

famous chiefly through the work of B. N. Peach and John Horne and their associates in the Geological Survey of Great Britain (Peach *et al.*, 1907).

In recent years the age and the origin of the Moine thrust, and its significance in the tectonic and metamorphic history of the Scottish Highlands, have become subjects of renewed interest. The present study was undertaken in the hope that the application of the techniques of structural petrology and structural analysis might provide answers to some of the problems that were not finally resolved during the systematic mapping and investigations of the Survey geologists. The Assynt region was selected for study because of the excellent development and exposure of the thrust planes.

An index map showing the location and the main geological features of the area is shown in figure 1 (in pocket), but reading of the paper will be greatly facilitated by reference to the geological map of the Assynt region (1923) or the maps in the memoir on the northwest Highlands (Peach *et al.*, 1907).

#### HISTORICAL REVIEW

Geological work in the Assynt area began with the studies of MacCulloch (1814, 1824), and a considerable number of papers were published before the systematic mapping of the area was undertaken by members of the Geological Survey in the period following 1885. The development of thought on the stratigraphy and the structure of the area during this period has been reviewed by Horne (Peach *et al.*, 1907, chap. 2) and McIntyre (1954). The most notable contributions were those of Nicol (1844, 1857, 1861) and Callaway (1881, 1883), who noted many of the structural features later mapped and named by the Survey geologists.

Nicol (1861) was the first to recognize that the Moine schists were everywhere in fault contact with the Lewisian gneiss and the Torridonian and Cambrian rocks to the west,\* and that the Cambrian succession in the Assynt area was disturbed and repeated by faulting. Although this discovery of Nicol's contained the clue to the complex structure of the northwest Highlands, his work was discredited at the time as a result of the efforts of Murchison and Archibald Geikie (Murchison, 1856, 1859, 1860; Murchison and Geikie, 1861), who considered that an undisturbed stratigraphic succession existed from the Lewisian gneiss, upward through the unmetamorphosed Torridonian and Cambrian formations, into the schists of the Moine series. Nicol's views were eventually vindicated by the work of Callaway (1881, 1883) in Assynt and of Lapworth (1883, 1884, 1885) in the Eireboll region to the north. These studies, which were supported by the later work of the Survey geologists (Peach and Horne, 1884; Peach *et al.*, 1888), led to the acceptance of the idea that the Moine schists had been carried over the unmetamorphosed sedimentary rocks of Torridonian and Cambrian age to the west on a series of great thrust planes.

The systematic mapping of the thrust zone by Survey parties, begun in Eireboll in 1883, reached the northern part of Assynt in 1885, but the area was not completely mapped until 1896, when Peach and Horne mapped the area east of Ben More. The 1-inch sheets 101 (Ullapool) and 107 (Lochinver and Assynt) were published in 1892, and the geology of the thrust zone in Assynt is described in the

\* The modern stratigraphic terminology is adopted here to avoid confusion.

memoir, *The Geological Structure of the North-West Highlands of Scotland* (Peach *et al.*, 1907). The survey of the central parts of Sutherland and Ross-shire was initiated while the main Survey party was working on the thrust zone and the areas to the west. Sheets 102 (Strath Oyke and lower Loch Shin) and 108 (central Sutherland) both contain parts of the zone of dislocation, and these were not published until 1925 and 1931, respectively, but a composite geological map of the Assynt region, comprising parts of sheets 101 and 107 and the uncompleted sheets 102 and 108, was published in 1923. The geology of the areas covered by sheets 102 and 108 is described in two memoirs: *The Geology of Strath Oyke and Lower Loch Shin* (Read *et al.*, 1926) and *The Geology of Central Sutherland* (Read, 1931).

The structure of the Assynt area is described in detail in the memoir on the northwest Highlands (Peach *et al.*, 1907) and summarized in the guide to the geological model of the district (Peach and Horne, 1914). The structure of the area and the sequence of movements, as described by Peach *et al.* (1907), are outlined below.

The region is traversed by four great thrust planes, each with a general dip toward the east-southeast. From east to west, these are (1) the Moine thrust, (2) the Ben More thrust, (3) the Glencoul thrust, and (4) the sole, or the lowest thrust plane. The Moine thrust is the most important of these structures. The trend of the outcrop of the thrust, which is remarkably constant to the north and south of Assynt, varies considerably in the area, giving rise to an embayment 15 miles long from north to south and approximately 7 miles wide. In the north the thrust dips at low angles to the northeast, whereas in the south it has a gentle southerly dip. It carries the crystalline schists of the Moine series, which underlie most of the northern Highlands, over the Lewisian gneiss, the Torridonian sandstone, and the Cambrian sedimentary rocks to the west.

The Ben More thrust carries a slice (the Ben More nappe) of Lewisian, Torridonian, and Cambrian rocks, showing their normal unconformable relations. The thrust has been folded and a number of klippen of the nappe lie to the west of the present outcrop of the thrust, on Beinn na Cnaimseag, on Beinn an Fhuarain, and between Ledbeg and Loch Urigill.

The Glencoul thrust to the west carries a slice (the Glencoul nappe) of Lewisian gneiss, capped by Cambrian sedimentary rocks. No Torridonian sandstones are exposed in the Glencoul nappe. The zone of thrusts is bounded on the west by the lowest thrust plane, or the sole.

Imbricate structure, or *Schuppen Struktur*, is commonly associated with the thrusts; in imbricate systems the Cambrian rocks are repeated by steep reverse faults which generally dip toward the east-southeast at steeper angles than the strata themselves. Imbricate zones are particularly well developed below the Glencoul thrust north and south of Loch Glencoul, and below the Moine thrust at several localities.

Each of the thrusts appears to be overlapped in turn by the overlying one; the Ben More thrust overlaps the Glencoul thrust south of Ben More, and appears to be truncated by the Moine thrust near the Stack of Glencoul and at a number of localities to the south of Assynt. A remarkable feature of the Moine thrust is its