fracture to the other two is, however, less determinate. Experiment, as well as field observation show, nevertheless, that it seldom exceeds 45°, and is usually a good deal smaller than this figure. I have named this result the Navier principle.

The principle applies, however, only to the initiation of a fault-line. When stresses are changing, earthquake motion may continue along a fault earlier than that which would be produced *de novo* by the forces actually in existence, so long as a certain amount of relief to the contemporaneous stress is produced in each case.

Two very convincing examples of the principle occur in Great Britain. The first, which is evident, for instance, in the Central Coalfield of Scotland, consists in the inclination of the east–west faults, which are all of the same age, and which I have named Borcovician. These form two series, dipping respectively north and south, at angles not far from 22½°, or a quarter of a right angle, from the vertical. The angle between the sets is thus roughly 45°, and there are dozens, if not scores, in each series.

The second example consists in the dextral and sinistral faults, connected with the nearly north–south Armorican pressure, in Pembrokeshire (*The Dynamics of Faulting*, fig. 19). The angle between the series is, in this case, more nearly 50°.

On the whole I think that the Navier principle will survive a few even harder " knocks " than those which Mr. Wellman has given it. In conclusion I must point out that *The Dynamics of Faulting* was not, as in Mr. Wellman's reference, written by Professor J. G. C. Anderson—whose actual work I greatly admire—but by the present writer.

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XENOLITHIC MONCHIQUITE

SIR,—I have read with interest the paper by Messrs. Walker and Ross on a xenolithic monchiquite dyke near Glenfinnan, published in your last issue (*Geol. Mag.*, xci, 1954, pp. 463–472). Optical data for minerals of the dyke rock and of its xenoliths are more detailed than any previously published in relation to similar Scottish minor intrusions, and constitute a welcome addition to our knowledge of such rocks.

The authors account of similar minor intrusions already known in Scotland, and of published opinion regarding the genesis of such intrusions and of their xenoliths is, however, incomplete. Scottish volcanic vents known to contain blocks of carbonated peridotite are also more numerous than the authors indicate.

A number of comparable monchiquitic minor intrusions and volcanic necks have been mapped by the Geological Survey in Ayrshire, and are briefly described in a memoir (" The Geology of Central Ayrshire," *Mem. Geol. Surv.*, 1949). The occurrences are as follows: (1) a monchiquite intrusion (probably a small plug) in the River Doon contains xenoliths of altered peridotite. This monchiquite is cut by a N.W. Tertiary tholeiite dyke (op. cit., p. 106); (2) the basal portion of a 4 ft. monchiquite sill in Meikleholm Glen is crowded with fragments of coarsely crystalline carbonated olivine-pyroxene rock and of pyroxene-hornblende rock. The position of the fragments is ascribed to gravitational settling (op. cit., p. 116); (3) an obscured intrusion of monchiquite (apparently a narrow dyke) near Carskeoch Farm is crowded with fragments of carbonated peridotite (up to about one inch across) composed of altered olivine associated with some pyroxene and brown spinel (op. cit., p. 118); (4) near the head of Meikleholm Glen, a dyke of ocellar monchiquite locally passes into agglomerate that contains " nodules " of altered peridotite (op. cit., p. 119); (5) three Central Ayrshire Permian volcanic vents (Patna Hill; Carnochan; Kirklafinn)

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are known to contain blocks and small nodules of peridotite, carbonated or otherwise altered (op. cit., pp. 105, 106).

Since G. W. Tyrrell wrote the paper quoted by Messrs. Walker and Ross, the Heads of Ayr vent and the adjacent Greenan Castle tuff have been described by the Geological Survey (op. cit., pp. 54–56, and fig. 5).

The mode of intrusion of xenolithic monchiquite dykes and the origin of their included igneous fragments (peridotite and pieces of large crystals of anorthoclase, barkevikite, biotite and titanaugite) are discussed in some detail in a paper published six years ago (" Problems of Carboniferous-Permian Volcanicity in Scotland ", *Quart. Journ. Geol. Soc.*, civ, 1948, pp. 137–138, 149–150).

An E.-W. composite or multiple monchiquite-camptonite dyke at Loch Moidart, Inverness-shire, is known to contain xenoliths of altered peridotite, and a neighbouring small mass of " agglomerate ", with a monchiquite matrix, contains blocks of altered peridotite and of Moine country rock (op. cit., 1948, p. 138).

There are other publications, dealing with " olivine nodules " in Scottish basic rocks and vents, which are not mentioned by Messrs. Walker and Ross (for some references see " British Regional Geology : The Midland Valley of Scotland ", *Mem. Geol. Surv.*, 2nd ed., 1948, p. 67).

Those who wish information on the age, distribution, and mode of occurrence of monchiquitic intrusions in districts near Glenfinnan should consult the following recent publications : " Faulted Permian Dykes in the Highlands," *Geol. Mag.*, lxxxviii, 1951, pp. 60–64 ; " A Monchiquite Vent, Stob a' Ghrianain, Inverness-shire," op. cit., 1951, pp. 140–144 ; " The Camptonite-Monchiquite Suite of Loch Eil," op. cit., 1951, p. 148 ; " Summary of Progress of the Geological Survey of Great Britain for 1951," *Mem. Geol. Surv.*, 1953, pp. 45, 46.

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20th December, 1954.

SUPERPOSITION OF CALEDONOID FOLDS ON AN OLDER FOLD-SYSTEM IN THE DALRADIANS OF MALIN HEAD

Sir,—I have read with interest Dr. Reynolds' and Professor Holmes' account of plasticine experiments and their application to the structure of part of Northern Donegal (*Geol. Mag.*, xci, 1954, pp. 417–444). As the latter is an area with which I am not familiar I should have refrained from comment had the authors not sought to force their theory as an explanation of the structures of South-West Donegal by dismissing without discussion one of the writer's sections of this area.

The authors do not make it clear to which of my sections they refer, but I assume from the context it is the section of Slieve League itself (text-fig. 1). Far from being drawn by the " down the plunge " method the section is derived from direct observation in an area of rugged relief amounting to nearly 2,000 feet. The shape of the outcrops, and particularly the prongs to which the authors attach so much importance, are due largely to the combined influence of topography and structure. The section is therefore drawn to explain observations on the ground, not to explain " thrusting in opposite senses ". In fact, nowhere in my paper do I postulate thrust-movements in any other directions than towards the north-west or north. It is obvious, however, that if a thrust is bent sideways (i.e. rotated about a vertical axis) it will *appear* to have moved in a different direction and if it is rotated about a horizontal axis it will *appear* as a normal fault, as in text-fig. 1 of my paper (but not as a thrust in the opposite sense). Such oscillations about the vertical can be observed east of Slieve League, although they are not fully brought out on the small-scale of the map.

Similarly the minor structures at right angles shown on my map are not