Chapter III

PETROGRAPHY

An attempt has been made to describe the petrographical characters of the following rock types encountered in the area under study:

1. Calc-granulite
2. Garnet-sillimanite-feldspathic gneiss
3. Garnetiferous gneiss
4. Feldspathic quartzite
5. Crystalline algal limestone
6. Shale
7. Hypersthene gneiss

1. **Calc-granulite**

The calc-granulite samples were collected from Faccor Hill, Devada Hill, Peroxide quarry (Garividi) and one from the Central Garbham quarry.

The calc-granulite is an equigranular and medium grained rock that exhibits granulitic texture. It is composed mainly of scapolite, orthoclase, diopside, hornblende, quartz, garnet, calcite and wollastonite. The accessory minerals identified included piedmontite, epidote, apatite, zircon, microcline and sphene.
The diopside is an important and a constant mineral occurring in all thin sections of calc-granulite. It is green in colour, irregular in form having a moderate relief with well-developed one set of cleavage. Some of the grains are faintly pleochroic. This shows characters similar to manganese pyroxene.

The scapolite is tabular in form with moderate relief. It is colourless in thin section and has straight extinction and the polarization colours are pink and yellow of second orders. The wollastonite is shining, long, thin, flat needles having an oblique extinction. It is generally in association either with calcite or with quartz. Calcite shows characteristic rhombohedral cleavage and twinkling in plain polarised light.

Quartz shows undulose extinction and some of the quartz grains are fractured. Orthoclase which shows carlsbad twinning, sometimes occurs as porphyroblasts.

Scapolite, quartz and orthoclase are the dominating minerals of calc-granulites. Garnet is pink in colour, somewhat fractured and the crystal boundaries are occasionally replaced by quartz (Pl. XI, Fig. 4), few garnet grains are altered to hydrated manganese oxides along the cracks. They are pitted presenting high relief and are isotropic. The piedmontite is orange coloured with relief higher than Canada balsam, and having one set of cleavage. Occasionally there are inclusions of manganese ores in orthoclase and quartz in which they appear
as multi-central replacement bodies (Pl.XII, Fig. 1).

2. Garnet-sillimanite-feldspathic gneiss

The garnet-sillimanite-feldspathic gneiss samples were collected from Garbham, Central Garbham mine and from Udikimeta hill areas. The rock which is medium to coarse grained, shows gneissose structure and consists mainly of orthoclase feldspar as the dominating mineral with sillimanite, garnet, quartz, graphite and biotite. Magnetite, apatite and rutile are the common accessory minerals.

Garnet in general is a very characteristic constituent of this group of rocks. It is light pink in colour, isotropic and refractive index is high. It is generally diablastic frequently shows inclusions of quartz, magnetite and needles of sillimanite where the garnets are altered manganese is found as incrustation over it. Feldspars, which are mostly orthoclase and plagioclase, occur in subordinate amounts. The plagioclases occur as minute grains.

Sillimanite occurs as long stout needles and arranged in a parallel disposition conforming to the general gneissosity of the rock. It has high refractive index and polarises in second order green and pink. The quartz is colourless and constitutes a major part of the rock. It shows undulose extinction and fracturing. The graphite occurring in this rock
in varying amounts, is opaque and usually occurs in the form of small flakes.

The rock collected from Central Garbham quarry (PL-XII, Fig. 3, 4) contains feldspar and garnet which are rounded to subrounded and elliptical in shape.

The rock samples collected from Udikimeta hill and Central Garbham areas (Pl.XIII, Fig. 1, 2) is composed of feldspar, quartz and garnet which are anhedral, broken, sharp-edged and angular in shape. These shapes indicate some brecciation of the rock which may be due to effect of faulting.

3. Garnetiferous gneiss

The garnetiferous gneiss, collected from East Garbham quarries. The rock is medium to coarse grained. It is composed largely of garnet with variable amounts of orthoclase, plagioclase, microcline, quartz, chloritoid, spinel and some opaque ore minerals (Pl.XIV, Fig.2). Garnet is euhedral, relief is high and occurs as porphyroblasts. Plagioclase is twinned, quartz usually shows wavy extinction. Spinel is light brown in colour, relief is high. There are clusters of fine tadpole-like inclusions of spinel in orthoclase with preferred orientation of the grains along the cleavage direction of the mineral. Chloritoid is characterised by the presence of strain slip cleavage (Pl.XIV, Fig. 1), the colour of chloritoid is light
grey and showing slightly pleochroism. Cleavages perfect in one direction and extinction almost parallel.

4. **Feldspathic quartzite**

The feldspathic quartzite, collected from East Garbham quarries and from Udikimeta, is medium-grained. In East Garbham quarries it occurs in the form of lenses and pockets within the calc-granulite. It is mainly composed of quartz, feldspar (microcline and plagioclase) augite and uralite. The augite is of brown colour, showing moderate to high relief. Augite alters into uralite (Pl.XIV, Fig. 3). Manganese ore is occasionally associated with orthoclase in the form of small inclusions.

5. **Crystalline algal limestone**

The crystalline algal limestone samples were collected from Koduru quarry. The rock is coarse grained and equigranular. It is composed of calcite (showing polysynthetic twinning), dolomite (showing polysynthetic twinning but the lamellae are thick, Pl.XI, Fig. 1), piedmontite, orthoclase, scapolite and leucite in addition to quartz. The common accessories include sphene and some opaque ore minerals.

The limestone is partly dolomitized. Idiomorphic crystals of quartz are occasionally found replacing the carbonate
minerals (Pl.XI, Fig. 2).

The presence of some algal bodies of doubtful origin in all the thin sections of the rock is important feature. One of the edges of the algal body shows cylindrical outline facing the arrow formed of calcite (Pl. X, Fig. 2). This filament like body has got distinct cellular outline and suture (Pl. X, Fig. 3). Thus it is not a mineral, as it looks like the structure of an algal body (Horowitz, A.S. and Potter, R.E. (1971) belonging to Precambrian age (Fig. 8). The rock appears to be a low-grade metamorphic product of a calcareous sediment.

6. **Shale**

In the manganese mines of Garividi village, small pockets and lenses of green shale near Vibhu soda plant and a few pockets of red shales in Dhobi pit were recorded for the first time by the author. These lenses and pockets of shale are found in association with calc-granulite and manganese ores.

The shale is ferruginous and alters into lateritic soil at the surface. It often shows thinly bedded appearance. The minerals identified include quartz, mica, sericite, kaoline and some ferruginous materials arranged in different regularly defined lithic planes. Along with the ferruginous material few patches of dark grey substance are also found which may possibly be the manganese ore. Quartz is generally inequigranular
and the crystals are angular to sub-angular and distributed evenly exhibiting typical wavy extinction.

There are a few porphyroblasts of medium grained quartz. The smaller quartz grains often show pressure shadow. The lighter bands of quartz alternate with bands of micaceous minerals (Pl.XIII, Fig. 4).

Sericite occurs mostly as fine fibrous aggregate. It shows either pale green or white colour. It is present in the rock in close association with muscovite and quartz. Occasionally the shale appears as phyllite with the increase of micaceous minerals.

7. **Hypersthene gneiss**

It occurs in the vicinity of Koduru area. In Jai Bhavani pit (Garbham) it occurs as lenticular bands within calc-granulites. In Peroxide pit (Garividi), the colour of hypersthene gneiss is light to dark grey. On weathered surface it is buff and cream coloured. In general, the rock exhibits spheroidal weathering and rhomboidal jointing.

The texture of hypersthene gneiss is equigranular, medium grained, composed mainly of quartz, potash feldspar, sodic plagioclase, hypersthene, garnet, biotite and hornblende. The accessory minerals identified include some opaque ore minerals and apatite (Pl.XIV, Fig. 4) with occasional presence of zircon.
Orthoclase is somewhat cloudy. The hypersthene is pale green in colour, shows greenish to pale reddish pleochroism, the crystals of hypersthene are subhedral to prismatic, relief is high. Garnets are dull red in colour and having inclusions of opaque ore minerals. Hornblende is green coloured, prismatic, relief is high and shows pale green pleochroism.