

successive overlap of all the underlying thrusts, until, south of Knockan Crag, it rests on the undisturbed Cambrian succession of the foreland. It follows that movement on the Moine thrust outlasted that on all the other thrusts, while the Ben More thrust was active after movement on the Glencoul thrust ceased. Peach *et al.* (1907, pp. 271-272) considered that the Moine thrust was probably the first of the great thrust planes to be produced.

The thrust masses were believed to have moved to the west-northwest over the foreland, perpendicular to the general strike of the thrusts and parallel to the prominent lineations in the mylonitic rocks and the Moine schists. The age of the movements was determined within certain limits. The plutonic igneous rocks of the Loch Ailsh and Loch Borolan masses and the numerous minor intrusions, all of post-Cambrian age, are cut by thrust planes, crushed and locally foliated by the movements. In central and north Sutherland the Moine schists are overlain unconformably by Middle Old Red Sandstone sediments. The movements must therefore be of post-Cambrian and pre-Middle Old Red (Devonian) age.

The Moine schists in the area are represented by mylonitic rocks, low-grade schists, and "granulitic siliceous flagstones." The following statement regarding the orientation of fold axes in the schists appears in Peach *et al.* (1907, p. 601): "A striking feature of the Eastern Schists is presented by the double system of folding which they possess. One system has a NNE and SSW strike [trend], the inclination of the axial planes being ESE. . . . This plication may be regarded as an obvious accompaniment of the movement of the thrust masses in a WNW direction. The other system strikes [trends] generally WNW and ESE, as if produced by forces acting at right angles to this trend." No definite information is given as to the relative ages of the two groups of folds.

There has been considerable disagreement as to the relative ages of the Moine metamorphism and the thrust movements. "In these rocks immediately above the Moine Thrust cataclastic structures are not uncommon, and the question has arisen as to whether they represent crystalline schists more or less broken down or sedimentary rocks which are on the way, so to speak, to become Moine-schist" (Teall, in Peach *et al.*, 1907, p. 600). The conflicting hypotheses implicit in this statement have been more fully stated in later publications (Peach and Horne, 1930; Read, 1934). Peach considered that the Moine schists were metamorphosed Torridonian, and that the regional metamorphism of the Moine schists and the thrusting were contemporaneous and took place in post-Cambrian times (Peach and Horne, 1930, p. 200). Horne, on the other hand, regarded the Moine series as metasedimentary rocks of pre-Torridonian age, which were only modified and mylonitized along the thrusts during the post-Cambrian movements (Peach and Horne, 1930, p. 201). Phemister (in Read *et al.*, 1926) and Read (1931) also believed that the general Moine metamorphism was distinct from, and earlier than, the thrust movements. Read subsequently (1934) reviewed the evidence bearing on this problem. He concluded (1) that the low grade of the Moine schists near the thrust zone was due to retrogressive ("dislocation") metamorphism; (2) that the similarity in texture and composition between these schists and sheared Torridonian rocks below the Moine thrust (perhaps the best evidence for their correlation) was due to "metamorphic convergence," as metamorphism of different rocks of the same

bulk composition, whatever their texture, will tend to give similar products; and (3) that the Moine series and its metamorphism were of pre-Torridonian, and probably Lewisian, age.

Since the classic work of the Survey geologists in the Moine thrust zone, Bailey (1935) and Sabine (1953) have suggested modifications in the interpretation of the structures below the thrust in the Assynt "bulge." There has also been a considerable amount of research on the microfabric and the small structures in the Moine schists and the mylonitic rocks in the Assynt area and elsewhere near the Moine thrust. For convenience, the work of Bailey and Sabine is reviewed first. The fabric studies, which are of considerable relevance to the present work, are treated subsequently in some detail.

Bailey (1935) proposed a number of changes in the interpretation of some of the major thrusts. He considered that Peach and Horne had ascribed too much importance to the Glencoul and Ben More thrusts, and suggested that the Glencoul and Ben More nappes are in fact parts of a single tectonic unit. He also showed that the Sgonnan Beag thrust, which was thought to underlie the Loch Ailsh syenite mass, was the original intrusive contact, modified slightly by shearing. In conclusion, Bailey drew an analogy between the Assynt "bulge" and the Aulloch massif in Provence, implying that the Assynt bulge is an axial culmination which developed concurrently with the thrust movements.

Sabine (1953) discusses the structural implications of the distribution of various types of hypabyssal intrusive rocks in the different structural units. The widespread occurrence of gneisses in the Glencoul and Ben More nappes and in klippen of the Ben More nappe, and the absence of this rock type in the mass between the sole and the Glencoul and Ben More thrusts, were interpreted as indicating that the Glencoul and Ben More nappes were parts of a single tectonic unit, as Bailey (1935) had suggested. Sabine proposed that the term "Ben More thrust" be restricted to the portion north of its intersection with the Glencoul thrust (on Braebag Tarsuinn), and that the portions of the thrust south of this and underlying the klippen to the west be renamed the "Assynt thrust-plane." For the tectonic unit as a whole he used the term "Glencoul-Assynt thrust-masses," and referred to the klippen as "klippen of the Assynt thrust-plane."

The distinctive "Canisp porphyry" outcrops only in the Torridonian and Cambrian rocks of the foreland. In view of the extensive development of other intrusive rocks in the zone of the thrust masses, Sabine considered this to be evidence of considerable displacement on the sole. A ledmorite dike outcrops at intervals in a straight line extending across the foreland from Rhu More Coigach to Elphin; this line, if prolonged eastward into the thrust zone, passes through the Loch Borolan mass, in which the type rock occurs (at Ledmore). Sabine cited this as evidence of little displacement along the sole in a north-south direction, but the argument is weakened by the existence of other intrusions of this rock in the foreland to the north (at Achmelvich).

F. C. Phillips was the first, and for many years the only, geologist to use the techniques of petrofabric analysis in Britain. Phillips (1937) has described the orientation of quartz, muscovite, and biotite in the Moine schists, and in rocks from the zone of the thrusts and the foreland. The optic axes of quartz in the