FLORA OF
RAIPUR, DURG & RAJNANDGAON

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

BOTANICAL SURVEY
OF INDIA
FLORA OF
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D. M. VERMA
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FOREWORD

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. Nayyar
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° 38’ and 82° 70’ E longitude and 19° 79’ and 22° 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.
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

D. M. Verma
P. C. Pant
M. I. Hanfi
Sal forests (Nagri).
Sal mixed forests (Bar-nawapara).
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°38' and 82°70' E longitudes and 19°79' and 22°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 approachcs, 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
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.

GEOLGY 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 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
Archaean System consists of gneissic rocks (frequently granite), crystalline metamorphosed sediments and schists. The rocks of D'harwar 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 out crops 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
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)

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<td>Mean max.</td>
<td>27.6</td>
<td>30.0</td>
<td>35.1</td>
<td>39.3</td>
<td>41.8</td>
<td>36.6</td>
<td>30.4</td>
<td>30.9</td>
<td>31.2</td>
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<td>28.7</td>
<td>26.7</td>
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<tr>
<td>Mean min.</td>
<td>13.2</td>
<td>14.5</td>
<td>20.0</td>
<td>24.6</td>
<td>27.8</td>
<td>26.2</td>
<td>23.9</td>
<td>23.6</td>
<td>23.9</td>
<td>20.9</td>
<td>15.9</td>
<td>12.6</td>
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<td>MEAN</td>
<td>20.4</td>
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Table 2—RAINFALL (mm)

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<td>Balod</td>
<td>8</td>
<td>16</td>
<td>15</td>
<td>14</td>
<td>85</td>
<td>316</td>
<td>365</td>
<td>454</td>
<td>390</td>
<td>184</td>
<td>11</td>
<td>5</td>
<td>1863</td>
</tr>
<tr>
<td>Dhamtari</td>
<td>8</td>
<td>18</td>
<td>13</td>
<td>23</td>
<td>20</td>
<td>231</td>
<td>385</td>
<td>355</td>
<td>209</td>
<td>57</td>
<td>13</td>
<td>4</td>
<td>1336</td>
</tr>
<tr>
<td>Raipur</td>
<td>10</td>
<td>22</td>
<td>18</td>
<td>16</td>
<td>22</td>
<td>227</td>
<td>375</td>
<td>358</td>
<td>192</td>
<td>54</td>
<td>13</td>
<td>5</td>
<td>1312</td>
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</tbody>
</table>
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, WRSL 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 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, Buddhun, Durg, Kamiteli, 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., *Cesalpinia bonduc*, *Ipomoea carnea* and *Mimosa hispida*, with several climbers like *Ziziphus oenoplia*, *Celastrus paniculatus*, *Cryptolepis buchananii*, *Ampelocissus* spp., *Mukia maderaspata*, *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, Soymida 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 tilifolia and Cassia fistula, and shrubs like Breynia vitisidaea, Embelia tsjeriam cottam, Chloroxylon swietenia, Holarrhena antidysenterica, Casearia graveolens, Helicteris isora, Semecarpus anacardium, Ochna obtusata, Indigofera cassioideae, 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 vahlili, 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, Perileptea edgeworthiana, Nelsonia canescens, Phoenix aculis, Chlorophytm tuberosum, Globba racemosa, G. bulbifera, Curcumia 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, Leucus, 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 spp., Ochna obtusata and Bauhinia vahlili. 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, Emblica officinalis, Helicteres isora and species of Ziziphus, Acacia, Gardenia and Xeromphis. The common climbers are Celastrus paniculatus, Ventilago denticulata, Cocculus hirsutus, Cissampelos pareira, Rynchosia minima, Atlyosia scarabaeoides, Mukia maderaspatana, Diplocycylus palma-
(x)

tus, Ampelocissus latifolius, A. tomentosa, Ziziphus oenopia, Pergularia daemia and Cryptoplepis 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 Legerstroemia parviflora, Butea monosperma, Diospyros melanoxylon, Albizia spp., Anogeissus latifolia, Terminalia spp., Aegle marmelos, Acacia catechu A. torta, A. pennata, Cordia obliqua, Emblica officinalis, Madhuca longifolia var. latifolia, Bauhinia spp., Nyctanthes arbor-tristis, Ziziphus mauritiana, Z. xylapyrus, Helicteres isora, Lannea coromandelica and Boswellia serrata. The shrubby layer is usually formed of Holarrhena antidysenterica, Grewia hirsuta, Mimosa himalayana, Flacourtia indica, Capparis zeylanica, Kirganelia reticulata, Securinega virosa, Casearia elliptica, Woodfordia fruticosa, Clerodendrum serratum and Solanum anguivi. The common climbers are Ziziphus oenopia, 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, Cryptoplepis buchananii and Pergularia daemia become more common in open forest pockets or its margins. Hypsilop saevaolens, Anisomeles indica, Alysicarpus spp., Tephrosia purpurea, Plecanthus 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 heynanum 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 Polycarpacea 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 borderline 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, Spirodea polyrhiza, Pithia striatia, Trapa natans var. bispinosa and Eichhornia crassipes.

II. Suspended submerged hydrophytes:

Ceratophyllum demersum, Utricularia aurea and U. exoleta.

III. Anchored submerged hydrophytes:


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 minuta, Nelumbo nucifera, Nymphaea pubescens, N. nouchali, N. rubra, Nymphoides hydrophylla, N. indica, Ottelia alismoides Monochoria
vaginalis, Sagittaria guayanensis ssp. lappula, Caldesia parnassifolia, Limnophyton obtusifolium, Tenagodcharis latifolia, Aponogeton natans and Potamogeton nodosus.

VI. Emergent amphibious hydophytes:


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:


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. * incumbens* var. *paniculatus*, *A. spinosus*, *A. tricolor*, *Basella alba*, *Amorphophallus sylvestris* 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. *hispinosa*, *Pithecellobium
(xiv)

dulce, Tamarindus indica, Terminalia bellirica. Momordica
diacoé, 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,
Eicusine coracana, Gyrax rufipogon, Punicum summirese and
Paspalum scrobiculatum.

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

Shorea robusta, Tectona grandis, Pterocarpus marsupium, Schleichera
oleosa, Ougeinia oogerinsis, Terminalia alata, Lagerstroemia parviflora,
Boswella serrata, Acacia catechu, Emblica officinalis, Albizia procera,
Anogeissus latifolia, Grewia iiiifolia, Soymdia febrifuga and Cleistan-
thus 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, Augie 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 nagpureense, Eclipta alba, Blepharispermum subaes-
sile, Tridax procumbens, Embelia tseriam-cottam, Catharanthus roseus,
Holarrhena antidysenterica, Rauwolfia serpentina, Gymnema sylvestre,
Strychnos nux-vomica, S. potatorum, Argyreia strigosa, Cuscuta reflexa,
Datura metel, Solanum xanthocarpum, Bacopa monnieri, Adhatoda vasica,

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. proccra.

(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 gummifera 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, Schleicheria 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 'Poj'. 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 'Yumraj' 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 hypogaeae L.) als (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, Caesalpiniaceae and Mimoseae though treated separately in the present Flora have been combined below for the sake of comparison only.
TABLE : LARGEST FAMILIES

<table>
<thead>
<tr>
<th>Flora of Raipur, Durg and Rajnandgaon</th>
<th>Flora of British India</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Leguminosae (129 spp.)</td>
<td>1. Orchidaceae</td>
</tr>
<tr>
<td>2. Poaceae (122 spp.)</td>
<td>2. Leguminosae</td>
</tr>
<tr>
<td>3. Cyperaceae (67 spp.)</td>
<td>3. Poaceae</td>
</tr>
<tr>
<td>4. Asteraceae (58 spp.)</td>
<td>4. Rubiaceae</td>
</tr>
<tr>
<td>5. Euphorbiaceae (43 spp.)</td>
<td>5. Euphorbiaceae</td>
</tr>
<tr>
<td>6. Acanthaceae (43 spp.)</td>
<td>6. Acanthaceae</td>
</tr>
<tr>
<td>7. Convolvulaceae (27 spp.)</td>
<td>7. Asteraceae</td>
</tr>
<tr>
<td>10. Rubiaceae (23 spp.)</td>
<td>10. Urticaceae</td>
</tr>
</tbody>
</table>

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, Scruella 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 acquiresments 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 plant of India.' This has provided an essential basis for critical appraisal, additions and delections, 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 baouleensis, Vitex peduncularis, Polypleurum stylosum, Euplophia 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 hieracifolia, Blepharispermum subsessile, Cuscuta campestris, C. santapauii, Cryptolepis elegans, Ceropogia hirsuta, C. tuberosa, Rhinacanthus nasutus, Peperomia pellucida, Elatostema cuneatum, Euplophia 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)


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

... NYMPHACEAE 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 ... Dileniaceae 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; placenta
tion axile ... Tiliaceae 21
16b. Flowers large, terminal, more than 7.0 cm across; placenta
tion parietal. ... Cochlosper-maceae 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 ... Dpi-teroca-
paceae 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 ... **Menispermaceae 4**

23b. Plants not as above.


25a. Sepals 2, jointed, the free part deciduous. Capsule circum-scss ... **Portulacaceae 14**

25b. Sepals and capsules not as above.

26a. Stamens alternate with the petals ... **Caryophyllaceae 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. Corolla actinomorphic; petals valvate; stamens 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.

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<tr>
<td>30a.</td>
<td>Adaxial petal interior (ascending imbrication) or petals absent</td>
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<tr>
<td>30b.</td>
<td>Adaxial petal exterior (descending imbrication)</td>
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28b. Ovules parietal, on two or more placentas

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<thead>
<tr>
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<tbody>
<tr>
<td>31a.</td>
<td>Plants insectivorous, covered with glandular hairs</td>
</tr>
<tr>
<td>31b.</td>
<td>Plants neither insectivorous, nor covered with glandular hairs.</td>
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<tr>
<td>32a.</td>
<td>Ovary stipitate, on elongated gynophore</td>
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<tr>
<td>32b.</td>
<td>Ovary sessile or subsessile.</td>
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</tbody>
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<tbody>
<tr>
<td>33a.</td>
<td>Slender herbs. Anther connectives produced beyond cells</td>
</tr>
<tr>
<td>33b.</td>
<td>Shrubs. Anther connectives not produced.</td>
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</tbody>
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22b. Ovary two - or more celled.

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<tbody>
<tr>
<td>34a.</td>
<td>Stamens tetradynamous, 4 long and 2 short</td>
</tr>
<tr>
<td>34b.</td>
<td>Stamens not tetradynamous.</td>
</tr>
</tbody>
</table>
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  ...  **MENISPERMACAEAE 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 phyllocladic. 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

... Caesalpinioideae 41

54b. Adaxial petal exterior (descending imbrication)

... Fabaceae 40

50b. Ovary two - or more - celled.

55a. Plants herbaceous.

56a. Leaves biterrnately 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 ... NYMPHARACEAE 5
64b. Terrestrial plants.

65a. Flowers unisexual; styles 2 - 4 ... BEOONIACEAE 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 ...  
67b. Leaves alternate, not gland - dotted ...  
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 ...  
68b. Plants not as above.

69a. Aquatic plants. Floating leaves rhomboid. Fruits 2 -spined ...  
69b. Plants not as above.

70a. Herbs. Inflorescence umbellate. Styles 2. Fruit of two mericarps ...  
70b. Plants not as above.

71a. Fruits winged ...  
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 ...  
73b. Leaves cauline, alternate, pinnately nerved. Stamens not geniculate; anthers opening by slits ...  

72b. Ovary one - two -celled; ovules pendulous.

74a. Slender herbs. Ovules many in each cell ...  
74b. Trees or shrubs. Ovule solitary in each cell ...
3b. Petals all united, at least at the base.

75a. Stamens more than the corolla lobes.

76a. Ovary inferior

76b. Ovary superior.

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

78a. Leaves twice-pinnate, rarely phyllodic. Corolla actinomor-
phic, petals valvate

78b. Leaves simple, digitate or once-pinnate. Corolla zygomor-
phic, petals imbricate

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

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

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

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

80a. Ovary partly or wholly inferior.

81a. Creepers or climbers with tendrils

81b. Plants of various habits, without tendrils.

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

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

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

84a. Stamens 2

84b. Stamens 4 - 6
82b. Anthers free.

85a. Leaves opposite or apparently whorled due to foliaceous stipules ... \textit{Rubiaceae 60}

85b. Leaves alternate ... \textit{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 ... \textit{Plumbaginaceae 64}

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

89a. Shrubs. Leaves alternate. Perianth gland - dotted. Fruits fleshy ... \textit{Myrsinaceae 66}

89b. Herbs. Leaves usually opposite. Perianth not gland - dotted. Fruits circumscissile ... \textit{Primulaceae 65}

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

90a. Leaves compound. Stamens united by filaments ... \textit{Leeaceae 36}

90b. Leaves simple. Stamens free.

91a. Flowers bisexual; corolla rotate, usually 8 - lobed; stamens epipetalous ... \textit{Sapotaceae 67}

91b. Flowers unisexual; corolla urceolate, 3 - 5 - lobed; stamens free from the corolla lobes ... \textit{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 ... \textit{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 ... \textit{Lamiaceae 86}

95b. Ovary not lobed; style terminal

96a. Plants viscid hairy ... \textit{Pedaliaceae 83}

96b. Plants not viscid hairy ... \textit{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


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

100b. Placentation parietal, sometimes interrupted 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 sinusae; 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 ... **CONVOLVULACEAE 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. Hipsid 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 ... VERBERNACEAE 85

112b. Flowers actinomorphic.

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 involu- cral 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

122b. Leaves petiolate. Perianth corolline ... \textit{Nyctaginaceae} 87

123b. Perianth 4 - 5 - lobed; ovary 1 celled, ovules 1 - 3.

124a. Stamens 4 - 5, as many as the calyx lobes ... \textit{Santalaceae} 97

124b. Stamens 8 - 10, twice as many as the calyx lobes ... \textit{Combretaceae} 46

118b. Ovary superior.

125b. Anthers not opening as above.

126a. Pistils two or more (carpels free).

127a. Trees ... \textit{Sterculiaceae} 20

127b. Herbs or climbing bushes \textit{Ranunculaceae} 1

126b. Pistil solitary (carpels solitary or united).

128a. Ovary 2 - 5 - celled.

129a. Ovules many in each cell ... \textit{Molluginaceae} 57

129b. Ovules one or three in each cell.

130a. Ovules axile ... \textit{Euphorbiaceae} 98

130b. Ovules all or mostly basal.

131a. Slender herbs. Capsules circumscissile ... \textit{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 connate 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