The average K_t value for metamorphic co-existing pyroxenes, as calculated by Bartholomé is 1·8 ; the K_d value of Kretz for these pyroxenes is 0·54. These two values are reciprocals. The same holds true for the K_t and K_d values of magmatic assemblages, which are respectively 1·4 and 0·73.

As Bartholomé has pointed out, these K_t values represent tie-lines in Ca-Mg-Fe diagrams. The K_d values consequently do the same. The conclusion of Kretz that the construction of tie-lines is a meaningless operation seems therefore not in agreement with his own calculations. Especially in the case of low K_t values, which probably correspond with high temperatures, the construction of tie-lines might prove to be useful. In this respect it is interesting to notice that the tie-lines of co-existing pyroxenes from nodular inclusions in lavas all intersect the Wo-Fs side of the triangle, although the average K_t value of these pyroxene pairs is 1·2, a value which would lead us to expect an intersection point close to the Wo corner on the Wo-En side of the triangle. The present state of knowledge leads to the conclusion that a shift of the intersection points of the tie-lines to the Wo-corner and beyond, points to a high temperature of formation of the co-existing pyroxenes. The only disturbing influence arises from the fact that no common opinion exists on the method of plotting cations other than Mg-Ca-Fe^{2+} in the composition triangle.

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STRUCTURES OF DEVON AND CORNWALL

SIR,—The letter from Dr. W. R. Dearman published on 1st January, 1962, in vol. xcviii, part 6, of this magazine under the heading " Devonian and Carboniferous Stratigraphy " is concerned chiefly with an interpretation of the structure of the tract of country extending from the Cornish coast at Boscastle eastwards to the northern tip of Dartmoor.

Dr. Dearman believes that this tract consists of inverted strata with a low northerly regional dip. He says that the inverted strata belong to the upper limb of a syncline and that a complementary anticline must lie to the north. I show his reconstruction in Text-fig. 1*a*.

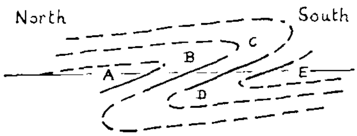
But this is not the only reconstruction that can be made. In Text-fig. 1*b* I show another. Here the inverted strata are the lower limb of an anticline facing downward and to the north.

The direct evidence available at the moment does not allow us to decide which, if either, of these reconstructions is correct. But the fundamental difference between them is that Dr. Dearman's involves, as he says, " a general southerly sense of translation " (i.e. overriding southerly rock transport), while the alternative reconstruction involves northerly transport.

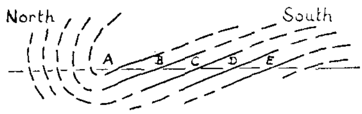
The question as to the general direction of transport can be considered (*a*) in the light of the internal evidence of minor structures, (*b*) in its broader regional setting.

If drag-folding can be demonstrated within the inverted strata, then, viewed from the west, southerly transport should result in dextral rotation of the folds as shown in Text-fig. 2*a*. Conversely with northerly transport the movement should be sinistral (Text-fig. 2*b*). The minor folds face in the opposite direction to the major folds. Thus in Text-fig. 2*a* (which corresponds with southward facing major structures as in Text-fig. 1*a*) the minor fold face northwards, while in Text-fig. 2*b* (corresponding to the north facing major structure of Text-fig. 1*b*) they face south. As far as my limited observations go the minor folds do face south.

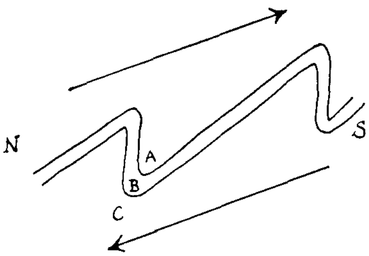
Dr. Dearman says that northerly transport within the inverted limb is not necessarily incompatible with a general southerly transport. But if there were



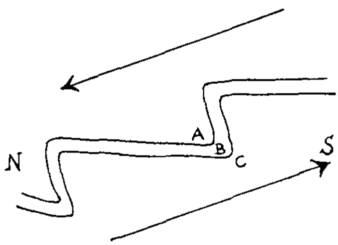
TEXT-FIG. 1a.



TEXT-FIG. 1b.



TEXT-FIG. 2a.—Drag-folds, southerly transport.



TEXT-FIG. 2b.—Drag-folds, northerly transport.

this general southerly transport one would expect to find some expression of this in a tectonic gradient with older, more deformed rocks lying to the north of the inverted belt passing into younger, more superficially deformed rocks to the south of it. Exactly the opposite situation is in fact encountered. To the south is a broad region of intensely deformed rocks with well developed slaty cleavage (as at Delabole) while to the north comparatively open folds and uncleaved shales occur.

While I believe that there is a tract of inverted strata such as Dr. Dearman postulates, this lies nearly 2 miles north of Boscastle, as stated by Ashwin (1958). There must be considerable doubt about the eastward extent of this tract, and I do not think there is evidence for believing that there is any continuous band of inverted strata reaching as far as Dartmoor. A much more valid generalization is that there is a line which runs continuously from the coast (somewhere between Crackington Haven and Widemouth) to the northern end of Dartmoor and separates quite sharply a northern style of tectonics, with open folds and steep axial planes, from a southern style with recumbent folds and a well developed bedding-plane cleavage. Work in progress should elucidate the nature of this change of style, but it cannot be neglected in any interpretation of the structure of the country discussed by Dr. Dearman.

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15th January, 1962.

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FESTOON BEDDING

SIR,—In 1960 (*Geol. Mag.*, **97**, 106–122) we gave a short account of festoon bedded sandstones from the Torridonian Epidotic Grits. Several people have taken the trouble to discuss this paper and particularly helpful analogies with younger deposits have been drawn by Prof. P. Allen, Dr. J. R. L. Allen, and their colleagues (*Geol. Mag.*, 1960, **97**, 261–263). More recently Dr. J. R. L. Allen (*Liverpool and Manchester Geol. Journ.*, 1962, **3**, 1–20) has given a most interesting account of festoon bedded sandstones from the Lower O.R.S. Comparison of the two accounts (Allen 1962, p. 10–11; Sutton and Watson 1960, p. 110–113) shows the O.R.S. and Torridonian deposits in question have much in common. In his discussion Dr. Allen makes a comment (1962, p. 15) which suggests that the two papers present radically different hypotheses as to the origin of festoon bedding. It seems to us that, though our nomenclature may differ, our underlying ideas are rather alike on this question.

Like Dr. Allen, we consider the structures are fluviatile. One suggestion of ours was that the Epidotic Grits could represent braided river deposits and we would readily accept the more detailed comparison with the braided channels of some swift sand-laden rivers, such as the Benue and the Niger, which Dr. Allen has made. Whatever the setting, and we agree that other environments are not out of question, an essential point seems to be that festoon bedding, as seen in the Epidotic Grits, developed as submerged irregular surfaces evolved. Troughs separated by cusps were present and step-like breaks occurred where deposits built out downstream. Such features were described by us and could be compared with systems of megaripples though we did not employ this term. We discussed the development of such irregular submerged surfaces and mentioned examples of the contemporaneous interplay of deposition and erosion, a point Dr. Allen has emphasized. We suggested that where festoon bedded grits overlie evenly bedded rocks, the lowest grits lie in troughs scoured out of the underlying beds (Sutton and, Watson, 1960, p. 111); compare Allen's observation that "each unit was deposited on a smooth scoured surface cut into the upper part of the bed or beds below" (Allen, 1962, p. 13). Once this preliminary erosion had occurred we suggested, the succeeding sequence of festoon bedded grits built up a succession of irregular surfaces marked by a shifting system of troughs in which deposition and erosion proceeded contemporaneously (Sutton and Watson on p. 111, 113). In this way a channelled or megarippled bottom developed, the detailed topography of which was repeatedly changed. As we wrote in 1960, "The form of the profile established during the development of the trough was maintained as the floor of the trough was built up... profile was preserved by material being laid down on one bank and carried

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