

rocks that took place during the latter part of the Cretaceous period, the ultimate residue of which has been preserved in the shape of great accumulations of quartzose sands and gravels that are to be found over almost all parts of the Otago goldfields.

From the Hokonui Hills, in Southland, to the Kakanui Ranges, in north-eastern Otago, these rocks have been totally removed, nor in the line at right-angles to this, from Popotuna Gorge in the south to the mountains on the northern boundary of the provincial district, is left a single outlier of this great series of formations.

The Otago District further shows the presence of a great series of rocks of older date that are interposed between those mentioned and the schistose rocks of the central goldfields. These embrace the deposits of Carboniferous and Devonian age represented by the Maitai and Te Anau series. With respect to these, the evidence is equally in favour of their having once extended over the whole of the goldfields area, but, as there was a period of erosion and denudation between the deposit of the Maitai and Kaihiku series, it may have been that during this the Carboniferous and Devonian rocks were largely denuded away from the area of the goldfields. But that they were removed in part only is shown by their inclusion with younger Secondary and Tertiary rocks along the line of fault extending from Bob's Cove on the northern shore of Lake Wakatipu, along the eastern slopes of the Richardson Mountains, to Skipper's Creek and Mount Aurum in the Upper Shotover Valley. Also, an extensive outlier of the same beds is to be met with in the Hunter Valley, at the head of Lake Hawea. There being no outliers of Secondary rocks favours the assumption that during the period of their deposition the schists were not exposed.

It is thus evident that denudation equal to the removal of many thousand feet of strata must have preceded the laying-bare of the schists, or any considerable area of them, and that by the time the lower beds of the Cretaceo-tertiary series began to be laid down the unaltered enveloping strata of older date had been removed almost to the extent that now appears. The proceeds of such denudation must have consisted largely of sandstone gravels, but these appear to have been wholly removed to beyond the limits of the Otago District. Naturally, it was to be expected that the lowest beds of the next succeeding formation would be largely composed of materials derived from the unaltered Secondary and Palæozoic rocks; but such is not the case, schistose rocks clearly supplying the greater bulk of the material. There is another curious point in connection with this subject of the denudation of the unaltered older rocks from Central Otago, which is, that the younger deposits of late Miocene or early Pliocene date are almost wholly composed of sandstone gravels, brought from a distance and deposited on a schistose area. So that in the one case we have sandstones denuded, but over the denuded area schistose gravels are deposited; while in the other case schists are denuded, and the deposits over the area are exclusively sandstone.

After the deposition of the Mataura series (Upper Jurassic) the land was upheaved, and the denudation of the newly-laid-down deposits was begun; but we may vainly speculate as to the limits of the land, or the culminating point and axis that determined the direction of the different watersheds: all that can be said is, that the New Zealand of that day did not greatly resemble the New Zealand of the present time, and just as likely as not its mountain-ranges trended in a direction different from what they now do. Therefore, in giving by sketch section an illustration of the present outlines as they appear from the Hokonui Hills in the south-west to the outer slopes of the Kakanui Mountains in the north-east, the dotted lines do no more than indicate the previous continuity of the beds to the south-west and north-east (see fig. 1), in which 1 represents the deeper-seated metamorphic rocks, 2 the Devonian and Carboniferous formations, and 3 the Permian and Secondary sequence.

The first deposits belonging to the Cretaceo-tertiary period indicate the operation of an energetic form of denudation. This is shown by the breccia deposits of Trotter's Creek and the Horse Range, and the breccia conglomerates of Blue Spur, Weatherstone's, and Waitahuna, and the same line continued south-east into the basin of the Kaitangata Coalfield.

*Lower Breccia Conglomerates.*—These constitute the Horse Range and Trotter's Creek breccias, lying at the base of the sequence of strata forming the Shag Point coalfield, within which are to be found the most complete sections illustrating the sequence of this lower part of the Cretaceo-tertiary series and its relation to the higher parts. Fig. 2 shows the arrangement of the beds from west to east, from the main road across the Horse Range to the Shag Point Hills, near Allandale. On this, A is the Horse Range; B, Puke Iwaiti Hill; C, the railway-line and valley from the Shag River to the sea, near Shag Point Railway-station; E, Allandale; X, old rock; 4, breccia conglomerate; 5, lower quartz drifts, with shales and coal-seams; 6, middle division of the Cretaceo-tertiary series.

Fig. 3 shows the section at right angles to the last, or from the slopes of the Horse Range, across Macgregor's Farm, to near the Shag River opposite Palmerston, in which A indicates the south-west slopes of the Horse Range; B, Woolshed Creek; C, Macgregor's Gully; and X, old rock; 4, breccia conglomerate; 5, older quartz drift, with coal-seam; 12, Recent deposits. The beds on Figs. 2 and 3 correspond in position with the breccia-conglomerate deposits of Blue Spur, Weatherstone's, and Waitahuna, &c., and, like these, are auriferous. The lower part of the Blue Spur deposit is remarkably like the breccias of Trotter's Creek Gorge.

The sequence and arrangement of the different beds forming the Blue Spur deposit is shown in Fig. 4, the line of section being taken from south-west across the deposit to the fault or boundary of the deposit on the north-east side. 1, metamorphic rock schist; 4a, the lower, more angular, and schistose part of the deposit; 4b, finer-grained sandy beds, containing leaves of trees, &c.; 4c, second thick band of breccia conglomerate, material less angular than the lower band; 4d, higher breccia conglomerate, separated from the middle by sandy clays and an impure seam of lignite. North of the line of section the upper part of this, or a distinct stratum overlying, is composed largely of sandstone as well-rolled conglomerates.

Fig. 5 shows the same beds along a line from north to south, or from Monro's Gully, A, to