CHAPTER X

SUMMARY AND CONCLUSIONS

An area of 238 square kilometers around Shillong and Mylliem in the Khasi and Jaintia Hills district of Assam, India, has been geologically mapped on a scale 5.08 centimeter to 1.609 kilometer (Map 1). The rock types found in this area represent two broad subdivisions, namely the metasediments and the igneous rocks. The metasediments include quartzites, conglomerate and pelitic rocks belonging to the Shillong Series. Intruded into the metasediments are the igneous rocks, which include both basic and acidic types. The basic type is represented by metadolerite known as the Khasi greenstone and the acidic type is represented by pink and grey coloured, coarse grained porphyritic granite, known as the Mylliem granite. Pegmatite, aplite and quartz occur as dykes and veins of the granite, while small pockets of sedimentary rocks of the Cherra sandstone stage occur as outliers over the granite.

The Shillong Series of rocks, which cover the entire northern part of the area and surround the Mylliem granite on all sides, are the oldest rocks of the area. They were originally sedimentary rocks, which is evident from their stratified nature, current bedding, graded bedding, etc. The earliest intrusives into these rocks are the Khasti
greenstones that occur as dykes, sills and flows and contain xenoliths of quartzites and pelitic rocks. The Mylliem granite is a later intrusive into the rocks of the Shillong Series and the Khasi greenstones and cover nearly 90 sq. kms. around Mylliem (25°29' : 91°49'). The granite shows cross-cutting relations with both the Shillong Series of rocks and the Khasi greenstones and contains xenoliths of these rocks.

The quartzites are highly arenaceous rocks with more than 80 percent of quartz, embedded in a matrix of sericite. There are two types of quartzites, one type being essentially sericitic and the other type containing needles and small patches of graphite in addition to sericite. The former is dominant in the area and is called the 'Shillong quartzite' while the latter occurs only in a narrow band on the north-western part of the area and is called the 'graphitic quartzite'. Conglomerate occurs in a bed underlying the graphitic quartzite and overlying a concordant body of the Khasi greenstone. Pebbles and cobbles of the conglomerate are composed of quartzite and quartz set in a matrix of sericite and quartz. The pelitic rocks occur in layers of varying thickness interbedded with the quartzites. Phyllites are composed of sericite, quartz, chlorite and iron ore while the pelitic hornfelses contains andalusite along with biotite, muscovite and quartz.
The Khasi greenstones are composed essentially of actinolitic hornblende and saussuritised plagioclase (An$_5$-32) with small amounts of chlorite, epidote, magnetite, ilmenite, sphene, biotite, quartz, etc. Skeletal crystals of augite, baveno and pericline twins in plagioclase and the relict ophitic texture of the rocks indicate their derivation from doleritic rocks. The chemical composition of these rocks also resembles that of dolerite and amphibolite.

The Mylliam granite is essentially a microcline granite with microperthite, orthoclase, quartz, plagioclase (An$_{20}$-34) and biotite with the usual accessory and secondary minerals. The homogeneous nature of the rock with regard to its mineralogical and chemical composition as well as the texture, the zonally arranged inclusions of early formed minerals in the potash feldspar phenocrysts, predominance of complex twins (c-twins) in plagioclase, etc. point to the crystallization of the rock from a granitic melt. Modal composition shows that it is a two feldspar granite with potash feldspar > quartz > plagioclase and a colour index 8.

The Shillong Series of rocks, which are the country rocks, form a huge thickness of strata and are very well bedded. The regional trend of the rocks to the north of the granite is NE-SW with a southerly dip (30°-40°), while the same rocks on the southern side of the granite trend NW-SE to NE-SW with a northerly dip (50°-60°). Although, near the
contact of the granite the trend of these rocks becomes parallel to the margin of the granitic body and dip towards the granite from all sides, yet cross-cutting relations exist between them at some places, especially where the margin of the granitic body takes a sharp bend. Away from the granite, the country rocks are folded into open, symmetrical and asymmetrical folds (major folds), while near the granite they are tightly folded into complex folds (minor folds), often disharmonic in nature. The fold axes trend along the strike of the rocks. The early lineations or b-lineations (L1), are parallel to the fold axes, while the later lineations or a-lineation (L2) is perpendicular to the former. The b-lineations plunge 7°-10° towards SW and 10°-30° towards NE on the northern and southern sides respectively of the granite. Thus, the lineations plunge towards the granitic body. Slaty cleavage and axial plane cleavage follow the same trend and dip direction of the stratification planes of the rocks on northern side whereas to the south of the granitic body, the cleavages and the stratification planes dip in opposite directions, the cleavages being directed away from the granite. Thus, the cleavages on both sides of the granite dip in the same direction. The country rocks show evidences of minor faulting and thrusting at the contact of the granite.
The overall structural pattern of the country rocks, discussed above, shows that the rocks form an asymmetric synclinal basin with its axial plane steeply dipping towards south. The basin is considered to have formed as a result of downwarping of the rocks due either to the weight of the sediments or to tectonic forces. The longitudinal and cross joints and the cleft girdle pattern of the quartz fabric in the quartzite are thought to have developed as a result of downwarping and folding (major folds) of the rocks. The variable nature of diagonal joints, the presence of complex minor folds and the peripheral a-c girdle of the quartz fabric in the quartzite were related to the emplacement of the granite.

The Myllies granite, which occupies the central part of the synclinal basin, described above, is a rectangular shaped body, the longer dimension being in the E-W direction. It exhibits various primary structural features. The flow lines or lineations show an average E-W trend while the flow layers dip to the north and south on the extreme northern and southern margins of the granitic body respectively, forming a dome shaped structure with an undulating surface. The longitudinal joints follow the trend of the lineation while the cross joints are perpendicular to the former. The diagonal joints make oblique angles to both the longitudinal and the cross joints. The joint planes in the
granite are often coated with hydrothermal minerals. The xenoliths in the granite are drawn along the flow lines in the granite. The o-axis fabric of quartz in the granite shows the presence of near perfect a-c girdle about the b-lineation along with subsidiary b-c girdles in some cases. These suggest complicated movement and rotation within the granite. Such complicated rotations are generally possible in a fluid magma.

The rocks of the Shillong Series have suffered low grade regional metamorphism during the downwarping of the rocks. They, however, show a higher degree of metamorphism within a narrow zone or aureole (nearly 400 meters) at the contact of the granite. Within this aureole the sericitic matrix of the quartzites has recrystallized into muscovite and the rock shows a compact granoblastic mosaic with the total obliteration of the original clastic nature. The low grade phyllites have also been transformed into high grade hornfelses with the development of porphyroblasts of andalusite.

The doleritic rocks, which gave rise to the Khasi greenstones, likewise, suffered regional metamorphism along with the rocks of the Shillong Series, whereby a mineral assemblage, actinolite-chlorite-epidote-albite were formed with some original igneous textures preserved in the rock. Within the contact aureole of the granite, regional meta-
morphism has been superimposed by thermal metamorphism, where actinolitic hornblends are changed into deep coloured hornblends while epidote and albite combined to form more calcic plagioclase (oligoclase). The rock also developed hornfelsic texture.

The xenolithic bodies of the Khasi greenstones, quartzites and pelitic rocks occurring in the granite are affected by the granitic fluid producing hybrid rocks of granitic composition.

Field relations of the granite with the country rocks, the structural and petrological characters of the granite, and the contact effects it has produced upon the country rocks, all indicate that the granite is of intrusive nature. Since, the granitic body occupies the central part of the synclinal basin formed by the country rocks, it is considered that the granitic magma has intruded along the trough of the tectonically controlled synclinal basin and exerted lateral pressure on the wall rocks. The lateral pressure has caused the country rocks to wrap around the granitic body, produced complex minor folds in them and resulted in faulting and thrusting of the rocks. As the contact aureole of the granite showing high temperature metamorphism is very narrow (nearly 400 meters) and the country rocks outside this aureole show low grade regional metamorphism, the Mylliem granite is considered to be a high level pluton.