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COMMONWEALTH OF AUSTRALIA

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DIVISION OF SOILS

SOIL SURVEY OF PORTION OF THE IRONGATE DISTRICT DARLING DOWNS, QUEENSLAND

BY G. G. BECKMANN

DIVISIONAL REPORT 4/56

ADELAIDE, MAY 1956

C.S.I.R.O.
Division of Soils

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INTRODUCTION

During October, 1953, an area of 1400 acres south of Irongate, a small town about ten miles north-west of Pittsworth, was surveyed to determine the pattern of soils found in this portion of the Toowoomba Mapping Sheet. These soils have developed from basalt and sandstone and have many distinctive features.

GEOLOGY AND PHYSIOGRAPHY

Irongate is situated on the western edge of the dissected plateau of Tertiary basalt which makes up most of the upland area of the Darling Downs. During the late Tertiary and Pleistocene the various flows have been cut back to their present position, exposing the underlying calcareous sandstones of the Walloon series. Dissection and downcutting have gone on through the sandstones, and in the valleys of creeks originating high up in the hills considerable depths of fine alluvium have been deposited.

Along the northern edge of the area surveyed is a flat basalt-capped ridge about 200 feet above the plains to the west. Parallel to this ridge at a lower level to the south is a long spur of sandstone. Between and below these on the colluvial slopes and along the narrow drainage line between them are bodies of transported material derived from both the basalt and the sandstone. These recent sediments extend some distance beyond the mouth of the drainage line into the eastern limit of the plains.

VEGETATION

There are three distinct vegetation formations in the Irongate district. Each is restricted to certain portions of the landscape. They are:-

(a) eucalypt forest with softwoods, on the basalt crests.

(b) brigalow-belah forest on the sandstones and on the colluvial slopes.

(c) grassland on the alluvial plains.

(a) On the flattish basalt crests is a mixed open forest of mountain coolibah (E. orgadophila) with an understorey of various softwood species, herbs and shrubs including rolypoly (Bassia quinquecuspis). Wire grass (Aristida sp.) is the dominant grass. Associated with it are Stipa sp., rat's tail grass (Sporobolus sp.), Chloris sp., and Danthonia sp. These run down to the lower edge of the steep scarp, but below this point eucalypts are seldom found.

(b) On the sandstone spur, the colluvial slopes below the scarp of the crest, and on the edge of the plain is a tall dense forest of brigalow (Acacia harpophylla) and belah (Casuarina cristata), the trees being usually fifty or sixty feet high. There is a varying dominance of each of these species, with belah generally dominant on the sandstone spur and on portions of the colluvial slopes. With it is a softwood scrub understorey including wilga (Geijera sp.) and turkey bush with numerous small chenopodiaceous herbs and shrubs. In other parts of the colluvial slopes, and particularly on the edge of the plains, brigalow is the dominant species. In addition to the softwoods and shrubs mentioned above, a few buddha (Eremophila mitchellii) are found.

(c) In the southwestern corner of the survey area is a portion of the extensive grassland of the plains associated with the Condamine River. (For detailed list of species, see Thompson, 1952.)

CLIMATE

Irongate is situated in an area in which two-thirds of the annual rainfall falls in summer. Thus, though there are useful falls in winter which provide sufficient moisture for planting, the growing of winter cereals, e.g., wheat, oats, depends on the retention in the soil of moisture from summer rains. The climate is classified as temperate and sub-humid. Occasional frosts can be expected here from April to late October, particularly on the more low-lying areas, the plains and the drainage lines.

No rainfall figures are available for the immediate vicinity of Irongate, but those of Pittsworth, eight miles to the south-east, and for Yarranlea, six miles to the south, should be approximately the same.

	Pittsworth	Yarranlea
Average annual rainfall	27.35 ins.	23.69 ins.
Number of wet days	82.	53

Summer normal for Pittsworth is 17 inches, winter normal 9 inches.

SOILS

For convenience in discussion the soils are arranged in five groups based on parent material, depth, and degree of profile development.

(a) Skeletal soils on basalt.

(b) Moderately deep soils on basalt.

(c) Soils on sandstone and its derivatives.

(d) Soils on colluvium (mixed basaltic and sandstone parent material).

(e) Miscellaneous soils.

(a) Skeletal soils on basalt

These are restricted to the flat crests and steep upper slopes of the ridges and to occasional basalt knolls at lower levels. They are all vary shallow, and usually very stony, and thus non-arable.

Kenmuir clay loam. This soil is very similar to Kenmuir clay loam as described in the Southbrook area (Thompson 1954), but here it generally has a yellowish tinge. In this locality it is found only on a rounded knoll below the general level of the flat-tops and on a slight flattening below a scarp. These sites are now cleared but the former vegetation appears to have been softwoods and mountain coolibah. At present it is mainly roly poly and various grasses, such as wire grass, rat's tail grass, Stipa sp. and Danthonia spp. Moderate amounts of basalt cobble (3-6") and stone (-12") are found on the surface, which is compact and pulverulent. For a description of Kenmuir clay loam see Thompson (loc. cit.).

Kenmuir loam (fine crumb var.). The most extensive of the skeletal soils, Kenmuir loam (fine crumb var.), is found over the greater part of the flat crests and on the moderately steep (10°-20°) scarps. It supports a mixed forest of mountain coolibah and softwoods, with shrubs and wire grass. This soil is a loam, occasionally a clay loam whose colour may be light greyish brown, dull greyish brown, or grey-brown, and it varies in depth from two to six inches. It has a strongly developed fine crumb structure and is usually loose when dry. There are slight to high amounts of basalt cobble and stone on the surface, and moderate to high amounts of gravel ($\frac{1}{2}$-4") within the profile. The main differences between this soil and Kenmuir clay loam are its generally lighter texture and its looser structure.

Type 17. On one of the flattish crests is an area of a skeletal soil (a dark organic loam) too small to map separately in this area but also found on the crests and upper slopes of several of the hills to the south-east and east. It has slight to low amounts of platy basalt cobble (6-12") and occasional boulders of siliceous material on the surface.

Depth in Inches	Description
0	Dark grey-brown loam, occasionally clay loam; very fine crumb structure, loose when dry; moderate amounts of angular weathered basalt gravel ($\frac{1}{2}$-3").
7 Max.	Hard basalt.

(b) Moderately deep soils on basalt

These are found only on the higher parts of the landscape, the basaltic crests, or narrow steps below these and above the colluvial slope.

Mallard clay loam. On one of the flat spurs and on the slope below its scarp are some fairly small areas of a rather distinctive shallow soil on basalt. It supports the usual vegetation of mountain coolibah, softwoods and some shrubs; grasses include wire grass, Stipa, and some Rhodes grass. The surface cobble is mainly basalt but in some places there are large siliceous boulders.

Depth in Inches	Description
0	Brown to grey-brown clay loam to light clay; very weak medium irregular blocky structure; friable to hard when dry and friable when moist; slight to moderate basalt gravel and small stone; changing abruptly to
2 5 7	Brown and darkish reddish brown medium clay; moderate irregular blocky structure; friable to firm when moderately moist and plastic when wet; trace to slight basalt gravel and small stone.
6 8 10	Variously mottled brown, red-brown, reddish brown, yellowish brown heavy clay; moderate coarse sub-angular blocky structure; friable to firm when moist and plastic when wet; trace to slight basalt gravel and small stone increasing with depth.
10 13 19	Light yellow-brown, yellow-grey, and reddish brown very weathered basalt, often of mealy consistence; passes into hard weathering basalt with depth.

Type 8. This type is a fairly well structured soil of moderate depth to basalt and is found on slopes of 5°-9° immediately below the scarp. It is a red clay soil in many respects similar to Aubigny Series, but has been separated as it has a deeper and darker surface and may not have carbonates in the lower part of the solum. The vegetation differs also. Here it consists of a softwood scrub with an occasional belah, and a shrub understorey, mainly chenopodiaceous. There are slight to moderate amounts of basalt cobble (3-9") on the surface.

Type 8 is probably a good agricultural soil, as it is very well structured and fairly deep, but may not be as fertile as the black clay soils, and the fairly steep slopes could make it very liable to erode. At present it is used only for grazing on native pastures.

The following profile description indicates the range included in this type.

Depth in inches	Description
0	Darkish brown or dark grey-brown clay loam to light clay; granular to crumb structure loose when dry, friable and firm when moderately moist; may have a trace of weathered basalt gravel.
3	Dark reddish brown, to dark brownish grey light to medium clay; sub-angular blocky structure; firm and friable when moderately moist; may have a trace to slight amounts of weathered basalt gravel.
10 (6 – 14)	Red-brown, dark brown with reddish brown, or dull orange-brown heavy clay; sub-angular blocky structure; firm when moderately moist; possibly a trace of weathered basalt gravel.
18	Orange-brown to reddish brown heavy clay with slight amounts of basalt gravel.
27 (22 – 32)	Orange-brown heavy clay with a granular appearance; firm when moderately moist, slight amounts of basalt gravel; may have a trace of carbonates.
30 (24 – Max. – 38)	Hard basalt.

Type 9. This is another of the moderately deep soils on basalt found on a low narrow step (5°-6° slope) below the scarp and adjacent to Type 8. The vegetation is that commonly found on this part of the landscape, and includes roly poly and Pittsworth mint. There are slight to low amounts of basalt cobble (4-9") on the surface.

Depth in inches	Description
0	Dark brown to very dark brown, medium clay; sub-angular blocky to granular structure; firm when moderately moist.
2	Dark brown or dark yellowish brown heavy clay; angular blocky structure; firm when moderately moist; trace of carbonates (concretions, $\frac{1}{8}$-$\frac{1}{4}$").
5 (4 – 6)	Dull brown or dull yellowish brown, occasionally orange-brown heavy clay; angular blocky to massive structure; very firm when moderately moist; trace to slight carbonates (both soft and concretionary).
10 (8 – 12)	Brown or olive-brown heavy clay; angular blocky to massive structure; firm when moderately moist; slight to moderate amounts of soft carbonates and some concretions.
20	Light yellowish brown, olive, or dull brown heavy clay, as above; moderate to high amounts of soft carbonates, with some concretions.
(24 – Max. – 40)	Sometimes on hard basalt.

(c) Soils on sandstone and its derivatives

These soils are restricted to the crest of a long flattish ridge of sandstone and to the very gentle (2^{o}-3^{o}) slopes below this, quite distinct soils being found on each of these two positions.

Oakview sandy loam. Oakview is the soil normally found on the flat or very gently rounded crests. The vegetation associated with it is usually a belah forest with a softwood scrub understorey, and also turkey bush, Myoporum desert, and some halophytic shrubs. Under virgin woodland the surface has usually a very loose, single grain structure and is very readily eroded by wind when the vegetation is removed. Thus the profile described below, representing that at an undisturbed site, may not be encountered everywhere; a truncated version, shallower to clay, is often found.

Depth in inches	Description
0	Patchy light brownish grey and brown-grey or darkish brown (7.5YR3/2) loamy sand to coarse sandy loam; single grain structure; loose when dry and very friable when moderately moist.
2	Light brownish grey or dull brown loamy sand; single grain structure, the mass being crudely angular blocky.
4 to 6	Orange-brown (5YR4/4) to darkish orange-brown sandy light to heavy clay; angular blocky to massive structure; very firm when moderately moist.
10	As above, with a trace of soft carbonates.
12 to 15	Yellowish to orange-brown (5YR4/4) or mottled yellowish grey and reddish brown sandy clay; as above with high amounts of soft carbonates or hard platy white carbonate.
20 to 26	Light greenish sandstone, usually impregnated with carbonates and containing some brown to olive clay (C horizon).
30 Max.	

Oakview series is rather variable. In places profiles similar to the above are found within a few feet of profiles with the C horizon at 12-15 inches and the orange brown clay horizon very thin. One area of Oakview includes a soil which is very similar in many respects but is deeper and of a distinct olive grey colour.

Oakview series is regarded as an atypical red brown earth, similar to Type 5 and the red brown earths on alluvium at Oakey, several miles to the north. It appears to be the normal soil which will develop at present on sandstone on flat to gently sloping, well drained sites. Occasionally traces of yellowish and black ironstone gravel are found in the upper layers. These appear to have been formed by the breakdown of large (up to six inch) concretions of ironstone which have developed in the past in the upper layers of the sandstone.

Though not very extensive, Oakview series is a valuable agricultural soil; its agricultural characteristics are discussed in a separate section.

Type 3. On the side slopes (2°-3°) of the flattish platform with Oakview series on the crest, are several disconnected areas of a yellowish to olive-grey heavy clay soil. At present no micro-relief is visible on the surface of this soil, but any originally present would have been destroyed by cultivation. The native vegetation was probably very similar to that on Oakview series but there could have been a few brigalow in addition to the belah. The parent material appears to be either Walloon series rocks or colluvial material derived from them.

Depth in inches	Description
0	Brownish grey to dark brown-grey medium clay; sub-angular blocky to granular structure.
3	Brown-grey to greyish brown (occasionally light yellowish to brownish grey) heavy clay, massive structure, firm when moderately moist or moist; trace of soft carbonates and a trace of brown and yellow ironstone gravel.
9	Dull light yellowish grey to light olive-grey heavy clay; structure, etc. as above; slight soft carbonates and a trace of ironstone gravel.
18 to 20	Olive-yellow, greenish grey, light yellowish grey or light olive-grey heavy clay; very firm when moderately moist or moist; slight to low carbonates, both soft and concretionary ($\frac{1}{8}$"). This layer may have light yellow, light yellow-grey, and yellowish brownish grey pockets.
24 to 27	Light yellow-grey to light yellow, mottled with increasing amounts of light grey to light bluish grey heavy clay; firm when moderately moist; slight amounts of carbonates, both soft and concretionary ($\frac{1}{8}$"); may have trace to slight amounts of gypsum.
30 to 36	Mottled very light grey to cream with light yellow heavy clay; slight to high soft carbonates; odd red specks; no visible gypsum.
45 Max.	Probably continuing as above.

Diffuse carbonates occur from a depth of 3-9". The surface in cultivated fields is loose and dusty.

(d) Soils developed on colluvium (mixed basaltic and sandtone parent material).

The soils of this group are found on the slopes leading down to the plains from the base of the scarp. They are most probably colluvial soils and at considerable depth should pass into sandstone. There are only two of these, Irongate clay (slope phase), a black earth, and Type 5, a red brown earth.

Irongate clay. This soil occurrs on the colluvial slopes as a slope phase and as the normal phase along the floor of the drainage line extending out onto the edge of the plains. As the profiles in both places are similar, they will be described here under Irongate clay, slope phase. The vegetation consists of a dense brigalow-belah forest with a varying dominance of each with an understorey of softwood species including wilga, turkey bush and occasionally buddha. The ground cover consists of numerous chenopodiaceous shrubs including saltbush (Atriplex sp.) and roly poly. There is little evidence at present of micro-relief on the slopes, except at one point where there has been a slight development of linear gilgai. There is generally no surface stone and the soil has a self-mulching surface.

Depth in inches	Description
0	Dark grey-brown or dark grey heavy clay; sub-angular blocky or angular blocky structure; firm when moderately moist.
4	Dark brown-grey to dark brownish grey (10YR2.5/1) heavy clay; angular blocky to massive structure; very firm when moderately moist.
(10 to (12	Dark brownish grey to dark greyish brown heavy clay; structure massive to weakly developed coarse angular blocky; extremely firm when moderately moist; traces of soft carbonates.
18	Brown to yellowish brown, with dark brown-grey (decreasing in amount) heavy clay; structure massive, very firm when moderately moist; slight amounts of soft carbonates; and trace to slight amounts of carbonate concretions.
24	Light brown to yellow-brown (10YR5/2) heavy clay; structure massive; very firm when moderately moist; slight to low amounts of soft carbonates and $\frac{1}{8}$" carbonate concretions; may have slight to low amounts of gypsum crystals.
30	Light brown or light yellowish brown heavy clay; structure etc. as above; trace to slight amounts of carbonates both soft and concretionary; slight amounts of gypsum crystals.
45 Max.	Probably continuing below.

This soil usually contains diffuse carbonates from 3" onwards.

The normal phase, on the plains, has a profile almost identical to that of the slope phase, except that the subsoil colours are light yellowish grey to olive yellow grey. Only occasionally are profiles met with which have the light brown subsoil more characteristic of the slope phase. There are a few hummocks and depressions and a general unevenness of the surface, but there is no definite micro-relief development.

Type 5. Type 5 is found on the 4°-5° slope below the scarp in similar positions to Irongate clay slope phase and also on a very gentle slope just above the plains. It appears to have been derived mainly from sand-

stone with an admixture of basaltic material. Moderate amounts of basalt cobble and stone from four to twelve inches in size lie on the surface and odd pieces of basalt gravel are found in the profile. There is a suggestion of micro-relief in places but it is not pronounced. Type 5 is similar to Oakview sandy loam in some respects, but differs in that it is found on steeper slopes and has a heavier surface texture.

Depth in inches	Description
0	Dark brown to dark grey-brown light to medium clay; sub-angular blocky to angular blocky structure; trace of gravel ($\frac{1}{2}$").
1 to 2	Dark grey-brown to dark brown-grey heavy clay; angular blocky to massive structure; with a trace of gravel ($\frac{1}{2}$").
3 to 12 (6)	Dull orange-brown to dull reddish brown heavy clay; angular blocky to massive structure; extremely firm when moderately moist.
9	Bright reddish brown clay; massive.
22 to 26 (24)	Brown to reddish brown clay, as above; low amounts of carbonates, both soft and concretionary ($\frac{1}{4}$-$\frac{1}{2}$").
32	Brown clay, as above; firm when moderately moist; may contain numerous siliceous lumps of basalt gravel.
45 Max.	Continuing as above.

(e) Miscellaneous soils.

Calcareous Soil. This soil occurs on a very gentle (3°) slope along the north eastern boundary of the area. It is easily recognized by its loose granular surface and by the patches of whitish calcareous material which are exposed in places.

Depth in inches	Description
0	Dark grey to very dark grey medium clay; granular structure; very firm when moderately moist.
3	Dark grey to dark brown-grey heavy clay; angular blocky to massive structure; firm when moderately moist; trace of soft carbonates.
9 to 14	Very light yellowish grey to very light grey with dark grey pockets; heavy clay; firm when moderately moist, slight to low amounts of soft carbonates.
30	Very light grey (yellowish) heavy clay, as above; slight soft white carbonate specks.
46 Max.	Continuing as above.

LAND USE AND AGRICULTURAL CHARACTERISTICS OF THE SOILS

The Irongate area lies on the edge of the wheat growing district of the plains. The main agricultural activity on farms within it, is the growing of grain crops, mainly wheat with some sorghum. Though a portion has been cultivated continuously for sixty years, dairying was formerly the main industry, and it is only in recent years that much has been cropped. Most farms on the basaltic hills adjacent to the survey area are dairy farms.

Irongate Clay. This soil behaves very much as the other black earths of the plains. Irongate clay has a lower field capacity and a lower wilting point than other black earths found on the Darling Downs but has a fair moisture storage when fallowed. It has a difficult consistence for cultivation, being very hard when it is dry. A considerable quantity of rain is required to make cultivation possible and the soil becomes very sticky when wet so that it is impossible to get on the fields for some time after rain.

The Irongate clay is alkaline throughout (up to pH 9), and is well supplied with nutrients, including fair amounts of available phosphate. There is a preponderance of calcium over magnesium in the clay fraction, but there are rather high amounts of sodium in the lower layers which tend to give rather poor structure. In addition to sodium in the clay, Irongate clay contains high amounts of soluble salts. Its yields are slightly lower than those of the other black earths but are still good. One field of Irongate clay and Type 5 has yielded 45 bushels of wheat and 60 bushels of sorghum per acre.

Oakview Series. The physical properties of Oakview series are different from those of Irongate clay. It has a very light surface so that cultivation can commence immediately after falls of rain as light as 25 points. Moisture storage in the clay subsoil is fair. For equal depths it has approximately half the water reserves of Irongate clay but plants can utilise water to a greater depth.

The soil reaction of Oakview series is variable in the upper layers but generally it is alkaline in the lower layers. The phosphorus level is reasonable but reserves do not appear to be very great. A comparison with Irongate clay shows that Oakview series gives lower yields in a good season (36 bushels of wheat per acre as against 42 bushels per acre on Irongate clay) and better yields in a poor season. Wheat ripens faster on Oakview series than it does on Irongate clay and the grain is generally heavier. One field of Oakview series has been cultivated for over fifty years and has never been fertilized, yet there has been no apparent decline in yields. This may be due partly to the use of improved wheat varieties and farming practices in recent years.

Both Oakview series and the slope phase of Irongate clay are subject to water erosion, numerous small gullies developing in the former and numerous moderately deep gullies in the latter. Oakview series suffers from wind erosion also as the sandy surface is very easily removed.

Type 3. This soil is very similar to Oakview in its yields but its behaviour and its moisture holding capacity would be more similar to those of Irongate.

Calcareous Soil. This soil gives very poor yields, only twenty-four bushels of wheat per acre in a good year. Many of its properties are related to its loose structure. It is easy to work and has good water penetration but dries quickly and apparently has a low range of available moisture. Loss of the available moisture is increased by deep cultivation.

Skeletal Soils. As these soils are extremely shallow and stony they are generally non-arable. They are often found on steep slopes and would thus be eroded readily. They have a very fine structure which allows them to dry out completely so that they would require constant additions of water to maintain sufficient moisture for crops.

ACKNOWLEDGEMENTS

The author is indebted to Mr. L. Smith (Botanist, Queensland Herbarium) for identification of plant specimens and to Mr. G.D. Hubble (C.S.I.R.O. Regional Soils Officer, Queensland) for advice and comments. Much information on the agricultural characteristics of the soils was provided by Messrs. Mahoney, Irongate.

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