

an appendix to McIntyre's paper (1954, pp. 219-220). A number of our conclusions are at variance with the hypothesis favored by Read, Phillips, and Wilson on the connection between the folding of the Moines and the thrust movements:

1. There has been a single penetrative movement about a common *B*-axis in the Moine Schists, the mylonites above the Moine Thrust and the deformed Lewisian, Torridonian and Cambrian rocks below. . . . The conspicuous *B*-axis must have been imprinted in post-Cambrian time.

3. Repeated movement is indicated locally by brecciation, movement on joints and even mylonitisation of the older mylonites of the Moine Thrust. [Christie *et al.*, 1954, pp. 219-220].

The presence of folds with axes plunging to the east and the southeast in the mylonitic rocks in the thrust zone has been noted by Wilkinson (1956) in Eire-boll and by Johnson (1956) in the Lochcarron and Coulin Forest areas. The structural relations in the Coulin and Lochcarron areas have been described by Johnson in later publications (1957, 1960).

STATEMENT OF THE PROBLEMS

The Survey memoirs contain a full and detailed description of the large-scale structures in the Assynt area, but references to small-scale features such as minor folds and lineations are few and brief. Two systems of folding in the Moine schists are mentioned in all three memoirs dealing with the area (1907, p. 468; 1926, p. 121; 1931, pp. 10, 28), and the authors of the Northwest Highland and Central Sutherland memoirs (Clough, in Peach *et al.*, 1907, pp. 506-507; Read, 1931, p. 10) make specific reference to folds in the mylonitic rocks. Subsequent investigators (e.g., Phillips, 1937, 1945; Wilson, 1953; McLachlan, 1953) have described the geometry of small-scale structures in the Moine schists, and recently (Wilson, 1953; McIntyre, 1954) the "plastic" style of folding in the schists has been contrasted with the "brittle" style of deformation in the mylonites.

The authors of the Northwest Highland memoir claim that the two "systems of folding" in the schists were "evidently produced by the same series of earth-stresses" in post-Cambrian times (1907, pp. 468, 601). Read, on the other hand, considers (Read *et al.*, 1926, p. 121) that they were formed during two distinct phases of deformation: the east-southeast trending folds were produced during an early phase and the north-northeast trending folds were produced during movements during a later phase. Read (1934) has developed this interpretation, and concludes that the east-southeast trending folds were contemporaneous with the general Moine metamorphism and are of pre-Torridonian age. This view has been supported by Phillips (1937, 1949, 1951), Wilson (1953), and McIntyre (discussion of Wilson, 1953; 1954). The evidence presented by Bailey, Kennedy, and MacGregor (see MacGregor, 1952), however, suggests that the Moine metamorphism and folding were entirely "Caledonian" (post-Cambrian), a conclusion that is in harmony with the views expressed in the northwest Highlands memoir on the origin of the folds. These closely related issues are the main subject of dispute in the present-day "Highland controversy." The problems involved in these issues may be summarized in the following way:

- 1) What is the relationship between the two groups of folds?

- 2) What is the relationship of each group of folds to
 - a) the regional metamorphism of the Moine schists, and
 - b) the thrust movements?

SCOPE AND PROCEDURE

The primary purpose of the present study is to give a detailed account of the tectonics of a part of the thrust zone embracing large- and small-scale structures, and to develop a kinematic interpretation of the structures on all scales. The following phenomena, listed in order of decreasing scale, have been investigated during the course of the work:

- 1) The orientation and mutual relations of the major thrusts and faults, and the form of large-scale folds associated with these structures.
- 2) The orientation and form of small-scale folds and lineations in the mylonitic rocks along the major thrusts and in the Moine schists.
- 3) The grain orientation in deformed rocks, notably in the mylonitic rocks and the Moine schists.

The importance of minor structures, such as folds and lineations, in determining the nature of rock deformation is now generally recognized, and particular attention was paid to these structures during the investigations. The relationships between the folds plunging to the east-southeast in the Moine schists and the structures associated with the Moine thrust were investigated with special care, in order to determine the sequence of the metamorphic and tectonic events. It was hoped that the study might also give some information on the significance of the Assynt "culmination," as indeed it has done.

A preliminary survey was made of the structures in the mylonites along the Moine thrust in order to determine the course to be followed in the later stages of the study. On the basis of this survey certain critical areas were selected for detailed examination, which included mapping on a scale of 6 inches to the mile. The Moine schists were examined in these areas and also along a number of traverses extending up to 3 miles eastward from the Moine thrust.

Petrofabric analyses of a large number of rocks, including quartzites, dolomites, mylonitic rocks, and Moine schists, have been made. The analyses were carried out in close association with the study of megascopic structural features, in order to supplement the information obtained from the field studies. For convenience in the presentation of structural data, the megascopic and the microscopical data are described separately, but I wish to emphasize that the synthesis and the final conclusions are based on a joint consideration of both aspects of the fabric.

Most of the techniques employed in the study are standard procedure in structural petrology. Orientation data throughout the paper are recorded on the lower hemisphere of an equal-area projection.

ACKNOWLEDGMENTS

I am grateful to Professor Arthur Holmes for guidance during the course of the work presented in this paper, and for criticism and advice regarding an early draft of the manuscript. Professor D. B. McIntyre and Professor L. E. Weiss