



CHAPTER I

GENERAL

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The two princely States of Gangpur and Bonai which constitute the district of Sundargarh had no alternative but to be wedded together to be a district. Although they are inhabited mainly by Scheduled Tribes, there is much difference between them ethnologically, physically and economically. While Bonai is thickly wooded, its adjoining area northern Gangpur is practically denuded of forests. The people inhabiting the Panposh subdivision are mainly Mundas and Oraons who are highly sensitive and are ever anxious to protect their rights. The Bhuiyans inhabiting the Bonai subdivision are of steady temperament, very hospitable and in appearance belong to a different race. While Mundas and Oraons are dark complexioned, Bhuiyans are nearer the upper Hindu castes. INTRODUCING
THE DISTRICT

The Rourkela complex of industries have drawn a large mixed population whose contact is evolving a new culture among the tribes. Its ultimate effect cannot be predicted.

Though Gangpur was advancing in consequence of the railway line going right through it, it was generally as backward as Bonai which had no railway communication touching it. In modern times the ex-Gangpur area is rapidly becoming industrialised with heavy and light industries springing up all over its northern portion and with the prospects of a very flourishing mineral economy round the lead-rich Sargipali. The entire district is covered with Community Development Blocks which aim at all-round development of the population agriculturally and industrially.

The Agharias who are not found elsewhere in such large numbers are a very advanced agricultural community who will undoubtedly take advantage of the Green Revolution which is coming over the country, and be an element in the culture, economy and evolution of the country.

Modern man has his eye on the mineral wealth of Sundargarh district. It is not known why ancient man thought of the district important enough to leave his mark in cave paintings and a mysterious language engraved on rock walls. From ancient time the district has been the home of many varieties of wild life. But in recent years wild animals are becoming extinct. While formerly in

Bonai you could meet a tiger on any forest path, now there is probably none. The only wild animal which is spreading is the elephant which has now no market and man cannot eat it.

Origin of
the name of
the District.

Sundargarh was first constituted a district on the 1st January, 1948. It comprised two ex-State areas of Gangpur and Bonai which merged with Orissa on that date. The town of Sundargarh, which was the capital of Gangpur ex-State, was made the headquarters of the district.

The district was named after its headquarters town "Sundargarh". The town was formerly known by the name Suadihi (Suadi) until sometime in the first decade of the present century. But although the reasons are obscure, Maharaja Raghunath Sekhar Deo, the 18th successor to the *Gadi*, presumably in an unwritten order renamed it as "Sundargarh" which literally means, "Beautiful Fort". It remained the headquarters of Gangpur ex-State till its merger with Orissa in 1948, when the district of Sundargarh was formed.

Location,
General
boundaries,
Total Area
and Popula-
tion.

Sundargarh occupies the north-western portion of the State and is situated between 21° 35'N and 22° 32'N latitudes and 83° 32'E and 85° 22'E longitudes.

The district is bounded on the north by the Ranchi district of Bihar, on the west and north-west by the Raigarh district of Madhya Pradesh, on the south and south-east respectively by the Sambalpur and Dhenkanal districts, and on the east by the Singhbhum district of Bihar and Keonjhar district. The district, as it is, does not form a compact geographical unit and is extremely irregular in shape. It extends over an area of 3,788 sq. miles or 9812.47 sq. km. But the area according to the Surveyor General of India is 3,751 sq. miles or 9,675 sq. km. It had a population of 1,030,758 persons (5,30,836 males and 4,99,922 females) in 1971. With the above area and population it ranks tenth and eleventh respectively among the districts of Orissa.

History of
the District
as an Admi-
nistrative
unit.

As mentioned earlier, the ex-States of Gangpur and Bonai on their merger with Orissa on 1st January, 1948, formed the present district. Since then it has been subjected to no territorial changes.

Both these ex-States were once under the suzerainty of Sambalpur which formed part of the dominions of the Maratha Rajas of Nagpur. They were ceded to the British Government in 1803 by the Maratha Chief Raghujji Bhonsla of Nagpur under the Treaty of Deogaon. But they were restored to him by a special engagement in 1806. They reverted to the British Government under the provisional agreement concluded with Madhuji Bhonsla (Appa Sahib) in 1818, and were finally ceded in 1826. In 1821 the feudal supremacy of Sambalpur over these

States was cancelled by the British Government and a fresh *sanad* was granted to the Chiefs. Both these States, for some time, formed a part of the South-Western Frontier Agency on its creation in 1833, but they were transferred to the charge of the Commissioner of Chota Nagpur in 1854. Again in 1905 they were transferred from the control of the Commissioner of Chota Nagpur to that of Orissa and a Political Agent was appointed. The ex-States remained under the control of the Political Agent till their merger with Orissa in 1948.

The district is divided into three subdivisions, viz., Sundargarh, Panposh, and Bonai. Of these, two subdivisions, viz., Sundargarh and Panposh originally belonged to the ex-State of Gangpur while the whole of Bonai ex-State became the third subdivision. Except Panposh which has its headquarters at Uditnagar, the other two subdivisions are named after their respective headquarters. Bonai derives its name from its forests (Bona in Oriya means forest) covering almost nine-tenth of its area.

The following table indicates the area and the population of the respective subdivisions.*

Subdivisions	Area in sq. km.			Population		
	Total	Rural	Urban	Total	Male	Female
1	2	3	4	5	6	7
Sundargarh ..	4,615.64	4,565.65	49.99	441,675	221,447	220,228
Panposh ..	1,840.19	1,683.24	156.95	412,019	219,565	192,454
Bonai ..	3,356.64	3,356.64	..	177,064	89,824	87,240

There are five Tahsils in the district. Sundargarh subdivision consists of three Tahsils, viz., Sundargarh, Hemgir, and Rajgangpur. Panposh and Bonai subdivisions have one Tahsil each. The headquarters of Panposh Tahsil is at Kuarmunda. The other Tahsils are named after their respective headquarters.

The table below shows the police station coverage of the Tahsils.

Name, Area and Population of Tahsils	Police Stations
1. Hemgir	.. 1. Hemgir
A-1, 450.4 sq. km.	.. 2. Lefripara
P-94,397	
2. Sundargarh	.. 1. Sundargarh
A-1,816.4 sq.km.	.. 2. Bhasma
P-191,182	.. 3. Talsara

* District Census Hand-book—1971, Sundargarh District, Part X-B, p. 6.

Name, Area and Population of Tahsils	Police Stations
3. Rajgangpur A-1,348.9 sq.km. P-156,096	.. 1. Rajgangpur .. 2. Bargaon
4. Panposh (Kuarmunda) A-1,840.2 sq.km. P-412,019	.. 1. Kalunga .. 2. Birmitrapur .. 3. Raiboga 4. Bisra 5. Raghunathpali
5. Bonai A-3,356.7 sq.km. P-177,064	.. 1. Bonaigarh .. 2. Banki .. 3. Gurundia 4. Tikayatpali 5. Maholpada 6. Koira 7. Kamarposh Balang.

The district has thus nineteen police stations of which Sundargarh and Bonai subdivisions have seven each while Panposh has only five. The population of each of the police stations will be found in Chapter-III, People.

TOPOGRAPHY

Natural Divisions

Geographically the district is not a compact unit and consists of widely dissimilar tracts of expansive and fairly open country dotted with tree-clad isolated peaks, vast inaccessible forests, extensive river valleys, and mountainous terrain. Broadly speaking, it is an undulating table-land of different elevations broken up by rugged hill ranges and cut up by torrential hill streams and the rivers Ib and Brahmani. The general slope of the country is from north to south.

Sundargarh and Panposh Subdivisions.

The territory covered by Sundargarh and Panposh subdivisions (comprising the ex-State of Gangpur) consists of a long undulating table-land about 700 ft. (213 m.) above the sea level dotted with hill ranges and isolated peaks of considerable height. On the west of Sundargarh subdivision lies the Hemgir Plateau, nearly 1150 ft (351 m.) high, in the centre of which is located the village Hemgir. To the north of Hemgir the land is considerably hilly while to the south it is relatively plain with a minimum elevation of 709 ft. (216 m.) near the Chuanbahal village. The eastern tract of the subdivision intervening between Chota Nagpur plateau and Mahabir range, for the most part, is open and well cultivated, the general elevation of which varies from 700' to 1000' (213 m. to 305 m.) but that of the reserved forests except,

of course, a few patches, comes under 1000' to 1500' (305 m. to 457m.). Besides, numerous isolated hills and sharp ranges running generally east to west are also evenly distributed throughout the country. On the north the Chota Nagpur plateau with its foot-hills gradually falls away to the plain while the Mahabir range, in the south, springs abruptly in an irregular wall of tilted and disrupted rock, and forms for some length the boundary between Sambalpur and this district. On the southern border, dense forests linking up with the forest-clad ranges of Bonai subdivision are also seen. Didrapahar, the highest peak 2509' (765 m.) of Sundargarh subdivision is located near the trijunction of Sundargarh subdivision, Bonai subdivision and Sambalpur district. The principal river the Ib, which enters the subdivision from Jashpur and passes through it from north to south, with its numerous tributaries drains the territory. Along the valley of the Ib, particularly to the south, an open and well cultivated plain country is found. Very rich and fertile soil formed out of the silts deposited through ages is seen in the areas along the river bank; black cotton soil is also found at places. The soil generally varies from pure sand or gravel in the upland, through various classes of loam on the slopes, to stiff clay loam with a sub-soil or pure clay at the bottom.

The South Eastern Railway running through Panposh subdivision from east to west makes nearly a sharp demarcation between two physically dissimilar tracts, one on the north and the other on the south. The block to the north formed by the broad valleys of the Sankh, the South Koel, and the Deo, although interspersed with isolated hills and series of small ridges striking east and west, is generally plain; but the tract to the south is comparatively more hilly and wooded excepting the valley of the Brahmani which extends to an appreciable distance south of Panposh. The region extending from south of Bisra to south of Chirobeda is much broken and hilly: it rises along the Singhbhum and Bonai boundaries to an elevation of 1800' to 2000' (549 m. to 610 m.) the highest peak being Bhaisamunda Pahar 2234' (681 m.). In the plains the elevation is about 600' to 700' (183 m. to 213m.) the lowest point on the Brahmani valley on the Bonai border near Banki village being 575' (175 m.). The land is completely denuded of its fertility and is unsuitable for cultivation. The predominant portion of the area is undulating where large tracts of ravines and rocky grounds are found. Forests with predominance of Sal (*Shorea robusta*) cover major portion of the area.

The Bonai subdivision (comprising the ex-State of Bonai) is chiefly an isolated hilly tract with an average elevation of about 800' (244 m.) above the sea level. It is shut-in on all sides by rugged

Bonai Sub-
division.

forest-clad hills, intersected by a few passes or gorges which connect it with the surrounding areas. It is inaccessible to the travellers and beasts of burden except at the regular passes. The space within does not form an extensive valley, but is interspersed here and there with hills, most of which are densely wooded to the summit. The only river Brahmani flowing from north to south divides Bonai into two fairly equal parts. It receives the tribute of the surrounding hill streams and passes through a gently undulating beautiful and spacious valley containing large groves of mango and other fruit trees, but owing to its rocky bed, is of little use for irrigation and waterway communication. With the exception of the flat cultivated plain of about 90-100 square miles (145-161 sq. km.) varying from 190' to 600' (58m. to 183 m.) in elevation on the left bank of the Brahmani between Bonaigarh and Kamarposh Balang, and the small patch in Koira situated at an elevation of about 2000' (610 m.), the whole of east Bonai is extremely mountainous. Several of the ranges exceed 3000' (914 m.) in altitude. The cultivated area consists of loamy, sandy, laterite and black cotton soil. The hilly and mountainous regions are chiefly occupied by aboriginal Bhuiyans-Kols and Gandas. Most primitive types of Bhuiyans who engage in destructive Dahi and Biringa cultivation mostly occupy the undeveloped areas. Exquisitely fine scenery abound this part of the country. Perennially flowing hillstreams, along the bank of which exist beautiful wild orchards and variety of farms, are abundant. The Khandadhar fall which drops over the western face of Chelliatoka range from a height of 800' (244 m.) presents a magnificent sight in the wild surroundings. It can be seen from miles away.

Apart from the cultivated plain stretching from Bonaigarh in a south-westerly direction towards Sarsara Balang, the whole of west Bonai is exceedingly mountainous and wooded. But, unlike the east, it is more rugged especially in extreme west along the border of Kuchinda subdivision (Sambalpur district) where it has predominance of quartzite rocks. The hills gradually slope away to the plains and thus assume no outstanding feature. Excepting a few fairly large villages adjacent to the cultivated areas, small hamlets are scattered in the jungles of the western Bonai.

Hill System

The hills are mainly extensions of the Deccan and Chota Nagpur Plateau. In Sundargarh and Panposh subdivisions there are mainly three hill ranges; apart from a few isolated outcrops. The one, in the reserved forest blocks of Mahabir Chhatam, Topkurlu, Bhaismunda and Chirobeda, on the south-east forming the boundary between Sambalpur and this district, runs east-west direction. The second, in the centres

starts from Gurabasa reserved forest in south-west to north-east direction and runs through Kumbahal, Runga, Peruabhadri, Panchra, and Brahmani reserved forests ending near the Sankh river. The third, on the western border of the district running south-east to north-west direction is an extension of the wide range of hills forming the watershed between the river Mahanadi and her affluent the Ib. Thus these mountain ranges seem to have started from a point in the middle of the southern boundary of the district and outflanking in three different directions divide the country into three separate plains.

The Hemgir plateau is flanked by a system of mountain which starts from Garjanjore (1966' or 599 m.) and runs due south-east up to Bendrichuan (1343' or 409 m.). There is an abrupt swing near the latter due west up to the water parting between the Garjhor and the Jhulenbar after which there is again a gentle bend due north-west up to the border of Raigarh district.

Among the ridges mention may be made of the great ridge, an extension of the Karampada range of Singhbhum, which apparently seems to be the spine of the Toda area in east Bonai. It extends from north-east to south-west and is capped with an immense deposit of high grade hematite. The Rontha plateau (2500'—3000' or 762—914 m.) from which descends the Khandadhar waterfall is also covered with iron ore. The Bichakhani hill yields millions of tonnes of iron ore which feed the Rourkela steel plant. A new railway line has been laid to the foot of the hill at Dumaro for transportation of the iron ore.

The principal peaks are Mankarnacha (3664 ft. or 1117 m.) and Badamgarh (3525 ft. or 1074 m.), both on Keonjhar boundary; Kumritar (3495 ft. or 1065 m.), the Bichakhani (2964 ft. or 903 m.), and Khandadhar (3000 ft. or 914 m.), all in Bonai police station; Rengalbera (2179 ft. or 664 m.) in Banki police station; Baghbindha (2650 ft. or 808 m.), Raipiri (2620 ft. or 799 m.) and the Kantamunda (2524 ft. or 769 m.), all in Gurundia police station; Chelliatoka (3331 ft. or 1015 m.), in Mahulpada police station; Balia (3313 ft. or 1010 m.) and the Karaspani (2483 ft. or 757 m.), both in Koira police station. All the above peaks are in Bonai subdivision. Besides, some unnamed peaks of considerable heights are also found. No hills of any significant height are found in Panposh subdivision. Among the peaks in Sundargarh subdivision mention may be made of Man (1935 ft. or 590 m.) on the Madhya Pradesh border; Satparlia (1327 ft. or 404 m.), and Jogijogan (1471 ft. or 448 m.), both in Sundargarh police station; Mahabir (1861 ft. or 567 m.) in Bargaon Police station; Didra (2509 ft. or 765 m.) in Rajgangpur police station

Main Peaks

on the trijunction of Bonai and Sundargarh subdivisions, and Sambalpur district. Other peaks on the Didra range are Bhaisamunda (2234 ft. or 681 m.), and Kichimiri (2050 ft. or 625 m.). The last named peak is also in the Rajgangpur police station. Andiabira (1455 ft. or 443 m.) and Bilpahari (1333 ft. or 406 m.) are among the less prominent peaks¹.

**RIVER SYSTEM
AND WATER
RESOURCES**

The principal rivers are the Ib and the Brahmani. The Sundargarh subdivision is drained by the Ib; the Panposh subdivision by two rivers, the Sankh and the South Koel, from the confluence of which the Brahmani owes its origin. The Bonai subdivision is drained by the Brahmani which flows from north to south and passes through its centre.

Brahmani

The Brahmani is formed by the confluence of the South Koel and the Sankh at Panposh. After a course due south through the Panposh subdivision which is unnavigable owing to extensive rock barriers and rapids for about 14 miles (22 km.) it enters the Bonai subdivision and after a course of some 38 miles (61 km.) in that subdivision flows into the Sambalpur district. The total length of the river in the district is thus 52 miles (83 km.) The confluence of South Koel and Sankh is a spot of remarkable beauty and sanctity; and according to local tradition this place is the scene of amour between sage Parasara and the fisherman's daughter Matsya Gandha, the offspring of which was Vyasa, the reputed compiler of the Vedas and the Mahabharat. About half a mile below the junction of these two rivers a fine bridge of the South Eastern Railway spans the Brahmani. Common jasper was found in the bed of the river and the local gold-washers (Jhoras) earned a small livelihood by washing gold from the bed. The Brahmani has no feeder stream of any importance. The hill streams all along its course force their water in and most important of these streams is the Kurhadi stream in Bonai. Other smaller hill streams of the Brahmani in east Bonai are the Sarkunda Nala, the Amrudi Nala, the Samji or Saminj Nala, the Rangan Nala, and the Korapani Nala, all of which are perennial throughout their course. Along the western bank it receives only a few insignificant streams among which Katangmurha Nala and Rukura Nala may be mentioned; these streams, unlike the eastern ones, dry up in summer. The Chirobeda Nala which is close to Saranda forest area of Bihar drains the south-east corner of the Panposh subdivision.

1. Elevation figures are mostly taken from the map prepared by the Surveyor General of India,

The Sankh rises on the Banspahar in the west of Ranchi. It enters the district on the north-west of Panposh subdivision and after flowing for about 8 miles (13 km.) in a south easterly direction forms the boundary of the Panposh, and Sundargarh subdivisions for a considerable distance and meets the South Koel at Panposh. The total length of the river in the district is about 40 miles (64 km.). It drains the eastern part of the Sundargarh subdivision. The Dhhina and Lurgi Nalas are its main feeders in the Panposh subdivision. Sankh

The South Koel enters the district from Singhbhum in Bihar from its eastern border close to the Jaraikela railway station and flows almost due west for about 28 miles (45 km.) till it joins the Sankh. The Deo, its main tributary on its north, rises in Ranchi district and drains the north-east corner of Panposh subdivision. The Katapu, Jharia Nala, another small feeder, is on its northern bank. On the south the tributary that deserves mention is Bursuonjhor which rises in the forests of Saranda near Tiriposhi. South Koel

The Ib rises on the Khudia plateau in the ex-State of Jashpur in Madhyapradesh and enters the district almost from the north at Tilijore. It flows slightly south-easterly till Gangpurgarh and then due south upto near Baurimundagaon where it turns due south-west for a certain distance and again turns due south at the district road near Sundargarh town. It forms the boundary between Sambalpur and Sundargarh for some distance before it leaves the district to meet the Mahanadi in Sambalpur. Its length in the district is about 60 miles (96 km.). Diamonds had occasionally been found in its bed and gold-washing was being done. Among other places Sundargarh, the headquarters town of the district, is located on its bank. Ib

The main tributaries of the Ib are the Tumba and Ichha along the western bank and the Sapai on the eastern bank. The other affluents are the Ghoira, Bor, Sarsagati, Kasi, Bad, San Banda, Kasi II, Banda, and Khorung. Two streams starting from Panchra and Sahajbahal meet at Barun and the united stream known as Sapai discharges itself into the Ib at Kaintra. The Ichha rises in Danardanpur area and flows into the Ib at Jamunadhipa. The Tumba starts from Megdega and meets the Ib at Kopasinga.

Among the smaller rivers mention may be made of the Bhedan, Basundhar, Hingir, Kur, Saphai, Suka, Kuchedega, Bendra, Kutra, Talda, Chodadia, and Lilari. The Bhedan which rises in the west Bonai and drains it leaves the district to meet the Ib near Brajraj-

nagar in the Sambalpur district. The other rivers which have the origin in this district leave it to meet the big rivers like the Mahanadi and the Ib in the adjoining districts.

All these rivers of the district are practically dry from the end of the cold weather till the rains and there is no systematic navigation on them. Their beds abound with great boulders and constant barriers of massive rock, forming in the cold and hot weathers large deep pools, the sanctuary of quantities of fine fish. Due to the presence of massive rocks and boulders in their beds only small boats ply on the Brahmani and the Ib and in the rainy season can go down the Ib to its junction with the Mahanadi. Transportation of timber to the coastal districts through river Brahmani which was being carried on until recent years has been almost abandoned due to the development of road and rail communications. The country is intercepted with numerous smaller streams, some of which are of considerable size; in the rainy season these hill streams sweep down in torrents rendering communication with the interior at this period of the year almost impossible.

Waterfalls

No waterfall worth the name occurs in the Sundargarh and the Panposh subdivisions. The Khandadhar in the Bonai subdivision which drops over the southern face of the Chelliatoka range (3,331 ft. or 1,015 metres) from a height of 800 feet (244 metres) presents a fine scenery from miles away. In a sweeping description Cobden-Ramsay writes * :

“In the wild hill tracts of Mayurbhanj, Keonjhar, Bonai, Kalahandi and at Barmul in Daspalla the soft beauty of the hill-clad ranges is relieved by wild precipitous bluffs scored and seamed by the storms of ages: in the rains raging torrents flashing for miles in the sunlight hurl themselves in fine waterfalls to the slopes below: the finest of these waterfalls drops over the sheer southern face of the Chheliatoka range (3308 feet) in Bonai”. He further describes, “In the high lands of Kalahandi, Keonjhar, Mayurbhanj and Bonai clear pellucid hill streams flow perennially, babbling over stone and rushing in tinkling waterfalls between grass-clad banks and sedgy shores, shaded by towering trees many are the deep silent pools with the banks fringed with masses of white lilies, and the silence broken only by the gentle gurgle of the stream as it slowly trickles from the pools or by the splash of some rising fish: here the kingfisher darts to and fro in all his glory and birds of every hue imaginable brightens the scene: in the rains these streams become wild tearing torrents sweeping all before them”.

* Feudatory States of Orissa by L. E. B. Cobden-Ramsay, p. 3.

Tanks are found almost in every village which serve as baths and Tanks sources of drinking water. They are also used for purposes of agril culture. To ensure supply of drinking water during the summer most of the villages have also wells.

With the erection of the steel plant at Rourkela, the Hindustan Steel Ltd., authorities have constructed a dam across the river Sankh at Mandira, 12 about miles (19 km.) above its confluence with the South Koel which ensures regular water supply both to the plant site and to the township throughout the year. A separate weir on the South Koel has also been put for supplying drinking water to Rourkela.

A number of minor irrigation projects have been worked out since the formation of the district in 1948 by throwing embankments across good catchment areas which provide water facilities to the villages for agriculture and domestic purposes. In Chapter IV are given the important minor irrigation projects of the district.

In the hill ranges are found several perennial springs rising from Springs underground water resources. Among them worthy of mention is the one at the foot of Vedavyas hill near Panposh: its water is considered sacred by the local people.

The rock formations found in the Sundargarh district belong mainly to the Gangpur and Iron-ore series of Precambrian Age, and to a minor extent to the other younger formations such as Gondwans in the west. The rocks of the Gangpur series are the oldest of all and are prevalent in the area covered by the former Gangpur State. The important rock types of Gangpur series are represented by mica-schists, quartzites, phyllites, calcitic and dolomitic marbles and lime stone, carbon phyllites, which are over-lain by the rocks of Iron-ore series, viz. mica-schists, phyllites and quartzites. The rocks of the Iron-ore series are well exposed in the whole of Bonai area and in some part of the ex State of Gangpur. These two groups of rocks are separated by a persistent zone of crushed conglomerate and quartzite, known as Raghunathpali conglomerate. Two groups of sedimentaries known as Dhanjori group and the Kolhan series are recognised in the Bonai subdivision which are younger than the Iron ore series as well as the Bonai granites (Singhbhum Granite). Rock formations of Gondwana Age are exposed to the west of the Ib river in the Hemgir area of Sundargarh subdivision.

GEOLOGY
Geological
Antiquity

The stratigraphy of the district in general, is represented by the following geological sequence:-

Recent .....	.....	Superficial laterite and alluvium
Permian to Upper Carboniferous	Gondwana	Himgir sandstones (Kamthi- Raniganj) Barakars Talchirs
.....	Unconformity	.....
Precambrian	Iron Ore Series.	Granite, pegmatite & vein quartz (main period of diastrophism) Basic igneous rocks, amphibolites and epidiorites mica-schists and phyllites with quartzites and carbonaceous phyllitic zones, Sheared conglomerate (zone of thrust) (Raghunathpali stage)
	Gangpur Series.	Mica-schists and phyllites with zone of Carbonaceous rocks (Laingar stage) calcitic & dolomitic marbles (Birmitrapur stage) mica-schists and phyllites with a zone of carbonaceous rocks (Kuarmunda stage) phyllites with Gonditic rocks (Ghoriajor stage). Base not seen.

Rocks of the
Gangpur
area

A major portion of the former Gangpur State, in between Birmitrapur, Gatitangar, Jaraikela, Dharuadihi, Sundargarh and Lefripara is occupied by the rocks of the Gangpur series. Majority of the ridges and hills of the area are formed of Carbonaceous Phyllites.

Mica-schist, limestone and dolomite underlie the soil and alluvium of plain country throughout the area and are exposed along the stream and river sections. A few thin beds and lenses of lateritised gonditic rocks containing manganese ore, occur amidst the area, along a narrow zone between Kinjirma and Bargaon at the western part and

extend through Pandrisilla in the middle of the area. The country lying to the south of the railway line between Jaraikela and Bamra is underlain by mica-schists and phyllites of the Iron ore series. The line of ridges extending over a length of 90 km. to the north of railway line between Jaraikela and Bamra is of sheared conglomerates and quartzites, which form a well marked horizon indicating a zone of thrust at the junction of the Gangpur series and Iron ore series. Occasional veins and dykes of quartz traverse the mica-schists and phyllites in the area.

The area around Sundargarh and to its north and north-east is occupied by gneisses and granites which form the southern continuation of the Ranchi granites. Pegmatite and quartz veins traverse these gneisses and granites.

Exposures of the coal bearing Gondwana sandstone, shale carbonaceous shale, occur to the west of the Ib river. The country is covered with thick soil and alluvium ranging from 6.1 m. to 7.6 m. The low mounds and hills occurring here and there amidst the plains are capped by laterites derived from the weathering of the underlying rocks, mainly sandstones.

The rocks of the Gangpur series have been folded into an anticlinorium plunging to the east with the axis of the fold running in an E-W to ENE-WSW direction. The structure of the Gangpur anticlinorium is very well brought out by the outcrops of limestone and dolomite with the associated lower and upper horizons of the carbon phyllites. There are minor synclinal folds at Dublabera, Hatibari and Lanjiberna. The general strike of the rocks in the area varies from EW in the eastern and central part to NE-SW between Lanjiberna and the Ib river at the western part. The strike suddenly changes to WNW-ESE towards Lefripara, i. e., to the west of the Ib river. The dip of the rocks in the northern part is to the north and that in the southern part is to the south. The amount of dip is usually steep (60°-90°).

In the recent years, a few geologists have done considerable amount of work on the structure of this area, but have expressed different views regarding the structure. The following rock formations are met with in the Bonai area.

Recent	Alluvium	Rocks of Bonai area.
Precambrian	Newer Dolerite	Quartz reefs aplitic granite and gneiss dolerite and gabbro.	
	Kolhan Series	Carbonaceous phyllites and quartzites. Shales and phyllites quartzites and conglomerates.	

	.....	Unconformity.....	.....
	Basic and Ultra-	Meta-gabbro and	meta-
	basic rocks.	dolerites.	
		Peridotites and pyroxenites.	
	Volcanics	Ferruginous shales or	
		altered lava and tuffs	
		Lava flows tuffs, horn-	
		blende chlorite rocks	
		and amphibolites.	
	Dhanjori Group	Calcareous schists, quart-	
		zite, quartz-sericite-	
		schists, sericite-chlorite	
		phyllites greywackes,	
		grits and conglomerates.	
	.....	Unconformity.....	.....
	Singhbhum granite	Bonai granite and gneiss	
	Volcanics in the	Lava flows, hornblende-	
	Iron-ore series	chlorite rocks and	
		amphibolites.	
Iron-ore Series	{	Iron-Ore Stage	Banded granulites phylli-
			tes, banded hematite
		quartzite, tuffs, cherts	
		lavas.	
		Chaibasa Stage	Quartzites and quartz-
			schists, mica schists
			and chlorite schists.

In the eastern part of the Bonai area, typical rocks of the iron-ore series represented by phyllites, banded hematite, quartzite, tuffs, cherts and lavas are found.

Banded granulites occur as bodies enveloped by the Bonai granite at SWS and SE of Rengalbera (22°00':84° 46') and at Lahunipara (21° 53': 84°56'). These rocks are considered to be the metamorphosed equivalents of the banded formations of the iron-ore stage of the iron-ore series.

Near Kantapali (21° 54' : 84° 48'), there are chloritic rocks and lavas overlying mica-schists. Associated with the Volcanics there is a band of conglomerate with concordant dip and containing water-worn pebbles of lava, quartzite and vein-quartz. The principal exposures of mica-schists are found south and SW of Darjin and west of Kantapali. Quartzites form a prominent range of hills extending in a general NE-SW direction diagonally across the area.

The Bonai granite is exposed in the plains west of Darjin ($21^{\circ} 56' : 84^{\circ} 54'$). It shows intrusive relation to the rocks of the Iron-ore series.

Overlying the Iron-ore series and probably the Bonai granite too with an unconformity, is a group of rocks namely quartzites, quartz-schists, phyllites, greywackes, grits and conglomerates. The conglomerates occur at or near the base of the argillaceous members of the group. They contain pebbles and cobbles of banded jasper, chert and granite. This group probably corresponds to the Dhanjori group of eastern Singhbhum. These rocks are exposed around Darjin, Bonaikela and Joraldi, etc.

Lavas and tuffs, overlying the Dhanjori formations are exposed around Kuljhari ($21^{\circ} 59' : 84^{\circ} 51'$) and near Rengalbera ($22^{\circ} 00' : 84^{\circ} 6'$). The volcanics S-W of Kuljhari have developed the mineral chloritoids. Those around Rengalbera are thoroughly altered.

Gabbro, pyroxenites and peridotites have intruded into Dhanjori formations particularly along the horizons of conglomerate. They are more or less continuously exposed over the whole length of Dhanjori. The intrusions are evidently guided by the synclinal structure of the Dhanjoris. Basic and ultrabasic rocks are also found in the Bonai granite as xenolithic patches, whereas a younger suite is seen in the form of dyke.

Dolerites are found intrusive into the Iron ore series, the Bonai granite, and the Dhanjori formations. They are not found in the Kolhans and the aplitic granite.

Kolhan formations are exposed around Tamra ($21^{\circ} 59' : 84^{\circ} 47'$). There is a possibility that the main outcrop around Kuljhari may be of Kolhan Age. In the southern and western portions the unconformity between these rocks and the underlying Dhanjoris is quite evident.

These two sedimentaries, together form a synclinorium plunging towards NNE in the area lying north and west of Darjin, north of Bargaon ($21^{\circ} 53' : 84^{\circ} 48'$), north-east of Bonaikela ($21^{\circ} 56' : 84^{\circ} 47'$) and north of Joraldi ($21^{\circ} 56' : 84^{\circ} 46'$).

The aplitic granite exposed in the area west of Bargaon and Bonaikela shows intrusive relation with the Dhanjoris and older rocks. It also appears to be post Kolhan as indicated by the configuration of Kolhan outcrops against the intrusive force of this granite. There are no dolerite dykes in the aplitic granite.

Prominent reefs of quartz are found traversing the mica-schists and the Bonai granite south of Darjin.

20319.

ECONOMIC
MINERALS
AND ROCKS.

Sundargarh district possesses a sizeable portion of the mineral wealth of Orissa. The most important minerals of economic value in the district are iron ore, manganese ore, limestone and dolomite, which are at present being exploited on a large scale. Several valuable minerals like base-metals and fireclay occur in the district. These, as well as other deposits and occurrences are summarised below.

Asbestos

Asbestos of Tremolite variety occurs as irregular veins in the ultra-basic rocks near the village Renjra in the Bonai subdivision.

Barytes

About 0.8 km. east of Khatangtola ($22^{\circ}22' : 85^{\circ}4'$) in the Panposh subdivision occurrences of barytes have been recorded.

Bauxite

Occurrences of bauxite derived from lateritisation of shales, etc. of Iron-ore series have been noticed in Mitihurda area. The bauxite occurs in small pockets and patches. The percentage of alumina in the ore was found to be above 45 per cent as determined from few samples. Few occurrences have been recorded in and around the Koira valley associated with laterite capping rocks of the Iron-ore series.

Building
materials

Pockets of *Calc-tufa* containing lime occur in the valley of Asurkol Pahar about 2 km. due west of Kuljhori. A similar deposit, but smaller one, is seen along the course of Kuljhor Nala itself, about 1.6 km. to the north of the site referred to above. Building materials like epidiorites and dolerites near Maholpada ($21^{\circ}38' : 85^{\circ}07'$) and Siria ($21^{\circ}42' : 85^{\circ}05'$) are quarried for use as road metal. Thin slabs of slate upto 1.8 m. long and about 25 mm. in thickness have been used as fencing and paving slabs. These occurrences are recorded near Hetpos, Talsara and Kuarmunda. Besides, quartzites are also quarried for use as road building materials, and railway ballasts near Panposh.

Clays

Kaolin : A small, irregular deposit of kaolin associated with pegmatites occurs near Menjapara ($22^{\circ}02' : 84^{\circ}11'$), 9.65 km. north of Dharuadihi railway station. It is suitable as a "filler" and also for ceramic purpose, if mixed with felspar.

Barakar sandstones around Amatpani ($22^{\circ}13' : 83^{\circ}39'$) contain about 17.8 per cent of white clay as matrix, the rest of the bulk being made up of good quartz sand. Though reserves are indefinite, the deposit should be workable for both clay and sand. Near Kurdrigatu, there is a bed of kaolin associated with grey sandy shales adjoining carbon phyllites, extending for 274 metres with an average width of 45 metres. Similar material is also found near Lardga ($22^{\circ}25' : 84^{\circ}47'$) and Baraibera ($22^{\circ}23' : 84^{\circ}49'$).

Fireclay: The Barakar formations in the Hemgir coal field contain several occurrences of different varieties of clays. Fireclay beds are encountered in a number of places in the entire strip of the Barakars in Baisundar valley. But good variety of clay beds are recorded in and around Tentuligadi-Siarimal, Balinga-Bankibahal—Forkbahal, Kirpsera-Garjanbahal, Khuntijharia, Dulunga, Khajurdihi, and Jharpalang-Girisuon.

Most of the areas mentioned above are held by mining leases. Detailed investigation of the fireclay deposits in Siarimal-Tentuligadi and Bankibahal-Balinga, Dulunga and Khejurdihi areas undertaken by the Directorate of Mines, Orissa, has indicated a reserve of 5·4 m. tonnes of fireclay of all grades. Besides, a reserve of 0·8 m. tonnes of clay has been estimated by detailed prospecting in the deposits near Garjanbahal and Khajurdihi.

China Clay: Kaolin originated from the altered felspars of the metamorphosed pegmaties are found at Kaintara (732), Bhaunra and Dharuadihi. They are locally used for white washing, but if exploited properly it can suitably support a pottery industry in a small scale.

A big stretch of Gondwana rocks in the former Hemgir Zamindari of Gangpur State, known as Hemgir coal field, extends from Amatpani (22° 12' 83° 39') to south east up to Ratakhand (21° 54' : 83° 51'). It forms the connecting link between the Ib river coal fields in the east and the Raigarh coal fields in the west. Coal

Outcrops of coal have been reported from Jhujia Nala near Ghogar-pali (22° 8' : 83° 39'), at the confluence of the Jhujia Nala and the Baisundar Nala, along the Baisundar Nala and near Dulunga (21° 57' : 83° 48') in the Deodaria Nala. It is reported that systematic drilling was carried out under the guidance of Dr. King (1871) in three places at Ratansara (22° 4' : 83° 40'), Gopalpur and Bankibahal (22° 2' : 83° 45') and three seams ranging in thickness from 1·2 m. to 6 m. (4 ft. to 20 ft.) were proved. The samples taken from the borings and other outcrops were in most cases disappointing due to high ash content and further exploration was, therefore, discontinued. A specimen analysis is as follows :—

	Per cent
Moisture	.. 4·24
Volatile matter	.. 32·98
Fixed carbon	.. 43·74
Ash	.. 19·04
Total	.. <hr style="width: 100px; margin: 0 auto;"/> 100·00

Specific gravity—1.427 ; does not cake ; ash-white. The total reserves of coal in this field is yet to be assessed.

Felspar

Pegmatite veins containing very coarse masses of potash felspar (orthoclase & microcline) suitable for use as refractories are fairly abundant in the granite tracts around Darlipali (21° 58' : 85° 55'), Sargipali (22° 03' : 83° 55'), Ghantburu (22° 01' : 84° 05') and other areas.

Gold

The gravels of the Brahmani river and some of its tributaries are washed for their gold content (placer gold) by the local Jhoras. The important occurrences are at 0.8 km. south of Jaraikela bathing ghat (21° 45' : 84° 39') opposite Birtola (21° 58' : 84° 53'), Dhenkia (21° 57' : 84° 52'), Kulghari (21° 59' : 84° 51'), and Siarkundar (21° 55' : 84° 52'). The recovery is said to be poor and of no economic importance.

According to Dr. M. S. Krishnan, gold washing was carried out in the lb river and its tributaries like the Ichha Nala during the last century. Colonel Houghton has recorded the occurrence of placer gold in the sediments contributed by the Koel, Karo, Sankha and Brahmani rivers.

Iron ore

The Singhbhum-Keonjhar-Bonai (Sundargarh) Iron-ore belt constitutes the most important store house of India's iron-ore wealth. It has a striking length of nearly 48 km., out of which about 23 km. fall in the Bonai area of Sundargarh.

The iron-ore deposits form a series of ridges with a NNE-SSW strike and occur in the rocks of iron-ore series in association with the banded hematite Jasper. The banded hematite Jaspers consist of alternating bands of Jasper or chalcedony and hematite, containing varying proportion of Iron oxide and silica. The maximum thickness of hematite Jasper formation is stated by H. C. Jones¹ to be about 914 metres in Bonai area. From the present study by the Directorate of Mines, the thickness of BHJ is found to be between 150 m. to 300 m.

The banded hematite Jasper is seen frequently to change into hard massive Iron-ore where followed laterally. It occasionally passes also into laminated ore with a shaly appearance or into lenses or pockets of powdery ore.

1. Iron Ore Deposits of Orissa and Bihar 1934, H. C. Jones, p. 198.

The important iron-ore deposits in the district with their proved reserves and grade are as follows :—

Sl. No.	Location	Reserve (in million tonnes)	Grade per cent Fe.	Reserve proved by
1	2	3	4	
1.	Baliapahar ..	25	64	Directorate of Mines, Orissa
2.	Mitihurda Group (21°50' : 85°20').	25	63	Ditto
3.	Badamgarh pahar (21°48' : 85°16').	21	64	Ditto
4.	Basada ..	25	63	Ditto
5.	Diringburu ..	4	64	Ditto
6.	Khandadhar group ..	200	62	O r i s s a Mining Corporation.
7.	Dandrapahar (21°51' : 85°09')	116	59	Hindustan Steel, Ltd. Rourkela
8.	Taldihi ..	227	61	Ditto
9.	Kulta ..	50	62	Ditto
10.	Other minor deposits ..	100	62	—
Total ..		800 m. tonnes (approx.)		

(The indicated reserves are much more)

Kyanite occurs in association with vein-quartz at many places, but all the occurrences are comparatively small and of no economic value. The occurrences south of village Sialjor (22°12' : 84°27'), west of Kudumunda (22°23' : 84°32'), Ghariajor, Kumbakera (22°29' : 84°44') and Alapaka deserve mention. Kyanite and Sillimanite

Sillimanite occurs in the quartz-schists, south of Kahchua (22°23' : 84°31'). It is of no economic importance.

The earliest occurrence was reported by M. S. Krishnan, one mile (about 2 km.) SE of Sargipali (22°05' : 85°55') and immediate north of hill 1254', in which traces of galena were discovered in the dump near abandoned pits. Detailed investigation around Sargipali is under progress by the Geological Survey of India. Lead and Zinc ore

Sulphide mineralisation has been noted in an area S E of Giringkela ($22^{\circ}8' : 83^{\circ}47'$), which displays visible specks of pyrite, galena and chalcopyrite along with pyrrhotite, bornite and arsenopyrite. Occurrences of base-metals have been recorded in the core of limestone at Kiringsera ($22^{\circ}15' 30'' : 84^{\circ}25'$). Prospecting operations by means of geochemical sampling in the area is under progress by the Directorate of Mines.

Limestone
and Dolomite

Limestone and dolomite which are the most important economic mineral deposits in the Gangpur area, occur in two series of outcrops, one along the northern limb and the other on the southern limb of the Gangpur anticlinorium. The deposits have been recorded by M. S. Krishnan while undertaking a systematic geological mapping of the State. Subsequently the deposits have been reassessed by the G. S. I. with a view to proving substantial reserves of limestone and dolomite for the Hirakud Dam Project and proposed steel plants of Orissa. The average width of the biggest horizons is between 610 to 760 metres of which the dolomite forms nearly 365 to 455 metres and limestone about 240 to 260 metres. The general strike of the bands varies from E W to ENE-WSW. The dip of the formations is generally steep. The limestone is fine to medium grained and is grey in colour. There is transition from pure crystalline limestone to calcareous phyllite. About one third of the limestone reserves in the area is of good quality and of a composition suitable for flux.

The limestone and dolomite occur in two distinct belts, one in the north, comprising the deposits at Raiboga ($22^{\circ}23' : 84^{\circ}37'$), Birmitrapur ($22^{\circ}24' : 84^{\circ}44'$), Hatibari ($22^{\circ}24' : 84^{\circ}51'$), Gatitangar ($22^{\circ}24' : 84^{\circ}54'$) and along the Khatma Nala and the Deo river and the other in the south, which stretches over a distance of more than 96 km. between Jaraikela in the east and Lefripara ($22^{\circ}7' : 83^{\circ}48'$) in the west. The important deposits in this belt are at Panposh ($22^{\circ}14' : 84^{\circ}49'$), Lanjiberna ($22^{\circ}15' : 84^{\circ}30'$), Kiringsera ($22^{\circ}15'30'' : 84^{\circ}25'$), Kukarbhuka ($22^{\circ}12' : 84^{\circ}30'$), Kinjirma ($22^{\circ}0' : 84^{\circ}06'$). The important deposits are discussed below :—

Birmitrapur deposit is the largest and forms the major source of flux grade limestone and furnace grade dolomite for the iron and steel plants in Eastern India. The limestone occurs over a total distance of nearly 6.4 km. with a width of 225 m. to 240 m. and forms a line of hills rising to an average elevation of 60 m. above plains. Dolomite occurs to the south of the limestone and occupy the plains, the width being 300 m. The strike of the beds is nearly EW and the average dip is 60° due north

There is a minimum width of 45 to 60 metres of limestone with less than 5 per cent silica, 90 to 105 m. width with 5 to 8 per cent silica. The percentage of iron oxide, alumina and magnesia in the limestone is 0.5, 1.5 and 2.4 respectively. Probable reserves of limestone containing less than 8 per cent insolubles within a depth of 60 m. are about 100 million tonnes of which 16 million tonnes would be with below 4 per cent insolubles but the total indicated reserve of limestone of all grades will be nearly 274 m. tonnes. The reserves of dolomite is estimated at 256 million tonnes. This deposit is being worked by Bisra Stone and Lime Co. Ltd. (Bird & Co.).

Exposures of limestone in Hatibari-Purnapani-Gatitangar-Katma Nala—Limbra belt section occur over an area of 12.8 km. by 8 km. between Kokrama and the Deo river and further east. The reserves of limestone with insolubles below 8 per cent will be about 20 million tonnes. The reserves of the individual areas are given below :

The limestone in Hatibari Block is being worked by the TISCO. The reserve of dolomite of furnace grade in this area is estimated at 0.5 million tonne and the same of flux grade limestone is about 1.5 million tonnes up to 30 m. depth.

The eastern portion of the deposit extending for a length of nearly 1.5 km. between the Hatibari quarry of the TISCO and Pahartoli, forms the Purnapani Block.

The limestone suitable for flux extends over a zone of 1.2 km. in length with a minimum width of 120 m. The probable reserves from this area are 7.3 million tonnes up to a depth of 30 m.

In the Gatitangar area, limestone is exposed for a length of about 1.5 km. with a width of about 0.4 km. The general strike of the bands is nearly EW and the dip is about 75° to 85°. The reserves for flux grade limestone (below 5 per cent insoluble) is estimated at 3.4 million tonnes up to a depth of 30 metres. But the reserves of limestone containing average 8 per cent insoluble would be about 5.5 million tonnes.

The Limbra deposits lie to the east of the Deo river. The Hindustan Steel Ltd. have estimated a reserve of 4.5 million tonnes within 30 metres depth containing 12 per cent insolubles.

The limestone and dolomite deposits at Dublabera (22° 18' : 84° 34') are situated at about 12.8 km. west of Kuarmunda railway station on the Rourkela—Birmitrapur branch. The limestone occurs in three bands with a thickness of 90 cm. to 120 cm. (3' to 4') each and separated from one another by 60—90 cm. (2' to 3') of impure limestone. The

dip is low (25°) and are grey to white in colour and medium to coarse grained in texture. The hills situated to the north-east of Dublabera consist of mainly dolomite though at the top limestone is exposed all along the southern and western escarpments. The hillock south of Sarmohan is composed mainly of dolomitic limestone. The limestone exposed in this region is not of good grade. The magnesia content in the limestone vary from 2.3 to 6.2 per cent. The Directorate of Mines have estimated a reserve of 3 million tonnes of limestone for the same deposits.

The limestone bands are exposed to the west, east and north of the village Lanjiberna ($22^\circ 15' : 84^\circ 30'$). The beds strike approximately EW and dip at 60° — 70° on either side. The deposit is traceable for a distance of about 1.6 km. with a maximum width of about 0.5 km. The deposit is divisible into three zones, the southern, the central and the northern of which the central zone is dolomitic. In the southern zone the limestone is mainly medium grained and most of it is suitable for cement. The northern and the southern zones run parallel to each other and extend eastwards from the south of Dhaurara. A reserve of about 16 million tonnes of limestone has been estimated in the two zones of the deposit more than half of which would be suitable for flux. The deposit is being worked by M/S. Orissa Cement Ltd.

The Kiringsera (Ludhkutali) deposit is situated 16 km. north of the Garposh railway station. The limestone exposures are traceable over a length of 720 m. with a maximum width of 300m. The beds strike E W with a dip of 35° to 40° northwards. A reserve of 2 million tonnes of limestone averaging 10-11 per cent insoluble was estimated by the Geological Survey of India.

Detailed proving operations undertaken by the Directorate of Mines, have revealed a total reserve of 30 million tonnes of limestone of all grades.

Representative chemical analysis :—

SiO ₂	CaO	MgO	R ₂ O ₃
8.70	49.44	1.58	..
7.72	50.10	0.91	2.00
10.30	47.93	1.15	1.90
14.50	44.29	2.35	4.50

The deposit situated at Kukarbhuka ($22^\circ 12' : 84^\circ 30'$) about 8 km. NW of the Sonakhan railway station is traceable from Gumardihi, on the east to Sialjor on the west, over a distance of

about 6 km. with a width of about 600 m. The beds strike in a EW direction and dip at 60° to 70° due south. The northern part of the deposit is occupied by limestone, while dolomite occupies the southern part. The dolomite is light grey, fine grained, massive in nature and suitable for furnace lining. This area is under the lease hold of M/s. Bisra Stone & Lime Company and the Tata Iron & Steel Company. The dolomites are now being worked by the Tata Iron & Steel Company. Since a greater part of the area is covered by alluvium the reserves have not been estimated.

There are three deposits at Katang ($22^\circ 14' : 84^\circ 29'$) about eleven km. north-west of Sonakhan railway station and are under the leasehold of B. S. L. Co. The limestone deposit is situated about one km. north of the village and the dolomites occur to its SE and SW. Limestone is traceable along the strike for a distance of about 720 m. beyond which on either side, it is covered with laterite. The width of the exposed limestone and dolomite is nearly 300 metres.

Since a greater part of the deposit is under water, the reserves of different grades of limestone have not been assessed.

The Khatkurbahal deposit ($22^\circ 17' : 84^\circ 29'$) is situated at about 16 km. NW of the Sonakhan railway station. The deposit is traceable for a distance of nearly 1 km. with a thickness of about 600 m. The general strike of the beds is EW and dipping 45° to 60° due north. The southern part of the deposit exposes limestone of good quality, whereas the northern part is all dolomitic. The reserve of limestone exposed in the southern part (40 m. width) is about 1.5 million tonnes.

The Purkapali deposit ($22^\circ 10' : 84^\circ 23'$) is situated at about 6 km. NW of the Garposh railway station. The deposit is traceable for 0.8 km. along the strike and 2.8 km. ($1\frac{3}{4}$ mile) across it. The greater width of limestone at this place appears to be due to folding by which the beds have been repeated. The general strike of beds is approximately NE-SW, dipping between 25° to 50° to the SE. The limestone for greater part of the deposit is flaggy and contains plenty of tremolite crystals, which are predominantly seen on the exposed surface. Minute specks of pyrite are also seen. The deposit is traversed by large number of quartz veins, thereby deteriorating the grade of the limestone. The deposit does not contain good limestone in any part. The area is held under lease by the Bisra Stone and Lime Company.

The deposit at Kaduapara ($22^\circ 9' : 84^\circ 22'$) is situated SW of the Purkapali deposit and is probably the south-western continuation of the same deposit. The main exposures of limestone are seen on the footpath,

in the Nala just SE and in another Nala about 0·8 km. east of the Kaduapara village. The beds dip 30° to 40° to the SE. It is associated with phyllites and for greater part of the deposit the limestone is flaggy and in general the quality of limestone is not better than that of Purkapali and, therefore, is of no commercial importance.

The Directorate of Mines has brought to light a 6 km. long belt of limestone around Kutra extending from Litibera on the east up to Telighana on the west. The limestones occur in detached patches. Detailed investigation has indicated that the limestone is high in silica content and probably can be used commercially only after beneficiation and blending with high grade ore.

The following additional deposits have been discovered and assessed by the Directorate of Mines :—

Name of Deposit	Location	Reserve in M. T.	Grade
1. Litibeda ..	22°15' : 84°25'	3·1	High silica limestone.
2. Kutra south ..	22°14' : 84°27'50"	14·3	Ditto
3. Telighana ..	22°13' : 84°25'	2·55	Ditto
4. Bimta ..	22°23'30" : 84°49'	0·76	Ditto
5. Luaram ..	22°27'30" : 85°01'30"	0·80	Ditto
6. Khairtola ..	22°20' : 85°0'30"	6·00	Dolomitic

Dolomite

The belt of dolomite occurring at the southern and south-eastern portion of Gangpur is fairly extensive and is exposed intermittently over a distance of 45 km. from the bed of the Koel, 6 km. NNW of the Jaraikela railway station in the east, to near Amghat 10 km. NE of the Rajgangpur railway station in the west. The width of the dolomite zone varies between 270 m. at the eastern part and 630 m. at the western end. The general strike of the dolomite is E W to ENE—WSW, with south or SSE dips varying from nearly vertical at places to a range between 45°—70°.

A few outcrops of dolomite are seen exposed at intervals along the bed of the Sapai river at the south-western part of Gangpur, extending in a NE—SW direction over a distance of nearly 25 km. from the junction of the Ib river to as far as Birbira.

Good quality dolomite occurs only in the middle portion (1) adjoining Tumnigudi near the Ghoriajor Road (2) between Bandubahal and Tillaimalti and (3) to the SW of Kinjirma.

The dolomite is medium grained, grey to white saccharoidal variety. From analysis, it was found that percentage of MgO varies from 18 to 20, CaO from 25 to 33 and silica within 5 per cent. There are also some impure bands but in average the quality is fair and may be suitable for furnace lining.

Exposures of dolomitic marble at Lefripara ($22^{\circ} 7' : 83^{\circ} 48'$) extend outcropping intermittently along the Ichha Nala for a length of nearly 3 km. from the Suruguda village in the east as far as the road bridge NW of Lefripara. The width of the dolomite band exposed, varies from 30 m. to 78 m. The nearest railhead is at Belpahar.

Here the dolomite is white to light bluish in colour and finely saccharoidal. The surface is traversed by thin veins of quartz and stringers of limonite. The outcrops at the western extremity carries grains of calc-silicates like tremolite, diopside, etc. But the central part of the deposit is more or less pure dolomite. But on the whole the dolomite here is fairly low in silica content and magnesia is above 20 per cent and $R_2 O_3$ is less than 1 per cent. This can be used for furnace lining. About 1.7 million tonnes of dolomite has been estimated for this deposit.

The vast reserves of limestone and dolomite of all grades in the district are summarised as follows :—

Flux grade, cement grade and high silica limestones.	Indicated reserve — 320 million tones (approximate)
Dolomite	... 280 million tonnes (approximate).

Extensive deposits of manganese ore occur in the district in two regions namely Bonai and Gangpur.

Manganes-
ore

The manganese deposits of the well known Singhbhum, Keonjhar-Bonai belt occur in highly folded shales of the Iron ore series and in gently folded sandstone and shales of Kolhan series which overlie unconformably the rocks of the iron ore series. The rock associated with the deposits are intensely weathered and the area is largely covered by laterite, reddish ferruginous soil and chert.

The deposits in the iron ore series are tabular bodies conformably enclosed by shales whose upper extension and outcrop are capped by laterite and chert.

The manganese deposits that are associated with the rocks of the Kolhan series and their weathering products occur as small lenses and layers conformably enclosed in shales as cross cutting stringers in shale and as pockets in laterite. Low grade manganese ore also occur as small stringers and pockets in purple sandstone interbedded with shales.

The deposits associated with the rocks of iron ore series are the largest and are most important source of the ore in the belt. They range in length up to 305m. and in thickness up to 6.10 m. and some of the deposits have been mined down dip distance of 12.2 m. The deposits consist of manganese oxide that commonly are cavernous and exhibit various textures like botryoidal and mamillary.

The ores consist of pyrolusite, psilomelane, and braunite.

The grade of ore even in individual deposits has a wide variation. Only about 30 per cent of the ores of the area contain more than 40 per cent MnO_2 . Some deposits yield small amounts of chemical and battery grade ore containing up to 97 per cent MnO . Iron oxides are the chief adulterants of these ores.

Important manganese deposits in the Bonai area in the Koira valley are as follows:—

- | | | |
|-------------|-------------------|--------------------|
| 1. Malda | (21°45' : 85°25') | 8. Nadidihi |
| 2. Koira | (21°50' : 85°15') | 9. Harischandrapur |
| 3. Kalmong | (21°55' : 85°15') | 10. Nuagaon |
| 4. Patmunda | (21°50' : 85°20') | 11. Mahulsukha |
| 5. Bhutra | (21°45' : 85°10') | 12. Sarkunda |
| 6. Dengula | | 13. Orahuni |
| 7. Ranisal | | 14. Kusumdihi |

The manganese deposits in the Gangpur region are associated with the Gonditic rocks, mica schists and phyllites of the Gangpur series. The rocks are highly folded. The deposits occur in the core of an easterly plunging anticlinorium, in a belt of about 64 km. in length. These deposits are tabular conformable bodies having maximum length of 305 m. and thickness of 6.10 m.

Most of the deposits are associated with typical gondites composed of quartz and spessartite with subordinate amount of primary braunite, rhodonite and other manganese silicates. Pyrolusite and psilomelane type oxides and hollandite are the principal supergene minerals.

The Ghariajor (22°03' : 84°08'), Manmunda (22°05' : 84°09') to Gantbur (22°06' : 84°12') group of deposits form the most promising block in this sector. These group of deposits have been worked

since long. Occurrences of bedded manganese ore varying in thickness from 10 cm. to 15 cm. have been reported from Amasdegi (22°01' : 84°03') to Gobira (22°19' : 84°44') in the eastern part of Gangpur. The other deposits in this area are located at Pandrisila (22°20' : 84°43') Kuhupani (22°18' : 84°27'), Panchra (22°17' : 84°22'). Dandijamira (22°14' : 84°20') etc. The ore occurring at all these places except Pandrisila, Dandijamira, Kuhupani is of low grade.

The reserves of deposits in the Gangpur area are not known but are probably small. Many of the working mines have been exhausted.

Probable reserves for the Bonai-Keonjhar belt are of the order of 20.3 million tonnes of all grades, of which 7 million tonnes of all grades (30 per cent and above including the oxide ores) may be available from Koira valley alone.

Occurrences of quartz of practically pure variety have been reported from Bamra (22°03' : 84°17'), Dandapara near Birmitrapur (22°24' : 84°44'), Kuchinda (22°05' : 84°42'), Targa (22°27' : 84°39') and around Birbira. They may be useful as source of quartz for ceramic and other purposes. Some bands of Barakar sandstones of the Hemgir coal field occurring near Amatpani (22°13' : 83°39'), contain good grade quartz sand in a matrix of Kaolin. A part of the hill about one mile SW of Jara (22°01' : 84°39') contains pure quartzites.

Powdery red ochre occurs as thin band in association with coal in the Baisundar Nala north of Gopalpur (22°03' : 83°42') overlain by fireclay. The band varies in thickness between 20 cm. to 30 cm. and extends over a length of about 2.5 km. up to Tiklipara (22°04' : 83°44'). A probable reserve of about 29,100 tonnes of red ochre has been estimated in the area by the Directorate of Mines, Orissa. This ore can be used for manufacture of paints, etc.

Fine to medium grained, pure green and grey soap-stones occur near Jharbera (21°49' : 84°53') and Bhaludungri (21°51' : 84°50') in Bonai subdivision. The ultrabasic rocks near Bonaikela (21°56' : 84°47') and Bargaon (21°53' : 84°48') contain minor pockets and lenses of soap-stone. The reserves of soap-stone in the area are estimated to be fairly large. Pure white and soft variety soap-stone has been recorded in a well in Biribara area at a depth of about 7 m. Occurrences of talc schists have been marked near Katepur (22°04' : 84°43') and Jarmal (22°03' : 84°11') and steatite schists near Suimba (22°02' : 85°09').

Numerous bands of talc and talcose rocks are also found associated with sheared chlorite-talc schists and ultrabasic rocks in the following places.

1. West-South-west and South-west of Bhaludungri.
2. Several places between Sisurdi and Bundhebhui.
3. Near Junadih and
4. At the western foot of the 1223 hill near Khajuribahal.

FLORA

The district has not been surveyed by the Botanical Survey of India. The general treatment of Botany of the Feudatory States of Orissa by Cobden-Ramsay runs thus :—"The narrower Valleys are often terraced for rice cultivation, and these rice fields and their margins abound in marsh and water-plants. The surface of the plateau land between the valleys, where level, is often bare and rocky, but where undulating is usually clothed with a dense scrub-jungle in which *Dendrocalamus strictus* is prominent. The steep slopes of the hills are covered with a dense forest mixed with many climbers. *Sal* (*shorea robusta*) is gregarious ; and among the other noteworthy trees are species of *Buchanania*, *Semecarpus*, *Terminalia*, *Cedrela*, *Cassia*, *Butea*, *Bauhinia*, *Acacia*, and *Adina*, which are found also on the lower Himalayan slopes. Mixed with these, however, are a number of trees and shrubs, characteristic of Central India, such as *Cochlospermum*, *Soymida*, *Boswellia*, *Hardwickia* and *Bassia*, which do not cross the Gangetic plain."

Hooker and Thompson have divided the flora of Bihar and Orissa into four Botanical provinces, northern part of Orissa comprising one of them. Bihar and Orissa as a whole is characterised by complete absence of *Cupuliferac* a general scarcity of laurels and myrtles, and by a few or very few, *Ranunculaceae*, *Magnoliaceae*, *Cruciferae*, *Guttiferaceae*, *Rosaceae*, *Umbelliferae*, and comparatively few *Orchidaceae*. Further, except for the genus *Ficus*, it possesses comparatively few of the *Urticales*. On the other hand, it possesses marked positive features in the presence, practically throughout, of the sal tree (but no other *Dipterocarp*) and in the almost general association with the sal in large numbers of individuals, if not species, of *Terminalia*, *Anogeissus*, *Bassia* (the Mohwa), *Butea*, *Scleichera*, *Rubiaceae* (notably *Gardenia* and *Wendlandia*), *Acanthaceae*, *Bauhinia*, *Diospyros*, *Zizyphus*, *Cleistanthus*, *Nyctanthes* and of the grasses *Ischaemum anguisit-folium* (Sabai) and *Heteropogon Contortus* (spear grass). The presence of *Soymida febrifusa* and *Cleistanthus Ocollinus* in some localities is the effect of excessive browsing. The hill tops contain more of thorny species such as *Gardenia*, *Zizyphus* or trees which can remain leafless for about 6 to 8

months a year i. e., *Sterculia urens*, *Annogeissus* or *Cochlospermum* species. As per Champion's classification of flora of India, this district falls under Peninsular Sal type and dry deciduous mixed forest.

A type of forest is met in Raiboga, Birmitrapur and even up to Kuarmunda where the Sal forests exhibit a 'shola' type of vegetation. The undergrowth consists of only grass and in drier areas Sal, once removed, is replaced by grass.

The striking feature of the Bonai forest is the proportionately high percentage of pole crops between 8" to 12" diameter and scarcity of large trees. This unusual condition is due to shifting cultivation in the past and uncontrolled sleeper operation resulting in over exploitation.

The forests occupy an area of 2665 square miles (5826 square km. Forests or over 70 per cent of that of the district : reserved forests cover 995 sq. miles (2562 sq. km.) and protected forests 1670 sq. miles (3264 sq. km.) The entire forest area is under the administrative control of two Divisional Forest Officers with headquarters at Bonaigah and Sundargarh. Sundargarh Division comprises 563 sq. miles (1440 sq. km.) reserved and 860 sq. miles (2200 sq. km.) protected forests and Bonai division covers 432 sq. miles (1122 sq. km.) reserved and 810 sq. miles (1064 sq. km., protected forests. The formation of Sundargarh forest division which started after the merger of Gangpur ex-State was concluded after transfer to its control of the forest areas of ex-Zamindary Estates, Sargipali, Raiboga, Nagra and Hatibari on 15th June, 1957 and Sarapgarh and Hemgir on 1st December 1963 under the provisions of the Orissa Estates Abolition Act.

The forests are of northern tropical dry deciduous type. The crop is a mixed one with Sal (*Shorea robusta*) as the dominant species. The eastern half of Bonai and the Rajgangpur range of Sundargarh division contain better quality of vegetation. The Sal which is the principal timber tree and more or less gregarious in these forests varies from a fairly pure to a mixed crop and occurs throughout the area. The Koira forests and some portions of Toda Reserve contain best quality of Sal. A Sal forest is a delightful sight early in March at the commencement of the hot weather, when the trees come into leaf and flower. The following are the principal associates of Sal, commonly found in all the forests.

Asan or Sahaj (*Terminalia tomentosa*) being more durable than Sal is usually preferred for building houses. The wood of Kurum (*Adina cordifolia*) is used for making combs. The Bija or Piasal (*Pterocarpus marsupium*) is an excellent wood, next in quality to Sal and teak

and from this tree true gum is obtained. The wood of Gambhari (*Gmelina arborea*) being very light is excellent for furniture. The Kusum (*Schleichera trijuga*) is a very hard wood but its value consists in propagation of lac, its fruit is also eaten by aboriginal people. The Aonla, (*Phyllanthus emblica*) the leaves of which are used for tanning gives a good strong pole. The sour fruit is used medicinally, and is made into pickle and preserved. The flower of Mahula or Mahua (*Bassia latifolia*) is used as food by the poorer classes and for manufacture of country liquor; a thick oil is also pressed from its seed and used both for cooking and lighting. The outer covering of its fruit is also eaten. The Karda (*Claistanthus colinus*) gives a very hard and durable wood. The fruit of Char (*Buchanania latifolia*) is used as an ingredient of sweetmeats. The wood of Amltas, locally known as Sunari (*Casia fistula*) is also used for house poles, this handsome tree is better known as the Indian laburnum, with its clusters of golden yellow flower which appear in April and May, the soft brown pulp round the seeds is used medicinally. The Tendu locally known as Kendu (*Diospyros melanxylon*) are common in all forests. From its heart wood a good ebony is obtained. Its leaves are used for making Biri and fruits serve as an article of food for the aboriginals. The Khair (*Acacia Catechu*) is an excellent wood. Its most important product is the resinous extract known as catechu. The Shisham or Sisoo (*Dalbergia latifolia*) another common tree, does not grow to a very large size and gives a very light wood excellent for furniture. Bandhan (*Ougeinia dalbergioides*) also gives a very strong wood. Among other fruit trees mango is commonly found in all the forests. A large number of edible root and indigenous drugs are also found.

The conspicuous shrubs are Dhatuki (*Woodfordia fruticosa*), Telai (*Wendlandia excerta*), Harssinghar (*Nyctanthes arbor-tristis*) and Kurdu (*Gardenia Gummifera*). Climbers are not abundant. The principal grass, Sabai or Panasi (*Eulaliopsis binata*) is used for paper pulp, rope making, and also used as fodder in young stage.

The provisions of the Orissa Forest Act, 1972 are in force since the 15th July 1972. Management of the forests are conducted strictly according to the prescriptions of the working plans. Indiscriminate felling is completely banned rendering homogeneous growth of vegetation possible.

Conservation
of wild life.

The shooting and hunting of wild animals and birds used to be regulated under the provisions of the Wild Birds and Animals Protection Act, 1912 and the Orissa Government Reserved Forests Shooting Rules, 1938. Cases of unauthorised shooting are severely dealt with.

Recently the Orissa Forest Shooting Rules, 1973 have been enforced in the entire State and apply to all the Reserved and Protected Forests. These Rules have been framed under the Orissa Forest Act, 1972 (Orissa Act 14 of 1972) and repeal the corresponding rules made under the Indian Forest Act, 1927 (Act 16 of 1927) and the Madras Forest Act, 1882 (Madras Act 5 of 1882). They aim at controlling and regulating the hunting, shooting, fishing, poisoning of water, setting traps or snares and collection of wild life in the reserved and protected forests. Hunting and shooting of any game during the close season as specified in schedule III of these rules separately in respect of each bird and animal are strictly prohibited. In Appendix I is given the list of species declared protected under these rules throughout the year majority of which are found in the district.

In keeping with the extensive and splendid forests, the district is the abode of numerous big game and rich in varieties of animal lives. The forests of Sundargarh division are comparatively poorer than Bonai in regard to wild life.

FAUNA

The elephant, *Elephas maximus indicus* (Hati) is fairly numerous. They are mostly seen in the east and west of Bonai and usually move in a herds, occasionally causing serious damage to the standing crops, specially rice fields near the jungles.

Mammals

The wild buffalo, *Bubalus bubalis* (Bana mainshi)—“The wild buffalo”, states L. E. B. Cobden-Ramsay “was at one time quite plentiful in Gangpur State (present Sundargarh and Panposh subdivisions) along the valley of the Brahmani and at Kumarkela some twelve miles west, but the advent of the railway proved his death-knell, and to-day there is not a single specimen left in Gangpur or Bonai. In 1900 the sole survivor, a solitary bull, was killed by a villager in the north-east corner of Bonai. Occasionally a solitary buffalo crosses the border from Jashpur to Gangpur”.

The bison, *Bos gaurus* (Gayal), a very retiring animal, is generally seen in the denser and remoter forests. It often lives in small herds and generally grazes in close proximity to elephants.

Among the principal carnivora may be mentioned the tiger, panther, hyaena, wild-dog, jackal and fox.

The tiger, *Panthera tigris* (Bagha) at the enumeration in 1968 numbered 28. The Census of 1972 put their figure at 6, two in Bonai and four in Sundargarh division. In the past, Bonai forests had an unenviable reputation for the number of man-eating tigers

with which they were infested. The aboriginal women frequently fell a prey to these beasts when they entered the jungle for gathering roots and leaves.

The panther, *Panthera pardus* (Kalara-patria) is found in great numbers in almost all the forests. It seldom exceeds two metres in length. It is mostly found in small hills adjoining the cultivated area, where it levies toll from the flocks of goats and sheeps. It is seldom found in the largest and more extensive forests. Black panther (*Panthera pardus negri*) is also met with in Bonai forests. A man-eating leopard is much more dangerous than a man-eating tiger.

The hunting leopard, *Acinonyx jubatus* (Chita), now extinct used to abound in the forests west of Sundargarh in Hemgir area.

The jungle cats, *Felis chaus* (Bana Biradi) and *Felis bengalensis* are fairly common in the forests. They usually frequent both the forest and open grass country and are very destructive to smaller ground games, such as peafowl, partridge and hare, etc.

The large civet cat, *Viverra zibetha* and the plam civet *Paradoxurus hermaphroditus*—The former is met with but not common while the latter is fairly common and seen mostly in areas adjoining the villages. They are very destructive to poultry.

The common grey mongoose, *Herpestes edwardsi* (Hatianeula), is occasionally seen in rocky hills in Sundargarh. It is usually larger in size and more yellow in colour than the common mongoose and has the tail tipped with black.

The jackal, *Canis aureus* (Bilua) is found all over the district usually in the scrub jungle near the villages and avoids dense forests.

The common fox, *Vulpes bengalensis* (Kokisial) is found in all the open parts of the district and is seldom seen in dense forests. It feeds chiefly on small birds and animals. It makes a fine pet when tamed.

The giant squirrel, *Ratufa indica bengalensis* (Gunduchi-musa) is a very handsome squirrel and is common in all the dense forests and lives in the branches of the tallest trees. The colour is chiefly of a chestnut red above with the rump and tail black, the lower parts are buff. They are easily tamed and make very amusing pets when taken young. Their delicate flesh is much appreciated by the forest tribes. The common striped squirrel, *Funambulus pennanti* is plentiful.

The common giant flying squirrel, *Petaurista petaurista*. "Although this variety of the large flying squirrel", writes Cobden-Ramsay "is supposed to be peculiar to Burmah, Mr. F. D. Whiffin has obtained several specimens in Gangpur and Bonai and in each case the colour has been the same ash coloured above and white on the belly. A specimen was sent by Mr. Whiffin to the Calcutta Museum in 1892. They are entirely nocturnal in their habits, and feed on fruits, nuts and insects, and breed in the holes of trees. With the parachute extended they have been seen to cover a flight of quite 100 yards¹".

The common porcupine, *Hystrix indica* (Jhinka) is met with in all the rocky hills. It is rarely seen due to its nocturnal habits. It feeds chiefly on roots.

The hare, *Lepus nigricollis* (Thekua) is found but rarely, mostly in bush jungles.

The pangolin, *Manis crassicaudata* (Bajrakapta). This quaint animal is seldom met with. It lives in deep burrows and feeds chiefly on insects, its favourite diet being the white ant. It grows from 2 to 2.5 feet (60 to 75 centimetres) in length and is covered with scales of a light olive colour.

The hyaena, *Hyaena hyaena* (Gadhia) is very common and is to be found over any carcass. They are nocturnal in habit and at times carry off dogs and goats.

The wild dog, *Cuon alpinus* (Balua kukura) is very rare but extremely destructive to game. They are of two varieties. The larger variety appears to be most common than the small light coloured one. The larger variety stands higher than a jackal and in the cold season has a bright chestnut brown coat: the ears are erect, the tail very bushy with a dark tip. The smaller variety is grey in colour. It is said to be most destructive to game, hunting in far larger packs than the larger ones. Tigers and leopards are known to have been killed by them.

The wolf exists but is very rare and is found only in pairs. They are destructive to goats and sheep.

The common Indian sloth bear, *Melursus ursinus* (Bhalu) is found all over the forests generally in caves in the hot and wet weathers and in heavy grass and bushes during the cold weather. It feeds chiefly on the mahua flowers (*Basia latifolia*), berries and white ants. They are a menace to sugarcane and maize.

¹. Feudatory States of Orissa.

Sometimes a bear develops carnivorous tendencies. They seldom attack man except when disturbed, yet many people are killed or injured by them. A mother bear with cubs is formidable when met at close quarters. They are often met with in twos or even threes, a mother and cubs or a male and female together.

The ratel or honey-badger, *Mellivora capensis* measures about 3 feet (one metre) in length. The upper part of its body is ashy-grey and the rest coal-black. It is entirely nocturnal in habits and is seldom seen. It lives chiefly in rocky caves in the hills and feeds on lizards, insects and honey.

The Sambar, *Cervus unicolor*, the largest of Indian deer, is found in all the fairly thick forests and generally frequents the high and most inaccessible hills. It is nocturnal in its habits grazing chiefly at night and returning to the hill tops for rest during the day.

The spotted deer, *Axis axis* (Chital) is common in all the forests. It is generally found in small herds preferring open forests close to water, and is seldom met in more hilly tracts. They are gregarious in their habits and less nocturnal than the Sambar and care little for the neighbourhood of man.

The Indian mouse deer, *Tragulus meminna*, the smallest of its tribe is found only in dense forests living in the hollows of trees on the ground. Owing to its diminutive size it is seldom seen. It stands 10 to 12 inches (25 to 30 centimetres) at the withers and in colour is brown with white or buff spots and longitudinal stripes.

The muntjac or barking deer, *Muntiacus muntjak* (Kutra) occurs but is seldom seen. It is often heard and easily recognised by its dog-like bark.

The Nilgai, *Boselaphus tragocamelus*, is found specially in open forests, where it feeds largely on wild berries. One of its favourite fruits is the Aonla (*Phyllanthus emblica*) which it devours in large quantities. It is generally found in small herds.

The four-horned antelope, *Tetracerus quadricornis* (Charisinga) is fairly common, the female and young male so much resemble the barking deer that they are frequently mistaken for the latter animal.

The langur or hanuman (*Presbytes entellus*) and the bandar (*Macaca mulatta*)—of these, the former is plentiful. They are found both in the forests and in cultivated areas. The langur is destructive to crop, specially to gram and pulse. It is regarded as sacred.

The Indian boar, *sus cristatus* (Ghusuri) is very destructive to crops.

The otter, *Lutra perspicillata* (Ud) is also found in this district.

A fair number of game birds are met with in the district. The Birds common peafowl, *Pavo cristatus* (Mayura), the National Bird of India, is numerous. Two kinds of spurfowl, *Galloperdix spadicea* the common red spurfowl, and *Galloperdix lunulata* the painted spurfowl are found almost in all the forests, but the latter is not very common.

The black partridge, *Francolinus francolinus* and the grey partridge *Francolinus pondicerianus*, are found but rarely. The hornbill, *Tockus birostris*, is often met with in forest tracts.

During the cold weather great flocks of geese, ducks and teal are found in the district. The two species of whistling teals and the little cotton teal are common.

The common sandgrouse, *Pterocles exustus* and the painted sandgrouse, *Pterocles indicus* are also met with. The Jungle bush quail is found in all the forests.

The district is quite rich in other common birds, both terrestrial and aquatic.

Crocodiles of large size are not found in the district. Both the Reptiles snub-nosed crocodile and the long-nosed fish-eating Tantia or Gharial (*Gavialis gangeticus*) are found in the rivers. The Godhi or monitor lizard (*Varanus monitor*) is commonly seen. They are likely to be exterminated soon due to the rising commercial value of their skin.

Various species of snakes occur in the district. Among the principal poisonous snakes may be mentioned the two varieties of cobra, *Naja naja kaouthia*, locally known as Tampa, and *Naja naja naja*, Naga or Gokhara, and the Chandra-boda or the Russel's viper *Vipera russelli*, the Kaudia Chiti or the common Krait, *Bungarus caeruleus*. The common non-poisonous snakes are the Ajagara (*Python molurus*), the Dhamana *Ptyas mucosus*, the Kandanalala (*Natrix stolata*), the Dhanda (*Natrix piscator*), the Domundia (*Eryx conicus*) and the Telia sapa (*Typhlops brahminus*).

The large deep pools in the beds of the rivers, the tanks and the Fish water reservoirs contain numerous small and large species of fish. The principal among them are Rohi (*Labeo rohita*); Mirikalī (*Cirrhinay mrigala*); Bhakur (*Catla catla*); Sala (*Ophiocephalus marulius*); Seula (*Ophiocephalus striatus*); Balia (*Wallago attu*); Ilishi (*Hilsa ilisha*) and various other species.

The wild animals and reptiles annually take a heavy toll of human lives. The following is the mortality figures for the years 1968—71.

Period	Death due to snake bite	Death due to attack of wild animals				Total
		Elephant	Tiger & Panther	Bear & Wolves	Other wild animals	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1968	61	..	1	1	15	78
1969	90	..	..	2	14	106
1970	55	..	..	1	..	56
1971	59	..	..	..	2	61

CLIMATE

The climate of this district is characterised by a hot dry summer and well distributed rainfall in south-west monsoon season. The cold season commences in November and lasts till the end of February. The hot season follows thereafter and continues till about the end of June. The south-west monsoon season starts from mid-June and continues to the end of September, October and November constitute the post monsoon season.

Rainfall

Records of rainfall are available for only two stations in the district for 42 and 68 years. Appendices II and III give the rainfall at these two stations and for the district. The average annual rainfall in the district is 1647.6 mm (64.86"). The rainfall is fairly uniform in the whole district. About 86 per cent of the annual rainfall is received during the monsoon months extending over June to September, July being the month with heaviest rainfall. The variation in the rainfall from year to year is not large. In the period 1901 to 1948 the annual rainfall was the highest in 1943 when it amounted to 138 per cent of the normal. The lowest annual rainfall which was 73 per cent of the normal occurred in 1924. In the same 48 year period, the annual rainfall less than 80 per cent of the normal occurred in only two years. It will be seen from Appendix III that the rainfall in the district was between 1400 and 1900 mm. (55.12" and 74.80") in 37 years out of 47.

On an average there are 78 rainy days (i. e. days with rainfall of 2.5 mm. 10⁻cents or more) in a year in the district.

The heaviest rainfall in 24 hours recorded in the district was 333.5 mm. (13.13") at Bonai on July 20, 1920.

Temperature

There is no meteorological observatory in the district. The following description of the climate is based on the records of the meteorological observatories in the neighbouring districts where the climatic conditions are very similar to those in this district. The hot season

commences by about the beginning of March when temperatures begin to rise. May is the hottest month with the mean daily maximum temperature at about 41° C (105.3° F) and the mean daily minimum at about 27° C (80.6° F). On individual days the maximum temperature may reach 47° C (116.6° F). The heat in May and the early part of June prior to the onset of the south-west monsoon is trying. The onset of the monsoon by about mid-June brings some relief. In between spells of rain the weather is oppressive due to the high moisture content of the air. In September due to breaks in the monsoon, the day temperatures increase slightly and this increase continues during October, but the nights become progressively cooler from October. From about the middle of November, day temperatures also begin to decrease rapidly. December is usually the coldest month with the mean daily maximum temperature at about 27° C (80.6° F) and the mean daily minimum at about 12° C (53.6° F). In the wake of western disturbances passing across northern India in the cold season, the district is sometimes affected by cold waves when the minimum temperature may go down to 4° or 5° C (38.2° or 41.0° F).

The relative humidities are high in the south-west monsoon season. Humidity
Later the humidity decreases and during the winter season the air is fairly dry. The driest part of the year is the summer season when the relative humidities are low especially in the afternoons when they are about 25 to 30 per cent.

During the south-west monsoon season the skies are heavily Cloudiness
overcast with clouds. In the latter half of summer and the post monsoon months there is moderate cloudiness. In the rest of the year the skies are generally clear or lightly clouded.

Winds are generally light to moderate with some increase in force Winds
in late summer and the south-west monsoon season. In the post monsoon and winter months winds are mainly from directions between north and east. In March winds are variable in direction. By April westerlies and south-westerlies become more common, and these are predominant during the period from May to September.

Storms and depressions from the Bay of Bengal during the monsoon season cross the east coast of India and move in a westerly to north-westerly direction. These cause widespread rain and strong winds. Occasionally storms from the Bay of Bengal in October may also affect the district or its neighbourhood. Thunder-storms occur during all the months of the year, their frequency being the least in November and December and highest during the monsoon season. Occasional dust storms and dust raising winds occur in the summer months. Special Weather Phenomena

APPENDIX I

Protected species throughout the year

English name	Local name
BIRDS	
The common peafowl (<i>Pavo cristatus</i>)	Mayura
ANIMALS	
Marbbed Cat (<i>Pardofelis marmorata</i>)	Meghua Chita Biradi
Wild Buffalo (<i>Bubalus bubalis</i>)	Bana Mainsi
Indian Pangolin (<i>Manis crassicaudata</i>)	Bajrakapta
Crocodile (<i>Crocodylus porosus</i>)	Kumbhira
Govial (<i>Gavialis gangeticus</i>)	Thantia Kumbhira
Black Buck (<i>Antelope cervicapra</i>)	Bali Harina
Four horned Antelope (<i>Tetracerus quadricornis</i>)	Chousingha
Tiger (<i>Panthera tigris</i>)	Mahabala Bagha (Except man-eater and cattle-lifters when specially declared dangerous by the competent authority).

APPENDIX II

Normals and extremes of rainfall

Station	No. of years of data	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual	Highest annual rainfall as per cent of normal year **	Lowest annual rainfall as per cent of normal year **	Heaviest rainfall in 24 hours *	Date
															per cent of normal year **	as per cent of normal year **	(mm.)	
Rajgangpur	49 a	20.6	38.3	16.8	16.8	32.0	239.0	476.5	468.9	232.2	77.2	12.5	5.3	1636.1	149 (1943)	61 (1924)	279.9	1938 Aug. 14th
	b	1.3	2.3	1.6	1.3	2.5	11.0	19.7	19.1	11.9	4.2	0.8	0.5	76.2				
Bonai	45 a	19.1	35.1	21.8	23.4	50.3	262.9	483.9	447.5	215.7	74.7	19.6	5.3	1659.3	168 (1920)	75 (1916)	333.9	1920 July 20th
	b	1.3	2.1	1.8	2.0	4.1	11.5	19.5	18.6	12.7	4.4	1.3	0.5	79.8				
Sundargarh District	a	19.9	36.7	19.3	20.1	41.1	250.9	480.2	458.2	223.9	75.9	16.1	5.3	1647.6	138 (1943)	73 (1924)	..	..
	b	1.3	2.2	1.7	1.7	3.3	11.3	19.6	18.9	12.3	4.3	1.1	0.5	78.2				

(a) Normal rainfall in mm. (b) Average number of rainy days (days with rain of 2.5 mm. or more).

* Based on all available data upto 1948

** Years given in brackets.

SUNDARGARH
APPENDIX III

Frequency of Annual Rainfall in the District

(Data 1901—1950)

Range in mm.	..	No. of years
1201—1300	..	2
1301—1400	..	3
1401—1500	..	4
1501—1600	..	9
1601—1700	..	9
1701—1800	..	9
1801—1900	..	6
1901—2000	..	2
2001—2100	..	1
2101—2200	..	0
2201—2300	..	2

47 years data only available.