

Compared with other irrigated countries, such as Egypt, the impression is gained that Central Otago has not sufficient water available to irrigate all its irrigable land, unless water is lifted at prohibitive cost. This means that some land can be irrigated annually, some only in favourable years, and some not at all. Land-values will therefore vary, and will not become stabilized until all water-supplies are utilized and those areas that require least water become known. In Central Otago water is required most when it is scarce; hence those areas that are most easily irrigated will have the highest value. In consequence of irrigation, therefore, land-values will vary in some inverse ratio to their water-absorbing capacity, a quantity that can only be determined by a long series of weir-discharge measurements.

In view of the recent agitation to have the price of irrigation water reduced, the following quotation is of interest: "The conclusion, based on Italian experience, is that irrigation is very beneficial to the individual farmer, when he can get water by paying 30 to 50 francs per hectare per year (11s. to 17s. per acre), but not to the Administration of the canal during at least the first thirty years; so the undertaking requires a great help from the State during this trying period."* The above charges refer to pre-war conditions. In Central Otago the charges for water are from 10s. to 16s. per acre and are expected to provide interest and sinking fund on the capital cost of construction.†

3. WAIROA SUBDIVISION.

(By M. ONGLEY.)

INTRODUCTION.

In November, 1926, work was begun in the Wairoa Subdivision, lying south of the Gisborne Subdivision described in Bulletin No. 21, and by the end of May, 1927, the survey districts of Paritu, Mahanga, Mahia, and parts of Nuhaka and Nuhaka North had been examined. This season, from October, 1927, to May, 1928, the survey districts of Waiau, Taramarama, Opoiti, Nuhaka North (part), Waihua (part), Clyde, and Nuhaka (part), covering some 600 square miles, were examined and mapped. The whole subdivision may be described as the district between Poverty Bay and Hawke Bay, extending inland to Lake Waikaremoana.

The area examined this season contains none of the Cretaceous rocks previously described in the east of the subdivision, but consists of Tertiary sedimentary rocks, 35,000 ft. thick, divided into several sets by four erosion intervals and one unconformity. The whole is gently folded into a broad syncline forty miles wide, its axis trending south of west from Te Reinga, down the Wairoa River, towards Napier, as pointed out by Smith‡ in 1876.

PHYSIOGRAPHY.

The district is part of a dissected plateau rising gently inland from 600 ft. near the coast to 2,500 ft. in the north-west of the subdivision, thirty miles inland. It is eroded into two sets of dip-slopes dipping into the Wairoa syncline. On the east side the strongest dip-slope, curving in from Tahaenui River west of north for sixteen miles, forms Whakapunake, which slopes 20° to 30° west. In Opoiti and Nuhaka North the country for ten miles east of this consists of similarly disposed though less well defined dip-slopes. The whole of the district west of the Wairoa River, to the west of the subdivision and beyond it, consists of strong eastward-sloping dip-slopes trending south-south-west beyond the north and south boundaries of the subdivision.

Although the plateau has been eroded into such well-marked strike ridges, most of the streams still maintain their original consequent courses down the slope of the plateau. Examples are Waihua, Waiau for the greater part of its course, Mangaone, Waihi, Waikare-Taheke, Mangaruhe, and Ruakituri streams, all flowing nearly parallel south of east. Subsequent tributaries of these streams and short lengths of the Waiau and Waikare-Taheke flow north-east or south-west along soft beds. The Wairoa River flows south through the subdivision along the Wairoa syncline, and the Nuhaka, twenty miles to the east, along a parallel syncline. Between these the lower Mangapoike and its tributaries, the Makaretu and Tukemokihi, are flowing out westward from the Mangapahi anticline. These streams have many short stretches along soft beds at right angles to their general direction; the upper part of the Mangapoike flows in long reaches along the strike. The Tahaenui, on the contrary, flowing south of east, at an angle of 30° to the coast, appears to be maintaining its consequent direction derived from the original slope of the plateau.

GENERAL GEOLOGY.

The beds of that part of the subdivision examined in the field season 1926-27 were described and tabulated in last year's annual report. As the work proceeded more information of the structure, relation, and sequence of the beds was obtained, and some difficulties, especially of correlation, arose. The Mangatu beds, described in the previous report, were not found. The erosion interval and basal Tutamoe conglomerate, which proved so useful an horizon-marker last season, was seen at only one place. It indicates that the lowest beds seen in the east limb of the Wairoa syncline belong to the Ihungia Series. The strata overlying can be readily correlated with the Tutamoe, Morere, Mapiri, and Otunua beds. The thick beds of tuffaceous sandstone, last season observed only in

* Luigi Luiggi, *Irrigation Works in Italy*, Brit. Assoc. Adv. Sci. Rep. 1914, p. 658, 1915; and *Engineering*, 18th September, 1914.

† R. B. Tennent and J. R. Marks, *N.Z. Jour. of Agric.*, vol. 28, p. 259, 1924; and *N.Z. Dept. of Agric.*, Bull. No. 120, p. 25, 1925.

‡ Smith, S. P.: "Sketch of the Geology of the Northern Portion of the Hawke Bay" (Trans. N.Z. Inst., vol. 9, pp. 565-76, 1877).