NEVIN, C. M., 1942. *Principles of Structural Geology*, 3rd Edn., New York.
OROWAN, E., 1942. " A Type of Plastic Deformation New in Metals," *Nature*, **149**, 643–4.
RAMSAY, John G., 1962. " The Geometry of Conjugate Fold Systems," *Geol. Mag.*, **99**, 516–26.

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AGE OF THE ALPINE FOLDS OF SOUTHERN ENGLAND

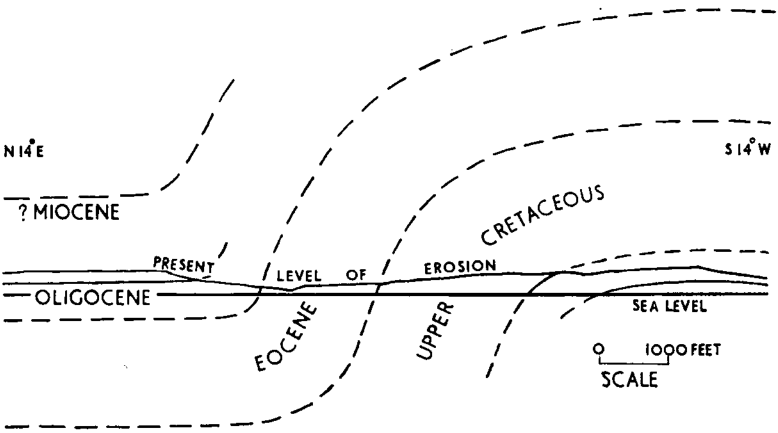
SIR,—It is well known that quite large folds of Alpine age occur in east–west lines across the southern part of England. Where well developed, as in the Isle of Wight for example, they show a pronounced monoclinal form which, at outcrop, involves Mesozoic and Tertiary strata. Very steep beds, " younging " to the north, form a middle limb connecting nearly horizontal strata to the north and south. Although these structures therefore have an overall simple fold form, in detail they are quite complex. For instance, Arkell (1938 ; 1947A) has very fully described and illustrated the cleavage and fault pattern associated with the Isle of Purbeck monocline. These monoclinal Alpine folds are the most recent orogenic structures to be seen in Britain and clearly merit a detailed structural study. Meanwhile, it seems worth attempting to fit their development into the Tertiary time scale of events as precisely as the evidence will allow.

The age of these folds is generally assigned to the Miocene period (for example, see Wells and Kirkaldy, 1948, pp. 290–1), but attempts have been made to define the date of the fold movements more closely. Wooldridge and Linton (1939, p. 15) and Arkell (1947B, p. 182 and p. 189) agree in placing the folding in late Oligocene or early Miocene times, following the deposition of the youngest strata, the Middle Oligocene Hamstead Beds (Curry, 1958, pp. 41–2), seen to be involved in the folds in the Isle of Wight. They argue that most of the Miocene period would have been occupied by denudation of the structures with the production of the surface bearing the Pliocene deposits of south-east England. There is, however, another aspect to this problem.

It is clear, as Webster (in Englefield, 1816, p. 201 and pl. 47, fig. 1) recognized, that the steeply dipping Chalk in the eastern Isle of Wight monocline was formerly connected to the flat lying Chalk seen in outcrop in the southern part of the island. Thus it may be estimated that about 2,000 feet of near horizontal Cretaceous rocks have been removed by erosion from the area immediately south of the steep limb of the fold (see, for example, Section No. 2, the relevant portion of which here forms the basis of Text-fig. 1, on Sheet 47 of the Horizontal Sections of the Geological Survey). Further, there seems to be no reason why this thickness should not have been overlain by the southward continuation of the Tertiary sequence now seen in the steep limb. Indeed, the recognition of Tertiary strata on the floor of the English Channel south of the Isle of Wight (Curry, 1962) supports the view that the Eocene and presumably also the Oligocene were formerly present above the Chalk in the southern part of the island. Altogether, then, there may have been some 4,000 feet of Cretaceous and Tertiary rocks above the present level of erosion immediately south of the steep limb.

If such a thickness has been removed then it seems reasonable to assume that a considerable thickness is likely to have also been eroded from the area only a mile or so to the north. Thus, on fitting the monoclinal fold form to the available data and completing the structure *above* the present level of erosion, it seems likely that *much younger* flat lying strata were originally present above the youngest now seen, the Hamstead Beds, and that these were involved in the fold structure (Text-fig. 1). It is indeed the presence of these orogenic folds that enables one to argue for the former extension of the stratigraphical succession.

With regard to the length of time that would be required for the development of these folds, it seems quite possible that they could have been produced in less than 1,000,000 years. Accepting the present evidence that the Oligocene and Miocene periods were each of the order of 10,000,000 years duration (Kulp, 1961, fig. 1), it therefore appears that the folding deformation may have occupied only a small fraction of Miocene times. One may imagine that sedimentation continued throughout Oligocene and *well into* Miocene times,



TEXT-FIG. 1.—The Isle of Wight monoclinal fold form (based on part of Section No. 2, Sheet 47 of the Horizontal Sections of the Geological Survey).

with the accumulation of considerably more than the 2,000 feet of Tertiary strata now preserved in the Isle of Wight. Indeed, this was the view expressed by White (1921, p. 148). Several million years of erosion could have followed a brief folding episode. It seems preferable, then, to place the time of this Alpine monoclinal folding as *late* as possible in the Miocene period.

I am grateful to Miss P. S. Walder and Professor P. Allen for stimulating discussion of this problem.

REFERENCES

ARKELL, W. J., 1938. Three tectonic problems of the Lulworth district : studies on the middle limb of the Purbeck fold. *Quart. J. geol. Soc. Lond.*, **94**, 1–54.

—— 1947A. The geology of the country around Weymouth, Swanage, Corfe, and Lulworth. *Mem. geol. Surv. Gt. Brit.*

—— 1947B. *The Geology of Oxford.* Oxford.

CURRY, D., 1958. *Lexique Stratigraphique International*, **1**, 3*a*, XII. Paris.

—— 1962. A Lower Tertiary outlier in the central English Channel, with notes on the beds surrounding it. *Quart. J. geol. Soc. Lond.*, **118**, 177–205.

ENGLEFIELD, H. C., 1816. *A Description of the Principal Picturesque Beauties, Antiquities, and Geological Phenomena, of the Isle of Wight.* London.

KULP., J. L., 1961. Geologic time scale. *Science*, **133**, 1105–1114.

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Wells, A. K., and J. F. Kirkaldy, 1948. *Outline of Historical Geology.* London.
White, H. J. O., 1921. A short account of the geology of the Isle of Wight. *Mem. Geol. Surv. Gr. Brit.*
Wooldridge, S. W., and D. L. Linton, 1939. Structure, surface, and drainage in south-east England. *Inst. Brit. Geographers*, Publication No. 10.

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AGE RELATIONS OF CONNEMARA MIGMATITES AND GALWAY GRANITE

Sir,—In Leake and Leggo's interesting paper (*Geol. Mag.*, **100,** 194–204) the migmatites which form the northern and western border of the Galway granite are attributed to an episode of regional metamorphism long antedating the intrusion of the granite. I have suggested (*Geol. Mag.*, **94** (1957), 452–464) that they are derived from the granite.

As Leake and Leggo's text-fig. 1 shows, the migmatites occur close to the granite and this is one reason why I have considered them related to it. However, the relationship is not simple. If it were there would be gradational contacts everywhere, highly potassic migmatites would always be most common close to the granite and basic rocks would become steadily more abundant farther away. I found (*op. cit.*, p. 458) and Leake (*Proc. Roy. Irish Acad.*, **59B** (1958), 155–203), and Leggo (*Geol. Mag.*, **100,** p. 195) have confirmed that potassic migmatites occur in various parts of the border. In some places close to the granite and in others near the outer margin.

To account for the sporadic distribution of migmatised and relatively unaltered rocks in the migmatite belt I suggested (*Geol. Mag.*, **94** (1957), p. 462) that there had been movements roughly parallel to the plane of the foliation in the belt during the rise of the granite which had brought migmatites, formed at a deep level, next to less altered basic rocks and had carried rocks formed in the inner part of the belt to the outer part. I had found it necessary to postulate these movements, either strike faults or folds or both, to provide an explanation of the narrowing of the outcrop of the migmatite belt across the Shannawon and Bunnagippaun faults.

An essential feature of my interpretation of the structure was that deeper parts of the granite were exposed in the east and higher parts in the west. In the deeper parts of the intrusion the contact is concordant and the higher parts cross-cutting. The material in the migmatites has everywhere been brought from depth.

Leake and Leggo have shown that the granite contact is just discordant in the Maam Cross-Screeb area where I had mapped it as concordant and they cite abundant evidence to show that the granite and its contained potash feldspars in that area are different from the migmatite and its contained potash feldspars. Both these facts are consistent with my hypotheses and the former, with other evidence cited in their paper, enables my picture of structural variation along the northern contact to be refined thus :—

1. Highest level, west of Bertraghboy Bay : Small granites cutting across gently dipping migmatites and basic rocks.
2. High level, west of Screeb : Main Galway Granite intrusion, unfoliated, cuts across migmatites dipping moderately.

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