

corrugations in the *s*-planes (fig. 18, *e*). The fold axes plunge to the east, or slightly south of east, at low angles.

Whereas the folds elsewhere along the Moine thrust in Assynt are generally recumbent and more or less consistently overturned in the same direction, at Knockan many of the folds are symmetrical and the axial planes of asymmetric folds are not consistently overturned in one direction. The over-all movement suggested by the folds is one of slight shortening parallel to the foliation and normal to the fold axis (*B*). These folds (pl. 5, *b*) are not similar in style to those in the primary mylonitic rocks in other areas; the brecciation indicates post-crystalline deformation.

The Moine schists between Knockan Crag and Meall nan Dearcag Mor are massive slabby rocks with a well-developed system of joints (pl. 5, *a*). The grade of metamorphism is extremely low, and the rocks seem to have suffered little deformation during regional metamorphism. The foliation is a bedding foliation, and at several localities current bedding is preserved. At the only locality examined where this was sufficiently well preserved to determine the direction of facing, the beds are right side up. There is no folding of the foliation but a faint lineation (*B*), plunging to the east or the east-southeast, is visible locally.

Secondary deformation of the schists is not widespread and does not decrease uniformly away from the Moine thrust. The schists immediately to the east of the primary mylonitic rocks are unbrecciated, but the degree of cataclastic deformation increases farther east until, approximately 400 yards west of Loch Odhar, it is intense; the foliation is distorted and there is considerable brecciation of the rocks in this area. The rocks are traversed by complex systems of quartz veins, with strike varying between north and north-northeast. The thickest veins intersect the bedding at low angles and dip toward the east at angles between 20° and 40° (fig. 18, *f*). These veins show marked evidence of shearing and the bedding is bent along some of the veins, showing a sense of movement such that the upper layers moved to the west over the lower. On the exposure illustrated in figure 18, *f*, one of the veins has been rodded by the shearing movement; the trend of the rods is slightly east of north. Branching outward at right angles from the thick veins are thinner veinlets, which are relatively undeformed. The origin of the veins is problematical, but it is clear that they define a *B*-axis with northerly trend, and their present disposition seems to be due to slip movement in which the upper layers moved toward the west. In some instances the main movement has been along the veins, but elsewhere (fig. 18, *g*) the foliation seems to have been the most important slip plane, as the veins are themselves folded on a small scale about north-trending axes. The veins have been folded by slip on *S*, a process analogous to that postulated to account for the eastward-dipping quartz veins near the Stack of Glencoul.

SUMMARY

A number of important facts emerge from the study of the Moine thrust zone in the above areas.

1. There is a common *B*-axis, defined by the megascopic elements of the fabric, in the Moine schists, the primary mylonitic rocks along the Moine thrust, and

some of the Cambrian rocks below the thrust. The rocks all belong to a single structural unit which must obviously have suffered penetrative deformation in post-Cambrian times.

2. The Moine thrust varies considerably in character along its outcrop in Assynt, but at all the localities studied, with the exception of Knockan Crag, the movements have been distributed through a zone of considerable thickness. The Moine thrust is merely a lithological boundary within this zone, separating rocks that are recognizable as Cambrian or Torridonian from mylonitic rocks of unknown origin.

3. After the deformation that produced the *B*-axis, the rocks locally suffered at least one subsequent (secondary) deformation which was not generally related to movements on the Moine thrust; the deformation was most intense in zones that cut across the Moine thrust, the primary mylonitic rocks, and the Moine schists. Late movement on or near the thrust is indicated by intense cataclastic deformation immediately above the thrust at Knockan, and by phyllonitization of pelitic layers near the thrust at other localities (e.g., Allt nan Sleagh).

4. During the phase of secondary deformation, the Moine thrust was displaced to the extent of approximately 500 feet by the Ben More thrust at the Stack of Glencoul and at Cnoc a' Chaoruinn. The imbricate structure in these two areas is related to the Ben More thrust and not the Moine thrust.

5. The so-called "double system of folding" in the "Eastern Schists," described by Horne (Peach *et al.*, 1907, p. 468), does not exist in the Assynt area. The *B_n*- and *B_s*-folds form two distinct maxima which were produced during the secondary phase of deformation, and not synchronously with the *B*-structures.

6. The widespread lineation, plunging to the east-southeast, in the competent rocks near the Moine thrust is not an *a*-lineation, as has previously been assumed, but a *B*-lineation. A faint *a*-lineation (slickensides) is also present, however, in some of the phyllonitized rocks near the thrust; this also plunges at low angles to the east and the east-southeast.

DISCUSSION OF THE MOVEMENTS

The first fact cited above in the summary is of great importance, as it clarifies the controversial issue of the age of the general Moine metamorphism and deformation. The deformation that produced the east-southeast-trending *B*-structures in the Cambrian rocks, the primary mylonitic rocks, and the Moine schists must obviously be of post-Cambrian age. It is clear on petrographic grounds that these east-southeast-trending folds (*B*) were formed before or, more probably, during the regional metamorphism of the rocks (Phillips, 1937). The hypothesis favoring a pre-Torridonian age for the general Moine metamorphism (Read, 1934; Phillips, 1937; Wilson, 1953) is therefore untenable; the Moine metamorphism and deformation took place in post-Cambrian times, as claimed originally by Peach (Peach and Horne, 1930), and more recently by Bailey (1950) and others.

The east-southeast-plunging lineations in the vicinity of the Moine thrust have generally been assumed to be *a*-lineations marking the direction of movement on the thrust, and have frequently been referred to as "slickensides" (Read, 1931; Bailey, 1935). They are penetrative, however, and cannot be confused with the