

two bores outside the oil-saturated area met with difficulties, and neither gave results of any great importance. Had it not been for the various bores, however, little could have been learnt concerning the geology of the district, for modern gravels hide almost all the older rocks. Thus the bores have given much useful information.

The occurrence of petroleum itself is the best possible indication of an oilfield, but other indications seen at Kotuku are gas-escapes, mineral springs, and, above all, the presence in the Miocene limestone of salt water in large quantity. The Miocene strata are gently folded, and, while some of the beds are of an impervious character, and therefore able to retain the oil, others are fairly pervious, and thus suitable for acting as oil-reservoirs. So far, the geological conditions for the occurrence of oil in quantity are very favourable. One has, however, to take into consideration the probable source of the oil and the probable position of any large reservoir before giving a final opinion.

Since small quantities of oil and natural gas occur in the conglomerate that underlies the limestone, it is practically certain that the Kotuku petroleum has a deeper source. It may therefore be concluded that rocks of coal-measures age underlie the conglomerate, and have given rise to the oil which appears in the overlying beds. This view is supported by the occurrence of petroleum and natural gas in the Greymouth Harbour Board's No. 3 bore at Dobson. According to the log, natural gas was encountered in the bore at a depth of 1,457 ft., and petroleum at a depth of 1,747 ft. If the supposed coal-measures at Kotuku have the same thickness as at Brunner, and were not denuded before the deposition of the Miocene beds, it is probable that the petroleum originates at a great depth, possibly 4,000 ft. or 5,000 ft. Since, owing to water-pressure, oil tends to rise in the strata, the main oil-reservoirs may be at any less depth. Again, since in all known oilfields of any importance petroleum has been encountered at varying horizons, it is obvious that in a new and practically unprospected district the exact depth at which oil may be expected must be ascertained by trial bores.

The tendency of oil to occur along anticlinal axes is well known, and therefore it is important to locate any anticlines that may be present in the Kotuku strata. The examination of the surface exposures of the Miocene beds in Deep Creek and the surrounding areas show that a gentle anticline with an approximate north-and-south course may be expected to traverse the district in the vicinity of Deep Creek. The surveys made in other districts show that the coal-measures of Westland, though not strictly conformable, agree in folding with the Miocene strata. It is therefore tolerably certain that any anticline in the Miocene beds will also be represented in the coal-measures beneath, and *vice versa*. The data obtained from the various bores seem to show that the anticlinal axis is to the west of Deep Creek, in the area between Petroleum and Sawpit creeks. Further boring, however, is necessary to determine with certainty the presence and exact position of an anticline. This need not be of a costly character.

To sum up, it may be said that the prospects of obtaining oil in quantity at Kotuku are so promising that the expenditure of a considerable amount of capital in further trial borings would be fully justified.

*Petroleum at Dobson.*—In the Greymouth Harbour Board's No. 3 bore, near Dobson, beds yielding natural gas and petroleum, as already mentioned, were passed through at depth of 1,457 ft. and 1,747 ft. At the present time, mineral water, bubbles of inflammable gas, and small amounts of semi-solid hydrocarbons (petroleum butter) are issuing from the top of the bore. If there were petroleum in quantity in this district one would expect to find signs of it in the neighbourhood of the Brunner anticline, and more especially in the domed section near Mount Buckley. This is not the case, and, therefore, until more definite data are obtained, it would appear to be inadvisable to incur expenditure in prospecting for petroleum in the Dobson district. Against this view might be urged the possibility of oil in the southern continuation of the Brunner anticline—say, beneath the dividing ridge between Kaiata Creek and the Stillwater Valley.

(6.) BUILDING-STONES, AND MATERIALS FOR LIME, CEMENT, BRICK, &c.—*Building-stones.*—The granites of the Hohonu Range and Mount Te Kinga are of varying quality, but, if sufficient demand should arise, could yield practically an inexhaustible supply of good building and monumental stone. From a quarry near Te Kinga Railway-station (just outside the subdivision) some fine granite has already been obtained.

At Dobson, in the upper horizon of the Island Sandstone, the Westland Stone Company is now operating on a fine-grained grey sandstone, easily worked, and well adapted for building and monumental purposes. According to tests made in the Canterbury College School of Engineering on 2½ in. cubes (approximate dimensions) the average crushing load was 706·3 tons per square foot, and the absorption in seventy-two hours only 3·705 per cent. A weathering test made on 1 in. cubes gave very satisfactory results.

The limestone and calcareous sandstone of the Cobden Beds are often suitable for building purposes. At Greymouth these rocks have been extensively quarried to obtain material for the breakwater and for road-metal, &c.

*Lime and Cement.*—At Greymouth the more calcareous layers of the Cobden Beds have been quarried for making lime, but are too arenaceous to be suitable for the purpose. Elsewhere—for example, at the head of Saltwater Creek and in Fireball Creek (near Kumara)—much purer limestone may be found. At both these localities Blue Bottom clays are found in the immediate vicinity, so that in course of time the manufacture of cement may possibly be undertaken.

*Brick.*—The Blue Bottom clays are suitable for brickmaking, and near Greymouth are used for that purpose. At Brunnerton an excellent fireclay that occurs under the main coal-seam is being manufactured into all classes of firebrick and other fireclay goods.