CHAPTER - III

T O P O G R A P H Y

PHYSIOGRAPHIC DIVISIONS

Division 1 NORTH EASTERN ROCKY TO ALLUVIAL UNDULATING TERRAIN (N. OF NARMADA)

2 SOUTH EASTERN RUGGED BASALTIC HILLS (S. OF NARMADA)

3 THE UPLANDS (SOUTH OF NARMADA)

4 THE COASTAL PLAINS (SOUTH OF NARMADA)

PHYSIOGRAPHIC DIVISIONS

The study area provides a striking diversity of relief in terms of ridges, hills, dissected plateaux, uplands, valleys, flood plains and coastal plains. The entire topography of the study area is essentially controlled by the extensive occurrence of volcanic rocks, the rugged hilly terrain of the east, both to the north and south of the river Narmada. In general, from east to west the entire landscape can be divided into two main types viz. (i) the hilly trappean area to the east and (ii) the rocky/alluvial uplands and coastal plains to the west. The river Narmada crosses the area from east to west. The abrupt change in height at a distance of about 40 km inland from the sea, marks the sudden change over of the plains and uplands into the rugged hills. Of the total 8090 sq.km of the study area, the hilly part comprises about 2600 sq. km while rest of the terrain is made up of uplands and plains. The relief when viewed from east to west shows a gradual but well defined change over. The rugged hilly terrain gives place to the undulating scattered hills over the uplands, and the latter in turn, roll over gradually into the coastal plains.

For the purposes of detailed description, the area has been divided into four main physiographic divisions.

1. North eastern rocky to alluvial undulating terrain (N. of Narmada).

2. South-eastern rugged basaltic Hills (S. of Narmada).

3. The uplands (S. of Narmada).

4. Coastal Plains (S. of Narmada).

Each of the above division has been further subdivided into units and sub-units (Chart III 1).

Division 1

NORTH EASTERN ROCKY TO ALLUVIAL UNDULATING TERRAIN

This physiographic division lying between the rivers Heran and Narmada; falls within the N. latitudes 21°.50' to 22°.15' and E. longitudes 73°.27' to 74°.15' and covers the 1 : 50,000 Toposheet Nos. 46 F/8, 12 & 16, 46. J/4, 46. G/9, 13 and 46. K/1. This north eastern hilly and undulating terrain typically characterised by an overall low relief is delineated by the watersheds of Heran and Unch rivers to the north and by the Narmada river flowing between Hanfeshwar and Chandod, to the south. The undulating ground is characterised by rocky exposures of Precambrians, Bagh beds and Deccan trap, interpersed with fairly wide alluvial areas. Its extension in E-W direction is of the order of 70 to 75 km. Its north south width however is variable. In the east, the N-S expanse of hills is about 40 km wide, this

is seen to decrease westward. Midway, it is about 18 km wide with Phenai Mata hill in the north, extending upto Naswadi and Garudeshwar in the south. Finally at the western limit near Chandod (along the river Narmada) and Bhiloda (near Heran and Orsang rivers confluence), the width is hardly 10 km. Relief wise, the area is seen to show a wide range from 50 m to 640 m in height, with rather uneven distribution of topographic features. The entire area within this physiographic division is seen to comprise prominent ridges and low rocky exposures interspersed within and rising above a soil cover. Most of the ridges and rocky out crops show a linear trend - E-W to NE-SW. The basaltic ridges may show continuous elongated hills or may comprise linear group of triangular or rectangular hills. In the east, many ridges are more than 600 m high, while in the western part occur, within the alluvial cover, low hills of basalt, metamorphics, sandstones and limestones of Bagh beds. From the relief point of view this north-eastern area can be further subdivided into two units as under :-

Unit I : The eastern trappean ridges and hills (Satpuras) (N. of Narmada).

Unit II : The western hilly and undulating alluvial plains (Vindhyas).

Unit I

The Eastern Trappean Ridges and Hills (Satpuras N. of Narmada).

The eastern rugged hilly terrain of this unit is made up of high trappean ridges and hills. In a strictly geographical sense, it could be included to mark the northern limit of the Satpura range, and could also be considered a north-western extremity of the Vindhya mountains. The hills almost follow the north bank of Narmada i.e. from Hanfeshwar to Vadgam - Limdi for about 120 km. But in the north, towards the Heran river these hills are covering only a distance of 50 km, from the east of Phulmal to the west of Panwad. Within the physiographic division, the south-eastern hills around Amba Dungar and Kawant are very high, their altitudes varying between 450 m to 640 m. This portion exhibits interesting topographic features. The overall altitude is above 300 m, but within its limits, the terrain is marked by "intermontane" flat valleys supporting some soil cover, and trappean hills of all shapes and sizes. The hill ranges rise above the ground and show height range variation from a few meters to as much as 150 m. on an average. But some of the prominent hills rise much higher and impart extreme ruggedness (Khandal Hill, 640 m, Handev Dungar 640 m, Amba Dungar 597 m, Karipani 503, Savdo Dungar 522 m and Nakal hills 496 m). The overall relief of the area shows rise towards east and southeast . However in the southwest, hills continues to be

quite high in the Men river basin and along the river Narmada, finally beyond Vadgam, the hills tend to become low and scattered, merging into the plains.

The rivers Heran, Aswan, Men, Ruwel and Narmada, their tributaries like Kari and Rami nadis and sub-tributaries follow E-W or SE-NW or N-S courses and all these have dissected the ground into a rugged terrain made up of elongated rectangular, triangular, parallel linear ridges and valleys, the valleys tending to become broad and wide towards north and northwest. Westward the valleys merge into the alluvial plains. These various E-W and NE-SW trending hills for the purposes of their detailed description have been grouped into various sub-units as under :-

i. Panwad - Phulmal Hills.
ii. Kawant and Bakhatgrah Hills.
iii. Amba Dungar and Karipani Hills.
iv. Kajalmata Dungar - Gadher Hills.
v. Vadgam - Limdi Hills.

Sub-Unit 1. I (i)

Panwad - Phulmal Hills

The hills of Panwad and Phulmal form the eastern and north-eastern part of the physiographic division 1. In a geographer's terminology, this hilly terrain can be taken to comprise the western extremity of the Vidhyan Range. The ridges and hills are seen to show a decreasing altitude range from 400 m to 100 m from east to west.

These hills form either continuous ridges or rows of circular hills. Some of the conspicuous hills are those of Utaoli (376 m), Wardali (355 m), Phulmal hill (328 m), Dokarbatia (400 m), Chaudar Mogri Hill (390 m), Bodabra hill, Akalwas hill (249m), Raicha hill (212 m) and Andharkauch hill (264 m). This hilly portion marks the watershed for the Heran river. All along the river and within the valley, occur widely spaced low altitude hills, and these hills are forested, the foot hills and valley plains are cultivated.

Between the Heran river and its tributary Kari nadi, the hills are scattered and show low altitude, though a distinct parallel linear arrangement is discernable. Within the Heran river valley, occur hills like Utaoli (376 m), Biswani (350 m), Derkunda (348 m), Pipliawat, Ambasota (265 m) and Titora (243 m). The ridges and hills from Dhamiwara (in the west) to Chaktalao (in the east) are ranging from 200 to 350 m and fall within the Kari nadi valley. Most of these low altitude ridges and hills are of basalt and show a variety of shapes. Significantly, quite a few linear trending hills indicate the existence of parallel basaltic dykes running in rows. One good example is seen in the extreme east from the village Undri to Jamli, where an elongated ridge is made up of a row of hills with round or conical summits. Hills at Palwi, Kalwa, Singalda, Khandikuo, Amirpur, Dhaniwari and Kawant also show linear trends and typically point to the existence of dykes.

Sub Unit 1. I (ii)

Kawant and Bakhatgrah Hills

South of Panwad-Phulmal Hills, the rocky terrain is marked by the hills of Mongra, Mohan fort and Kawant. This terrain shows impressive summits of volcanic rocks much higher than those of the eastern and northeastern portion. The range of rise is of the order of 250 m to 640 m. The Kawant and Bakhatgarh group of hills lie between the two rivers Kari and Narmada. A stricking feature of this high relief terrain is that it forms a rather steep watershed southward towards Narmada, while the northward watershed towards Kari nadi comprises a gently sloping rolling topography. Among the ridges and hills, extreme south-eastern hills of Mathwar, Chitwal, Karajwani are the most elevated, with altitudes more than 600 m (Mathwar Dungar 760 m). The basaltic ridges are linear, E-W oriented, parallel to one another; some hills or ridges are however NE-SW. Within this terrain of high hills, the areas of Kawant - Mohan Fort almost in the middle, and to the east, forms a relatively less rugged and low ground, dotted with small hills. The Kawant town is located in a intermontane valley and shows an altitude of 300 m above the M.S.L.

Sub-Unit 1. I (iii)

Amba Dungar and Karipani Hills

South-westward to Kawant the ground becomes increasingly rocky with high relief and is marked by ridges

and hills which extend to the south-west right upto the river Narmada. The hills are either E-W or NE-SW. Amba Dungar (497 m) Khandala (610 m), Mandev Dungar (640 m), Karipani (503 m), Savdo Dungar (522 m), Nakal hills (496 m) and Mongra hill (457 m) mark the prominent summits and ridges. Further south-west and west the relief tends to decrease in height.

Sub Unit 1. I (iv)

Kajalmata Dungar - Gadher Hills

To the W or SW of the Amba Dungar occur the group of hills among which the Kajalmata Dungar is the most prominent. It is a linear ridge extending in a NE-SW direction, with its highest peak being 589 m. The ridge covers about 15 sq. km area, is almost rectangular and flat topped becomes steep above 400 m, the main ridges over 500 m tends to become rather flat topped on which round summit hills attain the 550 to 590 m altitude. In addition to this ridge, there are other conspicuous hills that show a progressive decrease in altitude towards south and west.

Gadher and Chapat hills form the southwestern part of the Kajalmata Dungar. These ridges and hills have rather low altitude ranging from 300 to 500 m, and show a NE-SW alignment. On going south and southwest, along the river Narmada, the hills tend to decrease in height (e.g. △ 429 m, △ 387 m, △ 354 m and △ 304 m). The

Kajalmata Dungar becomes broad and flat towards west and the Gadhar hills are seen merging into Vadgam hills southwestward.

Sub Unit 1. I (v)

Vadgam Hills

The ridges and hills around Vadgam and Limdi could be taken as marking the Vindhya range. These consist of sandstone, limestone, dolomite (Bagh beds) and the basalt of Deccan trap. These hills to the southwest, gradually slope down to the river Narmada, while towards west the relief becomes low undulating, finally merging into the alluvial plains beyond Gerudeshwar. In the west and southwest i.e. near Vadgam Saidia Parvat hills range in height from 390 m to 465 m, either form continuous ridge or occur as linear group of hills. In general they show EW or NE-SW trends. Occasionally even SE-NW trend is also seen. Among these hills, three prominent hills are of altitudes 399 m, 462 m and 416 m. Other hills equally conspicuous are those of Amba (442 m), Limkhatar (384 m) and Gulwani.

Unit 1 - II

The Western Hilly and Undulating Alluvial Plains

Forming the western part of the main physiographic division, this region roughly lying between the rivers Heran and Men, forms approximately a NE-SW band. It extends out

Plate III 1 The alluvial plains (N. of Narmada) with low Cretrecous (Sandstone) hills in the background (Locality Naswadi).

from the eastern trappean hilly terrain and abuts south-westward against the river Narmada. In the extreme eastern part, its terrain is characterised by a few conspicuous linear, E-W trending hills rising above the alluvial plains. The striking hill of Phenai Mata marks the northern limit while the hills of Naswadi and Tilakwada lie at the southern limit. The terrain, westward tends to become increasingly flat and the western half is typically characterised by flat agricultural plains with sporadic hills of sandstone, metamorphics and granite. (Plate III 1).

The ridges and hills in the eastern part could be grouped into two : (i) Phenai Mata, and (ii) Naswadi.

The Phenai Mata group of hills include the Phenai Mata ridge and the Karali ridge which is north of Phenai Mata across the Heran river. All are either of basalt or of their differentiation products. The Phenai Mata ridge, supposed to be an extinct volcanic vent, is about 3 km long and 2 km wide, has rather flat top at about 425 m, above which rise a number of small projections, the highest being 481 m, forming the easternmost flank of the ridge. The slopes of the ridge are rather steep, almost cliffy between 275 and 425 m.

Across the river Heran at about 5 km distance northward occurs the Karali hill an E-W elongated ridge which is 8 km. long and 1.75 km wide. It rises about 60 to 80 m above the ground level (the height above M.S.L. being 333 m).

Plate III 2 Low altitude sandstone hills of Naswadi with alluvial plains in the foreland ?
(Locality : Near Naswadi).

It has a flat top above 230 m and the top itself is characterised by isolated hills reaching to the heights of 333 m, 283 m and 236 m. The smaller basaltic hills scattered in the area in between Karali and Phenai Mata show round and conical summits, attaining heights between 200 to 250 m (Ladwa hill 243 m) Wavia, hill 213 m and Kauchia hill 252 m).

The Naswadi group of hills, include the Naswadi hill, and also the hills around Garudeshwar. The Naswadi hill with the neighbouring hillocks covers 7 sq.km area, and the main hill rises to 132 m. These hills are of metamorphics. Southwest of Naswadi, the hills near Garudeshwar are of trap and sedimentaries. While the trap hills are round, elliptical and conical, the Bhadarwa hill forms an elongated flat topped ridge of Bagh bed 2 km long and 200 m wide; this hill rises to 118 m. (Plate III 2).

Towards west beyond Naswadi, the terrain shows an undulating alluvial plain topography with isolated hills. Among these, the conspicuous hill of Vajiria west of Naswadi, is made up of granite with sandstone (Bagh) at the top. This hill is of rectangular shape covering about 8 sq.km area with 110 m average height, its top comprises of summits rising 118 m, 115 m and 148 m. The hill has a steep slope and scarp towards north, while its southern slopes are somewhat gentler. East of Vajiria hill is the Punpawa hill (123 m high) and is made up of sandstone. The eastern limit of this hill is seen abutting against the river Aswan.

Again to the north of Punpawa occurs the Kanakua hill (153 m) of sq.km area and made up of three subsidiary hillocks; this hill is made up of sandstone. Next to the Kanakua hill, towards north another sandstone hill (100 m) at Nathpur is observed. And finally north of river Heran, two small sandstone hills, rising to the heights more than 100 m, occur at Lachharas and Londhra. These E-W aligned hills are very close to the bend of Heran river and delineate the watershed.

DIVISION 2

SOUTHEASTERN RUGGED BASALTIC HILLS (S. OF NARMADA)

Broadly comprising the south-eastern part of the study area, to the south of the river Narmada, this highly rugged terrain, in sensu stricto forms the Rajpipla hills. Located between 20°-46' to 20°-55' N. Latitude and 73°-20' to 73.55' E longitude, this hilly area falls within the Toposheet Nos. 46 G/1, 2, 3, 5, 6, 7, 9, 10, 11, 13 and 14 and 46 K/1 (1 : 50,000 scale). Ceographically, these represent the westernmost off-shoots of the Satpura hills. Made up entirely of horizontal lava flows of Deccan trap, the ruggedness and physiographic diversity of its different part is mainly on account of the degree and extent of dissection brought about my erosion along 5the different sets of joints and fractures. It is observed that within this division itself, the topographic features are fairly different in

Plate III 3 A general view of the trappean hilly terrain with Terav khadi in the foreground (Locality : Near village Juna Mosda)

different parts, and on the basis of which, it has been subdivided into three units :

I. Eastern Hilly Terrain (bound by the rivers Narmada, Karjan, Terav and Devganga to the north, west, south and east). (Plate III 3).

II. South eastern Hilly Terrain (bound by Terav and its tributary Sankali Khadi to the north and Karjan to the West).

III. Western Hilly Terrain (bound by Narmada in the north, Karjan in the east and Amravati in the south).

Unit 2. I

The Eastern Hilly Terrain

The eastern hilly terrain is characterised by a high degree of ruggedness comprising sharp ridges and hills with rather steep slopes. The dissection has taken place along the numerous joints and fractures in the basalt, as a result of which a characteristic rectangular drainage pattern has evolved. The most conspicuous and well defined drainage direction is NE-SW to ENE-WSW, a direction in which a number of streams are seen to flow. The various tributaries meeting these trunk stream broadly show a NW-SE trend. Significantly, the entire drainage pattern by and

large reflects the various fracture directions, which include N-S joints also. The degree of erosion is so high that nowhere the horizontal nature of the original surfaces are recognisable, and the entire landscape is seen to consist of narrow topped irregularly disposed ridges. The main hills and ridges (Dungars) with conspicuous intervening valleys (Khadis) are described below.

1. Dhamanmal Dungar : This includes a cluster of ridges and hills, with one of its hills marking the highest point (882 m) of the study area. Forming the south-eastern portion of the physiographic unit, most of the ridges and hill clusters show either N-S or NE-SW orientation. It is also observed that linear ridges, while descending towards the valleys of Devganga and Terav give place to series of round or conical hills.

2. Kokam Dungar : This hill is to the east of Dhamanmal Dungar, and forms an almost N-S ridge of about 3 km length, with two summits at its northern and southern ends (758 m and 791 m). Northward it abruptly terminates while to the south it gradually descends into the valley of Devganga.

3. Vinjiya Dungar : To the NE of Dhamanmal Dungar, this also forms a somewhat flat topped ridge. Its highest part is in the north (628 m) beyond whith the ground slopes towards the khadi of Vandri-Kanji. Its southern flank between 500 and 600 m height is steep and cliffy. Southward,

the ridge loses height and takes an easterly turn towards Devganga river into which it gradually descends.

4. Sakdu Dungar : Across the Kanji Khadi to the north and west of the Vinjiya Dungar, extends the rather irregular shaped ridge of Sakdu Dungar, almost parallel to the Khadi in a NNE-SSW direction. In fact, it comprises a narrow high ground made up of numerous elliptical summits which trend either ENE-WSW or NW-SE. The slopes on all sides are rather steep, the various highest points being 658 m, 694 m, 457 m and 358 m from WSW to ENE.

5. Mathasar Dungar : In fact this forms a ENE-WSW oriented row of hills and ridges, each quite distinct from the other. Three arcuate ridges each marked by summits 697 m, 457 m and 358 m from W to E make up this group of hills. A distinct lowering of altitude is observed towards Surpan.

6. Jharwani Dungar : It comprises a fairly large tract of hilly ground and is seen to consist of numerous hills of a variety of shapes and altitudes. Its highest point is 757 m, with a progressive decrease in the heights of the subsidiary hills towards Narmada to the north and northeast (e.g. Chopadi and Mathavali hills).

7. Lamba Sag Dungar : This dungar is to the West of Jharwani, and consists of a ENE-WSW trending ridge 4 km long and with three distinct summits (700 m, 660 m and 639 m). It is a narrow linear ridge with rather steep

slopes but no cliffs and escarpments. Its western end takes a turn to the north and merges into Juna Raj Dungar.

8. Juna Raj Dungar : It is a vast oval-shaped cluster of radiating hills with a distinct summit in the centre (795 m), from which extend ridges in three directions, viz. ENE towards Narmada (Gora - Vadgam), WNW towards Jitgarh and WSW towards Terav river. The ridges themselves are much dissected, more or less made up of linear groups of hills and summits. The ridges towards Vadgam and Jitgarh, in the highest portions show narrow flat topped surfaces. The conspicuous summits are 671 m, 611 m, 582 m and 165 m towards Gora and 616 m, 543 m and 353 m are towards Jitgarh.

9. Hindawa Dungar : This hilly ground is to the south-west of Dhamanmal Dungar, and is marked by a 525 m high peak, from which extend two linear clusters of hills southwestward, for a distance of about 15 km right upto Terav river. The individual hills are mostly a little above 300 m in almost all parts of this Dungar.

The entire hilly landscape is extensively criss-crossed by streams and nalas, imparting unusual variety to the shapes and sizes of hills and ridges. By and large, the entire drainage pattern is controlled by joint pattern and even the zig-zag courses of the major khadis are essentially due to the effects of intersecting

joints and fractures along which they take sudden bends. A brief account of the conspicuous and major streams, forming essentially an integral part of the topographic description is given below :

1. Som Khadi : It rises from Dhamanmal and follows a straight easterly course through the Kokam and Dumkhal ridges. This 12 km long khadi has a valley floor that slopes from 300 m near its source to 100 m where, it meets the river Devganga where village Dumkhal is situated.

2. Kanji Khadi : This stream originates in Vinjiya Dungar, and flows for 8 km in a northeastern direction. The villages of Vandri, Khokharaumar and Kanji are located along this khadi. It meets the river Devganga near Kanji.

3. Bhanumati Nadi (Khadi) : Streamlets originating from Sakdu, Mathasar and Jharwani ridges combine to form this nadi. It then flows due northeast for about 10 km before it meets Devganga. It has a narrow valley and its flow shows a fall of gradient from 300 m to 100 m at upto Surpan.

4. Dhirkhadi : This north flowing stream has a 15 km course. It originates in Mathasar Dungar and crosses Jharwani and Lamba Sag Dungars. Jharwani and Piprikhetar are the villages located in the valley of this khadi.

5. Shamariya khadi : Originating from the hills of Juna Raj Dungar, this stream however drains a plain area and meets the river Narmada near Phulwad.

6. Panch Khadi : It is a tributary of the river Terav, and is formed by the joining of tiny streamlets originating from the Juna Raj hills. This 10 km long khadi floor slope shows a drop from 300 m to 100 m towards west near village Kanjal on the river Terav.

7. Kaludi Khadi : This khadi is in fact a subsidiary of the river Terav, coming out of the eastern ridges (Dhamanmal, Mathasar and Hindava Dungar). It has a 25 km long westerly course, evidently, the river bed shows a much gentler gradient (from 300 m to 100 m run over in the 25 km). Flowing within a rocky channel, this stream tends to follow numerous joint directions in the trap as a result of which it has developed a conspicuously zig-zag channel, resembling meanders. No villages are located along this stream.

8. Sankali Khadi : This is another major tributary feeding the Terav river. It originates in Dhumanmal Dungar and follows a westerly course. This stream is 10 km long and shows height difference from 300 m to 200 m between its source and the confluence with Terav.

UNIT 2. II

South eastern hilly terrain :

This unit includes the hilly region to the south of ENE-WSW line marked by the Som khadi (of Devganga), Sankali khadi (of Terav) and the river Terav. To the east, the Devganga river valley separates this unit from the hills

of Maharashtra, while towards south and southwest, the State boundary marks the limit of the unit. Towards west the limit of this hilly terrain is marked by a NNW-SSW alignment along the villages Khatam, Pansar, Kanbudi and Gangapur. The basaltic terrain with a rugged relief has an area of about 500 sq.km and shows a progressive rise in height towards east from 300 to 700 m. The nature of the topography of this unit is quite different from the hilly terrain to the north (Unit 1 I Eastern Hilly Terrain). In this unit, topography essentially reveals a much dissected plateaux, whose remnants are still prominently recognised. The existing topographic features thus consist of flat topped plateau relics, ridges, hills and intermont valleys. The main dissection has been brought about by the river Terav and its tributaries during their westward and northward flows.

On the basis of the ruggedness of relief and the topographic features, the unit has been further divided into following four different sub-units.

i. The Mal-Samot dissected plateau.

ii. The hills between the khadis of Terav and Bogla.

iii. The Mosda group of hills.

iv. The Sagbara group of hills.

SUB UNIT 2. II (i)

The Mal-Samot dissected Plateau:

The Mal-samot and its surrounding area of about 120 sq.km is seen to be a dissected tableland, forming the easternmost part of the physiographic Unit 2 II. It is bound by valleys of Devganga in the east, Sankali Khadi, Som khadi and Terav river in the north, and Bogla khadi (of the river Terav) in the west and south respectively. Forming almost a flat terrain of about 70 sq.km at the altitude of 600 m, it typically represents a dissected plateau comprised of horizontal basalt flows. It has a thin soil cover. The plateau top is characterised by conspicuous round top hills and narrow flat topped arcuate ridges. The summits and crests of these hills and ridges rise further upto almost 700 m height. In a general way, the eastern and southern parts of the plateau are marked by ridges while the northern part is made up of small hills. The eastern and southern flanks show a very steep drops; northward also it slopes down quite steeply but not as much as in the east and south. The prominent ridges in the east viz. Mal (637 m), Saribari (699 m) and Mohabudi (649 m) show a sudden drop of about 300 m from 600 m height to 300 m, forming steep cliffs overlooking the river Devganga almost right upto the river bed. The ridges in the north (Devra

660 m, Piprimali 680 m, Gundvani 600 m and Mohbi (603 m), on the other hand form a cliff of 400 m altitude, beyond which northward it tends to slope steeply but gradually, in the form of descending row of hills, finally meeting the Som and Sankali khadis. Westward the plateau show a steep drop of 300 m; of course there are no cliffs, but the entire sloping landscape is criss-crossed by a network of intermontane streams, thereby giving rise to numerous hills progressively decreasing in height westward from 600 to 300 m.

This plateau with its rugged relief supports a thick forest with only a few villages where small scale farming is in practice. Fields are located on the plateau, along the foot-hills and in the valleys. Mal and Samot are the villages on the plateau itself showing cultivated fields and settlements. As this plateau is accessible from the west and connected by a state highway to Bharuch and Rajpipla via Dediapada and Piplod, there are good possibilities of developing this area as a holiday hill resort.

Sub Unit 2. II (ii)

The hills between the khadis of Terav and Bogla :

The area to the west of Mal - Samot plateau is marked by a group of hills, located between the two tributaries of the river Terav (Terav - Sankali khadi and Bogla khadi). Towards east the initial course of Terav khadi

separates these hills from the Mal - Samot plateau, and then the Terav khadi and its supporting stream network dissect the terrain into a cluster of hills during its westward flow. The northward flowing streamlet of Sankali khadi delimit these hills towards the north. In the south, the Bogla khadi marks the limit, first it separates them from Sagbara hills and then further westward it separates these hills from the Mosda group of hills.

This khadi bound hilly part of the unit, about 55 sq.km area, forms a rectangular landmass. The constituent hills of this area, from east to west show a progressive decrease in altitude ranging from 600 to 300 m. The main channel of Terav is 25 km long, while the length of the Bogla Khadi is 20 km. The courses of streams "meander" through the trappean hills, with a rather gentle gradient, showing a fall of about 200 m i.e. 400 m at the sources to 200 m at their confluence. These streams flow along intersecting joints and fractures and have therefore evolved abundant loops imparting zig-zag courses. The joint and slope controlled criss-cross dissection of the terrain has given rise to considerable irregularity to the relief, and the entire terrain is seen to be made up of numerous hills separated by intermontane 3rd and 4th order channels. The sub-unit broadly comprises following three group of hills, variable in shapes sizes and even in heights.

1. Dandawadi hills, in the southern part with highest summit (555 m) of the sub-unit near the village Khaman. The other hills are with heights 478 m, 460 m, and 440 m, all near the village Dandawadi.

2. Mathamogra - Morjadi hills in the western part, which also show an altitude range of 480 m to 440 m.

3. Northern group of hills, comprising a ENE - WSW ridge near the village Mathavali (400 m) with four summits ranging in heights from 451 m to 300 m.

SUB UNIT 2. II (iii)

The Mösda group of hills :

These hills form the western part of the physiographic Unit II. Located to the west of Bogla khadi and south of the river Terav, this sub-unit covers about 60 sq.km area. To the south the hills are seen merging with the Sagbara group of hills, while in the west, beyond Khatam, Pansar and Kanbudi villages, these hills roll down into the Dediapada uplands. The terrain of the area shows several rows of hills with linear trend. The various hill summits make four parallel rows running from ENE to WSW ranging in heights from 500 to 300 m. The undulating topography of this terrain with relict ridges and hills, represents the extension of the eastern ridges and hills.

In the eastern part of this sub-unit, there are two prominent Dungars (ridges) very close to the Bogla khadi :-

(i) Mosda Dungar (471 m - 300 m) is flat topped triangle shaped with three diverging ridges, the dungar is flanked by Bogla khadi and Terav river to the east and north. The hill has ENE - WSW trend and the three ridges trend towards north, south and SW, giving rise to a radiating cluster of hills, with a total areal extent of the area about 7 or 8 sq. km and to its south.

(ii) Babâdoti Dungar, a relict plateau of average 400 m altitude rising from the 300 m local base level.

The terrain to the west of these two dungars comprises four rows of hills which show a progressive lowering of altitude. These have been designated as under, after the nearby village names :

1. Bal (312 m), Singloti (300 m), and Panchumar (274 m).

2. Mosda Dungar (471 m), Arethi (389 m) and Nani-Singloti hills (329 m & 308).

3. Babâdoti dungar (421 m), hills south of Pansar (340, 322 m).

4. Sukval hills (400 m), Bantawadi hills (397 m) and Kanbudi hills (341 m).

SUB UNIT 2. II (iv)

The Sagbara group of hills

The hills to the south of the Bogla khadi belonging to this sub-unit, represent the south-eastern corner of the study area as well as of the physiographic division concerned. Towards east, the state boundary of Gujarat with Maharashtra marks the limit, beyond this towards Maharashtra, the hills are seen rising above 600 m. Southward, these hills abruptly terminate into Salemba alluvial plains, showing a sudden drop of 200 m with very steep southerly slopes. Towards west, the hills show decrease in heights and gradually merge into the upland topography, showing a fall of 200 m i.e. from 500 m to 300 m height. Covering an area of 75 sq.km this group of hills show a relief varying from 300 m to as high as 598 m. The hills in the eastern part marked a more rugged relief with steep and cliffy slopes and the various ridges are seen running southward into the plains. The overall topography comprises arcuate and elongated ENE-WSW aligned group of hills rising above a 550 m high undulating ground with summits rising as high as 598 m.

The constituent hills of the sub-unit are :-

(i) Gardha Dungar which is very close to Bogla khadi, and is a ridge made up of several round shaped hill summits (538 m, 523 m, 520 m and 500 m). (ii) Devidev Dungar

towards south, which marks the boundary of the State. It is a ridge like feature extending NE - SW, has a flat top at 520 m, over which hill summits rise upto 543 m altitude. (iii) To the west of Devidev dungar there are two ridges in a row known as Sagbara Dungar ; the ridges have flat tops at about 500 m height and above this level a number of round summit hills is seen rising upto 598 m. These elongated ridges show steep slopes to the south, marked by cliffs and escarpments. At the 300 m level, another set of ridges are seen to form secondary hills that show altitudes of 467 m, 423 m and 400 m.

UNIT 2. III

The Western hilly terrain (S. of Narmada)

This hilly terrain comprises the last unit of the physiographic Division 2, the limits of which are marked by the Karjan river valley in the east, the Narmada flood-plains in the north and by the uplands, across the rivers Madhuvati and Amaravati in the west and the south respectively. Topographically, the unit is made up of linear basaltic ridges which in fact are the extensions of the June Raj and Jitghat dungars of the Unit 2.I (Eastern Hilly Terrain). The ENE - WSW aligned trappean ridges and hills, from north to south, form four parallel chains of ridges (Dungars). Spread over an area of about 350 sq.km. the relief of the terrain shows a rise from 200 m in the

west to 480 m in the east. The stream network dissecting this terrain consists of west following and north flowing tributaries supporting the rivers Karjan, Narmada Madhuvati and Amaravati. An interesting feature of this unit is its characteristic drainage, which includes parts of three river basins i.e. the N - S oriented Karjan river basin (Eastern Portion of the Unit), the NE - SW oriented Amaravati river basin (southeastern portion of the unit), and the E - W oriented Madhuvati river basin (western portion of the unit).

The higher summits of each of the various ridges, viz. Tara Ghat (438 m) in the north to Ishwar Dungar (348 m) in the south with other summits like those of 392 m 380 m, 319 m, 361 m, and 330 m, form a divide that separates, the terrain into two sub-units, (i) to the east with its hills and the drainage of the Karjan basin, and (ii) the other to the west that includes the hills and the drainage of the Amaravati and Madhuvati basins. The detailed topographic features of the two sub-units have been briefly described below :

SUB UNIT 2 III (i)

Eastern sloping ridges

The sub-unit includes four chains of hills in the form of descending ridges terminating into the Karjan

valley, and comprises dungars of Gagar, Kotiya, Khuta Amba, Kakadpada, Ishwar and Khakharkua forming the eastern part of the Karjan basin :

1. The northernmost chain facing the flood plains of Narmada starts from Gagar Dungar (438 m) and extends eastward towards the Karjan river forming hill summits of 392 m., 335 m, 326 m, 273 m and 244 m heights.

2. The ridge of Khuta - Amba Dungar chain of hills has the highest peak 438 m altitude with other eastward running summits 380 m, 379 m, 364 m, 384 m and 283 m extending right upto the river Karjan.

3. The next southward ridge is that of Kakadpada Dungar 361 m and other hills 319 m, 310 m, 283 m, 273 m and 275 m, running eastward upto the Karjan river.

4. This southernmost ridge Ishwar Dungar (348 m) shows the chain of hills ranging in height from 335 m, 298 m, 261 m and 238 m near the river Karjan.

SUB UNIT 2 III (ii)

The Western sloping ridges

These ridges fall within the Amaravati and Madhuvati basins and mark a terrain that consists of Koliyapada, Vadkhunta, Asnavi and Varadiya dungars. These dungars characterise four chains of hills.

1. This chain of ridges of northern part facing the Narmada floodplains starts from Koliyapada Dungar (476 m) and is followed westward by other hills like 411 m, 416 m, 323 m and 197 m descending into the river Madhuvati.

2. The next chain to the south is that of Bodiya-kapat Dungar. It starts from 328 m high hills; other hills westward are 337 m, 310 m, 279 m, 239 m and 168 m terminating into the Madhuvati valley.

3. Further south, the Vadkhunta Dungar consists of summits ranging from 361 m, through 313 m, 278 m, 261 m, 219 m to 225 m it also abuts against the river Madhuvati in the west.

4. Asnavi Dungar is the southernmost. It also extends westward from the peak 348 m, high, with the other hill summits like 335 m, 298 m, 276 m, 270 m, 227 m, 228 m, 230 m, 241 m, 240 m and 224 m. This chain of hills descends south westward into the river Amaravati.

Plate III 4 Typical subdued undulating topography of the uplands. (Locality : Near village Netrang, way to Rajpardi)

DIVISION - 3

THE UPLANDS (SOUTH OF THE RIVER NARMADA)

This topographic division of about 1325 sq.km. area, lies to the south of Narmada and is restricted between 100 m and 300 m altitudes. It comprises an undulating terrain dotted with low altitude hills and ridges. Within the limits of the study area, these uplands occur to the west and southwest of the rugged hilly terrain. Further west, these merge into the coastal plains. These uplands have scattered hills and ridges within an undulating ground of alluvial and black cotton soils. To its north lie the flood plains of Narmada and to its west occur the coastal plains. On the toposheet the limits of the uplands to the west and east are marked broadly by the 100 m and 300 m contour lines respectively. Westward the uplands merge into coastal plains, while in the east a striking change in the relief marked by an abrupt rise. (Plate III 4).

The uplands are seen to comprise basalts of Deccan trap, Tertiary rocks, and alluvial and residual soils of Quaternary. The diversity in respect of drainage characteristics and topography within the uplands is fairly well defined, on the basis of which the author has been able to classify uplands into three main units :

I. Dediapada Uplands : The Dediapada Uplands are eastern trappean uplands, characterised by a somewhat rugged topography and prominently NNW flowing major streams with tributaries meeting them at right angles.

II. Netrang Uplands : These are the western Tertiary Uplands, characterised by an undulating topography and a drainage marked by west flowing network of streams.

III. Kadvali Uplands : These are North western Tertiary Uplands, comprising a rolling topography with numerous small meandering streams flowing almost northwestward, finally meeting the Narmada river.

The rivers Karjan and Amaravati that constitute the relatively major streams of the area, provide natural dividing lines for the above three units. The Karjan river and its Khadi known as Mohan separates the Dediapada and Netrang uplands. While the west flowing Amaravati river is dividing the uplands of Netrang from those of Kadvali.

UNIT 3. I

Dediapada Uplands :

Dediapada Uplands, comprising an area of 640 sq.km which is confined to the south and west of the rivers Terav, Karjan and its main tributary Mohan Khadi. This part of the uplands is the hilliest, rising from 200 m to 300 m altitude eastward. The Mosda and Saghbara group of hills

mark the eastern limit of this terrain, while in the south, the Mangrol and Mandvi hills delineate this physiographic unit. The village Dediapada located right in the heart of the terrain is the taluka headquarter. The undulating upland terrain shows scattered basaltic hills in rows and which are western extensions of the trappean hills (of the east). The Dediapada Upland comprises a gently undulating ground covered with 2 to 3 m thick residual black cotton soil over the basalt rocks through which peep out round topped low altitude hills. These hills have a very thin veneer of soil cover which support fairly thick forests. The flat uplands on the other hand provide good agricultural land and sites for small tribal village settlements. The ENE-WSW oriented hills show a progressive decrease in height westward. In all from north to south following four rows of linear hills have been recorded :

1. Ghantoli, Pangam and Solia hills (in extreme north between the rivers Karjan and Terav) : These hills merge northward into a hilly area which ultimately ends up at the confluence of Terav and Karjan rivers. This linear group of hills 8 km in length and includes the hills of 281 m, 298 m, 252 m, 245 m, 243 m and 200 m.

2. Besana, Sakwa and Dhanor line of hills (South of the river Terav) : The northward slope of the hills descend into the Terav river valley. These ENE-SWS

aligned hills range in height from 264 m, 257 m, 258 m, 222 m, 236 m and 202 m and form a 17 km long chain.

3. Ralda, Khokhraumar, Jharnawadi, Chuli and Garda hills : Further south these hills make a 30 km long chain of hill summits descending in height from 292 m through 249 m, 257 m, 254 m, 282 m, 263 m, 259 m, 245 m,224 m to 220 m from east to west.

4. Jamni, Kevdi and Patadi Chain of Hills : These hills represent the extensions of Sagbara group of hills and rise only of 20 to 30 m above the general ground level (of about 240 m). The hillsextending for 12 km are rather widely spaced.

The dissection of the uplands by the rivers Karjan, Terav and their khadis have evolved a rectangular drainage network and the topography shows an intricate alternating pattern of hills and khadis oriented either E - W or N - S.

The main drainage is comprise by the river Karjan and its major tributary to the west Mohan khadi, as well as the two conspicuous tributaries of Terav (to the east of Karjan river), all these flow north, north west ward. Numerous smaller streams that meet these major rivers and their khadis show dominently west south westerly flow. This type of drainage has been the main cause for the development of several linear groups of hills described above. The salient features of the major streams are described below :

1. Mohan Khadi : It is a tributary of Karjan river and originates in the Wankhal - Mangrol hills beyond the limits of the study area. Flowing along a course that fluctuates between N - S and NNW-SSE evidently at flows along the jointed basalt for about 35 km. Before meeting the Karjan near the village Bhatpur (of Dediapada Taluka), this khadi shows a drop of 111 m (from 311 m to 200 m).

2. Kanji Khadi : This 25 km long khadi originates in the Sagbara hills (290 m) and flows westward to meet the river Karjan near the village Gopalia (200 m), showing a 90 m fall in altitude in a distance of 25 km.

3. Kukalda Khadi : This khadi marks the course of the stream that flows westward from the Mosda hills (320 m), makes a run of 40 km over the upland terrain and finally meets the river Karjan at the village Ajanvai. A fall of 120 m in height is observed within 40 km length.

4. Dhaman khadi : This 16 km long northward flowing khadi originates in 257 m high Khokharaumar hill. It meets the Terav river near the village Bogaj (200 m). An altitude difference from source to the confluence within a distance of 16 km, is about 57 m.

5. Ralda-Besana khadi : This khadi starting from Gangapur hills (260 m) follows a 14 km long NNW course and meets the river Terav at the village Besana (200 m) with an altitude drop of 60 m.

Two significant features mark the drainage of this uplands unit.

i. The NNW flowing streams and Khadis do not show significant 'meandering' and obviously flow along straight prominent joints.

ii. The WSW flowing streams mostly follow zig-zag courses, and this phenomenon is due to their flowing across basalts with several inter-secting sets of closely spaced joints.

UNIT 3 II

The Netrang uplands

The Netrang Uplands unit comprises a subdued topography with low trappean hills and mounds of Tertiary sedimentaries. West of Karjan and south of Amaravati rivers, these are marked by scattered hills, interspersed over an undulating terrain the hills progressively lower down towards west from 300 m to 100 m within a distance of about 25 km. Further west it merges into the coastal plains. The Narrow gauge Railway line from Kosamba to Umarpada runs along the southern limit to this unit. On the toposheet towards west, the 100 m contour line passing through Dharoli, Daheli and Wankhal marks the limit of these uplands. This unit covers about 490 sq.km. The Kim river originates in the eastern part of these uplands, and flowing westward towards the sea forms the main drainage. Netrang is the principal village centre of all human activities.

Plate III 5 Low altitude trappean ridge in the upland (showing terrace farming. Locality : Near village Moti Daberi on the way between Dediapada and Rajpipla).

Broadly, its eastern part is basaltic and consists of ENE-WSW linear rows of hills. These are somewhat dissected trappean ridges with serrated crests, giving rise to series of hill-tops which show progressive decrease in heights westward. Comparatively the south eastern part is more rugged and includes Motiya Dungar, Rajwadi Dungar and Wankhal Dungar. From N to S, the Netrang uplands unit reveals several rows of hills trending ENE-WSW. (Plate III 5)

1. Kuri Ridge : Kuri Ridge is the northern most linear groups of hills, quite close to the Amaravati river and is 8 km long. It consists of three main connected summits - 206 m, 239 m and 212 m.

2. Galiba Ridge : The next southern ridge is that which includes the peaks of 274 m, 282 m, 231 m and 200 m. This 12 km long and about 2 to 3 km broad ridge starts from the west of the river Karjan and gradually tapers out westward. This hilly feature has a rather complex summit topography and its top consists of numerous conical hills trending ENE-WSW and NNW-SSE. It points to a dissected basalt flow.

3. Rupghat group of narrow parallel linear Ridges : About 12 km long elongated hilly ground is seen to comprise several narrow discontinue linear ridges, separated by shallow stream channels. These linear hills arranged in

parallel rows, have been found to represent a swarm of dolerite dykes, intrusive within the basalt. In all six much linear rows, each representing a ENE-WSW trending dyke, have been recorded; a number of conspicuous elongated hills marking these ridges range between 209 m and 203 m, with a few showing lesser altitudes.

Further south of these dyke ridge clusters, occur three main groups of hills. Motiya Dungar and Rajwadi Dungar with a cluster of linear hills in between. The Motiya Dungar is more or less a triangular group of hills with two prominent summits of 255 m and 248 m heights. Further south, is encountered a basaltic terrain typically characterised by several rows of low linear ENE-WSW trending hills. Southward the Rajwadi Dungar which again marks a conspicuous cluster of hills with several summits. The elongation of this dungar in ENE-WSW direction and the similar trend of its constituent hills as also the numerous linear hills near its base all very clearly suggest the presence of numerous intrusive dykes cutting the main basaltic mass. Existence of dyke swarms is more obvious in the low terrain to the west of this hill cluster, where the western portions of this uplands unit is characterised by numerous isolated linear low hills and mounds representing the dykes.

UNIT 3. III

The Kadvali Uplands

The unit marks the northwestern uplands, and lies

to the north of Amaravati river and west of Madhuvati river. To the north, this upland is flanked by the flood plains of Narmada. Beyond the 100 m contour westward the upland is separated from the coastal plains by a small tributary of the river Narmada (Hakran nadi). This upland unit consists of 195 sq.km area, and shows an undulating terrain made up of Tertiary rocks. The tertiaries are made up of standstone, limestone, shale and conglomerate, and are seen forms gently rising domes and crests. The basalts are confined to the extreme eastern part occur as sheets with a lateritic cover here and there. - Sporadic E-W dykes are also seen in the eastern half of the unit. The eastern half, i.e. ground of Kadvali, Jespur and Rampur is dotted with isolated hilly patches rising about 60-80 m above the ground level (i.e. above 100 m). The ground elevation varies from 100 m to 176 m altitude. In all, four groups of hills from north to south are recorded :-

1. Khaseli Dungar : This is a single hill which abuts against the river Mathuvati in the north near Tejpur where the river forms a small loop. This conical hill is 140 m high rising 80 m above the flood plains.

2. Kadvali Hills : This group of hills is about 5 km south of Khaseli Dungar, consists of the summits like 130 m, 128 m, 116 m and 122 m. These hills support stone quarries.

3. Jespur and Rampur group of hills : These hills are seen to form the extensions of Vadkhunta Dungar, and include

hills of Dholi (183 m), Raisangpur (156 m), Jespur (164 m and 144 m) and Rampur (176 m). Other hills are those with summits 150 m, 152 m and 115 m high.

4. Kariya Dungar : The dungar is the extension of Asnavi ridge. The constituent summits show altitude of 161 m, 150 m, 120 m and 106 m.

This upland unit has a marked westerly drainage with numerous meandering streams. The river Kaveri and its tributaries show enterenchment of the order of 8 to 9 m.

DIVISION 4

THE COASTAL PLAINS (SOUTH OF NARMADA)

The fourth and the westernmost physiographic division restricted to the south of the river Narmada, adjoining the uplands of the Netrang and Kadvali, is the terrain comprising the coastal plains. The coastal plains are fringed by a highly dissected and muddy coastline to the west. Situated between 21°-20' N to 21°-45'N latitude and 72°-30' E to 73°-30' E longitude, an area of 2000 sq.km falling within the Toposheet No. G1, 2, 3, 5 & 6 and 46 C 10, 11, 14 & 15 of 1 : 50,000 scale has been included in this study. The coastal terrain extending westward from the Gulf of Khambhat, from a 100 m altitude to M.S.L. To the north its limit is marked by the mouth and the flood plains of Narmada, while the southern limit of the Kim basin marks the southern boundary of the studied portion.

These coastal plains are characterised by an ascending sequence of Tertiary and Quaternary deposits - alluvial, silt and sand brought by the rivers.

This physiographic division has been subdivided into following three units on the basis of lithology, drainage characteristic and altitude considerations :

Unit I Tertiary Plains (Eastern)
II Alluvial Plains (Central)
III Coastline (Western)

The topographic and related aspects of the three units are described below :

UNIT 4. I

The Tertiary plains (Eastern unit) :

These Tertiary plains mark the eastern portion of the division. The western limit of this unit is marked by the northward flowing Amla khadi. These Tertiary plains composed of Tertiary rocks, are about 55 km wide and 25 km broad, and provide an undulating terrain with quite a few hills, either occurring as ENE-WSW oriented chains or as isolated mounds. The Tertiary rocks of this unit form gentle 'highs and lows' trending ENE-WSW (Please refer chapter No. II). The constituent rocks exposed consist of sandstones, limestones, clays and conglomerates, belonging to Jhagadia, Khand and Vagalkhod formations. The range of altitude variation is from 120 m to 60 m from east to west.

The higher ones amongst the mounds, in the northeast form a cluster which has been referred to as Ratanpur group of hills or Baba Guru Dungri. The Tertiary sediments are covered with a thin veneer of soil - alluvial as well as residual. The drainage characteristics of the unit are interesting and show considerable diversity. In the northern half, the various streams after initially flowing due WSW, take a northwesterly bend and flow into the Narmada flood plains. The two major rivers that show the above phenomenon, are Kaveri and Amaravati. The former is 36 km long, flowing over a distance of 25 km. The Amaravati river is 85 km long and flows over a distance of 60 km. Both characteristically show entrenched meanders of the order of 10 to 3 m from east to west. Some of the tributaries that meet these rivers also show a similar phenomenon. (Plate III 6).

The southern part of the unit is drained by Kim, river and its upstream tributary Tokri Nadi. This river and other small streams, flow WSW and meet the Gulf (sea) after meandering through the plains. This river also shows very conspicuous meandering with an entrenchment that varies from 10 m to 6 m from east to west.

UNIT 4. II

The Alluvial plains (central)

The alluvial plains just to the west of the Tertiary plains form the central portion of the division.

These alluvial plains are seen merging into the tidal flats of the coastline westward. The alluvial plains are made up of Quaternary deposits mainly alluvium (silt and sand) brought by the various rivers. This 30 km wide flat terrain shows a very gentle gradient towards the Gulf, with an altitude drop of only 20 m i.e. from 40 m to 20 m westward. These plain extend upto the mouth of the river Narmada in the north. The Kim river lies in the southern part of the plains, and its wide estuarine mouth delimits the plains to the west. In between these two rivers there are some smaller streams commonly known as khadis which are seen flowing westward dissecting the coast. These rivers include Amla khadi and Wand Khadi. These Westward flowing khadis and rivers have formed meanders and loops on the flat alluvial terrain that show an entrenchment of about 3 m to 5 m. This is a very striking phenomenon.

UNIT 4. III

The Coastline (Western)

The western flank of the coastal plain's end of the study area, forms a 115 km long (N-S) coastline overlooking the Gulf of Khambhat. The entire coastal zone falling within the limit of this unit is highly

Plate III 6 The river Amaravati in the coastal plain, its course showing alluvial cliffy banks.

Plate III 7 Eustarine mouth and muddy banks of river Narmada.

dissected by extensive tidal flats marking estuarine river mouths of Narmada, Kim and Sena. The extremely muddy shoreline is characterised by wide inter tidal flats which abut against a crenulated alluvial backshore. The most interesting physiographic features of this coastline unit are as under :

1. Narmada River mouth bar (Aliabet).
2. Estuarine mudflats.
3. Fragmantary sandy ridges of several generations.
4. Islands or 'bets' of alluvium rising above the estuarine mudflats. (Plate III 7).

The mouth bar of Narmada (Aliabet) is of gigantic dimensions, about 20 km long and 10 km wide of its western flank. Part of it gets submerged during high tide. During low tide, it is seen to be dissected by numerous seaward flowing tidal channels, and Aliabet is made up of sand, silt and clay and support mangroves in its several parts. Almost all along the coastal stretch, the foreshore area is characterised by a continuous stretch of mudflats, which are in fact inter-tidal deposits of the sediments brought by Narmada, Kim and Sena rivers. These inter-tidal mudflats are on an average 4 to 5 km wide but are occasionally as much as 10 km in width. Kim river flows for about 20 km or more within the mudflats before meeting the sea. The smaller stream of Sena also meanders across

the mudflats for several kilometers. The mudflats are characterised by numerous channels, through which the tidal waters flow back with the receding tide. Coastal sandy ridges of three generations have been observed along this coast. The two inner ones are quite prominent. Between Narmada and Kim, two 'en echelon' ridges are present. The eastern ridge is 5 km long, 1 km wide and 6 to 10 m high (Wamleshwar - Kanthiajal ridge); the western ridge is smaller, about 1.5 km long 0.5 km wide and about 5 m to 6 m high (Motimer Bet). South of Kim, all the three ridges are encountered. Two very well defined almost continuous ridges extend for about 8 km from Karanj to Delasa. The inner (eastern) ridge is almost 20 m high and is separated from the outer ridge by an intervening stretch of raised mudflats. These ridges are fairly consolidated and support some vegetation, but their tops are dotted with dunes of loose recent sandy material. Further west, towards the sea, within the expanse of mudflats, remnants of yet another sandy ridge, show sporadic occurrences. Of these, the most prominent is that of Dandi bet, facing the mouth of Sena river, which is 2 km long and about 700 m wide. Rising a few meters above the H.W.L. this bet is capped by recent dune material.

The estuarine river mouths of the rivers Narmada and Kim, also reveal quite a few relicts of alluvium, surrounded by mudflats. These bets or relict patches of

of alluvium represent an ancient dissected alluvial topography which was drowned during the subsequent rise of the sea level.

The overall picture of the coastline topography typically reveals constructional and destructional processes of a terrain where major rivers have interacted with a fluctuating sea level.