CHAPTER I

INTRODUCTION

1.1. LOCATION OF THE AREA

The area under investigation falls between the latitudes 25°30'57" N — 25°34'41" N and the longitudes 91°36'14" E — 91°42'49" E and is included in the Survey of India Topographic Sheet No. 78-00, published during 1910-11 and later corrected in 1936-37. It forms a part of the Shillong Plateau, West Khasi Hills District, Meghalaya (Fig. IB,C) and geologically a part of the Precambrian terrain of fragmented Super-continent Gondwana. The area is about 44 km west of Shillong (capital of Meghalaya) on the Shillong-Mairang-Nongstoin road. The total area covered in this study is about 77 sq. km (see Fig. I & II).

1.2. METHOD OF STUDY

1.2.1. Field Methods

The area as a whole has been geologically and structurally mapped on the scale of 1:15,840 or 4 inches to a mile. The base maps have been prepared by enlarging the Survey of India Topographic Sheet of one inch to a mile scale.

In the field, the distribution of various rock types and their field relations have been studied and mapped. Various mesoscopic folds, planar and linear structures and
their patterns have been studied following the methods of Turner and Weiss (1963) and Ramsay (1967). A number of field sketches have been drawn and field photographs taken to show various lithological and structural features of the rocks. The area has been divided into two parts and sufficient structural data have been collected from each part for statistical study.

A number of (about 250) representative, fresh rock specimens have been collected during the field work. The Burnton as well as—compass clinometer have been used for accurate measurements of dip and strike of bedding planes, lithological layerings, foliations and joints, pitch and plunge of folds and lineations.

These measurements are recorded and plotted in the field map with their appropriate symbols. Wherever any intrusive rock mass is met with, close observation is made to find out its contact with the country rocks. Cross-traverses, wherever possible, have been made to find out good exposures in situ.

1.2.2. Laboratory Methods

Altogether 200 thin sections have been cut from the samples collected from the field. Studies on textural, mineralogical and paragenetic aspects of the rocks have been carried
out and features of genetic significance have been noted. From the hand specimens and thin sections, some of the features are illustrated by camera lucida diagrams and photomicrographs. Optical mineralogical studies such as optic axial angles, extinction angles, birefringence, refractive indices and others have been carried out using the standard methods, including the use of U-stage (Wahlstrom, 1969). Anorthite content of plagioclase has been determined by the method of Turner (1947) and later modified by Slemmons (1962).

Modal analyses from representative thin sections have been carried out by Swift pointcounter, in the light of observations of Chayes (1956), Rosenblum (1956) and Plas and Tobi (1965).

The time relations between the formation of different minerals and the different phases of deformation have been studied and an attempt is made to establish the nature and degree of metamorphism and metamorphism affecting the rocks.

Thirty four representative samples — nine quartzofeldspathic gneiss, six granite, seven amphibolite, six Khasi greenstone, four calc-silicate, one metasediment and one impure-quartzite have been chemically analysed to find out their major element content. C.I.P.W. norm, Niggli values, ACF values and various oxide ratios have been calculated using TDC 316 computer.
1.3. NATURE OF EXPOSURES

Approximately eighty percent of the total investigated area is occupied by hills, where the degree of exposure is comparatively higher than in the valleys. Thorny shrubs, thick forests and residual soil coverings not only render geological field mapping difficult but also conceal a large part of the rocks under them. Exposures in the valleys are confined only to the stream cuttings. The hard gneisses and quartzites give rise to the most spectacular outcrops that stand out as huge wall-like bodies, although these are in accessible for geological investigation.

1.4. COMMUNICATION AND ACCESSIBILITY

The development of communication is greatly hindered by the relief of the area. The area is approachable only by motorized vehicles. The main all weather road connecting Shillong-Mairang-Nongstoin passes through this area. Outlying areas situated away from the main road is approachable only through footpaths and pony tracts. There are other minor roads that connect the main road to the outlying villages and used by the local inhabitants, thus making the area accessible on foot for the field work. The important villages are Bynther, Mairang, Nongbri, Nongti, Manai, Mawsaw and Mawmaram. Mairang has recently been elevated to a sub-Divisional headquarter of the district (see Map 1).
1.5. PREVIOUS LITERATURE

A preliminary study of the Precambrian rocks of "Mairang-Lyngkhoi Plateau" was carried out by Ghosh (1952). To this day this remains the only previous work on any aspect of geology of the area.

However, as the present area is an integral part of the Shillong Plateau, it will be highly appropriate to review briefly the available literature on the Precambrian geology of the plateau. Although the Precambrian geology of the plateau attracted the attention of the geologists around the middle of the last century, no serious attempt was made to study the rocks in detail. Early workers confined their works only on sections exposed in different parts of the region.

Oldham (1858), Medlicott (1869), Palmer (1924), Das Gupta (1934), Fox (1938) and Ghosh (1952) were some of the pioneer workers on the Precambrian geology of the Shillong Plateau. Recent workers (Choudhury and Rahman, 1959; Choudhury, 1962; Bhattacharjee, 1966 and Rahman, 1981) confined their work in different parts of the plateau. Although their studies are mostly petrological, some stratigraphical accounts of these rocks are given by Pascoe (1950), Wadia (1966), Krishnan (1968) and Choudhury and Rao (1975).

Oldham (op.cit.) was the earliest worker who studied the rocks of the plateau. He discovered two types of metamor-
phic rocks in certain parts of the plateau: one is older and more altered. It is represented by alternating bands of gneisses, quartzites and schists, greatly contorted and traversed in every direction by veins of finely crystalline granite and occasionally associated with bands of hornblendic rocks. The other group is essentially slaty, consisting of blue and flaky schist with some micaceous quartzose layers.

It was Medlicott (op.cit) who applied the term "Shillong series" to a sequence of sediments exposed in the Shillong Plateau under three divisions: the Shillong series, the Epidiorites and the Granites. According to his investigations the Shillong series consists of a considerable thickness of quartzites, locally conglomeratic and an uncertain thickness of early rocks in the state of slate. He described the epidiorites as the basic intrusive in the Shillong series (Shillong Group) and named them "Khasi Greenstone" for their wide distribution in the Khasi Hills. He was of the opinion that the granite masses were truly intruded rocks and were younger than Khasi greenstone. The utility of Medlicott's work is confined mainly to the study of different rock formations and their correlation with other formations of India.

Palmer (op.cit.) while dealing briefly on the main structural features of the area indicated that the plateau is an ancient mass of gneiss much intruded by a coarse granite. He observed that in some parts of the area, the gneiss is
typically a fine granulite with no large or conspicuous elements in it.

Bradsaw (cf. Pascoe 1950, p. 242) observes that the less metamorphosed, simple folded Shillong formation has a very youthful appearance.

Das Gupta (op.cit.) working on Mylliem granite confirmed the views expressed by the earlier workers that the granites of the region were intrusive in character. He inferred that the granite had intruded the Shillong series and was of much later age.

Ghosh (op.cit.) mapped the Precambrian rocks of the plateau. He gave an elaborate account of the rocks of Mairang-Lynkhoi plateau which borders the present area. He studied the junction of the Shillong series and the granite gneiss of the area and observed that the junction between the two groups of rocks were sharp and well defined. On the western side of the plateau the boundary runs roughly NE-SW and changes to ENE-WSW on the southern side of the plateau. He found that the rocks of the Shillong series have the same general strike as the boundary with high south-easterly and southerly dips.

He reported the occurrence of both para- and orthogneiss in the gneissic complex of Nongmawait-Rambrai-Nongstoin plateau and added that they were ultimately mixed up and folded. According to him the oldest rocks were a group of
ancient sediments which were intruded by a basic and acid igneous rocks and were metamorphosed under deep-seated conditions. They were subjected to further intrusions of granite.

Krishnan (1968, p. 151) has mentioned the rocks of the Nongstooin area, west of the present area. According to him the granite gneiss of the area includes lenses of quartz-biotite-sillimanite-cordierite and quartz-sillimanite rocks with sillimanite-corundum masses. These occupy a belt of half a mile (500 m) wide with general E-W strike.

Bhattacharjee (1968) in the course of his study of geology of the Shillong Plateau with reference to its structure and petrology, referred to NE-SW trend with a variation to E-W of the gneissic complex of the plateau. He further observed that the Precambrian rocks of the plateau are highly foliated and lineated. The small-scale folds are widespread with steep to vertical axis plunging parallel to the dominant foliation of the rocks.

Crawford (1969b) dated the Mylliem granite that is intrusive in to the Shillong Group. He found that this granite is 765 ± 10 million years old.

Earlier, Sarkar (1968) dated the muscovite in a sheared quartzite occurring at Jowai. The quartzite belongs to the Shillong Group. However, a much younger age (472 m.y.) than the Mylliem granite has been obtained, although the latter
is intrusive in to the former. This anomaly might have been caused due to the later development, much after the intrusions of the granite, of the muscovite in the shear-planes in the quartzite.

1.6. TERMINOLOGY USED IN THIS WORK

Certain terms which have varying meanings, are defined here to avoid confusion.


Gneiss: A foliated rock with gneissose structure. They are referred to by their characteristic mineral content. The term 'quartzofeldspathic gneiss' is used to describe the rocks having alternate bands rich of quartz, feldspar and biotite corresponding to the quartzofeldspathic gneiss of Heinrich (1956, p. 223) and Turner (1968, p. 4) and to rocks described elsewhere as 'acid gneiss' (cf. Bowes and Bhattacharjee 1967, p. 7-60). The term hornblende gneiss is used to gneissic rock having the composition of hornblende, biotite, quartz and plagioclase.

Schist: A metamorphic rock in which schistosity is the prominent structural element. The term 'sillimanite-garnet schist', 'quartz-sillimanite-garnet-feldspar schist', 'hornblende-
sillimanite schist', 'quartz-biotite schist', 'quartz-muscovite
biotite schist', 'grey actinolite schist', 'biotite schist'
and 'sericite schist' are employed after their characteristic
minerals.

Calc-silicate rocks: A derivative of calcareous sediments,
characteristic minerals are diopside, actinolite, plagioclase
and quartz.

Basic: As applied to rocks having composition comparable to
the basic igneous rocks.

The basic metamorphic rock is applied to here to the
dark coloured, well foliated amphibolites composed mainly of
hornblende and plagioclase.

Migmatite: An intermixed rock composed of dark coloured
older metamorphic rocks and light coloured quartzfeldspatic

Foliation: A set of parallel layers induced by deformation.
This is the broad (American) sense of the term and includes
metamorphic banding, gneissosity and schistosity.

Lineation: The parallel arrangement of regularly oriented
bodies usually found on foliation planes or affecting the
foliation planes.

Plunge: As defined by Phillips (1960, p. 9-11).