

flows may be misleading. An important fact connected with the 1886 eruption of Tarawera and adjoining localities is that large quantities of semi-basic lava were emitted from the Tarawera vents as scoria, lapilli, and dust, whereas Tarawera, prior to this eruption, was formed wholly of rhyolitic material. This great change in the composition of the erupted rock is highly significant, and invalidates Hector's conclusion that the Tarawera eruption was (probably) the mere temporary revival of the expiring energies of a recent focus of volcanic origin.* The remarkable, and one might almost say unique, nature of the Tarawera eruption will be fully discussed in the detailed report on the Rotorua Subdivision to be prepared by Mr. Grange next year.

The detailed investigation of the hot-spring waters and of the abundant gases associated with them will help greatly in settling the much-disputed problem of their origin. This work must be done mainly by the chemist. Analyses of the waters and of the sinters, combined with geological studies, will throw light on the mode of formation of the auriferous-quartz lodes of the Hauraki Goldfield and similar areas in other parts of the world.

Probably there are strongly marked variations in the intensity of the force of gravity in the thermal region. If so, exact measurements, whether by the Mendenhall or similar apparatus, or by the Eötvös torsion balance, may be expected to give results that will not only be of outstanding interest, but of value to the projected vulcanological survey. Similarly variations in the direction and intensity of the earth's magnetism may be predicted, and their determination will be equally useful.

As part of the vulcanological survey, continuous observations of the temperatures of the hot springs and of the ground at selected spots are necessary, and seismographs will, of course, have to be set up at various places. Exact bench-marks should be established at many points, more especially on the shores of lakes, so that any slow movement of the ground may be speedily detected, and the amount of displacement caused by earthquakes exactly ascertained.

On an earlier page I have stated that geological survey is rightly preceding detailed vulcanological observations, but clearly the geologist needs the assistance of the chemist and of the geophysicist before his work can be completed. The land-surveyor also is a necessary member of the team. On account of the need for numerous and long-continued instrumental observations of a delicate nature, the vulcanological survey will best be conducted by men with first-class training in physics, but the physicist will need help from the geologist in interpreting the instrumental data.

9. ARTESIAN WATER-SUPPLY, HASTINGS AND PAKIPAKI DISTRICTS.

(By P. G. MORGAN.)

In consequence of a request received from the Lands and Survey Department for a report by the Geological Survey on the effect that the lowering of Lake Poukawa and the drainage of the neighbouring swamp would have on the artesian water-supplies at Pakipaki and Hastings, on the 21st February last I left for Hastings in order to make the required investigation. On the 22nd I visited Havelock North, Pakipaki, and other places. So far as time allowed, I also made inquiries from well-informed people in Hastings and Pakipaki. On the 23rd I returned to Wellington.

Lake Poukawa is situated east of Te Hauke Railway-station (82 ft. above sea-level and twenty-five miles by rail south-west of Napier). It drains north-east by means of Poukawa Creek to Awanui Stream, which runs into the old channel of the Ngaruroro Stream south of Hastings. The railway-line and the main road from Wellington to Napier follow Poukawa Creek valley. The valley-bottom north-east of Poukawa Railway-station is narrow and swampy. Obviously there is no gravel in this valley or other bed that would allow underground drainage from Lake Poukawa to the Heretaunga Plain at Pakipaki, Hastings, &c. The notion that seems to be held by one or two persons that such drainage takes place may be dismissed as fantastic. Very little water drains into the lake, and, if there were any subterranean drainage, in dry weather the lake would disappear.

On the other hand, the artesian water that can be tapped under the Heretaunga Plain at Pakipaki (39 ft. above sea-level), Hastings (39 ft.), Tomoana (25 ft.), Wakatu (15 ft.), Clive (18 ft.), and Napier clearly enters the gravels and sands of the plain at higher levels near the foot of the Ruahine Mountains and soaks through them seaward. Layers of clay prevent the water in the deeper part of the gravels and associated beds (which are known to have a maximum thickness of over 650 ft.) from rising to the surface of the lower part of the plain, and, except as tapped by bores, it finally reaches the sea far out from the shore. The artesian waters of Christchurch, the Hutt Valley, &c., occur under similar conditions.

There is therefore no reason for supposing that the draining of Lake Poukawa and the surrounding swampy ground will directly affect the artesian water-supplies at Pakipaki and Hastings in any detectable degree. Indirectly, through Poukawa Creek drying up in a period of drought, the artesian pressure at Pakipaki might be lessened slightly—say, to the extent of an inch or two.

The following factors should be borne in mind :—

- (1) The Pakipaki and Hastings artesian water is tapped at shallow depths (95 ft., 135 ft.), and, since the overlying strata are not watertight over a wide area, it follows that the pressure at the surface is not great. The head varies from 2 ft. to 6 ft. or 8 ft.—rarely more.
- (2) In dry weather the head, and consequently the flow from the artesian bores, lessen considerably. This could be predicted from the shallow depth of the top of the water-bearing stratum, and the nature of the overlying beds.
- (3) The cutting of ditches in the country and the establishment of a proper system of drainage in the town of Hastings tend to lower the water-table, and this indirectly lessens the effective artesian pressure, though it does not affect the quantity of artesian water available.

* Rep. Geol. Explor. during 1886-87, No. 18, p. 243; 1887.