils:—		
Reddish brown to black series:—		
Crawford series:—		
Crawford silty clay	426,240	2.9
Crawford stony clay	4,098,112	28.1
Crawford gravelly clay	31,104	0.2
Crawford clay	237,312	1.6
Crawford soils (undifferentiated)	993,024	6.8
Miscellaneous:—		
Rough stony land	4,554,304	31.2
Gray to light brown soils:—		
Brackett series:—		
Brackett stony soils (undifferentiated)	1,105,920	7.6
Brackett siltyclayloam	80,640	.6
Miles series:—		
Miles soils (undifferentiated)	367,488	2.5
Red soils:—		
Vernon series:—		
Vernon fine sandy loam	1,152	.1
Terrace, Stream, Bottom and Valley Basin Soils:—		
Grayish brown to dark brown soils:—		
Frio series:—		
Frio silty clay loam	566,784	3.9
Frio gravelly soils (undifferentiated)	417,024	2.9
Roswell series:—		
Roswell fine sandy loam	46,080	0.3

TABLE 4—Continued. CLASSIFICATION AND AREA OF SOILS (BUREAU OF SOILS).

Soil Groups and Types.	Acres.	Per cent.
Red soils:—		
Pedernales series:—		
Pedernales stony sandy loam	44,928	.3
Pedernales sandy loam	216,576	1.5
Pedernales loam and sandy loam (undifferentiated)	36,864	.2
Pedernales stony fine sandy loam	88,704	.6
Pedernales stony loam	33,408	.2
Llano-Burnet Basin Soils:—		
Upland soils:—		
Reddish colored soils:—		
Tishomingo series:—		
Tishomingo stony sandy loam	264,960	1.8
Tishomingo gravelly sandy loam	145,152	1.0
Tishomingo stony clay loam	133,632	.9
Tishomingo stony fine sandy loam	12,672	.1
Tishomingo sandy loam	195,840	1.3
Tishomingo fine sandy loam	4,608	.1
Tishomingo loam	14,975	.1
Pontotoc series:—		
Pontotoc stony sandy loam	3,456	.1
Pontotoc sandy loam	36,864	.2
Grayish-brown soils:—		
Lancaster series:—		
Lancaster stony sandy loam	20,736	.1
Lancaster sandy loam	65,664	.5
Miscellaneous:—		
Katemcy soil (undifferentiated)	2,304	.1
Total	14,576,000	

BLANCO SERIES.

Blanco Silty Clay Loam. The Blanco silty clay loam consists of a light gray to slightly pinkish gray clay loam 8 to 10 inches deep, with a heavy clay loam subsoil of somewhat darker color. This soil occupies only a small area. A few bodies lie in the valley of the Llano River at Junction, along the north fork of the Llano River between Junction and Roosevelt, and for a short distance along Bear Creek, The soil occurs as terraces 15 to 25 feet above the normal water level of the stream. This is a productive soil and well suited for use in the production of all farm crops of the area. Little of it is at present under irrigation, although the situation is favorable for this purpose.

Blanco Fine Sandy Loam and Silt Loam Undifferentiated. This type includes a variety of soils which could not be separated on the map on account of their small extent. They vary in texture from fine sandy loam to loam to silt loam, the greater part being a loose grayish brown fine sandy loam, 8 to 10 inches deep, on a subsoil of yellowish brown loam or silt loam. The areas are of small extent, occurring in strips from one-fourth to one-half mile along the river courses, the widest being found on the Guadalupe River in the vicinity of New Braunfels. Other strips occur near Kerrville and along the Blanco and Pedernales Rivers in Blanco and Gillespie counties. For the most part they are above overflow. Nearly all of these soils are in cultivation, producing one-half to one-fourth bale cotton on the unirrigated areas and from one-half to one bale per acre under irrigation. The soils give good results with early truck. Potatoes yield as much as 100 to 150 bushels per acre. These soils could be easily irrigated.

For analyses, see soils of Hays and Comal counties. The sample of Blanco loam of Hays county is likely to need crop rotation and supplies of nitrogen first. It is well supplied with total phosphoric acid, though a little low in active phosphoric acid. The sample of Blanco silt loam from Comal county is low in nitrogen and active phosphoric acid. It needs legume rotation and phosphates. Later on it will need potash.

BRACKETT SERIES.

Brackett Stony Soils. The Brackett soils are derived principally through the weathering of soft limestone on the Edwards Plateau, and are distinguished from the Crawford soils by their much lighter color. The Brackett Stony Soils, undifferentiated, usually consist of a gray, yellowish gray, or light brown clay loam, carrying a large proportion of white limestone fragments. As a rule, the type is very shallow, resting on limestone rock at a depth of 6 to 8 inches below the surface. The largest body is found in the vicinity of Del Rio in the southwestern part of Val Verde county, where for more than eighty miles it extends northwest in a more or less continuous strip across the divide which separates the drainage of Devil's River, the Rio Grande and the Pecos. The type is also found west of the Pecos, and in the extreme northwest corner of the area. Extensive bodies occur in the western part of Hays and Travis counties, the eastern part of Blanco county, and in the northeastern part of Burnet county. Small areas occur throughout Menard, Kimble, Schleicher, and Sutton counties.

The surface is rolling upland, which ranges from almost level to level and sloping. This type is unsuited for cultivation, and is used for grazing, considerable numbers of goats and cattle being pastured on it. During dry seasons, in the western part of the area when the weeds and grasses are gone, stock feed on guajillo leaves as long as they are green, and after that they feed on the desert growth of Sotol weed and Sacahinste grass. Often the ranchmen burn off the dagger-like leaves and split the edible part with an ax. It is said that in Crockett and Val Verde counties cattle require thirty to forty acres of land per head, while in the eastern part fifteen to thirty acres are considered sufficient.

For analyses, see soils of Val Verde county. These soils are low in active phosphoric acid.

Brackett Silty Clay Loam. Brackett silty clay loam, usually known as "upland mesquite flats," consists of 6 to 8 inches of a gray to grayish brown surface soil with a light brown or white silty clay loam subsoil of compact structure. At a depth of 20 inches to 2 feet the type rests upon limestone rock, usually of a chalky nature. This soil is found chiefly in the southern part of Val Verde county in the vicinity of Del Rio. Some areas occur near Comstock, some small bodies occur in the long draws in various parts of Crockett, Schleicher, and Sutton counties. The type has a smooth topography and consists of upland

flats and shallow, basin-like depressions. The drainage is poorly developed and some of the rounded depressions have no surface drainage. The greater part of the type is used for grazing. Kafir, milo, and sorghum are uncertain when depending upon rainfall alone, but under irrigation good crops of corn, sorghum, and kafir may be obtained.

For analyses, see soils of Val Verde county. These soils are low in active phosphoric acid.

CRAWFORD SERIES.

Crawford Stony Clay. The surface soil consists of a dark brown to black heavy clay containing many large fragments of limestone. At the depth of 8 to 10 inches the soil varies from light brown to brown to reddish brown heavy compact clay, which rests on limestone rock at a depth of 2 to 4 feet. There are numerous small patches of lime where the surface soil is deeper.

This soil is an extensive type and occupies nearly all the level upland in the southern half of the area east of Val Verde county. It includes nearly all of the north half of Edwards county, southern Sutton county, and the area along the eastern boundary of Val Verde county. Extensive bodies are found on the high divide that occurs in Kerr, Gillespie, and Blanco counties, and on the greater part of the less eroded upland of Comal, Hays, and Travis counties. Other extensive bodies are found south of Menard in Menard county in the vicinity of Mayer, Schleicher county, and in the eastern half of Burnet county.

This soil is found usually on the high plateaus and high divides between the main drainage ways of the area and its topography ranges from almost level, or gently rolling and hilly, to moderately rough and broken. This soil is well drained. It is primarily adapted to grazing. The shallow soil and the high content of stone make it unfit for cultivation, except in small isolated bodies where the quantity of stone is small and can be removed. In such localities kafir and sorghum have given fairly good results. The greater part is used for grazing cattle which feed in the winter chiefly on weeds, prickly pear, and live oak leaves.

For analyses of this type, see soils of Hays and Sutton counties. In Sutton county the sample is low in active phosphoric acid; in Hays county it is well supplied with plant food.

Crawford Clay. The surface soil consists of 6 to 8 inches of dark brown chocolate brown, or black clay loam or clay with dark brown to reddish brown clay subsoils of compact structure usually several feet deep. Sometimes the limestone comes near to the surface. If plowed when dry, it forms a mellow surface soil, but when it is wet it is sticky and difficult to plow. This soil is found on the highest part of Eldorado Plain. The largest body begins near the northwest corner of Schleicher county and extends southeast past Eldorado to the Sutton county line. The surface is level to gently rolling with good surface

drainage. The land is used chiefly for grazing, but satisfactory yields of staple crops have been obtained when thoroughly cultivated when rainfall conditions are good.

For analyses of these soils, see soils of Burnet county. This sample is well supplied with plant food.

Crawford Silty Clay. The surface soil is a dark brown to reddish brown silty clay loam 8 to 10 inches deep with a heavy silty clay subsoil of compact structure and somewhat redder color than the surface soil. Small chalky particles of decomposed limestone are scattered through soil and subsoil. Massive limestone is found beneath the subsoil, and is found sometimes at a depth of from 15 to 20 inches from the surface. When plowed at the proper degree of moisture, the soil is pliable, but when wet it is sticky and tenacious. This type is extensively distributed in the area, but usually occurs in small bodies, closely associated with the Crawford stony or gravelly soils in the eastern part of the area. A large tract occurs in northwest Edwards county and comparatively large bodies are found near Comfort, Boerne, Rock Springs, Bandera, and on the high divides south of Fredericksburg. The type is well drained and in many places favorably situated for irrigation. The soil is well adapted to the staple crops of the area, and excellent crops of corn, cotton, oats, wheat, grass, and alfalfa can be grown where water for irrigation is available. Where irrigation is not possible, good yields of sorghum, milo, and kafir are secured when proper methods of dry farming are followed.

For analyses, see soils of Hays, Kendall, Kerr, Bandera, and Comal counties. The samples from Bandera, Hays, Kerr, and Comal counties are well supplied with plant food. That from Kendall county is low in active phosphoric acid. Legume rotation is the primary need.

Crawford Gravelly Clay. This soil is similar to the Crawford clay excepting that it contains a high percentage of gravel, composed of angular limestone fragments and rounded cobbles of chert. In some places this coarse material interferes seriously with cultivation. The type occupies only a comparatively small area. The largest area lies on the high divide between Comfort and Fredericksburg, northwest of Kerrville, and between Boerne and New Braunfels. The greater part of this type is used for grazing. A few fields have been cleared and put in cultivation to cotton, corn, sorghum, milo, and kafir. Fairly good yields are secured in favorable seasons, but in ordinary years the yields of corn and cotton are low.

Crawford Soils Undifferentiated. A number of shallow valleys with long gentle slopes occur in the northeastern part of Burnet county, which contain a number of small bodies of Crawford soils which range in texture from heavy loam to clay loam and clay. It was impracticable to separate the various types in this reconnoissance survey. The greater part of these soils consists of a light clay loam or clay, with large quantities of lime and organic matter with a light brown to reddish brown clay loam or clay subsoil, resting on soft limestone at the

depth of 2 to 4 feet. The soils work up well when sufficiently dry for cultivation, but when wet they are sticky and heavy. The topography varies from level to gently rolling, and the soils are well drained and lie favorably for cultivation. The series in the west are suited only for grazing, but in Burnet county these soils constitute important farming lands and are well adapted to the production of staple crops. Cotton, corn, sorghum, and oats are grown and in ordinary years cotton yields from one-fourth to one-third bale per acre. During wet seasons and when thoroughly cultivated it yields as much as three-fourths bale per acre. Corn yields from 30 to 35 bushels per acre, depending upon the rainfall and the cultivation. Sorghum yields from two to three tons, and oats 25 to 30 bushels.

FRIO SERIES.

Frio Silty Clay Loam. The Frio silty clay loam is a dark grayish brown to brown silty clay loam surface soil with a slight reddish cast, 10 to 15 inches deep, with a subsoil consisting of a light brown to grayish brown compact, silty clay loam or silty clay. It is an alluvial soil, consisting of material originally derived from weathering of limestone. It occurs in nearly all the valleys of the limestone regions of the area surveyed. The largest body is found in the valley of the San Saba River, and begins in shallow draws on the Eldorado Plains and extends entirely across Menard county, varying in widths from one to three miles. Another important body is found near Junction along the Llano River and its upper tributaries. Smaller bodies are found along the Guadalupe, San Saba, Medina, Frio and Nueces Rivers, and their tributaries, as well as along draws throughout the Edwards Plateau. Along the larger streams, such as the Llano and San Saba Rivers, the soil occupies three or more terraces, separated by a bluff 16 to 20 inches in height and having good drainage. Within the smaller valleys and draws the type has a gentle slope extending back from the dry water courses to the foot of the uplands. In its native state the type is heavily wooded.

This is one of the most important types of the area. It is naturally productive, easily worked and adapted to a wide range of crops, and a large part of it may be irrigated at comparatively small expense. In the vicinity of Menard and Junction a large acreage of the type is irrigated and used for the production of cotton, corn, sorghum, oats, Johnson grass, alfalfa, and vegetables. Under irrigation cotton yields one-half to one bale per acre; corn, 40 to 65 bushels; alfalfa from one to two tons per acre per cutting, with a usual production of three cuttings; oats, 45 to 60 bushels per acre, and sorghum, three to five tons per acre. Without irrigation crops are uncertain.

For analyses, see soils of Menard, Kimble, Kerr, and Edwards counties.

The sample from Menard county is well supplied with plant food. The sample from Kimble and Kerr counties is low in nitrogen. The samples from Kerr and Edwards counties are a little low in active phosphoric acid though good in total phosphoric acid.

Frio Gravelly Soils. These areas represent gravelly soils of varied texture. They are usually a gravelly, silty clay loam surface soil. The gravel consists of water worn fragments of limestone, ranging from 2 or 3 inches in diameter to 6 or 8 inches. These soils are found in the valleys of the Edwards Plateau, and are formed by the streams in the time of floods. Larger areas are found in the valley of the Devil's River, the Pecos, the Frio, and the upper draws of the Guadalupe, Llano, and San Saba. The type is found in narrow strips in practically every valley within the limestone portion of the Edwards Plateau. The average width is one-fourth to one-half miles. Vegetation is rather sparse. These soils are adapted only to grazing on account of the high content of gravel and stone, although small bodies are found where the gravel is less abundant, and which can be used for cultivated crops when irrigated.

Gravelly Soils Undifferentiated. These consist of water worn gravel, composed of limestone and chert, ranging from 1 to 6 inches in diameter, and occupy a number of gravel-capped ridges bordering the valley of the Rio Grande in the vicinity of Del Rio. The soil is unfit for cultivation and is used as a range for cattle and goats.

HOUSTON SERIES.

Houston Clay Loam. The surface soil is a dark brown to black clay loam, 8 to 12 inches deep, with a dark gray clay subsoil which grades into a lighter calcareous material. The color of the surface soil varies from light gray near the base of limestone hills to black in the valleys and level areas. The soil is well supplied with organic matter and is not hard to handle if not cultivated when too wet. Only a small area of this type is found in the district surveyed. The topography varies from level to gently rolling. The surface is sufficiently sloping to secure good drainage. Corn, cotton, and sorghum are the chief crops grown.

For analyses of the soil, see Hays county. The sample is low in active phosphoric acid.

Houston Clay. The surface soil is a dark gray to black heavy clay loam or clay, 10 to 12 inches deep with yellowish brown lime concretions. The subsoil is a stiff drab or yellowish brown clay and becomes lighter colored with increased depth. When wet it is sticky and plastic, but plowed in the right condition it works down into a fine loamy soil. It occupies only a small area in this section. The surface is level to gently rolling. It is a productive soil. It requires frequent cultivation to retain moisture. Cotton yields one-fourth to one-third bale per acre in dry years, and from one-half to one bale per acre when the rainfall is sufficient. Corn yields 20 to 50 bushels per acre in favorable seasons, but is frequently injured by dry weather. Sorghum yields three to five tons per acre in favorable years. Johnson grass is grown to some extent.

For analyses of these soils, see soils of Comal and Hays counties.

The sample from Hays county is well supplied with plant food. That from Comal county is low in nitrogen and in active phosphoric acid.

Houston Black Clay. This soil consists of a dark gray to jet black clay, 10 to 12 inches deep, with a dark gray to black plastic clay subsoil of slightly lighter color. It is locally known as black waxy land. If cultivated at the right degree of moisture, it breaks up into a fine character, but it forms clods when plowed too wet. It occupies only a small area in the area surveyed in the vicinity of New Braunfels, Manchaca, and Austin. The drainage is usually excellent. Cotton yields from one-fourth to one-half bale per acre under ordinary conditions, and with favorable rainfall one bale per acre. Sorghum yields from three to four tons from the first cutting, one to one and one-half for the second cutting. The soil is considered an excellent soil for general farm crops.

For analysis of the soil, see soils of Hays, Comal, and Travis counties. The sample of Hays county is low in active phosphoric acid. Those of Comal and Travis counties are well supplied with plant food.

Houston Gravelly Clay. The surface soil is a dark brown to black clay loam or clay, 10 to 12 inches deep, containing a large amount of gravel and water worn stones 1 to 5 inches in diameter. The subsoil is a light brown to black, stiff, heavy clay, containing more gravel than the surface soil. It is not a good soil to till, even when plowed at the proper time. This soil occupies only a small area, on low, rounded ridges with excellent drainage. When well cultivated this soil gives good yields of all staple crops. Cotton yields from one-fourth to three-fourths bale per acre, corn from 20 to 35 bushels, and sorghum yields from three to six tons for the first cutting and one to one and one-half tons for the second cutting under favorable rainfall conditions.

For analysis of the soil, see soils of Comal county. The sample is low in nitrogen.

KATEMCY SERIES.

Katemcy Soils Undifferentiated. These soils have a dark brown to black surface soil, ranging in texture from fine sandy loam to loose sandy loam to loam and clay loam. Granite outcrops occur in places. The soils occur in only two small bodies in the northern part of Mason county, the total area being about three-sixths square miles. They have a level, valley-like topography and are enclosed on the west and south by a high ridge of limestone hills. The drainage is good. Practically all of these soils are under cultivation. Good yields of staple crops are secured.

LANCASTER SERIES.

Lancaster Stony Sandy Loam. Lancaster stony sandy loam consists, as a rule, of a light sandy loam or loamy sand, 3 to 6 inches deep, resting upon sandstone rock. When wet the soil has a dark brown color, and when dry a grayish brown appearance. In some places along draws, the soil is 12 to 15 inches deep. Quantities of angular fragments of yellowish or brownish stone are scattered over the surface. This soil occurs chiefly in Mason and Llano counties. The largest body occupies about four square miles and lies southeast of Fredonia. Several other areas occur between Fredonia and Mason in Mason county, and in the vicinity of Valley Spring and Click in Llano county. The surface ranges from hilly to rough and broken. The shallow and stony character of the soil renders it practically unfit for agriculture, but it furnishes fairly good grazing.

Lancaster Sandy Loam. Lancaster sandy loam consists of a brown or slightly reddish brown medium-textured sandy loam or loamy sand surface soil, 18 to 24 inches deep, with a small amount of sandstone and quartz gravel, with a yellow or a mottled yellow and gray, compact sandy loam subsoil, usually underlaid by sandstone rock at a depth of three feet or less. The largest body of about ten square miles is found near Streeter. Other bodies are found in the vicinity of Fredonia, Katemcy, Mason, Pontotoc, Valley Spring, Starkes, Cherry Spring, and Loyal Valley. The soil occupies level to gently rolling areas and has good drainage, while the porous nature of the surface soil and subsoil secures good under drainage. A large portion of the type is under cultivation and produces one-fourth bale of cotton and 15 to 20 bushels of corn in an average season. It is said that crops have never been a complete failure on this soil even in the dryest years. Berries and all kinds of truck do very well with the proper cultivation.

For analyses see soils of Mason county. The sample is low in active phosphoric acid and in nitrogen. Legume rotation and phosphates are needed.

LAREDO SERIES.

Laredo Silt Loam. The Laredo silt loam consists of a gray to light brown silt loam, 8 to 10 inches deep, with a light, slightly yellowish brown silt loam or clay loam subsoil. It occurs as terraces along the streams and constitutes valuable farming land when irrigated. It is found as a narrow strip along the Rio Grande and Pecos Rivers. The largest body occurs at Del Rio. The surface varies from level to gently rolling. The soil could be easily irrigated, although only a small amount is as yet under irrigation. In the vicinity of Del Rio, about 2000 acres are irrigated and used for the production of cotton, corn, oats, sorghum, Johnson grass, and truck, such as Bermuda onions, cabbage, peppers, and sweet potatoes. All of the crops give good yields. The soil has a tendency to bake and form a crust on the surface, and for this reason requires frequent cultivation.

For analyses of these soils, see Val Verde county. The sample is low in active phosphoric acid.

MILES SERIES.

Miles Soils Undifferentiated. The Miles soils are light colored soils which have been formed under semi-arid conditions in the northwestern part of the area from the weathering of limestone. A greater part of the area is mapped as Miles soils undifferentiated, and consist of a silty clay loam surface soil, of a light grayish brown color, 8 to 12 inches deep, with a few fragments of a white or pinkish colored limestone. The subsoil is a light grayish brown or yellowish brown material of heavier texture with a slightly pinkish cast. The quantity of limestone increases with the depth of the soil until it grades into a mass of limestone at the depth of 2 to 5 feet. Small areas of light grayish brown silty clay and silt loam are found in which the limestone fragments are almost entirely absent. These soils are confined almost entirely to the high open plains of Crockett county. The largest body begins near the northeast corner of the county and extends for nearly fifty miles along the north and south divide which separates the drainage of Johnson Creek and Howares Creek. At the Crawford ranch this body divides and a large lobe extends southeast for nearly twenty miles. The soils have a level to gentle rolling surface. They are used almost entirely for grazing cattle and goats and provide good pasturage when not overstocked. These soils are friable, easily worked and naturally productive, but on account of insufficient rainfall they do not produce well. Moderate yields are produced in ordinary seasons, but in favorable seasons, which occur about once in five years, excellent yields of cotton, corn, oats, and also other staple crops are harvested.

For analyses, see soils of Crockett county. The sample is well supplied with plant food.

MILLER SERIES.

Miller Fine Sandy Loam. The Miller fine sandy loam consists of a brown to reddish brown fine sandy loam 10 to 12 inches deep with a brown to reddish brown clay loam or clay subsoil. It is an alluvial soil, found only in narrow strips along the Colorado River. The largest bodies average from one-fourth to one-half mile in width and occur in the beds of the river at Austin, Bluffton, and in the vicinity of Kingsland and Marble Falls. Several other bodies lie along the river in Llano and Burnet counties. The type occupies the lowest portion of the Colorado River valley, which is 15 to 20 feet above the normal flow and very rarely reached by floods. Most of the type is used for grazing. In the vicinity of Austin the average yield of cotton is one-half to three-fourths bale and of corn, 40 to 50 bushels per acre.

For analyses, see soils of Llano county. The sample is low in nitrogen.

PEDERNALES SERIES.

Pedernales Stony Sandy Loam. The Pedernales stony sandy loam consists of a red or reddish brown sandy loam surface soil, 8 to 12 inches deep, with a red sandy clay subsoil about 10 inches thick and resting on limestone at a depth of 15 to 18 inches. Quantities of flat limestone fragments are scattered over the surface. Outcrops of rock also occur. The greater part of this type is confined to Blanco county, where it occurs in strips one-half to three miles or more in width along the Pedernales River and Cypress Creek. Other small areas occur along some of the small creeks in the southwestern part of Mason county and along Live Oak Creek in Gillespie county. The topography varies from level and gently rolling to rough and broken. The greater part of the type has no value for farming and is used for grazing.

For analyses, see soils of Mason county. The sample is well supplied with plant food.

Pedernales Stony Fine Sandy Loam. The Pedernales stony fine sandy loam has a red to reddish brown fine sandy loam surface soil from 2 to 6 inches deep resting on limestone or sandstone rock. Many fragments of limestone and sandstone occur on the surface of the soil. This type occurs in Llano, Burnet, and Mason counties. An area of approximately fifty square miles lies northwest of Terry Springs. Other areas are found in the vicinity of Valley Springs, Starkes, Katemcy, Fredonia, Hilda, Burnet, Marble Falls, and on Riley Mountain. The topography ranges from hilly to rough and broken. The soil is too rough, shallow and broken to place in cultivation, but is used for grazing.

For analysis, see soils of Gillespie county. The sample is low in nitrogen.

Pedernales Sandy Loam. The Pedernales sandy loam usually consists of a reddish brown to reddish, medium textured, sandy loam surface soil with a compact, red sandy clay loam to clay subsoil several feet deep, resting upon limestone rock. Small areas of darker colored and heavier textured soils occur, and also knolls of heavily textured gravelly soils, together with strips of fine sandy loam. The type is confined almost entirely to the valley-like basins of the Pedernales and Llano Rivers and their tributaries, and occurs in Gillespie, Blanco, Mason, Menard, and Kimble counties. The largest area extends in a wide strip from Morris ranch, in Gillespie county, eastward to the Blanco county line, a distance of thirty miles. Other areas are found in the northern part of Blanco, the southwestern part of Mason, the northeastern part of Kimble and the southern part of Menard counties. The surface is level to rolling, with sufficient slope for good drainage in most cases, although there are small flat areas that would undoubtedly be improved by under drainage. A large part of this type in Gillespie county has been cleared and cultivated for a number of years and is some of the most valuable agricultural soils in the region. Corn

yields 20 to 25 bushels, cotton one-third to one-half bale, sorghum two to and and one-half tons, oats 35 to 60 bushels, and wheat 25 to 35 bushels per acre in average seasons. A considerable part of the type in Mason county is still used for grazing. Small grains give better chances of success, as they are sown in the fall and make most of their growth during winter, spring, and early summer months, when the rainfall chiefly occurs.

For analysis, see soils of Gillespie county. Two of the samples are very low in active phosphoric acid. Two are low in nitrogen, the other one is only fair. Legume rotation and phosphate fertilizers are indicated.

Pedernales Stony Loam. The Pedernales stony loam consists of a brown loam, or silty loam surface soil, 2 to 8 inches deep, resting on limestone rock, and contains large quantities of gravel, with scattering fragments of limestone rock on the surface. Areas occur in the southern part of Mason county. The largest area is southwest of Hilda, and occupies approximately forty square miles. The surface is hilly to rough and broken. The type is too rough and shallow to be used for other than grazing purposes.

For analyses, see soils of Mason county.

Pedernales Loam and Sandy Loam Undifferentiated. These soils consist of areas of loam and sandy loam in such small bodies that it was impracticable to make a separation on a map of the scale used. Heavier portions of the type consist of a reddish brown to dark brown loam surface soil, 10 to 15 inches deep, with a red sandy clay loam subsoil resting on limestone at a depth of 2 feet or less. The greater part of the type consists of light brown to reddish brown or red, medium-textured sandy loam, 12 to 18 inches deep, with a sandy clay loam subsoil underlain with limestone rock at a depth of 3 to 6 feet below the surface. The greater part of this type is found in eastern Menard and western Mason counties, the largest bodies occurring in the vicinity of Hext and northeast of London. The surface is level to gently rolling, with sufficient slope to insure good drainage. The greater part of the type is under cultivation. In favorable seasons corn yields 10 to 20 bushels, cotton one-fourth to one-third bale, and oats 50 to 75 bushels per acre. Milo, millet, and sorghum also do well. As the soil is shallow, summer crops are frequently damaged by drouth.

For analyses, see soils of Menard county. The sample is low in active phosphoric acid and nitrogen. Legume rotation and phosphates are indicated.

PONTOTOC SERIES.

Pontotoc Sandy Loam. The Pontotoc sandy loam consists of a bright red, medium-textured, sandy loam surface soil, having an average depth of 2 feet, and a lighter colored subsoil of slightly heavier texture. There are areas in which the subsoil is a red loam or sandy clay loam. In other cases, sandstone occurs at the depth of 2 feet or

less. Areas of this type border the sandstone and limestone hills in Llano, Mason, and Burnet counties. Nearly all the areas mapped are small, the largest, containing approximately two square miles, lies northwest of Streeter. Other areas are found in the vicinity of Burnet, Mason, Fredonia, Hilda, and Riley Mountain, and northeast of Lone Grove. The topography varies from level to gently rolling, with good surface drainage. Practically all of this type is under cultivation. It is easily cultivated and warms early in the spring, but frequent cultivation is necessary to retain sufficient moisture. Cotton ordinarily yields one-fourth to one-third bale, and corn 12 to 15 bushels. Oats yield 50 to 60 bushels, and wheat 25 to 30 bushels in seasons of normal rainfall.

For analysis, see soils of Mason county. The sample is low in nitrogen. Legume rotation is indicated.

Pontotoc Stony Sandy Loam. The Pontotoc stony sandy loam consists of a bright red sandy loam of fine to medium texture, mixed with many fragments of bright red sandstone, and resting on dark gray sandstone rock at a depth varying from a few inches to two feet or more. Outcrops of rock occur frequently. The type is of a very small extent, occurring only in a few small bodies, as low rounded ridges, or on the lower slopes of hills in Mason, Llano, and Burnet counties. An area is found at the base of Bald Mountain, about eight miles northwest of Burnet. On account of the rough topography and stony character of the soil the type is used only for stock ranges.

ROSWELL SERIES.

Roswell Fine Sandy Loam. This soil for the greater part consists of a brown, fine sandy loam, 6 to 10 inches deep, with a light brown fine sandy loam subsoil of heavier texture. A phase of the type developed near the northwest corner of the area consists of a light gray to grayish brown silt loam, 8 to 12 inches deep, with a silty clay loam subsoil, which when dry is light reddish or pinkish brown and when wet a light chocolate color. This soil occurs as a strip from one-fourth to two miles wide and about forty-five miles along the Pecos River and Five Mile Creek in the extreme northwest corner of Crockett county. It is an alluvial soil, above high water mark, but not too high for irrigation. This soil was not utilized for farming purposes at the time this survey was made.

Rough Stony Land. This consists of land too rough and stony for tillage, and adapted only to grazing. It includes a difference of the soil character rather than difference in types. The soil is for the most part very shallow and on the slopes large areas occur where the hard underlying limestone is exposed. The soil is rarely more than a few inches deep. The soil is very extensive in area and is found in all the counties surveyed. The topography is very rough and broken. The land is incapable of being cultivated, but fairly well adapted to grazing.

SAN ANTONIO SERIES.

San Antonio Silty Clay Loam. The San Antonio silty clay loam consists of a dark chocolate brown or brownish red silty clay loam, 6 to 10 inches deep, with a dull red to brownish red compact clay subsoil, carrying small quantities of small limestone fragment, which become more numerous with the depth. The material passes into rounded fragments, which rest on limestone rock 3 to 5 feet below the surface. The soil is usually deeper near the streams. The type is both alluvial and colluvial in origin. It is of relatively small extent, but of considerable agricultural importance. It occurs almost entirely in narrow valleys of Cibollo Creek and the Guadalupe, Medina, and Sabinal Rivers. There is a narrow strip along the base of the escarpment at San Marcos. The largest and most important body is found along the Guadalupe, where it comprises a more or less continuous strip one-fourth to one-half mile from near the town of Ingram to a few miles below Waring. The type occurs in narrow valleys and has a gentle slope towards the stream.

This is one of the best agricultural soils in the area. It is early, easily worked, and productive, and is favorably situated for irrigation. The principal crops are cotton, corn, oats, wheat, sorghum, and kafir. Cotton yields one-half bale or more per acre in favorable years, although the average is about one-third bale per acre. Corn yields about 30 bushels; oats, 30 to 60 bushels with an average of about 35 bushels; and one acre is said to furnish grazing for two cows for about two months during winter. Wheat yields 18 to 30 bushels with an average of about 25. Very little of the land is under irrigation.

For analyses, see soils of Kerr and Kendall counties. One sample is well supplied with plant food, the other is low in nitrogen.

TISHOMINGO SERIES.

Tishomingo Stony Sandy Loam. The Tishomingo stony loam has a brown or reddish brown sandy loam surface soil, 18 to 24 inches deep, with a red, yellow, or mottled brown, gray, and yellow sandy subsoil. The soil, however, varies considerably. It ranges in depth from 6 to 36 inches. Angular quartz and feldspar gravel are usually found in both surface and subsoil in considerable quantities, and outcrops of rock also occur. The soil as a rule is too shallow and rocky to be of value for farming. Bodies ranging from a few acres to several square miles occur in the northern part of Gillespie and Blanco counties, in the eastern part of Mason county, and in all parts of Llano county. The topography ranges from rolling and hilly to rough and broken. The soil has thorough drainage, but the rainfall of the section is deficient. Only a very small quantity of this type has been placed under cultivation. In seasons of average rainfall cotton yields one-fourth to one-third bale and corn 15 to 25 bushels per acre. Nearly all of the type is used for pasture, and it is a good soil for this purpose, as the grasses start early in the spring and are not so readily killed by the

long dry spells as are the heavier soils. It is estimated in the eastern part of the area that ten acres will support one cow, whereas in the western part twenty acres are required.

For analysis, see soils of Llano county. The sample is low in active phosphoric acid and not well supplied with nitrogen.

Tishomingo Stony Fine Sandy Loam. This soil consists of red or reddish-brown sandy loam surface soil, 18 to 20 inches deep, with a red, compact, gravelly loam to gravelly clay loam subsoil, resting upon bed rock at an average depth of two feet or less. The surface soil has considerable quantities of angular quartz and feldspar gravel. Along some of the draws the soil with subsoil is three feet deep, while on the ridges it is often not over one foot deep. Only a few bodies of this type have been mapped. A few of these cover an area of several square miles in the southeastern part of Llano county. The topography is rolling to hilly. The soil is devoted almost exclusively to grazing.

For analyses, see soils of Llano county.

Tishomingo Gravelly Sandy Loam. The Tishomingo gravelly sandy loam consists of a reddish-brown to dark brown heavy sandy loam or light loam, 15 to 20 inches deep, containing much angular quartz and feldspar gravel. The subsoil is a very compact, gravelly clay of a bright red color as a rule, although there are areas in which it is yellow or mottled red and yellow, resting upon decomposed granite at a depth of 2 to 5 feet.

This type is found in various parts of Llano, Mason, and Burnet counties. The most extensive bodies embrace several square miles and lie between Lone Grove and Kingsland, in the eastern part of Llano county, and west of Marble Falls in Burnet county. Other areas occur in the vicinity of Katemcy, Plehweville, Oxford, and Grit, southeast of Castell, and in the extreme southeastern part of Llano county.

The topography is level to gently rolling and as a rule the soil is well drained, although some small level areas and depressions are poorly drained. Only a small part of the type is under cultivation. The soil does not retain moisture as well as some of the lighter soils. The most extensively cultivated area is near Bluffton. Most of this type is used for grazing.

For analyses, see soils of Mason county. The soil is fairly well supplied with plant food.

Tishomingo Stony Clay Loam. The Tishomingo stony clay loam consists of 3 to 8 inches of a red loam, or a heavy red fine sandy loam, containing considerable quantities of angular quartz and feldspar gravel, with a red clay loam or clay subsoil usually underlaid by bedrock at a depth of 18 inches to 2 feet from the surface. This type occurs chiefly in Mason and Llano counties, and extensive areas occur in the vicinity of Llano, Mason, and southeast of Kingsland. Small areas are also found in the northern part of Blanco and Gillespie counties. It has a rolling to level topography, with good surface drainage, while the

soil retains moisture well when properly cultivated. A few small areas have been placed under cultivation and produce from one-fourth to one-third bale of cotton, 15 to 25 bushels of corn, and two to two and one-half tons of sorghum per acre in seasons of average rainfall. In seasons of abundant rainfall the yields are considerably greater. The greater part of this type is grazing land.

For analyses, see soils of Llano county. The soil is low in active phosphoric acid.

Tishomingo Sandy Loam. The surface soil consists of a red to reddish brown medium-textured sandy loam or loamy sand, carrying small quantities of fine quartz gravel, 18 to 24 inches deep, with a compact sandy clay loam subsoil of a dark red color resting upon weathered rock at a depth of 2 to 4 feet deep. The soil frequently has a dark brown color. Extensive areas occur where the subsoil is either yellow or red, mottled with yellow and gray. Variations in texture occur. This soil occurs to a limited extent in the northern part of Gillespie and Blanco counties, but most of it is found in the eastern part of Mason, the western part of Burnet, and through all parts of Llano county. The areas range from a few acres to several square miles in extent. Extensive areas are found in the vicinity of Mason, Castell, Valley Spring, and Pontotoc. The surface varies from level to gently rolling or occasionally hilly. The soil has good natural surface drainage. This soil is widely cultivated, although large areas are used exclusively for grazing. Sorghum yields from one and one-half to two tons, oats 20 to 30 bushels, cotton one-fourth to one-third bale, and corn 15 to 25 bushels per acre in the average season. In good seasons larger yields are secured. The soil is easily worked and a good mulch is easily secured.

For analysis, see soils of Llano county. The sample is low in active phosphoric acid.

Tishomingo Fine Sandy Loam. Tishomingo fine sandy loam consists of a fine red sandy loam, 10 to 12 inches deep, with a red clay loam subsoil of rather compact structure on rock at a depth of about 5 to 6 feet. The soil is friable and easily worked. It occupies only a small area, occurring in a small body in the basin-like area near Fairland and in other small bodies throughout the other Tishomingo soils in Llano and Mason counties. The surface is level to gently sloping. Practically all this type is cleared and highly cultivated. In favorable years excellent yields of cotton, corn, sorghum and small grain crops are secured. The soil stands drouth well.

For analysis, see soils of Burnet county. The sample is well supplied with plant food. Legume rotation is indicated.

Tishomingo Loam. The Tishomingo loam consists of a red loam, or sandy loam, carrying considerable quantities of angular gravel, with a compact, red clay loam, or clay subsoil, resting on rock at the depth of one to three feet, with an average depth of two feet. The type occupies approximately twenty-three square miles in the area surveyed. A

body of it lies east of Loyal Valley in Mason county, and other bodies along Coal Creek, in the southeastern part of Llano county and in the southeastern part of Burnet county. The surface is rolling and has good surface drainage. Practically all of the type is used for grazing, although one or two small tracts are in cultivation.

For analyses, see soils of Llano county. The soil is fairly well supplied with plant food.

VERNON SERIES.

Vernon Fine Sandy Loam. The Vernon fine sandy loam consists of a brown to reddish brown fine sand, or fine sandy loam, 6 to 10 inches deep with a light brown fine sandy loam subsoil. Both surface soil and subsoil are loose and open in structure, and the surface is drifted into small ridges and dunes by the wind. This soil occupies only one small body near the corner of Crockett county, although it is found in considerable areas further north of the section surveyed. This type is best suited to grazing. Irrigation is necessary for successful farming.

LIST OF SOIL TYPES BY COUNTIES.

The following is a list of types found by counties:

Bandera County.

Crawford silty clay.
Crawford stony clay.
Frio silty clay loam.
Rough stony land.
San Antonio silty clay loam.
Brackett stony soils.
Blanco fine sandy loam and silt.
Crawford gravelly clay.

Blanco County.

Rough stony land.
Crawford silty clay.
Frio silty clay loam.
Crawford stony clay.
Brackett clay loam.
Crawford gravelly clay.
San Antonio silty clay loam.
Blanco fine sandy loam and silt.
Pedernales stony fine sandy loam.
Pedernales stony sandy loam.
Tishomingo sandy loam.
Pontotoc sandy loam.
Tishomingo stony sandy loam.

Burnet County.

Tishomingo loam.
Tishomingo stony clay loam.
Tishomingo sandy loam.
Tishomingo gravelly sandy loam.
Tishomingo stony sandy loam.
Rough stony land.
Crawford stony clay.
Brackett clay loam.
Miller fine sandy loam.
Crawford silty clay.
Pedernales stony fine sandy loam.
Pontotoc sandy loam.
Crawford soils.
Pontotoc stony sandy loam.
Crawford gravelly clay.
Blanco fine sandy loam and silt.

Comal County.

Crawford stony clay.
San Antonio silty clay loam.
Crawford silty clay.
Crawford soils.
Crawford gravelly clay.
Houston gravelly clay.
Rough stony land.
Houston clay.
Houston black clay.
Blanco fine sandy loam and silt.
Brackett stony soils.

Crockett County.

Crawford stony clay.
Rough stony land.
Miles soils.
Frio silty clay loam.
Crawford clay.
Frio gravelly soils.
Roswell fine sandy loam.
Crawford soils.

Edwards County.

Crawford stony clay.
Crawford silty clay.
Rough stony land.
Frio gravelly soils.
Brackett stony soils.
Frio silty clay loam.
Crawford gravelly clay.

Gillespie County.

Crawford silty clay.
Crawford stony clay.
Brackett stony soils.
Crawford gravelly clay.
Pedernales sandy loam.
Rough stony land.
Houston clay loam.
Frio silty clay loam.
Pedernales loam and sandy loam.
Pedernales stony sandy loam.
Tishomingo stony sandy loam.
Tishomingo sandy loam.
Pedernales sandy loam.
Lancaster sandy loam.
Pontotoc sandy loam.
Pedernales stony fine sandy loam.

Hays County.

Crawford stony clay.
Crawford silty clay.
Brackett stony soils.
Blanco fine sandy loam and silt.
San Antonio silty clay loam.
Houston clay.
Crawford gravelly clay.
Rough stony land.
Houston loam.

Kendall County.

Crawford silty clay.
Crawford stony clay.
Rough stony land.
Frio silty clay loam.
Brackett stony soils.
San Antonio silty clay loam.
Crawford gravelly clay.

Kerr County.

Crawford gravelly clay.
Brackett stony soils.
Crawford silty clay.
Crawford stony clay.
Frio silty clay loam.
Frio gravelly soils.
San Antonio silty clay loam.
Rough stony land.
Brackett stony soils.

Kimble County.

Crawford soils.
Crawford gravelly clay.
Frio gravelly soils.
Frio silty clay loam.
Crawford silty clay.
Blanco silty clay loam.
Rough stony land.
Pedernales sandy loam.
Brackett stony soils.
Houston clay.
Crawford stony clay.

Llano County.

Tishomingo sandy loam.
Tishomingo gravelly sandy loam.
Tishomingo stony sandy loam.
Tishomingo stony fine sandy loam.
Tishomingo stony clay loam.
Rough stony land.
Pedernales stony fine sandy loam.
Miller fine sandy loam.
Lancaster sandy loam.
Pontotoc sandy loam.
Crawford stony clay.
Crawford soils.
Katemcy soils.
Lancaster stony sandy loam.

Mason County.

Rough stony land.
Pedernales stony fine sandy loam.
Pedernales stony loam.
Pontotoc sandy loam.
Tishomingo sandy loam.
Pedernales sandy loam.
Pedernales stony sandy loam.
Tishomingo loam.
Tishomingo stony sandy loam.
Lancaster sandy loam.
Pontotoc stony sandy loam.
Crawford soils.
Crawford silty clay.
Crawford gravelly clay.
Lancaster stony sandy loam.
Pedernales stony loam.

Menard County.

Crawford stony clay.
Crawford silty clay.
Crawford soils.
Frio silty clay loam.
Rough stony land.
Pedernales stony fine sandy loam.
Brackett stony soils.

Real County.

Rough stony land.
Frio gravelly soils.
Frio silty clay loam.
Blanco fine sandy loam and silt.
Crawford silty clay.
Crawford stony clay.
San Antonio silty clay loam.
Brackett stony soils.

Schleicher County.

Crawford soils.
Frio gravelly soils.
Crawford clay.
Frio silty clay loam.
Rough stony land.
Crawford stony clay.
Miles soils.

Sutton County.

Crawford stony clay.
Rough stony land.
Frio gravelly soils.
Crawford soils.
Miles soils.
Frio silty clay loam.
Crawford clay.

Travis County.

Crawford stony clay.
Brackett stony soils.
Rough stony land.
Houston black clay.
Crawford gravelly clay.
Pedernales sandy loam.
Crawford soils.
Crawford silty clay.
Houston clay loam.
Miller fine sandy loam.
Tishomingo stony sandy loam.
Tishomingo stony clay loam.
Tishomingo gravelly sandy loam.

Val Verde County.

Crawford stony clay.
Rough stony land.
Frio gravelly soils.
Frio silty clay loam.
Brackett silty clay loam.
Brackett stony soils.
Gravelly soils.
Laredo silty loam.

TABLE 5. COMPARISON OF SOILS.

Per Cent.	Bandera County.		Burnet County.				Caldwell County.		Comal County.			
	Crawford silty clay.		Tishomingo fine sandy loam. (probably).		Crawford clay (probably).		Susquehana fine sandy loam.		Houston clay.		Blanco silt loam.	
	Surface 6130	Subsoil 6131	Surface 4336	Subsoil 4337	Surface 11375	Subsoil 11376	Surface 336	Subsoil 337	Surface 6085	Subsoil 6086	Surface 6087	Subsoil 6088
Phosphoric Acid	.18	.14	.11	.15	.19	.12	.04	.04	.05	.05	.07	.07
Nitrogen	.17	.13	.05	.05	.16	.08	.10	.05	.07	.03	.04	.02
Potash	.63	.82	.41	.67	.80	.68	.34	.43	.58	.50	.26	.28
Total Potash	1.34	.98	3.64	3.46	1.40	1.24	1.00	1.48	.84	.88	.50	.54
Lime	1.63	.77	.22	.29	15.22	19.75	.70	.62	14.47	16.33	40.94	39.94
Magnesia	.31	.24	.34	.47	.39	.65	.20	1.27	.40	.40	.54	.68
Alumina and Oxide of Iron	22.42	25.23	5.69	9.14	9.14	7.60	15.12	14.40	13.79	14.20	3.82	4.06
Insoluble and Soluble Silica	57.14	46.68	89.64	82.82	52.42	49.77	72.39	73.88	46.22	45.15	17.34	18.18
Loss on Ignition	10.01	9.93	1.85	2.29	11.36	10.46	5.20	5.14	9.83	11.20	2.56	8.64
Moisture	6.41	6.78	1.97	4.17	3.05	2.77	5.35	4.67	5.81	5.47	1.00	1.94
Parts Per Million.												
Active Phosphoric Acid	.....	.....	322	231	163	75	7	11	4	4	16	1
Active Potash	.....	.....	50	74	366	155	272	113	331	80	124	53
Acidity	0	0	0	0	100	100	0	.....	0	0	0	0

TABLE 5—Continued. COMPARISON OF SOILS.

Per Cent.	Comal County.						Crockett County.		Edwards County.		Gillespie County.	
	Houston black clay.		Houston gravelly clay.		Crawford silty clay. (dark phase).		Miles soils undifferentiated.		Frio silty clay loam (probably).		Pedernales sandy loam.	
	Surface 6089	Subsoil 6090	Surface 6091	Subsoil 6092	Surface 6134	Subsoil 6135	Surface 7071	Subsoil 7072	Surface 7223	Subsoil 7224	Surface 6114	Subsoil 6115
Phosphoric Acid	.06	.15	.03	.05	.11	.09	.12	.11	.11	.09	.03	.02
Nitrogen	.10	.07	.07	.08	.18	.14	.17	.13	.17	.10	.04	.02
Potash	.69	.35	.54	.52	.27	1.10	.93	.82	.96	.88	.26	.76
Total Potash	.68	.44	.78	.65	1.76	1.31	1.92	1.76	1.49	1.39	2.20	1.77
Lime	5.12	1.32	2.62	2.45	6.20	7.94	14.72	16.86	20.64	20.24	.16	.27
Magnesia	.56	.29	.24	.35	.43	.53	.49	.48	.08	.25	.12	.24
Alumina and Oxide of Iron	18.04	13.92	16.71	16.77	16.34	16.48	10.81	11.23	8.7	9.84	3.35	9.99
Insoluble and Soluble Silica	54.06	71.12	61.72	60.09	56.42	52.91	51.27	43.36	42.90	42.44	93.57	82.75
Loss on Ignition	12.04	6.10	8.08	8.39	10.48	11.34	13.40	13.23	11.08	11.10	1.87	2.31
Moisture	8.83	6.50	8.26	9.30	7.03	6.50	4.26	4.27	4.39	3.97	.88	3.45
Parts Per Million.												
Active Phosphoric Acid	157	12	94	74	78	8	44	16	29	13	21	2
Active Potash	578	234	515	535	.....	.....	417	258	335	148	169	181
Acidity	0	0	0	0	0	0	0	.....	.....	.....	0	0

TABLE 5—Continued. COMPARISON OF SOILS.

Per Cent.	Gillespie County.					Hays County.					
	Pedernales sandy loam.		Pedernales sandy loam.		Pedernales stony fine sandy loam.	Houston black clay.		Crawford silt clay.		Blanco loam.	
	Surface 6124	Subsoil 6125	Surface 6128	Subsoil 6129	Surface 6141	Surface 324	Subsoil 325	Surface 326	Subsoil 327	Surface 328	Subsoil 329
Phosphoric Acid	.02	.03	.03	.04	.11	.08	.06	.11	.33	.12	.10
Nitrogen	.02	.04	.07	.03	.08	.13	.06	.18	.09	.11	.07
Potash	.10	.84	.84	1.23	.30	.20	.06	.78	.81	.05	.40
Total Potash	1.22	1.73	2.24	2.06	1.56	.84	1.72	2.02	1.66	.98	.72
Lime	.13	.21	.45	.42	.86	19.61	14.40	1.58	1.62	34.91	34.44
Magnesia	.07	.26	.30	.34	.17	.62	.22	.83	.24	.91	.48
Alumina and Oxide of Iron	1.04	16.93	11.82	16.41	6.29	9.74	12.64	15.00	15.54	5.75	5.30
Insoluble and Soluble Silica	97.46	71.38	77.68	71.19	87.63	42.07	48.91	63.19	62.81	23.61	22.44
Loss on Ignition	.85	5.18	4.38	4.52	4.41	11.53	7.62	7.44	9.79	12.20	7.73
Moisture	.20	5.56	5.33	6.06	.89	4.03	7.01	8.55	8.59	2.75	2.51
Parts Per Million.											
Active Phosphoric Acid	8	3	3	4	397	10	.....	384	2054	36	.....
Active Potash	146	319	425	329	299	281	90	141	443	149	.....
Acidity	0	0	0	0	0	0	.....	.....	.....	0	0

TABLE 5—Continued. COMPARISON OF SOILS.

Per Cent.	Hays County.							Kendall County.			
	Crawford stony clay.		Houston clay.		Houston loam.		Yazoo clay.	Crawford silty clay. (probably).		San Antonio silty clay loam (probably).	
	Surface 330	Subsoil 331	Surface 332	Subsoil 333	Surface 334	Subsoil 335	Surface 338	Surface 1209	Subsoil 1210	Surface 7147	Subsoil 7148
Phosphoric Acid	.18	.11	.10	.12	.03	.03	.12	.03	.01	.04	.05
Nitrogen	.20	.28	.28	.10	.18	.06	.13	.13	.04	.12	.11
Potash	.58	.28	.04	.03	.29	.44	.41	.43	.49	.80	.76
Total Potash	.82	1.02	.82	.58	.84	.86	1.10	.66	.....	1.26	1.14
Lime	12.40	16.61	19.32	30.21	.37	.60	9.86	27.14	17.98	2.88	7.43
Magnesia	.30	.02	.44	.45	.23	.63	.96	7.27	11.73	.34	.55
Alumina and Oxide of Iron	16.01	15.60	12.17	8.27	6.23	15.81	....	4.11	3.99	14.68	15.04
Insoluble and Soluble Silica	45.09	41.75	38.75	26.90	85.24	71.05	....	10.33	10.02	62.96	55.69
Loss on Ignition	12.00	13.44	9.75	8.69	4.35	5.83	7.72	1.18	20.31	8.44	8.76
Moisture	6.12	6.61	5.30	5.00	2.32	5.41	5.65	1.73	1.47	7.66	7.37
Parts Per Million.											
Active Phosphoric Acid	31	36	83	11	12	6	97	6	30	29	8
Active Potash	198	7	140	103	287	115	140	74	.....	524	115
Acidity	0	0	0	.....	0	0	....	.....	.....	.....	.....

TABLE 5—Continued. COMPARISON OF SOILS.

Per Cent.	Kerr County.						Kimble County.		Llano County.		
	Frio silty clay loam. (probably).		Crawford silty clay. (probably).		San Antonio silty clay loam.		Frio silty clay loam.		Tishomingo sandy loam. (probably).	Miller fine sandy loam.	
	Surface 4380	Subsoil 4381	Surface 5955	Subsoil 5956	Surface 6120	Subsoil 6121	Surface 6132	Subsoil 6133	urface 976	Surface 6110	Subsoil 6111
Phosphoric Acid	.05	.06	.09	.07	.10	.05	.07	.06	.15	.10	.04
Nitrogen	.07	.09	.15	.09	.02	.01	.06	.03	.05	.04	.04
Potash	1.19	1.26	1.42	1.33	.55	.53	.38	.73	.50	.42	.71
Total Potash	1.82	1.54	1.94	2.00	1.04	.89	.96	1.23	3.71	1.62	1.32
Lime	.60	.97	1.17	.95	29.90	31.44	33.74	23.12	1.76	.42	1.34
Magnesia	.65	.64	.69	.60	.56	.14	.28	.25	.58	.20	.17
Alumina and Oxide of Iron	16.82	17.32	13.88	17.13	7.10	5.90	5.20	8.48	7.96	5.15	10.08
Insoluble and Soluble Silica	67.74	59.83	67.14	66.32	32.27	28.31	27.73	41.57	85.55	90.37	79.86
Loss on Ignition	6.27	7.53	7.80	6.52	4.85	7.21	10.99	13.25	3.34	1.63	3.53
Moisture	6.03	6.35	6.17	7.05	3.32	3.30	2.37	3.63	1.81	1.19	3.44
Parts Per Million.											
Active Phosphoric Acid	20	8	109	19	4	4	.....	33	671	120	31
Active Potash	634	77	1005	694	.....	.....	.....	68	120	.....	.....
Acidity	0	.....	0	0	0	.....	0	0	....	0	0

TABLE 3—Continued. COMPARISON OF SOILS.

Per Cent.	Llano County.								Mason County.			
	Tishomingo stony clay loam.		Tishomingo sandy loam.		Tishomingo stony sandy loam.		Tishomingo loam.		Pontotoc sandy loam.		Tishomingo gravelly sandy sandy loam.	
	Surface 6112	Subsoil 6113	Surface 6116	Subsoil 6117	Surface 6126	Subsoil 6127	Surface 6136	Subsoil 6137	Surface 6106	Subsoil 6107	Surface 6108	Subsoil 6109
Phosphoric Acid	.05	.07	.04	.04	.08	.04	.04	.10	.09	.11	.04	.04
Nitrogen	.07	.08	.05	.05	.05	.05	.07	.05	.04	.04	.06	.04
Potash	.61	1.00	.29	.70	.33	.45	.34	.84	.33	.34	.19	.63
Total Potash	2.84	1.88	2.52	3.00	3.52	1.67	2.12	1.51	3.06	2.34	4.62	2.10
Lime	.86	.71	.21	.31	.19	.44	.38	.45	.11	.13	.22	.20
Magnesia	.61	.65	.20	.33	.24	.32	.27	.38	.14	.11	.08	.....
Alumina and Oxide of Iron	14.61	22.09	4.84	11.82	6.05	14.70	11.22	14.90	6.70	5.94	3.45	18.79
Insoluble and Soluble Silica	77.81	64.22	91.78	79.34	90.12	74.66	81.41	74.36	90.05	90.02	93.10	70.77
Loss on Ignition	2.09	6.54	1.87	3.45	2.15	5.29	3.90	4.59	1.71	1.68	2.18	5.79
Moisture	1.74	4.20	.90	3.35	.76	3.76	2.10	4.28	.93	.98	.56	3.56
Parts Per Million.												
Active Phosphor c Acid	10	4	6	5	9	.....	33	9	237	234	32	8
Active Potash	613	756	296	291	243	.....	279	209	361	.....	235	.....
Acidity	0	0	0	0	0	.....	0	0	0	0	0	0

TABLE 5—Continued. COMPARISON OF SOILS.

Per Cent.	Mason County.		Menard County.			Travis County.					
	Pedernales stony sandy loam.	Lancaster sandy loam.	Pedernales loam.		Frio silty clay loam.	Bastrop fine sandy loam.		Houston black clay.		Susquehana fine sandy loam.	
	Surface 6139	Surface 6140	Surface 6118	Subsoil 6119	Surface 6138	Surface 108	Subsoil 109	Surface 110	Subsoil 111	Surface 112	Subsoil 113
Phosphoric Acid	.06	.03	.04	.04	.15	.07	.08	.07	.06	.02	.02
Nitrogen	.13	.03	.07	.06	.11	.03	.03	.12	.08	.04	.04
Potash	.32	.12	.57	.89	.....	.28	.06	.29	.35	.11	.31
Total Potash	1.83	1.85	1.58	1.95	1.40	1.78	1.10	.66	.88	.42	.71
Lime	16.13	.14	.33	.42	18.50	10.60	13.01	5.66	8.51	.91	.45
Magnesia	.30	.11	.26	.....	.25	1.00	.64	.68	.68	.10	.24
Alumina and Oxide of Iron	3.91	2.56	7.13	11.26	9.94	5.35	7.43	6.45	9.07	1.19	12.46
Insoluble and Soluble Silica	60.02	95.51	85.97	78.29	45.40	64.33	63.98	65.16	59.54	95.53	77.65
Loss on Ignition	8.78	1.39	3.25	3.81	9.85	10.58	6.53	10.89	8.79	1.78	4.10
Moisture	1.52	.40	2.24	4.21	4.59	2.31	2.23	6.88	6.41	.51	4.45
Parts Per Million.											
Active Phosphoric Acid	49	15	14	11	166	17	26	39	44	58	4
Active Potash	.....	133	408	493	546	75	55	176	64	141	.....
Acidity	0	0	0	0	0	0	.....	.....	.....	.....	0

TABLE 5—Continued. COMPARISON OF SOILS.

Per Cent.	Travis County.		Sutton County.		Val Verde County.						
	Travis gravelly loam.		Crawford stony clay.		Brackett stony soil (probably).		Brackett silty clay loam.		Laredo silt loam.		Brackett stony clay loam.
	Surface 114	Subsoil 115	Surface 6122	Subsoil 6123	Surface 1260	Subsoil 1261	Surface 6094	Subsoil 6095	Surface 6096	Subsoil 6097	Surface 6098
Phosphoric Acid	.04	.04	.09	.04	.01	.02	.06	.06	.19	.13	.02
Nitrogen	.13	.07	.12	.09	.03	.03	.09	.06	.09	.05	.10
Potash	.52	.65	1.12	.91	.20	.17	.32	.26	.61	.60	.24
Total Potash	1.60	2.16	1.43	1.43	.56	.....	2.30	.80	.88	1.82	.90
Lime	1.47	.76	2.12	2.44	.27	.25	27.00	27.03	10.73	13.62	28.43
Magnesia	.16	.12	.53	.54	.22	.18	.27	.33	.31	.57	.26
Alumina and Oxide of Iron	15.06	19.08	16.62	16.41	2.10	1.78	4.64	5.90	9.39	9.30	3.98
Insoluble and Soluble Silica	67.21	63.07	60.73	63.23	96.37	95.66	38.48	38.39	63.71	48.38	37.01
Loss on Ignition	7.80	7.75	8.34	7.20	1.17	1.15	10.06	6.43	6.46	10.42	9.58
Moisture	6.42	7.81	8.12	7.91	.28	.46	2.43	2.13	2.32	2.63	2.23
Parts Per Million.											
Active Phosphoric Acid	12	4	74	73	11	.....	11	6	11	64	10
Active Potash	208	.....	591	528	141	.....	198	75	543	406	45
Acidity	.....	.....	0	0	0	0	0	0	0	0	0

DESCRIPTION OF SAMPLES.

Bandera County.

6130. Crawford silty loam, depth 0-12 inches; brown to reddish brown silty clay; two miles northeast of Bandera.

6131. Subsoil to 6130, depth 12-36 inches; reddish brown, heavy silty clay.

Burnet County.

4336. Tishomingo fine sandy loam (probably), depth 0-9 inches; reddish brown fine sand; one miles north of Fairland.

4337. Subsoil to 4336, depth 9-21 inches; reddish fine sand.

11375. Crawford clay (probably), depth 0-6 inches; drab clay loam; eleven miles south of Copperas Cove.

11376. Subsoil to 11375, depth 6-15 inches; gray clay loam.

Caldwell County.

336. Susquehanna fine sandy loam, three miles north of Lockhart.

337. Subsoil to 336.

Comal County.

6085. Houston clay, depth 0-10 inches; dark brown clay; two and one-half miles southwest of New Braunfels.

6086. Subsoil to 6085, depth 10-36 inches; yellowish brown clay.

6087. Blanco fine sandy loam and silt (undifferentiated), depth, 0-10 inches; grayish brown fine sandy loam; two and one-half miles northeast of New Braunfels.

6088. Subsoil to 6087, depth 10-36 inches; yellowish brown loam.

6089. Houston black clay, depth 0-12 inches; black compact clay; three and one-half miles southeast of New Braunfels.

6090. Subsoil to 6089, depth 12-30 inches; black heavy clay.

6091. Houston gravelly clay, depth 0-10 inches; black gravelly clay; three miles southeast of New Braunfels.

6092. Subsoil to 6091, depth 12-36 inches; black gravelly clay.

6134. Crawford silty clay, depth 0-10 inches; dark brown silty clay; five miles northeast of New Braunfels.

6135. Subsoil to 6134, depth 10-36 inches; heavy dark brown silty clay.

Crockett County.

7071. Miles soils, undifferentiated, depth 0-12 inches; brown silty clay loam; twelve miles northwest of Ozona.

7072. Subsoil to 7071, depth 12-30 inches; light pinkish brown soil.

Edwards County.

7223. Frio silty clay loam (probably), depth 0-12 inches; dark brown loam; Barksdale, Texas.

7224. Subsoil to 7223, depth 12-24 inches; dark brown clay.

Gillespie County.

6114. Pedernales sandy loam, depth 0-24 inches; red fine sandy loam; one miles northwest of Fredericksburg.
6115. Subsoil to 6114, depth 12-36 inches; red compact sandy clay.
6124. Pedernales sandy loam, depth 0-24 inches; brown sandy loam; two miles north of Cherry Springs.
6125. Subsoil to 6124, depth 24-36 inches; yellow sandy clay loam.
6138. Pedernales sandy loam, depth 0-8 inches; red heavy loam; three miles south of Fredericksburg.
6139. Subsoil to 6128, depth 8-36 inches; red clay.
6141. Pedernales stony fine sandy loam, depth 0-6 inches; red very fine stony sandy loam; three miles northwest of Cherry Springs.

Hays County.

324. Houston black clay, depth 0-10 inches; San Marcos.
325. Subsoil to 324.
326. Crawford silt clay, depth 0-10 inches; San Marcos.
327. Subsoil to 326.
328. Blanco loam, depth 0-10 inches; San Marcos.
329. Subsoil to 328.
330. Crawford stony clay; San Marcos.
331. Subsoil to 330.
332. Houston clay, depth 0-10 or 12 inches; San Marcos.
333. Subsoil to 332.
334. Houston loam, depth 0-10 inches; San Marcos.
335. Subsoil to 334.
338. Yazoo clay, depth 0-10 inches; San Marcos.

Kendall County.

1209. Crawford silty clay (probably); Welfare, Texas.
1210. Subsoil to 1209.
7147. San Antonio silty clay loam (probably), depth 0-10 inches; black heavy clay; seven miles northwest of Boerne.
7148. Subsoil to 7147, depth 10-24 inches; red and black mottled clay.

Kerr County.

4380. Frio silty clay loam (probably), depth 0-8 inches; dark red sandy soil; southwest side of Center Point.
4381. Subsoil to 4380, depth 8-18 inches; dark red sandy soil.
5955. Crawford silty clay (probably), depth 0-9 inches; black clay; five miles southwest of Comfort.
5956. Subsoil to 5955; brown clay.
6120. San Antonio silty clay loam, depth 0-10 inches; pinkish red silty clay loam; Kerrville.
6121. Subsoil to 6120, depth 10-36 inches; light pinkish red silty clay loam.

Kimble County.

6132. Frio silty clay loam, depth 0-10 inches; light pinkish gray silty clay loam; Junction.

6133. Subsoil to 6132, depth 10-36 inches; light bluish gray silty clay loam.

Llano County.

976. Tishomingo sandy loam (probably), red sandy soil; Llano.

6110. Miller fine sandy loam, depth 0-12 inches; reddish brown fine sandy loam; six miles southwest of Bluffton.

6111. Subsoil to 6110, depth 1-36 inches; pinkish red clay loam.

6112. Tishomingo stony clay loam, depth 0-8 inches; dark red loam; eight miles east of Llano.

6113. Subsoil to 6112, depth 8-36 inches; dark red clay loam.

6116. Tishomingo sandy loam, depth 0-18 inches; reddish brown sandy loam; one mile southwest of Castell.

6117. Subsoil to 6116, depth 18-36 inches; red sandy clay loam.

6126. Tishomingo stony sandy loam, depth 0-24 inches; red to reddish brown sandy loam; five miles northeast of Castell.

6127. Subsoil to 6126, depth 24-36 inches; mottled red, yellow and brown sandy loam.

6136. Tishomingo loam, depth 0-6 inches; dark red loam; three miles east of Loyal Valley.

6137. Subsoil to 6136, depth 6-36 inches; dark red clay loam.

Mason County.

6106. Pontotoc sandy loam, depth 0-24 inches; Indian red sandy loam.

6108. Tishomingo gravelly sandy loam, depth 0-14 inches; reddish brown gravelly sandy loam; seven miles west of Mason.

6109. Subsoil to 6108, depth 14-36 inches; red, mottled with yellow gravelly clay loam.

6139. Pedernales stony loam, depth 0-4 inches; grayish brown loam; five miles south of Hilda.

6140. Lancaster sandy loam, depth 0-18 inches; light brown sandy loam; one mile north of Mason.

Menard County.

6118. Pedernales loam, depth 0-15 inches; reddish brown loam; four miles east of Hext.

6119. Subsoil to 6118, depth 15-36 inches; reddish brown sandy clay.

6138. Frio silty clay loam, depth 0-12 inches; dark gray to black silty clay loam; two miles west of Menard.

Travis County.

108. Bastrop sandy loam; Austin.
109. Subsoil to 108.
110. Houston black clay; Austin.
111. Subsoil to 110.
112. Susquehanna fine loam; Austin.
113. Subsoil to 112.
114. Travis gravelly loam; Austin.
115. Subsoil to 114.

Sutton County.

6122. Crawford stony clay, depth 0-10 inches; dark brown to black clay; thirty-three miles southeast of Sonora.
6123. Subsoil to 6122, depth 10-36 inches; dark brown to black clay.

Val Verde County.

1260. Brackett stony soil (probably), depth 0-5 to 8 inches; Seminola.
1261. Subsoil to 1260, depth 7-11 inches.
6094. Brackett silty clay loam, depth 0-8 inches; brown silty clay loam; three miles northeast of Del Rio.
6095. Subsoil to 6094, depth 8-36 inches; light brown silty clay loam.
6096. Laredo silt loam, depth 0-8 inches; brown silt loam; one and one-half miles south of Del Rio.
6097. Subsoil to 6096, depth 8-36 inches; light brown silt loam.
6098. Brackett stony clay loam, depth 0-8 inches; light brown silt loam; four miles northeast of Del Rio.

TABLE 6. INTERPRETATION OF ANALYSES.

Type and County.	Phosphoric acid.	Potash	Lime.	Corn possibility in bushels per acre.		
				Active phosphoric acid.	Active potash.	Total nitrogen.
Bandera County:—						
Crawford silty loam	good	good	good	.....	.....	48
Burnet County:—						
Tishomingo find sandy loam	good	good	good	50	37	18
Crawford clay	good	.....	high	45	157	43
Caldwell County:—						
Susquehanna fine sandy loam	good	good	good	6	120	28
Comal County:—						
Houston clay	good	good	high	6	157	23
Blanco silt loam	good	good	high	12	51	12
Houston black clay	good	good	high	45	182	33
Houston gravelly clay	good	good	high	40	182	23
Crawford silty clay (dark phase)	good	good	high	35	.....	48
Crockett County:—						
Miles soil (undifferentiated)	good	good	high	30	182	48
Edwards County:—						
Frio silty clay loam)probably)	good	good	high	18	157	48
Gillespie County:—						
Pedernales sandy loam	low	good	fair	18	80	13
Pedernales sandy loam	low	Low	faif	6	51	8
Pedernales sandy loam	good	good	good	6	182	23
Pedernales stony fine sandy loam	good	good	good	50	120	28

TABLE 6—Continued. INTERPRETATION OF ANALYSES.

Type and County.	Phosphoric acid.	Potash.	Lime.	Corn possibility in bushel per acre.		
				Active phosphoric acid.	Active potash.	Total nitrogen.
Hays County:—						
Houston black clay	good	fair	high	12	120	38
Crawford silt clay	good	good	good	50	51	48
Blanco loam	good	low	high	24	51	33
Crawford stony clay	good	good	high	24	80	48
Houston clay	good	low	good	40	51	48
Houston loam	low	good	high	12	120	48
Yazoo clay	good	good	high	40	51	38
Kendall County:—						
Crawford silty clay	low	good	gigh	6	37	38
San Antonio silty clay loam	good	good	high	18	182	38
Kerr County:—						
Frio silty clay loam	good	.....	good	18	207	23
Crawford silty clay	good	low	good	45	207	43
San Antonio silty clay loam	good	good	high	.....	.....	8
Kimble County:—						
Frio silty clay loam	good	good	high	.....	.....	23
Llano County:—						
Tishomingo sandy loam	good	good	good	74	51	18
Miller fine sandy loam	good	good	good	45	.....	18
Tishomingo stony clay loam	good	good	good	12	207	23
Tishomingo sandy loam	good	good	good	6	120	18
Tishomingo stony sandy loam	fair	good	fair	6	120	18
Tishomingo loam	good	good	good	24	120	23
Mason County:—						
Pontotoc sandy loam	fair	good	fair	50	157	13
Tishomingo gravelly sandy loam	good	good	good	24	120	23
Pedernales stony sandy loam	good	good	high	30	.....	38
Lancaster sandy loam	fair	fair	fair	12	51	13
Menard County:—						
Pedernales loam	good	good	good	12	182	23
Frio silty clay loam	good	.....	high	45	182	33
Travis County:—						
Bastrop fine sandy loam	good	good	good	12	37	13
Houston black clay	good	good	high	24	80	33
Susquehanna fine sandy loam	low	fair	good	30	51	13
Travis gravelly loam	good	good	good	12	120	38
Sutton County:—						
Crawford stony clay	good	good	high	6	182	33
Val Verde County:—						
Brackett stony soil	low	fair	fair	.....	.....	13
Brackett silty clay loam	good	good	high	12	51	28
Laredo silty loam	good	good	high	12	182	28
Brackett stony clay loam	low	good	high	6	29	28

INTERPRETATION OF ANALYSES.

The standards used in this bulletin for the analyses with strong acid are approximately as follows:

Lime:

.00—.05 per cent—low.

.051—.10 per cent—fair in sands, low in loam and clays.

.101—.20 per cent—good in sands, fair in loam, low in clays.

.201—.30 per cent—good in sands, loam; fair in clays.

.30—.50 per cent—good in sands, loam and clays; low in very heav clay.

Phosphoric acid:

.00—.03 per cent—low.

.031—.10 per cent—fair in sands, low in loams and clays with lo lime; fair in loams and clays with fair lime good in loams and clays with good lime.

.101—.15 per cent—good in sands; fair in loam and clay with low
.101—.15 per cent—good in sands; fair in loam and clays with low lime; good in loam and clays with fair or good lime.
.151—up—good.

Potash:

.00—.05 per cent—low.
.051—.10 per cent—fair in sands; low in loams and clays.
.101—.15 per cent—good in sands; fair in loams; low in clays.
.151—.25 per cent—good in sands and loams; fair in clays.
.251—up—good.

A deficiency of lime may be offset to a certain extent by an abundance of vegetable matter. The quantity of lime present must also be considered in making the interpretation of the quantity of potash present.

STANDARDS FOR INTERPRETATION OF ANALYSES WITH WEAK SOLVENTS.

The following figures are used in interpretation of the estimation of total nitrogen, active phosphoric acid and active potash of the soil. They are based upon results published in Bulletins 126, 145 and 151 of this Experiment Station, and in case of phosphoric acid, on the results of additional pot experiments not yet published. The figures are not the same as those given in the bulletins mentioned, but are based upon the curve to which the actual determinations approximate. It must be recalled that these results do not represent actual field production, but are average results based upon the plant food taken from the soil in a large number of pot experiments. The results are expressed in terms of bushels of corn in order to give concrete form to them. There are exceptional soils which deviate quite widely from these results, and pot experiments themselves are somewhat variable. These variations will be studied later, and also the relation between the results of the pot experiments, and actual field production. See Table 7.

TABLE 7. METHOD OF INTERPRETING ANALYSES.

Nitrogen.		Potash.		Phosphoric Acid.	
Per Cent.	Corn Equiv. Bushels.	Per Million.	Corn Equiv. Bushels.	Per Million.	Corn Equiv. Bushels.
.000-.02	8	0- 50	29	0- 10	6
.021-.04	13	50-100	37	10- 20	12
.041-.06	18	100-150	51	20- 30	18
.061-.08	23	150-200	80	30- 40	24
.081-.10	28	200-300	120	40- 60	30
.101-.12	33	300-400	157	60- 80	35
.121-.14	38	400-600	182	80-100	40
.141-.16	43	600-800	207	100-200	45
.161-.18	48	.....	.....	200-400	50
.....	.....	.....	.....	400-up	(74)

We wish it distinctly understood that these figures do not represent the actual production of the soil in the field, and are not intended to do so. They merely aid in showing the relation between pot experi-

ments and chemical analyses. There are considerable variations in individual soils, and the interpretation may not be strictly correct, since so much depends upon field conditions. The figures are merely intended to show the relative deficiencies of the soil in the various forms of plant food. The actual field production undoubtedly is quite different in a number of cases; in many instances considerably larger than the "corn possibility."

ACKNOWLEDGMENT.

Analyses and other work involved in the preparation of this bulletin have been done by Messrs. Ogier, Rather, Gilmore, Asbury, Hodges, Enochs, and other members of the staff.