

FLORA OF
RAIPUR, DURG & RAJNANDGAON

D. K. VERMA, P. C. PANT, M. I. HANFI

BOTANICAL SURVEY
OF INDIA

**FLORA OF
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FLORA OF INDIA

Series 3

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सत्यमेव जयते

BOTANICAL SURVEY OF INDIA

Department of Environment

©Government of India, February, 1985

Price

Published by the Director, Botanical Survey of India,
Howrah-711103 and printed at Deep Printers,
3/26, Ramesh Nagar, New Delhi-110015

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F O R E W O R D

Botanical Survey has taken up printing of District Floras which ultimately would form the base work for whole State Floras. In this direction Flora of Raipur, Durg and Rajnandgaon covers three districts.

There are large number of virgin forest pockets in Madhya Pradesh including the regions covered in this work and as such the richness of the Flora is substantiated by the presence of about 1032 species covered under 568 genera. All the specimens are housed in the Central Circle of Botanical Survey of India at Allahabad for reference purposes by the Botanists of the region.

From the climatic point of view the three districts present three different types of topography, with partially xerophytic environment, a rich agricultural fertile land mass and a dense moist forest region. Its flora therefore would give three distinct types of vegetational set up showing a variety of species adapted to above climatic conditions.

The authors' study of this region would be very interesting for students, scientists and industrial houses dealing with plant products as raw materials. I do hope that the present work would provide a comprehensive coverage of floristics of this vast region and I am sure that the authors would welcome any suggestions for the improvement of the publication in its future editions.

Dated : 27.10.84
P.O. Botanic Garden
Howrah 711103.

M. P. Nayar
Director
Botanical Survey of India

PREFACE

Madhya Pradesh in Central India, one of the larger states of the country, does not have a Flora of its own. This region with innumerable patches of rich tropical forests somehow got left out as a central pocket while all around it major Indian Regional Floras were published for the Upper Gangetic Plains (Duthie, 1903-1929), Bombay Presidency (Cooke, 1901-1908), Madras Presidency (Gamble, 1915-1936) and Bihar and Orissa (Haines, 1921-1925). However, considering the time involved in proper exploration, processing the collections, identification and writing a Flora of Madhya Pradesh by a team of professional botanists, it was decided to take up smaller regions for intensive studies. The present composite Flora of the three districts, Raipur, Durg and Rajnandgaon is an outcome of this thought. Although floristic studies are generally accepted as part of the activities of an enlightened society, and publication of a Flora an academic achievement, its immense utility is portrayed in teaching, and in identification of plants by botanists, foresters, geologists, economic botanists, agriculturists, vaidyas, plant-based industries, and inquisitive plant-hunters. It is hoped that the present Flora would meet the needs of these people working in the region, and its vicinity. We are equally hopeful that it would also accelerate botanical activities in the region, and generate public interest in wild plants, leading to recognition and protection of rare and threatened species.

The three districts with a total area of about 45,000 sq. km lie between $80^{\circ} 38'$ and $82^{\circ} 70'$ E longitude and $19^{\circ} 79'$ and $22^{\circ} 48'$ N latitudes, in the south-eastern part of Madhya Pradesh. The Flora deals with 1032 species, spread out in 568 genera and 127 families of Angiosperms. It is based mainly on our own collections which were started in 1972. Subsequently, eight more exploration tours were undertaken, yielding a total collection of 3092 field numbers. The specimens are deposited in the Herbarium of the Botanical Survey of India, Central Circle, Allahabad (BSA). A few species which have earlier been reported from the region but not collected by us have also been included, with references to the concerned publication.

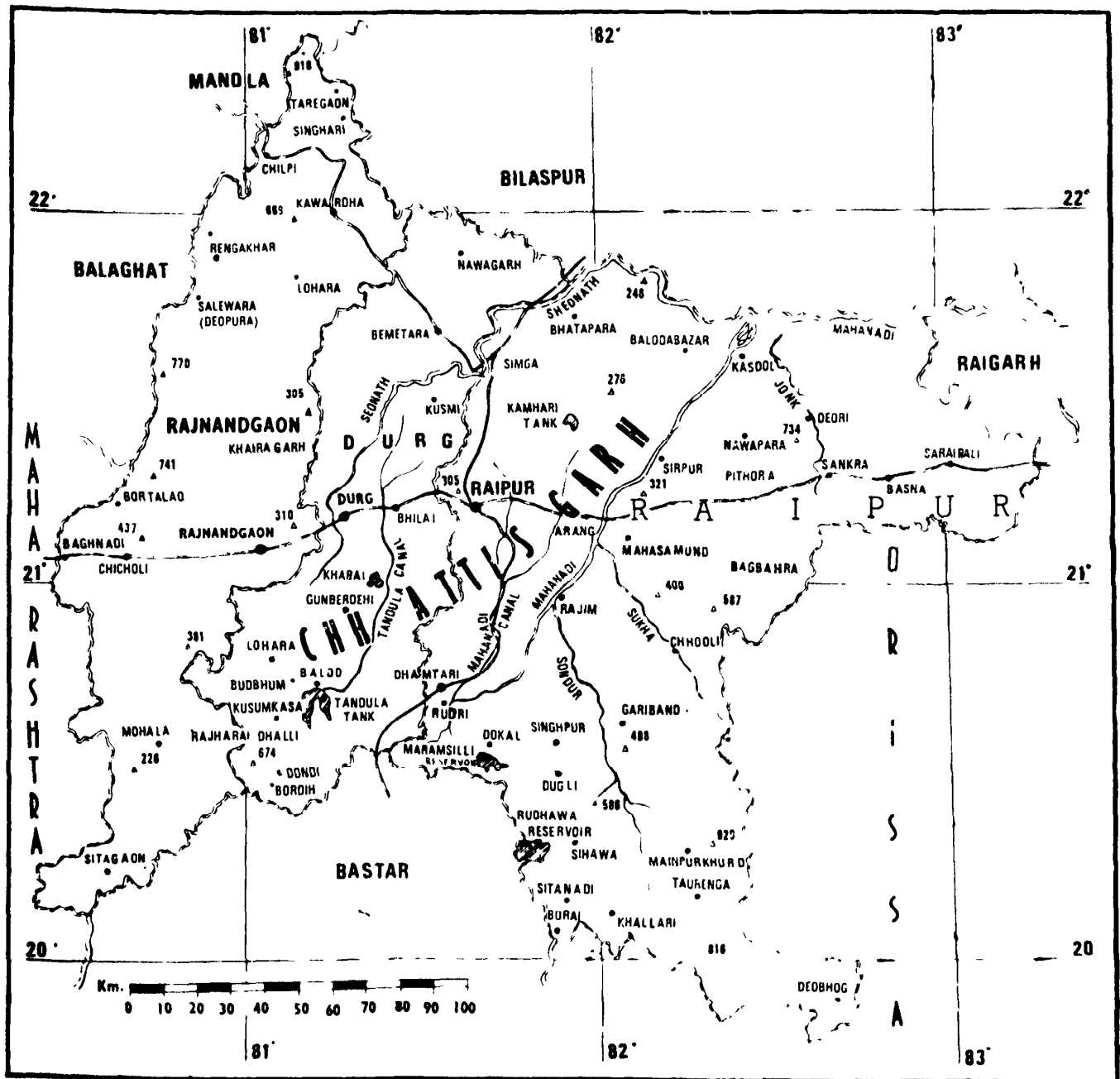
Starting with a short introduction and key to the families, the Flora chiefly includes keys to genera and species, correct botanical names and some selected synonyms, with citations, local names (when available), short description of the species, and notes on habitat, phenology, distribution and economic/medicinal uses, if any.

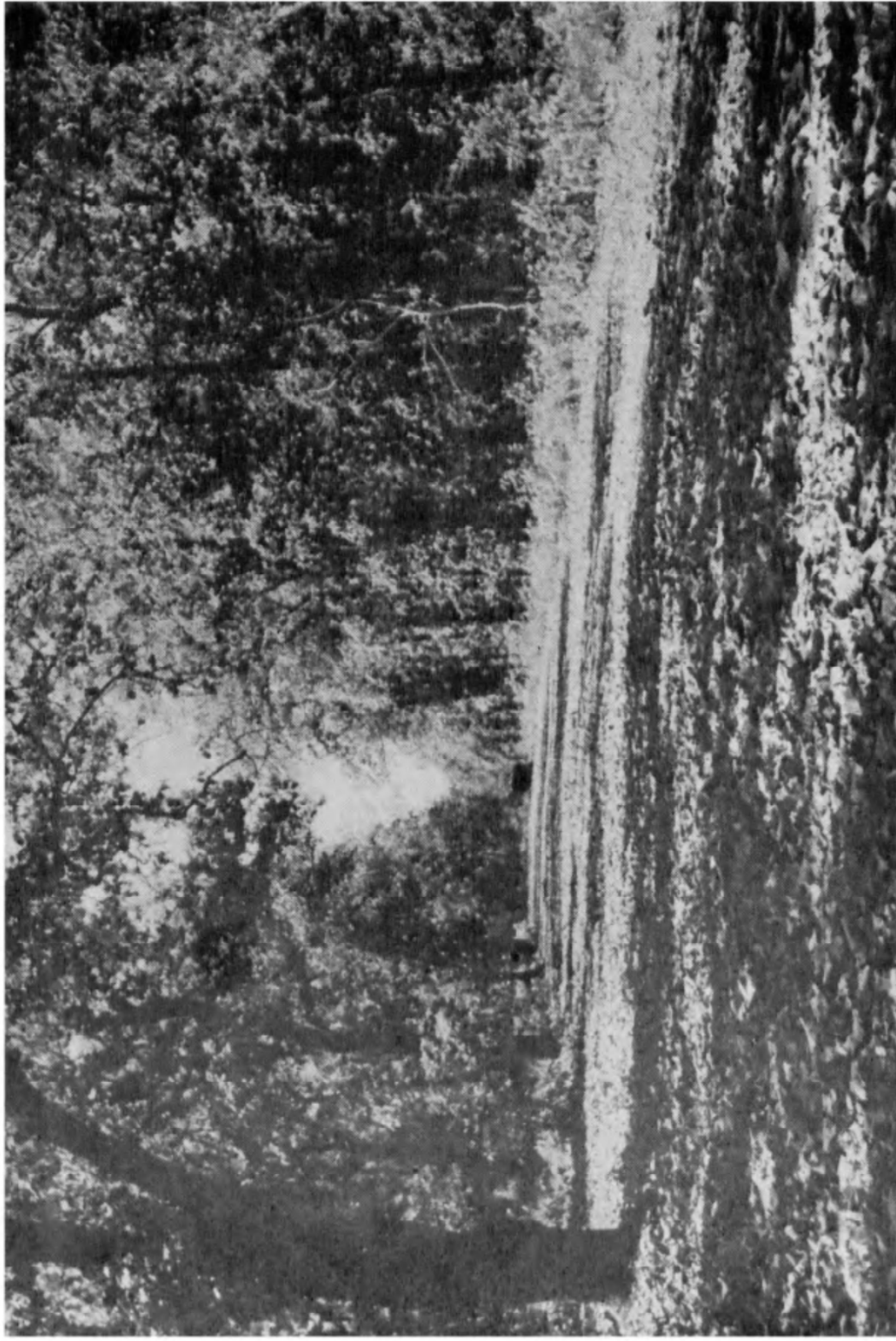
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To Dr. M. P. Nayar, Director, Botanical Survey of India, Howrah, we owe a great degree of gratitude for facilities, constant encouragement, and his personal interest in seeing through its early publication. We are also indebted to Dr. K. Thothathri, Joint Director, Dr. N. P. Balakrishnan, Deputy Director, and Dr. V. S. Agarwal, Editor of Publications, Botanical Survey of India, for their valuable help and suggestions at various stages. The officers of the Forest Department, Raipur Circle, particularly Sri M. Dixit and Sri D. P. Sangar, were of immense help during our exploration work, and to them, as well as their staff also, we would like to record here our sincere thanks. The acknowledgement would be incomplete without a mention of our own field-staff who have laid a very deserving claim on a word of thanks for their assistance in collection and processing of specimens. Our thanks are also due to our photographer, Sri M. A. Siddiqui, for the photographs included in the present Flora.

Botanical Survey of India
Allahabad
26th October, 1984

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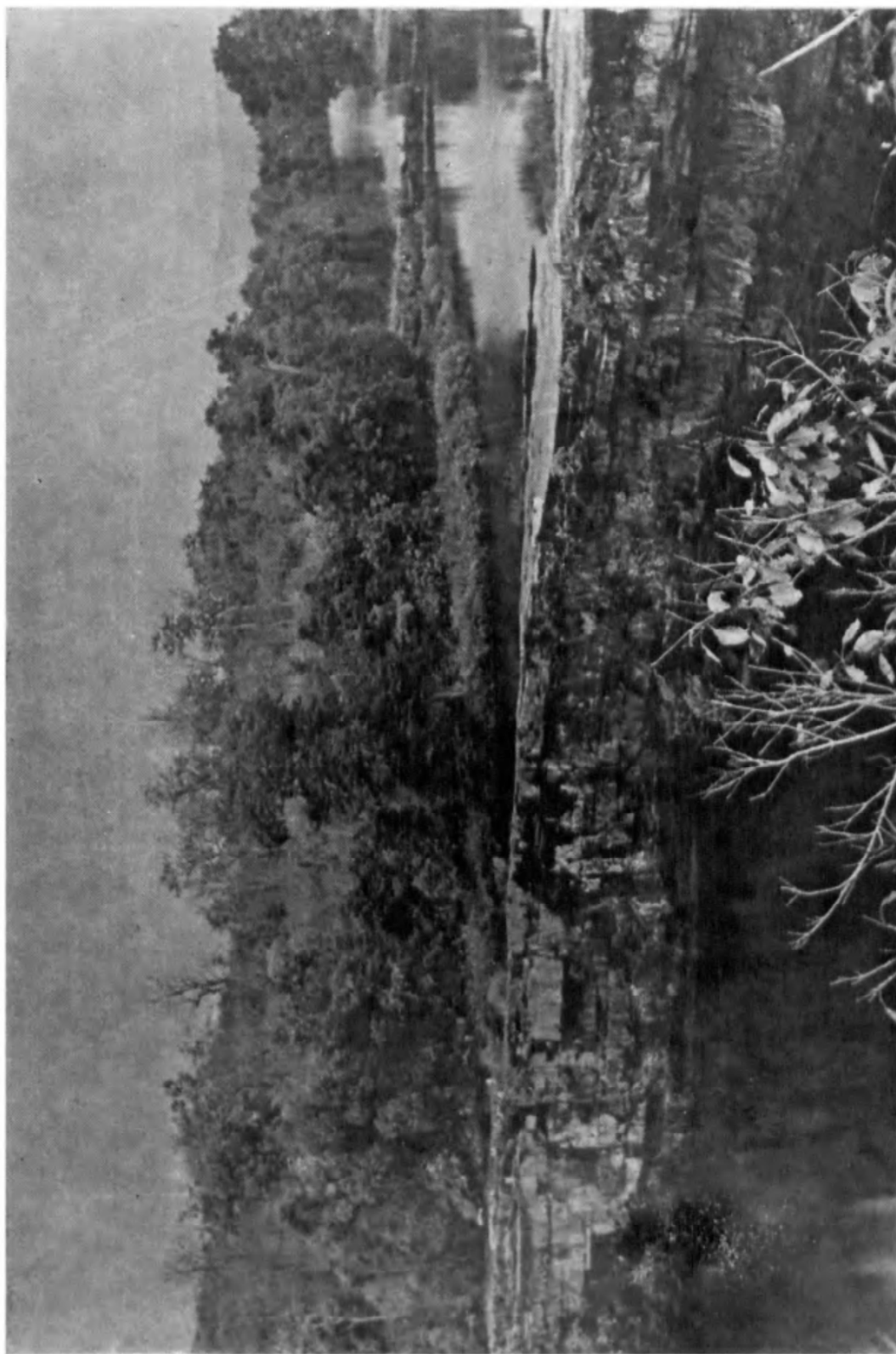




Sal forests (Nagri).



Sal mixed forests (Bar-nawapara).



Miscellaneous forests (Deodhara, Taurenga).



Miscellaneous forests on hill-tops (Nagri).



Diospyros melanoxylon (Nagri).



Tribal's imagination (Bar-nawapara).

INTRODUCTION

(D. M. Verma, P. C. Pant & M. I. Hanfi)

PHYSIOGRAPHY

Raipur, Durg and Rajnandgaon are three adjacent districts of Madhya Pradesh, in Central India, lying within $80^{\circ}38'$ and $82^{\circ}70'$ E longitudes and $19^{\circ}79'$ and $22^{\circ}48'$ N latitudes, comprising of an area of about 45,000 sq. km. It is in the northern part of the Deccan Peninsula, in south-east Madhya Pradesh, bounded on the south-west by Maharashtra state, on the east by Orissa state, on the north by Balaghat, Mandla, Bilaspur and Raigarh districts and on the south by Bastar district of Madhya Pradesh. Of the three districts, Raipur, with an area of about 25,000 sq. km is larger than even the combined areas of Rajnandgaon and Durg. Rajnandgaon, which was formerly a part of Durg district, was constituted as a separate district on 26th January, 1973. The maximum length and width of the three combined districts are 273 km and 225 km respectively.

The area is approachable through the National/State High-ways from Bilaspur, Jabalpur, Nagpur, Vishakhapatnam and Sambalpur. There are only two main railway-lines from Nagpur to Bilaspur and from Nagpur to Vishakhapatnam, both passing through Rajnandgaon, Durg and Raipur and a branch-line from Raipur to Dhamtari. Hence, movements are mainly through roads which are motorable in fair-weather, and well spread out. However, during rainy season, a lot of hurdles are created by the numerous over-flowing rivers and streams, and all approaches, particularly to interiors in the hilly terrains in west, south and east, are virtually cut off.

Topographically, the region can easily be divided into the Chhattisgarh Plains in the centre, flanked by a hilly and plateau tract on its west, south and east. On the north, the Chhattisgarh Plains continue into Bilaspur district. In general, the area slopes towards north-east.

The Chhattisgarh plains which occupies more than half the area of the region, has a general altitude between 250 - 350 m. It is a fertile alluvial region, mostly under cultivation. In history, it was also known as Mahakosala, or Dakshini Kosala (to distinguish it from the country of the same name in the north). The drainage is mainly provided by the

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Mahanadi river which originates in the Sihawa hills of south Raipur. It first flows northwards and then eastwards, and then through Orissa to the Bay of Bengal. Its major tributary is Seonath river which flows through Rajnandgaon and Durg, collecting water from the western parts. Other tributaries, though numerous, are smaller streams descending from the adjoining hills. Thus, Hanp, Sakri, Karua and Dotu from the Maikal Range in the west, Kharkhara, Tandula, Sitanadi, Sondur, Pairi, Sukha and Jonk from the southern hills and plateaus, and many others, all contribute to the waters of Mahanadi.

However, it is the hilly regions in the western, southern and eastern parts which are floristically rich and more interesting. The area is sparsely populated, well forested, much less cultivated, and even though human pressures are operating, it is in these places that most of the reserved forests and Game Sanctuaries with good vegetation and diverse flora are found. In the western part of Rajnandgaon is the Maikal Range of rather deep sloping hills which continue northwards towards Satpura hills. With a general range of 600-800 m, its highest elevation of 918 m is found at the northern end. The southern and the eastern hilly regions are in continuation with the Eastern Ghats through Bastar and Orissa. Higher elevations are found along the south-eastern boundary of Raipur, with highest elevation of 929 m at Mainpur Khurd. This Raipur Plateau is locally divided into Shishupal hills, Sihawa hills and Atang hills. A few reservoirs like Tandula, Maramsilli and Dudhawa have been built for irrigating the large expanse of Chhattisgarh Plains.

GEOLOGY AND SOIL

The area forms part of the northern limit of the well known geological division of India the Deccan Peninsula. Like other parts of the Peninsula, our region also was never submerged under the sea. It is generally composed of horizontal rock-beds on a firm and immovable foundation, and has remained so except for some fracturing due to vertical, downward or upward, movement of some large segments within it. The present day hills in the region were formed due to unequal weathering that has been going on for ages on the Deccan Plateau, cutting down deeper on the land surrounding the hills. The region contains the oldest rocks of the world belonging to Archaean System. Almost equally old, and more common, are the metamorphosed Archaean sedimentary rocks grouped under the name of Dharwar System, and the two are scarcely distinguishable. After a long interval of time during which these were eroded, sometimes almost to the base-level, the next rock-system began to be deposited. This is known as the Cuddapah System. The

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Archaean System consists of gneissic rocks (frequently granite), crystalline metamorphosed sediments and schists. The rocks of Dharwar System are often highly metalliferous, containing ores of iron and manganese. The bulk is formed of phyllites, schists and slates. There are different kinds of schists, quartzites, granites, limestones and brilliantly coloured jaspers. The Cuddapah System is mainly composed of hard Chandrapur sandstones, shales, slates, quartzites and limestones. Besides, they contain cherts, jaspers and some manganese and iron ores.

The rocks of Archaean and Dharwar Systems, chiefly consisting of granites, schists, quartzites, slates and limestones, are frequently found exposed in the hilly regions in the western, southern and eastern parts of our area. These are usually overlaid with Chandrapur sandstones and shales of the Cuddapah System. The Chilpi series of the Dharwar, in the north western part, includes a great thickness of highly disturbed slates and phyllites, with quartzite and basic trappean intrusions. In the Chhattisgarh plains, the Cuddapah System is represented by the stratified rocks of two series. The lower are known as the Chandrapur series, consisting of sandstones, and the upper one known as Raipur series, consisting of purple shales and limestones. The Chandrapur series is exposed only along the rim of the basin.

In addition to the above, towards close of the Cretaceous, the volcanic outbursts in the Peninsula resulted in the eruption of thick layers of lava and associated pyroclastic materials. It resulted in thick horizontally bedded sheets of basalts known as the Deccan Traps. It is found in the Chilpi hills in the north-west. The Lateritic deposits, formed due to metasomatic replacement of Dharwar slates and schists by manganese bearing solutions are of irregular distribution and occur as caps on the outcrops of the Dharwar rocks. The laterite is a comparatively recent Pleistocene formation.

The soil produced by the Archaean, Dharwar and Cuddapah rocks is shallow, stony, sandy loam or clayey loam, generally called the 'residual soil'. This has been grouped as Red soil. However, the colour, though generally red, often grades into brown, chocolate, yellow, grey or even black. This is generally found in the hilly regions and its neighbourhoods. Another kind, known as the Black cotton soil or the Regur, is also found in areas around Chilpi, Rajolidih, Borai, Gariaband etc. Its origin is ascribed to long-continued surface action on rocks like the Deccan Trap and gneisses of basic nature. It is extremely sticky when wetted and retains large proportion of moisture for a long time. It is dark, blackish, rich in humus and iron, and very fertile. The lateritic soil found in patches throughout the districts are generally poor and locally called '*Bhata*' lands. In addition to these there are large deposits of

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alluvial soil in the basins of the several rivers in the Chhattisgarh Plains. These are light yellow loamy soil with a high degree of productiveness, and locally called '*Matasi*'. This is generally under paddy cultivation. The black soil is also sometimes locally called '*Kanhar or Dorsa*'.

CLIMATE

The climate of the region is broadly divisible into summer season from March to June, rainy season from July to October and cold season from November to February. Of these, the post-monsoon period in October November is most pleasant. At times frost may be experienced in December January but it is harmless and hangs around valleys and river-courses. Hail-storms also sometimes occur in late winters. Thunderstorms is a common phenomenon during May June.

The mean temperature data for Raipur (305 m) is given in Table 1. The highest temperature reaching in the afternoons of May June has been recorded as 47.2°C and the lowest in the pre-dawn period of December January has been recorded as 3.9°C. These conditions more or less prevail throughout the Plains of Chhattisgarh. The hilly terrain in the west, south and east, with an elevation of up to 929 m certainly has a few degrees lower temperature, though proper records are not available.

The average monthly rainfall for three representative areas is given in Table 2. The average annual rainfall in general varies from 1100 mm (in Pithora) to about 2000 mm in the southern hilly tract. About 90% of it falls in the rainy season between June September. These are often torrential, causing much soil erosion. The shallow bedded streams and rivers, with almost dry beds or little water between November - June, suddenly swell up cutting off most of the communication, particularly in the interiors. The rainfall in the remaining months is reduced to a few irregular showers. The wettest parts are its southern hills and plateau while northwards, the Chhattisgarh Plains are comparatively drier.

PEOPLE

The three districts combined together have a population of about 50 lakhs, mainly belonging to '*Gond*' tribe. Of these, about 85% live in rural areas. Here again, a larger proportion is settled in the Chhattisgarh Plains as compared to the hill ranges and plateaus. Raipur city, which is the most developed city in eastern Madhya Pradesh with several professional colleges, institutes, offices, factories, and business centres, has the highest population of over 3 lakhs.

INDUSTRIES

The whole tract was pretty backward till about 1960 when industrial development picked up at a rapid pace. Now there are several oil mills,

Table 1—MEAN TEMPERATURE IN RAIPUR (°C)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean max.	27.6	30.0	35.1	39.3	41.8	36.6	30.4	30.9	31.2	31.4	28.7	26.7
Mean min.	13.2	14.5	20.0	24.6	27.8	26.2	23.9	23.8	23.9	20.9	15.9	12.6
MEAN	20.4	22.3	27.6	32.0	34.8	31.4	27.2	27.3	27.6	26.2	22.3	19.5

③

Table 2—RAINFALL (mm)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Balod	8	16	15	14	85	316	365	454	390	184	11	5	1863
Dhamtari	8	18	13	23	20	231	385	355	209	57	13	4	1336
Raipur	10	22	18	16	22	227	375	358	192	54	13	5	1312

rice mills, soap mills, cotton mills and factories making cement, utensils, lac, bidis, and furniture etc. Rice, timber wood, bamboo and bidi leaves are exported in large quantities.

Surpassing all these is the Bhilai Steel Plant established with Indo Russian collaboration, celebrating its silver-jubilee. Situated in Durg dist. on the highway between Raipur and Durg, it has developed its own township. As expected, it is causing plenty of air pollution and this problem is very much worth further investigation. The pollution could be felt even while breathing. A general observation revealed several dust covered retarded roadside trees speaking of ill health. Trees of *Cassia fistula*, *Pongamia pinnata* and *Peltophorum pterocarpum* appeared to be more susceptible as compared to *Ficus religiosa*, *Pithecellobium dulce*, *Mangifera indica*, *Dalbergia sissoo* and spp. of *Albizia*, *Manilkara* and *Eucalyptus*.

EARLIER COLLECTIONS AND PUBLICATIONS

The contributions of Clarke (1898), Blatter (1911), Haines (1916), Mooney (1942), Hewetson (1951), Santapau (1958) and Burkill (1965) were all looked into in search of earlier collections from our area. The earliest record of a very few stray collections are those of Watt (*ca* 1894) and Marten (1898) in Raipur, and Lowrie (1908-09) in Raipur and Durg (incl. Rajnandgaon). It is obvious that this region remained unrepresented in J.D. Hooker's Flora of British India.

The credit for the first serious attempt at botanising the area should go to Henry Haselfoot Haines, a British Forest Officer, and a reputed botanist who later published Botany of Bihar & Orissa (1921-1925). His collections, from 1912 onwards, from ours and the adjoining regions, resulted in the publication of his *Descriptive List of trees, shrubs and economic herbs of the Southern Circle, Central Provinces* (1916). It includes about 350 species from Raipur, Durg and Rajnandgaon districts. Unfortunately, his collections could not be consulted while writing the present Flora since most of these are housed in foreign herbaria (A, ABD, K, NY, WRS� etc.). Hemant Sharma made some collections in Raipur city around 1980-82 in connection with his pollen studies, and his unpublished list was made available to us by Prof. V.B. Sharma, Botany Department, Government Science College, Raipur. Mention may also be made of a few publications on aquatic vegetation of Raipur (D.K. Tiwari, 1960a, b; Unni, 1967a), Compositae of Raipur (Unni, 1967b) and Cyperaceae of Madhya Pradesh (Verma & Chandra, 1981). A few collections of R. M. Singhal (1951) and S.D.N. Tiwari (1948 onwards) have also been reported from Raipur in some floristic publications on Madhya Pradesh.

S.K. Jain (1961-62) and G. Panigrahi (1963) also collected a few specimens from Raipur while going to Bastar district.

PRESENT COLLECTIONS

Plant collection in the region on which the present Flora is mainly based was started with the first exploration tour, in May-June, 1972, to Raipur district by D.M. Verma. During a total field stay of 25 days, the party camped at Dhamtari, Sitanadi, Khallari, Taurenga, Gariaband, Pithora and Kasdol. From there, movements and collections were made both on foot and by Jeep. Naturally, the camping places were more intensively collected though efforts were always made to cover as much of area as possible. A total of 554 field numbers were collected. More or less the same pattern was followed during subsequent field trips. A total of five collection tours were undertaken to Raipur district by D.M. Verma during May-June, 1972 (25 days), by D.M. Verma & M.I. Hanfi in January, 1976 (16 days), and August, '76 (13 days), by D.M. Verma in October, '76 (13 days) and by D.M. Verma & M.I. Hanfi in February, '84 (7 days) and in all 1784 field numbers were collected. The camping places were Borai, Dhamtari, Dugli, Gariaband, Kasdol, Khallari, Nagri, Pithora, Raipur, Sitanadi and Taurenga. In Rajnandgaon district P.C. Pant & M.I. Hanfi collected in April, 1974 (8 days), October, '74 (12 days), September, '76 (13 days) and August, '78 (5 days) with camps at Baghnadi, Chilpi, Deopura, Rajnandgaon, Singhari and Taregaon, and a total collection of 907 field nos. In Durg district P.C. Pant and M.I. Hanfi collected in April 1974 (6 days) and August, '78 (13 days) with camps at Balod, Buddhum, Durg, Kamteli, Khargaon, Malaidah and Rajolidih, and a total collection of 401 field nos. Thus, in the three districts of Raipur, Rajnandgaon and Durg, 131 days were spent in field work and a total of 3092 field numbers were collected. All these specimens are housed in the herbarium of the Botanical Survey of India, Central Circle, Allahabad (BSA).

VEGETATION

The climatic, edaphic, altitudinal and biotic variations with their complex interrelationships and species composition have resulted in different kinds of vegetation cover in the area which needs a much more detailed study than attempted during the present Flora-oriented project. The following account, based on field-notes during movements to different parts, is not very comprehensive, and is aimed only at giving a general idea of the vegetation in the region. The forests cover about 40% of the area, of which about 60% are reserved forests and the remaining protected forests or under Forest Corporation.

The Chhattisgarh Plains has long been under cultivation and at present only small patches of degraded tropical dry deciduous forests have been left, if at all. It is rather more characterised by scattered stunted and crooked trees and shrubs of *Butea monosperma*, *Lagerstroemia parviflora*, *Albizia* spp., *Acacia leucophloea*, *A. nilotica* spp. *indica*, *Mangifera indica*, *Terminalia* spp., *Ficus racemosa*, *F. benghalensis*, *F. religiosa*, *Azadirachta indica*, *Pithecellobium dulce*, *Syzygium cumini*, *Mitragyna parvifolia*, *Aegle marmelos*, *Diospyros melanoxylon*, *Bauhinia* spp., *Calotropis* spp., *Caesalpinia bonduc*, *Ipomoea carnea* and *Mimosa himalayana*, with several climbers like *Ziziphus oenoplia*, *Celastrus paniculatus*, *Cryptolepis buchananii*, *Ampelocissus* spp., *Mukia maderaspatana*, *Ipomoea* spp., *Atylosia scarabaeoides* and *Cissampelos pareira*. Particular mention may be made of the 'mahua' trees, *Madhuca longifolia* var. *latifolia*, which are considered sacred and stay unlopped. In addition, *Albizia* spp., *Dalbergia sissoo*, *Delonix regia*, *Cassia fistula*, *Peltophorum pterocarpum*, *Pongamia pinnata*, *Eucalyptus* hybrids, and *Pterocarpus marsupium* are frequently planted on the roadsides. The ground flora, during rainy and post rainy season, consists of several annual or perennial species of grasses, sedges and other herbs and creepers, but by the middle of winter it is completely grazed and presents a bare desolate spectre. Mention may be made of two epiphytic orchids, *Vanda tessellata* and *V. testacea* which grow freely on *Mangifera indica*, *Butea monosperma*, *Madhuca longifolia* var. *latifolia*, *Diospyros melanoxylon* and *Terminalia* spp. The former with large brown banded flowers immediately catches the eye.

In contrast to the Chhattisgarh Plains, the western regions like Taregaon, Chilpi, and Rengakhar, the southern regions like Rajhara dhalli, Borai, Sitanadi, Khallari and Taurenga and the eastern regions like Deori, Bagbahara, Barnawapara and Chhoora harbour several extremely rich reserved forests of sal, teak and mixed kinds. According to Champion & Seth (1968) these have been broadly grouped into Tropical Moist Deciduous Forests and Tropical Dry Deciduous Forests. These may be of mixed type (Tropical Moist Deciduous Mixed Forests and Tropical Dry Deciduous Mixed Forests), or with predominating *Shorea robusta* (Tropical Moist Deciduous Peninsular Sal forests and Tropical Dry Deciduous Peninsular Sal forests), or with predominating *Tectona grandis* (Tropical Moist Deciduous Teak Forests and Tropical Dry Deciduous Teak Forests). A short account of the two major groups is given below :

I. Tropical Moist Deciduous Forests :

A good development of these forests with a fair amount of sal (*Shorea robusta*) can be observed in the reserved forests around Chilpi,

Rangakhar, Borai, Sitanadi, Khallari and Taurenga. It has tall trees of *Shorea robusta*, *Terminalia* spp., *Pterocarpus marsupium*, *Dalbergia paniculata*, *Adina cordifolia*, *Stereospermum chelonoides*, *Schleichera oleosa*, *Garuga pinnata*, *Lannea coromandelica*, *Bombax ceiba*, *Soyimida febrifuga* and *Boswellia serrata*, and smaller trees like *Lagerstroemia parviflora*, *Briedelia squamosa*, *Mallotus philippensis*, *Diospyros melanoxylon*, *Anogeissus latifolia*, *Buchanania lanzan*, *Gmelina arborea*, *Antidesma ghaesembilla*, *Ficus* spp., *Grewia tiliifolia* and *Cassia fistula*, and shrubs like *Breynia vitisidaea*, *Embelia tsjeriam cottam*, *Chloroxylon swietenia*, *Holarrhena antidysenterica*, *Casearia graveolens*, *Helicteris isora*, *Semecarpus anacardium*, *Ochna obtusata*, *Indigofera cassioides*, *Woodfordia fruticosa* and species of *Leea* and *Desmodium*. The common Madhya Pradesh bamboo, *Dendrocalamus strictus*, forms dense thickets. The conspicuous climbers and ramblers in these forests are *Millettia extensa*, *Smilax zeylanica*, *Bauhinia vahlii*, *Olex scandens*, *Combretum roxburghii*, *Ventilago denticulata*, *Ichnocarpus frutescens*, *Dioscorea pentaphylla*, *D. puber*, *D. oppositifolia* and *D. bulbifera*.

The undergrowth in dense forests is often sparse, and not much varied. The common species are *Eranthemum purpurascens*, *Perilepta edgeworthiana*, *Nelsonia canescens*, *Phoenix acaulis*, *Chlorophytum tuberosum*, *Globba racemosa*, *G. bulbifera*, *Curcuma* spp., *Zingiber* spp., *Tacca leontopetaloides*, *Carex speciosa*, and a few ground orchids like *Eulophia* spp., *Habenaria* spp., *Geodorum densiflorum*, and *Peristylus* spp. The edges of the forests have a very luxurious growth of numerous annual and perennial species of *Cleome*, *Desmodium*, *Alysicarpus*, *Tephrosia*, *Crotalaria*, *Blumea*, *Cynoglossum*, *Barleria*, *Leucas*, *Phyllanthus*, *Euphorbia*, *Pupalia*, *Aerva*, *Commelina*, *Cyanotis*, and sedges and grasses. The species diversity and undergrowth in forests with high proportion of *Shorea robusta* (sal forests) is comparatively poorer than in the mixed forests. Sal is generally absent on hill slopes.

The degraded forests of the tropical moist deciduous type also have a composition somewhat similar to that described above but for the conspicuous absence or scarcity of species like *Shorea robusta*, *Dalbergia paniculata*, *Adina cordifolia*, *Lannea coromandelica*, *Garuga pinnata*, *Bombax ceiba*, *Leea* ssp., *Ochna obtusata* and *Bauhinia vahlii*. Instead, these forests are mainly composed of *Terminalia alata*, *T. bellirica*, *Lagerstroemia parviflora*, *Anogeissus latifolia*, *Cleistanthus collinus*, *Diospyros melanoxylon*, *Briedelia squamosa*, *Butea monosperma*, *Cordia obliqua*, *Buchanania lanzan*, *Emblia officinalis*, *Helicteres isora* and species of *Ziziphus*, *Acacia*, *Gardenia* and *Xeromphis*. The common climbers are *Celastrus paniculatus*, *Ventilago denticulata*, *Cocculus hirsutus*, *Cissampelos pareira*, *Rhynchosia minima*, *Atylosia scarabaeoides*, *Mukia maderaspatana*, *Diplocyclus palma-*

tus, *Ampelocissus latifolius*, *A. tomentosa*, *Ziziphus oenoplia*, *Pergularia daemia* and *Cryptolepis buchananii*. There is also a corresponding change in the ground flora with more intrusion of grasses, sedges and Asteraceae members.

Teak (*Tectona grandis*) is usually absent in these forests except where plantations of this timber species have been raised by the Forest Department, some of which are more than 50 years old. Only in a few places teak has been found to be naturally(?) occurring in association with other trees and shrubs.

Sometimes *Terminalia alata* becomes extremely dominant and forms almost pure patches.

II. Tropical Dry Deciduous Forests :

These are found in comparatively drier areas, generally in and around the Chhattisgarh Plains. Though not always conspicuously different from the moist deciduous forests, since transitional stages are not uncommon, dry deciduous forests are dominated by *Lagerstroemia parviflora*, *Butea monosperma*, *Diospyros melanoxylon*, *Albizia* spp., *Anogeissus latifolia*, *Terminalia* spp., *Aegle marmelos*, *Acacia catechu*, *A. torta*, *A. pennata*, *Cordia obliqua*, *Emblia officinalis*, *Madhuca longifolia* var. *latifolia*, *Bauhinia* spp., *Nyctanthes arbor-tristis*, *Ziziphus mauritiana*, *Z. xylopyrus*, *Helicteres isora*, *Lannea coromandelica* and *Boswellia serrata*. The shrubby layer is usually formed of *Holarrhena antidysenterica*, *Grewia hirsuta*, *Mimosa himalayana*, *Flacurtia indica*, *Capparis zeylanica*, *Kirganelia reticulata*, *Securinega virosa*, *Casearia elliptica*, *Woodfordia fruticosa*, *Clerodendrum serratum* and *Solanum anguivi*. The common climbers are *Ziziphus oenoplia*, *Smilax zeylanica*, *Celastrus paniculatus*, *Ampelocissus latifolius*, *A. tomentosa*, *Asparagus racemosus*, *Hemidesmus indicus* and *Ichnocarpus frutescens*. A few other climbers like *Rhynchosia minima*, *Atylosia scarabaeoides*, *Ipomoea* spp., *Mukia maderaspatana*, *Diplocyclus palmatus*, *Cryptolepis buchananii* and *Pergularia daemia* become more common in open forest pockets or its margins. *Hyptis suaveolens*, *Anisomeles indica*, *Alysicarpus* spp., *Tephrosia purpurea*, *Plectranthus mollis*, *Cassia tora*, *Pavetta tomentosa*, species of *Indigofera*, *Crotalaria*, *Leucas*, *Euphorbia* and a large variety of grasses and sedges are common along forest margins.

It may also be mentioned that sometimes *Anogeissus latifolia*, *Butea monosperma*, *Boswellia serrata*, *Aegle marmelos* and *Acacia catechu* almost individually dominate small patches of dry deciduous forests, and such forests are often named after these individual species.

Terminalia arjuna and *Syzygium heyneanum* are commonly found along banks of the rivers and streams. While the former is also found elsewhere, the latter is very specific in its habitat. Bushes of *Tamarix ericoides* and *Rotula aquatica* are frequent in river-beds.

The rock boulders in the dry uplands bear in their crevices only a few species like *Polycarpaea aurea*, *P. corymbosa*, *Indigofera astragalina*, *I. glabra*, *Cassia absus*, *Anisochilus carnosus*, *Trichurus monsoniae*, *Arthroxon prinodes*, *Chrysopogon verticillatus*, *Digitaria stricta*, *Dimeria ornithopoda*, *Perotis indica* and *Pogonatherum crinitum*.

AQUATIC PLANTS

The numerous rivers, streams, drains, ponds and ditches harbour a number of water-loving species, in and around it, and these are generally grouped together as aquatic plants. However, the exact interpretation or circumscription of this group is debatable since there are numerous border-line species which grow both in marshy lands and water, and still others which grow in drains and ditches which are temporarily filled up during rains. The 85 species mentioned below have been chosen as aquatic in a more strict sense and have been classified into six categories on the basis of their general habit. The wetland hydrophytes, pretty large in number, have been excluded.

I. Free-floating hydrophytes :

Azolla pinnata, *Wolffia globosa*, *Lemna perpusilla*, *Spirodela polyrhiza*, *Pistia stratiotes*, *Trapa natans* var. *bispinosa* and *Eichhornia crassipes*.

II. Suspended submerged hydrophytes :

Ceratophyllum demersum, *Utricularia aurea* and *U. exoleta*.

III. Anchored submerged hydrophytes :

Polylepium stylosum, *Myriophyllum oliganthum*, *Blyxa aubertii*, *B. octandra*, *Hydrilla verticillata*, *Vallisneria spiralis*, *Najas guineensis*, *N. indica*, *Aponogeton crispus*, *Potamogeton crispus*, *P. mucronatus* and *P. pectinatus*.

IV. Anchored hydrophytes with floating shoots :

Neptunia oleracea, *Ludwigia adscendens*, *Ipomoea aquatica*, *Alternanthera philoxeroides*, *Hygroryza aristata* and *Cyperus platystylis*.

V. Anchored hydrophytes with floating leaves :

Marsilea minima, *Nelumbo nucifera*, *Nymphaea pubescens*, *N. nouchali*, *N. rubra*, *Nymphaea hydrophylla*, *N. indica*, *Ottelia alismoides* *Monochoria*

vaginalis, *Sagittaria guayanensis* ssp. *lappula*, *Caldesia parnassifolia*, *Limnophyton obtusifolium*, *Tenagocharis latifolia*, *Aponogeton natans* and *Potamogeton nodosus*.

VI. Emergent amphibious hydrophytes :

Aeschynomene aspera, *A. indica*, *Ammania baccifera*, *A. multiflora*, *Rotala densiflora*, *R. indica*, *R. rotundifolia*, *Ludwigia octovalvis*, *L. perennis*, *L. prostrata*, *Enhydra fluctuans*, *Limnophila indica*, *L. sessiliflora*, *Hygrophila auriculata*, *Polygonum barbatum*, *P. dichotomum*, *P. glabrum*, *P. hydropiper* spp. *microcarpum* var. *triquetrum*, *P. limbatum*, *Crinum defixum*, *Typha angustata*, *Cyperus distans*, *C. nutans* var. *eleusoides*, *C. pangorei*, *Eleocharis acutangula*, *E. congesta*, *E. dulcis*, *Fimbriistylis schoenoides*, *F. tetragona*, *Scirpus articulatus*, *S. juncoides*, *S. lateriflorus*, *S. maritimus*, *Brachiaria reptans*, *Coix aquatica*, *Echinochloa colona*, *E. stagnina*, *Hymenachne pseudointerrupta*, *Ophiuros exaltatus* and *Phragmites karka*.

FERNS AND FERN ALLIES

While the main efforts were concentrated on the collection of flowering plants, a few ferns and fern allies were also collected, and these are listed below:

Azolla pinnata R. Br., *Ophioglossum nudicaule* L.f., *O. reticulatum* L., *Marsilea minuta* L., *Isoetes coromandelina* L., *Equisetum debile* Roxb., *E. diffusum* D. Don, *Selaginella bryopteris* (L.) Baker, *S. repanda* (Desv.) Spring, *Ceratopteris thalictroides* (L.) Brongn., *Lygodium flexuosum* (L.) Sw., *Adiantum caudatum* L. and *A. lunulatum* Burm.

SANCTUARIES

In keeping with Wild Life Conservation three sanctuaries were established in Raipur district during the last decade. These are :

1. **Bar-Nawapara Sanctuary** with an area of 244.66 sq. km. in the northern part of Raipur district, established in 1975.
2. **Sitanadi sanctuary** with an area of 566.53 sq. km. in the southern part of Raipur district, established in 1974.
3. **Udanti Sanctuary** with an area of 247 sq. km. in the southern part of Raipur district along Udanti river, established in 1979.

All these areas were formerly Reserved Forests with generally a high proportion of *Shorea robusta*. Sitanadi area is particularly extremely rich in species composition. Tigers, panthers, bisons, sambhars, cheetals, wild

boars, monkeys, bears and neel-gai are the common animals. These sanctuaries would also go a long way in conserving the flora, especially its herbaceous elements which unknowingly escape the attention of conservationists or foresters. In addition to the above sanctuaries a part of the Chilpi area in western Rajnandgaon has now been included under Kanha National Park.

ECONOMIC BOTANY

Leaving aside urban population the majority of the people still depend to a large extent on wild plants for their various needs. During field trips some efforts were also diverted towards collection of information on local uses of plants. These were mainly gathered by talking to tribals inhabiting the interiors of the southern parts of Raipur who are still partly dependant on surrounding native plants, to village elders and forest staff, and also by having a look at the local weekly markets. Whenever possible, this information was cross-checked. Still, errors might have crept in since some people were not readily prepared to divulge their *secret knowledge* and might have given wrong information under persuasion, while still others were over-jealous to leave a good impression and came out with some or the other uses of most of the plants enquired into. The following names have been sorted out in this background, and broadly categorized according to their uses.

I. Edible Plants.

- (a) Rhizomes/tubers (cooked) of *Nelumbo nucifera*, *Nymphaea pubescens*, *N. rubra*, *Dioscorea bulbifera*, *D. glabra*, *D. pentaphylla*, *D. puber* and *Tacca leontopetaloides*.
- (b) Leaves and tender shoots (cooked) of *Cleome gynandra*, *Cocculus hirsutus*, *Melochia corchorifolia*, *Corchorus capsularis*, *C. olitorius*, *Bauhinia malabarica*, *B. purpurea*, *Cassia tora*, *Cordia obliqua*, *Polygonum glabrum*, *Amaranthus hybridus* spp. *incurvatus* var. *paniculatus*, *A. spinosus*, *A. tricolor*, *Basella alba*, *Amorphophallus sylvaticus* and *Dendrocalamus strictus*.
- (c) Flowers (cooked) of *Sesbania grandiflora*, *Bauhinia purpurea*, *B. racemosa*, *Semecarpus anacardium*, *Celastrus paniculatus*, *Woodfordia fruticosa*, *Madhuca longifolia* var. *latifolia*, *Nelumbo nucifera* (carpels) and *Hibiscus subdariffa* (calyx).
- (d) Fruits (raw, cooked or pickled) of *Dillenia pentagyna*, *Annona squamosa*, *Mangifera indica*, *Buchanania lanzan*, *Grewia abutilifolia*, *G. hirsuta*, *Aegle marmelos*, *Ziziphus mauritiana*, *Z. rugosa*, *Moringa oleifera*, *Trapa natans* var. *bispinosa*, *Pithecellobium*

dulce, *Tamarindus indica*, *Terminalia bellirica*. *Momordica dioica*, *Xeromphis uliginosa*, *Flacourtia indica*, *Embelia tseriam-cottam*, *Diospyros malabarica*, *D. melanoxylon*, *Carissa opaca*, *Cordia obliqua*, *Gmelina arborea*, *Syzygium cumini*, *Emblica officinalis*, *Ficus racemosa*, *F. virens*, *Phoenix acaulis* and *P. sylvestris*.

- (e) Seeds (cooked or roasted) of *Semecarpus anacardium*, *Sterculia urens*, *Indigofera glandulosa*, *Vigna aconitifolia*, *V. trilobata*, *V. umbellata*, *Bauhinia vahlii*, *Cassia occidentalis*, *Coix aquatica*, *Eleusine coracana*, *Oryza rufipogon*, *Panicum sumatrense* and *Paspalum scrobiculatum*.

II. Timber Wood (for construction, agricultural implements, furniture, carts etc.)

Shorea robusta, *Tectona grandis*, *Pterocarpus marsupium*, *Schleichera oleosa*, *Ougeinia oogeinsis*, *Terminalia alata*, *Lagerstroemia parviflora*, *Boswellia serrata*, *Acacia catechu*, *Emblica officinalis*, *Albizia procera*, *Anogeissus latifolia*, *Grewia tiliifolia*, *Soymida febrifuga* and *Cleistanthus collinus*. These are the commonly used forest species. Several more tree species are also used as per availability. In addition, wood from several planted species like those from *Dalbergia sissoo*, *D. latifolia*, *Mangifera indica* and *Syzygium cumini* and poles from the common bamboo, *Dendrocalamus strictus* are in frequent use.

III. Medicinal Plants

It has not been possible to get conclusive details on diseases and plant parts used, mixture of different species, methods of application etc. Information on these aspects, if locally available, has been given in the text under individual species. Only a selected list of 54 spp. is presented below for reference. However, most of these are established medicinal plants and details can be found in literature.

Cissampelos pareira var. *hirsuta*, *Nymphaea pubescens*, *Abutilon indicum*, *Thespesia lampas*, *Helicteres isora*, *Azadirachta indica*, *Celastrus paniculatus*, *Aegle marmelos*, *Ziziphus oenoplia*, *Pongamia pinnata*, *Psoralea corylifolia*, *Pterocarpus marsupium*, *Uraria picta*, *Bauhinia vahlii*, *Cassia fistula*, *C. occidentalis*, *C. tora*, *Mimosa pudica*, *Terminalia arjuna*, *T. bellirica*, *T. chebula*, *Diplocyclos palmatus*, *Momordica charantia*, *Centella asiatica*, *Peucedanum nagpurens*, *Eclipta alba*, *Blepharispernum subsessile*, *Tridax procumbens*, *Embelia tseriam-cottom*, *Catharanthus roseus*, *Holarrhena antidysenterica*, *Rauvolfia serpentina*, *Gymnema sylvestre*, *Strychnos nux-vomica*, *S. potatorum*, *Argyreia strigosa*, *Cuscuta reflexa*, *Datura metel*, *Solanum xanthocarpum*, *Bacopa monnieri*, *Adhatoda vasica*,

Andrographis echioides, *A. paniculata*, *Barleria cristata*, *B. prionitis*, *Vitex negundo*, *Ocimum sanctum*, *Boerhavia diffusa*, *Achyranthes aspera*, *Girardinia zeylanica*, *Costus speciosus*, *Curculigo orchoides*, *Asparagus racemosus* and *Cyperus rotundus*.

IV. Other Economic Plants

- (a) Beverages and drinks from *Cassia occidentalis*, *Tamarindus indica* and *Madhuca longifolia* var. *latifolia*
- (b) Brooms from *Thysanolaena maxima* and *Phoenix acaulis*.
- (c) Cotton from *Bombax ceiba*, *Gossypium hirsutum*, *Calotropis gigantea* and *C. procra*.
- (d) Dyes from *Butea monosperma*, *Nyctanthes arbor-tristis*, *Mallotus philippensis*, *Lawsonia inermis*, *Woodfordia fruticosa* and *Curcuma* spp.
- (e) Fibres generally from *Bauhinia vahlii* but also from *Bauhinia purpurea*, *Abutilon indicum*, *Hibiscus cannabinus*, *Grewia serrulata*, *Triumfetta rhomboidea*, *Soymida febrifuga* and *Eulaliopsis binata*.
- (f) Fish poisons from fruit pulp of *Gardenia turgida*, *Xeromphis spinosa*, *Cleistanthus collinus* and *Casearia elliptica* and roots of *Millettia extensa*.
- (g) Gums & resins from *Sterculia urens*, *Lannea coromandelica*, *Boswellia serrata*, *Butea monosperma*, *Acacia catechu*, *A. leucophloea*, *A. nilotica* ssp. *indica*, *Anogeissus latifolia*, *Gardenia gummiifera* and *Eulophia nuda*.
- (h) Match sticks from *Bombax ceiba* and *Boswellia serrata*.
- (i) Oils (for animal feed, medicine, soaps, burning or flavouring, messaging, as also for frying and pickles) from *Shorea robusta*, *Madhuca longifolia* var. *latifolia*, *Pongamia pinnata*, *Schleichera oleosa*, *Cochlospermum religiosum*, *Buchanania lanzan*, *Azadirachta indica*, *Casearia graveolens*, *Ventilago denticulata*, *Jatropha curcas*, *Celastrus paniculatus*, *Eucalyptus* spp., *Cymbopogon martinii* and *Vetiveria zizanioides*.
- (j) Paper pulp from *Dendrocalamus strictus*.
- (k) Plates and bowls mainly from leaves of *Butea monosperma* and *Bauhinia vahlii*.
- (l) Rolling tobacco (*bidi*) for smoking. Leaves of *Diospyros melanoxylon* for industries. Tribals use leaves of *Bauhinia* spp.

- (m) Thatching & mat-making from *Phoenix acaulis*, *P. sylvestris*, *Imperata cylindrica*, *Saccharum spontaneum* and *Typha angustata*.
- (n) Washing from seeds of *Sapindus emarginatus*.
- (o) Weighing. Seeds of *Abrus precatorius* used by jewellers.

V. Crop Plants

Rice (*Oryza sativa* L.) cultivated in rainy season, is the main crop of the region. The villagers usually boil it with plenty of water till it is turned into a liquid form. This is their staple food and is called 'Pej'. Because of water scarcity usually only one crop is possible. However, irrigation facilities are being developed through tube-wells, and dams like Rudri, Maramsilli, Dudhawa, Sondur, Saroda, Pipariya Ruse, and Tandula etc., with a net-work of canals.

Besides rice (*Oryza sativa* L.) of which one of the finest variety 'Yuvaraj' is being cultivated around Nagri (in Raipur) the other common crops are bajra (*Pennisetum americanum* (L.) Leeks), bhutta (*Zea mays* L.), jowar (*Sorghum* spp.), kodo (*Paspalum scrobiculatum* L.), wheat (*Triticum aestivum* L.), maria (*Eleusine coracana* (L.) Gaertn.), chana (*Cicer arietinum* L.), matar (*Pisum sativum* L.), moongphali (*Arachis hypogaea* L.) alsi (*Linum usitatissimum* L.) rai (*Brassica nigra* (L.) Koch), sarson (*Brassica juncea* (L.) Czern. & Coss.), til (*Sesamum orientale* L.) and pulses like teori (*Lathyrus sativus* L.), arhar (*Cajanus cajan* (L.) Millsp.) and urd (*Vigna mungo* (L.) Hepper). Besides, several seasonal vegetables are also grown.

FLORISTIC ANALYSIS

The Flora of Raipur, Durg and Rajnandgaon districts deals with 1032 species in 568 genera and 127 families of flowering plants. Out of these 287 species in 136 genera and 25 families belong to Monocots and 745 species in 432 genera and 102 families belong to Dicots. The proportion of Monocots to Dicots is 1 : 2.8 and total genera to species is 1 : 1.8. Taking into account the entire Indian subcontinent, Hooker (1904) gives the proportion of Monocots to Dicots as 1 : 2.3 and genera to species as 1 : 7.

The ten dominant families in the present Flora have been listed below and a comparison has been made with the list given by Hooker (1904) for Flora of British India. Fabaceae, Caesalpinaceae and Mimosa-ceae though treated separately in the present Flora have been combined below for the sake of comparison only.

TABLE : LARGEST FAMILIES

Flora of Raipur, Durg
and Rajnandgaon

1. Leguminosae (129 spp.)
2. Poaceae (122 spp.)
3. Cyperaceae (67 spp.)
4. Asteraceae (58 spp.)
5. Euphorbiaceae (43 spp.)
6. Acanthaceae (43 spp.)
7. Convolvulaceae (27 spp.)
8. Malvaceae (25 spp.)
9. Scrophulariaceae (24 spp.)
10. Rubiaceae (23 spp.)

Flora of British India

1. Orchidaceae
2. Leguminosae
3. Poaceae
4. Rubiaceae
5. Euphorbiaceae
6. Acanthaceae
7. Asteraceae
8. Cyperaceae
9. Lamiaceae
10. Urticaceae

The Flora contains about 140 tree spp., 71 shrubby spp., 75 climbing or sarmentose spp., and the remaining, almost equally divided, annual or perennial herbs or undershrubs. As per the list given before there are 83 aquatic spp. Epiphytes are poor, being represented only by *Dendrophthoe falcata*, *Scurrula parasitica*, *Viscum nepalense*, *V. orientale*, *Vanda tessellata* and *V. testacea*. The insectivorous plants are two spp. of *Drosera* and eight spp. of *Utricularia*.

RARE AND THREATENED SPECIES

Recent spread in developmental activities, urbanisation, and additional land acquirements for farming and grazing etc. are resulting in severe damage to natural habitats, thus threatening the very survival of several species. The necessity of conserving these and others that are being over-exploited for their miscellaneous utilities is now well recognised. Various Organisations like International Union for Conservation of Nature and Natural Resources (IUCN), National Committee on Environmental planning and Coordination (NCEPC) and National Committee on Man and Biosphere (MAB) are interested in listing of species threatened with extinction and measures for their conservation. Recently, Jain & Sastry (Howrah, 1983) have published 'Materials for a catalogue of threatened plants of India.' This has provided an essential basis for critical appraisal, additions and deletions, for finalising an account of such species. It may be emphasised that in a country like India where the flora is insufficiently known, the number of Botanic Gardens are limited, and the masses are not yet awakened to the needs of conservation, cordoning off of representative areas with rare and threatened species appears to be the most effective and practical measure.

Analysing the flora of Raipur, Durg and Rajnandgaon districts in this background, after consulting major Indian Herbaria and publications, it is found that the following species endemic to Indian sub-continent have not been collected/rarely collected from any part of the country during the last thirty years.

Crotalaria notonii, *Acacia donaldi*, *Rotala fysonii*, *Rauvolfia serpentina*, *Alstonia venenata*, *Tylophora macrantha*, *Utricularia baouleenis*, *Vitex peduncularis*, *Polypleurum stylosum*, *Eulophia explanata*, *E. herbacea*, *Theriophonum minutum*, *Amorphophallus sylvaticus* and *Oropetium villosulum*.

Some of the other rare species only for Madhya Pradesh flora are : *Leea robusta*, *Myriophyllum oliganthum*, *Coffea benghalensis*, *Blumea hieraciifolia*, *Blepharispermum subsessile*, *Cuscuta campestris*, *C. santapau*, *Cryptolepis elegans*, *Ceropegia hirsuta*, *C. tuberosa*, *Rhinacanthus nasutus*, *Peperomia pellucida*, *Elatostema cuneatum*, *Eulophia flava*, *E. graminea* and *Potamogeton mucronatus*.

STYLE OF PRESENTATION

The Flora starts with a key to the families following Bentham & Hooker (1862-1883) system of classification, with some modifications as per our recent knowledge. Under each family is given a key to genera, and under each genus a key to species. The keys to families, genera and species are artificial, formed by the senior author (DMV). In formation of keys preference has been given to use of macroscopic characters and to a combination of vegetative, floral and fruiting characters particularly while dealing with spp. where these phases are known to be widely separated. Genera and species under each family are arranged alphabetically. For each species correct botanical name and basionym, if any, have consistently been given. If the species has been described under some other name in major Indian Floras, such names have also been given under synonymy. The literature references have been usually confined to original citation, though it may be mentioned that numerous publications, including Floras from India and adjacent countries, monographs and scattered notes in various journals have been consulted in writing the present Flora. Local names, whenever known, are given at the end of citations. The species have been briefly described, generally excluding the characters given in the keys. Data on habitat, altitude, flowering (*fl.*) and fruiting (*fr.*) time are all based on our own collections unless the species has been included on the basis of some other publication. Under each district, collection localities have been given with reference to better known places given in the map. Collection

numbers are not given since, unless mentioned otherwise, all the specimens are deposited in the Herbarium of the Central Circle, Botanical Survey of India, Allahabad (BSA).

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TAXONOMIC ACCOUNT

KEY TO FAMILIES

(D.M. VERMA)

- 1a. Leaves usually reticulately-veined. Flowers usually 4- 5 -
merous. Cotyledons usually 2. Vascular bundles of the stem
usually arranged in a circle.
- 2a. Perianth present, two - several - seriate.
- 3a. Petals all free or only some united.
- 4a. Ovary fully superior, or at least one whorl of
the perianth hypogynous, or stamens hypogynous
or inserted on the top of a hypogynous disc in
which the ovary may be immersed.
- 5a. Stamens more than twice as many as the
petals.
- 6a. Aquatic plants with rotundate peltate
leaves. Pistils many, embedded in fleshy
turbinate receptacle ... NYMPHAEACEAE 5
- 6b. Plants not as above.
- 7a. Stamens all united by filaments.
- 8a. Trees. {Leaves digitately
compound. Styles as many as
the carpels. Fruit a woody
capsule ... BOMBACACEAE 19
- 8b. Plants not as above ... MALVACEAE 18
- 7b. Stamens all free, or in five phalanges
of three stamens each.
- 9a. Stamens in five phalanges of
three stamens each ... STERCULIACEAE 20
- 9b. Stamens all free.
- 10a. Pistils more than one.
- 11a. Sepals deciduous.
Perianth 3-seriate, 3-
merous ... ANNONACEAE 3

- 11b. Sepals persistent. Perianth 2-seriate, 5-merous ... DILLENIACEAE 2
- 10b. Pistil one.
- 12a. Stamens arising from hypanthium (perigynous) ... LYTHRACEAE 50
- 12b. Stamens arising from receptacle (hypogynous.)
- 13a. Ovary stipitate, on a gynophore ... CAPPARACEAE 8
- 13b. Ovary sessile.
- 14a. Flowers unisexual ... EUPHORBIACEAE 98
- 14b. Flowers bisexual.
- 15a. Leaves palmately - nerved.
- 16a. Flowers small, axillary, up to 1.5 cm across; placentation axile ... TILIACEAE 21
- 16b. Flowers large, terminal, more than 7.0 cm across; placentation parietal. ... COCHLOSPERMACEAE 10
- 15b. Leaves pinnately-nerved.
- 17a. Herbs. Sepals 2 ... PAPAVERACEAE 6
- 17b. Trees or shrubs. Sepale 5.
- 18a. Leaves 3-foliolate, with pellucid, aromatic glands ... RUTACEAE 27
- 18b. Leaves simple, without pellucid, aromatic glands.
- 19a. Flowers ca 1 cm across, in panicles; anthers dehiscing by longitudinal slits. Fruits winged ... DTPTEROCARPACEAE 17
- 19b. Flowers ca 3 cm across, in sub-corymbose racemes; anthers dehiscing by pores. Fruits not winged ... OCHNACEAE 29

5b. Stamens fewer, at the most twice as many as the petals

20a. Leaves scale-like ... TAMARICACEAE 15

20b. Leaves well developed, expanded.

21a. Leaves simple.

22a. Ovary one-celled.

23a. Climbers. Flowers 3-merous, unisexual ;
ovule solitary, marginal ... MENISPER-
MACEAE 4

23b. Plants not as above.

24a. Placentation free-central.

25a. Sepals 2, jointed, the free part
deciduous. Capsule circum-
sciss ... PORTULACA-
CEAE 14

25b. Sepals and capsules not as
above.

26a. Stamens alternate with
the petals ... CARYOPHYL-
LACEAE 13

26b. Stamens opposite the
petals.

27a. Shrubs. Leaves
alternate, gland-
dotted ... MYRSINACEAE 66

27b. Herbs. Leaves
opposite, not
gland-dotted ... PRIMULACEAE 65

24b. Placentation parietal or marginal.

28a. Ovules marginal, on one
ventral placenta.

29a. Leaves twice-pinnate,
rarely phyllodic. Cor-
olla actinomorphic ;
petals valvate ; sta-
mens four-many. Seed
with a U-shaped
lateral line ... MIMOSACEAE 42

- 29b. Leaves simple, digitate or once - twice - pinnate. Corolla zygomorphic ; petals imbricate, rarely absent ; stamens ten (—five). Seed usually without a lateral line, rarely with a closed line.
- 30a. Adaxial petal interior (ascending imbrication) or petals absent ... CAESALPINIACEAE 41
- 30b. Adaxial petal exterior (descending imbrication) ... FABACEAE 40
- 28b. Ovules parietal, on two or more placentas
- 31a. Plants insectivorous, covered with glandular hairs DROSERACEAE 44
- 31b. Plants neither insectivorous, nor covered with glandular hairs.
- 32a. Ovary stipitate, on elongated gynophore ... CAPPARACEAE 8
- 32b. Ovary sessile or subsessile.
- 33a. Slender herbs. Anther connectives produced beyond cells ... VIOLACEAE 9
- 33b. Shrubs. Anther connectives not produced. ... FLACOURTIACEAE 11
- 22b. Ovary two - or more celled.
- 34a. Stamens tetradynamous, 4 long and 2 short ... BRASSICACEAE 7
- 34b. Stamens not tetradynamous.

35a. Flowers irregular.

- 36a. Flowers large, more than 1.5 cm long ; sepals 3,
posterior petaloid, usually spurred ; stamens 5 ;
ovary 5 - celled ... BALSAMINACEAE 26

- 36b. Flowers small, less than 1.0 cm long ;
sepals 5, inner 2 petaloid ; stamens 8 ; ovary
2-celled ... POLYGALACEAE 12

35b. Flowers regular.

37a. Leaves opposite.

38a. Slender herbs.

- 39a. Style 1 ; ovules free-central ... LYTHRACEAE 50

- 39b. Styles 2 - 5 ; ovules axile ... ELATINACEAE 16

38b. Woody shrubs or climbers.

- 40a. Stamens 2 ... OLEACEAE 69

- 40b. Stamens 10 ... MALPIGHIACEAE 23

37b. Leaves alternate.

41a. Flowers all unisexual.

- 42a. Pistil 1 ... EUPHORBIACEAE 98

- 42b. Pistils 3 - 6 ... MENISPERMACRAE 4

41b. Flowers all bisexual or intermixed with unisexuals.

- 43a. Plants climbing or creeping,
with tendrils ... VITACEAE 35

43b. Plants of various habits, without tendrils.

- 44a. Leaves with pellucid,
aromatic glands. ... RUTACEAE 27

44b. Leaves without pellucid, aromatic glands.

- 45a. Petals 3, of which
2 are deeply bifid;
fertile stamens 3,
opposite the petals,
staminodes 6, bifid ... OLACACEAE 32

45b. Flowers not as above.

- 46a. Sepals and petals 5, imbricate or contorted ; stamens alternating with staminodes ; filaments connate at the base ; ovary 3 - 5 - celled but spuriously 6 - 10 - celled due to secondary placenta ... LINACEAE 22
- 46b. Plants not as above.
- 47a. Stamens opposite the petals ... RHAMNACEAE 34
- 47b. Stamens alternating with the petals.
- 48a. Venation pinnate ... CELASTRACEAE 33
- 48b. Venation palmate.
- 49a. Stamens united below ... STERCULIACEAE 20
- 49b. Stamens free ... TILIACEAE 21
- 21b. Leaves compound.
- 50a. Ovary one-celled.
- 51a. Styles 3 - 4 ; ovule one, basal ... ANACARDIACEAE 38
- 51b. Style 1 ; ovules usually two or more.
- 52a. Trees with 2 - 3 - pinnate leaves. Stamens 5 ; staminodes 5 - 7. Fruit a ribbed cylindrical 3 - valved capsule ... MORINGACEAE 39
- 52b. Plants not as above.
- 53a. Leaves twice - pinnate, rarely phyllodic. Corolla actinomorphic ; petals valvate ; stamens four - many. Seed with a U - shaped lateral line. ... MIMOSACEAE 42
- 53b. Leaves simple, digitate or once - twice - pinnate. Corolla zygomorphic ; petals imbricate, rarely absent ; stamens ten (- five). Seed usually without a lateral line, rarely with a closed line.
- 54a. Adaxial petal interior (ascending imbrication) or petals absent ... CAESALPINIACEAE 41
- 54b. Adaxial petal exterior (descending imbrication) ... FABACEAE 40
- 50b. Ovary two - or more - celled.
- 55a. Plants herbaceous.
- 56a. Leaves biternately compound ... SAPINDACEAE 37
- 56b. Leaves ternately or pinnately compound.

- 57a. Leaves opposite, pinnately compound ... ZYGOPHYLLACEAE 24
- 57b. Leaves alternate, ternately or pinnately compound ... OXALIDACEAE 55
- 55b. Plants woody.
- 58a. Climbers or creepers, with tendrils ... VITACEAE 35
- 58b. Trees or shrubs, without tendrils.
- 59a. Leaves with pellucid, aromatic glands ... RUTACEAE 27
- 59b. Leaves without pellucid, aromatic glands.
- 60a. Flowers regular, at least some unisexual ; stamens appendaged by scales at the base ... SIMAROUBACEAE 28
- 60b. Flowers and stamens not as above.
- 61a. Flowers often irregular ; disc extrastaminal ... SAPINDACEAE 37
- 61b. Flowers regular ; disc intrastaminal.
- 62a. Stamens twice as many as the petals ; filaments free, or connate at the base only ... BURSERACEAE 30
- 62b. Stamens either less than twice as many as the petals, or the filaments united into a tube ... MELIACEAE 31
- 4b. Ovary fully inferior, or perianth and stamens perigynous.
- 63a. Stamens more than twice as many as the petals.
- 64a. Aquatic plants ... NYMPHAEACEAE 5
- 64b. Terrestrial plants.
- 65a. Flowers unisexual ; styles 2 - 4 ... BEGONIACEAE 54
- 65b. Flowers bisexual ; style 1.
- 66a. Plants spiny, succulent, almost leafless. Petals many ... CACTACEAE 55
- 66b. Plants unarmed, woody, leafy
Petals four - ten.

- 67a. Leaves opposite, gland - dotted ... MYRTACEAE 47
- 67b. Leaves alternate, not gland - dotted ... LECYTHIDACEAE 48
- 63b. Stamens twice as many as the petals, or less.
- 68a. Aquatic plants. Leaves upper simple, linear, lower pectinately dissected. Flowers in axillary fascicles; stigmas 2 - 4, plumose, sessile ... HALORAGACEAE 45
- 68b. Plants not as above.
- 69a. Aquatic plants. Floating leaves rhomboid. Fruits 2 - spined ... TRAPACEAE 52
- 69b. Plants not as above.
- 70a. Herbs. Inflorescence umbellate. Styles 2. Fruit of two mericarps ... APIACEAE 58
- 70b. Plants not as above.
- 71a. Fruits winged ... COMBRETACEAE 46
- 71b. Fruits not winged.
- 72a. Ovary one - several - celled; ovules on axile, parietal or central placenta.
- 73a. Leaves basal or opposite, palmately nerved. Stamens geniculate; anthers opening by pores ... MELASTOMATACEAE 49
- 73b. Leaves cauline, alternate, pinnately nerved. Stamens not geniculate; anthers opening by slits ... ONAGRACEAE 51
- 72b. Ovary one - two - celled; ovules pendulous.
- 74a. Slender herbs. Ovules many in each cell ... VAHLIACEAE 43
- 74b. Trees or shrubs. Ovule solitary in each cell ... ALANGIACEAE 59

3b. Petals all united, at least at the base.

75a. Stamens more than the corolla lobes.

76a. Ovary inferior ... CACTACEAE 55

76b. Ovary superior.

77a. Leaves usually compound. Ovary of one carpel with marginal placentation. Fruit a legume, sometimes indehiscent or lomentoid.

78a. Leaves twice-pinnate, rarely phyllodic. Corolla actinomorphic, petals valvate ... MIMOSACEAE 42

78b. Leaves simple, digitate or once-pinnate. Corolla zygomorphic, petals imbricate ... FABACEAE 40

77b. Leaves always simple. Ovary of two or more carpels with axillary placentation. Fruit a berry.

79a. Flowers usually unisexual corolla urceolate, 3-5-lobed EBENACEAE 68

79b. Flowers always bisexual; corolla rotate or campanulate, usually 8-lobed ... SAPOTACEAE 67

75b. Stamens as many as the corolla lobes, or less.

80a. Ovary partly or wholly inferior.

81a. Creepers or climbers with tendrils ... CUCURBITACEAE 53

81b. Plants of various habits, without tendrils.

82a. Anthers united around the style (syngenesious).

83a. Flowers in involucrate heads; ovary one-celled ... ASTERACEAE 61

83b. Flowers not in heads; ovary two-or more-celled.

84a. Stamens 2 ... STYLIDACEAE 62

84b. Stamens 4 - 6 ... CAMPANULACEAE 63

82b. Anthers free.

85a. Leaves opposite or apparently whorled due to foliaceous stipules ... RUBIACEAE 60

85b. Leaves alternate ... CAMPANULACEAE 63

80b. Ovary superior.

86a. Stamens opposite the corolla lobes.

87a. Ovary one - celled ; placentation free - central.

88a. Flowers long - tubular ; calyx with stalked glands ; styles 5 ... PLUMBAGINACEAE 64

88b. Flowers rotate ; calyx not glandular ; style 1.

89a. Shrubs. Leaves alternate. Perianth gland - dotted. Fruits fleshy ... MYRSINACEAE 66

89b. Herbs. Leaves usually opposite. Perianth not gland - dotted. Fruits circumscissile ... PRIMULACEAE 65

87b. Ovary two - many - celled ; placentation axile.

90a. Leaves compound. Stamens united by filaments ... LEEACEAE 36

90b. Leaves simple. Stamens free.

91a. Flowers bisexual ; corolla rotate, usually 8 - lobed ; stamens epipetalous ... SAPOTACEAE 67

91b. Flowers unisexual ; corolla urceolate, 3 - 5 - lobed ; stamens free from the corolla lobes ... EBENACEAE 68

86b. Stamens alternate with the corolla lobes.

92a. Corolla irregular ; stamens 2 or 4.

93a. Inflorescence usually with conspicuous bracts. Fruits elastically dehiscent ; seeds often on upcurved processes ... ACANTHACEAE 84

93b. Plants not as above.

94a. Ovules and seeds few.

95a. Ovary 4-lobed ; style arising from between the lobes of the ovary ... LAMIACEAE 86

95b. Ovary not lobed ; style terminal

96a. Plants viscid hairy ... PEDALIACEAE 83

96b. Plants not viscid hairy ... VERBENACEAE 85

94b. Ovules and seeds many.

97a. Leaves compound. Seeds winged ... BIGNONIACEAE 82

97b. Leaves simple or dissected. Seeds not winged.

98a. Plants of aquatic or wet places, typically with small insectivorous bladders.
Placentation free - central ... LENTIBULARIACEAE 80

98b. Plants of various habitats, never insectivorous. Placentation parietal or axile. ...

99a. Plants root - parasites. Leaves scale - like, never green ... OROBANCHACEAE 79

99b. Plants free - living. Leaves green, expanded.

100a. Placentation axillary, solid and unbranched ... SCROPHULARIACEAE 78

100b. Placentation parietal, sometimes intruded and meeting below middle of locule but branched or winged.

101a. Perianth 4 - 5 - merous ; corolla contorted ... GENTIANACEAE 73

101b. Perianth 5 - merous ; corolla imbricate or valvate ... GESNERIACEAE 81

92b. Corolla regular ; stamens usually 5

102a. Leaves alternate.

103a. Flowers in scorpioid cymes or the calyx with appendaged sinuses ; style terminal or gynobasic.

104a. Style terminal. Fruit a capsule, usually many seeded ... HYDROPHYLLACEAE 74

104b. Style usually gynobasic. Fruit of 4 nutlets, rarely a drupe ... BORAGINACEAE 75

103b. Flowers neither in scorpioid cymes (though often in dichasia) nor the calyx appendaged ; style always terminal.

105a. Placentation parietal ... GENTIANACEAE 73

105b. Placentation axile.

106a. Ovules numerous in each cell ... SOLANACEAE 77

106b. Ovules one - two in each cell.

107a. Sepals free ; corolla lobes contorted and infolded. Fruit a capsule ... CONVULVULACEAE 76

107b. Sepals connate ; corolla lobes imbricate. Fruit dry with 4 nutlets or drupaceous with 1 - 4 - celled pyrene BORAGINACEAE 75

102b. Leaves opposite.

108a. Stamens two ... OLEACEAE 69

108b. Stamens four or more.

109a. Carpels united only at the stigmatic disc ; pollen in pollinia ... ASCLEPIADACEAE 71

109b. Carpels and pollen not as above.

110a. Plants with milky sap. Corolla lobes contorted in bud. Fruit often of two follicles and seeds with silky appendage APOCYNACEAE 70

- 110b. Plants with clear sap. Corolla lobes contorted or not. Fruits never follicular.
- 111a. Hispid herbs. Anthers connate into a cone, connectives produced and twisted around each other. Fruit of 4 nutlets ... **BORAGINACEAE 75**
- 111b. Plants not as above.
- 112a. Flowers zygomorphic ... **VERBENACEAE 85**
- 112b. Flowers actionomorphic.
- 113a. Placentation axile ... **LOGANIACEAE 72**
- 113b. Placentation parietal ... **GENTIANACEAE 73**
- 2b. Perianth absent, or if present then uni-seriate.
- 114a. Plants submerged.
- 115a. Plants thalloid, attached to rocks in streams ... **PODOSTEMACEAE 92**
- 115b. Plants leafy, free floating ... **CERATOPHYLLACEAE 102**
- 114b. Plants not submerged.
- 116a. Perianth absent.
- 117a. Flowers in cyathia ; a naked female flower surrounded by several male flowers each of a single jointed stamen - the whole cluster subtended by often sepaloid or petaloid involucral bracts and forming a bisexual pseudoflower ... **EUPHORBIACEAE 98**
- 117b. Flowers in spikes **PIPERACEAE 94**
- 116b. Perianth present.
- 118a. Ovary inferior or half - inferior.
- 119a. Plants stem - parasites **LORANTHACEAE 96**
- 119b. Plants free living or root - parasites (in *Santalaceae*).
- 120a. Plants herbaceous, erect or creeping.
- 121a. Leaves alternate. Flower showy, ca 1 cm or more long, unisexual ... **BEGONIACEAE 54**

- 121b. Leaves opposite. Flowers minute, 2 - 5 mm long, bisexual.
- 122a. Leaves subsessile. Perianth calycine LYTHRACEAE 50
- 122b. Leaves petiolate. Perianth corolline ... NYCTAGINACEAE 87
- 120b. Plants woody, usually trees or shrubs.
- 123a. Perianth 2 - 3 - lobed ; ovary 6 - celled, ovules many ... ARISTOLOCHIACEAE 93
- 123b. Perianth 4 - 5 - lobed ; ovary 1 celled, ovules 1 - 3.
- 124a. Stamens 4 - 5, as many as the calyx lobes ... SANTALACEAE 97
- 124b. Stamens 8 10, twice as many as the calyx lobes ... COMBRETACEAE 46
- 118b. Ovary superior.
- 125a. Anthers opening by 2 or 4 upcurled lids ... LAURACEAE 95
- 125b. Anthers not opening as above.
- 126a. Pistils two or more (carpels free).
- 127a. Trees ... STERCULIACEAE 20
- 127b. Herbs or climbing bushes RANUNCULACEAE 1
- 126b. Pistil solitary (carpels solitary or united).
- 128a. Ovary 2 - 5 - celled.
- 129a. Ovules many in each cell ... MOLLUGINACEAE 57
- 129b. Ovules one three in each cell.
- 130a. Ovules axile ... EUPHORBIACEAE 98
- 130b. Ovules all or mostly basal.
- 131a. Slender herbs. Capsules circumscissile ... AIZOACEAE 56
- 131b. Trees, shrubs or climbers. Fruit not circumscissile.

- 132a. Plants armed. Leaves simple, 3 - nerved ... RHAMNACEAE 34
- 132b. Plants unarmed. Leaves compound or if simple then not 3 - nerved ... SAPINDACEAE 37
- 128b. Ovary 1 - celled.
- 133a. Plants twining. Female flower with a single petal ; male flower with a corolline cupule ... MENISPERMACEAE 4
- 133b. Plants not as above.
- 134a. Herbs with ochreate stipules ... POLYGONACEAE 91
- 134b. Plants not as above.
- 135a. Plants herbaceous.
- 136a. Perianth and bracts scarious, stamens often connote below ... AMARANTHACEAE 88
- 136b. Perianth and bracts not scarious ; stamens free.
- 137a. Leaves 3 - nerved from the base. Flowers unisexual ; style unbranched ... URTICACEAE 99
- 137b. Leaves pinnately nerved. Flowers bisexual ; style branched.
- 138a. Twining herbs. Bracteoles adnate to the perianth ; anthers versatile ... BASELLACEAE 90
- 138b. Erect herbs. Bracteoles free from the perianth ; anthers erect or incurved ... CHENOPODIACEAE 89
- 135b. Plants woody.
- 139a. Stipules absent ... FLACOURTIACEAE 11
- 139b. Stipules present.
- 140a. Style branched.
- 141a. Anthers inflexed and reversed in bud ; ovule 1, apical ... MORACEAE 101