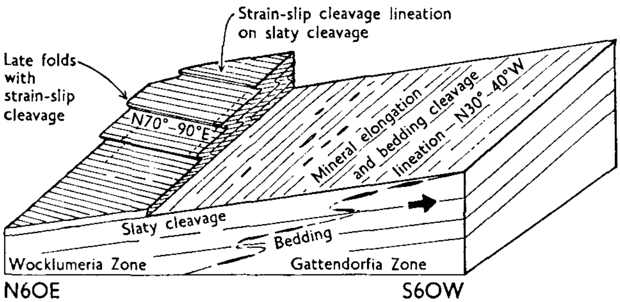
## STRATIGRAPHY AND STRUCTURE AT BOSCASTLE, CORNWALL

SIR,—In 1961, Dr. E. B. Selwood gave an account in this Magazine of the stratigraphical significance of his discovery of a trilobite fauna in the California Quarry, Boscastle. He demonstrated from his faunal evidence that the Devonian–Carboniferous boundary was present in an uninterrupted but inverted succession of dark-grey, spotted phyllites structurally overlying the Tredorn Phyllites. Thus it may be inferred that there is a south-facing group of inverted strata within what was formerly accepted as a conformable sequence with a regional dip to the north (Dewey, 1948, Fig. 7).

The paper provoked some discussion on the interpretation of the regional structure between Boscastle and the western margin of Dartmoor (Simpson, 1962 ; Dearman, 1962*a* and *b*). At that time no inquiry was directed to the possible local structural and stratigraphical significance of minor structures in the small quarry on the cliff top a few yards to the north (Grid ref. SX 0902 9086) of the California Quarry. I visited the locality for this purpose in May, 1964.

Dr. Selwood had noted, in passing, the abundant evidence in this quarry of movement along planes more or less parallel to the bedding. Bedding is clearly picked out by thin siliceous seams and by small lenticles (4 by $\frac{3}{8}$ in.) which weather to dark brown rottenstone. Several examples were found in which lenticles dipped at less than ten degrees steeper than slaty cleavage inclined at 10 to 20 degrees towards N. 35° E. ; lenticles may also be more gently inclined than the cleavage but only a few examples of this were found. The direction of intersection of bedding with cleavage is marked both by a mineral elongation and by a fine lineation on cleavage planes. Both lineations plunge at less than 4 degrees in a direction N. 30°–40° W.

This combination of minor structures (Text-fig. 1) could reasonably be expected to be associated with recumbent, very tight folds with an axial plane, slaty cleavage and a gentle axial plunge to the north-west. No such folds could be found at this locality, but clearly the facing direction of the inverted succession is neither to the south nor to the north as supposed in earlier discussions (see for example Simpson, 1962, Text-fig. 1*a* and 1*b*) but slightly to the west of south-west.




TEXT-FIG. 1.—Minor structures in the small quarry at the top of the cliff just north of the main California Quarry, Boscastle. The quarry face trends N. 60° E.–S. 60° W. and faces N.N.W. An early slaty cleavage and associated linear structures are deformed by later minor folds, overturned to the north, with strain-slip cleavage. Solid arrow shows the facing direction of bedding on slaty cleavage.

A south-westerly facing structure implies a limitation of outcrop width in the same direction. There is therefore a need to reconcile the location of the California Quarry on the north-eastern limb, though close to the axis, of the

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Davidstow Anticline. The narrow outcrops of individual formations have been traced inland by Dewey (1948, Fig. 4) from the coast near Boscastle for at least 15 miles east-south-eastwards to Launceston. Such continuity could be achieved, and maintained, by repetition of kindred structures facing first south-west and then south-east along the length of the outcrop.

I am indebted to Dr. E. B. Selwood for confirming the position of his locality. The work was carried out with the aid of a D.S.I.R. Research Grant ; this is gratefully acknowledged.

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## TRACE ELEMENTS IN TANGANYIKA TUFFS

Sir,—The significance of trace element analyses obtained by Bowden (unpublished work) to determine the origin of the carbonate matrix of northern Tanganyika tuff cones, has been summarized by Dawson (1964). The object of investigating tuffs for certain trace elements, typical of carbonatites, was first applied to two calcareous types (Table 1) collected by Quennell from Longido (north-east corner of Text fig. 1, Dawson, 1964, p. 130). Because of high barium and strontium, together with lanthanum, yttrium and niobium (Table 1, analysis 1), it was concluded that the tuffs had been derived from nearby volcanoes and were the result of carbonatitic activity. Similar conclusions have been deduced by Downie and Wilkinson (1962) by assessing the geological evidence for the Basotu area.

Recently, tuffs, calcareous tuffs, and limestones from the Serengeti region have likewise been analysed for trace elements. These rocks, mapped on a regional scale over an area exceeding 5,000 square miles, usually consist of mineral grains of sanidine, pyroxenes, amphiboles, mica, etc., embedded in a carbonate matrix. The rocks vary from coarse tuffs (grain size *ca.* 2 mm.) in the east, near the volcanoes, to almost pure limestones in the west. Averaged chemical data are presented in Table 1. Niobium and yttrium are detected in the majority (twenty-two) of the specimens, and it is significant that lanthanum ranges from 50 to 600 p.p.m.

The geological and geochemical evidence both indicate that explosive carbonatitic volcanoes ejected vast amounts of pyroclastic material, which was deposited as tuffs, calcareous tuffs, and limestones, up to 100 miles from the parent volcanoes.

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