

Pass Stone is conformable to the Amuri Limestone, there is a Cretaceous-Tertiary formation in New Zealand, while if it is unconformable, there are distinct Cretaceous and Tertiary formations.

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TERTIARY FOSSILS IN THE WEKA PASS STONE, NEW ZEALAND.

SIR,—The discovery of Tertiary fossils in the Weka Pass Stone in the Lower Waipara district, as reported in this issue by Dr. J. Allan Thomson, is of special interest in connexion with the Cretaceous-Tertiary controversy now taking place in New Zealand. On four different occasions I had carefully searched for recognizable fossils in this rock in the typical Weka Pass District without result, and in consequence referred the Weka Pass Stone to the Cretaceous Waipara succession. This discovery, it should be noted, does not in any way affect the argument for or against a Cretaceous-Tertiary succession to New Zealand. What it does is to show that the unconformity between the Lower Tertiary and the Cretaceous must be placed, not above the Weka Pass Stone as done by me, but below it as contended by Hutton. By the aid of a sketch-map kindly made for me by Dr. Thomson I had no difficulty in finding the new fossiliferous locality in the Lower Waipara. Although fossils are scarce I succeeded in finding two fine examples of *Pseudamusium huttoni* (Park) and two of *Cirsotrema lyrata* (Zittel), both typical of the Tertiary Oamaru Series. The fossils occur in the lower third of the Weka Pass Stone, and are usually not many feet above the junction of the Amuri Limestone.

Hutton always contended for an unconformity between the Weka Pass Stone and Amuri Limestone. The latter is a hard grey chalky rock without bedding planes. Its upper surface on which the Weka Pass Stone rests, as seen along the escarpment facing Doctor's Creek in the Lower Waipara where the Tertiary fossils were recently found, is undulating and gently corrugated, and in places broken into angular fragments that have been recemented so as to present a rudely brecciated appearance. But the physical break is nowhere great, and since both the Weka Pass Stone and Amuri Limestone are tilted at the same angle and exposed in the same scarps it is frequently difficult to distinguish any trace of stratigraphical discordance. Nevertheless, the discovery of Tertiary fossils in the Weka Pass Stone is a splendid justification of Hutton's contention. Above Hutton's unconformity the fossils are typically Tertiary and below typically Cretaceous.

In North Canterbury the Lower Tertiary (Oamaru) Series rests on the Cretaceous (Waipara) Series, but in South Canterbury and North Otago it rests on older Mesozoic or Palaeozoic rocks. Where the Oamaru Series rests on these older rocks in the south it always begins with a series of terrestrial beds containing seams of brown coal, but where it rests on the Cretaceous rocks in the Waipara district the terrestrial beds are absent. It would thus appear that marine deposition began first in the north and gradually spread southward as the subsidence progressed. The marine Weka Pass Stone in the north is apparently contemporaneous with the terrestrial brown Coal-measures in the south. When subsidence began at the close of the Cretaceous the first areas to be invaded by the sea would naturally be the old Cretaceous basins, which would explain the early appearance in the north of *Pseudamusium huttoni* and *Cirsotrema lyrata*, both of which it should be noted pervade all the marine beds of the Oamaruan in the south.

The correlation of the Weka Pass Stone and the Ototara (Waitaki) Stone in the south, as urged by McKay, is opposed to the palaeontological evidence, for whereas the Pareora fauna underlies the Mt. Brown (Waihao, Waitaki, Duntroon, Ototara) and Kakanui calcareous horizons, it everywhere overlies the Weka Pass Stone.

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