

ART. XLII.—*Fluctuations in the Water-level of some Artesian Wells in the Christchurch Area.*

By F. W. HILGENDORF, D.Sc.

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IN 1896 Hutton recorded the fluctuations of two artesian wells at the Christchurch Museum.* Speight continued the observations on one of the wells in 1910,† and since then has taken occasional readings, copies of which he has kindly given me for the purposes of this paper. In 1911 I took a series of readings on a 340 ft. well at Lincoln College, fourteen miles south-west of Christchurch,‡ and have taken monthly readings ever since. From 1912 till the present time Mr. A. D. Dobson, Christchurch City Surveyor, has taken observations on a 217 ft. well at Merivale, a mile and a quarter north-west of the Cathedral, and has given me his readings. In 1914 Mr. Symes and I, aided by a grant from the Hutton Fund, erected a continuous-record machine on a well of uncertain depth on Papanui Road, about three miles north-west of the Cathedral (see this volume, p. 493), and the readings of this well have been used here. The graph shows the fluctuations in the static level of the water in these four wells. The comparatively small variation in the three Christchurch wells as contrasted with the large variation of the Lincoln well affords conclusive proof that the wells in the neighbourhood of Christchurch have a relatively constant source of supply, while the well at Lincoln has a relatively intermittent one. The most reasonable explanation of this feature of the graph is that the main supply of the Christchurch artesian wells comes from the Waimakariri River, while the Lincoln well is supplied chiefly by the rainfall direct, or by percolation from the Selwyn River, which in its middle course flows only during or after heavy rains.

There are two facts that might be used to controvert this explanation were the evidence of the present graph not so overwhelming.

(1.) The Christchurch wells do, as was pointed out by Hutton and Speight, respond very rapidly to a day's rain, but that the rainfall is their chief source of supply is rendered improbable by their relative steadiness during the dry years 1914–16. There can be no influence of either the rainfall or the Selwyn River that would not be more distinctly felt at Lincoln than at Christchurch, as will be shown by a glance at the map in *Trans. N.Z. Inst.*, vol. 44, 1912, p. 146. If either of these influences, then, kept the Christchurch wells steady, they should have kept the Lincoln well steady too, and therefore we are driven to conclude that percolation from the Waimakariri is the chief source of the Christchurch supply.

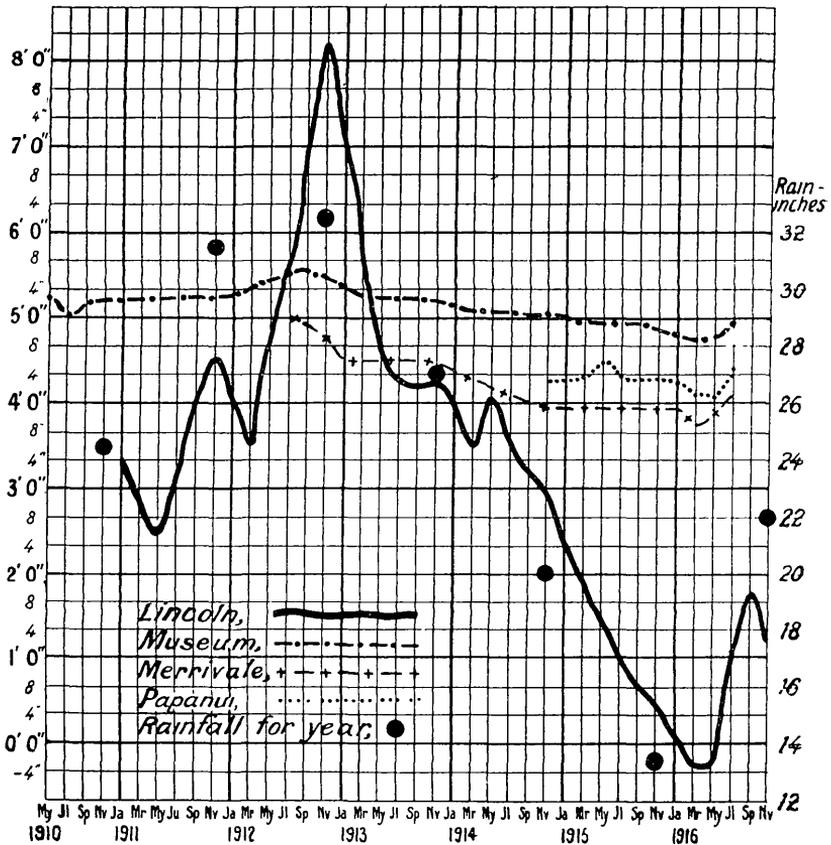
(2.) The second observation that does not support this supposition is that floods in the Waimakariri do not influence the level or the flow of the

* F. W. HUTTON, On the Behaviour of Two Artesian Wells at the Canterbury Museum, *Trans. N.Z. Inst.*, vol. 28, 1896, p. 654.

† R. SPEIGHT, A Preliminary Account of the Geological Features of the Christchurch Artesian Area, *Trans. N.Z. Inst.*, vol. 43, 1911, p. 420.

‡ F. W. HILGENDORF, Fluctuations in the Level of the Water in some Artesian Wells in the Christchurch Area, *Trans. N.Z. Inst.*, vol. 44, 1912, p. 142.

Christchurch wells, as has again been noted by Hutton. But, since the Waimakariri is flowing always, it is probably losing water by percolation always, and not only during floods; and the rise of water-level may be so toned down by passage through miles of gravel as to be unrecognizable by the time it reaches Christchurch. This is rendered probable by the behaviour of the well at Belfast, six miles from Christchurch, as described by me,* where a river rise of 8 ft gave a well rise of 5 in. The absence



Graph showing fluctuations in static level of four artesian wells in or near Christchurch.

of response of Christchurch wells to Waimakariri floods, then, is not necessarily at variance with the evidence of the graph, that the Waimakariri is the chief source of the Christchurch artesian water-supply

In 1862 or 1863, at R. Taylor's brewery, on the site of the present Normal School, some pipes were driven into the ground to form a staging. After a time water was found flowing from these pipes, which thus formed the first artesian well in Christchurch. The City Council then sank a 2 in pipe at the corner of Tuam Street and Ferry Road to a depth of 81 ft, and

* Loc. cit., p. 158.

a good flow resulted. This well was completed on the 10th February, 1864, and on the 15th February, 1864, the Council started another well, this time in Cathedral Square. For the above information I am indebted to Mr. J. Lothian Wilson, of Kaiapoi. From this date onwards for about fifty years thousands of private wells were sunk in the Christchurch area, and it was soon found that the earlier ones, sunk to depths of 40 ft. and 80 ft., suffered a serious and continuous fall in their static level. Deeper and deeper wells were then sunk, tapping various water-bearing strata down to 400 ft. in depth. The fall in the static level of large numbers of wells was viewed very seriously, as indicating a possible failure of the water-supply; but the evidence of Hutton and Speight's long-period observations on the Museum well shows that the fall has been checked, if not arrested. The static level of the 190 ft. well above Hutton's datum was, in

1894	..	..	9 ft. 8 in.	} Average fall per year, 3·5 in.
1910	..	..	5 ft. 3 in.	
1916	..	..	5 ft. 0 in.	} Average fall per year, 0·5 in.

At the time Hutton made his observations he estimated the yearly fall at 5·5 in., so that its rate has been greatly reduced during the last twenty-two years.

Why the wells have ceased to fall is not certain. There are good grounds for believing that it is due to natural causes connected with the supply of water from the Waimakariri and the under-drainage to the sea. But in 1909 the City Council sank, within the area of an acre or two, four wells, 8 in. in diameter, to the 80 ft. stratum, and from these and three similar wells sunk in 1912 water is pumped to supply nearly the whole town. From this date, then, the sinking of private wells almost entirely ceased, and this fact may have so important a bearing on the static level of the pre-existing wells that the matter is not suitable for discussion until a new series of long-period observations have been made.

ART. XLIII.—*Note on the Fluctuation of Water-level in a Christchurch Artesian Well.*

By L. P. SYMES.

[*Read before the Philosophical Institute of Canterbury, 2nd August, 1916; received by Editors, 30th December, 1916; issued separately, 10th December, 1917.*]

MANY writers, notably Hutton, Speight, and Hilgendorf, have discussed the Christchurch artesian system, and have shown that the water-level rises every evening, that it rises with rain, and that the Waimakariri River has no apparent influence. Hutton also described a "Sunday rise." These results were founded on intermittent observations made at hourly or less frequent intervals. To obtain more definite knowledge the writer, in conjunction with Dr. Hilgendorf, set up an instrument to make continuous records of the fluctuations in water-level. An isolated well at Papanui, not in use, was selected, though unfortunately its depth is not yet ascertained. This note deals with some of the results obtained through the