

and yellowish-brown clay loam. All the soils are as infertile as those on the steep white-argillite country. Alluvial soils derived from greywacke and Tertiary mudstones have been divided into three sub-groups:—

- (1) Young soils on river-flats covered by floods within historic times :
- (2) Old soils lying on terraces well above flood-level :
- (3) Old soils on dissected uplands.

(1) The greatest areas of young soils occur on the Heretaunga Plains and on the Ruataniwha Plains bordering the Tukituki and Waipawa Rivers. Silt loams, clay loams, and clay are the principal textures. The general profile is dark-brown topsoil on mottled-grey and yellowish-brown subsoil, indicating the presence of a high ground-water level. On higher ground, where the ground-water level is well below the surface, the subsoil is yellowish-brown in colour. These soils are but little leached and are the most fertile in the province. On the best of them excellent rye-grass - white-clover pastures are maintained without top-dressing. Sharply contrasting with them are the gravelly sand strips marking recent channels of the rivers, these being of little value agriculturally.

(2) The soils on terraces above flood-level are podsolized, the profiles resembling those on the mudstone soils.

(3) The dissected uplands in the Norsewood are carved out of fluvial deposits consisting of grey-wacke gravel and fine-grained material. The usual soil profile is—

6 in. dark-brown silt loam ;
18 in. – 30 in. (and over) compact yellowish-brown silt loam ;
On gravels.

The underlying gravels allow of good drainage.

(5) *Soils derived from Volcanic Ash.*—The volcanic soils lie on the western side of the railway. Several subdivisions within them have been made, the chief being—

- (a) Shallow dull-brown soils on gravels :
- (b) Deep golden-brown soils :
- (c) Buff soils (Taupo pumice).

The brown soils are derived from andesitic ash blown from Tongariro volcano, whereas the buff soils are derived from rhyolitic ash blown from Lake Taupo at a more recent date.

The shallow dull-brown soils occur on wide flats bordering the Ngaruroro and the Tukituki and Waipawa Rivers on the Ruataniwha Plains, and on the Takapau flats. The profile is—

6 in. dark-brown sandy loam ;
12 in. free dull-brown sandy loam ;
6 in. compact dull-brown sandy loam ;
On gravel.

Like the other brown volcanic soils, they differ from those previously described in having a free subsoil. The soil is easily worked and quickly warms up ; its physical condition is ideal. The chief drawback is its droughtiness ; it is probably the most suitable type in Hawke's Bay for irrigation.

Closer to the range on flattish upland surfaces the volcanic ash is more than 3 ft. thick. The profile is similar to that on the dull-brown soil except that the colour of the subsoil is golden-brown and the compact horizon extends to more than 3 ft.

Both types, the dull-brown and golden-brown, can be classed as brown podsoles, the profiles being typical of podsoles developed on basic and intermediate igneous rocks. They are about as infertile as the grey podsoles, and cattle grazing in the days before top-dressing occasionally exhibited the symptoms of phosphate deficiency. The brown podsol of Hawke's Bay is one of the volcanic soils on which stock do not suffer from bush sickness. If deficiency of cobalt in the soil is the cause of this disease one could predict healthiness, for the brown podsol contains 13·2 parts per million of cobalt, whereas the unhealthy Taupo pumice has only 2·0 to 2·5 parts per million.* Also the particularly healthy limestone soils of Hawke's Bay contain 7·5 parts per million of cobalt.

The Taupo pumice soil covers the uplands to the west of Napier and Hastings. The topsoil and subsoil is a sandy silt and the subsoil is compact. Being a young deposit it is only slightly podsolized, and is consequently more fertile than the brown podsol. Experiments in the Rotorua district on Taupo pumice soil by the Department of Agriculture show that the pastures respond markedly to phosphatic top-dressing.

Discussion.

From the above it is seen that there are distinct groups of soil depending for their fertility on—

- (1) The rock from which they are derived ;
- (2) Their age ; and
- (3) Topography.

The white Cretaceous rocks give rise to the poorest soils, and there is an upward gradation through Cretaceous mudstones to Tertiary mudstones to limestones. The influence of age is well exemplified by the alluvial deposits : the older deposits on high-level terraces are excessively leached, whereas those of very recent age have suffered practically no loss of fertility. Again, the brown soils derived from andesitic ash were originally better supplied with plant-nutrients than the buff rhyolitic ash, but the position is now reversed owing to the much greater age of the former. Topographic influence is seen to advantage in the Tertiary mudstones, which are podsolized on the rolling and flat country.

* Analyses by Dr. J. C. Andrews, of Hellaby's Ltd.