CHAPTER I

INTRODUCTION

Prologue :

The majestic Himalayan ranges have, for more than a century, attracted geologists from all parts of the world. They have tried to piece together its geology and solve the multitude of problems posed by varied lithology and complex structures. The pioneering investigations in these ranges were conducted largely by the officers of the Geological Survey of India. In recent years, the universities, government organisations and some geologists from abroad have contributed substantially to our knowledge of the Himalaya. The difficult terrain, inaccessibility of many areas and lack of even basic facilities have proved to be major deterents to systematic investigation with the result that the information available regarding many regions is fragmentary. A case in point is the Kumaun Himalaya. The Nainital-Ranikhet-Almora tract of this region (Fig.1.1) has received considerable attention and a fairly large number of research papers have been published on its geology. However, the region immediately to its west remains largely unmapped. Investigations to fill in this lacuna in the geological map of the Kumaun
Fig. 1.1: Index map showing location of Tota Am area
have been undertaken only very recently.

**Previous Work:**

The Lesser Kumaun Himalaya forms one of the better known regions of the Himalayan ranges. The pioneering work in this region was carried out in the nineteenth century by Strachey (1851), Oldham (1883), and Middlemiss (1887, 1890). The most significant contributions were, however, made only in the twenties and thirties of the present century through the work of Pilgrim and West (1928), Auden (1934, 1937) and Heim and Gansser (1939). Their outstanding studies have provided the basis for the more detailed investigations which were undertaken in the Nainital-Ranikhet-Almora Region (Fig. 1.1) after the Second World War. The geological setting of this part of the Kumaun Himalaya has been described in some detail by Gansser (1964) and generalised geological maps have been prepared by Heim and Gansser (1939), Pande et al (1963), Tewari and Medhi (1964), Raina (1972) and Misra et al (1973).

The region to the west of Nainital, including the area covered by the present investigation, has received scant attention. Sahni and Mathur (1964) have briefly referred to the Ramnagar area in their review of Siwalik stratigraphy. Preliminary sedimentological studies on the Siwaliks of this area have been carried out by Tandon (1971, 1972a, 1972b), the present writer (Soman, 1973) and Prakash et al (1974). The distribution of lithological
units in the northern part of the area under study has been outlined by Srivastava (1972) and Singh and Mohanty (in Balasundaram, 1973). They have, however, not given any geological maps. Recently, an attempt has been made by Rao et al (1973) to interpret the structure of the sub-Himalayan belt around Ramnagar.

Other important structural, stratigraphic and petrological studies on the Himalayan region, which have a bearing on the present investigations, are given at relevant places.

Object of the Present Investigation:

This investigation forms a part of a comprehensive scheme for the study of the petrology and structure of the western Kumaun Himalaya undertaken by the Geology Department of the University of Poona. It was undertaken with the object of:

1) delineating the different lithological units in the largely unmapped western parts of the Almora and Nainital districts, Uttar Pradesh;

2) conducting a detailed study of the Siwalik rocks in order to determine their provenance and environment of deposition;

3) describing the various lithostratigraphic units of the Krol 'nappe' occurring in the area under study, determining the environmental conditions under which they were deposited, and correlating these units with the lithostratigraphic units of the type area; and

4) carrying out a structural study of the area and reconstructing its structural history.
Location and Communication:

The area under study, about 240 square miles in extent, forms a part of the Nag Tibba range of the Lesser Himalaya. It is included in the one inch topographic sheets No 53 0/2 and 53 0/3 of the Survey of India. Bounded by latitudes 29° 23' 00" N and 29° 45' 00" N and longitudes 79° 00' 00" E and 79° 15' 00" E, it covers the western parts of the Almora and Nainital districts in the Kumaun division of Uttar Pradesh, India (Fig. 1.1). The biggest township in the area is Ramnagar situated in the Bhabar belt near the southern boundary of the area. It is a railway terminus of the North Eastern Railway.

A metalled road connecting Ramnagar to Ranikhet provides the main means of communication in the southern part of the area. The northern part of the area is served by two fair weather roads. One runs along the western margin of the area and connects Ramnagar with the Gharwal region of Uttar Pradesh; the other runs approximately north-south along the central part of the map area from Sankar to Manila. To the west of the area is the Corbett National Park. The villages in the area are connected by mule tracks and footpaths. Most of the villages are small settlements consisting of a few huts each. The locations of the important villages are shown in the locality map (Fig. 1.2).
Fig: 1.2
PHYSIOGRAPHICAL AND
LOCALITY MAP OF
TOTAAM AREA
ALMORA AND NAINITAL
DISTRICTS,
UTTAR PRADESH
Physiography:

The area covered by the present investigations includes the talus covered fringes of the Gangetic plains known as the 'Bhabar', the densely forested Siwalik foothills, and the ranges of the Lesser Himalaya. The Bhabar belt occupies the southernmost part of the map area and is constituted of thick Quaternary alluvial fans which are cut by a number of rivulets. The general elevation of this belt is about 1,500 feet. The Siwalik hills, constituted mainly of sandstones, form the low ranges fringing the Bhabar belt to its north. The ranges trend approximately WNW-ENE and are cut by the river Kosi and its tributaries. Two prominent ranges of the Lesser Himalaya, having a general E-W trend, occur in the central and the northern parts of the map area. The southern of these two ranges, known as the Bhaunikhal range, is constituted mainly of quartzite and extends from Semalkhet in the west to Deokhand in the east. It forms the divide between the Kosi and Ramganga valleys. The water divide occurs at an altitude of approximately 5,000 feet, the highest point being 5,212 feet near Bhaunikhal. On the northern flanks the range exhibits steep scarps along the river Ramganga. The northern range occurs along the northern margin of the map area and is here designated as Manila range. It has an average height of about 5,000 feet and the highest point at Manila is 6,215 feet. Between
these two main ranges there are a number of secondary ranges which emanate from the Manila range and extend in approximately N-S directions up to the Ramganga river. These ranges are locally known as Adali-, Pingoli-, Paisiya- and Korela range and are separated by approximately N-S trending valleys respectively called Patlion-, Badangarh- and Nair gadheras. The average height of these ranges is about 4,000 feet and the highest elevation on each range is approximately at 5,200 feet (Fig. 1.2). An idea about relief can be had from Plate 1, Photo 1.

The two important rivers in the area are the Kosi and Ramganga. In the central part of the map area the Kosi has a WNW-ESE trend and separates the Siwalik ranges from the Lesser Himalaya. In the western part of the map area, near the village Mohan, it takes a knee shaped bend and cuts through the Siwalik hills before dissipating in the Gangetic plain. The important tributaries of the river Kosi are Pipalia sot and Tehra gadhera which have an approximately E-W trend and join the river Kosi near Dhikuli and Ramnagar respectively. The Ramganga river flows N-S for a considerable distance before entering the area covered by the present investigations near Dugoli. It then flows SSW up to Shatol where it is diverted to the west by the Bhaunikhal range. It follows a general meandering course and goes out of the map area near Jamira on the western margin. The main tributaries
of the Ramganga river flow along the Patlion, Badanagarh, Nair and Gabhini gadheras, which have a general N-S trend.

Field Work:

The field investigations were carried out by the author during the summer and autumn months of 1971 and 1972. In all, the author spent about four and half months in the field mapping the different lithological units and collecting data on the different structural elements.

The geological mapping was carried out on Survey of India topographic sheets of 1 inch = 1 mile scale. Initially, preliminary traverses were taken along the three main roads and some mule tracks. Later, detailed mapping and collection of structural and sedimentological data was undertaken during the course of short traverses across the general strike of the formations. About 400 rock samples, including about fifty oriented specimens for petrofabric and palaeocurrent studies, were collected.

Laboratory Investigations:

The various laboratory techniques adopted during the present investigation are enumerated below. The details regarding the procedures followed are given at relevant places in the text.

About 300 thin sections were prepared for microscopic examination and subjected to detailed petrological and mineralogical studies. Modal analysis of the different rocks was carried out with the aid of a mechanical stage.
and point counter. The modes were determined on the basis of approximately 3000 counts per thin section. The optic angles and extinction angles of minerals were determined on a four axes Universal stage. The anorthite content and twin laws of plagioclase feldspar were also determined on the Universal stage according to Slemmons' (1962) method.

The grain size distribution of Siwalik rocks was determined by sieve and pipette analysis using standard sedimentary procedures. In the case of quartzites from the Krol belt the grain size distribution was determined from thin sections. For shape analysis of the Siwalik sandstones the outlines of the individual grains were drawn with the help of a camera lucida; the various dimensions of the grains were then determined with the help of a scale and the radii were measured with a transparent 'Wadell's Circular Scale'. In the case of the Siwalik conglomerates shape analysis was based on measurements of the three principal dimensions of the individual pebbles. For heavy mineral analysis the rocks were disaggregated, sieved, panned and the heavy minerals were separated using bromoform. Paleocurrent directions were determined from microscopic grain orientation measurements made on thin sections cut parallel to the bedding planes of oriented Siwalik sandstones. Clay minerals in the -4μ fractions were determined by X-ray diffraction method.
Mesoscopic structural data collected during field investigations, and data on the orientation of \( c \) axes of quartz grains determined by Universal stage procedures, were plotted on equal area net to obtain fabric diagrams.
Photo 1: View of the Lesser Himalayan Ranges in the northeastern part of the Totapuri area taken from near Thakuli village. The Nair gadhera is seen in the foreground and the Manila range in the background.