INTRODUCTION

THE VINDHYAN "SYSTEM"

The ancient unmetamorphosed sediments of possibly Purana (Proterozoic) age constituting the Vindhyan "System" (or more correctly Vindhyan Supergroup as discussed elsewhere) occur in a large arcuate belt, roughly 104,000 sq km in area, situated along the northern periphery of the Indian Shield (Fig. 1). They are flat-lying or nearly so almost throughout the basin except along some zones of structural disturbance especially at the basin margins. The Vindhyan sequence rests on the structurally disturbed and metamorphosed Archean and older Purana (Bijawar and Gwallor) rocks with a marked erosional unconformity. The sequence is conformable throughout its great thickness (over 4,200 m) save for some local unconformities at different horizons, and is divisible on lithologic basis into four units, namely, Semri, Kaimur, Rewa and Bhander in the ascending order. The Semri, also referred to as the "Lower" Vindhyan, is mainly constituted of fine clastics and carbonates, whereas the upper three units (Kaimur, Rewa and Bhander), known collectively as the "Upper" Vindhyan, are formed of alternate sandstone and shale horizons and contain generally one carbonate horizon of significance.

The attempted correlation of Vindhyan rocks with sequences of
known ages on the basis of doubtful criteria (such as colour, composition and presence of some structures, both organic and inorganic) and the absence of definitive fossils in them led various workers to suggest highly variable and contradictory ages for them, ranging from Upper Pre-Cambrian to late Paleozoic (see Srivastava, 1966 and Misra, 1969 for a critical review). The Vindhyans are now believed to be 1400 to 900 m.y. old on the basis of radiometric dating by Vinogradov et al. (1964). According to Crawford and Compston (1970, p. 368), the age of the Vindhyan System "extends over a very long period from at least 1200 m.y. and possibly 1400 m.y. to perhaps 550 m.y. or even later".

Attempts to interpret the broad depositional environment and/or paleogeography of the Vindhyan basin were made by Wyllet (1869), Vredenburg (1906), Auden (1933), Sahni (1941), Krishnan and Swaminath (1959), Ahmad (1962) and Misra (1969). Truly sedimentological investigations involving the study of sedimentary structures, paleo-currents, and depositional environments of small detached parts of the Great Vindhyan Basin commenced in the mid fifties of this century (Mathur, 1955, 1965; Awasthi, 1961, 1964; Basumallick, 1961, 1962a, 1962b; Misra, 1961; Misra and Awasthi, 1962; Banerjee and Sen Gupta, 1963; Banerjee, 1964; Lahri, 1964, Jafar et al., 1966; Mishra, 1967; Bhattacharya, 1969; Bhardwaj, 1970). These studies indicated that the Vindhyan rocks were deposited mainly in a nearshore marine and fluvio-deltaic environment. Howsoever creditable these efforts may be, much more integrated work employing latest sedimentological techniques
is needed to cover the entire Vindhyan basin and evolve an overall sedimentary model for it. Profuse development of several kinds of sedimentary structures, varied lithology, unmetamorphosed nature, sub-horizontal disposition, and large outcrop area make the Vindhyan sequence ideally suited for studying the sedimentary process-response phenomena in ancient sediments.

CHOICE AND LOCATION OF INVESTIGATED AREA

The huge crystalline massif (Bundelkund granite) located in the northern part of central sector of the Vindhyan basin divides it into two portions, a western and an eastern. The rather inaccessible western portion has received far less attention of previous workers than the eastern one and, therefore, the Department of Geology, Aligarh Muslim University, took up its systematic sedimentological investigations since 1965. The present investigation of the Bhander Group succession in the Mandalgarh-Singoli area is a part of the same programme to study the western portion of Vindhyan basin in detail. The area investigated is critical since it lies adjacent to the Great Boundary Fault of Rajasthan which is supposed to denote the north-western limit of Vindhyan sedimentation.

The investigated area lies between the two Tehsil towns of Mandalgarh in Rajasthan and Singoli in Madhya Pradesh (Fig. 2). Apart from Bijolia located in the northeastern part and Begun in the
southwestern part, no other important habitation is present in the area. The area is spread over 1330 sq km and is delimited by latitudes 24°55' and 25°15'N and longitudes 75°00' and 75°25'E. Physiographically, the area consists of an arcuately trending shale scarp resting on a lower platform of carbonate rocks and capped by an upper sandstone platform (Bijolia platform of Heron, 1936). The lower platform occupies the northwestern, southwestern, and southern portions of the area and supports most of the population. The Bijolia platform lies towards the northeast and is very sparsely populated save for some cultivated area south of Bijolia. The area is accessible by road from rail heads at Kota in the northeast and Chittorgarh in the southwest.

AIM AND SCOPE OF INVESTIGATION

The present investigation mainly aims at constructing a depositional model for the uppermost stratigraphic interval (Bhander Group) of the Vindhyan succession in the study area. The constructed model is essentially a process-response model (Krumbein and Sloss, 1963, p. 236) and is largely based on the study of sedimentary characters like geometry, lithology, primary structures, and the lateral and vertical variations in these properties. This study also attempts to reconstruct the paleogeography and sediment dispersal patterns during the deposition of Bhander Group sediments.

Geological map of Bhander Group of the investigated area (Fig. 2)
was prepared on one inch to a mile scale by taking closely spaced traverses and using blown up Survey of India sheets 45 O/SW (1938 edition, half inch) and 45 P (1957 edition, quarter inch).

Stratigraphic sections of each constituent formation of Bhander Group were measured and studied in detail at several suitable locations to collect stratigraphic and sedimentologic information such as thickness, spatial relationship, lithology, stratification and internal structures.

Sedimentary structures, especially cross-stratification and ripple marks, were studied in respect of their scalar and vectorial properties. A total of 3594 cross-stratification azimuths and 68 ripple asymmetry azimuths were recorded. Another structure of one-way directional significance, asymmetrical current-drag fold, provided a total of 22 azimuths. Two-way directional structures such as symmetrical ripple marks, parting lineation, rill marks, etc. yielded a total of 690 azimuths.

Petrographic studies were carried out on sandstone and carbonate samples collected during traverses. Since the sandstones of the study area are highly indurated, their petrographic characters such as grain size, grain roundness, mineral composition, and diagenesis were studied in a total of 200 thin sections. It was not considered necessary to study a larger number of thin sections of sandstones in view of the very little inter-sample variability in
textural and compositional characteristics due to their super-mature nature. The texture, composition, and diagenesis of the carbonate rocks were studied in 160 thin sections. This detailed thin section analysis helped in the recognition of several carbonate micro-facies which were found invaluable in the interpretation of sub-environments.

The results of the above mentioned investigations were integrated to set up a depositional model for the investigated rocks and to reconstruct the paleogeography, sediment dispersal patterns, provenance, and the broad tectonic setting during the deposition of Bhander Group.

ACKNOWLEDGEMENTS

The investigation was supervised by Dr. V.K. Srivastava, Reader, Department of Geology, Aligarh Muslim University, and the author is grateful to him for guidance at all stages of the work. The author is thankful to Dr. F. Ahmad, Head, Department of Geology, Aligarh Muslim University, for providing laboratory and library facilities. The author also wishes to express his sincere thanks to his colleagues, Dr. S.M. Cashyap, Mr. Noman Ghani and Dr. S.M. Zainuddin for critically reading the manuscript and for preparing the photomicrographs. The assistance rendered by Messrs M.A. Raz, M.A. Khan, Salimuddin, and Habib Ahmad in typing the thesis and in the preparation
of drawings and photographs, etc. is sincerely appreciated.

Lastly, the author wishes to express his appreciation of the patience with which his wife and children bore the neglect due to long hours of work.