

Fortunately the evidence before us will remain there for all time to come (not geologically speaking), and our successors will be best able to judge what is really the truth, which we all ought earnestly to strive to discover.

ART. XLII.—*Note on Geological Structure of the Canterbury Mountains.*

By DR. HECTOR, Director of the Geological Survey of New Zealand.

[*Read before the Wellington Philosophical Society, 13th February, 1885.*]

THE following note is an abstract of a paper that will appear in the Geological Reports in reply to a recent paper by Professor von Haast\*, which impugns the correctness of a small sketch map of the geology of New Zealand, which I issued in 1883.

The chief, or rather almost the only geological contention in the paper referred to is that there is no evidence known to Dr. von Haast that warrants the subdivision of his Mount Torlesse formation, of which he says "the greatest portion of the Provincial District of Canterbury is composed." This formation he maintains to be of Lower Carboniferous or Upper Devonian age: Firstly, because certain fossils which he discovered in 1861 at Mount Potts, comprising fossil shells and *saurian bones* were by Professor McCoy, of Melbourne University, pronounced to belong to that horizon: Secondly, fossil plants which he obtained at the same time from the Clent Hills, twelve miles from Mount Potts, are stated to have been referred by the same distinguished palæontologist to a Jurassic formation: and Thirdly, both animal and plant fossils from these localities are stated on Professor McCoy's authority to be "identical with *exuvise* found in the coal-fields of New South Wales."

Unfortunately, I am unable to refer to the wording of Professor McCoy's deliverance on this matter, as it has never been published, so far as I am aware. If, however, it is true that fossils among which were *saurian bones* were really sent to Professor McCoy in 1861, and he felt compelled to refer them to a Devonian or Lower Carboniferous formation, I cannot but think that such a renowned master in palæontology would have long since emphatically enforced such an important discovery, for, as geologists are aware, even to this day the earliest trace of a *saurian* is only found in Permian formations.

However, in a paper published in 1879,† which has perhaps escaped Dr. von Haast's notice, I pointed out, after personal inspection, that the

\* Art. xli., *ante*.

† Trans. Roy. Soc. N.S.W., 1879, and abstracts in Prog. Rept. N.Z. Geol. Surv., 1879.

correlation of the Mount Potts fossils with the marine strata underlying the coal measures of New South Wales is incorrect, and that the proper equivalent of the latter in New Zealand is to be found at the base of the Maitai series. For instance, in addition to the presence of saurian bones, there is a total absence of true Spirifers; the broad-winged Spirifer that has been so often mentioned in connection with the Mount Potts beds being really a *Spiriferina* of the sub-genus *Trigonotreta*, King, distinguished by having a strong central septum in the rostral valve and a punctate shell structure, characters wholly wanting in true Spirifers. This particular fossil is indeed identical with a species very characteristic of the Permian, and it has been collected in many other parts of New Zealand where the stratigraphy leaves no doubt of its true position in that formation. No true Spirifer has yet been found on the eastern side of the New Zealand Alps, and no *Spiriferina* of the type of *Trigonotreta* is found in the true Spirifer beds at Reefton and in New South Wales, which I refer to Lower Carboniferous or Devonian. The ample collections from both the Australian and New Zealand localities in support of this are in the Colonial Museum, and here therefore arises a conflict of evidence that can only be cleared up by knowing what fossils were really submitted to Professor McCoy, and what was the wording of his report on them.

Dr. von Haast, however, could not accept on Professor McCoy's alleged authority that the Clent Hills plant beds were Jurassic, because he was "convinced that they were of the same age" as the Mount Potts beds. He considers this divergence from his authority has been since justified, because he thinks Professor McCoy has been worsted in a controversy about the age of the plant beds associated with coals and marine fossils in New South Wales. But in this particular case of the Clent Hills the experience in New Zealand has proved that Professor McCoy was quite correct in his alleged determination, and this without a whit affecting the question of the age of the New South Wales plant beds, as there is not a single fossil plant found in the proper coal formation of New South Wales which also occurs among the fossil plants of the Clent Hills beds; on the other hand the latter agree perfectly with fossil plants found in the Clarence River (New South Wales), in Queensland, and in Tasmania, which are always accepted as Jurassic. We thus find that the Mount Potts and the Clent Hills beds form almost the lowest and the highest numbers of a great Permio-jurassic system, the sequence of which has been very clearly worked out in other parts of New Zealand, where there had been less of the "folding and crumpling" to which Dr. von Haast alludes. The Permian base of this system has never been found resting with any approach to conformity on the Maitai series, which is Lower Carboniferous, the Upper Carboniferous formation or the Lower Coal

Measures of New South Wales being still undiscovered in New Zealand. Dr. von Haast's Mount Torlesse formation must therefore, if it is palæozoic, be restricted as equivalent to the Maitai series.

The circumstance which he notices that the fossiliferous beds of his Mount Torlesse formation (*i.e.* the Clent Hills beds) generally appear when great denudation has taken place, and the many localities he cites for these fossils, which we have every proof are really of mesozoic age, even without the direct observations which have been made, would quite justify the belief that over a very large area of the Canterbury district lower mesozoic, and not only palæozoic, rocks prevail at the surface. Indeed the areas of the latter are becoming more and more restricted as the structure of the country is worked out in detail. Except in the typical section, near Nelson, of the Maitai series, where true Carboniferous Brachiopoda and corals have been found, it is unfortunately almost devoid of fossils, a calcareous tubular body which has been long known as the Mount Torlesse Annelid and obscure plant remains being the only fossils that have yet been found out of the Nelson District. These are, however, pretty common wherever the upper part of the Maitai Series is exposed. From near Wellington in the North Island there is no locality recorded until we reach the Ashley Gorge and Glentui, but there is reason to believe that a large portion of the Seaward Kaikoura Range is composed of this formation. Following south we find the characteristic tubular fossil in the south-eastern end of Mount Torlesse, Big Ben Range of the Malvern Hills, Mount Hutt, source of the Rangitata, Mount Cook, and at Lake Ohou. On the western slopes we find it at Nelson, Taipo Range, south of the Teremakau, and in the glacier *débris* brought down from the Alps between Hokitika and Okarita. The Maitai series thus crops out along both sides of the Canterbury Alps, but both outcrops are to the eastward of the only area of Lower Palæozoic rocks which we know in New Zealand.

Without any attempt to portray the minor irregularities, the only possible generalization of the geology of the country on such a small scale map was to express it by a synclinal, and this view is supported to a remarkable degree by the observations scattered through the geological reports. No doubt changes in the map will be required in future, as the examination of the country is proceeded with, just as they have been required in the past. To cavil at such changes being made on the ground that they seem to over-sensitive persons to have been "written only to find fault," is to bar the progress of science. But it is not even a change that is complained of in Dr. von Haast's paper, but only an expansion of our knowledge that had been quite anticipated by that author.

The particular case to which exception is taken, may be stated as follows:—Dr. von Haast submits “that it is even more than probable that this large assemblage of beds,” which to evade difficulties of survey he had lumped as his Mount Torlesse formation, “may belong to several *distinct periods* ranging from the palæozoic to the lower mesozoic, but hitherto it has been impossible to divide this formation, for the present at least, into smaller groups owing to the want of fossils.” Well, in the progress of the Geological Survey, the requisite fossils have been found and the subdivision made. Why should Dr. von Haast object?

ART. XLIII.—*Analysis of Slate in contact with Granite from Preservation Inlet, New Zealand.* By A. LIVERSIDGE, F.R.S., Professor of Chemistry and Mineralogy, University of Sydney. Communicated by Professor F. W. Hutton.

[Read before the Philosophical Institute of Canterbury, 27th November, 1884.]

ANALYSIS of a specimen of slate and granite in contact was read before the Otago Institute in November, 1877 (Trans. N.Z. Inst., 1877, p. 505). Since then a further analysis of another portion of the slate has been made with the following results:—

	ANALYSIS.						
Hygroscopic moisture	..	..	..	..	..	..	·480
Silica	..	..	..	..	..	..	53·350
Alumina	..	..	..	..	..	..	19·889
Iron sesquioxide	..	..	..	..	..	..	2·294
„ protoxide	..	..	..	..	..	..	5·241
Manganese protoxide	..	..	..	..	..	..	1·522
Lime	..	..	..	..	..	..	3·025
Magnesia	..	..	..	..	..	..	5·060
Potash	..	..	..	..	..	..	3·904
Soda	..	..	..	..	..	..	3·652
Undetermined, combined water, etc.	..	..	..	..	..	..	1·583
							100·000
Specific gravity	..	..	..	..	..	..	2·72

The above results, in common with the first analysis, show that on the whole there is no very great similarity in composition between the granite and slate, such as might be expected were the granite merely a metamorphosed or crystalline form of the slate; it would rather appear that the granite is distinctively intrusive, and not derived from the slate by metamorphic action.