

upper containing greensand, limestone, claystone, and their various gradations. These rocks have been subjected to decidedly more disturbance than the overlying Tertiary series, and with the exception of the claystone are readily distinguishable from them in hand-specimens.

*Waikohu Series.*—The rocks of this series occupy a considerable area in the Mangatu and Waikohu survey districts. They extend from the Mangatu River to the Hihiroroa Stream, and have their chief exposure along the river after which the series has been named. They consist chiefly of clay-shales and sandstones in thick layers, and also in very rapid alternations of the same rocks. Fault junctions between this and the preceding series occur at several points, but a junction of deposition was nowhere observed. The lowest rock noted was a conglomerate or breccia-conglomerate bed, perhaps 50 ft. thick, consisting of angular, subangular, and rounded fragments of limestone and calcareous claystone, evidently derived from the Cretaceous beds, and proving the unconformable relationship of the Mangatu and Waikohu rocks.

*Turanganui Series.*—In ascending order the Turanganui Series consists of carbonaceous sandstone and grit, locally passing into conglomerate, followed by a thick deposit of structureless claystone which towards the top becomes more sandy, and grades into alternating beds of sandstone and claystone. The conglomerate is composed chiefly of rounded pebbles of igneous rock, but contains also pieces of claystone and limestone, some small and rounded, others large and angular. As a whole the rocks of this series resemble those of the Waikohu Series, but are less sandy and are softer. The relationship to the latter series is unconformable; angular unconformities may be seen in the Wheao and Mangatu streams.

*Tawhiti Series.*—The name "Tawhiti Series" was applied by Sir James Hector to a great thickness of beds of clay- and sand-stone covering large areas in the Raukumara Division. The formation is characteristically developed at Tawhiti Hill, near the coast, four miles north of Tokomaru Township. In a general way the succession of beds resembles that of the preceding Tertiary series, but the rocks are decidedly more arenaceous and fossiliferous. Fossil Mollusca and Brachiopoda are very common, and thick extensive layers of sandy limestone occur, especially in the southern portion of the area examined. These Hector and McKay separated under the name of the "Ormond Limestone." The Tawhiti Series in the Gisborne and Whatatutu subdivisions is unconformable with the Turanganui beds. There are numerous sections definitely proving this relationship, although in one or two localities an appearance of conformity has been found. The Tawhiti beds are believed to be of Upper Miocene age, but they possibly extend into the Pliocene.

*Waipaoa Series.*—The movements that brought the Tertiary epoch to a close resulted in the uplift of the sea-floor and its sculpturing by subaerial denudation. During the period of depression that followed the valleys formed when the land was elevated were filled with gravels and pumice sands. These form the Waipaoa Series, and are considered of Pleistocene age.

*Recent Deposits.*—During Recent times the land has been intermittently elevated, and raised beaches at various heights, as previously noted, occur along the coast. These, together with sand-dunes, the terrace and flood-plain gravels of the streams, and also aerial pumice, form the Recent deposits of the subdivision.

*Volcanic Rocks.*—The Raukumara Division lies at no great distance from the volcanic belt of the North Island. Although no dyke or flow rocks are known to occur within it, there are numerous layers of fine-grained fragmental material of volcanic origin in the Tertiary rocks. The oldest of these were noted in the upper portion of the Turanganui Series. During the deposition of the Tawhiti beds pumiceous material was increasingly abundant, and reached a maximum towards the close of that period. The Waipaoa beds are largely composed of pumice of sub-aqueous deposition, while similar material of subaerial origin covers the remnants of the maturely sculptured uplands not yet destroyed by the rejuvenated streams.

#### ECONOMIC GEOLOGY.

The geological survey of the Whatatutu and Gisborne subdivisions was undertaken on account of the presence in the area of numerous mud and salt-water springs. From many of these inflammable gas emanates, while a few also yield traces of petroleum. In the great majority of cases it can be definitely shown that the springs are connected with faults, while in the others the structure is doubtful. On Waitangi Hill the gas and oil come from rocks of Cretaceous age, and according to Hector and McKay a like condition obtains in the Waiapu district lying to the northward. At Kaiti Headland, at Totangi, and in the Waimata Valley Cretaceous rocks either occur *in situ* near the springs, or fragments of them are contained in the wide zones of pug and crushed rock from which the gas emanates. At Waihirere (near Ormond) there is no trace of pre-Tertiary rocks. It cannot be doubted but rocks of Cretaceous age underlie the whole of the Gisborne Subdivision, and there seems no reason why an alternative source for the oil should be sought.

In Bulletin No. 9, dealing with the Whatatutu Subdivision, the rock structure was considered to have arisen from the crumpling of the beds into a complex series of folds. The present writers entirely dissent from this interpretation. In their view the tilting of the strata has been caused by faulting. What folding does occur is in close connection with the fracture-zones, and the deformations produced thereby are of quite insignificant amount. The main fault-belts cross the area in an east-and-west direction, and the major blocks thus formed are again subdivided by minor fractures having a north-north-east orientation. The strikes and dips observed in the various blocks are too irregular to admit of any brief account of structural details being given in the present report. In all boring hitherto undertaken but little heed was given to the geological structure, which appears to have been misunderstood, and in every instance the wells have been put down in faulted ground near seepages and springs. As a result the unfaulted country has not been tested. But the prospecting of the possible oil-bearing areas will