

to the literature scattered through the text. In addition there is a very useful bibliography of 34 pages, which seems to be fairly complete, although it does not claim to be exhaustive. The book should be very useful to those in search of information as to the occurrence of mineral products anywhere within the Empire.

CORRESPONDENCE.

THE AGE OF THE HIRNANT BEDS.

SIR,—I feel that some explanation is needed of the long interval which has elapsed without my replying to Dr. Elles' letter on the above subject in the *GEOLOGICAL MAGAZINE* (December, 1923). On my return from Bwlch y groes last summer, I had marked on my reprint of Dr. Elles' paper, which appeared in the *GEOLOGICAL MAGAZINE* for September, 1923, the corrections which were required to bring the sketch-map of Bwlch y groes on p. 412 of that issue into accordance with the facts as revealed by the examination of the ground by Professor Pugh and myself. This copy was mislaid until recently. In the meantime, however, Professor Pugh's paper on the Ordovician-Silurian succession in the adjoining area to the south has appeared in the *Quarterly Journal of the Geological Society* (December, 1923), and reference to this paper will make clear my reasons for my belief in the Ordovician age of the Hirnant shales. In the first place I must disclaim any "eagerness" to prove their Ordovician age, but I have felt that Dr. Elles has been working on a false basis ever since she attributed the Conway Castle Grit with its Ordovician fauna to the Silurian. It was the statement that the Bwlch y groes locality yielded definite evidence of the Silurian age of the Hirnant Beds which induced me to visit that locality and subsequently to enter into this controversy. Dr. Elles' map shows on the west side of Bwlch y groes the Moelfryn sandstones dipping eastward under the Foel y Ddinas mudstones (*Phacops mucronatus* beds) and these in turn under the Lower Valentian which yielded graptolites of the *M. atavus*-zone. Actually the sandstones dip in the opposite direction and are faulted against Valentian rocks on the east. On this side of the pass, therefore, where Dr. Elles obtained a *Phacops* referred to *P. mucronatus* there is no succession from the true *P. mucronatus* beds or Foel Ddinas mudstones to the Valentian. Near the centre of the pass there is, however, a continuous succession from the Moelfryn sandstones through these mudstones to a higher group of dark-blue mudstones. The latter are included by Dr. Elles in the Valentian, but they lie below the lowest beds of the Valentian rocks which are present in full development in the crags to the south.

These dark-blue mudstones are the equivalents of Professor Pugh's Garnedd Wen beds at Corris (*Q.J.G.S.*, vol. lxxix, table facing p. 515), which yielded *P. mucronatus* at their base (*ibid.*, p. 525). They are

also the equivalents of the Drosgol grits and Brynglas mudstones which overlie the *Dicellograptus anceps* beds in the Plynlimon district. As Professor Pugh has shown, they diminish rapidly in thickness and become finer-grained when traced northwards through Central Wales. It is these beds which appear to pass northwards between Bwlch y groes and Hirnant into the Hirnant shales. The change is even beginning south of Bwlch y groes, where occasional fossils appear in them. The Bwlch y groes locality, therefore, not only affords no evidence that the Hirnant shales are Valentian, but on the contrary proves that they underlie the whole of the Valentian of Central Wales.

Dr. Elles in her recent communication states that she found *P. mucronatus* at about 5 inches vertically below the *Dimorphograptus* beds. Since about 200–300 yards to the east the *Dimorphograptus* beds are underlain by about 100–150 feet of still lower Valentian beds the specimen of *Phacops* must have been obtained from these Valentian beds. The species has been previously recorded from the Valentian, as Dr. Elles states, but it is rare in those rocks, and Dr. Elles is to be congratulated upon adding a further record. From her remarks about *Ph. eucentra* and *P. mucronatus* s.s. it seems that Dr. Elles envisages this as a possible explanation.

I fail to see how my statement that the position of the *P. mucronatus* beds in the Plynlimon district is 2,400 feet below the base of the Silurian is “most misleading”. It is a statement of fact, and I do not see that the additional statement which Dr. Elles demands that it also overlies the *Dicellograptus anceps* zone adds any material information unless Dr. Elles is under the impression (which I find difficult to believe) that the top zone of the Ordovician (zone of *D. anceps*) is also the top of the Ordovician. That zone is separated from the top of the Ordovician by strata, mostly barren, ranging in thickness from 2,400 feet in Central Wales to 10 feet (“Barren band”) in the Southern Uplands of Scotland. It is in these barren beds that locally, as at Hirnant, Conway, and Ashgill, the Hirnant fauna is developed.

One word more; as the author of the species *Monograptus atavus* I may claim to hold certain opinions regarding its characteristics, but I find that Dr. Elles appears to confuse undoubted specimens of that species with *M. cyphus* with which it has little in common. This point is, however, of small importance, since in the Lake District there are reasons for supposing that a considerable break occurs between the “*Dimorphograptus* beds” and the Ashgill shales. The missing strata are, however, fully developed at Bwlch y groes and elsewhere throughout Central Wales.

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