Geomorphology of the Mangho Pir Spur

Position and Physical Aspect of the Area

Mangho Pir lies at the south-west corner of the Kohistan Mahal of Lower Sind. Immediately north and north-east of the Karachi plain, we have the Mol and the Mehar Plateaus. These plateaus are composed of the Gaj limestone, lying in the middle of two gentle synclinal folds and are bounded by steep scarps. They are separated by an anticlinal fold, which has been eroded and is now occupied by a river valley and the Nari inliers are here exposed. Southwards this anticline fades out and after a gap rises at the Drigh Road Dome, extending south-west upto Ghizri. The Mol and the Mehar Plateaus become lower in elevation to the south and merge into the synclinal valleys occupied by the Malir and the Lyari rivers respectively. The western scarp of the Mehar Plateau extends to the south-west, parallel to the Hab river upto Lang Lohārani and from there parallel hills extend due south towards Mangho Pir village, in the form of homoclinal ridges. Here they form a loop and then extend to the south-west upto Cape Monze, where the north-western limb of this anticlinal is seen.

Thus in the Karachi area, we find three parallel anticlinal folds, separated from one another by two synclinal valleys, extending south-west from the Kohistan Mahal area. The direction of the folds north of the Karachi area is north-south, but further south they turn more and more to the west and assume a trend from north-east to south-west. The first one is a low and gentle fold, running from Korangi Creek to the east-north-east. Then separated by the synclinal valley of the Malir river, rises the second anticlinal, the Drigh Road Dome. Starting from Ghizri, it runs to the north-east. North of Malir Cantt. the axis of the anticline is depressed and

after leaving a gap, again rises north-eastwards. Then comes the synclinal valley of the Lyari, which is followed by the third and much higher and prominent anticline. This anticline is not wholly represented in this area. The parallel homoclinal ridges running through the Mangho Pir area along the left bank of the Hab river constitute the south-eastern limb of this anticline. The axis of the anticline lies on the other side of the Hab and the counterpart of this limb is shown, on this side of the Hab, only near Cape Monze.

The Mangho Pir hills constitute a spur of this anticline projecting south of the Band Murad area. The axis of this secondary anticlinal, north of Mangho Pir village, runs nearly north and south, but its actual position is obscured, as the core has been entirely eroded and the strata here are now covered with detritus. From this point the anticlinal pitches in a south-westerly direction, the axis passing through Amri Talab and farther on in the direction of Shams Pir Island, which is a rocky island within the Kiamari Lagoon. The elevation of the anticlinal near the sea is very slight. Between Maurypur Road and high water line, it is represented by isolated flat-topped hillocks capped by post-tertiary conglomerates. This anticlinal is followed to the west by a synclinal forming a re-entrant and drained by the Leyar Nadi.

Structure and Nature of the Rocks

The oldest rocks exposed in the core of the spur, round the central hill-mass, belong to the Nari group (Lower Miocene and Oligocene). They are mainly composed of massive, thick-bedded sandstones, with a few bands of clay, shale or iron stone. Towards the base, brown and yellow limestones are met with but they are subordinate to other formations. Overlying Nari rocks are the Gaj series (Miocene), a mass of highly fossiliferous, pale or buff-coloured limestones, with some bands of clays and sandstones. Above them are Manchar rocks (Pliocene) consisting mainly of clays, sandstones and conglomerates. There is a complete passage from one group to the other and no unconformity is observable. The Manchars are capped unconformably by a mass of coarse, massive post-tertiary conglomerate. Thus the whole structure is composed of alternating beds of varying durability.

Disturbances in the Rocks

According to Dr. Crookshanks, the folds in the Karachi area have resulted from the lateral compressions acting in north-westerly and east-north-easterly directions. North-westerly compression has been much more important, and has produced the three anticlinal folds of this area. Rocks to the north-west of Karachi have been bent into sharp fold. But its effect gradually diminishes towards the south-east. The east-north-easterly compression has been on a much smaller scale. It has given a dome-like structure to the Drigh Road hills and has resulted in the formation of the Mangho Pir spur, projecting southwards from the main anticline. This secondary anticlinal is asymmetrical in form, the dips being much steeper on the eastern flank than they are on the west.

In the conglomeratic beds of the upper Manchars, pebbles of nummulitic limestones and Gaj limestones are common. This shows, as indicated by Blanford in "Geology of Western Sind", that these older tertiary beds had been upheaved and denuded in the later Manchar period, though there is no unconformity between these and the later formations. Thus, according to Blanford, the earth movement in Sind commenced during the deposition of the Manchar beds but the greater changes took place after the highest Manchar strata had been deposited, as all the beds dip conformably. The post-tertiary conglomerates overlie the Manchars unconformably. They too are not perfectly horizontal, but tilt slightly with the lower rocks, indicating that the movement has continued even after the formation of the post-tertiary conglomerates. Oyster shells are found occasionally associated with these conglomerates, showing that they have been formed along the coast, and all the formations have finally been uplifted vertically after the formation of these sub-recent conglomerates.

Faults and Fissures Traversing the Spur

In the Kohistan Mahal area, Blanford has traced many strike faults and crush zones along the anticlinal axes. Anticlines often give place to strike faults and vice versa. In this area we are not sure whether the Hab valley north of the Mangho Pir area is due

entirely to erosion or if some strike fault in the main anticline has helped in the valley formation. But, during the earth movements and subsequently, numerous transverse faults have been formed. The entire limb to the south Hab has been divided into segments by these faults with varying downthrows.

The longest fault is that which passes through the Mangho Pir hill proper in a north-north-west-south-south-east direction. It traverses the entire width of this secondary anticlinal as well as the synclinal to the west. North of the peak marked 582 on the map, the fault bifurcates and the two branches finally disappear beneath the alluvium of the Hab valley. The downthrow has been to the north-east of the fault-lines, being greater along the eastern branch, with the result that the anticline, here has become narrower, the ridges coming nearer to the axis and the syncline to the west has become wider, its margins jutting out of the line of the strata dipping inward. The spring below the Ziarat lies on this fault. This fault appears to be a reverse fault and for some distance towards the southern end it has become a strike fault. Its fault-scarp has not yet been wholly obliterated by erosion. In the case of other faults no fault-scarps exist, and they can only be recognised by the apparent horizontal shift of the strata.

To the north, within a distance of less than five miles, three more faults, running parallel to the first, cross the whole succession of the ridges. The downthrow has been, except in case of the second one, successively to the north resulting in the shift of the strata to the west. Numerous springs are found along these faults. A reverse fault is also noticed on the right of the Orangi gorge, where strata have been bent into a minor anticlinal, broken on the crest, with hade to the west and downthrow to the east. The gorge itself marks the position of a minor down warp to the east of the fault. But above the gorge the stream follows the line of the fault. To the south-west the anticline has been badly denuded and it is difficult to trace any faults there. Apart from the larger faults mentioned, there are a large number of minor faults and fractures which can easily be seen on the aerial photographs of the area under stereoscope.

Climatic Effects

The climate of the area is arid, the annual rainfall being below 10 inches. It is concentrated mostly in a few weeks of the monsoon season, and occurs generally in heavy downpours, causing heavy run-off and flooding the dry channels. The rainfall is extremely variable, ranging from 0.47 inches in 1871 to 28.00 inches in 1869 and 26.63 inches in 1944 at Manora. In the 95 year rainfall records of Manora (1856–1950) there were 24 years with rainfall above 10 inches and 7 years with more than 20 inches. Thus a few years of meagre rainfall are always followed by a year or more with rainfall much above normal.

Temperatures during summer are very high, mean monthly maximum temperatures at Manora, from March to July being above 90°F and in May 96°F, while at Drigh Road the mean for May is 110°F. Extreme temperatures are still higher. Insolation is very intense during summer and even in winter it is considerable. Temperature ranges are also high. Wind velocity during monsoon season is high, being about 15 m.p.h. and increases towards the afternoon. Vegetation is scanty, providing little protection to the surface.

Evolution of the Present Landscape

It has already been mentioned that the older rocks had been uplifted even before the upper Manchars were deposited, and were subjected to the process of denudation. The work of destruction had already advanced considerably before the upheaval finally came to a close. After the final uplift, the anticlinal, composed of alternate beds of varying durability, with its broken summit, and shattered with numerous large and small faults, was subjected to rapid erosion. Under subtropical sun and arid conditions, mechanical disintegration, particularly exfoliation due to alternate heating and cooling of the rocks was more important than chemical or biological processes of decay. Wind was also an important agent in eroding and transporting the rock waste. But the running water was still the far more dominant agency in the destruction of the relief and the transport of the products of different processes of decay, particularly during the wetter years. Most of the landforms have been evolved by the

fluvial cycle, of course, modified and retarded in progress by the aridity of the region.

After the emergence of the land, longitudinal consequent streams started in the synclinal valley, now occupied by the Lyari east of the anticline, and in the re-entrant valley to the west. Secondary or transverse consequents started down the two flanks, joining the primary consequents. These rapid torrents, active only for a short period, during the rainy season, quickly removed the upper soft strata and selected lines of weakness, particularly faults and fissures, and also joints in the limestones. As they entrenched deeper into the flanks of the anticlinal, they encountered more weaker beds of soft sandstones, clays and shales. Into these weaker beds, started subsequent tributaries, advancing headwards, forming and lengthening the subsequent valleys. Obsequent and secondary dip-streams joined these subsequents, from the scarp and dip slopes respectively. This pattern is best represented by the well-integrated system of the Orangi Nadi and its tributaries.

Dip slopes were formed of the hard limestones, which under dry conditions prove more durable rocks. But in the scarp slopes under the limestones, were exposed strata of less durability and the obsequent streams eroded headwards rapidly into the escarpments. Erosion on the dip slopes was much slower and the law of equal declivity could not work here. Due to this differential denudation, the escarpments receded rapidly under the law of homoclinal shifting. With the retreat of the scarpments, the subsequent streams shifted down in the direction of the dips, thus reducing the elevation of the ridges. The retreat of the scarpments was naturally more rapid where the dips were less steep. Consequently, the valleys formed over the strata with gentle dips were broader compared to the valleys over the steeply dipping strata. Dips on the eastern flank are much steeper, hence the valleys are narrower and the subsequent ridges close together and the relief to this side is comparatively sharp. But over the western flank and in the direction of the pitch, strata dip less steeply and therefore, the valleys to this side become much broader and the ridges far apart. Through these processes the land has been maturely dissected.

Under arid conditions the control of the structural features in the evolution of the present landscape has been dominant. The anticline pitches to the south-west and the strata are inclined at an angle of over 10° in this direction. Towards the "nose" of the anticline, the strata curve round. The ridges in this direction assume a roughly semi-circular pattern of infacing cuestas and hogbacks. Streams also follow the same trend. North of Mangho Pir the core of the anticline has been entirely eroded. The infacing cuestas here are only less than a mile apart and run in a north-south direction. Towards the western flank in the north, the strata again turn round the re-entrant to the west and form an S-shaped curve. All the lines of the ridges and the intervening valleys follow the same alignment.

The varying dips of the strata have influenced the shaping of the ridges in another way. On the eastern flank in the outer ridges, south of Mangho Pir village, the dips are steep, generally above 35°. It has resulted in the formation of narrow hogback ridges. They are continuous except where they have been breached by the faults. While on the western flank dips are gentle, ranging between 7° and 15° and have resulted in the formation of cuestas. The outer ridges on this side are much broader and have long and gentle slopes formed of Gaj limestone. Water, here, has better chance of accumulating into larger streams and causing much more erosion due to solution of the limestones, and thus bottle-necked valleys have been formed on these slopes. Tributaries of the Orangi Nadi have also eroded deeply, scalloping the scarpment. In this way, the outer ring of the hills has been breached through at many places by the streams and divided into triangular hill masses, with their bases to the west and the apices to the east. The infaces of these hill masses rise in terraces. The highest point lies near the apex. In some cases, this highest point at higher elevation, has been isolated from the main hill by a little col, and from there the cut-off portion rises as a perfectly conical hill.

Drainage Pattern

The drainage lines are represented by the dry beds of hill torrents. Clearly defined and well-integrated channels are found

only in the southern half of the area. The greater part of this section is drained by the Orangi Nadi towards the Lyari. Its course runs obliquely across the axis of the anticline and drains a considerable area also to the west of it. All its tributaries are subsequents. Adjustment to the structure is more or less complete, and drainage has a trellised pattern. All the tributaries, even in the hilly tract, have accordant junctions. The Orangi itself within the hilly tract, at a few places is crossed by low limestone ridges, dipping downstream which serve as local base-levels and the curve of the stream is not perfectly smooth. In the northern section, covering the upper portion of the syncline as well as the anticline, valleys are much broader, flat and smooth. Most of this area drains towards the Hab river, which is a perennial, much larger and more vigorous stream and occupies an anticlinal erosion valley to the north of the area. The bed of the Hab river, serving as local base-level for the streams joining from Mangho Pir area, is nearly 60 feet lower compared to that of the Lyari, and much of the area has been added to the Hab drainage system by the process of river capture or recession of the water-shed. In this section there are very well-defined channels, and drainage seems to have been disintegrated. The rocks underlying the broad valleys are soft Nari sandstones. Deflation by wind appears to be more important in this section. Accumulation of wind-blown sands can be seen at different places on the leeward side of the hills. Human interference may be another factor in the disintegration of the meagre drainage. All over the area earth-dams have been thrown across the minor streams to hold the water in the fields for dry farming. As the topography becomes more and more subdued, the wind action will be more dominant and a true arid cycle may be introduced, which may ultimately modify all the forms evolved by stream action, unless fresh upheaval of the land accelerates other degrading processes.

Minor Landforms

Piedmont zone: Along the eastern flank of the spur there is a narrow belt, where the soft rocks of the upper Gaj and the Manchars have been entirely planed off by the lateral erosion. The eroded platform is thinly covered with rainwash and wind-blown sand or loess. A few isolated limestone ridges within the upper Gaj section,

rise from the level surface in the form of monadnocks. Such residual hillocks can be seen within the limits of the Industrial Trading Estate. In this belt, the streams, emerging out of the hilly tract, remain in their tributary stage. Beyond this they divide into distributaries and form low alluvial fans. The transition from the alluvial plain of the Lyari through the zone of alluvial fans or the bahada to the eroded platform is rather gradual. But beyond this the hills rise very abruptly to form hogbacks or steep cuestas. Their outer slopes are bare, rocky, smooth and wind-swept, and at the foot there is the accumulation of scree.

Towards the inface, below the vertical face, or at places even overhanging limestone beds, the slope is covered with talus and is strewn with large boulders broken from the overhanging ledges. Along the foot a thick bed of soft yellow shale is exposed. It is deeply gullied and the interfluves form a succession of low rounded hillocks or mounds all along the foot of the hills. Along the western margin of the Orangi basin the receding cuestas have left behind a narrow strip of pediments, which towards the foot of the cuestas, rise in terraces. In this zone some headward eroding tributaries of the Orangi have developed an amphitheatre-like feature. A similar pediment formation is observed at the northern foot of the Ghoralaki hill.

Valley plains: Valleys between the Orangi and the Ghoralaki hills are comparatively narrow, long and rather straight. In form they are asymmetrical and open V-shaped. Gully erosion is every-where in evidence. In the western half of the Orangi basin, valleys are broader, but the valley bottoms are not flat and smooth, and present a rolling topography. Between the valley plains rise isolated residual hills. Gully erosion is noticeable along the banks of the streams, while over the interfluves sheet erosion is dominant. It has removed the finer particles from the soil and the upper layer has become sandy and is now covered with a layer of thin chips of limestone, a product of exfoliation, washed down from the hill slopes. Below a few inches the soil is still fine-textured.

In the Halkani and round Mangho Pir village, valleys are much broader, with flat and smooth bottoms. Wind erosion is more

vigorous. North of Ghoralaki hill, the east-west alignment of the valley and a breach in the hills to the east, provide a free passage to the strong westerly or south-westerly winds, and a shallow depression or a playa has been formed by wind erosion. After rains it is filled with water and a considerable area becomes marshy. To the south-east, within the eastern bend of Ghoralaki hill, the whole area is covered with loess. North of Mangho Pir village also some valleys within the north-south running hills are covered with windblown material derived from the northern Halkani or the Hab valley.

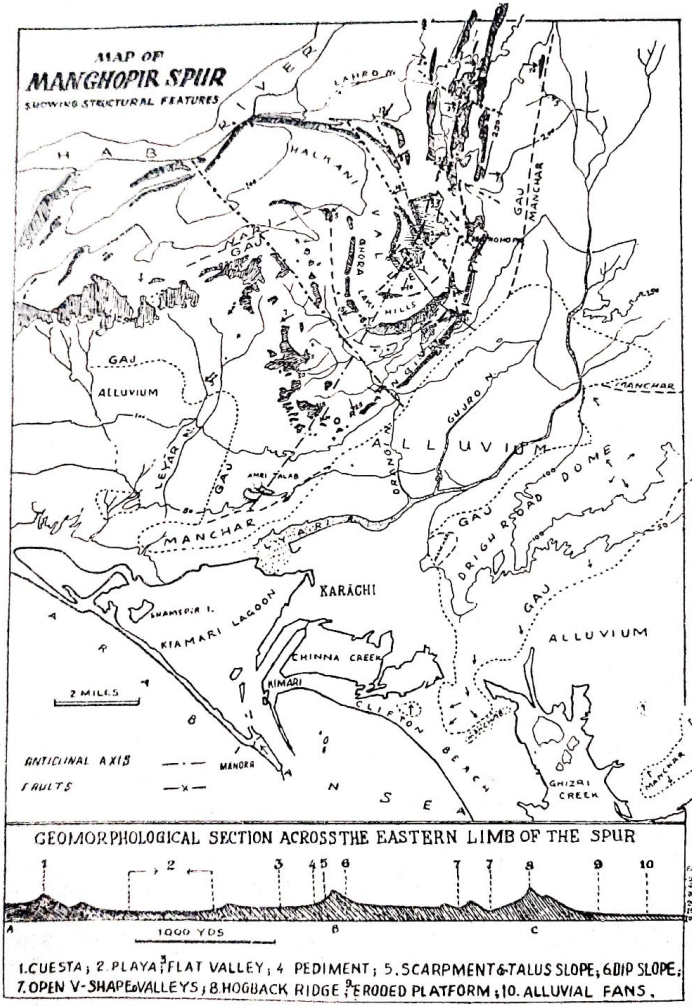
Rejuvenation of the Cycle of Erosion

There is clear evidence of recent upheaval and acceleration of erosion. There are high cliffs of marine erosion, marked with sea-caves, near Clifton and also beyond the Hab in the Lasbela State, extending for many miles, which now stand far from the sea. Near Cape Monze, much above the high water mark, there is a narrow wave-cut bench, over which there are heaps of oyster shells attached to the rocks, and the hard limestone rock is pitted with circular holes bored by marine organisms. Blanford has noted, near the mouth of the Hab, a raised oyster bed about 50 feet above high water mark. All this shows that the land has risen quite recently.

This uplift of land has resulted in lowering the base-level, and rejuvenating the rivers. Their gradients in the lower courses have increased and they have started degrading their channels. In their lower courses a few miles from the mouth, minor rapids have been formed. In the Lyari Nadi a narrow channel within the bed, a valley in valley, has been formed and the rapid and the nick are working upstream. A similar feature can be seen in the bed of the Orangi above its junction with the Lyari.

Role of Mangho Pir Spur in the Formation of the Karachi Harbour

The coast of the Karachi area is a coast of transverse deformation. Anticlines and synclines, all with a pitch roughly to the south-west, run transversely to the sea. Initially the anticlines formed headlands, and the lower parts of the intervening synclines were submerged and formed embayments. Headlands extended farther



1. CUESTA; 2. PLAYA; 3. FLAT VALLEY; 4. PEDIMENT; 5. SCARPMENT & TALUS SLOPE; 6. DIP SLOPE; 7. OPEN V-SHAPED VALLEYS; 8. HOGBACK RIDGE; 9. ERODED PLATFORM; 10. ALLUVIAL FANS.

into the sea and the synclines farther inland. The Mangho Pir spur formed a smaller headland between the two larger ones extending beyond Manora Island and Cape Monze. It was separated from these headlands by two bays, that of the lower Lyari syncline and the other of the re-entrant to the west, respectively.

Thus, an indented shore line, in a general way similar to that of a submerged coast, was produced, and the rectification of the coastal outline started. The headlands were subjected to the severe attacks of the waves. The process of retrogradation is still proceeding rapidly between Cape Monze and Hawkes Bay. Manora headland, composed of weak Manchar rocks capped by quaternary conglomerate, yielded more easily to the marine abrasion. Manora, Kiamari and a few more islets are the only remnants of this headland.

At the same time, bays were being filled up with the material brought by the streams and also shore drift. Now the direction of the Monsoon current along this coast is mainly from the north-west. This littoral current transported silt and sand, derived from the Cape Monze and other headlands, across the bay mouths, and spits were formed on the lee side of the headlands which gradually grew into bars. A similar spit on the lee side of Mangho Pir spur near Shams Pir grew outward to form a bay bar which joined it to Manora. A similar but smaller bay bar joined the northern peninsula to the spur. Thus, a lagoon was formed behind these two bars, hinged at the headland of the spur, which now serves as the harbour. The present condition of the harbour is the result of modification due to recent uplift and engineering works.

Influence of the Geomorphic Features on Human Settlements

The influence of geomorphology is reflected in the pattern of human settlements in this area. The hilly tracts provide rough pasture for cattle, sheep and goats. In the valleys are found some good tracts of cultivable land, but the rainfall is scanty. Cultivation is possible only after rains, in the field enclosed by earthen dams, by dry farming methods. So the people come and settle temporarily in these parts either for cultivation or grazing. Permanent settlements are found only near the permanent supply of drinking water, which

can be obtained from the Hab river, or a few wells in the dry beds of some streams, or from the springs. The springs are the most important source of supply within the hilly area. All these springs are situated along or near some fault, crossing these hills, and all of them are localized in a single formation of coarse, gritty sandstone between two compact beds of limestones, near the junction of the Gaj and the Nari groups. The same formation is met with at ʃal Chakro, at Mangho Pir, and extends far to the north. More than a dozen springs are found within a distance of about 10 miles. Most of he permanent settlements are found near these springs, which supply water for drinking and in some cases a small quantity for irrigating the date-palm groves, and also supporting a little cultivation.

Conclusion

Thus, the Mangho Pir area is an excellent example of geomorphological peculiarities and their effects on human life and of what nature has in store for man within a short distance from the city of Karachi.