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1st August, 1968.

SIR,—Dr. I. G. Gass' rejection on stratigraphic grounds of Geochron Laboratories potassium-argon date  $148 \pm 30$  m.y. in favour of the Oxford Age Unit date of  $25.7 \pm 5$  m.y. is not acceptable because only the strata above the Khor Shinab flow have been dated by fossils.

Carella & Scarpa (1962) reported a fauna indicating a Middle Miocene (Helvetian) age for the Abu Imama formation which overlies the flow, but the underlying formation was assigned to the Maghersum formation simply on lithological grounds. Therefore the flow and underlying strata could be older than Miocene, especially as the Mukawwar formation which outcrops nearby has been dated palaeontologically as "Cretaceous transitional to Paleocene." A Jurassic, or at the latest an Early Cretaceous, age for the Khor Shinab basalt analysed by Geochron Laboratories is a possibility, but clearly more work is needed in the area to provide a satisfactory solution because the specimens appear to have been collected from different parts of a continuous outcrop.

I am particularly grateful to Dr. Gass for drawing attention to the tholeiitic basalts reported in dredge hauls by Chase, and for commenting on the relationship of the Wonji fault belt and the central volcanic islands.

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29th October, 1968.

#### THE AGE OF THE OLDEST SILURIAN BEDS OF THE RUMNEY (CARDIFF) INLIER

SIR,—During the course of stratigraphical and palaeontological studies in the Silurian of the Welsh Borderland and South Wales I have encountered some conflicting opinions in the literature regarding the age of the beds of the Rumney (Cardiff) inlier. Confusion appears to have arisen in the past as a result of the mis-identification of fossils, but now a reinvestigation of the faunas, combined with detailed mapping, allows the age of the oldest beds in the inlier to be firmly established. The mapping of the area is still in progress, but as a number of co-workers in the Silurian are engaged in problems of correlation and palaeogeographical reconstruction the preliminary results are considered to be of sufficient interest to warrant early publication.

The presence of Silurian rocks at Cardiff was first recorded by Glass (1861, p.168) who submitted a collection of fossils to Murchison and Salter for identification. Murchison

concluded that the fossils, which were from Pen-y-lan quarry (Grid Ref. ST/1980.7877), were 'par excellence of the Wenlock age' and in the same year Bevan (1861, p.234) suggested that the beds in the quarry 'appear to be Wenlock Shale'. A more detailed study enabled Sollas (1879) to recognise beds of Wenlockian and Ludlovian age throughout the inlier and he was able to suggest (p.479) that the exposures at Pen-y-lan are the oldest in the area. My own mapping confirms these observations. From an analysis of the fauna Sollas concluded (p.480) that the beds at Pen-y-lan 'have very much of a Llandovery facies' and he assigned them to a position near the base of the Wenlock Series. This decision was clearly influenced by the identification of a number of what are now considered to be typically Upper Llandoveryan species, e.g. the brachiopods *Pentamerus oblongus* J. de C. Sowerby and '*Strophomena compressa* (J. de C. Sowerby) (= *Leptostrophia compressa*). Moreover Sollas also recorded *P. oblongus*, together with another typically Llandoveryan brachiopod species, '*Stricklandinia lirata* (J. de C. Sowerby) (= *Costistricklandia lirata*), from considerably higher Wenlockian beds in the Rumney River (Grid Ref. ST/2099.7895) and he specifically suggested that the range of *P. oblongus* should be extended at least into the middle of the Wenlockian. In the present century little or no original work has been done in the area and Sollas's original identifications and age determinations were largely accepted by the officers of the Geological Survey (Strahan & Cantrill 1902, 1912). However, the record of *P. oblongus* has since been interpreted in a number of more general works concerned with the geology of South Wales (e.g. Pringle & George 1937, p.41; 1948, p.37; Anderson & Owen 1968, p.91) as indicating the presence of beds of Llandoveryan age in the inlier.

Unfortunately the specimens originally collected by Sollas cannot be traced, but there are in the National Museum of Wales a number of specimens in old collections from both Pen-y-lan and the Rumney River which Sollas may possibly have seen and which may throw some light on his identifications. A number of these specimens are identified as *P. oblongus* on their old labels; some in fact belong to *Meristina obtusa* (J. Sowerby) and others to *Gypidula galeata* (Dalman). Other specimens identified as *Strophomena compressa* belong to *Coolinia pecten* (Linnaeus) and a single specimen identified as *Stricklandinia lirata* is a crushed valve of a rhynchonellid. It seems likely that Sollas's specimens were similarly mis-identified.

My own work on the shelly faunas at Pen-y-lan quarry suggests that the oldest beds exposed in the inlier are of Late Wenlockian age and that they are best correlated with some high horizon in the Wenlock Shale or the Wenlock Limestone of the Welsh Borderland. This correlation is based especially on the common occurrence of brachiopod species such as *Meristina obtusa* and *Megastrophia (Protomegastrophia) semiglobosa* (Davidson) together with trilobites such as *Encrinurus tuberculatus* (Buckland), *Calymene blumenbachi* Brongniart and *Acastocephala macrops* (Salter). A preliminary statement of these conclusions has been made elsewhere (in Ziegler *et al.*, 1968, p.765) and a full account will be given when the mapping of the area is completed.

Further evidence which confirms these findings is now provided by the discovery, in the National Museum of Wales collections, of three graptolite specimens from Pen-y-lan quarry. All three specimens (N.M.W. Registration Nos.22.10 G.2a-b; 54.300 G.1; 63.68 G.1) belong to *Monograptus flemingii* Salter, a species which is confined to the Wenlock Series where it first appears with certainty in the zone of *Cyrtograptus rigidus* (Dr. R. B. Rickards, pers. comm. 1968) and extends into the zone of *Cyrtograptus lundgreni*. These graptolites thus confirm the Wenlockian age of the oldest beds in the inlier and are consistent with the Late Wenlockian age suggested by the shelly faunas.

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### A SEISMIC REFRACTION LINE ACROSS THE SOLENT

SIR,—We would like to present the results of a reversed seismic refraction line shot between Thorns Beach (SZ39309610), on the mainland of Hampshire and Elmsworth Brickworks (SZ46209228), near Newtown on the Isle of Wight, a distance of about 5 km.

Reversal was obtained by firing, in either direction, a series of shots across the Solent, the geophone spread being laid on land. The technique adopted was similar to that described by Griffiths *et al.*, (1961).

A total of twenty shots was fired at sea, eleven on the line shot towards Thorns Beach and nine on the line shot towards Elmsworth Brickworks. Charges varied in weight from 0.5 kg to 2 kg. Water depths beneath each shot were recorded. The shot positions were fixed by theodolite bearings observed from two survey stations situated on land at each end of an accurately measured base line. Error in reading the bearings is estimated to be of the order of 2 minutes of arc. Thus at a distance of 3 km the error in shot position is of the order of 6.5 m. This is considered to be one of the principal sources of error in this survey.

The time-distance graph obtained for the reversed line is shown in Figure 1. To simplify presentation the arrival data plotted is for the geophone nearest to the shot. A correction has been applied to these arrival times for variation of water depth.

No direct arrivals were observed, but the time for the shot nearest to either end of the line can be used to give a limiting maximum velocity for the top layer. In both cases this is calculated to be less than 1,700 m/sec (5,600 ft/sec). A short reversed line fired at Thorns Beach gave a near surface velocity of  $1,660 \pm 6$  m/sec ( $5,450 \pm 20$  ft/sec). This velocity is used for the surface layer (layer 1) in the interpretation.

The apparent velocities and their intercepts together with standard errors are summarized in Table 1. Figure 2 presents our interpretation of the depths to the refractors. This indicates that the three main refractors rise slightly towards the mainland.

The lowermost refractor (layer 3/layer 4 interface) we consider to be the Tertiary-Cretaceous unconformity, which Wooldridge & Linton (1955) have estimated to be about 500 m deep in this area.

Layer 4 with velocity of 3,500 m/sec must consequently be the Chalk. Laboratory determinations by Laughton & Stride (1957), for a stratigraphic profile within the Chalk at Flamborough Head, indicate a velocity range from 3,000 m/sec to 5,000 m/sec. More recently, commercial seismic investigations in the North Sea (Cook, 1965) reveal a compressional wave velocity for the Chalk of approximately 3,650 m/sec. These velocities are appreciably higher than velocities for the Chalk obtained by Bullard *et al.* (1940) in eastern England (1,930–2,520 m/sec), and Day *et al.* (1956) in the English Channel and the Western Approaches (2,290–2,440 m/sec). Stride (1959) suggested that a velocity of 3,000 m/sec observed in refraction surveys over the Dogger Bank may represent the Chalk, but could include Upper Palaeozoic and/or other Mesozoic rocks.

The velocities for the Tertiary sequence within the Solent area compare with the class I velocities (1,700–2,500 m/sec) obtained from seismic refraction studies in the English Channel by Hill & King (1953), and Day *et al.* (1956), who identified this velocity interval as Mesozoic and/or Tertiary strata.