MORPHOLOGY OF NORTH KOEL BASIN

The North Koel basin depicts a panorama of varied relief features. It is a complex region of Chotanagpur plateau where the landscape is characterized by imposing Pats, scarps and rivers having some of the highest waterfalls of the Chotanagpur plateau, Pat girt alluvial basin of Chechari and the alluvial valley of Amanat and North Koel river in the lower part. The variety in geological and lithostratigraphic units provides a base for the remarkable features of the landscape. Alluvium has covered the basement rock and in some places basement rock peeps through the alluvium. The area passed through a constant process of denudation as there is no evidence of primary marine transgression in this region. The region faced various climatic epochs which represent the semi-arid, sub-humid, glacial, and humid climate which envisaged the weathering of rocks by different agencies.

The four distinct morphological features the Pats, scarps, dissected uplands and valley flats have evolved through the cyclic development which is interrupted by diastrophic movement and lava spreading. The morphometric analysis has revealed that the region faced nine cycles of erosion. The hills and ridges trend along the ENE-WSW.

The North Koel basin consists of Hazaribagh plateau in the NE, Ranchi plateau in the SE and dissected terrain of Palamau for the major part of the basin and the alluvial valley of North Koel in the central part. The mesas and buttes covered with laterite mainly are locally termed as Pats in Chotanagpur Plateau. The Pats are found in the southern part of the basin on the either side of the North Koel valley. The Pats are flanked by scarps which exhibit steep slopes. The Pats are dissected by the North Koel river into eastern and western segments.

The dissected uplands of Palamau are distinct in the north of the Pat region. This is an undulating plateau region with hills abruptly projecting above the plateau dissected by the North Koel river into western and eastern segments. The dissected uplands are also flanked by scarps.

The scarps are the conspicuous features in the North Koel basin. They are divided into Pat scarps and upland scarps. Both the Pat scarps and upland scarps have steep slopes. The scarps are the sharp edges of successive highlands. The rivers have steep gradient over the scarps. The notable scarps are found in the east of Netarhat, Pakri Pat and Bagru hills. The steeper slopes are rocky and
MORPHOLOGY
NORTH KOEL BASIN

Morphological Divisions

Primary
Secondary
Tertiary

FIG 6.1
The soil in the lower parts of the scarps is thicker and mixed with boulders and rock fragments. The scarp topography along with the laterite cover is responsible for the occurrence of springs. There are also scarp falls.

The scars of the area reveal four elements:

1. The upper gentle convex slope,
2. Steep rocky slope occurring below 1,
3. Debris covered slope occurring below 2,
4. The gentle concave lowest slope.

The four elements of slopes proposed by L.C. King may be correlated with the above noted features of Palamau scarps, 1) waxing slope, 2) free face, 3) debris slope, 4) waning slope fig.6.1 represents the model.

The scarps of Pat region are imposing. The scarps of dissected upland in the north are broken by tributaries of North Koel.

Some authors have proposed their views regarding the origin of scarps. According to their views scarps are formed due to faulting and warping but they have failed to demarcate faulting in the fields (E. Ahmed & P. Devi 1965). The course of the North Koel river and the alignment of the scarps is distinctly parallel in the upper part. It leads to infer that the scarps are formed by parallel retreat. Therefore, the origin of scarps may be envisaged in the manner as proposed by L.C. King by the theory of parallel retreat.

The North Koel river carves out a well defined elongated valley in western higher plateau of Ranchi and the dissected upland of Palamau. This central valley is broad in the lower part. The North Koel river exhibits river terraces. The valley represents the impact of diastrophic and climatic epochs which is depicted by several geomorphic features revealing evidence of rejuvenation. The Central Valley is divided into upper, middle and lower. The alluvial valley extends from Daltenganj to Sonegarh upto the confluence with Son river.

Considering the above discussion the North Koel Basin may be divided into three major morphological units. I) Pats in the south, II) dissected uplands of the north III) the Central Valley. These three units of first order are further subdivided into second and third order sub-units based on the landform consideration and morphometric characteristics of the region. The primary and secondary regions are shown in the map 6.2. The morphometric characteristics are depicted in table 6.1. The scarps are discussed along with Pats and uplands.
HILL SLOPE

Standard Hill Slope Of L.C. King

Hill Slope Of Netarhat Facing N.Koel River
THE PATS

The Pats are the highlands covered with duricrust mainly extend northwards from the source of the North Koel river to the south of the major bend of North Koel river towards the west. The Pats exhibit the highest altitude of the basin. The formation of laterite on the top of hills might have been responsible for the preservation of relatively higher altitude. The Pats are divided by numerous affluents of North Koel into isolated tableland similar to mesa and buttes. The altitude of Pats varies between 914-1164 m. The Pats in the east are characterized by the presence of concretions of bauxite. The weathering process under certain circumstances leads to the formation of a profile of laterite comprised of a) top zone of concentration of iron oxides, b) a mottled zone, c) the lowest zone of weathering called the pallid zone. The last zone grades into unaltered rocks. The age of planar surfaces is the age of laterization.

These Pats are flanked by scarps having steep slopes. These isolated tablelands have maintained their flat tops and are formed on the basaltic cover which has been converted to laterite due to process of weathering. The junction between the gneissic terrain and the base of laterite capping is exposed at the highlands. The Pats extend from the borders of Madhya Pradesh and Bihar to the east upto the North Koel basin perimeter. The notable Pats of the region are Netarhat, Jamira, Bagru, Orsa, Serengdag, Mandua, Rudni, etc. The Pats are basically divided into two parts by the North Koel river - the western and the eastern segments.

A. THE WESTERN PAT

It extends west from the source of North Koel river upto the Darichapahar in the north. The Pat lands are broken by the Dhardhari, and some important tributaries of the North Koel river. Therefore the Pat lands of the west are further subdivided into five units of third order 1) Narrow Pat. 2) Extensive Pat from Birpokhar to the confluence of Dhardhari 3) Netarhat Pat 4) dissected hills of Lawai Pahar 5) Orsa and Jamira Pat. These five units of third order are further subdivided into six units of fourth order. This is one of the most extensive Pat land of the North Koel basin. The highest altitude of the basin is also noted here. The summit height of these Pats is generally above 914 m.
1. **Narrow Pat**

The Narrow Pat is flanked by scarps with steep slopes extend from the source of the North Koel to the confluence of Dhardhari river. The course of the North Koel is parallel with the alignment of the Pats. The height increases from 929 to 1010 m from south to north. The spurs project eastward which are dissected by the rivulets.

2. **Extensive Pat land**

Extensive Patland known as Pakri Pat extends sinuously and becomes broader from the confluence of Dhardhari with North Koel river to the Birpokhar in the north and Chechari basin in the west. It is also known a Pakri Pat. The altitude varies between 609 - 1102 m. The Dhardhari river has entrenched its valley in the laterite capped Pat and revealed the underlying granitic rock. This region represents the obsequent drainage of Dhardhari and the boat hook shape of the tributaries. The notable Pat is Dumbar 1036 m. There are narrow valleys. An eastward projection of this Pat forms spur of quartzite and lime silicate rocks which is responsible for the constriction of the valley of the North Koel river.

Chundku Pahar (823 m) is a conical hill. The Asiria (864 m) Dhaja (1012 m) are notable. The mesa like elongated Pat of Birpokhar 1102 m extends SE to NW. The interfluence between Beti and Narma is known as Gamhar Pat 991 m. The drainage texture is coarse. The Birpokhar represents three distinct erosion surfaces at the altitude of 1102 m, 990 m, 609 m which is distinctly visible in aerial photograph. (Photo could not be produced as it is restricted).

3. **Netarhat Pat**

Netarhat group of Pats is a massive tabular block having steep scarps overlooking the North Koel in the east, Kohabarwa in the NW and Chechari basin in the west. This has been dissected by rivers into smaller Pat region, a) Netarhat Pat, b) Joradumar Pahar, c) Darichapahar.

a) **Netarhat Pat**

The Netarhat Pat is 1070 m high and extends 18 km N - S and 2 - 3 Km east to west at the top. The streams have specifically dissected the region into triangular facets. Netarhat Pat forms the water divide between the drainage flowing to west into Chechari basin and to the east to north Koel. Netarhat scarp in the east is high and steep slopes even 70° is noted. Rock faces are also found. Deeply weathered rocks are notable. The Nahir valley forms gorge on the western scarp of Netarhat.
The Orsa Pat sloping towards Burha valley and the dissected scarp and the badland

The incised gullies notable on the scarp of Orsa Pat
Three levels of hills of Orsa Pat and the alluvial Chechari basin

The upper part of Burhagagh and the highly weathered rocks showing block disintegration
The plateau top depicts evenness of the surface underlain with laterite. Magnolia Point on the western edge of the plateau overlooks Chechari basin. The Netarhat surface represents the oldest planation level having undergone degradation. The water passes from the surface through pore spaces of thick stratum of laterite and protects it from erosion. The climate has changed from semi-arid to humid. The erosion has not stopped which is evident by steep gradient of streams. There is deeply weathered quartzite lying as soft powdery mass on the scarp faces near Netarhat plateau scarp. The thick mantle is due to more humid climate. In an earlier climate a planation surface characterized by extensive exposures of bed rock had been formed. Later a higher rate of weathering encumbered the bed rock with the mantle of waste.

b) Joradumar Pahar

The northern part of Netarhat plateau is known a Daswan Pat (609 - 1105 m). The Pandra nadi has dissected it into two parts the Daswan Pat and Joradumar Pahar (1099 m) and one promontary in SW is Garitam Pahar (1097 m) elongated NE to SW. Pandra Nadi forms one waterfall 15 m high at 889 m altitude and another Ghaghri falls 42 m high. The river forms gorge in the scarps. The Daswan Pat is dissected by Pandra, Dhardhari and Kohabarwa. Chiria Pass (792 m) provides communication from east to west.

c) Darichapahar

The Darichapahar situated in the north is dissected into triangular facets by the Dhardhari and Suelakhar rivers. Darichapahar is a group of dissected hills with steep slopes on the east and north. The drainage density is high. Daricha 1107 m, Bela 1070 m a conical hill, Kesra 1021 m a rounded hill, Roha 914 m, Bahadur 792 m are notable Pahars. This region rises above 609 m surface. Bela Pahar is a group of rounded hill. The altitude is low in the central part.

4. Dissected Pats & hills

It extends south west of Netarhat plateau girdling the Chechari basin in the south east.

This region is characterized by complicated lithology. There are dolerite, lime silicate, and quartzite mainly and granite gneiss also. This region is intricately dissected by north flowing Burha and south flowing Sankh river. The Barpat mesa 1103 m is dissected and overlooks its lower buttes in the north 928 m and 838 m. The region to the east of Barpat is eroded to low hills e.g. Tahir 884 m. Lawai
The water descends in steps in the middle part of the Burhagagh

The block disintegration of rocks
Joints in the country rock responsible for step falls

The water falls through four channels in the lower part
Pahar 884 m is composed of pseudo-diorite a rounded hill. Chormanrwa 1082 m is a mesa. The barbed hook drainage pattern gives clue to river capture. The Son river was perhaps flowing towards north and the capture of Sankh led to the division of drainage into two parts and the Burha drainage was separated from the Sankh drainage. Sisitongri 1084 m is laterite capped granitic dome with ring like drainage pattern. Domuhani nadi has carved its valley in phyllite rocks and forms gorge in the upper part. South of this the lime silicate rocks represent converging dip exhibiting synclinal tendency. The Chapikona nadi carving its valley in granite, pseudo diorite and lime silicate rocks forms two important waterfalls i.e. Gutamgagh 36 m near Nowatoli at 838 m altitude and another Choraghug-hragagh 7.6 m falls at 746 m altitude. This fall shows narrow and steep valley. The flat topped hill 914 m on the east represents a well defined erosion level.

5. Orsa & Jamira Pat

This is one of the loftiest and highest Pat region extending northwards from the source of the Burha river. It is divided into a) Orsa, b) Jamira and c) Pat & hills.

a) Orsa Pat

Orsa Pat 1110 m extends from the source of the Burha river to the Burhagagh Falls. The mesa like flat top gave rise to settlement. The incised valley of Burha shows high sinuosity over this Pat. The scarps overlooking the Chechari basin are very steep and covered with weathered materials through which the country rock is exposed occasionally. The triangular facets extend towards the Chechari basin. The debris slope of the scarps covered with alluvial soil is generally cultivated. The peculiar feature of the scarps is the soil cover in the lower part. The scarp near Burhagagh falls represents alluvium in the lower part and red soil and coarse sandy soil in the upper part. The patches of black soil of the region indicate the presence of trap rock. The Burhagagh Falls is 111 m high and descends in four steps. The water during the dry season falls through two channels and a narrow precipitous wall divides the two branches. The water of the river is cooler than usual. The block disintegration of granite gneissic rock produced rectangular blocks piled upon each other. The four steps of the waterfall may be correlated with the four major erosion surfaces of the area. The four steps of the falls represent four phases of upliftment which is experienced by the area. The river here exhibits pebbles and alluvium also. Thus the stream represents clearly the rejuvenated features. Burha is a perennial stream here.
Fluvial action has polished the rocks and potholes in the lower part of Burhagagh.

Hatma Pahar forming the eastern limit of dissected ridge.
b) Jamira Pat

Jamira Pat (1067 m) is an extensive laterite capped tableland extends north of Burhagagh falls to the Sugabandh falls. The highest point of Jamira Pat is 1164 m and at Tamolgarh 1143 m an ancient fort is visible. The Mur nala shows incised meanders over Jamira Pat. There are rapids also in the course of the river. This region exhibits rugged topography. The course of the Burha is parallel with the scarps and may be assumed to be formed by parallel retreat of scarps. Drainage texture is fine. The headward erosion by streams is notable. Murli Pahar in the north eastern end of Jamira Pat represents break of slope. The region is composed of gneissic rock. The linear ridge from NE to SW has been formed which follows the foliation of the rock. The Burha river cuts across them transversely and forms Sugabandh falls.

c) Pat and hills

This Pat region is the continuation of Jamira Pat which is situated at the southern perimeter of Haraiya river. Nawadih mesa shows the highest altitude (1164 m) of the North Koel basin. The streams from this region flow north into Haraiya and Burha and south into Kanhar.

The hilly region drained by Butahi and Bargak shows certain peculiar features. The Karra Pahar (977 m) is a rounded hill with steep slopes. Lachchupat (954 m) is a group of four hills which are parallel and elongated NW to SE. These hills e.g. Sowatongri (945 m) show break of slope i.e. very steep nearly vertical slope at the upper edge. The altitude decreases from S to N. The notable levels are 960 m, 838 m, 636 m. Sowatongri exhibits steep slopes on the N and W and gentle slope in the S and E. Gulgulpat (1164 m) shows highest altitude of the basin. The Bargak river forms three waterfalls in the region: 3 m high at 945 m, 6 m at 838 m, and 30 m at 696 m level. These falls represent knickpoints and this view is supported by the summit heights of Lachchupat also. The relief is rugged. The valley of Bargak is wide and open between 457 to 533 m and it is replaced by steep valley and falls 4.5 m at 457 m level. The crescent shaped hill has influenced the course of the river. Charwa Pahar 518 m is also elongated in NE to SW direction which is due to the trend of foliation in the gneissic rock. Gano Pahar (442 m) shows a 30 m fall on a tributary of Gunga Nadi.

B. The Eastern Pat

This Patland extends eastwards from the North Koel valley upto the basin perimeter in the east. This is one of the most extensive Patland of Chotanagpur
plateau and notable for the presence of concretions of bauxite. There are isolated tablelands with evenness of the top of the surface. The extension of these Pats in the east is much more than the westward extension of the Western Pat. The height of the Pats increases from S to N. The scarps on the east facing the South Koel river show very steep slope and rise abruptly from the floor of South Koel valley. The scarps of the west overlooking the North Koel valley are not so steep. Considering the major isolated blocks this Pat region is further subdivided into three units of third order 1) South Eastern Pat, 2) Bar and Kondlepat, 3) Serengdag group of Patlands in the north.

1. South Eastern Pat

It extends NW from the source of the North Koel river to the Bhanwar Pahar in the north. This Patland is dissected into small hills mainly by Bandi Koel and Jowa.

Buku Pahar is the dissected Patland extending south of the confluence of Bandi Koel with the North Koel river. The water divide between the South Koel and North Koel is identical with the direction of the North Koel river. The great distance between the En. perimeter and the North Koel valley represents the extensive nature of the Patlands. The altitude increases from 945 m in the S to 1006 m in the N. The dissection of the area by numerous gullies have given various shapes to these erosional remnants. The headward erosion by Bandi Koel flowing to the west & Turgo nadi flowing to the east have dissected the hill near Sargaon into a col with the two sides of the hill looking just like the wings of a butterfly. Buku Pahar 984 m extends NE to SW but dissected on all sides. The region south of Bhelwadih is dissected into isolated hills by river. The altitude is 1006 m. The smaller buttes form triaxial arrangement.

Bhanwar Pahar is bounded by Jowa valley in the NE and North Koel in the SW. This is a sinous ridge (685 - 945 m) which runs from SE to NW and formed by lime silicate rock which is less susceptible to erosion by water. The hard and resistance rocks of this Pahar constricted the valley of North Koel. Bhanwar Pahar (948 m) is a conical hill with steep slopes. The other hills of this ridge are flat topped. The dissection by Jowa and North Koel have formed Doarsini Pass in this ridge. This ridge is broader in the SE. The southern part shows triangular facets.
The Bandi Koel river principally has dissected these Patlands into two parts and the river flows through the middle part. The valley runs from SE to NW. The altitude varies between 685 & 838 m.

2. **Bar & Kondle Pat**

The Patland between Jowa and Phulijhar valley is a dissected rectangular Pat extending from SE to NW surrounded by steep scarps. The Nakti Pahar Barpat area (685 m to 1060 m) shows formation of laterite above 838 m. The notable Pats are Bar 1051 m, Kondle 1045 m, Balato 1050 m. Balato Pat shows radial drainage. The tributaries of North Koel river have carved much longer valleys than the tributaries of South Koel river on these Patlands. The river valley in the Ghaghra and Gugurtolli village shows wide valley in the Pat area also. The Ruki Ghat col (792 m) provides communication from E to W. Nakti Pahar 792 m runs from W to E. The course of the rivers are parallel with the scarps facing the Phulijhar valley and Jowa valley.

3. **Serangdag Patlands**

The largest tableland forming the watershed between the North and South Koel rivers has been described as Serangdag after the village of the same name. This tableland is extensive rectangular block showing alignment from SE to NW which has been dissected into smaller tabular blocks by the parallel valleys running from SE to NW direction mainly. These Patlands are divided into 3 regions a) Bagru Pat, b) Kanwa and Dhopad Valley, c) Serangdag plateau.

a) **Bagru Pat**

Bagru hill 1057 m is a triangular mesa rising abruptly 365 m above the gneissic floor overlooking the South Koel river in the east. It extends NW in the form of a narrow ridge known as Karkat Pahar. Garh Pat 1061 m is also a triangular mesa. There are small lateritic hills e.g. Kham Pahar 1026 m. There is a sinuous mesa between Chunghat and Naricha nala. The Bokhara Pahar 1112 m gives rise to radial drainage. There are wide open valleys representing maturity.

b) **Kanwa & Dhopad Valley**

The Kanwa valley is broad and open. Gully erosion is conspicuous. The wide valley in Pat region should represent maturity but subsequent rejuvenation has activated the region as is evident by active headward erosion. The joints in the granitic rocks are responsible for the formation of rectantular bends in the course
of the river. The Dhopad valley is situated between Bokhara Pahar and Mahua and Rudni Pat. The wide valley is bounded by scarps on the NE.

c) Serengdag Plateau

It is a rectangular block dissected by Jori, Ghaghra and Auranga. The narrow valleys have formed the linear mesas. Absolute flat surfaces at the top and steep scarps overlooking the steep and narrow valleys are the characteristic features. The modified trellis drainage pattern reveals the high degree of adjustment between structure and the drainage exhibiting maturity but the rugged topography and steep and narrow valleys with high waterfalls leads to conclude that this is a polycyclic region. The mesas are known by the name of the village. There are valleys which are even 121 m deep. Dudha Pat 1036 m is like the shape of T, Bana Pahar a rounded hill (1021 m). Dhulua Pat is oval shaped (1053 m). Banjaripattoli Pat 1036 m runs from N to S and two parallel streams run on its either side. The Serangdag Pat 1059 m. is 1 to 2 km wide flat surface. Paintalli Pat 1069 m and Garh Hanrup 1051 m are other notable Pats. All these Pats are dissected towards north but they are joined together in the south. These laterite capped Pats occur above 1036 m. The shape of this plateau may be compared to a palm. The NW part which is dissected and separated by the tributaries of North Koel into hills and ridges generally have the alignment from SE to NW and looks like the fingers. The five notable projection towards the NW are i) Turwa Pat (the highland between Chaupat and Ghaghra nala) ii) Serangdag and Mahuapattoli between Ghaghra and Jori nala, iii) Arunachaitan Pahar between Jori and Tithi, iv) Panch Pahar between Tithi and North Koel v) Aonlatoli Pahar.

Turwa Pat 1059 m, 1082 m, Saru Pahar 1092 m mesas are separated by a col form a narrow ridge. Bhonru Pahar 1057 m is a conical hill. The Judwani Pahar 993 m is deeply dissected by Juda which forms gorge 213 m deep. The rivers west of Turwa Pat are guided by the epidioritic intrusions which runs from NE to SW. The valleys and spurs follow these lineaments. Chiria Pahar 846 m is a granitic tor.

Serangdag Pat is a group of five rounded hills lying above 762 m. The height of the top is 914 m. The consequent slope is from SE to NW which is followed by the North Koel but the subsequent slope is NE to SW. Here Serangdag Pat is situated. The Mahuapattoli 1051 m dissected by Nindi and Jori on its either side is 5 km wide at the top. The Mahuapattoli and Pakrapatoli 1066 m are joined in the south. The other Pats are Kabira 1079 m, Dhankat 1067 m. The
Jalimagagh is 36.5 m high. The northern extension is known as Banalal hills. Janhuapat is 884 m high. A ridge running from SE to NW is dotted with five small flat topped hills. This region has narrow and steep valleys with modified trellis pattern and thick cover of laterite which is an indication of maturity leads to conclude that the region is polycyclic in origin.

There is a ridge above 609 m which is marked by two rounded hills-Gatitungri 969 m, another hills 685 m. Arunachaitan Pahar 825 m is a narrow elongated hill. Panch Pahar is a group of five hills. Aonlatoli Pahar 936 m is a conical hill. The radial drainage has developed here. There is exposure of bouldery trap on the northern slopes.

4. Rudni, Pokhra and Mandua Pat

This region of isolated mesas is drained mainly by the Auranga river. The Pats are generally 1067 m high and separates the drainage of North Koel from the South Koel. The Rudni Pat 1064 m and Pokhra Pat 1067 m are separated by a col. The Pokhra Pat 1067 m is a foot shaped mesa bounded by steep scarps on all sides. The Gala nala had dissected it into three parts. The Mahuapat is 1067 m high. Dhauta Pat 1051 m is a narrow flat topped ridge and western slope is nearly vertical. There is a gorge near Lawapani. The notable Pats from SE to NW are Bangla 1071 m, Siskari 1051 m, Garh 1067 m steep slope towards south, Dudhia 1067 m & Lunhri. There are also several small rounded hills which are formed due to erosion. The highly dissected topography, steep valley, scarps at the edge of the ridges and gorge like valleys alternating with wide valleys gives a panorama of landscape in this region. The Gala and its tributaries form an example of trellis drainage pattern.

Manduapat 1067 m. is situated between the headwaters of Auranga and Barpani nala. The Siramkhar nala cuts a gorge on the NWn edge of Manduapat.

There is a region of hills which forms watershed between Auranga and South Koel river. These hills are Khamar Pat 1068 m and Lohandi 991 m. The Birjangha Pahar 969 m is separated from these hills by Birpandhatoli pass.

The Mahua Pat 1067 m. is a rounded flat topped hill and a ridge north of this is marked by Saida Pahar 1052 m a rounded hill, Rotipakhal Pahar 868 m is a flat topped ridge with steep slope.
5. Bulbul hills

This region is situated north of Chaupat and south of Dhardhari valley. The streams have dissected the region into prominent spurs and steep valleys. These features have produced pinnate type of drainage. Bulbul hill is 1021 m high. The relative relief of the southern slope is greater than the northern slope and the southern slope is steeper also. This region extends up to Sonwar village in the west.

II. DISSECTED PALAMAU UPLANDS

The dissected upland of Palamau extends northwards from the northern limit of Patlands. This is an undulating plateau region with scarps which is characterized by erosional remnants rising well above the surface of the plateau. The hills have steep slopes in certain region and represent granitic tors, castle koppie and sometimes flat topped hills formed of sandstone. This dissected terrain of Palamau is divided by the North Koel river into eastern and western segments of second order units. These regions are further subdivided into sub-regions.

A. WESTERN DISSECTED UPLANDS

It extends west of North Koel valley and north of Patlands. The Palamau highlands are dissected by North Koel. They show rugged topography particularly in Haraiya and Burha basin. The upland in the south represents steep slopes and high waterfalls with high gradient of the rivers. It is further subdivided into 7 units. The hills and ridges show alignment from NE to SW.

1. Dissected Plateau

The dissected plateau extends north of the Jamira and Netarhat Pat and bounded by North Koel valley in the north. The streams of the area have divided this into 3 units. a) Kohabarwa Pachnadia Plateau, b) Aksi hill, c) Burha.

a) Kohabarwa Pachnadia Plateau

Kohabarwa plateau is drained by Kohabarwa nadi and the height decreases from SE 1067 m to 381 m in NW. The drainage texture is fine. There is gorge in the course of the river. There is a spring known as Sutapani. The region has rugged topography. Sima Reserved Forest are found on the valley and the highlands. The entrenched character of Kohabarwa nala is conspicuous. The hills run from SW to NE. Bharwarbandh 625 m is an elongated hill. Dhonti Pahar is a rounded hill (588 m).
The Pachnadia Plateau is drained by Pachnadia river. Pachnadia cuts transversely across the ridges and flows north. The topography is rugged. The altitude decreases from 750 m in the south to 350 m in the north. The drainage texture is moderately fine. Harha Pahar 750 m runs from NE to SW.

b) Aksi hills

The crescent Aksi hills dissected by streams is 1068 m high.

c) Burha dissected plateau

It is drained by lower part of Burha and Saneya river. The altitude of Burha plateau is between 350 and 1006 m. Turer 943 m and Burha Pahar 914 m are the two hills on the ridge. Drainage channels radiate in different direction. Bagchungari 635 m is a ridge. The drainage density is high and drainage texture is fine. This plateau represents an ideal example of rejuvenated features of Burha basin.

Saneya highland is drained by Saneya river. Gusain Pahar 545 m represents radial drainage. The Saneya valley is wide and open. The altitude of the region is between 321 and 943 m.

2. Dissected hills of Haraiya basin

This is the most rugged part of North Koel basin characterised by hills and ridges running from west to east and the drainage is parallel in the same direction. The different channels have divided this region into 2 units a) Masuriya and Gunga hills, b) dissected plateau with hills. The region has youthful topography with rapids and waterfalls and combined with braided channel and incised meanders.

a) Masuriya and Gunga hills

These low hills (457 - 646 m) are situated between Saphi river in the north and Gunga in south. The undulating plateau is marked by certain erosional remnants. Lambi Pahar 695 m is a crescent shaped ridge seperated by a col from Sindri Pahar 685 m which is seperated by the trinangular flat topped Semli Pahar 848 m. It represents break of slope between 685 - 762 m. Masuriya river has dissected the northern ridge into two parts - Taiya 685 m and Burha 810 m representing steep slope in the north and south. These hills rise from 533 m. Kani Pahar is a small elongated hill (571 m) in the north. Khaira Pahar 592 m is a nearly vertical rising hill from 381 m altitude. There is a ridge running from west to east dissected into small hills e.g. Khajar 640 m, Jhurma 646 m, Bans 518 m Amohi 571 m - steep slope. The North Koel cuts gorge across Kholu Pahar 494 m. The badland has developed in Gunga valley between 335 - 381 m altitude.
b. Dissected plateau with hills

This plateau with steep slope is situated between Gunga and Kulhi nadi. Mandra Pahar 609 m is a group of hills. The trellis drainage pattern has developed on the southern edge.

3. Saphi Plateau and Hills

This plateau and hilly region is comprised of Archean and Gondwanas. The region is divided into: a) low gently undulating plateau, b) Saphi sandstone hill, c) dissected ridge.

a) Low plateau

The gently sloping plateau shows gully erosion between 442 – 457 m. This plateau above 304 m represents the upper part of Saphi basin and comprised of granite and gneiss. Sonbarsa Pahar 550 m rises above 457 m erosion surface. Sithwa Pahar 653 m shows break of slope at 609 m altitude.

b) Saphi Sandstone Hill

The Mahadeva rocks form a group of hills which is elongated in E - W direction and is characterised by undulating top and escarpment at the edge, e.g. Manga 717 m, Bihi 764 m, Murli 464 m and Garpahari form escarpment in the north. Mirukana 457 m, Choranti Pahar form steep escarpment towards south. The Saphi river forms a picturesque gorge in the sandstone.

c) Dissected ridge

This dissected ridge NE - SW north of Saphi basin extends east up to Hatma Pahar. These dissected hills from west to east are Jharna 511 m, Lambi 486 m, Mall 533 m, Ranimal 464 m, Hatma 352 m. The rivers cut through the ridge and take southerly bend to join North Koel and Saphi river. The northern edge of Ranimal and Bagh Pahar is faulted. The Biridadan Nadi flows along the faulted edge and forms a fall 21 m high and cuts across the ridge to join the North Koel.

4. Undulating Plateau

This undulating plateau is marked by gentle slope and very low erosional remnants. This group of features is on the whole of a subdued nature compared to those described above. It is formed of granite and gneisses.
Harwariya plateau is drained by upper part of the Tahie river. The region between Tetardih and Kuswar is prone to gully erosion. The undulating plateau with gentle slope is composed of hornblende biotite gneiss and granite gneiss. There are certain topographic prominences in the area. Hornblende schist gives rise to small hills e.g. Nawadih 388 m. Sewadih Uchri 595 m is a conical hill with steep slope. The lime silicate rock because of their chemical property form Ban Pahar 330 m which has broken steep slope. Harhi Pahar 365 m is made up of calcium silicate rock. The injection of quartz vein into the country rock and its resistance to weathering has formed a ridge NNE to SSW dissected by Saunri nadi into two parts, Bara Pahar 436 m and Lam Pahar 390 m. Akla hill is also injected by quartz vein. There are intrusions of dyke. Maila Pahar 551 m is a granitic hill. This region has certain natural reservoirs near Udaipur and Chapri which are local deeps in the bed of the river.

The Tahie river forms a gorge north of Sagardinua dissecting the basic dyke. Bhalu Manar group of low hills 335 - 350 m show alignment from SE to NW.

The region to the west which is drained by Arraj river shows the alignment of ridges from SW to NE. Arraj forms a narrow valley in the upper part. Bhaunraha is flat topped hill (459 m). Banda is conical hill 361 m with steep slope. The altitude of the region varies between 228 - 457 m.

The plateau region south of Danro river descends towards Danro river in the form of scarp. The hills are formed of amphibolites with occasional occurrence of lime silicate rocks. The porphyroblastic granite gneiss forms a hill 396 m north of Punwadihi.

The incised meanders of Taraohan nadi near Barwakhar, (23°56'N; 84°5'E) are notable on Kwaldaha plateau. The eastern edge facing the North Koel river shows steep slopes. The Kundel nadi shows 3 m fall. Hornblende schist effects the topography of the region.

5. Plateau

This region of isolated hills marks the watershed between the Danro and Banki drainage system. This is a gently sloping plateau where hills rise steeply from the plateau surface representing lithological variations. There are two rounded hills 474 and 479 m in the west. The Dhamdhamia is a granitic ridge 446 m extending SE to NW. There are doleritic intrusions. There are some isolated granite gneissic hills which are above 304 m. Steeply sloping hills 420 m are marked by migmatites.
The confluence of Saphi river with North Koel river and the sandstone hill on the western bank of North Koel river - Saphi Isolated hills situated in a linear fashion

Isolated hills situated in a linear fashion on either side of Pareya river - Karkatta
on the eastern extension. There are gneissic domes. Jomotia Pahar dissected by rivulets (513 m) rises abruptly from 243 m. The eastern slope forms escarpment. Further south from this there are linear hills and ridges where parallel channels join Danro and North Koel.

6. **Isolated hills**

This group of seven isolated and conical hills rises steeply from the 228 m surface. These hills are Donga 384 m, Lambha 350 m, Majural 311 m and another 412 m situated in a linear fashion on either side of Pareya river.

7. **Dissected plateau**

This plateau extends north of Banki river (L.B.). The limestone show synclinal folding in the west. There are two parallel faults which do not exhibit significant topographic expression. The gneissic hill 372 m is intruded by quartz vein. A narrow elongated WSW to ENE ridge (501 m) of North Koel shows southern faulted boundary. This is injected by quartz vein. There are two cols. East of the ridge there is badland. The plateau region forms scarps of low magnitude in SE facing the Banki river.

**B. EASTERN DISSECTED UPLAND WITH HILLS**

This region extends east of the North Koel valley and north of the Patlands. The region has been dissected into small uplands and hilly region by the tributaries of North Koel river therefore it is further subdivided into 12 regions.

1. **Triangular hilly region**

The triangular hilly region (381-1029 m) is situated between the North Koel valley in the West and Dhardhari valley in the east. The drainage texture is fine. This triangular hilly region has its apex in the south. There are small isolated hills e.g. Badamghat (642 m), Budha (936 m) which represent radial drainage. The general slope of the region is towards north. The hills look towards the flat and wide valley of Dhardhari in the east and narrow valley of Dhaidhong on the west. There is a pass near Sonwar village through which the communication from Aurangia to Chaupat valley is available. Sonwar perhaps is the wind gap town where the diversion of Chaupat river has occurred.

2. **Hilly region**

This granite gneissic region bounded by North Koel in SW is subdivided into: a) dissected plateau, b) dissected hills with steep slopes.
a) Dissected plateau

This is an undulating plateau region east of Garanj nala bounded by Charo
nala in the NW and North Koel river in the south. There are small conical hills
of Tungari (695 m), Bans Pahar (620 m). Tungari shows radial drainage. The Labhar
RF area shows formation of badland. There is foliation trend from NE to SW which
guides the course of Parsapani nala. The Achar hill (486 m) shows steep slopes
in N and S and is dissected into two parts by Paraspani nala. The river forms entrenched
meanders. Paraspani and Satnadia cut transversely across these hills and flow
south to join North Koel. The presence of sillimanite bearing gneisses and schists
constitute a prominent ridge running from NE to SW near Garu (23°40'N ; 84°14'E)
which has guided the course of North Koel river.

b) Dissected hills

The region of dissected hills bounded by Charo nala in the NE and North
Koel in the SW, represents steep slopes, high gradient and high drainage density.
Malhania Pahar is a Barakar grit ridge (488 m). The southern boundary is faulted.
The Satbahini river represents gully erosion north of Malhania Pahar. The major
east west fault crosses the nala and a hot spring known as Tattapani has developed
near Balbal. It represents the faulted contact between Gondwana and Archeans.
The water is so hot that hand cannot be placed in the water. There are bubbles
in the water.

This hilly region (381 - 533 m) is intricately dissected by the Charo, Bhitehi
and Satbahini nalas. There is group of granite and gneissic hills e.g. Lukuljheria,
Banskatia (533 m) dissected by Bhitehi nadi. These northern slopes are steep. Budhu-
beon 579 m is an elongated flat topped hill with steep slopes.

3. Chetag hill

This region is bounded by Ghaghri river in the south and Satbahini river
in the north. There are conical and rounded hills. This region forms the north
eastern projection of the highlands of North Koel basin. The Chetag hill 951 m
is a granitic dome with very steep slopes and radial drainage pattern. West of
Chetag hill is a ridge following the NE to SW alignment which is transversely
dissected into three parts by Satbahini and its tributaries. The hilly region south
of Sukri valley is y shaped. The altitude varies between 533 - 1010 m.
The boulders strewn in the bed of Satbahini nala

The black streak in the bed of Satbahini river depicts the hot spring known as Tattapani.
Incised meanders of Auranga and rocky terraces - Palamau

Holes in various directions situated below the present level of Auranga river

Gullies formed in undulating plateau of Auranga - Betla
4. **Tatta Parallel ridges**

Parallel ridges 381 - 579 m with parallel valleys are dissected by Tatta nala. The channels follow the foliation strike from NE to SW in hornblende schist. Tatta nala has a sinuous course. Near Nakpatitoli the ridge is breached. This ridge extends further SW and is known as Lambi Pahar which denotes an elongated hill. Matnag group of low hills are aligned NE to SW.

5. **Auranga Plateau**

The dissected and gently undulating plateau (304 - 518 m) with low hills is mainly drained by Auranga river. This is divided into two parts a) dissected plateau above 304 m altitude, b) the plateau below 304 m altitude.

a) **Dissected plateau**

This dissected plateau extends NW of the eastern Patllands. The altitude of the plateau decreases from 457 m in the east to 304 m in the west. The monotony of gently sloping undulating plateau is broken by small isolated hills. The Rajdaha nala has dissected the Mahadeva hill into two parts. The Amwatikar is flat topped hill 548 m high. The Rajdaha nala has incised its valley in Gondwanas and exposed the underlying granite gneissic rock. Near Latehar there is a granitic hill with flared slope which is due to concentration of weathering in scarp foot zone.

The Auranga valley in the upper reaches also shows wide valley. From Jamni-khar the hills fade out and the region is prone to gully erosion. The region slopes from SE to NW. The Dhardhari, Bagdagga, Gowa, Khirkhir and Gala nalas in lower part are the notable areas of gully erosion. The Dhardhari river appears to be misfit with a wide valley and a narrow channel. There may be possibility that Chaupat river was once connected to the Dhardhari which may be apprehended because of the peculiar character of Chaupat and the development of wide bed of Dhardhari in comparison to its narrow stream.

The Auranga river forms conspicuous meanders over the Gondwana deposits. The gully erosion decreases after the confluence of Dhardhari with Auranga. There are small hills which break the monotony of the plateau region. Khawatola (471 m) is biotite gneiss rounded hill. The water divide between Auranga and Amanat rivers is guided by the intrusion of doleritic dyke in the Talchirs. The foliation dip of biotite gneiss is towards north which has guided the course of Jalma and Jamunijharia. The crescent shaped hills of Sanni 451 m and Lachmi 411 m are
The gently sloping Auranga plateau and the gullies - Betla

Gently sloping hills on the eastern bank of the North Koel river
formed of quartzite which is intruded by basic rocks. The Auranga shows rejuvenated features in this region already discussed in detail.

b) Low plateau

This is a low plateau sloping from SE to NW. The slope is steeper than the region described above. Near Palamau Forte there are rock terraces which reveal the rejuvenated nature of Auranga. There are potholes which are found well above the present level of Auranga. These potholes are oriented in different direction giving clues to changes in the direction of the channel. There are isolated hills where fort has been constructed Palamau hill is (429 m) a conical hill with steep slope. The exposure of hornblende schist has guided the course of Auranga near Palamau Forte. There is a natural depression near Palamau Forte known as 'Kamaldah'. The hills range between 274 - 429 m. Chendi and Butaha (350 m) are quartzitic hills. The gradient of Auranga increases in lower part. The exposure of bed rock reveals the rejuvenated character of Auranga. The relative relief of middle part is lower than the lower part of Auranga river.

The confluence between the North Koel and Auranga is marked by a triangular patch of land (riverine delta) formed by sand deposition near Kechki. The rocks of the region represent retrograde metamorphism. There is huge deposit of sand nearly 5 m high from the bed near the confluence just like a wall on the right bank suggesting vertical dissection of resurrected alluvial terrace. There is occurrence of trap near the confluence.

6. Chehla Pahar and Barichatan hills

This region comprises of Hutar Gondwana basin. Chehla (304 - 487 m) and Lahara Pahar are formed by ferruginous Barakar sandstone and form sharp water-divide between Chehelapanikar and Satbahini nadi. The drainage density and stream frequency is high. Panch Pahar is a group of sandstone hills trending NE to SW (405 m).

Barichatan Barakar sandstone hill rises 200 m above the 304 m erosion surface shows three breaks of slope and ultimately ends in a scarp. These hills are densely forested and represent flat skyline.

7. Low hills

This group of low hills is situated between Maila in the east and North Koel river in the west. This is an undulating region with some erosional remnants which represent granitic tors and are examples of block disintegration. The small
Triangular patch of land (riverine delta) formed by deposition of sediments brought by Auranga river

Ferruginous Barakar sandstone hill of Chehla and the sand terrace and the bed of North Koel river - Putagarh
Barichatan sandstone flat topped densely forested hill - Barwadih

Barichatan hill and gently sloping terrain - Barwadih
tors are Chonana 314 m, Pokhraha 261 m, Khairahi 350 m, Banhi 309 m and Chianki 323 m. The Chianki hill is an assymetrical hill whose eastern slope is much steeper than the western slope. The granitic blocks are projected towards the sky.

8. **Undulating plateau**

This plateau is drained by Chako and Amanat rivers. The Chako river following the structural control flows NE to SW divides the undulating plateau into two parts.

The plateau in the east is a gently sloping undulating plateau (457 - 533 m) with high drainage density drained by Chako and Amanat. There is a shear zone which follows roughly the NE to SW direction. Metadolerite dyke runs from SE to NW which is different from the direction of the dolerite dyke. This region faced tectonic movement from the two sides. The course of the Amanat river is guided by lithological strike. There are small hills (457 m) with low relief. The Baridohar hill (497 m) is notable. The Amanat river represents incised meanders. There is small hill Karmhi Pahar 380 m.

Undulating plateau of Amanat in the west is drained by Amanat, Piri and Maila nala. This region is composed of biotite gneiss and granite and patches of hornblende schist. It forms watershed between Auranga and Amanat. The undulating plateau is dotted with isolated hills e.g. Doki Pahar 651 m. There are hills with uniformly steep slope divided into two parts by Satbahini. Harahi Pahar 482 m and Chandwar Pahar 657 m are conical hills. The altitude varies between 320 - 381 m. The hilly region in the north is fan shaped. Kamat ridge aligned in NE to SW is broken into small hills by Satbahini. The highest part of the hills is 564 m formed of epidotised granite gneisses. There is another ridge 320 m high also extends NE-SW. The basic dyke intruded into the granitic rock gave rise to Hurilong dome (419 m) where ring like drainage has developed. Another ridge (398 m) formed by hornblende gneiss is situated between Kallawa and Piri nala. All these hills are low and gently sloping.

9. **The Amanat Valley**

The Amanat river flows over Hazaribagh plateau in the source region where the direction of the river is parallel with the water divide in the north. This is a gently sloping region whose altitude is between 533 - 579 m. The Amanat follows the strike. The valley is wide and prone to gully erosion upto the confluence of Jhikia with the Amanat river.
The Amanat river forms angular bends after the confluence with Jhikia. The middle part shows narrow valley than the upper part. The relative relief also increases. This character of Amanat is similar to the character of North Koel in the middle part. This character extends westward upto 304 m erosion surface.

The valley flats of Amanat and its tributaries between Kolhua and Khairant are composed of granite. The Amanat river flows from E - W over Talchirs. The basic difference in the landforms over Gondwanas and Archeans is that Archeans exhibits gully erosion whereas Gondwanas does not form badland in this region.

a) Jhikia

Jhikia basin represents two types of landforms gently undulating plateau characterized by the erosional remnants and the badland. The hills lie between 533 - 609 m. There is group of five hills near Birbir village having 609 m summit elevation. Rajguru hill is 672 m. Jhikia valley is between 518 - 579 m. The Jhikia forms incised meanders near the confluence with Amanat.

b) Patam Valley

The Patam valley is wide and open in the upper and middle part. The gullies have intricately dissected the region. The drainage density is high also. The Patam valley narrows near the confluence with Amanat.

10. N. Hilly Region

This region of isolated hills 228 - 518 is situated south of the Banki (R.B.) river. These hills are divided into 3 isolated blocks by Sadabaha, Libji and Jingoli nala. The drainage texture is coarse. The small hills situated between Banki and Khuti Sot rivers are elongated W to E. Lohardaga 281 m has rocky slope. The other hills are Lambha 318 m and Gidha 290 m.

The hilly region further eastward which is drained by Sadabaha, Durgauti and Jingoli extends northward upto the limit of Augen gneiss. There are also migmatites intruded in the country rock. The skyline from Rajhara is characterized by conical hills with steep slopes connected by a ridge rising above 304 m erosion surface. The hills are rugged and steep slopes predominate. The conical hills with steep slopes are Majhauil 583 m, Phutaha 563 m has borken slopes on its all sides. Malenga 525 m and Dumkatari Pahar is flat topped hill has nearly vertical slope at the top and then steep slope downwards. The hills of the same nature are Ranga 399 m, Derwa 396 m, Chandila Pahar 387 m. A ridge dissected into two major parts by Libji nala is known as Suranga Pahar 521 m in the east. This is a steeply
The dry sandy bed of Durgauti river in the undulating plateau and the conical hill

The rugged slope of quartzitic hill formed by block disintegration is devoid of vegetation - Mohammedganj
sloping hill like a tunnel. Gai Ghat is the pass in this hill. The ravines form gorge in the Surang Pahar which adds a distinct relief feature to the landscape.

The western part of the ridge extends west into Harhepa, Girwara Pahar 584 m extending SE - NW. This is a conical hill. It extends north in the form of a group of five flat topped hills and gradually thinning out towards west. This is known as Geruwara Pahar 518 m. There is nearly vertical slope at the top then steep slope. They represent break of slope in the profile of hills. Kutila is a conical hills with break of slope. This hilly region breaks the monotony of the flat plain of North Koel.

The topographical eminences are some hills, knolls and granitic tors with steep slopes. The notable hills are Manatu 672 m, Kandwa 566 m. The first order streams are even considerably long depicting maturity of the landscape.

11. **Banki Plateau**

This undulating plateau region with erosional remnants drained by Banki, Gobardaha and Churia nadi is situated south of Banki river. The occasional steep slopes are the impact of lithological variation and tectonic movements of the area. The epidioritic intrusions are notable. The foliation dip is in many directions. There is evidence of folding. The axis of the plunge of the fold is from east to west. The altitude of the region varies between 228 - 434 m. There is a synclinal hill 302 m near Karma Kalan (24°21'N ; 84°10'E) which is an example of inversion of relief and an indication of polycyclic origin of the region. The migmatites are intruded in the region. There is a shear zone running from NE to SW. Garhatua hill is 321 m high. The influence of plunging fold is exhibited by the angular bends of Banki river.

12. **Plateau with steep hills**

This region is situated in the north of the Banki river (R.B.). The eastern region is a gently undulating plateau formed of migmatites and granite gneisses. There are low hills representing erosional remnants above 304 m e.g. Kajwata 345 m. The shear zone is demarcated by a ridge. The ruggedness of the region is due to epidioritic intrusions and folding activity.

The region to the west is mainly formed by quartzite. There are small isolated hills with steep slope, break of slope and block disintegration has made them rugged. These hills are completely devoid of vegetation. Drainage density
The exposure of roots of the trees due to soil erosion and the sandy terrace of North Koel river - Putagarh

Three levels of gullies distinct on the valley side slope of rejuvenated North Koel - Gari
is high. Khoira Pandu 568 m is a conical hill with steep slope and remarkable break of slope. Banskhatia Pahar 387 m is a flat topped hill. Hathidaha 384 m is a conical hill.

III. THE CENTRAL VALLEY

The North Koel valley is also designated as Central Valley because it occupies the central part of Palamau Uplands. The course of the North Koel river is divided into: A) upper, B) middle and C) lower. The upper part flows over the Patlands. The middle part of the North Koel reveals steeper gradient than the upper part. The North Koel represents the interrupted profile indicating rejuvenation of the area. The lower part of the North Koel valley denotes a plain and alluvial valley.

A. UPPER NORTH KOEL VALLEY

This part of North Koel valley extends north from the source to the westward bend of the North Koel river. The North Koel river follows a meandering course over the Patlands. There are two waterfalls one at Rajdergagh 4 m and another further downstream with 6 m fall. The North Koel valley is narrow and bounded by scarps on its either side. From Tendar to Banar gully erosion is very prominent upto the foot of the scarps. The valley is generally 3 to 4 km wide. The wide valley is replaced by the gorge where Bhanwar Pahar in the east and spur from west constricts the valley of North Koel which is due to local lithological variation in the hardness of the rock. The North Koel valley widens where the tributaries join from either side. The westward projection of Aonatoli Pahar has narrowed down the valley of North Koel. The gully erosion is not evident north of Banari. The valley flats are again widened by the confluence of Jori nala near Barkadohar. The North Koel river runs almost parallel with the scarps. The region between Barkadohar to Bandwa is intricately dissected by gully erosion. The region is converted into miniature relief blocks. The valley flats of Jowa, Phuljhar, Jori and Ghaghra are found in the upper part of North Koel river. The gully erosion has formed badland.

The Adar Pass (685 m) at the head of the Phuljhar valley provides communication from east to west whereas the Phuljhar valley flats are found below 685 m altitude. The course of the river and the adjoining scarps almost run parallel.

There is no well defined channel in the bed of the Ghaghra river. The flat bed is filled with sand only, there is a subterranean flow which emerges only during the rains.
NORTH KOEL VALLEY

UPPER PART

Cross Section Of North Koel Valley

Horizontal Scale

Fig 6.3
B. MIDDLE PART OF NORTH KOEL VALLEY

From Bandwa to the south of the Daltenganj is the middle part of the North Koel valley which is characterized by the juvenile features formed due to rejuvenation. The nature of the North Koel Valley changes northwards from Bandwa. The North Koel river and its tributaries represent incised meanders. The North Koel valley is narrow in contrast to its upper part & has been described above. There are formation of bars also in the bed of the river which has formed the braided channel. The North Koel flows over the undulating plateau region and the notable Pat scarps come to an end here.

The North Koel bends westward near Karwal. The region from Garu to Mondal exhibits four tier terraces all along the course of North Koel and its tributaries Kohabarwa and Burha mainly. The North Koel Valley from Garu to Mondal exhibits patches of straight channel and conspicuous formation of point and longitudinal bars. A prominent meander loop in the course of the North Koel near the confluence with Kohabarwa nala is due to presence of a hill which is hard and resistant to weathering. There are river terraces which are cut in alluvial soil also and the gully erosion have dissected these terraces intricately.

Kutmu dam is being constructed on the North Koel river near Mondal. The North Koel valley is assymetrical here with steep left bank and gentle eastern bank. Granitic rock represents good example of block disintegration. The growth of vegetation in the joints have further helped the process of weathering. The thalweg of the river shows potholes. There is also sand bar in the course of the river. The bed of the river where it is excavated for the construction of the dam depicts cross bedding in the sand which reflects a change in the direction of the river.

The valley from Mondal to Barwadih is characterized by pink granite consisting of pegmatite and hornblende schist. The North Koel river forms a prominent meander near Saphi village. The sediments in the bed of the river are not graded. The upper level of the bed consists of coarse sand and middle level the deposits are partly angular and partly rounded. The lower part reveals finer sediments. The deposits indicate non assortment. Thus the deposits in the form of four levels with varying nature represent the formation of four terraces coinciding with the four levels of the hills which is observed in the basin. The variation in the texture of the deposits depicts fluctuation in the volume and velocity of the river in the past. There is a point bar formed of mud after the confluence of Saphi with North Koel. The cliff side of the meander is etched in coarse sandstone hill.
The formation of river terraces and badland in the rejuvenated course of Nakti nala - Mahuadanan

The dissected terraces and the newly developing sandy terrace of Nakti nala
The northern bank of Nakti nala consisting of red soil intricately dissected by gully erosion.

Incised valley of Nakti nala and the river terraces.
Badland due to gully erosion

Block disintegration of granites by the side of North Koel valley - Kutmu
The North Koel flows over Gondwanas and near Putagarh the Gondwana deposits are replaced by Archeans. The river bed is wide and the valley is characterised by agricultural land on either side. The metamorphics are exposed in the bed of the river near Putagarh village. The rocky outcrop in the bed of the river shows block disintegration. The formation of lower terrace of coarse sand is evident. The slip off slope represents a break of slope which is due to sharp decline of flow. The soil of the adjoining region is fine but the sand in the bed is coarse. The river is fordable during dry season. The trucks ply through the bed of the river.

From Barwadih to Mangra there are agricultural fields in small patches and the region is gently undulating plateau covered with natural vegetation. The incised valley of North Koel is prominent near Kechki. There is exposure of bed rock. The region on either side represents low hills in this region. The Chechari basin and Aksi, Saphi, Deori and Dhardhari valley are the morphological divisions in the middle part.

1. **Aksi Valley**

The Aksi valley in the lower part reveals that the terraces have been cut in the alluvial soil. The region is intricately dissected by gully erosion. The Aksi valley is wide and the river carries sand and water in the rainy season only.

2. **Chechari Basin**

The Burha river has formed centripetal drainage in the middle part which is known as Chechari basin. Chechari basin is an oval shaped basin filled with alluvium 9-12 m in depth and is surrounded by Netarhat in the east Jamira Pat in the west and dissected hills of complex lithological character in the south. The soil of the region provides rich agricultural land. The rivers have incised their valleys in the alluvium and revealed the underlying granitic rock. Nakti nala a tributary of Burha river reveals five terraces in the region south of Mahua danr. These terraces are well defined due to difference in their colouration. The upper terrace is intricately dissected by gully erosion but still they are preserved in this area. The upper terrace consists of red earth than yellow soil and again red earth, the lower terrace of sand and the fifth terrace is under the operation of construction.

The height of the basin is between 309 - 655 m and relative relief is very low 0 - 15 m. The major streams of this region carry water throughout the year which is due to high rainfall and seepage of water from the laterite capped Pat
NORTH KOEL VALLEY
MIDDLE PART

Cross Profile

Horizontal Scale

FIG 6.4
Block disintegration and the growth of vegetation in the joints of the rocks - Kechki

The different levels of sedimentation in the bed of North Koel river - Saphi
region. The scenic beauty of this region is notable. The whole drainage of the basin converges into a single channel known as Burha river flowing towards the north.

3. **Saphi Valley**

   The Saphi river in the lower part is prone to gully erosion. The Saphi plain in formed of fine soil and the prevalence of fine sediments in the river also provide muddy water. The Saphi valley in the lower part provides agricultural land.

4. **The Deori Valley flats**

   The Deori river forms flat valley over the Archeans and the valley is wide and open.

5. **The Dhardhari Valley**

   The valley flats are found over the Archeans. This region is also characterised by the presence of river terraces. Chipadohar area also shows agricultural land. There is 3 m high mound of alluvial soil and below this is red earth. The presence of tree has protected the mound to be eroded. There is considerable soil erosion in the region. This region reveals black, red, yellow patches of soil. There is also exposure of bed-rock. The wells in Chipadohar are 7 'Parsa' deep (one parsa is equal to 2 m). There was opportunity of studying the soil profile where a well was being dug. The wells are generally 14 m deep sometimes even 25 m deep. From the boring of the soil it was observed that red earth occupied the upper layer, alluvial soil middle layer and sandy soil lower layer. Sometimes below the sandy soil is the rock and in other places the rock is found below alluvial soil. These rocks are highly weathered and referred to as 'Mara Pathar', when these rocks are fresh and does not show any sign of weathering these are called as 'Jindha Pathar'. The wells carry water throughout the year. Thus four tier terraces are formed everywhere and the sandy terrace is youngest in origin.

C. **LOWER PART OF THE NORTH KOEL VALLEY**

   The character of North Koel changes near Daltenganj. The valley is wide and its vastness is added by the confluence of the valley of Amanat also. The monotony of the landscape having yellow Gondwana soil persists in the region. The North Koel follows braided character in Daltenganj. The river bank is nearly 10 m high and the gullies have eroded this bank by headward erosion. The gullies debouch from the bank to the channel of North Koel and form talus cone which consists of fragments of rocks. This feature is very conspicuous in this region.
The 10m. high river bank and the talus cone facing the North Koel river - Daltenganj

The exposure of yellow sandstone pointing towards the confluence of Amanat with North Koel river - Singraha Kalan
The North Koel river takes a notable turn towards west near Rajhara. Fragments of rocks measuring 25 to 30 cm in length are noticed in these talus cones. The bank of North Koel is eroded by the slope wastage. The North Koel is incised. There is deposition of coarse sand on the western bank of North Koel near Dalten-ganj. Small pebbles are also observed as bed of load. The bed of the river is uneven due to large and small mounds of deposits which represent sudden deposition of sand after the retreat of flood water. The slope of western bank is steeper than the eastern bank. The pink sand derived from pink granite adds picturesque beauty to the landscape. There are small knolls covered with soil perhaps represent the resurrected terraces. The gully erosion is notable. There is a granitic tor on the eastern bank where boulders have been tied by wire to check the erosion by the river and the incursion of flood water. North of the confluence of Durgauti with North Koel there are exposures of sandstone and the region shows badland. The region after the confluence of Sadabaha represents low dome shaped mounds covered with soil generally rise 6 - 15 m.

There is exposure of sandstone on the eastern bank of North Koel near the confluence of Sadabaha with North Koel. Ripple marks are notable in the bed of the river. There are series of steps generally 5 cm high which depicts the gradual drying out of the channel and water recedes forming these steps on the sand. These slope from the bank towards the centre on the slip off slope side of the meander. There are potholes near Gargi. The sandstone is overlain by regolith cover where the gullies have eroded them and formed two levels. The gullies on the upper surface show steep slope and formed talus cone at the middle level. From the middle level gullies descend to the lower level. Thus this region also exhibits four tier terraces and accompanied by four levels of hills also. Gari village shows narrow and deep gullies sometimes they are 1 - 3 meter deep. The slope of river bank clearly reveals 4 levels, which is the impact of rejuvenation as evident near Murkan Kalan. There is a ferruginous sandstone hill near Kajri railway station. The sandstone has been weathered into balls of ferruginous sandstone by the action of chemical weathering. These balls of various sizes varying from the size of a T.T. ball to a ball of 23 cm radius are strewn over the top of the hill by the side of the North Koel river. These rounded balls add a special feature to the landscape. There is another low hill which consists of pebbles of varying sizes and angular fragments of rock. After crossing Kajri railway station there are small knolls covered with soil but represent minor rectangular blocks of undulation. The confluence of Amanat with North Koel is marked by huge deposition of sand.
Small knolls covered with alluvial soil represent minor rectangular blocks of undulations.

The wide sandy bed of the North Koel river with Son - Sondhipara near the confluence.
The Son river and the two levels of Kaimur scarps facing the confluence of North Koel with Son river and the alluvial fields.
which drops vertically from the top to the bed of the river which is 3 meters below. The landscape changes near Lalgarh Bihar railway station. There is gently sloping land covered with soil with occasional exposures of country rock. The North Koel valley is steep on the south and gentle on the north here. The North Koel valley narrows near Karkatta. The presence of sand island has bifurcated the course into two channels. From Rehli Kalan the hills on the west represent five breaks in the slope.

The North Koel valley narrows between Rehli Kalan and Joga and broadens further north. The presence of quartzitic hills restricts the expansion of North Koel valley. The North Koel valley again broadens north of Mohammedganj. There are ingrown meanders. A barrage is being constructed. The present channel at Mohammedganj flows through the middle part of the thalweg. The entire region is characterized by low mounds of soil which represent perhaps the resurrected terraces in the area. The North Koel valley north of Mohammedganj consists of alluvial soil and provides good agricultural land. The North Koel joins the Son near Sonegarh village. The land is nearly 6 m high from the present bed of the river but it is flooded when severe floods occur in the Son river.

There is pebble bed overlain by soil in the confluence area of North Koel and Son river. The land on the west slopes towards North Koel in the form of two steps. The flow of the channel through the central part of thalweg is notable and indicates changes in the course of the river.

The notable rivers in the lower course of the North Koel which have formed the plains are 1) Amanat, 2) Sadabaha, 3) Banki, 4) Tahle, 5) Danro & 6) Banki L.B.

1. Amanat Valley

The Amanat river represents ingrown meanders near Birtia Dandar (24°6'N ; 84°23'E). The river forms wide valley in which agriculture is practised. The Gondwanas are weathered and converted to regolith.

The Amanat valley from Goradhi to the confluence with North Koel river forms a wide and open valley which is suitable for cultivation. There are exposures of country rock. The altitude is between 198 - 243 m. Small gullies only are prone to formation of badland. The Amanat river also represents steep bank and wide flat thalweg. There is exposure of gneissic rock in the bed of the Amanat river near Haratua. The highly weathered gneissic rocks have formed peculiar features similar to the skin and mouth of a crocodile here. The rock exposure in the bed is highly polished due to fluvial action. The rocks show cracks which are due to
NORTH KOEL VALLEY
LOWER PART

Valley

Altitude in Meters

Cross Profile

Horizontal Scale

FIG 6.5
The highly weathered gneissic rocks formed peculiar features similar to the skin and mouth of crocodile - Haratua.

The weathered gneissic rock and the insertion of boulders in the potholes.
the exposure to weather during dry season. The banks of the Amanat river are characterized by knolls which are yellow or red in colour depending on the character of the parent rock. These knolls show steep and gentle slope where the slope is steep it is prone to gully erosion and badland is formed. The Gondwanas near Jaitu Khar represent folding in siltstone. The siltstone in the bed of the Amanat river bears potholes which are elongated towards the east which is opposite to the direction of the flow of Amanat river representing change in the course of the river.

The confluence materials of Maila, Kuddia and Amanat are characterised by fine silt and coarse sand. Mud cracks are noted near the road bridge near confluence.

The Amanat forms a big meander loop before its confluence with the North Koel river. There is deposition of sand on the bank of the river in lower part and where the Amanat joins the North Koel this sand deposition is notable. The Amanat river becomes narrow near its confluence with North Koel. The Amanat valley consists of Maila plain, Jingoli valley flats.

a) Maila Plain

The Maila nadi in the NW forms extensive badland. Piri nadi also forms badland. The Maila nadi does not receive any tributary from the left bank near Satbarwa. There are small erosional remnants Ekta 429 m, Kotha 401 m. The Maila river flows against the direction of the foliation of the rock which reflects the superimposed nature. The Talchirs because of variation in local lithological hardness exhibit small undulations in Maila basin.

b) The Jingoli Valley

The Jingoli valley represents wide flat bed with steep banks which is the character of rejuvenated streams. Jingoli cuts across the sandstone hills therefore sandstone flat topped hills are found on the banks of Jingoli river. The size of quartz particles in the sandstones is quite big and the agents of weathering have weathered the sandstone. The surface is uneven and quartz pebbles are strewn over the banks. Small hillocks covered with soil are the conspicuous features on the eastern bank of Jingoli river. The banks are eroded by gullies which are incised and form talus cone where they debouch from the bank to the thalweg of Jingoli river. The river forms an oxbow lake near Harla Khurd (24°15'N ; 84°15'E). The mature condition of the river is well pronounced here. The lower part of Jingoli flows over Gondwanas.
The bluff covered with soil on the right bank of Amanat river and sandstone exposed at the basal part - Jaitu Khar

Confluence of Jingoli with Amanat and the huge deposition of sand by the Amanat river - Singraha Kalan
The gently undulating terrain and the confluence of Amanat with North Koel
2. **The Valley flats of Sadabaha**

Sadabaha, a perennial stream flows over the gently sloping granite terrain. The altitude is between 198 - 274 m. The river turns towards SW near Palwa and valley flats begin. There are two faults in the course of Sadabaha which is between Talchir and Archeans and between Talchir and Barakar. The later fault is represented by break in the profile of the river and rapids are formed. The rocks are mainly weathered to regolith. There is a meander cut off near the confluence. The bed of the river was much wider in the past & it is a misfit river. There is exposure of sandstone near the confluence.

3. **Banki Plain**

It starts from Rud. The valley gradually broadens downwards and there is alluvial soil. The bed of the river is narrow but the valley is 6 km. wide.

4. **Tahle Plain**

The region east of the confluence of Arraj with Tahle is a gently sloping plain. The altitude varies between 175 - 228 m. The region is characterized by flat valley of Tahle with occasional patches of badland on the tributaries. There are several embankments. Amphibolites form small hill.

5. **Danro Plain**

Danro plain is a gently sloping region with soil cover. The Gondwanas have been stripped off by the agents of denudation. Only two small patches of Talchir rocks are found near Baila Jhakra 24°7'N; 83°39'E. The region is composed of granite gneissic rocks. The granitic hill (372 m) north of Chamal is dissected by Danro into two parts. A rock barrier near Dewgana bifurcated the river into two parts. The gully erosion is notable only north of Urla river. The altitude varies between 183 - 289 m in Danro plain.

The bed near Garwa is a deposition of sand only with no marked channel and the river forms a notable meander here.

6. **Banki Plain (L.B.)**

The Banki nadil flows over a flat valley. This is the only region where low level laterite at 343 m is found. The region is covered with Lower Gondwana soil. The boundary between the valley flats and the hill is formed by a fault which extends from SW to NE. The river forms incised meanders. The river has deeply
cut into the Gondwanas and exposed the underlying gneissic rock. These rocks exhibit well developed joints. There is badland in several places. The monotony of plain is broken by Burhi Khar hill 281 m on the northern bank of Banki river near the confluence.