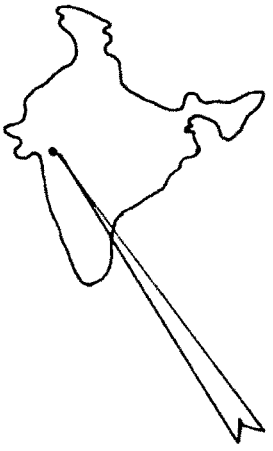
CHAPTER I

I N T R O D U C T I O N

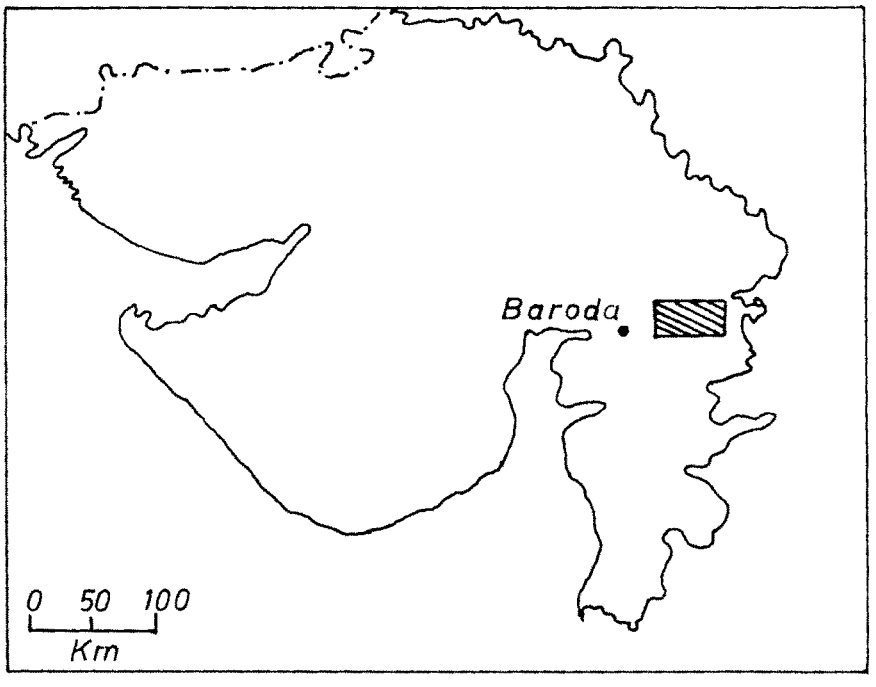
GENERAL

The Champaner Series is an important Pre-Cambrian formation of Gujarat, and consists of an interesting assemblage of varied meta-sediments. On account of the rich manganese deposits which they contain, rocks of this Series have attracted considerable attention in the past. As the approach of most of the previous workers was directly or indirectly related to the occurrence of manganese in these rocks, the Champaner Series was generally considered important on account of its manganese content only. Recent studies however, have shown that

Fig. 3



LOCATION MAP



this Series is much more interesting than realised and its stratigraphy, sedimentation, structure and metamorphism require special attention. The Champaner Series, in fact, is an important formation and its rocks reveal many vital facts of the Pre-Cambrian stratigraphy of Gujarat and Rajasthan.

The present study which dwells upon a large portion of the Champaner Series, was taken up with the above in view, and accordingly for these investigations, an area was selected which contained almost all important rock groups of the Series.

LOCATION

The study area comprising about 360 sq.km lies in the southern part of the Panchmahals district and includes the famous mining centres of Shivrajpur and Pani. The town of Shivrajpur is about 48 air km NE of Baroda (Fig. 3). The famous Pavagadh hill, known for its basalt flows and the rhyolite capping, lies on the boundary of the area in the NW. The granite hill N of Raypur village forms the NE corner of the area and marks the eastern-most limit. This hill is locally known as Makhania Dungar. Northern boundary passes just N of the

railway line joining Nathpura to Pani Mines. The southern limit of the area is marked by the village Malbar in the E and Bhamaria in the W.

PHYSIOGRAPHY AND DRAINAGE

The region could be divided into two main physiographic units which are closely related to and controlled by the lithology and structure of the geological formations. The south-eastern half of the area is hilly while the north-western portion comprises a gently undulating low lying terrain.

The hilly pattern is represented by flat-topped, sinuous ridges of metamorphic rocks. The hill ranges first appear north of Raypur in the NE corner of the area and run for about 7 km in a westerly direction like a huge wall. Composed of hard quartzites, this rampart like ridge has the maximum elevation of 420 metres above M.S.L. It is broken only at four places where gorges have been cut by north flowing streams forming water falls and rapids. To the S of this quartzite ridge is an elevated well-dissected plateau of softer metamorphic rocks. On this plateau are situated villages like Kevra (22°27':73°48'), Intvada (22°28':73°46'), Vadali (22°28':73°44'),

Poyelli (22°27':73°43'), and Ranjitpura (22°27':73°41'). All throughout its extension due W, this plateau is flanked by a quartzite ridge which steeply slopes down towards the southern plains. At those places where granite flanks the plateau (such as south of Intvada), it descends rather gently towards the granitic terrain.

Beyond the villages Dharia and Ghanta, to the W this ridge becomes rather sinuous and constitutes a rugged topography marked by zigzag hills. A conspicuous elliptical hill made up of quartzites lies to the S of these ridges (N of Narukot), beyond which lies a rather flat area. A ridge reappears a few meters S of Narukot and continues westward upto Bhamaria. This ridge forms the southern border of the area. The entire hilly terrain S of Dharia and Ghanta has an average elevation of 250 meters, the maximum height of 350 meters shown by a hill S of Poyelli.

The low ground is due to the presence of softer rocks like shales and phyllites. The ground is comparatively more flat and even in the W as compared to in NW and N.

There is only one big and perennial stream in the area, Dhadhar river which drains the NW part; originating

in the plains N of Surajpur, it flows southward. Rest of the streams are small and seasonal, going dry during the summer.

The drainage pattern on low grounds is rather dendritic, but in a broad way, the flow direction is towards the Dhadhar river to which most of them ultimately meet. The stream courses in the hilly terrain are dependent on the geological features, such as strike and dip of the strata, joints etc.

On account of the ruggedness of topography, and lithological and structural variations, the streams in hilly areas are seen to flow in all directions.

CLIMATE AND RAINFALL

Though the area is subjected to considerable variation of temperature, the climate remains healthy. It is pleasant during winter months (November to February), when the climate is dry and cool with maximum temperature reaching about 25°C. The summer season from March to June is dry and hot, and during this the temperatures as high as 43°C are recorded. Temperatures go upto 45°C to 46°C at times. Rainy season sets in with the break of monsoon in the last week of June or in early

July. During rainy season the climate is moist and relaxing. The annual rainfall varies from 750 mm (30") to 1000 mm (40") with the average of 860 mm (35") approximately.

VEGETATION

The area is marked by a considerably diverse vegetation. The hilly portions generally support moderately wooded jungles of mostly deciduous trees. A few evergreen trees are also met with on some hill tops and their slopes. Such forests grow on quartzitic and granitic tracts of the country. But there are also granitic outcrops which bear less vegetation and the land is rudely cultivated by local people for their usual food. Profusely growing trees are found in the forests of south-eastern corner of the area i.e. S of Narukot. On the other hand, the soil in the phyllitic areas appears to be fertile, many of the hill-tops being fully cultivated.

The flora of economic importance comprises Teak (Tectona grandis), Sal (Shorea robusta), Mahuva (Basia latifolia), Kahir (Acacia catechu), varieties of Eucalyptus and Mango trees. Teak seems to be prevalent throughout, growing profusely in quartzitic and granitic

areas, but it seldom attains a girth sufficient to form valuable timber. Also Sal and Kahir are useful as timber.

Mahuva thrives well in the low lying tracts of micaceous and granitic gneisses. Apart from its value as timber tree, its flowers from which an alcoholic liquor is distilled are favourite article of food of local inhabitants.

Mango and Tamarind are very common in village areas. Among others occurring around villages in plains are Eugenia Jambolana, Bor (Ziziphus jujuba) Nim, Banyan and Pipal.

Wild-date and Palmyra (Borassus flabellifer) also grow. These are the only two species of palms commonly noticed. Many varieties of cactus are grown as fences for farms and houses. The area is characterised by scattered patches and tracts of cultivated land either on hill-tops, or in the low-lying plains. The chief crops are wheat, Juar, Bajra (millets), maize, gram, cotton, Tur and oil-seeds. Chillies, turmeric, sugar-cane and rice are also grown on a small scale.

WILD ANIMALS

The wooded hill slopes and valleys afford favourable shelters for wild animals like hyaenas, bears, wolves and jackals. The tigers are only occasionally encountered. Poisonous snakes are quite common.

POPULATION AND HABITATION

The population is very thin and villages comprising of a few scattered huts are situated at wide distances. Almost the entire population is agriculturist, and sustains on annual harvest and animal products. All of them live in hardships, yet they are very kind and hospitable.

COMMUNICATION AND TRANSPORT

The highway that connects Baroda to Chhota Udepur via Halol and Bodeli runs NW-SE across the middle of the area. This road enters the area in the NW from Pavagarh and extends right across to Jambhugodha to the SE. The manganese-mining centre of Shivrajpur is situated on this route. Shivrajpur is also a railway station on narrow-gauge Champaner Pani Mines Section. Pani Mines is connected to Shivrajpur only by the railway line.

By road, it can be reached only via Jetpur situated to the E of area. Except for the highway, rest of the roads are only fair-weather cart tracks connecting most of the parts in the interior where traffic during monsoon is almost impossible. Numerous foot-tracks form a network throughout the area and afford easy accessibility to its various parts.

PURPOSE AND SCOPE OF INVESTIGATION

The present investigation was taken up at the instance of Prof. S.S. Merh, with a view to carry on a detailed and systematic study of the Champaner Series. The main objective of this investigation was to unravel the complex evolutionary history of the Series with special reference to its sedimentation, stratigraphy, deformation and metamorphism. The area mapped forms parts of Survey of India 1:63360 (1 inch) Topographical sheets Nos. 46 F/11 and 46 F/15. These sheets were photographically enlarged to the scales of 1:31680 (2" = 1 Mile) and 1:15840 (4" = 1 mile), and mostly the former scale was used for the purposes of mapping. In case when more details were required, 1:15840 (4" = 1 mile) enlargement was utilized.

The rocks encountered for the most part, comprise a folded and metamorphosed metasedimentary sequence

consisting of slates, phyllites, quartzites, mica-schists and crystalline limestones which have been invaded by granites. In general, the low cultivated plains show scattered outcrops and they are occupied by softer rocks like phyllites. Barring these low plains, the rest of the area the hilly terrains shows exposures in abundance. In most instances they are easily accessible. The lithological boundary between different rocks are quite often obscured by talus, debris, forest under-growth and soil. During and after the rains exuberent growth of tall grass, hides considerably the outcrops. Consequently, in many parts of these jungles, it is difficult to move about freely till the month of December or January.

The mapping for the most part, was carried out by traverse method. Traverses were planned to run both along and across the strikes of the sedimentary rock units. They were so designed as to reveal metamorphic variations as well. A number of special traverses were taken to delineate lithological boundaries on the map. In a number of cases, important exposures were studied in more detail and observations recorded on map sheets of larger scales. A systematic collection of representative samples, numbering 1000 was made. Exhaustive

and detailed descriptions of various field data were entered in the field diary. The field characters of the different lithologic units examined included modes of occurrence, structures (both primary and secondary) nature of variations in sedimentary rocks, field evidences of metamorphic changes and degree of metamorphism etc. Primary structures like sedimentary bedding, cross-bedding, graded-bedding, convolutions, ripplemarks, etc. were noticed. Deformational structures, preserved as folds, cleavage planes (metamorphic foliation), lineations, joints, faults etc. were also carefully recorded.

To support the field data, an intensive laboratory work was carried out. About 200 selected samples were analysed. 150 thin sections were critically examined under microscope for petrographic and structural details. Chemical analyses of 15 specimens was carried out, on the basis of which appropriate variation diagrams were prepared.

Different structural elements, planar and linear, were plotted on Schmidt's Equal Area Net.

The sedimentary aspects of different rock types have been described solely on the basis of the internal and external primary structures, gross lithology,

sedimentary petrological provinces or rock associations, etc. On account of recrystallization due to low grade regional metamorphism sedimentological studies were not possible. However a few samples of quartzites were subjected to thin section mechanical analysis.

BRIEF GEOLOGY

The rocks of the study area are regarded as the southern continuation of the Aravalli rocks of N Gujarat and Rajasthan.

The regional geological setting in which this Series occurs, will be clearly understood from the following succession:

Soils and alluvium	Recent - Sub-Recent
Pavagarh traps and associated rocks	Deccan Trap
Bhamaria Sandstone	Upper Cretaceous(Bagh beds)
----------Unconformity----------	
Intrusive granite	Post Aravalli
Champaner Series	Aravalli
----------Unconformity----------	
Basement gneisses, etc.	

Bhamaria sandstones of Cretaceous age overlie these metasedimentaries in the south-western corner of the area, while the granites that have intruded this Series, mostly occur in the SE. The author has classified the Champaner succession into three parts, separated by two unconformities (a disconformity and a paraconformity). The rocks of this Series comprise a wide range of lithological types - argillaceous, arenaceous and calcareous. The most striking rocks are those belonging to a graywacke suite, occurring almost in the middle of the succession.

The Champaner Series shows widespread folding on an EW axis and the various formations show a number of moderately tight angular folds whose axes plunge due WNW at gentle angles. Folds on all scales are encountered.

The rocks in general show a low grade of regional metamorphism.

The emplacement and intrusion of granite has resulted into very interesting phenomenon. Contact mignatization has given rise to augen-bearing gneisses near the contact with argillaceous rocks. Wherever the calcareous rocks have been affected by contact metasomatism, distinct skarn minerals have developed.

The superimposition of contact metamorphism on regionally metamorphed rocks is seen in the development of cordierite and andalusite bearing hornfelses at a number of places along the granite contact.