CHAPTER II

STRUCTURE RELIEF AND DRAINAGE

I. GEOLOGICAL FORMATIONS

Manipur is a part and parcel of Assam-Burma geological unit. For want of a detailed geological exploration in this area, our knowledge of its tectonic and geological history is inadequate.

During the Archaean period, there extended on the north of Gondwana Land, a sea, called the Tethys, covering approximately the present Indo-Gangetic plain, the Himalayas and its offshoots in Burma and the plain of Irrawaddi. This sea continued to receive sedimentary deposits of conglomerates, shales, sandstones and limestones, eroded from the Archaean rocks, during the Palaeozoic and much of Mesozoic period.

During the Jurassic period there arose a continent called the Angara Land to the north of the sea. Eastern Tibet, and western China, later on, emerged as continental areas. During the Cretaceous period there appeared another shallow sea along the submerged east coast of Indian peninsula, part of its (peninsula's) northern floor formed the Shillong plateau. The east Himalayas were either a narrow peninsula or an isthmus, connecting China with Gondwana Land.

This geological unit underwent an orogenic activity in the late Cretaceous or early Cenozoic which greatly altered the geographic and tectonic alignments of the region and established a new pattern of
sedimentation. This orogeny was accompanied by extensive igneous activity. The Shan plateau was uplifted in the east and a narrow belt along the west, which marked the beginning of a tectonic highland of Arakan Yoma and Naga hills. The tectonic highland created two large gulfs namely the gulf of Assam and the gulf of Burma, whereas deltas progressively fanned out to sea. The orogenic activity in the newly formed Arakan Yoma was very pronounced during the mid-Miocene. A final orogenic phase in the early Pleistocene raised the Arakan Yoma almost to their present height and pushed the Burmese gulf further south.¹

According to Oldham the succession of beds in Manipur and Naga hills is as follows:

Alluvium

Glacial (?) gravels and talus deposits of Naga hills

Tertiary

Serpentine rocks— intrusive

Cretaceous

Axials.

In this region, rocks from upper Cretaceous to the present alluvium are found. The oldest rocks found in Manipur are confined to the eastern part of the state, close to Indo-Burma border (Map 4). They are grouped as Cretaceous rocks, accompanied in many places by serpentine. The serpentine belt extends from the jade mines of northern Burma through Naga hills and east Manipur hills into the Arakan region.²

**Geology and Mineral Map of Manipur**

- **Alluvium**
- **Tipam and Surama Series** (Miocene excluding Pontian)
- **Barak Series** (Oligocene and Eocene)
- **Jaintia and Disang Series** (Eocene including Paleocene)
- **Serpentine** (Tertiary)
- **Fault** (Probably Jurassic)

**INDEX:**
- Nickel
- Copper
- Limestone
- Chromite
- Lignite
- Asbestos
- Clay
- Salt Springs
- Minor Gas Seepage
- Limestone

**Geological Survey of India**

**Mineral sites based on provisional data.**

**Based on Map No. 1: Geographical Map of Assam, after Mathur and Evans. Compiled from Surveys by the Geologists of Burma Oil Company Ltd. and Associated Companies and by the Geological Survey of India.
In Manipur the Trappean intrusions are confined to the eastern portion of Tangkhul region, occurring in dykes of varying size. The main axis of intrusion forms a band, a mile or two in breadth, which runs in north-south direction throughout the whole of the eastern part of the state. About this Oldham says:

Is a characteristic dark coloured serpentine; it frequently becomes a gabbro and contains bronzitic, and is intersected by veins of gold coloured chrysolite, or sometimes carbonate of magnesia; ...... In the neighbourhood of some of the larger masses of serpentine the sandstones and shales are converted into greenstone and chloritic schist.5

The serpentine rocks are younger than Cretaceous, and the associated sedimentary rocks have been described as Axials. The sedimentary rocks, east of the main serpentine body, stated as Axials (Cretaceous), are mainly variegated shales, slates, and siltstones with some amount of sandstones and quartzites.4

In the Tangkhul Naga region around Ukhrul, limestone of Cretaceous age is found. Along the Indo-Burma border, the monotonous flysch succession is interrupted by a conglomerate containing pebbles of serpentine. The beds on the east side of conglomerate are more metamorphosed with a more foliated habit and a harder texture than the beds to the west. The more easterly beds consist mainly of

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argillaceous deposits with occasional arenaceous bands with a greater degree of metamorphism. 5

According to the geologists of Burma Oil Company, the Tertiary rocks in Manipur belong to two series namely Disang and Barail. They prefer the term Axials, in a restricted sense, for rocks older than Disang, probably Cretaceous. The peridotites, altered into serpentine, are stated to be in part pre-Tertiary, probably Cretaceous and in part post-Middle Miocene. 6

The Tertiary rocks which are found almost all over the state, range in age from Eocene to Pleistocene. In Assam, the lowest Tertiary beds are Mallet's Disang series, "A very great thickness of almost unfossiliferous shales, slates and phillites, best exposed in Naga Hills and Manipur." 7

Almost all the foothills northwest of Tengnoupal are of Disang shales. Lithologically the series consists of dark olive grey and buff coloured splintery shales, which are well bedded, highly jointed and cleaved, often intercalated with thin beds of fine grained sandstones and silt stones. 8

The Disang series is provisionally recognised by Oldham as older series and contains beds of slates, sandstones and quartzites, well distributed over the Angami Naga area and elsewhere. These beds

6 Anand, Banerjee and Dayal, loc. cit.
8 Anand, Banerjee and Dayal, loc. cit.
are met after crossing the Makru river, on the road from Cachar to Manipur. In the bed of Barak river, the series contains beds of almost pure pipe clay. Towards the crest of Leimatak sand-stones appear at an east-north-east dip, which continues as far as the alluvium of Manipur valley. To the east of this valley there is a huge series of slates and quartzites with an easterly dip. The beds extend towards Tangkhul Naga area of great serpentine intrusion.⁹

II. RELIEF

There are two main relief features in Manipur namely mountain and plain. Mountains cover about ninety two per cent of the total land of the state. They stretch roughly north-south as parallel folds with altitudes varying between 2500 feet (762 metres) to nearly 10,000 feet (3048 metres), above sea level. They are part of Assam-Burma Tertiary ranges, which sweep in a long curve from the north eastern corner of Assam to cape Negrais in Burma. In this state they enclose the central plain or the valley of Manipur. It is a small high-level plain at an altitude of about 2600 feet (792.4 metres), high enough, to draw attention, in such a mountainous country.

The whole of Assam-Arakan Tertiary belt has undergone strong folding, and long anticlinal axes can sometimes be followed for many miles, the more sharply folded ones being associated with thrust faults trending more or less north-east and southwest. Though some anticlinal crests remain intact at the surface, they have usually proved to have been removed at depth by thrusting.¹⁰

In the hills between Manipur and Cachar, folding is more dominant than faulting and asymmetrical anticlines separated by broader synclines are more prevalent.\textsuperscript{11} The whole appearance of the mountain belt is, "A succession of long parallel ranges separated by deep valleys, still further south, the whole belt gradually narrows forming the Arakan Yomas."\textsuperscript{12}

All along the eastern part of Manipur through which runs the Indo-Burma border, there are series of parallel ranges through which the rivers have, in places, cut transverse valleys.\textsuperscript{13}

The mountain ranges have occasional connecting spurs and ridges of lower elevation between them. Their greatest altitude is attained to the north near Nagaland-Manipur border, close to Mao. The highest point in this tract is Mount Japvo, 9892 feet (3015.08 metres) above sea level. The Japvo range throws out numerous spurs towards the east and west. From this point southwards there is a steady decrease in the height of the hill ranges. "The general aspect of the hill ranges is that of irregular serrated ridges, occasionally rising into conical peaks and flattened cliffs of bare rock."\textsuperscript{14}

\begin{itemize}
\item \textsuperscript{11}Ibid., pp. 98-99.
\end{itemize}
The topography in general is very rugged with the hills rising to five thousand feet (1524 metres), on the average, above sea level. The important ranges to the east of the valley of Manipur are: Sarameti, Somrat, Kassom, Nupitel or Mapethe and Yomadung. The ranges to the west are: Nungjaibung, Kalanaga, Chakka Wungba, Kaupum (a spur from Laimatol) and Kopru Laimatol. The prominent peaks are: Tenipu 9824 feet (2994.36 metres), Koubru 8404 feet (2561.54 metres), Iso 8070 feet (2459.74 metres), Khayangbung 9295 feet (2833.12 metres), Siroi 8425 feet (2567.94 metres), Kachoobung 8195 feet (2497.84 metres), Leikot 9290 feet (2831.59 metres) and Tampaba 8412 feet (2563.98 metres) above sea level. The topography is accentuated by the action of a network of rivers and rivulets. The whole area is converted into one of steep slopes.

The central plain or the valley as already stated, is the most striking topographic feature in a mountainous country like Manipur. It is roughly oval in shape and irregular in outline. It is about 36 miles (57.92 kilometres) from north to south, and about 20 miles (32.19 kilometres) from east to west, where it is broadest. It is a flat plain surrounded by mountains. The plain extends right up to the foot of the mountain range, where the slope abruptly changes. The plain slopes from north to south. In the northern part it rises above 2750 feet (838.2 metres) above sea level. In its southern part it is slightly less than 2800 feet (792.48 metres) above sea level (Map 5).

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It is comparable to an oblong shallow saucer, the lowest part of which is formed by the Loktak lake. The plain, however, is dotted by a few hills like Chingmeirong, Langthaban, Waithou, Langathel etc. The prominent hills projecting above the water of Loktak lake are Karang, Thanga, Ithing, Sandra etc. There are a few small mounds like Pishum, Chinga, Nongmeibung, Lalambung etc. They are less than 500 feet (152.4 metres) above the surrounding plain.

III. DRAINAGE AND RIVER VALLEYS

The state lies in the catchment area of two river systems namely the Ganga-Brahmaputra and the Chindwin-Irrawaddi. The tract of land between the plains of Cachar and Manipur forms the catchment of the Barak river. The water-parting is marked by the Japvo-Barail range on the north, roughly along the boundary between Manipur and Nagaland up to Mokokchung. The first range, west of the central plain, acts as the water-parting of the Barak river. Further south, the water-parting is marked in Mizoram. Nearly half of Manipur lies in the Barak catchment.

The eastern half of Manipur including the central plain lies in the catchment of the Chindwin-Irrawaddi system. The water-divide, on the north is formed by the eastern spurs of Japvo east of Mao, which itself is situated on the divide, with land sloping to the north as well as to the south. The drainage to the north finds its way to Brahmaputra through Dhansiri river. The rivers flowing to the south, whether passing through the central plain or through the eastern hills, are tributaries of Chindwin in upper Burma.
In general the rivers occupy parallel valleys, separated by parallel ranges, except where they have cut transverse valleys. The rivers have very narrow 'V' shaped valleys, so that, more or less, a regular slope could be followed from the mountain crest to the valley bottom. It is only in some cases, where, the rivers have begun to develop flood plain, one comes across a narrow bending strip of level land.

Almost entirely in the Assam-Arakan mountain belt one finds anticlinal ridges and synclinal valleys. Strike ridges and strike valleys are very common. The cycle of erosion which started after the land was raised above sea level due to orogenic activity, contemporary to the Himalayan orogeny, is in advanced stage of youth and is heading fast towards maturity. Hundreds of rivers gush through the hills, and the surface is being worn down very rapidly due to soft rock, heavy rain, depletion of natural vegetation and primitive method of cultivation.

The main rivers, draining into the Ganga-Brahmaputra system, include, the Barak and its tributaries. Barak is the biggest river of Manipur. It rises in the northern range, about 10 miles (16.09 kilometres) east of Mao and follows a southwesterly course. It crosses the Imphal-Dimapur road at Karong, and takes a bend towards north. Then it follows a westerly course till it reaches the northwest corner of the state. The river then debouches to the south and glides along the whole way up to Tipaimukh. At Tipaimukh it is joined by the Tipai river which flows northwards from Mizoram. Curiously enough, both the rivers come from exactly opposite directions, a feature very rare, if not impossible.
It is, however, to be noted that for a long distance the Barak flows east of Kalanaga range up to Tipaimukh. At that place it takes the sharpest hair-pin bend and flows along the western slope of the aforesaid range. The river follows a northerly course, which is just parallel, but in opposite direction to its course, east of the Kalanaga range. At Jirighat it is joined by Jiri river. From there, the Barak turns to the west and after many meanderings through the districts of Cachar, and Sylhet (in Bangladesh), it falls into the old bed of Brahmaputra near Bhairab Bazar.\footnote{B.C. Allen, Assam District Gazetteers, Vol. IX, Part II, Naga Hills and Manipur (Calcutta: British Baptist Mission Press, 1905), p.3.}

The important tributaries of Barak are Jiri, Tipai, Makru, Irang etc. The Jiri river originates in the Barail range and flows southward. The Makru river flows east of the Makru range. It flows nearly parallel to the Jiri river. It also rises in the Barail range near the water-shed of Assam and Manipur, flows southward and discharges its water in the Barak.

The Irang is the biggest tributary of the Barak. It rises west of Kairong, in the hills far to the northwest of Manipur valley. It flows towards southwest and receives numerous unnamed small rivulets. Two of its tributaries namely Iyii and Leimatak are of considerable size. The Irang follows a course roughly parallel to Barak and joins it at a place about 20 miles (32.19 kilometres) north of Tipaimukh.

The rivers of Manipur, draining into Chindwin-Irrawaddy system, carry the drainage of the eastern half of the state including the central
plain. They may be divided into the easterly and the westerly flowing streams. The main divide for these streams runs roughly north-south passing through Mao-Ukhrul-Tengnoupal-Laimaton hill.

The westerly streams are much bigger and more important since they pass through the central plain. They originate in the hills towards the north. Important among them are Imphal, Iral, Thoubal, Nambul etc. The Iral river rises about 15 miles (24.14 kilometres) east of Maram. The Thoubal originates in the hills near Ukhrul. These two rivers are important tributaries to Imphal river.

The Nambul river rises near Kangjupkhul and follows a course west of Imphal river. These two rivers pass through the Imphal town, and are hardly three furlongs apart, when nearest to each other in the town. They flow sluggishly through the alluvium of the central plain. The Nambul river and many small brooks join the Loktak lake, from where the combined water is drained into Imphal river through a short channel called Kordak. The Imphal river goes by different names such as Turel Achouba, Meitei Turel or Manipur river.

Manipur river does not fall into Loktak lake, since its bed is lower than the water level of the lake, rather it receives the excess water of the lake. The Khugai river takes its origin in the hills south of the Manipur valley, flows northwards and discharges its water in the lake. The Chakpi river rises in the hills southeast of Manipur valley and empties itself in the Manipur river.

The east-flowing rivers or the rivers draining the mountainous region of Manipur along the Indo-Burma border are many but of small size.
The YU river flows through Kabaw valley. Its tributaries are Tuyungbi, Taret, Lokchao, Lalim Lok, Thuidam etc. YU river is a tributary of Chindwin. The Chingai river and its tributaries drain the northeastern part of Ukhrul region and join the Chindwin river.

IV. IMPORTANT GEOMORPHIC FEATURES

Among some of the geomorphic features, may be mentioned, the transverse valleys that occur along the Indo-Burma border. Another feature of importance is the occurrence of flat topped ridges and smooth valley sides, widening out at the head in higher parts of Ukhrul area. This is an indication of the effect of glaciation in the past. Thus, Siroi gives the impression of a glacial peak.17

Still another important feature is the lines of low hills in the central plain, perhaps two or three. They are evidently the highest points of the range of which the bottom portion has been submerged in the alluvium. Such submerged ridges are parallel to the bordering ranges, suggesting that the formation of the valley was originally much the same as that of the surrounding hills and valleys. The hill ridges in the central plain are, however, considerably lower than those surrounding it. The submerged hills project above the plain as steep hills, almost bare of vegetation.

In the central plain, one finds another important feature, that is, a few patches of high level gravel deposits above the general

17 Kingdom Ward, Plant Hunter in Manipur (London: Jonathan Cape, 1952), pp. 70-86.
level of the plain. Such patches represent almost level ground, gently sloping down the valley. Their formation is closely connected with the formation of the central plain. They usually occur in small strips along the course of a few streams, and in some cases are high enough, about 100 feet (30.48 metres) above the level of the surrounding plain, so that the rivers cut across them. They can be seen near Sekmai, Kanglatongbi, Bishenpur etc. There is absence of terrace in them. Other high level deposits occur at the mouth of Thoubal river, before it enters the central plain; one near Sugnu and another at Chakpikarong. In the case of a few rivers too, this feature is common, but not in all. They show signs of rivial action in stratification and false bedding.\textsuperscript{18}

Another notable feature is related to the course of Manipur and Barak rivers. In all probability, the mountain ranges on the northern and eastern part of Manipur had come into being earlier than the ranges in the Mizo hills. The drainage then, found its outlet to the south through the rivers mentioned above.

At a later stage, probably, there was uplift in the southern part of Manipur and Mizo hills which caused the Barak drainage in this area to be reversed, compelling it to take a sharp bend in its course northward. This reversal of drainage in that area could be ascribed to uplift, where the Barak could not adjust itself to the rising land across its path.

The Manipur river, on the other hand could adjust itself, and maintained its course across the rising land to the south. This phase,\textsuperscript{18}

\textsuperscript{18}R.D. Oldham, \textit{op.cit.}, pp.234-235.
however, was not without its effects. It led to impounding of water and formation of a lake in its upper reaches, where we have the plain of Manipur today. It was followed by gradual silting up of the lake and the formation of a plain.

V. PHYSIOGRAPHIC UNITS

The state is a geographical unit, very well-defined and demarcated by geographical features like water-partings, river courses and foothills. It may be broadly divided into two physiographic units, namely the hill tract of young, unconsolidated sedimentary rocks and the small central plain of recent alluvial filling.

The hill tract is an area of sharp relief. It is badly dissected by rivers. Some of the big rivers have started flood plain formation, only in a limited sense; otherwise there is absence of level land. At many places one comes across bare rocks on the surface, devoid of vegetation.

This area, however, is important from the point of view of economic geography. Because of its dissected character, specially the rivers being entrenched among the mountain ranges, there is possibility of multi-purpose projects. Besides, there is likelihood of mineral deposits of economic value. And, there is a lot of forest wealth.

The small central plain covers about 8 per cent of the total geographical area of the state. It is significant in the economic geography of Manipur. Its level land and rich fertile soil have proved
conducive to agriculture since early times, and its topography, amenable to easy communication, has attracted human settlement.