

The Weka Pass stone varies in colour from pale-yellowish-white to greyish-white. Bedding-planes are well developed at intervals of a few feet, but vertical jointing, as so well seen in the Amuri limestone, is hardly noticeable, and consequently the Weka Pass stone as seen *in situ* presents a more massive appearance than the bulk of the older rock, from which it may also be distinguished even in hand-specimens by its somewhat coarser grain and more sandy nature.

CONTACT OF AMURI LIMESTONE WITH OVERLYING ROCK.

Though, as previously stated, the Amuri limestone everywhere appears conformable in strike and dip with the overlying Weka Pass stone, which may conveniently be regarded as including the underlying thin sandy glauconitic layer into which it passes, the actual contact presents some peculiar features, not easily reconciled with the view of a perfectly conformable succession held by several observers. As seen in the gorge of Weka Pass Creek and on the road towards Waipara, the upper surface of the Amuri limestone is everywhere irregular, showing shallow basins or hollows and fissures of some depth (1 ft. to 2 ft.), all filled with glauconitic sandstone. The fissures are really irregular cavities, following joint-planes to a great extent, but evidently enlarged by chemical erosion or solution. Small peninsulas of limestone, some of which are joined only by a narrow neck to the main mass, extend several inches upward into the glauconitic sandstone. Numerous pieces of limestone, mostly of irregular shapes, but some with rounded outlines, occur in the lower 9 in. or 10 in. of the glauconitic sandstone; a few, mostly rounded, extend sporadically to about 2 ft. above the upper surface of the Amuri limestone. One or two very small pebbles of probable greywacke, together with a small rounded phosphatic lump, probably a fragment of bone, were also observed by the writer. In 1886 McKay (10, pp. 83-84) collected some phosphatic nodules near the Pigeon Rock, but his deduction that all the supposed pebbles or fragments of Amuri limestone in the glauconitic sandstone are phosphatic concretions is not borne out either by appearances or by the analysis of the writer's sample quoted on a later page. Marshall, Speight, and Cotton, who have closely examined the Weka Pass section, evidently consider the inclusions in the glauconitic sandstone to be of the same composition as the Amuri limestone, but explain them as nodules separated by interlamination of glauconitic matter that arose through a change in the conditions of deposition (21, p. 386). The term "floaters" probably very nearly expresses their views. The writer, on the other hand, regards the limestone "nodules" as certainly formed by the action of eroding-agents on an exposed surface of Amuri limestone. The irregularly shaped fragments close to the base of the glauconitic sandstone, together with the "peninsulas," &c., may, if the reader likes, be regarded as due wholly to chemical solution; but the more rounded pieces found as much as 2 ft. above the Amuri limestone must have been transported by water, and are therefore correctly described as pebbles.

EXPLANATIONS OF CONTACT.

The explanations of the contact between the Amuri limestone and the overlying glauconitic sandstone as given by various writers have in most cases been highly coloured by preconceived ideas, nor can the present writer hope wholly to escape similar influences. The several possible explanations may be stated as follows:—

- (1.) The contact indicates a distinct unconformity, both physical and palæontological, between Cretaceous and Oligocene or Miocene.—Hutton's view; Park's view in 1904 and since 1912 (17, p. 413; 24, pp. 496-97).
- (2.) It indicates a break in deposition, due to currents or other minor change (probably McKay's view), or to elevation not amounting to unconformity.
- (3.) No marked break in deposition, but some change in conditions of deposition.—View held by Marshall, Speight, and Cotton in 1911.

The facts observable at Weka Pass appear to the writer to be clear proof of at least local unconformity. Though, apart from palæontological evidence, they do not necessarily prove more, yet Hutton's view of strong unconformity has first claim to the consideration of the student, both on the grounds of priority* and of having the weightiest evidence in its favour. In other words, the burden of disproof is on his opponents. The chief evidence in favour of unconformity may be summarized as follows:—

- (1.) Irregularly eroded upper surface of Amuri limestone.
- (2.) Presence of indubitable pebbles of Amuri limestone in the overlying bed of glauconitic sandstone.
- (3.) The palæontological break indicated by the presence of Cretaceous fossils in beds underneath the Amuri limestone, whilst immediately above, in the Weka Pass stone, are characteristic Miocene fossils.
- (4.) The sudden change at the contact from limestone to glauconitic sandstone, the overlap of Weka Pass stone on Amuri limestone, and other minor data mentioned by Hutton and Park.

The chief reasons for favouring a conformity are

- (1.) The apparently complete agreement in strike and dip between the beds above and below the contact.
- (2.) In places the contact of Amuri limestone and the overlying bed is regular. The writer has not seen such contacts, but has been informed by Dr. J. Allan Thomson that they exist in the area west of Waipara.

* Hector's brief account of 1869 (see Progress Report in Rep. Geol. Expl. during 1868-69, No. 5, pp. x-xiii) is founded on a "hurried visit," and contains no evidence that he examined the Weka Pass section. From Von Haast's paper published in 1871 (Rep. Geol. Expl. during 1870-71, No. 6, pp. 5-19) one may reasonably conclude that he did not examine the Amuri limestone and Weka Pass stone contact.