epoch. This same unequal elevation would also account for the narrow gorge, already mentioned, by which the Waimakariri enters the Canterbury Plains, and which, according to Dr. von Haast, has been entirely cut since the glacier epoch.* If this hypothesis be correct, it follows that the inland sea in which the Waipara, Oamaru, and Pareora rocks were deposited, must have entered the Trelissick Valley from the Waimakariri by Craigieburn; the Broken River gorge not having been cut until long afterwards; and as all these rock systems bear marks of an epoch of subaërial denudation following that of their deposition, it follows that the sea entered by this channel at three different times, each time followed by an epoch of upheaval.

[Addendum.]

Christchurch, 30th September, 1886.

Mr. J. D. Enys has informed me that, since my visit to Castle Hill Station, he has discovered a dyke nearly at the top of Gorge Hill—between Broken River and the Porter—which he believes to be a continuation of dyke d. This furnishes absolute proof that one of the dykes, at any rate, is younger than the Waipara System; and probably, therefore, all are younger.

F. W. H.

Art. LIII.—*On the so-called* Gabbro *of Dun Mountain.*

By Professor F. W. Hutton, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 4th November*, 1886.]

This is a very coarsely-crystalline rock composed of two minerals only. One is a foliated greenish-brown mineral, like bronzite or diallage, in irregular crystalline masses. The other is an opaque-white or greenish-white felspar, like saussurite. The specimen was given to me by Sir J. von Haast, and I do not know its field relations further than that it comes from the Dun Mountain, near Nelson. Its specific gravity is 3·15.

The foliated mineral.—Under the lens the principal cleavage planes are seen to be finely striated; this striation being due to the development of a second plane of cleavage, less perfect than the first, and crossing it at an angle of about 67°. In thin sections, showing both cleavages, the mineral gives brilliant polarization colours, and always extinguishes parallel to the fine striations and oblique to the principal cleavage. This shows

* "Geology of Canterbury and Westland," p. 213.

that these sections must be transverse to the principal axis; for if not, the cleavages would either be at right angles to each other (Rhombic System, or Ortho-pinacoid), or else the extinction would be oblique to both cleavages (Clino-pinacoid). The edge formed by these cleavage faces is therefore parallel to the principal axis, and as the principal cleavage is not on an axis of elasticity, it must be parallel to one face of the prism: no cleavage seems to be developed parallel to the other face.

A section, approximately at right angles to the principal axis—as proved by the angle between the cleavages—shows, with convergent polarized light, a symmetrical bisectrix with wide axial angle, and the axial plane in the direction of the striations. Cleavage flakes from the principal cleavage (210) give straight extinction, and show an optic axis on the margin of the field, with the axial plane in the direction of the striations; thus giving a further proof that this cleavage is parallel to the face of the prism.

Cleavage flakes of the second cleavage show no striations, but extinguish apparently parallel to the first cleavage; this, however, is not very exactly marked. They show no interference figure with convergent polarized light.

These straight extinctions, and the bisectrix seen on 001, prove that the mineral belongs to the Rhombic System. Now, in the Rhombic System, the angle between 110 and 100 must lie between 0° and 45°, while the angle between 110 and 010 must lie between 45° and 90°. Consequently, as in our case the angle between the two cleavages is about 67°, it follows that the second cleavage, and the plane of the optic axes, are parallel to the brachy-pinacoid.

The angles of the prism will be 134° and 46°, but the measurements are not very exact, owing to the want of proper instruments; they are however sufficiently so to show that the mineral is not a rhombic pyroxene but a rhombic amphibole, and probably, therefore, anthophyllite. Pleochroism is well marked in sections more or less parallel to 001. The colour for α being greenish-yellow, and for β reddish-brown. Sections parallel to the cleavages do not show any marked pleochroism, so that the colour for γ is greenish-yellow, like that for α. Before the blow-pipe the mineral is infusible, or fusible only with great difficulty. All these characters agree with anthophyllite, but the typical form of that mineral is said by E. S. Dana to have its principal cleavage parallel to 100, and the relative lengths of the lateral axes are not so unequal as in our variety.

The felspar.—This mineral is so much altered as to show merely a number of granules and rods in a transparent base, which is generally quite amorphous, but occasionally cryptocrystalline. No doubt it is some kind of plagioclase, but whether it has been anorthite or labradorite can only be determined by chemical analysis; at present it is saussurite.

The question now arises, What name are we to give the rock? There is no special name applied to plagioclase-anthophyllite rocks—apparently because anthophyllite is rare. But as anthophyllite is a rhombic amphibole, it may be grouped with hornblende; so that perhaps the name corsite might be made to include our rock. The typical corsite—*i.e.*, the orbicular diorite of Corsica—is said by Cotta to be composed of anorthite, blackish-green horn-blende, and some quartz. Later writers have omitted the quartz as undoubtedly of secondary origin, and corsite is now defined as an anorthite-hornblende rock. The hornblende is generally the foliated variety called smaragdite, and is supposed to be a decomposition product of augite; so that, from this point of view, a corsite would be an altered eucrite or gabbro, and in the latter case could hardly be distinguished from euphotide, as restricted by Professor Bonney. Mr. Teall looks upon corsite as a variety of diorite in which the felspar is anorthite.*

Now, although hornblende is undoubtedly often a secondary product after augite, we cannot suppose that all hornblende has been thus derived; that all syenites have been augite syenites, and that all diorites have been gabbros or dolerites. Evidently hornblende is often an original constituent of a rock, and therefore, under certain conditions, we have no reason to suppose that it may not become schillerised as augite does; smaragdite answering to diallage, and anthophyllite to bronzite or hypersthene. This being so, it would seem to be advisable to have a name to represent this particular condition of amphibole rocks, and I would suggest that the name corsite be enlarged to include all rocks essentially composed of plagioclase and a foliated amphibole (such as smaragdite and anthophyllite); it would then bear the same relation to diorite that gabbro and norite do to dolerite. With the pyroxene rocks the kind of felspar is not always taken to warrant a separate name, as shown by norite, which is a plagioclase-enstatite rock; and gabbro is often made to include eucrite. Why, therefore, should the amphibole rocks be treated differently to the pyroxene rocks? In the rock from the Dun Mountain, there is nothing to indicate that the anthophyllite is a changed pyroxene, but it is itself altered in places into a green fibrous mineral which may be smaragdite.

---

* "British Petrography," p. 73, footnote.