1.

CHAPTER I
INTRODUCTION

AREA, POSITION AND UNIFYING FACTORS

The Mayurakshi river basin lies between latitudes 23°38'00" N to 24°38'00" N and longitudes 86°50'00"E to 88°12'49"E covering an area of 3351.87 sq. miles (8681.27 sq.kms). The river basin being one of the western tributary basins of the Bhagirathi-Hooghly river system, shares the parts of both states of West Bengal and Bihar. The Western part of the basin is included in the geomorphic provinces of the Chotanagpur plateau. This is a part of the administrative district of Santhal Pargana of Bihar. The region lying to the east of the basin is a part of the Bengal basin included in the administrative districts of Birbhum and Murshidabad of West Bengal. Between these two lies the plateau fringe area which is a part of Birbhum district (fig. No. 3).

"The highlands of Chotanagpur is the eastern most continuation of the Indian peninsula" (fig. no. 1). It is a topographical continuation of the Satpura, although their geological history is different.  

The western part of the study area is partly occupied by the Rajmahal hills - the north-eastern tip of the Chotanagpur plateau. The Assam plateau is also a part of the peninsular block, though it is separated from the peninsula by the Malda gap.  

Fig. 2
LOCATION OF THE
MAYURAKSHI RIVER BASIN
IN INDIA

THE BASIN

SCALE
0 200 400 miles
0 322 644 kms
2.

by the Ganjetic plain. The southern limit of the Rajmahal hills is the Brhamani river. This highland consists of a number of lava plateaus and residual hills.

To the south of the Brahmani river the granitic-gneissic floor of the Chotanagpur plateau is exposed. This ancient landmass includes a variety of landscape units. Unhindered erosion has exposed the granitic-gneissic cores, while uplifts, tilting and warping have caused rejuvenation initiating new cycles of erosion. Being a part of the peninsular India, it suffered from upper-carboniferous crustal movements which manifested themselves into block type of earth movements developing tensional cracks and subsidence forming Gondwana basins.¹ The outpouring of the Rajmahal lava during the upper Gondwana period is remarkable episode in the geomorphology of the area. During the end of the Mesozoic and the commencement of the Tertiary era, a conspicuous revolution of the land and sea was initiated and culminated in the uplift of the Himalayan orogeny and severing of the Indian Peninsula from the Indo-African continent. These are responsible for the uplift and tilting of the Chotanagpur area. Rajmahal has formed a hinge zone, tilting to the north and east developing the western and south-western scarps of the Rajmahal highlands. These events - lava flows, uplift, tilting and erosion - all of which are related with Indian peninsula is general and Chotanagpur in particular, have their imprints upon the geomorphology and drainage network of the area concerned.

¹. ibid.
FIG. NO. 3
LOCATION OF THE BASIN OF THE RIVER MAYURAKSHI IN WEST BENGAL & BIHAR

[Map showing the basin of the River Mayurakshi in West Bengal & Bihar with labels for Sikkim, Nepal, Bhutan, Assam, Bihar, Orissa, Bangladesh, and the Bay of Bengal.]
Between the Gangetic plain to the east and Chotanagpur plateau to the west there is a belt of country sloping eastwards. This may be called the plateau fringe area which has come into existence at the expense of the Chotanagpur plateau. This area testifies prolonged erosional processes as controlled by the base level of erosion.

The eastern part of the basin comprises of a part of the Gangetic plain. Approximately to the east of 87°E longitude the Arehean basement complex disappears below the Gangetic alluvium. Geology of this part of the basin was unknown until recently till the extensive subsurface investigation in connection with the exploration for petroleum. Geophysical evidences show that the Bengal plain or Bengal delta is a thick overlay of sediments of the Garo-Rajmahal gap which separated the Archaeonian surface of Assam hills from the Deccan shield. This Garo-Rajmahal gap surely formed a landmass for a long time. "This is, however, no geophysical evidences to help us to ascertain the exact date until which the Garo-Rajmahal saddle remained a part of the ancient landsurface of Bengal."

The geophysical data available from the drilling operations of standard vacuum and oil company states that from late cretaceous to pleistocene period marine transgressions and regressions took place repeatedly over the Bengal basin and deposition occurred under marine, estuarine, brackish and marine environment.

3. Ibid.
Between the Archacean shield and the Gangetic plain lies the plateau fringe area which is comprised of lateritic formations. "In fact along the eastern margin of the Deccan Shield we can see lateritic terraces". This lateritic Rush tract was the first deltaic landform developed in the miogeosyncline of the Naga-lasai orogen.

In both the deltas - in the first deltaic landform, i.e. the delta of the Mayurakshi and the Bhagirathi delta, delta building process is now stopped and the process of floodplain formation is active.

The present basin provides a wide range of study due to its complicated geophysical history and geomorphological problems. Being parts of two geomorphic units, it cannot escape from the events that took place during the evolution of the Indian peninsula and the Gangetic plain. Within the study area, there are great inequalities in terms of rock formations, type of earth movements, drainage patterns, altitude of hillocks and geomorphic surfaces. Only further detailed study and field investigations of the area can facilitate advancement of the proper interpretation of the morphology of the area.

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2. Ibid.
PREVIOUS WORKS

The Mayurakshi drainage basin located in part of the Chotanagpur plateau and Gangetic plain has attracted the attention of the eminent geologists and experts of various disciplines. But detailed study of geomorphology was few in number. The mineral wealth of the Chotanagpur has attracted the geologists and the possibility of the existence of petroleum caused a detailed study of the Gangetic alluvium of the Bengal basin.

The detailed geological mapping by G.S.I. was carried out originally on one inch to one mile topographical sheets as the fundamental basis of the work. Scales of geological maps varies from one inch to a mile to thirty two miles.

The first detailed study of the area is by V. Ball (1877). His study of the geology of the Rajmahal hills has given us a detailed idea of the rock formations, structure and geological history of the Rajmahal hills. 'The manual of the geology of India and Burma' provides a good knowledge of this part of the Chotanagpur plateau. Although the study of Wadia and Krishnan have outlined the structure in a consistent manner. But all these studies are mainly on the geological aspect and they have worked

as geologists rather than geomorphologists. In recent years there is some advancement in the study of the geomorphology of the Chotanagpur area. The first credit goes to Chatterjee S.C. in his work on the Ranchi Plateau.¹ He has also discussed the evolution of the physiography of the Chotanagpur in general.² A detailed study of the geomorphological evolution of the Chotanagpur has been attempted by Singh, R.P. (1969).³ In addition to the Chotanagpur hills he made a detailed analysis of the geomorphology of the Rajmahal hills - its structure, tectonics and erosional history and above all the evolution of the drainage pattern.

On the other hand the study of the geomorphology of the Bengal basin has been carried out by another group of geologists which has opened the field of the study of the area concealed below the Holocene alluvium. Sengupta, S (1970)⁴ in his paper 'Geology of the Southwestern Bengal' assessed the evolution of this part of Bengal with the help of bore hole data. This author in his another paper has analysed the geomorphology of


The first reference of the drainage system of the basin comes from the map constructed by Rennell (1779) from which we can ascertain the change of the river direction. Hunter, W.W. (1877) also attempted to sketch the hydrological system of the river basin. Sen Satyakam (1956) has done a pioneer work on the geomorphology of the Central Mayurakshi basin — its physiographic divisions and the evolution of the drainage system.

Many other authors have analysed the geomorphology of the Chotanagpur plateau which are of great value to ascertain the physiographic evolution of the study area. Among them the works of Singh, S (1977), Mukhopadhyay (1980) are notable.

4. Rennell (1779) — 'The Jungletery Dt. with the adjacent provinces of Burbhoom, Rajemal, Boglipour and comprehending the countries situated between Murshidabad & Bihar.
5. Hunter, W.W. (1877) — 'Statistical account of Bengal (Santhal Pargannah, Birbhum and Murshidabad).
METHODOLOGY

In this study, the author has attempted to evaluate the systematic geomorphology of the Mayurakshi river basin. The evolution of the drainage basin over the Archaean complex through the long geological ages has given rise pronounced erosional features with the development of a number of erosional surfaces with breaks of profiles followed by the younger Tertiary deposits of the depositional plains in the east. Therefore the study of the essential elements of the Mayurakshi river basin is comprised of the study of the (a) physical background of the area, i.e. the geology, relief, drainage, climate, soil and natural vegetation, (b) identifications of the geomorphic processes and forms, (c) drainage network analysis, such as, drainage pattern, ordering of streams and study of the geometry of the channel characteristics like channel pattern, sinuosity indices, cross sections and long sections and also the evaluation of the hydrological characteristics of the rivers based on the available data of selected sites only and (d) detailed morphometry of the area for the quantification of the relief and slope.

The Chapter I on Introduction introduces the position, extent and the geomorphic personality and relation of the Mayurakshi basin with the rest of the Chotanagpur plateau and Bengal basin.

In Chapter II on physical settings the author attempts to analyse the details of the physical parameters of the basin as already stated along with an introduction to the recently
implemented Mayurakshi river valley project from all the available published and unpublished works and intensive field work. In this chapter the author has endeavoured to assess the role of the above mentioned parameters on the geomorphic forms and processes.

In Chapter III on Geomorphic processes and forms, the role of the geomorphic processes has been assessed followed by the detailed evaluation of the land forms. On different geological formation of this polygenetic landscape different geomorphological processes have operated with the resultant effect of the association of some geomorphic features known as land systems.

As the fluvial processes predominate over the region and drainage basin has been taken as the unit of investigation the drainage network system provides the main clue to the investigation of the geomorphology of the area concerned. The evolution of the drainage basin, the ordering of the streams and the drainage and channel patterns are analysed in ch.IV which are the key to the understanding of the fluvially eroded landscape.

In Ch.V, in order to reveal the characteristics of the landscape, different morphometric techniques have been employed for the quantitative assessment of the different aspects of the landscape, e.g., relief, slope and drainage. These indices have been assembled and processed according to requirements in order to evaluate the main landscape units - the erosional surface, the fringe surface of both erosion and deposition and the depositional surface. Thus some significant conclusions regarding the
the geomorphic evolution such as the number of erosion surfaces, form elements of the landscape and possible causes of their evolution have been derived.

Finally, in Ch. VI, the impacts of geomorphology on agricultural, mining and quarrying, dam construction, soil erosion and conservation have been assessed.

The study thus carried on, is based on available data and empirical observations. Most of the data and informations were collected from Government publications, records, memoirs etc. specially those of Survey of India, National Atlas and Thematic Mapping Organisation etc.

The author in the study of this basin had to depend primarily on the one inch to one mile survey of India topographical sheets to delineate the drainage basin and to conduct contour and drainage analysis which provided the basis of the morphological and morphometric evaluation. The geology of the basin has been studied in details by critical appraisal of all the published works, i.e. records, memoirs, monographs, journals of the G.S.I. and consulations of both the published and unpublished geological maps; These detailed studies on the geology, relief and drainage paved the path for the macro and micro geomorphic subdivisions of the basin. Field work has been carried on in order to identify the erosional and depositional geomorphic forms, eg., terraces, floodplains, bad land topography etc. These were both identified and measured with the help of dumpy level. Thus the field investigation has come to the aid of the geomorphic mapping.
Apart from the field work several techniques were followed for morphometric and statistical analysis.

Already it has been stated that the study of climate is necessary to an understanding of the geomorphic processes. For this purpose, climatic data depicting temperature, precipitation, evaporation of different stations of the basin have been collected from the records of Indian Meteorological Department, Alipore. From the analysis of five yearly moving average of rainfall, simple monthly average of rainfall and temperature, spatial distribution of average rainfall, temperature range, evaporation etc. we get an idea of the impact of climate on the present day distribution of geomorphological processes in different terrains of varying lithology and structure.

The study of weathering profiles, laterisation, the distribution of soil types, soil catena etc. are done on the basis of the data available from the Department of Agriculture, West Bengal and the Rajendra Krishi Mahavidyalaya, Bhagalpur.

The data for hydrological analysis, ground water table and natural vegetation have been collected from I. & W Department of West Bengal, Central Ground Water Board of Calcutta and Forest Office of Birbhum respectively.

Several common techniques have been adopted to depict the main aspects of the morphometry of the basin, i.e. slope, altitude, relief, profiles and textures of dissection. Different profiles like serial, superimposed, composite and projected profiles are drawn on the basis of one Inch Survey of India toposheets. The Grid map with a mesh area of one sq. mile
(2.59 sq. km.) is drawn for the collection of data for the preparation of different morphometric maps and diagrams which constitute the most detailed original morphometric work by the author of the study area. These data have been used for further statistical analysis such as bi-variate correlation for obtaining linear regression and correlation co-efficient. Computed long profiles of the Mayurakshi and her tributaries have drawn which help the understanding of the nature of the development of erosion surfaces in accordance with the number of occurrences of major erosion cycles.

Finally the morphometric attributes have been identified, correlated and finally synthesized in order to delineate the morphological units of the Mayurakshi basin. As only the slope, relief and amount of dissection are not adequate enough to provide the basis for the fuller understanding of the terrain, therefore some aspects of soil, geology, natural vegetation and geomorphic processes have also been utilised to find out the macro and micro divisions of the study area.

As the geomorphology has large impacts on both the socio-economic and physical conditions of the basin, some observations on the impact of geomorphology of the basin on agriculture, dam construction, soil erosion and conservation, mining and quarrying have been made.

Though the data is scanty and not always reliable, all possible attempts have been done to analyse the geomorphology of the Mayurakshi river basin.