portion having been overlapped by another and more anterior body-segment; this is succeeded by a band covered by scale-markings (*a*), about six rows deep, and next these follows the posterior crenulated border (*b*). (The specimens are numbered 2910 and 2911.) The first of these shows a piece of a body-segment, 75 mm. long by 40 mm. deep; only 20 mm. of the margin is preserved. There is a trace of another segment which underlies the above, also showing scale-markings and a small part of the scalloped margin. No. 2911 measures 60 mm. in length, by 40 in depth; 50 mm. of the posterior crenulated margin is preserved.

Like the remains of the Merostomata from British and Irish localities, those from Brazil and the Cape are also associated with plant-remains, and may have been of lacustrine origin. It is highly probable that, although based only upon fragmentary remains, *Hastimima* includes specimens of more than one species, if not of more than one genus. It is not my intention, however, to suggest fresh names for these fragmentary Arthropods; but their presence in such widely separated localities is a matter of extreme interest, and may prove useful as a means of marking synchronous or homotaxial horizons over very large areas. Similar fragments (see woodcut, Fig. 1) were observed by the late Mr. W. H. Baily in the Devonian rocks of Kiltorcan, as well as those already referred to in the Upper Ludlow of Shropshire.

IV.—NOTE ON THE LANGKOFL THRUST-MASS.

By MRS. MARIA M. OGILVIE GORDON, D.Sc., Ph.D., F.L.S.

IT will be remembered that two years ago, in 1907, I pointed out the occurrence of important planes of overthrust at the base of the Dolomite Mountain-massive of Langkofl and Plattkofl in South Tyrol, which explained its apparent 'reef-like' form, and its curious position above Wengen lavas in some places and Muschelkalk at others. I showed that at Langkofl the Upper Werfen Strata and Muschelkalk form a shear-slice above which the Schlern Dolomite rocks of the Langkofl Mountain have been overthrust, and below which the Wengen lavas and tuffs of the Ciampinoi meadowland are present; also that the planes above and below this shear-slice are crush-planes of extremely low inclination.

Last autumn I continued my researches in this district, but unfortunately, owing to the pressure of other business, it is only now that I have had an opportunity of preparing my work for publication.

In mapping the Ciampinoi and Wolkenstein hill area that descends from Langkofl to Gröden Valley, I traced an important thrust-plane northward across the Gröden Valley to the Sorasass Alpe and Pitsch-Berg on the north side. Disturbed strata are present in the Ciampinoi and Wolkenstein hill area, belonging to the Wengen, Buchenstein, Muschelkalk, and Werfen horizons, and they continue the same E.N.E.—W.S.W. strike as the thrust-band below the Langkofl. They are overthrust above the Wengen lavas and tuffs of the valley segment. Where the fault-plane is exposed on the western slope of the Ciampinoi hill it strikes N. 10 E. and dips *ca.* 20 E.,

but the surface is waved and bent, and the outcrop of the plane is frequently interrupted by small cross-faults. The plane is essentially a crush-plane, at which the older group of rocks has been thrust westward.

On the north side of the Gröden Valley the thrust-plane continues through the Pitsch-Berg, where the Werfen or Lower Triassic Strata have been overthrust westward above the Middle Trias. Further north rise the Dolomite peaks of the Geissler group, whose geological relations and 'reef-like' form Mojsisovics compared closely with those of the Langkofl Massive (*Dolomit-Riffe*, 1879, pp. 210-11). The band of Muschelkalk Rock at the base of the Dolomite in both these Massives reaches the height of 2200 met. contour, whereas in the Triassic succession of the Gröden Valley below St. Christina it is exposed at the 1400-1500 met. contours. The explanation, however, is provided in this important overthrust of the rocks of the Upper Gröden area, and the subsequent flexures and faults which the thrust-mass has undergone.

Near St. Christina, I detected in three of the stream-cuttings on the south side of Gröden Valley the same thrust-plane, almost horizontal, passing through the Wengen lavas and tuffs, and duplicating that horizon and the Buchenstein Strata; and I traced it westward where it underlies the Seiser Alpe. Thus the Langkofl or Schlern Dolomite thrust-mass simply rests upon another thrust-mass on the west. At a still lower level another thrust-plane is present, passing through the Buchenstein and Mendola Dolomite horizons, and with overthrust again of Augite, Porphyrite, and Buchenstein rocks.

The Upper Gröden thrust-mass is therefore composed of subjacent thrust-slices of varying thickness and importance. The thin shear-slice of portions of Werfen, Muschelkalk, Buchenstein, Porphyrite, and Wengen tuffs emerging from below Langkofl on the north side owes its position to an east-west dislocation within the thrust-mass. The thrust-planes below and above it are apparently the same as those above and below the lower segment of Schlern Dolomite and Wengen-Cassian Strata in Sella Massive. This thin shear-slice underlies the thick development of Schlern Dolomite in both Massives, which represents the main thrust-segment. In the Sella Massive it is succeeded by another thrust-slice at the Boe summit, where Raibl and Dachstein horizons have been overthrust above Upper Trias and fragments of Jurassic and Cretaceous Strata. The conformable succession of Schlern Dolomite upon Upper Cassian horizons belonging to the thrust-mass is well preserved on the southern and eastern flanks of the Langkofl Massive.

The similarity of the geological relations in the Langkofl and Sella Massives proves the essential continuity of the important thrust-plane at the base of the Schlern Dolomite. The varying dip of the plane to north or south or in other directions, both in Sella and Langkofl, is due to superimposed plicational and dislocational effects; while the position of the overthrust Cassian Strata and Schlern Dolomite relatively to different stratigraphical horizons in the underlying shear-slice indicates the previous existence of folds in the rock-masses cut

by the thrust-plane. The observations at Langkoff confirm the results I obtained for the district generally that the earliest folds had an east-west strike, while the overthrusts took place during a more advanced period of strong cross-compression.

At Langkoff the complex of thrust-slices has been segmented by several north-south 'step' faults of slight throw, the effect of which has been to lower the segments on the east side towards the north-south fault in Sella Pass with upthrow on the east. In former papers I have shown that this is also the case in Sella Massive, and has shattered the eastern aspect of that mountain as compared with the western; and that it also holds good for the Enneberg and Sett Sass area where the step faults lower the Valparola exposures of Raibl and Dachstein Strata on the east of Sett Sass. The dolomitic rock in these mountain-massives and in the Ampezzo and Gader Thal district is part of the same thrust-mass as Sella and Langkoff.

The Wengen Strata of the underlying or St. Christina and Seiser Alpe thrust-mass may be traced continuously from the north of Langkoff round the west of Plattkoff to the Duron Valley slopes on the south of the Dolomite Massive. There the thrust-mass of Langkoff and Sella Massive is downthrown, and the underlying mass upraised, on the north and south respectively of that leading east-west fault which I called the Rodella-Buchenstein fault.

The thrust-planes in the group of Lower and Middle Trias reappear in the south or Duron Valley slopes, and have the same effect as at St. Christina of duplicating or cutting out various horizons. The chief thrust-plane of the Duron Valley slopes occurs at 1700-1800 met. contour and continues as a well-marked plane of overthrust throughout the Mt. Donna and Bufaure Mountains. Above it are sheared slices of Werfen, Muschelkalk, Buchenstein Strata, and the Wengen lavas and tuffs; below it is a succession of Lower and Middle Trias which exhibits the petrographical and palæontological characteristics of the so-called northern and southern, or 'Rand' facies of the Dolomites, i.e. with well-defined Upper Werfen fossiliferous zones and the Middle Trias developed for the most part as a homogeneous calcareous or calcareo-dolomitic mass. According to my mapping of the thrust-planes in Fassa this calcareous facies exposed in the Vallaccia, Costabella, Marmolata, and other Massives represents the basal mass above which the thrust-slices with the porphyritic, tufaceous, and dolomitic facies have been driven.

Subsequent folds and faults have lowered the rocks of the overthrust slices in some places between portions of the basal mass, so that in the Fassa and Contrin region the one facies suddenly gives place to the other and the complication of detail is very great.

V.—SOME GLACIAL FEATURES AT ABEREDW IN THE WYE VALLEY, NEAR BUILTH WELLS.

By L. RICHARDSON, F.R.S.E., F.G.S.

(PLATE XXIX.)

WHILE pioneering for an excursion of the Cotteswold Naturalists' Field Club at Aberedw in the Wye Valley, between Builth Wells and Hay, certain very interesting physiographic features,