

## Ordovician stratigraphy of Aberiddy Bay, Pembrokeshire

SIR,—May we comment on Mr A. C. Waltham's recent paper, in the *Geological Magazine* (1971, p. 49)? Like him, we have noted that the bedding–cleavage relationship is consistent with inversion of the beds on the north side of the bay and, on annual visits with field-parties from Cambridge, have searched for corroborative evidence. This seems an opportune time to record a few significant discoveries concerned mainly with the faunas of these rocks. The fossils mentioned include specimens collected by Mr P. J. E. Woods and other members of student parties, whose assistance we gratefully acknowledge.

Geometrically, the lowest beds exposed on the north side of Aberiddy Bay are grey shales and mudstones which dip, approximately northwards, beneath the Castell Limestone, and which were included by Cox (1916) in his *Dicranograptus* shale unit. In this shale unit, near the junction with the Limestone, occur trilobites which indicate with some certainty the zone of *Nemagraptus gracilis*, which is taken, for present purposes, as the basal zone of the Caradoc.

The species present are:

- Trinucleus fimbriatus* Murchison (SM.A. 79242–4)
- Telaomarrolithus* cf. *intermedius* Hughes (SM.A. 79247–8)
- Cnemidopyge* sp. (SM.A. 79245–6)
- Nileid, ?*Homalopteon* sp. (SM.A. 79241)

It has recently been shown that *T. fimbriatus* is restricted to the *N. gracilis* zone at Builth (Hughes, 1971), and this instance is the first confirmed occurrence outside the region. *Telaomarrolithus*, known from Llandeilo, Builth and Shelve, is entirely restricted to the *N. gracilis* zone, *T. intermedius* being from the lower part of the zone at Builth.

The beds which, geometrically, overlie the Castell Limestone and which, according to Cox and Waltham, are separated from the latter by a reversed fault lying parallel to the bedding, are slates containing trilobites, referred by Cox to the *Didymograptus bifidus* zone of the Llanvirnian. From these beds, in the southern part of the Porth-gain quarry, the following trilobites have been obtained:

- Cnemidopyge* cf. *parva* Hughes (SM.A. 79233, 35, 37, 40)
- Cf. *Ogygiocarella debuchii angustissima* (Salter) (SM.A. 79228–31; A. 54672–4)
- Platycalymene* cf. *tasgarensis simulata* Hughes (SM.A. 79232, A. 44759, A. 54148)
- ?*Barrandia* sp. (SM.A. 79238)
- Trinucleid spp. (SM.A. 79234, 36).

The preservation does not allow confident specific assignments, but the occurrence of *Cnemidopyge* cf. *parva* and *Platycalymene* cf. *tasgarensis simulata* indicate a Llandeilo age by comparison with the faunas of Builth (Hughes, 1969) and Mydrim (Toghill, 1970). The assignment of specimens to *Ogygiocarella debuchii angustissima* is very tentative. Whittard (1964, p. 244) identified SM.A. 54672–4 as *Ogyiocaris* sp. Although, owing to the cleaved nature of the rock, it is difficult to be certain, some specimens indicate that the inner margin of the doublure is scalloped, contrary to Whittard's belief, showing that they more likely belong to the genus *Ogyiocarella*; while the presence of twelve or thirteen ribs suggests a closer affinity to *O. debuchii angustissima* than to *O. debuchii* itself, and suggests an upper Llandeilo or even basal Caradoc age. The occurrence of ?*Barrandia* sp. and trinucleids has little stratigraphical significance, although they are common elements of the Llandeilo fauna at Builth.

Geometrically overlying these 'trilobite beds' in the Porth-gain quarry are slates from which we have obtained the following, clearly indicating the *Didymograptus murchisoni* zone of the Llanvirnian:

- Didymograptus murchisoni* (Beck)
- D.* ? *murchisoni* (Beck)

*Didymograptus ? stabilis* (Elles & Wood)  
*Didymograptus cf. geminus* (Hisinger)  
*Diplograptus priscus* (Elles & Wood)

The slates which occur in the cutting high up in the northern part of the quarry are, geometrically, still higher and from these we have obtained:

*Didymograptus aff. bifidus* (Hall)  
*Didymograptus cf. speciosus* Ekström  
*Didymograptus sp.*  
*Hallograptus sp.*,

an assemblage suggesting a horizon as low as the *D. bifidus* zone.

The Llanrian volcanics, outcropping in the extreme north of the Porth-gain quarry and along Trwyn Castell, form the highest horizon (geometrically) at this locality but there is evidence of inversion in the attitude of small scale graded bedding in pyroclastic rocks. This is well seen in cliff top exposures immediately west of the castle ruins.

In summary, therefore, structural, sedimentary and faunal evidence point to inversion of this succession, and in this general conclusion we are agreed with Waltham. In detail, however, we differ from some of his conclusions. Study of the faunas is difficult because of poor preservation and distortion due to cleavage. But the evidence so far available indicates that stratigraphically overlying the Llanrian Volcanics are slates ranging from the *D. bifidus* zone up into the Llandeilo, followed by the Castell Limestone and by the '*Dicranograptus* shales', the lowest part of which is basal Caradoc. It follows that the latter correlate broadly with the Mydrim Shales, and not with the Hendre Shales as proposed by Cox and agreed by Waltham. Indeed, it seems possible that the shales at Abereddy with *T. fimbriatus* might be the lateral equivalent of the Mydrim Limestone. The Castell Limestone would then lie within the Llandeilo (together with the underlying 'trilobite beds'), and could well be a very local calcareous development.

It also seems to us that the supposed reversed fault of the Porth-gain quarry, postulated by Cox to account for the duplication of beds, and by Waltham to explain the supposed absence of the *murchisoni* beds, is no longer necessary, since the former problem is solved by inversion and the latter is erroneous. It is, in fact, instructive to re-read Cox's remarks on this (p. 306):

'The fault is marked by a fault-breccia occurring in one main and several subsidiary bands, which, where exposed, keep quite parallel with the bedding-planes. The larger breccia-band is about 6 inches thick. It is a rather curious coincidence that the beds on each side of the dislocation dip at almost exactly the same angle (about 60° north-north-westwards), and that both sets of beds are crossed and about equally affected by a cleavage dipping about 40° north-north-westwards, so that the importance of this fault is not at all clear until the fossils are collected. This is still more the case, since similar little bands of breccia may be seen among the *Dicranograptus* Shales in places where there has obviously been no sliding movement at all, but merely a little crushing.

We would describe the 'fault-breccia' as local and irregular mineral veining along the strike of the beds and suspect that Cox would not have associated this with significant fault movement in the absence of what seemed, at the time, to be compelling stratigraphical evidence.

The remaining problem, as Waltham points out, is to account for the absence in the normal limb of the fold, exposed in the southern part of the bay, of beds present in the inverted limb. These missing beds, however, consist not only of the Castell Limestone, but also of the stratigraphically underlying 'trilobite beds' and the overlying shales with *Trinuclaus fimbriatus* et cetera. We agree that non-sequences may well be present; that lateral variations in lithology may be involved; and we note the presence of strongly brecciated shales (perhaps indicative of strike faulting) in the normal limb of the fold. But we have, at present, no new evidence to offer on this problem.

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SIR.—May I thank Messrs Black, Bulman, Hey and Hughes for their most valuable comments on the paleontology of the Aberiddy Bay area. My own interest in the geology of the area was primarily structural and my fossil collecting was relatively minimal.

The quoted paleontological evidence for the age of the beds in the Porth-gain quarry prompts a modified interpretation of the structure which I cannot refute.

At Aberiddy the structural evidence was adequate to show that Cox was, at least in part, incorrect over his correlations of the *Dicranograptus* shale and the Castell Limestone. I had suspected, but, lacking adequate knowledge of the geology in adjacent areas, could not prove, that the *Dicranograptus* and Hendre Shales did not correlate, as suggested by Cox. The paleontological evidence is sufficiently conclusive.

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## Phases of deformation in North Wales

SIR.—In a recent paper, Dr B. T. D. Lynas (*Geol. Mag.* **107**, 1970, 505–510) proposed that the low angle slaty cleavage developed in pelitic rocks on the northern flanks of the Harlech Dome (North Wales) is a pre-Caledonian structure. He suggested that was produced by near vertical compression stresses induced as a result of magmatic uplift of the Harlech Dome in mid-Caradocian times. I believe this hypothesis to be untenable for the following reasons.

1. Between Blaenau Ffestiniog and Dolwyddelan, in the area to the west and northwest of that described by Dr. Lynas, the low angle cleavage characteristic of the Ffestiniog Slate Belt (S1 of Lynas) gradually steepens in dip and swings in strike until it becomes axial planar to the Dolwyddelan syncline. The latter structure is considered by most authors (e.g. Williams & Bulman, 1931, 452–453; Shackleton, 1954) to be of Caledonian age. Nowhere, in open sections between Ffestiniog and Dolwyddelan, is there any evidence that the low angle slaty cleavage either dies out away from the