

## CHAPTER 1

### GENERAL

#### 1. Introducing the District

The district of Balangir is flanked in the north-west by the Gandhamardan hills, a name of Ramayan fame, and in the north-east by the rock-infested Mahanadi. It is traversed by many hill streams and is interspersed with evergreen woodlands, the shelter of Bison and Sambar. It is the nature's cradle for the Kutia Khonds, Binjhals and Gonds. The district is famous through centuries for the Bhulias and Kosthas, master-craftsmen who work excellent motifs on cotton and tassar fabrics. It is the land of Tantric culture, being the seat of the famous seven maidens<sup>1</sup>, who excelled in esoteric practices of Tantrayana (*see* Patnagarh—Chapter XIX). In Balangir at Ranipur-Jharial there exists the temple of 64 Yoginis—one of the four such temples in India<sup>2</sup>. It is also notable for having experimented in the past a republican form of Government that was overthrown by Ramai Deo, a Chauhan youth, whose mother hailed from Mainpuri in north India. Ramai founded the kingdom of Patna in the 14th century, which within a short span of its militant career became the head of the cluster of eighteen Garhs. The ruins of forts not only in the urban areas like Patnagarh, Titilagarh and Sonepur but also in the remote localities like Tusra, Jharial and Binka speak of the past glory of the kingdom. The Chauhan rule ended with the merger of the States of Patna and Sonepur with Orissa on the 1st day of January, 1948. They together form the district of Balangir.

#### 2. Origin of the name of the District

The district of Balangir like many other districts of Orissa is named after the headquarters town of Balangir. This town was also the headquarters of the feudatory State of Patna, since the eighties of the nineteenth century. According to tradition, Balangir was established by Balaram Deo, the brother of Narasimha Deo, the 12th Raja of Patna. As Balaram Deo is known to have flourished about the middle of the 16th century, the origin of the town of Balangir has also been attributed to that period. It is said that the town being founded by Balaram Deo was named after him as Balaramgarh, from which the present name Balangir has been derived. There is, however, no recorded evidence to support this theory. It may be that the name

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1. Their abode came to be known as Kuanri-Patana (the camp of maidens) from which the kingdom was called Patna.

2. The other three temples of 64 Yoginis are at Khajuraho in Madhya Pradesh, Hirapur near Bhubaneswar in Orissa and Bheraghat near Jabalpur in Madhya Pradesh.

[14 B. of R.—2]

Balangir like many other place names of the district is of non-Aryan origin. No other facts are available to trace the origin of the name of Balangir.

### 3. Location, General Boundaries, Area and Population

The district lies between 20°9' and 21°11' north latitudes and 82°41' and 84°16' east longitudes. It is bounded on the north by the district of Sambalpur, on the east by the district of Baudh-Khondmals, on the south by the district of Kalahandi and on the west by the Nawapara subdivision of the district of Kalahandi.

The area of the district is 3,411.6 square miles or 8,836 square kilometres. According to the Surveyor-General, it covers an area of 3,439 square miles or 8,907 square kilometres. It had a total population of 1,068,686 in the 1961 Census out of which 534,219 were males and 534,467 females. In order of area and population the district holds the 11th and 8th position, respectively among the districts of Orissa.

According to 1961 Census, the Scheduled Caste population of the district was 187,422 (93,513 males and 93,909 females), which is 17.5 per cent of the total district population. The tribal population was 220,916 (109,087 males, 111,829 females) which is 20.7 per cent of the total population in the district.

#### Density of Population

The density of population according to 1951 Census was 269 per square mile, but according to 1961 Census it was 313. The density of the State of Orissa in 1961 was 292. Balangir presents a slightly higher density than the State average.

The following table shows the subdivisionwise break-up of the area, population and density of population.

Subdivision	Area in square mile	Population (1961 Census)	Density per square mile (1961 Census)
Balangir	868	305,406	352
Patnagarh	726.6	187,786	258
Sonepur	882	274,515	311
Titilagarh	935	300,979	322
Total of the district	3,411.6	1,068,686	313

#### 4. History of the District as an Administrative Unit

Patna was an important State in western Orissa under the Chauhans since 14th century A. D. By the 16th century A. D. almost the whole of western Orissa came under the political sway of the Chauhan rulers of Patna who counted as many as eighteen Garhs under them. The twelfth king Narasimha Deo handed over to his brother Balaram Deo the territory lying north of the river Ang. The latter founded the State of Sambalpur which became the most powerful of the Garhjat cluster and from that time onwards the importance of Patna declined. Sonepur, which was formerly a chiefship subordinate to Patna, was constituted as a separate State by Raja Madhukar Sai of Sambalpur about the middle of the 17th century A. D. Since then it was counted along with Patna and Sambalpur as one of the Garhjat States.

The States of Patna and Sonepur were under the occupation of the Marathas of Nagpur since 1755. These States along with other territorias were occupied by the East India Company early in 1804 in course of the Second Maratha war, but were returned to the Raja of Nagpur in 1806. In 1818 after the Third Maratha war these States again reverted to the Company. Under the British these two States were first included in the 'South Bihar and Chotanagpur Mahals', an administrative division created in 1819 and then in the South-West Frontier Agency which was organised under Regulation III of 1833. When the Agency was abolished in 1854 these two States came under the jurisdiction of the Commissioner of Chotanagpur. After creation of Central Provinces in 1861, Patna and Sonepur along with the States of Bamara, Rairakhol and Kalahandi and the district of Sambalpur were included in the new province. All the above States were declared as Feudatory States in 1863 and in 1905 were transferred to Bengal along with the district of Sambalpur to form a part of Orissa Division.

In 1905, the post of Political Agent was created for the Orissa States under the Commissioner of Orissa. The Bihar and Orissa Province was constituted in 1912, and the Orissa States continued to be under the Commissioner of Orissa Division till 1922, when the Political Agent with his headquarters at Sambalpur was placed directly under the Governor of Bihar and Orissa. When Provincial Autonomy was inaugurated under the Government of India Act, 1935, Patna and Sonepur along with other Feudatory States of Orissa were brought under the direct control of the Governor-General exercising his jurisdiction as Crown Representative through the Political Agent at Sambalpur.

The Feudatory States of Orissa except Mayurbhanj merged with the Province of Orissa on the 1st January 1948, as a result of which new

districts were formed in the Province. The ex-States of Kalahandi Patna and Sonapur were combined together to form a new district called Balangir-Patana district on the 1st January 1948. But subsequently on 1st November 1949 the ex-States of Patna and Sonapur were separated and they together formed a new district called Balangir district with 4 subdivisions, namely, Balangir, Patnagarh, Titilagarh and Sonapur. For administrative convenience, a part of the ex-State of Sonapur which was in Dahia out-post of Birmaharajpur police-station has since been added to Manmunda police-station of Baudh-Khondmals district.

### 5. Subdivisions, Tahsils and Thanas

The district is divided into four subdivisions, five tahsils and 17 police-stations. The following table shows the extent and population of each subdivision, tahsil and police-station of the district.

Subdivision and its area (square miles) and population (Male and Female)	Tahsil & its head-quarters	Police-station		Population, 1961 Census		
		Head-quarters	Area in sq. miles	Persons	Male	Female
1	2	3	4	5	6	7
Balangir A. 868.0 P. 305,406 M. 152,925 F. 152,480	Balangir	1. Balangir	361.5	136,283	68,567	67,716
		2. Loisinga	179.5	80,420	40,382	40,038
		3. Tusra	327.0	88,703	43,977	44,726
Patnagarh A. 726.786 P. 187,786 M. 93,698 F. 94,088	Patnagarh	1. Patnagarh	290.6	82,116	41,029	41,087
		2. Belpara	194.6	55,964	27,927	28,037
		3. Khaprakhol	241.4	49,706	24,742	24,964
Sonapur A. 882.0 P. 274,515 M. 136,868 F. 137,647	(1) Sonapur	1. Sonapur	90.0	23,245	11,575	11,670
		2. Tarbha	166.0	59,141	29,606	29,535
		3. Binka	128.0	38,736	19,430	19,306
		4. Dungripali	152.0	64,630	31,996	32,364
	(2) Birmaharajpur	1. Birmaharajpur	254.0	71,077	35,369	35,708
		2. Sindhol	92.0	17,956	8,892	9,064
Titilagarh A. 935.0 P. 300,979 M. 150,727 F. 150,252	Titilagarh	1. Titilagarh	168.0	76,580	38,574	38,006
		2. Sainatala	347.0	71,199	35,696	35,503
		3. Kantabanji	212.4	74,649	37,368	37,281
		4. Turekela	93.6	26,370	13,242	13,128
		5. Sindhekela	114.0	52,181	25,847	26,334

## 6. Topography

The western part of the district is an undulating plain, rugged and isolated, with hill ranges running in various directions. A lofty irregular range called the **Gandhamardan** forms the natural boundary to the north-west. The soil in this area, for the most part, is light and sandy. The main forest area stretches along the western boundary bordering the Nawapara subdivision of Kalahandi district, and then turns to the east running parallel to the **Gandhamardan** range. This forest tract is broken by occasional clearings and small settlements, but it mostly consists of thick vegetation in which bamboo of excellent quality grows and *Sal*, *Sahaj*, *Piasal*, *Dhaura*, and Ebony form the principal timber. The crest of the range of **Gandhamardan** hills is a fine plateau, some ten miles long, with an average height of 3,000 feet. For the most part, the district lies on the north-west bank of the Tel, which forms the boundary between this district and the districts of Kalahandi and Baudh-Khondmals.

## 7. Hill System

The **Gandhamardan** forms a natural boundary to the north-western side of the district. This range consists of several hills, the highest among them being **Gandhamardan** of 3,296 feet. The smaller hills deserving mention are **Butel** (2,670'), **Chahdli** (2,630'), **Thuta** (2,056'), **Bender** (1,920'), **Patpani** and **Chhatardandi**. The hill is topped by a cap of high level laterite. Rain water soaking through the laterite collects under it and then oozes out in springs on two sides. From the northern crest of this range springs a famous stream<sup>1</sup> which descends to the foot of the hill in fine water-falls and finally issues forth to the plains of **Nrusimhanath**, a famous place of pilgrimage in Sambalpur district. On the southern slope, a similar stream issues from the crest of the range and is known as **Harisankar**, and at the foot of the hill at **Nandupala** where the stream reaches the plains there is a temple. The crest of this range of hills is the ten mile long **Gandhamardan** plateau standing at an average elevation of 3,000 feet.

The **Gandhamardan** hill was known in early times as **Gandhagiri** or **Parimalagiri** and it may be identified with the "Po lo mo lo ki li" mentioned by the Chinese pilgrim **Yuan Chwang**. The **Gandhamardan** of the **Ramayan** may as well be identified with this range of hills.

The next important hilly belt occurs quite close to **Balangir** town and extends on the north-west to **Mahadasani** in **Borasambar** in Sam-

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1. The stream is successively called **Kapil-dhar**, **Bhim-dhar** and **Chal-dhar**.

balpur district and on the south-east to Sikarpat hill in the Kandhan tract of Gudvella. The conspicuous peaks of this range are Bhim Dungri, Matkai (22,591), Banda and Khansel. Separated from these ranges by an extensive plain and the river Mahanadi, is the Singhasan hill system. Unlike the other ranges, the Singhasan extends from north to south and attains a height of 2,045 at one point. With the exception of the Gandhamardan and the Singhasan, the other ranges are discontinuous and broken for several miles by plains.

## 8. River System

### Main rivers and tributaries

#### (i) MAHANADI

The principal river of the district is the Mahanadi which flows through the central part of Sonepur subdivision from north to south. It receives the river Tel at Sonepur town and after that takes an easterly direction forming the boundary of the district for about 25 miles. The river looks magnificent with great width and depth and is liable to heavy floods during rains. At places it contains dangerous rapids and the entire bed is strewn with rock outcrops and big boulders. Navigation is possible with difficulty by country-made flat-bottomed rafts.

In medieval inscriptions, the Mahanadi near Sonepur is known by the name Chitrotpala. A copper plate charter issued by Kumara Somesvara Deva, Telugu-Choda prince of Sonepur, in 11th century A.D. refers to the river Chitrotpala and its big whirlpool called Lankavartaka. This whirlpool is still to be found in the river near Sonepur and it is now known as the Lankesvari Darha. Navigators take their boats through this part of the river with great risk. A big rock near the whirlpool contains the figure of the goddess Lankesvari who is worshipped by the boatmen and the local people.

#### (ii) TEL

This river starts from the north-west of the district of Koraput and flowing through the district of Kalahandi touches the border of this district about 4 miles to the west of Kesinga Railway Station. It forms the boundary between the districts of Kalahandi and Balangir for a considerable distance after which it enters into Balangir district about 2 miles south of Tusra and flows only about 5 miles within the district. It then forms the boundary between this district and the district of Baudh-Khondmals till it meets the river Mahanadi at Sonepur. In fact, excepting a course of about 5 miles, the river forms the eastern boundary of this district. It has no perennial source of water-supply. But during rains it is liable to floods when it brings with its rapid currents poisonous snakes besides uprooted trees. When full, the river is utilised for floating down bamboos and timber to distant places. After the construction of the Hirakud Dam, the principal source of Mahanadi flood is the Tel.

The confluence of this river with the Mahanadi is regarded by local people as a very sacred place. It is known as the Rameswar Ghat and a big temple dedicated to Rameswara Siva has been erected here by the Chauhan Rajas of Sonapur.

The Tel finds mention in the Buddhist Jataka stories. In the Sera Vanijja Jataka it is called Telavaha.

#### (iii) TRIBUTARIES OF THE TEL

The Tel is fed by a number of tributaries of which those flowing inside the district of Balangir are the Undar, the Lanth, the Sungad and the Suktel. The Undar comes from the Nawapara subdivision of Kalahandi district and drains the southern part of the Titilagarh subdivision. The Lanth (also called Barabhai Lanth) and the Sungad are local streams and take their rise from the north-western belt of hills of the district. At the confluence of Sungad and Tel are found ruins of a medieval fort known as Kharligarh.

The Suktel takes its origin from the slopes of the Gandhamardan range and flows through the subdivisions of Patnagarh, Balangir and Sonapur. It meets the Tel a few miles south of its confluence with the Mahanadi. The Suktel is identified with river Suktimati which finds mention in the Mahabharata and Puranic literature (*see* Chapter II).

#### (iv) ANG

This river rises from the hills of Borasamber in the district of Sambalpur and is fed by the streams flowing down the northern slope of the Gandhamardhan range. In Sambalpur district, it first flows in northerly direction for a short distance and then swerves to the east in wide semi-circular shape and enters the district of Balangir near Agalpur. It joins the Mahanadi a few miles above Sonapur town. A portion of its course forms the boundary between Sonapur and Balangir subdivisions of the district. This river carries considerable volume of water during the rains, but it soon dries up in cold season.

#### (v) JIRA

Among other rivers, mention may be made of the Jira, the northernmost affluent of the Mahanadi in this district. This river meets the Danta not very far from the southern border of Sambalpur and the combined stream forms for a distance of about 15 miles the boundary of the districts of Balangir and Sambalpur till it joins the Mahanadi.

#### (vi) SALESINGH

The Salesingh-jor is fed by the water from the Singhasana range and meets the Mahanadi to the south of its confluence with the Jira.

## 9. Tanks

There are no natural or artificial lakes in the district, but there are a number of large tanks meant either for irrigation or for drinking water purposes. The town of Balangir has many tanks, the biggest being the Karanga Kata which is reserved by the local municipality for the purpose of drinking water. Other important tanks in the town are Maharani Sagar associated with some Rani of Chauhan Raj family, the Gait Sarobar excavated by Maharaja Pruthviraj Deo in commemoration of the visit of Sir Edward Gait, the Governor of Bihar and Orissa, and Ghee Kundi (a pot of ghee) located to the south of the town. In the town of Titilagarh there is a big tank at the foot of the Kumuda hill which is locally called Deobandh. The town of Patnagarh, being the old capital of the Chauhan Rajas of Patna, contains large number of tanks named after different rulers of the State. These are Ramsagar, Bhojsagar, Hirasagar, Sanisagar, Darpansagar and Bhanusagar. All these, excepting Bhojsagar which has been recently renovated and Bhanusagar, are in a state of disrepair. At Loisinga, there is another big tank—Chakradhar Sagar, named after the local Zamindar Chakradhar Singh Ray who was living in early 20th century.

## 10. Geology

Balangir district constitutes a portion of the peninsular region. It has largely remained a table-land, a mass of great rigidity and has not been affected by inner movements of the earth though some portions of the peninsular India has been affected by structural disturbance of vertical nature.

The following rock types are met with in this district (in order of increasing antiquity) :—

Recent and Sub-Recent { Alluvium  
Laterite

Lower Gondwana Sandstones

Unconformity

Archaean (Pre-Cambrian) { Quartz, pegmatite and breccia veins, gneissic rocks (injection gneiss augen, streaky and porphyritic gneisses); Leptynitic gneisses; Granulitic rocks (including hybrid varieties resembling charnockites); Rocks of the Khondalite series (including garnetiferous, graphitic sillimanite-schists and gneisses, garnetiferous quartzites and calc-silicate rocks).

The Archaean formations of the Eastern Ghat region, represented mainly by the rocks of the Khondalite Series, extend up to the western limit of the district. These are quite widespread in the district. The

next younger series of rocks, in this area, consisting of garnetiferous gneisses are thought to be the products of hybridism between the Calc silicate rocks and aplitic solutions. The concluding phases of the Archaean in the Mahanadi tracts have been marked by a large-scale intrusion of a very coarse-grained, often porphyritic granite with the accompanying pegmatite facies. Large-scale feldspathisation of the older rocks, particularly the granulitic rocks and the leptynitic gneisses resulted in a variety of injection gneisses.

The next younger formations in this area consist of certain fresh water sediments perhaps of lower Gondwana (Talchir stage) age and are exposed as isolated sandstone patches in the Tel valley.

The youngest geological formations of the area are laterite an alluvium, the former occurring extensively as surface capping on the plains as well as on the 3,000 foot high Gandhamardan plateau.

#### 11. Mineral Resources

A great variety of ores and minerals occur in this district. Of these, the important ones are Graphite, Galena (lead ore), Manganese ore and Bauxite.

##### Graphite

Graphite occurs mostly in the form of disseminations, thin bands and pockets in the highly siliceous gneissic rocks in several locations in this district. Some of the important occurrences are listed below:—

##### *Balangir Subdivision :*

1. Barghati
2. Bankiamunda
3. Gambharimal
4. Jamujhari
5. Lakhanpur
6. Dudukamal
7. Uchhabpali
8. Harbhanga
9. Dameipali
10. Phatamunda
11. Sikachhida

##### *Patnagarh Subdivision :*

12. Dhaurakhaman
13. Beheramunda
14. Telenpali
15. Chormunda
16. Pandesara

17. Bhaludungri
18. Brahmani
19. Bender Reserve Forest
20. Landapathar
21. Bahabal
22. Bakbahal
23. Raju Reserve Forest
24. Malikmunda
25. Tengrapathar
26. Oriyapali

#### *Tūtilagarh Subdivision*

27. Dharpagad
28. Phapsi
29. Malisira
30. Tentulikhunti
31. Chandutara
32. Tikri Reserve Forest
33. Barnei Reserve Forest
34. Ghusuramunda
35. Kiribanji Reserve Forest

These graphites are mostly of flaky amorphous variety and contain about 30—35 per cent carbon, on an average,

#### **Lead Ore: (Galena)**

Lead mineralisation is noted in a set of quartz veins and breccia reefs near Dungripali, Badipara, etc. east of Saintala and near Limpara. The Galena (lead sulphide) is of pure crystalline variety and contains traces of silver and zinc. Copper mineralisation is also reported from these veins.

#### **Manganese Ore:**

The Manganese deposits of this district occur in the highly weathered rocks of the "Khondalite" series. Manganese ore also occur in association with laterites, in several places. Some of the important occurrences are at (i) Gadshankar, (ii) Champasar, (iii) Bharatbahal, (iv) Babja, (v) Bhaludungri (vi) Badipali, (vii) Barjhula, (viii) Salepali-Jhumkimal Reserve Forest, (ix) Gerdi, (x) Kumiapali (xi) Tikrapara, (xii) Charmunda (xiii) Lohadungri, (xiv) Dungripali in Balangir subdivision, (xv) Kapilbahal, (xvi) Tamian, (xvii) Dandhpani, (xviii) Dumerijharan (xix) Thelkochapar.

Manganese content in the ore is usually low, being around 30—35 per cent. Besides, the ores are high in iron and phosphorous. The ore mineral is mostly psilomelane.

**Bauxite:**

Extensive deposits of bauxite, the principal ore of aluminium, have been found in the Gandhamardan plateau, on the border of Sambalpur-Balangir districts by the State Directorate of Mines. Bauxite occurs in the form of lenses, pockets and thin blankets under a capping of laterite. A total quantity of about a million tonnes of bauxite containing over 44 per cent aluminium oxide, has been proved in this plateau.

Besides, abundant quantity of aluminous laterites occur in this area.

**Mica:**

It is found to occur in the pegmatite veins intruding garnetiferous gneiss and quartz-schists, near Salebhata, Kulasingha, Ambabhali, Rabanguda, Kuabanus, Siletpara.

**Steatite:**

Both massive and laminated varieties of grey steatite occur at Jibandadar in chlorite and Talc schists. The material is locally used for making utensils and is found to be suitable for making refractory tiles and bricks.

Other mineral occurrences include Rock crystal at Bahanpadar and Kadlipali and Garnet near Birmaharajpur and Binka. Clay occurrences are seen at the railway cuttings at several places.

**12. Flora**

**Botanical divisions of the district and the nature of vegetation found in it with special reference to rare types of flora.**

The flora of Balangir district consists of many families, which are common in tropical climate. There is good vegetative growth throughout wherever conditions are favourable.

As one enters the district, he notices good avenues of trees alongside the road, mostly of *tamarind*, *Karanj* and *Chakunda* (*Cassia siamea*), etc.

On the open country mango groves are numerous. Tal (*Borassus flabellifer*) and *Khajuri* (*Phoenix sylvestris*) are seen topping the canopy. On the fields *Mahua* (*Bassia latifolia*), Babul (*Acacia arabica*) and other miscellaneous species such as *Harida* (*T. Chebula*), *Bahara* (*T. belerica*) are found. Besides, at the outskirts of the village the following species are commonly found:

- Tamarind* (*Tamarindus indica*)
- Jamun* (*Eugenia jambolana*)
- Bel* (*Aegle marmelos*)
- Borokoli* (*Zizyphus jujuba*)
- Maya* (*Psidium guava*)
- Badhal* (*Anona squamosa*)
- Bara* (*F. bengalensis*)
- Aswatha* (*F. religiosa*)

Amongst the flowering species the following are commonly noticed:  
*Sunari (Cassia fistula)*—The Indian Laburnum tree with long pendular racemes of yellow flowers.

*Chakunda (Cassia siamea)*—With panicles of yellow raceme.

*Palasa (Butea frondosa)*—Remarkable for its brilliant scarlet or orange flowers in summer on the leafless tree. It is sometimes called "The Flame of the Forest".

*Siris (Albizia lebbek)*—Remarkable for its green canopy on the top of which are greenish yellow flowers, conspicuous and beautiful to look at.

*Kanchan (Bauhinia variegata)*—Which has large blossoms of four white or pink petals and one petal pink or variegated.

*Kantapalasa (Cochlospermum gossypium)*—Conspicuous for its large yellow flower growing on dry hill slopes. Its gum is used for food. It is called the torch tree which is carried by post-men, runners and others during their night marches through the forest.

*Krushna Chuda (Poinciana regia)*—A lovely avenue tree with its brilliantly red petals in summer.

Amongst flowering shrubs *Dhatuli (Woodfordia floribunda)*, *Sefali or Harasingar (Nyctanthes arbor-tristis)*, *Kurai (Holarrhena antidysenterica)*, *Madhabilata (Hiptagemadablata)* and others are notable in this district.

The following are the flora of economic importance :

Vernacular Name	Botanical Name
<i>Sal</i>	.. <i>Shorea robusta</i>
<i>Teak</i>	.. <i>Tectona grandis</i>
<i>Gambhari</i>	.. <i>Gmelina arborea</i>
<i>Sisoo</i>	.. <i>Dalbergia latifolia</i>
<i>Bahara</i>	.. <i>Terminalia belerica</i>
<i>Sahaj</i>	.. <i>Terminalia tomentosa</i>
<i>Rohon</i>	.. <i>Soymida febrifuga</i>
<i>Harida</i>	.. <i>Terminalia chebula</i>
<i>Anla</i>	.. <i>Phyllanthus embilica officinalis</i>
<i>Bhorum</i>	.. <i>Chloroxylon swietenia</i>
<i>Kusum</i>	.. <i>Schleisoera trijuga</i>
<i>Simul</i>	.. <i>Bombax malabaricum</i>
<i>Girungila</i>	.. <i>Sterculia urens</i>
<i>Ritha</i>	.. <i>Randia Sp.</i>
<i>Khair</i>	.. <i>Acacia catechu</i>
<i>Murmuria</i>	.. <i>Helicteris isora</i>
<i>Siali</i>	.. <i>Bauhinia vahlii</i>
<i>Sunari</i>	.. <i>Cassia fistula</i>
<i>Kendu</i>	.. <i>Diospyros melanoxylon</i>

Besides, there are some stem parasites which cause great damage to the crop, out of which *Loranthus* is well-known.

The district has a good source of fodder grasses which would make good hay. The following are some of the important grasses that are commonly found :

*Dub grass (Cynodon dactylon)*  
*Musial (Iseilema wightii)*  
*Sukla (Pollinia argentea)*  
*Panasi (Pollinia eripoda)*  
*Kaila (Andropogon annulatus)*  
*Kasa (Sachharum spontaneum)*  
*Khas (Andropogon squarrosus)*  
*Tikhari (Andropogon variety)*

Bamboos are abundant in some blocks of the forest. Sabaigrass (*Eulolopsis binata*) is found in abundance and is used for rope making and is sent out for the paper industry.

There are varieties of creepers of different genus. Among the introduced varieties in gardens, the following are common.

*Bougainvillea spectabilis* or *Kagajaphula*  
*Peltophorum ferrugineum* or *Bada chakunda*  
*Poinciana regia* or *Krushna Chida*  
*Dalbergia lanceolaria* or *Sujanipati*  
*Polyalthia longifolia* or *Debadar*  
*Passiflora quadrangularis* or *Radhatamal* and innumerable  
 Compositae and Malvaceae.

### 13. Forest

The forests of the district are of xerophilous nature due to several factors, chief amongst which are a poorly distributed rainfall, geological formation which is very resistant to weathering, the soil being shallow, sandy and dry, intensive shifting cultivation in the past and recurring forest fires. The combined effect of all these factors has been the depletion of the forests which most likely contained more of *Sal* in the former times. It has also resulted in production of bamboo climax type of forest, and in some places a savannah type of forest. The area of reserved forest is 453.32 square miles and of the protected forest 257.72 square miles, the total being 20.80 per cent of the geographical area of the district.

The forests can be classified under five heads according to vegetation :

- (1) *Sal* Forests
- (2) Low Mixed Forests
- (3) Alluvial Mixed Forest
- (4) Teak Forest
- (5) Bamboo Forests

(i) **Sal Forests**

*Sal* grows well in all localities, except swampy, dry, and rocky areas. The best sal forest occurs on flat regular plains, where the soil is deep loamy sand or sandy loam or where the ground is little broken up by nalla. *Sal* almost grows in patches, due to its gregarious habit, with the following associates which are common :

In the over wood—*Bija* (*Pterocarpus marsupium*), *Sahaj* (*Terminalia remon-tosa*), *Mahua* (*Bassia latifolia*), *Dhaura* (*Anogeissus latifolia*) *Sal* (*Shorea robusta*).

In the middle Storey—*Char* (*Buchania latifolia*), *Kendu* (*Diospyros melanxaylon*), *Harida* (*Terminalia chebula*), *Anla* (*Phyllanthus emblica*), *Dhaman* (*Grewia latifolia*), *Senha* (*Lagerstroemia parviflora*), *Khair* (*Accacia catechu*), *Sunari* (*Cassia fistula*), *Bamboo* (*Bambusa arundinacea*), *Dhasuli* (*Woodfordia floribunda*), *Nil* (*Indigofera tinctoria*), *Harsan-ghar* (*Nyctanthes arboratristis*), *Phoenix acaulis* and *Grewia* species.

In well grown area *Sal* attains a height of 70' to 80' and a girth 6' to 7'.

(ii) **Low Mixed Forests**

It occurs in mixed patched with sal forests, generally occupying the poor soils. The common species are *Sahaj*, *Dhaura*, *Kendu*, *Hiland*, *Sisoo*, *Harida*, *Mahua*, (*Mohul*), *Char*, *Rohan*, *Sal*, *Khair* and *Chantoo*.

Although growth in height and girth in these patches is usually poor, in better patches *Bija*, *Sahaj*, *Hiland* and *Dhaura*, grow up to a height of 60' and a girth of 6' on an average.

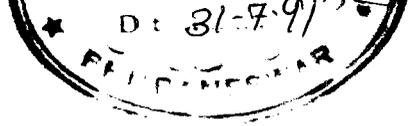
(iii) **Alluvial Mixed Forests**

This type is confined only to the edges of nallahs and on flat ground. The commonest species are *Sahaj*, *Karla* (*Gleistanthus coolimus*), *Behera Mundi* (*Mitragyna parvifolia*), *Hiland*, *Pandhel* (*Pterospemum suaveolens*), *Simul* (*Bombax malabaricum*), *Made* (*Launaa grandis*), *Dhaman* (*Grewia tillaeifolia*), *Dhubon or Dalon* (*Dalbergia paniculata*), *Keketa* (*Garugapinnata*), *Sisoo*, *Khair*. This type of forest is densely stocked with a complete canopy. *Sal* is found occasionally as individual of great size.

The following creepers are common in all the above types of forests, the common species being *Siali* (*Bauhinia vahlii*), *Mal palas* (*Butea uperba*), *Gaj* (*Millettia auriculate*).

(iv) **Teak Forests**

Teak is found in Chhatrandi, Budharaja, Hilipi, Munda, Karaj-khol and Chakagujia blocks in Balangir area which borders the Khariar and Charbhata blocks in Sonapur area. The most important tree in this sub-type is teak with all sorts of miscellaneous species of which the most conspicuous are *Anogeissus latifolia* and *Terminalia remon-tosa*.



Teak is, however, of poor quality. Regeneration of Teak is patch and hence unreliable.

(v) **Bamboo Forests**

This type is generally found in the valleys and on the lower slope of the hills and occasionally on the higher slopes and tops of hills. They grow gregariously and there is a striking absence of all growth on the floor beneath these. *Guly dendrocalamus strictus* is also found. Other bamboos such as *Bambusa* are rare but confined to isolated patches. The common associates are *Garkhair* (*Acacia dynaldii Gambhari* (*Gmelina arborea*), *Khair* (*Acacia catechu*), *Sisoo* (*Dalbergia latifolia*), *Kanta palsa* (*Chochlpermum grosypium*), *Gundurli* (*Sterculia urens*), *Salai* (*Boswellia sewata*), *Made* (*Launaea grandis*).

**14. Broad effects of Government Policy on the Flora of the District**

(i) The question of forest conservation was raised in 1886, when the Commissioner of the Chhatisgarh Division drew the attention of the Political Agent to the advisability of setting aside and conserving waste lands in the States. The Settlement of such lands was carried out in the course of Settlement Operations during 1887—90. The operation of conserving waste lands was necessarily confined to hills and jungles which had not been in actual possession of any individual and was being exploited by persons who liked to do so.

In such tracts the right of the State was asserted. The selected tracts were demarcated separately from the village areas and a small forest staff was appointed.

The forests were divided into three classes :

- (1) State forests
- (2) Malgajari forests
- (3) Zamindari forests

From time to time additional areas, which had been overlooked at the time of the above Settlement, were being acquired. Even then, a good deal of valuable forests was not being controlled by the State. Subsequently, efforts were made to regulate the removal of forest produce from the waste lands adjoining the villages, but all such attempts proved abortive as the village forests were gradually depleted.

In the year 1910, the Political Agent recommended that certain waste lands, which were situated on localities where it was essential to supplement the supply of forest-produce and which were undergoing rapid denudation or had been actually denuded of forests, should also be included into the reserves. The selection of such areas could not be done wisely, as a result of which many such areas were almost completely denuded and could only be afforested at considerable expense.

After reservation in 1889, the forests were managed by the Revenue officials with the help of a very small staff of 19 subordinates. There was no system of working. The forests were being exploited according to demand without any definite plan. The needs of the local population had been the chief call on the forests and other produces were being sold when purchasers came forward. The forests were divided into (1) Reserved forests and (2) Protected forests, they were demarcated and fire protection was attempted. Revenue collection and detection of offences were the only duties of the staff.

Since reservation, the reserved forests were nominally closed to all cutting, but bases were given to some companies during 1915-19.

In 1916, a rough plan for working of the forests was drawn up by Cooper, the then Agency Forest Officer. Improvement fellings were introduced by cutting all dead and dying trees and those of unsound growth or of inferior species which interfered growth of the better class trees.

But unfortunately, the fellings were more drastic than were intended. The high percentage of unsound trees necessitated heavy felling, as a result of which after the felling had been carried out the canopy was excessively opened and large blanks were created. The trees were not coppiced or cut back but were simply girdled, so the scope of future regeneration was destroyed. The regeneration of *Sal* forests in the district is also doubtful since the samplings require rather more of shade for protection from heat.

Some forests were worked under "Coppice with standard system" but with little success. Further, it was often found impossible to mark in the suitable trees as standards either in groups or in those evenly distributed over the area. So the departmental working of coupes under 'Simple coppice' was adopted in some blocks from the year 1923. All other blocks not reserved in 1907 were thrown open for exploitation by cesspayers and other purchasers where they cut anything without any rule or regulation. From the 1st July 1928, the forests were worked under the following system:

- (1) Selection system in High Forest
- (2) Coppice with standard

Coupes are opened up every year and leased out to successful bidders on contract, who work under the supervision and guidance of the Forest Staff as per rules and regulations. The forests are, at present, worked under a working plan revised in 1938.

#### ii) Game Laws

For the purpose of hunting, shooting, fishing, poisoning the water and setting of traps or snares, killing and catching of elephants, the

Orissa Government Reserved Forest Shooting Rules of 1938 are in operation in Balangir district in Reserved Forests. In order to preserve and maintain the existing species of birds and other animals (except carnivora) a specific close season is observed, during which shooting is prohibited.

The wild buffalo has become extinct from the district. The last animal was shot in the year 1954. In the past, wild buffaloes migrated from Khariar forests and could be seen in Chhatardandi block.

The following animals are found in the district :

- (1) Carnivora—Tiger, Panther, Leopard, Sloth Bear, Wild Dogs and Wild Cat.
- (2) Deer family—Sambar, Spotted Deer, Barking Deer and Nee lgai (Antilope).
- (3) Bovine—Bison, Wild Buffalo (When they migrate)
- (4) Vermins—Hyaena, Jackal, and Wild Pig
- (5) Painted Partidge, Green Pigeon, white Ibis, Black Ibis, Peafowl, Red Jungle Fowl and Quails.
- (6) Migratory Birds—Koyal, Pochards, Brahmni Ducks.

### (iii) Bana Mahotsava

This festival assumes importance because of the denudation of vegetation. During the festival, seeds, stumps and grafts are supplied by the Forest Department free of cost to the people according to their requirements. Small plantations are raised by the Forest Staff.

## 15. Fauna :

Much of the wild fauna is fast vanishing because of the limitless hunting by the "Shikaries" and destruction of forests. The wild mammals include the following types :

### (i) Wild Mammals

(1) *Panthera tigris* : Tigers (*Bagha*)—These animals are found everywhere in the forests of the district. Majority of them are game-killers while occasionally one becomes a man-eater.

(2) *Panthera pardus* : Panthers (*Kalara Patria*)—They are plentiful in every part and are usually seen near the small hills adjoining cultivated lands where they prey upon the goats and sheep. Not many years ago, an important guest of the Maharaja shot a number of leopards in one night by tying baits on machans on road-side and motoring along at night, shooting leopards on the baits.

(3) *Felis chaus* (*Bana Biradi*)

[ 14 B. of R. —4 ]

(4) *Melursus ursinus* : Bear (*Bhalu*)—This is the common Indian Sloth Bear. Their favourite food is 'Mahua' flowers but they are very destructive to sugarcane too.

(5) *Herpestes edwardsii*—Mongoose (*Hatia Neula*)

(6) *Cnon alpinus* (*Balia Kukura*)—They are numerous and are extremely harmful to game. They are intelligent hunters. They hunt in packs.

(7) *Canis aureus*—Jackal (*Bilua*)

(8) *Hyaena hyaena*—Hyena (*Gadhia*)

(9) *Viverricula indica* (*Salia patani*)

10) *Paradoxurus hermaphroditus* (*Katasha*)

(11) *Hystrix indica* Porcupine (*Jhinka*)

(12) *Axix axix* : Spotted deer (*Chittal*)—These animals are very common and are found moving in small herds, in low lands near water.

(13) *Tragutus meminna*: Indian mouse-deer (*Khuranta*)

(14) *Muntiacus muntjak* : Barking Deer (*Kutura*)

(15) *Antilope cervicapra* : Black-buck antelope (*Krushna Sara*)—These animals are found in the jungles bordering the district of Kalahandi.

(16) *Cervus nicolor* : Sambar—It is a forest-loving animal generally seen in high hills. It is the largest of all the Indian deer.

(17) *Bos gaurus* : Bison (*Gayala*)—These animals were at one time numerous but their number is getting reduced. They are often found moving in herds.

(18) *Macca mulatta* : Bandar (*Pati*)

(19) *Presbytis entellus* : Langur (*Hanuman*)—These two are the most common primates found in the forests.

(ii) Birds—Most of the birds found in other parts of Orissa are found in this district too. They are listed below :

- |                                   |                                       |
|-----------------------------------|---------------------------------------|
| (1) <i>Corvus splendens</i>       | .. Domestic crow ( <i>Pati Kau</i> )  |
| (2) <i>Corvus macrorhynchos</i>   | .. ( <i>Damara Kua</i> )              |
| (3) <i>Gallus gallus</i>          | .. Jungle fowl ( <i>Bana kukuda</i> ) |
| (4) <i>Gallus domesticus</i>      | .. Domestic fowl                      |
| (5) <i>Pavo cristatus</i>         | .. Peacock ( <i>Mayura</i> )          |
| (6) <i>Corcias benghalnsis</i>    | .. Blue jay ( <i>Bhadabhadalia</i> )  |
| (7) <i>Gracula religiosa</i>      | .. Hill mynah ( <i>Sari</i> )         |
| (8) <i>Passer domesticus</i>      | .. House sparrow ( <i>Chatia</i> )    |
| (9) <i>Milvus migrans</i>         | .. ( <i>Chila</i> )                   |
| (10) <i>Haliastur indus</i>       | .. ( <i>Sankha chila</i> )            |
| (11) <i>Torgus calvus</i>         | .. Vultures ( <i>Saguna</i> )         |
| (12) <i>Eudynamys scolopaceas</i> | .. Koyal ( <i>Koili</i> )             |
| (13) <i>Acridotheres tristis</i>  | .. Common mynah                       |

- (14) *Halcyon smyrnensis* and *Alcedo* King fisher  
*atthis*.
- (15) *Dicrurus adsimilis* .. Drongo
- (16) *Pycnonotus cafer* .. Redvental bulbul
- (17) *Streptopelia chinensis* .. Spotted dove

### (iii) Reptiles and Amphibians

This district has its own share of reptiles including a variety of snakes which are responsible for the death of a number of human beings every year. The following is a list of the more common reptiles and amphibians :

- (1) *Gavialis gangeticus* : *Ghadial* (Crocodile)—It is commonly found in the Mahanadi and its tributaries.
- (2) *Kachuga tectum* : Common aquatic tortoise (*Kachapa*)
- (3) *Trionyx gangeticus* : Alligator—These too are also found in the Mahanadi and its tributaries.
- (4) *Varanus* sp. Monitor lizard (*Godhi*)
- (5) *Naja naja*—Cobra (*Tampa* and *Gokhara*)
- (6) *Echis carinatus* : Saw scaled viper (*Chiti*)
- (7) *Bungarus fasciatus*—Banded Krait (*Rana*)

The last three are the most common poisonous snakes. The other snakes are :

- (8) *Python molurus* : (*Ajagara*)
- (9) *Natrix stolata* : (*Bamhuni sapa*)
- (10) *Ptyas mucosus* : (*Dhamana*)
- (11) *Eryx conicus* : (*Domundia*)

The following three frogs and toads are the common Amphibian representatives of this district.

- (12) *Bueo melanostictus* : The common Indian toad (*Kuji bengal*)
- (13) *Rana tigrina* : The tiger frog (*Bamhuni bengal*)
- (14) *Rana cyanophlyclis* : (*Pani bengal*)

### (iv) Fish

There are a number of fishes in the rivers and ponds of the district. The Fishery Department is culturing and cultivating the three major Indian carps and one minor carp. The following are a few of the more common fish :—

- (1) *Labeo rohita* .. *Rohi*
- (2) *Catla catla* .. *Catla* (*Bhakur*)
- (3) *Cyprinus carpeo* ..
- (4) *Cirrhina mrigala* .. *Mrigal* (*Mirikali*)
- (5) *Amphipnous cuchia* .. *Kuchia*
- (6) *Notopterus notopterus* .. *Pholi*

- |                                     |    |                                       |
|-------------------------------------|----|---------------------------------------|
| (7) <i>Amblypharyngdon mola</i>     | .. | <i>Mohuruli</i>                       |
| (8) <i>Wallago attu</i>             | .. | The freshwater shark ( <i>Balia</i> ) |
| (9) <i>Barbus stigma</i>            | .. | <i>Kerandi</i>                        |
| (10) <i>Glossogobius giuris</i>     | .. | <i>Baligarada</i>                     |
| (11) <i>Clarius batrachus</i>       | .. | <i>Magur</i>                          |
| (12) <i>Heteropneustes fossilis</i> | .. | <i>Singhi</i>                         |
| (13) <i>Ophicephalus marulius</i>   | .. | <i>Salo</i>                           |
| (14) <i>Ophicephalus gachua</i>     | .. | <i>Chenga</i>                         |
| (15) <i>Mastacembelus armatus</i>   | :  | <i>Todi</i>                           |
- and allied species.

**(v) Insects**

The district abounds in various common insects characteristic to the peninsular India of which a few can be mentioned :

- |  |    |                    |
|--|----|--------------------|
| (1) <i>Mantis religiosa</i>                        | .. | The Praying mantis |
| (2) <i>Neepa sp.</i>                               | .. | The water scorpion |
| (3) <i>Rentra sp.</i>                              | .. | The water insect   |
| (4) Beetles, the Tiger beetle, Ground beetle, etc. |    |                    |
| (5) A number of colourful butterflies.             |    |                    |

**(vi) Other invertebrates**

- |                         |    |           |
|-------------------------|----|-----------|
| (1) <i>Pila sp.</i>     | .. | Snail     |
| (2) <i>Peretima sp.</i> | .. | Earthworm |

**16. Climate**

The climate of this district which is in the north-eastern corner of the Deccan plateau is similar to that of the adjoining districts, the heat in summer, however, being less severe. The year may be divided into four seasons. The hot season from March to May is followed by the south-west monsoon season lasting up to about the end of September. October and November constitute the post-monsoon season. The cold season is from December to February.

**(i) Rainfall**

Records of rainfall in the district are available for five stations for periods ranging from 28 to 49 years. The details of the rainfall at these stations and for the district as a whole are given in Tables 1 and 2. The average annual rainfall in the district is 1,443.5 mm. (56.83"). The variation in the annual rainfall from year to year is not large. In the 48 year period from 1902 to 1949 for which annual rainfall data are available, the highest annual rainfall amounting to 15 per cent of the normal occurred in 1917. The lowest annual rainfall, which was 71 per cent of the normal, occurred in 1912. During the same period rainfall less than 80 per cent of the normal occurred in 7 years two of them being

consecutive. Considering the rainfall at individual stations, it is seen that two consecutive years of annual rainfall less than 80 per cent of the normal occurred twice each at Titilagarh and Binka and 3 consecutive years once at Sonepur. It will be seen from table 2 that the annual rainfall in the district was between 1,200 and 1,600 mm. (47.24 and 66.93") in 32 years out of 48. A note on the study for determining cyclical fluctuations in the rainfall data in Balangir district has been incorporated at the close of the Chapter. It gives an analysis of a three-year cycle in the rainfall pattern of Titilagarh which may be treated as representative of Balangir district.

On the average, there are 67 rainy days (days with rainfall of 2.5 mm. 10 cents or more) in a year. The number varies from 61 at Sonepur to 69 at Binka.

The heaviest rainfall in 24 hours recorded at any station in the district was 365.5 mm. (14.39") at Sonepur in 1918 on June 16.

### (ii) Temperature

There are two meteorological observatories, one at Titilagarh and the other at Balangir. While the records at Titilagarh are available for about 10 years, those at Balangir extend to only four years. The description of the climate which follows is based on the data for Titilagarh and the meagre data for Balangir, which may be taken as representative of the conditions of the district as a whole. The hot season commences by about the beginning of March when the mean daily maximum temperature is at 41.4°C (106.5°F) and the mean daily minimum temperature is at 27.8°C (82.0° F). During May and early part of June on individual days the maximum temperature may sometimes rise to about 47° C (116.6° F). With the onset of the south-west monsoon by about the second week of June temperatures drop appreciably. In October, after the south-west monsoon withdraws by about the first week, the day temperatures are nearly the same as in the previous month but the nights become cooler. From November temperatures decrease progressively, the drop in night temperatures being more rapid. December is usually the coldest month with the mean daily maximum temperatures at 28.1°C (55.8°F). In the cold season short spells of cold weather occur in the wake of western disturbances passing across north India and the minimum temperature sometimes goes down to about 6° or 7°C (42.8° F). The highest maximum temperature recorded at Titilagarh was 42.2°C (117.0°F) in 1955 on June 7 and the lowest minimum was 6.1°C (43.0°F) in 1954 on January 28.

### (iii) Humidity

The relative humidities are high in the south-west monsoon and post-monsoon months. The air becomes gradually drier thereafter. Summer is the driest part of the year with the relative humidities particularly in the afternoons often going down below 30 per cent.

**(iv) Cloudiness**

During the south-west monsoon season, skies are generally heavily overcast. In the summer and post-monsoon months there is moderate cloudiness, the afternoons being more cloudy than the mornings. In the other months skies are mainly clear or lightly clouded.

**(v) Winds**

Winds are generally light to moderate. The average speed of the movement of monsoon in this region is about 200 miles per day. During the south-west monsoon season the winds are mostly from the south-west or west. In the post-monsoon and cold seasons winds are mainly from directions between the north and north-east. In the summer months, the winds are variable in direction.

**(vi) Special Weather Phenomena**

Storms and depressions in the Bay of Bengal, during the monsoon season and in October, pass through the district or its neighbourhood and cause widespread heavy rain and strong winds. Thunderstorms mostly in the afternoons occur in the summer season and in October. Rain during the south-west monsoon season is also very often associated with thunder. Even though there has not been large variation from the normal rainfall, almost every year there is scarcity in some area or other on account of irregular distribution of rainfall. The district as a whole has not suffered from inadequate rain except in 1899 and 1900 when there was shortage of 7". Even that would not have caused any distress had the rainfall been well distributed. On account of failure of rain for the seed to germinate there was widespread distress in 1900.

In the last 70 years the only year of gross deficiency in rainfall was in 1965, when the total rainfall in the year was 846 mm.=33.83" and it was ill-distributed. As in 1900, the area which suffered most was the south and the westerly regions where there are very few irrigation reservoirs.

Tables 3, 4 and 5 give the temperature and humidity, mean wind speed and special weather phenomena, respectively for Titilagarh.

## Note on the Study for Determining the Rainfall Cycle in Balangir District.

### 1. Introduction—

On the suggestion of Dr. P. Parija, ex-Vice-Chancellor, Utkal University, a study was undertaken in the Bureau of Statistics & Economics, Orissa to discover if there was any periodicity of rainfall in certain parts of the State. The rainfall data of various observatories in the State were analysed by applying appropriate statistical methods. This note presents the results of such analysis in respect of Titilagarh observatory of Balangir district for which data were available over a period 1950—1965.

### 2. Method of analysis :

The objective of the study was to measure cyclical fluctuations in the rainfall data in respect of Balangir district basing on the rainfall data obtained from the Meteorological Department of Government of India for the period 1950 to 1965 (vide Table 3). The residual method was adopted for obtaining the cyclical components of the time series data. This method consists of removing from the given time series, the components, namely, trend and seasonal variations. According to the multiplicative model, we have  $Y = T \times S \times C \times I$  where,  $Y$  is the value of the time series,  $T =$  Trend,  $S =$  Seasonal variation,  $C =$  Cyclical fluctuation and  $I =$  Irregular variations. For determining the cyclical fluctuations namely  $C \times I$ , it was first necessary to remove trend and seasonal variations by division.

On the residual series the Periodogram analysis was conducted. For this analysis if  $u_t$  represents the residual series, at time  $t$ , then it is desired to know whether  $u_t$  contains a harmonic term with certain period. For this purpose the following quantities are considered.

$$A = (2/n) \sum u_t \cos. \frac{2\pi t}{\mu}$$

$$B = (2/n) \sum u_t \sin. \frac{2\pi t}{\mu}$$

Where  $n$  is the number in the time series and  $\mu$ , the period. If  $R^2 = A^2 + B^2$ , then  $R$  is known as the "intensity" corresponding to the trial period  $\mu$ .

A number of trial periods  $\mu$  were taken about the true period  $\times$  which was guessed by plotting the data on a graph paper and  $R^2$  was calculated in each case. The true cyclical period was obtained by equating to  $\times$  that value of  $\mu$  for which  $R^2$  was maximum.

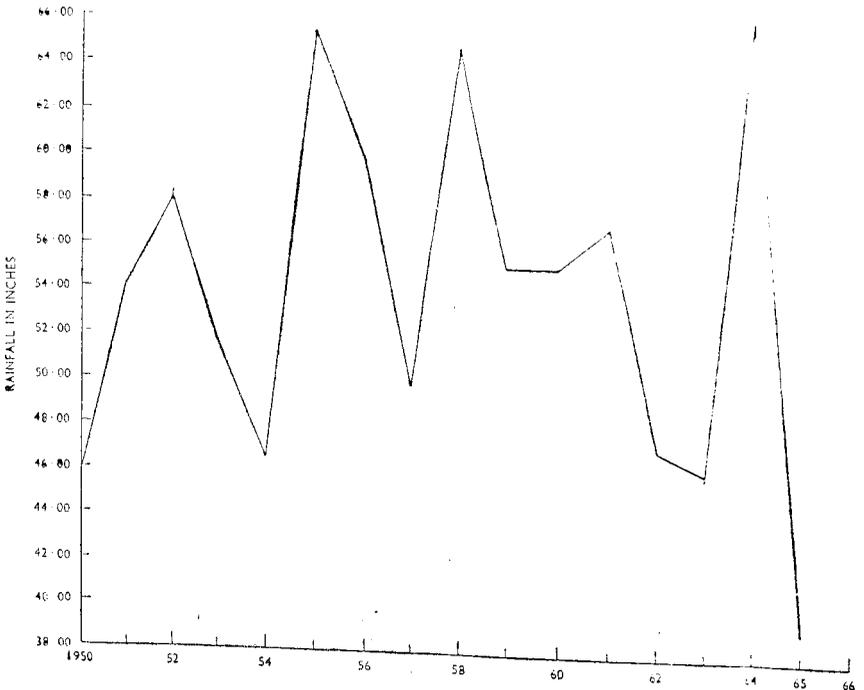
### 3. Results:

On the basis of the periodogram analysis it was found that the intensity was maximum corresponding to a 3 year period. The following table shows the values of  $R^2$  for different trial periods, 3, 4, 5, and 6 years.

Period (Years)	$R^2$
3	2172.83
4	68.98
5	441.65
6	28.19

It is evident from the above table that  $R^2$  is maximum corresponding to a 3 year period. It can, therefore, be stated with a reasonable degree of confidence that the rainfall data of Titilagarh observatory, which may be taken to be representative of Balangir district, conform to a three-year cycle.

The rainfall data for the period from 1950—1965 (for which period only the rainfall data could be obtained) have been shown in the graph below.



This chart shows the total rainfall during the 5 months from June to October for all the years under study. It is clear from the chart that 1952, 1955, 1958, 1961 and 1964 had been years of peak rainfall whereas 1954, 1957, 1960, 1963 had been drought years. 1966 and 1967 have been found to be years of lean and peak rainfall respectively.

#### **4. Conclusion :**

Rainfall data of only one observatory of Titilagarh was available for Balangir district. We have assumed that the rainfall pattern observed in Titilagarh would be representative of Balangir district. On the basis of this assumption, the foregoing analysis clearly bring out the fact that there exists a three-year cycle in the rainfall pattern in Balangir district. Unfortunately a longer time series was not available. It would, therefore, be of interest to watch the future pattern of rainfall to test the accuracy of the hypothesis of a three-year rainfall cycle.

TABLE  
Normal and extrem

Station	No. of years of data	Jan.	Feb.	Mar.	April	May	June	July	Aug.	
Balangir	<i>a</i>	48	15.0	21.3	16.3	26.9	42.4	24.0	88.1	394.2
	<i>b</i>		0.9	1.7	1.4	2.1	2.9	10.5	16.0	16.4
Titlagarh	<i>a</i>	34	11.7	10.9	13.2	14.7	24.6	27.8	34.6	35.0
	<i>b</i>		0.7	0.9	1.3	1.5	2.2	3.3	17.1	16.9
Patnagarh	<i>a</i>	28	14.5	14.7	14.7	14.8	27.0	21.0	30.0	42.7
	<i>b</i>		0.7	1.4	1.4	1.2	2.1	10.3	17.0	16.8
Sonepur	<i>a</i>	49	11.7	21.6	10.9	21.3	22.1	24.0	34.0	39.4
	<i>b</i>		0.8	1.4	0.9	1.6	1.6	9.7	17.8	15.6
Binka	<i>a</i>	36	16.5	22.6	14.2	16.0	30.7	23.0	34.0	42.2
	<i>b</i>		1.1	1.6	1.1	1.4	2.3	16.0	17.0	17.1
Bolangir (District)	<i>a</i>		13.9	18.2	13.9	18.7	29.1	23.7	34.0	40.1
	<i>b</i>		0.8	1.4	1.2	1.6	2.3	10.1	16.0	16.6

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

## of Rainfall

Sep.	Oct.	Nov.	Dec.	Annual	Highest annual rainfall as % of normal year **	Lowest annual rainfall as % of normal year **	Heaviest rainfall in 24 hours.*		
							Amount (mm)	Date	
226.3	65.3	14.5	4.3	1457.7	152 (1917)	61 (1912)	282.2	1905	September, 8
11.1	3.9	1.0	00.4	68.9					
24.54	69.3	17.5	2.8	1374.5	188 (1917)	58 (1923)	221.2	1948	August, 15
4.11	12.0	1.0	0.2	67.1					
243.3	73.9	20.6	2.5	1449.2	150 (1933)	59 (1935)	245.1	1940	July, 9
11.3	4.3	1.4	0.3	68.5					
209.0	60.7	11.9	4.6	1407.0	157 (1933)	52 (1923)	365.5	1918	June, 16
9.9	2.8	0.9	0.3	60.8					
436.2	58.7	15.0	4.1	1529.0	150 (1927)	63 (1948)	282.5	1928	July, 26
11.5	3.3	1.1	0.2	69.3					
232.0	65.6	15.9	3.7	1443.5	150 (1917)	71 (1912)			
11.0	3.7	1.1	0.3	67.0					

\* Based on all available data up to 1956. \*\* Years given in brackets.

TABLE 2

Frequency of annual rainfall in the district (Data 1901—1950)

Range in mm	No. of years	Range in mm	No. of years
1001—1100	.. 4	1601—1700	5
1101—1200	.. 6	1701—1800	4
1201—1300	.. 4	1801—1900	0
1301—1400	.. 5	1901—2000	1
1401—1500	.. 11	2001—2100	0
1501—1600	.. 7	2101—2200	1

(Data available for 48 years only)

TABLE 3

**Rainfall data (Total of June to October) of Titlagarh for the period  
1950—1965**

Year	Rainfall (inches)	Residual series $U_t$ (Cyclical Irregular percentages)
1	2	3
1950	.. 45.75	81.54
1951	.. 54.17	102.59
1952	.. 58.17	114.34
1953	.. 51.63	93.82
1954	.. 46.60	93.24
1955	.. 65.36	131.85
1956	.. 59.86	104.55
1957	.. 49.89	81.06
1958	.. 64.75	121.77
1959	.. 55.11	113.15
1960	.. 55.11	113.44
1961	.. 57.05	135.64
1962	.. 47.18	81.83
1963	.. 46.24	108.83
1964	.. 65.90	124.87
1965	.. 39.32	72.08

TABLE 4

**Normals of temperature and relative humidity  
(Titilagarh)**

Month	Mean daily maximum temperature	Mean daily minimum temperature	Highest maximum ever recorded	Lowest maximum ever recorded	Relative* Humidity (%)			
	OC	OC	OC	Date	OC	Date		
January	.. 28.7	13.6	31.7	1957 January 20	6	1954 January 28	58	40
February	.. 32.2	16.6	37.8	1953 February 26	10.0	1956 February days	6	33
March	.. 36.1	20.5	42.2	1955 March 31	13.9	1952 March 6	4	26
April	.. 39.2	25.4	45.0	1956 April 23	18.6	1957 April 4	4	27
May	.. 41.4	27.8	46.7	1956 May 10	21.1	1951 May 3	3	27
June	.. 36.9	26.7	47.2	1955 June 7	21.8	1960 June 21	64	51
July	.. 31.1	24.4	37.2	1952 July 11	21.1	1956 July 4	4	77
August	.. 30.4	24.4	35.0	1954 August 28	21.8	1951 August 7	64	79
September	.. 31.1	24.2	35.0	1953 September 30	21.7	1956 September 29	83	76
October	.. 31.4	22.3	36.1	1951 October 7	15.0	1954 October 31	79	69
November	.. 29.2	16.2	33.3	1956 November 2	10.6	1952 November 30	73	54
December	.. 28.1	13.2	33.3	1955 December 1	7.2	1955 December 28	72	47
Annual	.. 33.0	21.3					67	51

\*Hours I. S. T.

TABLE 5

Mean wind speed in Km/hr.

Titilagarh

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Jan.	Feb.	March	Apr.	May	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	Annual
2·0	2·5	3·2	4·3	5·3	5·4	4·4	3·5	2·7	2·6	2·1	1·8	3·3

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TABLE  
Special weather  
Titila-

Mean No. of days with	Jan.	Feb.	Mar.	Apr.	May	Jun.
Thunder	0.1	0.7	3.8	5.2	7.1	8.5
Hail	0.1	0.0	0.1	0.0	0.0	0.0
Dust-storm	0.1	0.0	0.7	2.2	2.0	2.1
Squall	0.0	0.0	0.0	0.0	0.0	0.0
Fog.	4.6	1.2	0.0	0.0	0.0	0.0

6.  
phenomena

garh

Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
4·6	7·3	8·4	3·5	0·0	0·0	49·2
0·0	0·0	0·0	0·0	0·0	0·0	0·2
0·0	0·0	0·0	0·1	0·0	0·0	7·2
0·0	0·0	0·0	0·0	0·0	0·0	0·0
0·0	0·0	0·0	0·2	0·1	0·1	6·2