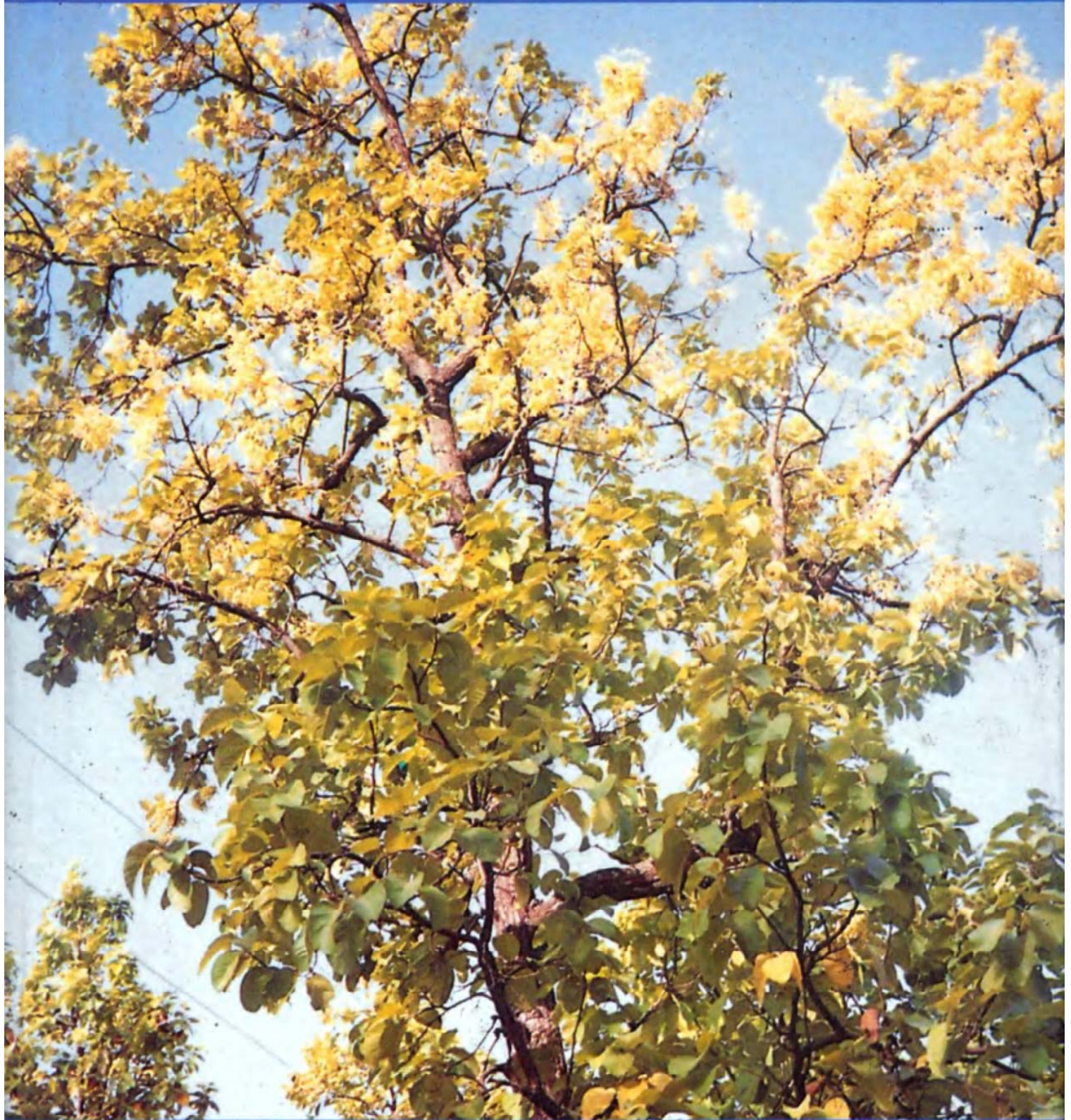


FLORA OF MADHYA PRADESH

VOLUME I

EDITORS : D. M. VERMA
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MADHYA PRADESH



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FOREWORD

Madhya Pradesh, the heartland of India abounds in diverse wild-life forms. It harbours approximately 2400 species of higher plants within an area of 4,63,452 sq. km and constitute an important source for germ-plasm. A number of wild relatives of cultivated plants, endemics, rare and threatened plant species occur in this area.

The old literature, scriptures, epics etc. speak volumes of richness in biodiversity and culture of its people. A large number of *adivasis* (tribals) inhabit forest areas of Madhya Pradesh and depend on the forest wealth for their sustenance. They have lived in complete harmony with the nature since time immemorial. The advent of development-exploitation of mineral and metal resources, construction of minor and major hydro-electric or thermal plants, development of means of communication, felling of the forest tracts for rehabilitation and agricultural purposes are having telling effect on the plant resources of the area. The forest areas are gradually shrinking due to population explosion and increasing demand on forest resources for sustenance of the human at large. A number of plant forms may then disappear prematurely before their inventorisation, assessment and utilisation of potentialities for human welfare. Sustainable utilisation and conservation is the demand of the time.

The publication of Flora of Madhya Pradesh is very timely. It inventorises the plant resources available at this very moment in the area. It will go a long way in monitoring the progress or degradation of our resources and help taking corrective measures to protect this natural heritage so that it can be handed over to the posterity.

Calcutta

Oct. 20th, 1993.

P. K. Hajra

Director

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The arduous, sustained and tenuous exploration work and the endeavour to collect specimens of as many species as possible, sometimes even in perilous circumstances, by the Scientists, Scientific Assistants and field-staff working in the Central Circle, Botanical Survey of India, Allahabad provided rich materials for preparation of this Flora and was a continuous source of inspiration to us. Sincere thanks are also due to Shri S.M.A.Naqvi, Artist, Late M. A. Siddiqui, Photographer and Shri Raja Ram, Library Assistant for help pertaining to illustrations, photographs and library consultation, and to Shri M. D. Saroj, U. D. Clerk and Shri H. R. Srivastava, Stenographer for typing the manuscript.

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November 18th, 1993

R. D. Dixit

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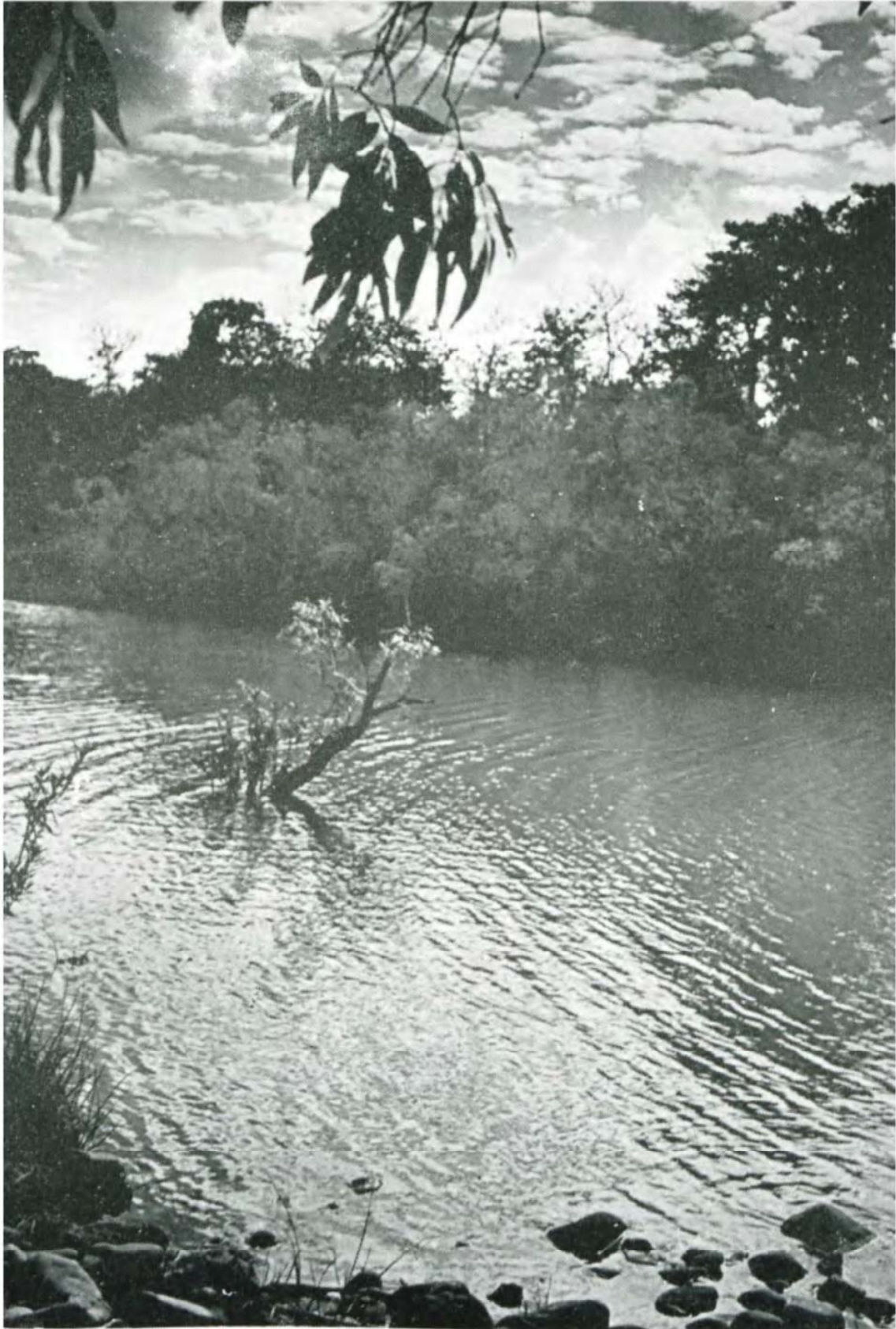


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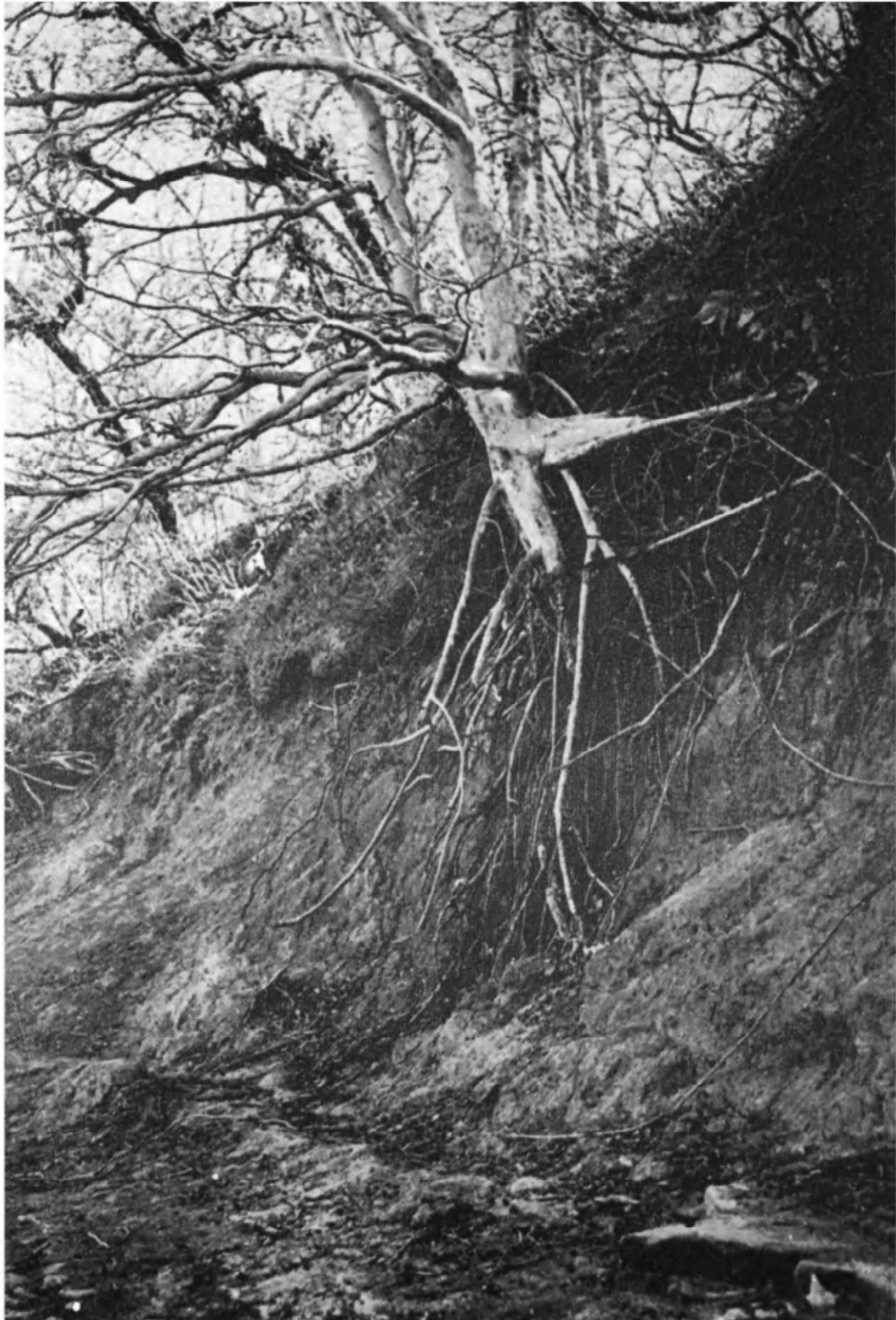


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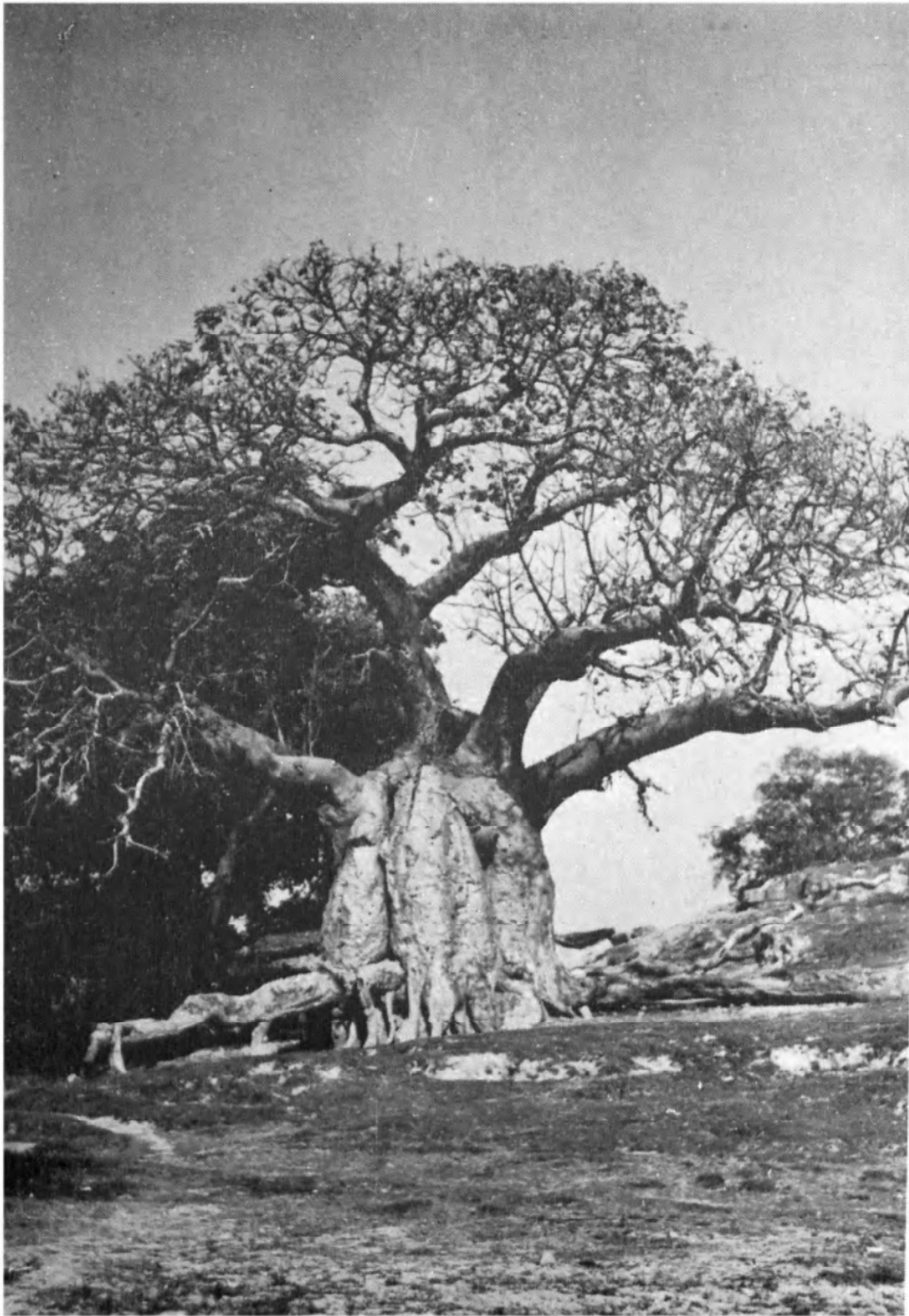


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INTRODUCTION

(D. M. Verma and A. K. Mukherjee)

Madhya Pradesh, as the name indicates, lies in the Central part of India between latitudes $17^{\circ} 48' N$ to $26^{\circ} 52' N$ and longitudes $74^{\circ} 02' E$ to $84^{\circ} 24' E$. It came into being as a result of state reorganization on the 11th November, 1956, including in its reconstituted political boundaries all or most of the districts of Vindhya Pradesh, old Madhya Pradesh, Mahakoshal, Bhopal and a part of the Kotah district of Rajasthan. The physiographic regions which now fall partly or fully in the present day Madhya Pradesh are Madhya Bharat Pathar, Bundelkhand Uplands, Malwa Plateau, Vindhya Range, Narmada Valley, Satpura Range, Baghelkhand Plateau, Vindhyan Scarplands or Bhandar Plateau, Mahanadi Basin or Chattisgarh Plains and Dandakarnya. These names, alongwith Chambal Valley, Mahadeo Hills, Pachmarhi Hills, Kaimur Hills, Maikal Range, Bastar and Bailadila Hills are frequently referred to in earlier plant collections and other botanical contributions.

This forest heart-land of the country with an area of about 4,63,452 sq. km and famous for its teak, tanks and temples is a naturalist's paradise with almost one-third of its area covered with tropical forests of teak, sal and miscellaneous kinds harbouring wild animals like tigers, panthers, wild boars, sloth bears, wild buffaloes, blue bulls, antelopes, deers, chinkaras and sambhars. The area also includes several eye-catching water falls at Pachmarhi in Hoshangabad, Chitrakoot in Bastar and Chachai in Rewa, and the enchanting Marble Rocks along Narmada river at Bheraghat in Jabalpur. The Sanchi stupa, the Heliodoras pillar and the Udayagiri caves with its magnificent relief sculptures in Vidisha, the Bagh caves in Indore comprising wall paintings in Ajanta style, the world famed Khajuraho temples - the monuments of human love and female beauty, built by Chandela Rajput rulers in the 10th - 11th centuries, the observatory at Ujjain, the Bhopal lake created by King Bhoj in 11th century and numerous other temples, tombs and forts speak of its rich scientific and cultural heritage. Some jewels of Indian poetry like Kalidas and Bhavabhuti and the famous musician of Akbar period, Tansen, also hailed from Madhya Pradesh. Alongside, in the south east corner, are the tribals of Bastar whose physique, primitive way of life, health and medicare, shelter, food-habits and social customs are a living link to our present day civilization.

AREA AND PHYSIOGRAPHY

Madhya Pradesh is the second largest state in India with an area of

about 4,63,452 sq. km and occupies the central region of the country. It is surrounded by Rajasthan on its north-west, Uttar Pradesh and Bihar on its north and north-east, Orissa on its east and south-east, Andhra Pradesh and Maharashtra on its south and Gujarat on its south-west. The State has been divided into seven Commissioner's Divisions of (i) *Indore* with districts of Jhabua, Mandasor, Ratlam, Dhar, Ujjain, Indore, Dewas, East Nimar and West Nimar; (ii) *Gwalior* with districts of Morena, Bhind, Gwalior, Datia, Shivpuri and Guna; (iii) *Bhopal* with districts of Raigarh, Shajapur, Schore, Bhopal, Vidisha, Raisen, Hoshangabad and Betul; (iv) *Jabalpur* with districts of Sagar, Damoh, Narsimhapur, Jabalpur, Chhindwara, Seoni, Mandla and Balaghat; (v) *Rewa* with districts of Tikamgarh, Chhatarpur, Panna, Satna, Rewa, Sidhi and Shahdol; (vi) *Surguja* with districts of Surguja, Bilaspur and Raigarh and (vii) *Raipur* with districts of Rajnandgaon, Durg, Raipur and Bastar. In all there are 45 districts. Bastar is the largest and the most backward, but floristically the richest of these districts.

The Vindhyas and the Satpuras are two parallel mountain ranges running south-west to north-east through almost the middle of the state. The branch of the Vindhyas which strikes across Bundelkhand is called the Panna Hills, while the arm which runs in the north of the Son river is known as the Kaimur Hills. The small chain of mountains which links up the Vindhyas and the Satpura systems near Amarkantak in Shahdol is called the Maikal Range. The Bastar Hills in the south are the outcrops of the Eastern ghats. In the eastern fringes of Raigarh and Surguja are the Ramgarh Hills and Jashpur Pats continuing into Chhotanagpur Plateau in Bihar. According to Physiographic Divisions of India, Madhya Pradesh includes parts of North Central Highlands, South Central Highlands, North Deccan and Eastern Plateaus. The state has been broadly divided into the following physiographic regions.

1. Gird Region : It comprises the low-lying areas embracing the country around Gwalior and to the north and north east of it, extending thence across into the Bundelkhand of which it includes the greatest part till it meets the Kaimur Hills in Baghelkhand. The area of this tract is about 47,600 sq. km and it consists of a plain country with some undulations at elevations varying from 152 to 274 m above mean sea level.

2. Malwa Plateau : This plateau has an elevation between 450 – 600 m above mean sea level and an area of about 89,600 sq. km. It includes all the country lying between the great Vindhya barrier which forms the northern bank of the Narmada Valley and a point just south of Gwalior. Its eastern limit is marked by the ridge which runs from south to north starting through Bhilsa while its western limit marches into the Rajasthan border.

3. **Narmada Valley** : It is a long and narrow strip along the Narmada river walled in by the Vindhyas and the Satpuras to the north and to the south, respectively, and extending for a length of 320 km from Jabalpur to Handia with an average width of 32 km.

4. **Satpura Ridge** : South of the Narmada Valley the Satpura stretches across the state, in the shape of a large triangle, its eastern face extending for about 160 km from Amarkantak to Saletakadi in Balaghat district and its sides running westward for about 640 km and meeting gradually in Nimar. The Satpura plateau includes in its ranges southern parts of the West Nimar, East Nimar and Hoshangabad districts, whole of the Betul and Chhindwara districts, and northern parts of the Balaghat, Durg, and Bilaspur districts. The Satpuras form the watershed of the plains lying north and south of them.

5. **Chhattisgarh Plain** : On the eastern side of the Satpura range lies the Chhattisgarh Plain at a height of between 162– 457 m above mean sea level. Except for a few undulations, the level of the plain is generally unbroken. It includes major parts of Rajnandgaon, Durg and Raipur, the southern parts of the Bilaspur and Raigarh districts, and the northern plains of the Bastar district.

RIVER SYSTEM

Madhya Pradesh is criss crossed with several rivers and numerous rivulets. These are rainfed and become raging torrents during monsoon rains, largely disrupting vehicular traffic from a few hours to several days, shrinking or drying during dry months. The Chambal originating at Mhow in Dhar and flowing north-east along the western boundary of Madhya Pradesh empties into Yamuna at Auraiya in Etawah, in Uttar Pradesh. The Betwa originating in Raisen, also flowing north-east, meets Yamuna near Hamirpur. The Ken, originating in Raisen, meets Yamuna near Fatehpur. The Tons originating in Kaimur Hills meets Ganga before Mirzapur. While Kali Sindh, Parbati and Sind are important tributaries of the Chambal, Dhasan is that of the Betwa and Sonar is that of the Ken. Similarly, the Son, originating at Amarkantak, after some south-western curves flows to the north east and meets the Ganga near Patna in Bihar. Rihand river is one of its important tributary. All these rivers contribute waters to the fertile Northern Gangetic Plains. The Mahanadi originating at Mainpur Khurd in Raipur first flows westwards into northern Bastar then curving north and east through Raipur enters Orissa and ultimately empties into the Bay of Bengal. It forms the Mahanadi Basin in the Chhattisgarh Plains. Seonath and Hasdo are its main tributaries. The Indravati, originating in Koraput district of Orissa flows to the west, almost bisecting Bastar, then curves southwards and meets the easterly flowing Godavari. The

Narmada, originating at Amarkantak, forms the long narrow Narmada Valley between the Vindhya and the Satpuras. The Narmada, along with the Tapi cutting through the southern fringes of Madhya Pradesh, flows westwards and empties into the Gulf of Cambay. A number of dams have been constructed on these rivers and more are in the offing.

CLIMATE

Madhya Pradesh enjoys the widespread Indian monsoon climate with maximum rain falling between the end of June and September, the post-monsoon periods of October-November, a winter season of December to the middle of February, sometimes extending to March with a few winter showers, and a dry hot summer season of April, May and June. The average annual rainfall varies from 700 mm to 2000 mm. A narrow strip starting from the western district of Vidisha and Bhopal and broadening south-east covering Sagar, Damoh, Narsimhapur, Jabalpur, Shahdol, Sidhi, Rewa, Surguja, Raigarh, Mandla, Bilaspur, Balaghat, Seoni, Durg, Raipur and Bastar experiences higher rainfall ranging between 1200 to 2000 mm. North-west regions of Bastar, eastern parts of Surguja and Raigarh, Pachmarhi in Hoshangabad and small patches in Shahdol, Mandla and Balaghat are the highest rainfall areas. The regions with minimum rainfall are found in the south-western districts of Mandasor, Ratlam, Jhabua, Dhar, Indore and West Nimar. Some of the northern districts of Morena, Bhind, Gwalior and Shivpuri are also quite dry.

The mean daily maximum temperature during May is around 42.5° C in parts of Gwalior, Morena, Shivpuri, Datia and south western fringes of Balaghat and Durg. The maximum temperature sometimes soars to as high as 47° C during some of the afternoons. The western parts of Mandasor, Ratlam, Ujjain, Dewas, Jhabua, Dhar, Indore and Shajapur, some parts of Betul, Chhindwara, Seoni, Mandla, Shahdol, Surguja and eastern Bastar experiences maximum summer temperature between 37.5° C and 40° C. However, in the remaining larger region of the state it varies between 40° C and 42.5° C. The mean daily minimum temperature in January varies between 7° C and 10° C in the northern half of Madhya Pradesh — the minimum sometimes reaching as low as 1° C to 3° C for a few days. In the southern half of the state it varies from 10° C to 15° C except for the south western fringe of Bastar where it fluctuates between 15° C and 17.5° C. Hail-storms and fog, though occur, are not very common.

GEOLOGY

Madhya Pradesh represents all the pre-Cambrian rock system, namely, Archaean, Dharwar, Cuddapah and Vindhyan. Cambrian to middle carboniferous strata are absent in this state. The Gondwana system, which

ranges in age from the upper Carboniferous to the Jurassic, derives its name from the ancient Gond kingdom of the area south of Narmada, where the formation was first discovered. There exists a chain of outcrops of marine Cretaceous strata along the Narmada valley.

Archaean rock outcrops are mainly found in the Gwalior, Tikamgarh, Chhatarpur, Surguja, Balaghat and Bastar districts. Outcrops of *Dharwar* rocks are found in the Rewa, Jabalpur, Chhindwara and Balaghat districts. Most of the India's manganese ores come from the rocks of Dharwar System. *Cuddapah* rocks are found in the Raigarh, Bilaspur, Raipur, Durg and Bastar districts. The *Vindhyan* System of rocks which derives its name from the Vindhya Range, north of Narmada Valley, are found particularly in Malwa, Bundelkhand, Panna Hills and Kaimur Hills in Rewa. These are also found in Chhattisgarh region. The famous Panna diamond bed lie in these rocks. Many of the historical buildings and monuments have been built by Vindhyan Sandstones. *Lower Gondwana* rocks are found in the Mahadeo and Pachmarhi Hills in Satpura Range and *Upper Gondwana* in Jabalpur region.

Deccan Trap, a step-like successive volcanic eruption that occurred in Eocene, originally covered almost all the earlier rock formations in the western and central Madhya Pradesh. However, since denudation has been going on for ages, a number of out-crops of rocks of older Systems have been exposed at different places, often widely separated. Much of the black cotton soil or *regur* is due to the subaerial weathering of the basalts *in situ* and a subsequent admixture of the weathered products with iron and organic matter.

MINERALS

The bulk of the valuable minerals in India are products of metamorphic rocks of pre-Cambrian period. The principal Ore and metal deposits, the precious and semi-precious stones, mica and a large number of valuable minerals are derived from the Dharwar System. About 98% of the coal is of Lower Gondwana age. The main petroleum horizons in India are Tertiary.

All the pre-Cambrian rock systems and also the Gondwana System are present in Madhya Pradesh. This state is considered the second most minerally rich province, next to Bihar and Orissa, carrying good reserves of iron and manganese, coal, limestone, bauxite, clays, ochres, corundum, sillimanite, silica sand, dolomite, steatite (talc), red oxide of iron ore, niobium, graphite, feldspar, diamond and lepidolite.

Nearly 30% of India's high grade *iron ore* occurs in Durg (supply to the Bhilai steel plant), Bailadila range in Bastar, and in Jabalpur

Gwalior districts. The state possesses about 25% of India's *Coal reserves* in five coalfield groups namely, North Chhattisgarh, South Chhattisgarh, Central India, North Satpura basin and South Satpura basin but the coal is non-coking in quality. The main contributor of *manganese* are the Balaghat and the Chhindwara districts, even though small quantities are also found in the Jabalpur and the Jhabua districts. The state possesses the largest reserves of *bauxite* in India. The important regions are in the Balaghat, Mandla, Jabalpur, Surguja, Bilaspur, Bastar and Raigarh districts. There are vast reserves of limestone in the Jabalpur, Satna, Morena, Raipur Durg, Bilaspur, Bastar, Mandasor, Dhar, Hoshangabad, Damoh, Panna, Raisen and Sehore districts. Bilaspur supply all the *dolomite* required by the steel plants of Bhilai and Rourkela. *Fire-clay* and *China-clay* occur mainly in the Jabalpur, Chhindwara, Durg, Bilaspur, Gwalior, Mandasor, Satna, Shahdol, Narsimhapur, Sidhi, Bastar, and Surguja districts. *Talc* and *Soap-stone* occur in marble rocks of Jabalpur and also in the Durg and Jhabua districts. *Corundum* occurs in the Sidhi district. *Asbestos* occurs in the Jhabua district. *Diamonds* are found in Panna district in two types of deposits (i) conglomerate and gravel and (ii) pipe deposit. High quality *marble* deposit is found at Sukma in the Bastar district. It is also found at Gohrapahad in the Morena and at Bheraghat in the Jabalpur district. Red and yellow *ochres* of good quality occur in the Jabalpur, Gwalior and Satna districts. Minor deposits are also found in the Panna and Raisen districts. A deposit of white *Shale*, suitable for making slate pencil, occurs in the Mandasor district. Glass making *Silica sand* occurs in the Morena, Vidisha, Rewa and Jabalpur districts.

SOILS

The major soil groups found in Madhya Pradesh are alluvial, deep black or regur, medium black, shallow black, mixed red and black, red and yellow and skeletal soils.

1. **Alluvial Soils:** The north-western part of Gird region are covered with these soils which are quite fertile. The soils of Bhind and Morena districts come under this group. The surface texture grades into sandy-loam to loam and clay-loam to clay. The pH is neutral to slightly alkaline.

2. **Black Soils:** These soils occupy almost half of Madhya Pradesh and mainly cover the Malwa Plateau, the Narmada Valley and the Satpura Ridge. The texture is loam to clay. Calcareous concretions are always present. They are usually deficient in phosphorus, nitrogen and organic matter, but are rich in potash and lime. Depending on some physical and chemical properties some of these soils are often called black-cotton or regur soil. The sub-groups of black soils are: (i) *Deep black soils* covering the major parts of the Narmada Valley, level portions of Vindhyan and Satpura

plateau, especially the areas of the Hoshangabad and Narsimhapur districts. The clay content varies between 20 and 60 percent. They have high moisture retention capacity. (ii) *Medium black soils* covering the largest area comprising mainly the Malwa Plateau, Nimar region and extending up to the Sidhi district and all along the northern side of the Vindhyan Range, and in the South-western districts of Jhabua, Dhar and other hilly areas. These soils vary greatly and a mosaic of different types is found. (iii) *Shallow Black Soils* mainly covering the Satpura Ridge comprising districts of Seoni, Chhindwara and Betul. These are clay loams with 15-30 percent clay.

3. Mixed Red and Black Soils: These are prevalent in the eastern part of the Gird region and in most parts of Bundelkhand and Baghelkhand area. Red and black soils usually alternate in these areas. The red soils are light-textured, and usually devoid of lime concretions and free carbonates. The commonest form is sandy clay. They are usually deficient in nitrogen phosphorus, organic matter and lime. Its important sub-types found in these areas are: (i) *Black clayey soils*; (ii) *Less dark clayey soils*; (iii) *Light medium deep yellowish soils*; (iv) *Shallow gravelly red soils* and (v) *Some alluvial soils* in the beds of rivers.

4. Red and Yellow Soils: These soils occupy mainly the Chhattisgarh plains and most of the eastern districts of the Madhya Pradesh. Red and yellow soils occur together. Although they are generally described as light sandy soils yet silty loam to silty clay soils are common. They are poor in phosphorus, organic matter and lime. They are acidic to alkaline. In the Bastar district most of the soils are acidic having wide range of C/N ratio. In the districts of Durg, Balaghat, Bilaspur and Raipur, deep clayey soils, yellow sandy loam soils, a mixture of these in the slopes, and reddish-yellow gravelly sandy soils are found in the wastelands of the upland regions.

5. Skeletal Soils: These are gravelly soils of the uplands of the Vindhya and the Satpura Ranges and cover parts of the districts of Shahdol, Mandla, Surguja, Raigarh, Bastar and Jhabua. They are generally poor, though some patches of good black soils are also met with.

LAND USE

Madhya Pradesh is predominantly a land of forests and agriculture. Approximately 31.5% of the area is under forest cover which is about 26.3% of India's forest area. The more densely forested districts are Bastar (70%), Surguja (52%), Balaghat (44%), Mandla (41%), East Nimar (40%), Shahdol (39%), Sidhi (38%), Raipur (38%), Raigarh (35%), Bilaspur (33%) and Chhindwara (32%). Agriculture occupies about 42% of the land area. Millets and wheat in the central and northern regions, paddy in the eastern and south eastern regions and cotton in the south-western parts are the major

crops. The remaining land area is lying fallow or under other uses.

PEOPLE

The people of the northern areas of Madhya Pradesh including the Narmada valley are mainly descendants from the *Indo-Aryan* stock. Those of the southern and eastern areas contain a good mixture of the *aboriginal tribes*, the *Gond* and the *Dravidian* stocks. The rest of the areas of the state was formerly peopled by the *Gonds* and other primitive tribes, such as the *Korwas*, the *Marias*, the *Baigas*.

The Adivasis of Madhya Pradesh include the *Muria*, *Maria*, *Paria*, the *Bhatara* in Bastar, the *Pondos* and *Kerwas* in Surguja, the *Uraons* in Jashpur, the *Munda* and *Korkus* in Betul, the *Gonds* and *Baigas* in Mandla, the *Bhils* in Jashpur, Bhopal, Jhabua, Dhar and Nimar.

The agriculturists form about 78% of the total population of the state. The Chief agricultural classes are the *Ahirs*, *Gaderias*, *Kachhis* and *Lodhis* in Bundelkhand and Baghelkhand, while the *Gujars*, *Malis* and *Kunbis* predominate in the Malwa. The *Rajputs*, *Kunbis*, *Lodhis* and *Gujars* are important cultivators in other wheat growing areas of the state. The *Pawars* are important cultivators in the Balaghat district. In Chhattisgarh district the *Kurmis*, *Telis*, *Chamars* and *Pankas* are the main cultivators. The *Rawats* of Chhattisgarh act as household servants.

The *Hill-Maria* and *Bison-Horn-Maria* of Bastar district follow shifting cultivation on the steep slopes of the hills.

FOREST TYPES

The forests in Madhya Pradesh cover about 1,46,000 sq. km, which comes to approximately 31.5% of the total area. These also, as usual in other tropical regions, have been subjected to general misuse and over-exploitation by shifting cultivation, fires, grazing and lopping. Besides, large areas have been directly or indirectly affected because of industrial development, construction of dams, road-building and various other human activities. Fortunately, some small scattered patches were preserved by the ex-rulers as their hunting reserves, or by the tribals because of their religious faith or because of these being simply inaccessible. Presently the Government of India, in an effort to preserve and develop these forests, have taken several legislative measures and also declared several forest pockets as Reserve Forest, Biosphere Reserve, National Parks and Game Sanctuaries. However, generally the forests that we find today in Madhya Pradesh are in various stages of degradation. Almost the whole of southern and central eastern and eastern parts of Madhya Pradesh receiving higher rainfall are more moist and green than its western, north western and central western regions. However, since the development of

vegetation is the net result of many complex factors, like climate, geology, soil, available moisture, topography, biota, soil organisms and wild life, and their interactions producing many types and intermediaries, it is often difficult to predict their relationship or attempt their classification. Patches of dry deciduous forests or scrubs may be found in the generally moist deciduous forest zones, the development of sal or teak, or the floristic composition, may be found to be markedly different in the adjoining areas. According to the classification given by Champion and Seth in *Forest Types of India* (1968), two main forest types, viz., *Tropical Forests* and *Montane Subtropical Forests*, occur in Madhya Pradesh. Except for some hill tops like Pachmarhi and Bailadila, the entire Madhya Pradesh falls under *Tropical Forests*, and these have been further divided into Northern semi-evergreen forests, Moist deciduous forests, Dry deciduous forests and Thorn forests. The moist deciduous forests and the dry deciduous forests have again been subdivided into various types as enumerated below, and in each such type, they again recognise two forms, viz., the North Indian forms and the South Indian forms. However, they also admit that these forms integrate in Madhya Pradesh and are scarcely distinguishable here.

I. TROPICAL FORESTS :

1. Northern tropical semi-evergreen forests :

These are dense forests with the canopy reaching a height of 24 — 36 m. While a number of top storey trees are deciduous, they are deciduous only for a short-period, and that also not simultaneously. The second storey is entirely evergreen. Woody climbers, epiphytes, orchids and ferns are generally abundant. Some eastern parts of Madhya Pradesh adjoining Orissa and receiving an annual rainfall of about 1400 — 1700 mm have this kind of forest, though in a rather degraded stage nearing the moist deciduous forests.

Terminalia alata, *Stereospermum suaveolens*, *Tetrameles* sp. and *Shorea robusta* form the top storey while the lower storeys consist of *Artocarpus lakoocha*, *Michelia champaca*, *Celtis tetrandia*, *Bridelia squamosa*, *Calamus* spp., *Dillenia* spp., *Ficus* spp., *Glochidion* spp., *Phoebe lanceolata*, *Litsea nitida* and *Leea* spp. Moist bamboo brakes of *Bambusa arundinacea* are common.

2. Tropical moist deciduous forests :

In these the dominants are mainly deciduous spp. but subdominants and lower storeys are largely evergreen. Top canopy is rarely dense and even but over 25 m high, and comprises of only a few species. The evergreen habit of the lower storey gives the forests as a whole a more or less evergreen appearance. Climbers and epiphytes are generally abundant.

An almost leafless period during March — April of the upper storey is characteristic. The greater part of this forest type occurs on hilly ground in regions with about 1500 mm and higher annual rainfall, and with dry season of 4 — 5 months. Parts of Hoshangabad, Balaghat, Seoni, Raipur, Durg, Bastar, Surguja, Raigarh and Mandla districts have this type of forests.

The common constituents of these forests are the tall trees of *Shorea robusta*, *Tectona grandis*, *Pterocarpus marsupium*, *Terminalia alata*, *T. bellirica*, *T. chebula*, *Lannea coromandelica*, *Dalbergia paniculata*, *Adina cordifolia*, *Bombax ceiba*, *Stereospermum chelonoides*, *Garuga pinnata*, *Soymida febrifuga*, *Lagerstroemia parviflora* and *Anogeissus latifolia*, and smaller trees and shrubs of *Bridelia squamosa*, *Cleistanthus collinus*, *Mallotus philippensis*, *Diospyros melanoxyton*, *Buchanania lanzan*, *Cassia fistula*, *Schleichera oleosa*, *Ougeinia oojeinensis*, *Miliusa tomentosa*, *Careya arborea*, *Dillenia pentagyna*, *D. indica*, *Chloroxylon swietenia*, *Helicteres isora*, *Antidesma ghaesembilla*, *Gmelina arborea*, *Grewia tiliifolia*, *Breynia vitisidaea*, *Shrebera swietenoides*, *Embelia tsjeriamcottam*, *Ochna obtusata*, *Casearia graveolens*, *Holarrhena antidysenterica*, *Semecarpus anacardium*, *Ficus* spp. and *Leea* spp. The common Madhya Pradesh bamboo, *Dendrocalamus strictus*, forms dense thickets. The conspicuous climbers and ramblers in these forests are *Millettia extensa*, *Ventilago denticulata*, *Bauhinia vahlii*, *Smilax zeylanica*, *Celastrus paniculatus*, *Ichnocarpus frutescens*, *Combretum roxburghii*, *Hemidesmus indicus*, *Olex scandens*, *Ziziphus oenoplia*, *Dioscorea bulbifera*, *D. pentaphylla*, *D. puber* and *D. oppositifolia*. The undergrowth in dense forests is mostly sparse, and not much varied. The common species are *Eranthemum purpurascens*, *Perilepta edgeworthiana*, *Desmodium* spp., *Phoenix acaulis*, *Globba racemosa*, *G. bulbifera*, *Curcuma* spp., *Zingiber* spp., *Nelsonia canescens*, *Chlorophytum tuberosum* and *Carex speciosa*. Ground orchids like *Eulophia* spp., *Geodorum densiflorum*, *Habenaria* spp. and *Platanthera susanae* are common in well protected forests of this type. In the valleys and gorges of parts of Raipur, Bastar, Balaghat, Hoshangabad and Shahdol, the forests are dominated by evergreen species like *Trewia nudiflora*, *Toona ciliata*, *Diospyros montana*, *D. malabarica*, *Putranjiva roxburghii* and *Ficus* spp., with a thick undergrowth of ferns. Along the banks of several streams in places liable to erosion and temporary flooding and on coarse sandy non-retentive soil but with ample supply of water, *Terminalia arjuna* forms narrow belts.

This group of forests has been further divided on the basis of predominance of a particular species or according to ecological degradation into moist teak bearing forests; moist mixed deciduous forests; moist peninsular sal forests; *Terminalia alata* forests; secondary moist mixed deciduous forests and moist sal savannah. These are found scattered throughout the moist deciduous forest zone.

3. Tropical dry deciduous forests :

In these the dominants are almost entirely deciduous, and lower storeyed trees and shrubs are also composed of several deciduous spp. giving the whole forest a look of dryness. The top canopy is invariably open and light, usually between 8 — 20 m high. Several species of moist deciduous forests may also be found particularly in sheltered places but they lack the finer development seen in the moist type. Woody climbers and epiphytes are few, and orchids and ferns are almost entirely absent. There is an almost leafless period during March — April. This kind of forest is mostly found in undulating areas with low rising hills in regions receiving annual rainfall of 850 — 1300 mm with a long dry season extending for about 6 months. Due to other factors and degradation, patches of dry deciduous forest are also found in parts of Raipur, Bastar, Raigarh, Surguja, Balaghat, Seoni, Mandla and other regions receiving higher annual rainfall. However, generally the dry deciduous forests are found in the northern, western and central western districts of Sidhi, Rewa, Satna, Panna, Chhatarpur, Sagar, Damoh, Vidisha, Guna, Morena, Shivpuri, Gwalior, Datia, Raisen, Mandasor, Ratlam, Ujjain, Indore, Dhar, East Nimar and Jabalpur.

The common constituents of these forests are the taller trees of *Terminalia* spp., *Tectona grandis*, *Pterocarpus marsupium*, *Cochlospermum religiosum*, *Soymida febrifuga*, *Lannea coromandelica*, *Diospyros melanoxylon*, *Butea monosperma*, *Lagerstroemia parviflora*, *Anogeissus latifolia*, *A. pendula*, *Mitragyna parviflora*, *Emblia officinalis*, *Sterculia* spp., *Boswellia serrata*, *Bridelia squamosa*, *Albizia* spp., *Hardwickia binata*, *Bauhinia* spp., *Cordia obliqua*, *Aegle marmelos* and *Acacia* spp., and a variety of smaller trees and shrubs like *Acacia* spp., *Gardenia* spp., *Grewia* spp., *Helicteres isora*, *Holarrhena antidysenterica*, *Wrightia* spp., *Casearia elliptica*, *Carissa* spp., *Alangium salvifolium*, *Nyctanthes arbor-tristis*, *Ziziphus* spp., *Capparis zeylanica*, *Flacourtia indica*, *Mimosa* spp., *Securinega virosa*, *Kirganelia reticulata* and *Woodfordia fruticosa*. There are several species of rather slender climbers like *Rhynchosia minima*, *Atylosia scarabaeoides*, *Cocculus hirsutus*, *Cissampelos pareira*, *Ipomoea* spp., *Coccinia indica*, *Mukia maderaspatana*, *Diplocyclos palmatus*, *Momordica dioica*, *Cryptolepis buchananii*, *Pueraria tuberosa*, *Marsdenia* spp., *Ziziphus oenoplia*, *Pergularia daemia* and *Tinospora cordifolia*. Lianas and extensive climbers are generally absent.

The degraded stages present a picture of scrub, savannah or even a dry grassland. It is common to see in the north western parts the reasonably tall trees of *Anogeissus pendula* reduced to spreading and creeping forms or even looking like cushions under heavy browsing, especially by goats. Scattered stunted and malformed trees or thickets of *Butea monosperma* sometimes reduced to a woody base bearing a few leaves

is also a common sight. Bamboo brakes of *Dendrocalamus strictus*, pure or sparsely mixed with a few deciduous species, are of a drier form than found in the moist deciduous forests. *Boswellia serrata*, sometimes mixed with *Sterculia* spp. and *Lannea coromandelica*, is often found dominating the ridges and the plateaus. The river-banks are frequently dominated by *Syzygium heyneana* or *Terminalia arjuna*.

This group of forests has also been further divided on the basis of predominance of a particular species or according to ecological degradation into *dry teak bearing forests*; *dry mixed deciduous forests*; *dry peninsular sal forests*; *dry deciduous scrub*; *dry savannah forests*; *dry grasslands*; *Anogeissus pendula forests*; *Boswellia forests*; *Babul forests*; *Hardwickia forests*; *Butea forests*; *Aegle forests*; *dry bamboo brakes* and *Riverain forests*. These are found throughout the drier regions of the state.

4. Tropical thorn forests :

In these the low thorny hard leaved evergreen trees and xerophytes dominate. The canopy is more or less broken and under 10 m high. Trees have short boles and low branching crown. Number of species is less but usually mixed. Climbers and epiphytes are scarce. There is an abundant growth of annual grasses during the rains. In Madhya Pradesh only small patches of these forests are found in the plains and the low hills of the north west border of Morena and in the south west corner of West Nimar receiving an annual rainfall of 700 — 1000 mm with long dry spell. The soil is generally shallow and poor.

The common constituents of these forests are *Acacia* spp., *Ziziphus* spp., *Albizia* spp., *Aegle marmelos*, *Gardenia* spp., *Randia* spp., *Cordia obliqua*, *Balanites roxburghii*, *Prosopis spicigera*, *Mimosa* spp., *Gymnosporia spinosa* and *Flacourtia indica*. The types of thorn forests occurring in Madhya Pradesh are *Southern thorn forest*; *Southern thorn scrub* and; *Ravine thorn forest*.

II. MONTANE SUBTROPICAL FORESTS :

It is represented only by the following central Indian type of Subtropical forests found on some hill tops of Madhya Pradesh, Orissa and Mt. Abu in Rajasthan.

Central Indian Sub-tropical Hill Forests :

The sites occupied are exposed and often with poor soil, and being subjected to human interference, the residual forest is mostly of an inferior type with short-boled and branchy trees. The forests resemble the dry deciduous forests though with a higher proportion of the evergreens.

It occurs as small patches on hill tops over 1200 m at places like Pachmarhi and Bailadila. The rainfall is relatively high but there is a long dry spell. The soil, except in the gullies, may be shallow to fairly deep on the flatter tops of Pachmarhi, and often lateritic.

Michelia champaca, *Syzygium cumini*, *Manilkara hexandra*, *Mangifera indica*, *Symplocos laurina*, *Salix tetrasperma*, *Carallia brachiata*, *Litsea monopetala*, *Dillenia* spp., *Mallotus philippensis*, *Toona ciliata*, *Gnetum scandens* and *Calamus* spp., together with tree ferns like *Cyathia* sp., are the common elements of these forests.

AQUATIC PLANTS

The numerous rivers, streams, drains, ponds and ditches throughout the state support a somewhat specialized flora grouped together as aquatic plants. However, the exact interpretation or circumscription of this group is debatable and there are innumerable borderline species which grow both in wetlands and in water, and still other which grow in drains and ditches temporarily filled up during the rains. The following list contains only those species which generally complete or almost complete their life-cycle in water. These have been classified into six categories :—

1. Free floating hydrophytes :

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

2. Suspended submerged hydrophytes :

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

3. Anchored submerged hydrophytes :

Aponogeton crispus, *Blyxa aubertii*, *B. octandra*, *Cryptocoryne retrospiralis*, *Hydrilla verticillata*, *Myriophyllum oliganthum*, *Najas* spp., *Nechamandra alternifolia*, *Podostemon wallichii*, *Polypleurum stylosum*, *Potamogeton crispus*, *P. mucronatus*, *P. pectinatus* and *Vallisneria natans*.

4. Anchored hydrophytes with floating shoots :

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

5. Anchored hydrophytes with floating leaves :

Aponogeton natans, *Caldesia parnassifolia*, *Limnophyton obtusifolium*,

Marsilea minuta, *Monochoria hastata*, *M. vaginalis*, *Nelumbo nucifera*, *Nymphaea pubescens*, *N. nouchali*, *N. rubra*, *Nymphoides hydrophylla*, *N. indica*, *Ottelia alismoides*, *Potamogeton nodosus*, *Sagittaria guayanensis* ssp. *lappula* and *Tenagocharis latifolia*.

6. Emergent amphibious hydrophytes :

Acorus calamus, *Aeschynomene aspera*, *A. indica*, *Ammania baccifera*, *A. multiflora*, *Brachiaria reptans*, *Coix aquatica*, *Crinum defixum*, *Cyperus distans*, *C. nutans* var. *eleusinoides*, *C. pangorei*, *Echinochloa colona*, *E. stagnina*, *Eleocharis acutangula*, *E. congesta*, *E. dulcis*, *E. geniculata*, *E. palustris*. *Enhydra fluctuans*, *Eriocaulon achiton*, *E. cinereum*, *E. quiquangulare*, *E. sollyanum*, *Fimbristylis schoenoides*. *F. tetragona*, *Fuirena ciliaris*, *Hydrolea zeylanica*, *Hygrophila auriculata*, *Hymenachne pseudointerrupta*, *Isoetes coromandeliana*, *Limnophila aromatica*, *L. indica*, *L. sessiliflora*, *Lipocarpa chinensis*, *L. sphacelata*, *Ludwigia octovalvis*, *L. perennis*, *L. prostrata*, *Ophiuros exaltatus*, *Oryza sativa*, *Phragmites karka*, *Polygonum barbatum* *P. dichotomum*, *P. glabrum*, *P. hydropiper* ssp. *mucrocarpum* var. *triquetrum*, *P. limbatum*, *Ranunculus scleratus*, *Rotala densiflora*, *R. indica*, *R. rotundifolia*, *Scirpus articulatus*, *S. juncooides*, *S. lateriflorus*, *S. maritimus* and *Typha angustata*.

BOTANICAL COLLECTIONS

Madhya Pradesh, as we know now, was formed as a result of state reorganization in 1956. It was carved out, in full or in part, of regions earlier falling under Central Provinces and Berar, Central India Agency or Central India, Madhya Bharat, Vindhya Pradesh, Baghelkhand, Bundelkhand and Jashpur, Surguja and Bastar belonging to the Eastern States Agency. Hence, earlier collections coming from any of these regions, as also from Vindhya Range, Satpura Range, Malwa Plateau, Chambal Valley and Narmada Valley, are likely to be from the present day Madhya Pradesh, but specific localities must be individually checked for confirmation.

The earliest record of exploration in the present day Madhya Pradesh appears to be that of V. Jacquemont, a French botanist, who collected in Sidhi, Rewa, Satna and Panna in 1830, and in Mandasor, Ratlam, Ujjain, Indore and West Nimar in 1832. Subsequently, N. Vicary (1833) collected in Central India, Bundelkhand, Sagar and Jabalpur; D. Ritchie (c. 1838) in Central India; M.P. Edgeworth (1838 and 1847—1848) in Bundelkhand, Dhar, Malwa and Indore, W. Griffith (c. 1839) in Malwa Plateau, Narmada Valley and Jabalpur, W. Munro (c. 1839) in Chambal (Morena); D.F. Macleod (c. 1839—40) in Jabalpur; M. Kittoe (1839—40) enroute from Northern Circars in Orissa to Nagpur in Maharashtra; R.H. Beddome (1848)

in Jabalpur; C.W.W. Hope (1860—61) in Panna, Rewa and Baghelkhand; D. Brandis (1863, 1888—89) in Satpura Range and Bijawar; G. King (c. 1867) in Bundelkhand, Malwa, Guna and Sagar; T.C. Jerdon (1868) in Central India and Sagar; R. Thompson (1870) in Central Provinces; J.C. Hobson (prior to 1874) in Asirgarh (Khandwa); O. Kuntze (c. 1875-76) in Jabalpur; A. Barclay (1876) in Guna; C.B. Clarke (c. 1876) in Jashpur, Surguja and Central India; J.J. Wood (1878) in Jashpur and Surguja; Mrs. C. Morris (1881) in Pachmarhi (Hoshangabad); W. Schlich (1883) in Central Provinces; J.F. Duthie (1888—91) in Bundelkhand, Indore, Nimar, Jabalpur, Sagar, Damoh, Betul, and Hoshangabad; C. Maries (1889—90) in Gwalior, Wingate (? 1890's) in Gwalior, Bundelkhand and Sagar; G. Watt (c. 1894) in Raipur and Bilaspur; J. Marten (1894) in Jabalpur, A.E. Lowrie (? 1896) in Indore; and R.S. Hole (1896—1902) in Central Provinces, Jabalpur and Seoni.

While some of the above-mentioned collectors, professionally botanists, foresters, administrators, surgeons, army personnels, missionaries and engineers etc., went in for a complete gathering of the botanical specimens, others made only stray collections or collected specimens of only specialized groups like ferns, woody elements or economic plants. However, these at the most were the collections available at the time of the publication of J.D. Hooker's *Flora of British India* (1872—1897). It is to be noticed that a large south eastern region of Madhya Pradesh comprising the districts of Bastar, Raigarh, Raipur, Bilaspur, Mandla, Durg, Rajnandgaon and Balaghat remained almost unrepresented in the above Flora.

The collections were continued by R.S. Hole, Rev. A. Campbell, Rev. L. Cardon, Mrs. A.S. Bell, A. Meebold, I.H. Burkill, D.O. Witt, Masters, Allington, W.F. Biscoe, C.G. Rogers, H.H. Haines, A.B. Pandey, R.R.D. Graham, P. Mukherjee and C.C. Stevens up to about 1920 in various parts including those of Balaghat, Bilaspur, Durg and Raipur by Haines (?1914—1920's). The collection activity almost ceased between 1920 — 1947. During this period only H.F. Mooney made a good gathering in Bailadila hills (Bastar), Jashpur and Surguja. L.A. Kenoyer, H. Crookshand and C.E. Hewetson also contributed to some extent.

From 1948 onwards, with the interest taken by the Forest Department and the Universities, the exploration and plant collection again gradually picked up. The revitalization of the Botanical Survey of India in 1955 and opening of its Central Circle at Allahabad on the 30th July, 1962 started an era of well planned intense plant collection activity in Madhya Pradesh. These collections housed in the Herbarium of the Botanical Survey of India, Central Circle, Allahabad (BSA) now form the main basis for writing the present Flora of Madhya Pradesh. It has not been possible to study all the collections of the past century, or more, scattered in various herbaria in

India, and abroad. A deeper insight into these early collections would highlight the changed pattern of the flora of Madhya Pradesh due to intense biotic interference and tremendous rate of urbanization and industrialization etc. in various parts of the state, particularly during the last about fifty years.

FLORISTIC PUBLICATIONS

There have been a number of publications on the botany of various parts of Madhya Pradesh. These include regional or district Floras, list of species, forest Floras, economic or medicinal species, new distributional records, new species, or a mention of floristic composition in ecological accounts. J.D. Hooker's *Flora of British India* (1872 — 1897) was the first Flora to deal with plants of this region. Stewart and Brandis *Forest Flora of North-West and Central India* (1874) covers a large part of the state while Duthie's *Flora of the Upper Gangetic plains and the adjacent Siwalik and sub-Himalayan tracts* (1903 — 29) covers the parts of Madhya Pradesh lying north and west of the Vindhyan Range. Forsyth gave an interesting account of the forests and tribal life in *The Highlands of Central India* (1871). Hole (1904), Haines (1916) and Witt (1908, 1911, 1916) published mainly on woody elements or economic plants of different regions. Mooney's *Supplement to the Botany of Bihar and Orissa* (1950) includes some plants from Jashpur and Surguja and his sketch of the flora of the Bailadila range published in *Indian Forest Records* (1942) is the first account of plants of Bastar district. Other significant contributions on the flora of Madhya Pradesh were made by Wood (1902), Biscoe (1910), Kenoyer (1924), Pathak (1926), Sagreiya (1938), Sagreiya and Singh (1959), Maheshwari (1958, 1960, 1961, 1962, 1963), Sebastine and Balakrishnan (1963), Joseph (1963), Joseph and Vajravelu (1967), Kapoor and Yadav (1962), A.S. Rao and Sastry (1965), Subramanyam and Henry (1967), S.D.N. Tiwari (1963, 1968, 1972, 1979), Jain (1963, 1964, 1965), Panigrahi *et al* (1965, 1966, 1967), Panigrahi and Murti (1989), Saxena (1972, 1976), Sengupta and Ram Lal (1973), Oommachan (1977), Verma *et al* (1981, 1985), Mukherjee (1984), Lal and Anand Kumar (1986), Khanna (1989, 1990, 1991) and Srivastava (1983, 1985, 1987, 1989), Sengupta (1977), Verma (1977), Chakraverty and Verma (1985) have given a detailed account of plant exploration and floristic publications concerning Madhya Pradesh.

It may be seen that unlike other Indian regions covered by various regional Floras like those of Cooke (1901 — 1908), Prain (1903), Haines (1921 — 1925), Duthie (1903 — 1929), Gamble (1915 — 1936), Kanjilal *et al* (1934 — 1940) and Bamber (1916), the State of Madhya Pradesh does not have a Flora of its own. There appears to be two main reasons for it. Firstly, the state with its present political boundaries did not exist in the first quarter of the century when Flora publications by some experienced and devoted

botanists were at its peak, and secondly large tracts were unexplored or inadequately explored. The present Flora of Madhya Pradesh fills up this gap in our knowledge of Indian botany.

USEFUL PLANTS

From times immemorial, plants have been used as a source of food, shelter, clothing, medicine, fibre, gum, resin and oil, and for an array of other miscellaneous purposes. Several species are put to more than one use, and some are more important than the others for the same purpose. There are quite a few monumental works like those of Watt (1889 — 1892), Kirtikar and Basu (1935), Wealth of India (Anonymous 1949 — 1976), Agarwal (1986), Useful Plants of India (Anonymous 1986), and others, dealing with the economic and medicinal plants of India. Detailed information on these aspects can always be obtained from these. However, an introduction to a regional Flora will appear incomplete without some insight into its useful elements but a detailed account would become a burden on the Flora. Hence, only a list of more important useful species has been provided below. These species have been categorized, as per their most common use, into timber wood, edible plants, medicinal plants and plants of miscellaneous use.

1. Timber Wood : (for construction work, railway sleepers, poles, agricultural implements, furniture, carts and instruments etc.) :

Acacia nilotica ssp. *indica*, *Adina cordifolia*, *Anogeissus latifolia*, *A. pendula*, *Azadirachta indica*, *Dalbergia latifolia*, *D. sissoo*, *Gmelina arborea*, *Hardwickia binata*, *Mangifera indica*, *Michelia champaca*, *Ougeinia oojeinensis*, *Prosopis cineraria*, *Pterocarpus marsupium*, *Schleichera oleosa*, *Shorea robusta*, *Syzygium cuminii*, *Tectona grandis*, *Terminalia alata* and *Xylia xylocarpa* yield the more valued timber of long durability and strength, and are popularly in use. Other species falling into this group are *Acacia leucophloea*, *Alangium salvifolium*, *Albizia* spp., *Alstonia scholaris*, *Anthocephalus cadamba*, *Careya arborea*, *Toona ciliata*, *Cleistanthus collinus*, *Diospyros* spp., *Eucalyptus* spp., *Garuga pinnata*, *Kydia calycina*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Litsea monopetala*, *Mitragyna parvifolia*, *Putranjiva roxburghii*, *Schrebera swietenoides*, *Sterculia* spp. *Stereospermum* spp., *Trewia nudiflora* and *Ziziphus* spp.

2. Edible plants :

(i) Rhizomes / tubers (cooked) of *Curcuma* spp. *Dioscorea bulbifera*, *D. glabra*, *D. pentaphylla*, *D. puber*, *Eleocharis dulcis*, *Manihot esculenta*, *Nelumbo nucifera*, *Nymphaea* spp., *Nymphoides indicum*, *Sauromatum venosum* and *Tacca leontopetaloides*.

(ii) **Leaves and tender shoots** : (cooked) of *Amaranthus* spp., *Amorphophallus sylvaticus*, *Basella alba*, *Bauhinia* spp., *Cassia tora*, *Cleome gynandra*, *Cocculus hirsutus*, *Corchorus* spp., *Dendrocalamus strictus*, *Glossocardia bosvallea*, *Gnaphalium indicum*, *Hibiscus furcatus*, *H. radiatus*, *H. sabdariffa*, *Holostemma annularis*, *Ipomoea aquatica*, *I. quamoclit*, *Lysimachia candida*, *Martynia annua*, *Melochia corchorifolia*, *Melothria heterophylla*, *Merremia emarginata*, *Neptunia oleracea*, *Nymphoides heterophylla*, *N. Indica*, *Olax scandens*, *Ottelia alismoides*, *Oxalis corniculata*, *Oxystelma secamone*, *Pergularia daemia*, *Phoenix acaulis*, *Phyla nodiflora*, *Polygonum* spp., *Portulaca oleracea*, *Rivea hypocrateriformis*, *Sonchus* spp. and *Tribulus terrestris*.

(iii) **Flowers** : (cooked) of *Bauhinia purpurea*, *B. racemosa*, *Celastrus paniculatus*, *Hibiscus sabdariffa* (calyx), *Holostemma annularis*, *Madhuca longifolia* var. *latifolia*, *Moringa oleifera*, *Nelumbo nucifera* (carpels), *Oxystelma secamone*, *Pergularia daemia*, *Semecarpus anacardium*, *Sesbania grandiflora* and *Woodfordia fruticosa*.

(iv) **Fruits** : (raw, cooked or pickled) of *Abelmoschus esculentus*, *Aegle marmelos*, *Annona reticulata*, *A. squamosa*, *Antidesma ghaesembilla*, *Artocarpus* spp., *Buchanania lanzan* (seeds), *Carissa* spp., *Cordia obliqua*, *Dillenia indica*, *D. pentagyna*, *Diospyros malabarica*, *D. melanoxylon*, *Embelia tsjeriam-cottam*, *Emblica officinalis*, *Erycibe paniculata*, *Feronia limonia*, *Ficus hispida*, *F. racemosa*, *F. semicordata*, *F. virens*, *Flacourtia indica*, *Gmelina arborea*, *Grewia* spp., *Mangifera indica*, *Manilkara hexandra*, *Melothria heterophylla*, *Momordica dioica*, *Moringa oleifera*, *Ottelia alismoides*, *Oxystelma secamone*, *Parkia biglandulosa*, *Phoenix acaulis*, *P. sylvestris* (toddy), *Prosopis cineraria*, *Solanum torvum*, *Spondias pinnata*, *Syzygium cuminii*, *S. heyneanum*, *Tamarindus indica*, *Trapa natans* var. *bispinosa*, *Xeromphis uliginosa*, *Ziziphus mauritiana* and *Z. rugosa*.

(v) **Seeds** : (cooked or roasted) of *Bauhinia vahlii*, *Cassia occidentalis*, *Coix aquatica*, *Eleusine coracona*, *Indigofera glandulosa*, *Oryza rufipogon*, *Panicum sumatrense*, *Paspalum flavidum*, *P. scrobiculatum*, *Pithecellobium dulce* (raw seed aril), *Semecarpus anacardium*, *Sterculia urens*, *Vigna aconitifolia*, *V. trilobata* and *V. umbellata*.

3. Medicinal plants :

Madhya Pradesh is known to harbour a rich wealth of medicinal plants which continues to be used for amelioration of people's sufferings.

The following list of 193 species contains only those with established medicinal properties and generally used by Indian Pharmaceutical Industries. Scattered notes gathered during field exploration on medicinal uses by local people have been given under individual species.

Abrus precatorius, *Abutilon indicum*, *Acacia catechu*, *A. farnesiana*, *A. nilotica* spp. *indica*, *A. senegal*, *A. sinuata*, *Achyranthes aspera*, *Acorus calamus*, *Adhatoda vasica*, *Aegle marmelos*, *Alangium salvifolium*, *Albizia lebeck*, *Alternanthera sessilis*, *Alstonia scholaris*, *Amaranthus caudatus*, *A. spinosus*, *Andrographis echinoides*, *A. paniculata*, *Anogeissus latifolia*, *Anthocephalus cadamba*, *Argemone mexicana*, *Argyreia nervosa*, *A. strigosa*, *Asparagus racemosus*, *Azadirachta indica*, *Bacopa monnieri*, *Balanites aegyptiaca*, *Baliospermum montanum*, *Bambusa arundinacea*, *Barleria cristata*, *B. prionitis*, *Barringtonia acutangula*, *Bauhinia racemosa*, *B. tomentosa*, *B. vahlii*, *B. variegata*, *Berberis asiatica*, *B. lycium*, *Blepharispermum subsessile*, *Boerhavia diffusa*, *Bombax ceiba*, *Butea monosperma*, *Caesalpinia bonduc*, *Calotropis gigantea*, *C. procera*, *Canscora decussata*, *Careya arborea*, *Cassia absus*, *C. auriculata*, *C. fistula*, *C. obtusifolia*, *C. occidentalis*, *C. tora*, *Cassytha filiformis*, *Catharanthus pusillus*, *C. roseus*, *Celastrus paniculatus*, *Centella asiatica*, *Cissampelos pareira* var. *hirsuta*, *Cleome simplicifolia*, *C. viscosa*, *Clerodendrum indicum*, *C. phlomidis*, *C. serratum*, *Clitoria ternatea*, *Cocculus hirsutus*, *Convolvulus arvensis*, *C. microphyllus* *Cordia obliqua*, *Costus speciosus*, *Crateva nurvala*, *Crinum asiaticum*, *Crotalaria juncea*, *Curculigo orchioides*, *Curcuma aromatica*, *C. zedoaria*, *Cynodon dactylon*, *Cyperus rotundus*, *Dalbergia sisoo*, *Datura metel*, *D. stramonium*, *Desmodium gangeticum*, *D. triflorum*, *Desmostachya bipinnata*, *Diospyros peregrina*, *Diplocyclos palmatus*, *Dregea volubilis*, *Eclipta prostrata*, *Embelia tsjeriam-cottam*, *Embllica officinalis*, *Emilia sonchifolia*, *Enicostema axillare*, *Erythrina variegata*, *Eucalyptus* spp., *Eulophia nuda*, *Euphorbia hirta*, *E. nerifolia*, *E. tirucalli*, *Evolvulus alsinoides*, *Girardinia zeylanica*, *Gmelina arborea*, *Gossypium arboreum*, *G. herbaceum*, *Guizotia abyssinica*, *Gymnema sylvestri*, *Helicteres isora*, *Hemidesmus indica*, *Holarrhena antidysenterica*, *Hygrophila auriculata*, *Ichnocarpus frutescens*, *Ipomoea nil*, *Lawsonia inermis*, *Lepidium sativum*, *Leptadenia reticulata*, *Leucas capitata*, *Litsea monopetala*, *Macrotyloma uniflorum*, *Madhuca longifolia* var. *latifolia*, *Mallotus philippensis*, *Manilkara hexandra*, *Marsdenia volubilis*, *Martynia annua*, *Melia azedarach*, *Mimosa pudica*, *Momordica charantia*, *Mucuna prurita*, *Nelumbo nucifera*, *Nymphaea nouchali*, *N. pubescens*, *Ocimum basilicum*, *O. sanctum*, *Oldenlandia corymbosa*, *Operculina turpethum*, *Oroxylum indicum*, *Oxalis corniculata*, *Pavonia odorata*, *Peucedanum nagpurensis*, *Phyllanthus amarus*, *Pistia stratiotes*, *Plantago* sp., *Plumbago zeylanica*, *Polygala arvensis*, *Pongamia pinnata*, *Psoralea corylifolia*, *Pterocarpus marsupium*, *Rauvolfia serpentina*, *Saccharum spontaneum*, *Salvia plebeia*, *Sapindus emarginatus*, *Scirpus grossus*, *Semecarpus anacardium*, *Sesamum orientale*, *Shorea robusta*, *Sida acuta*, *S. alba*, *S. cordata*, *S. cordifolia*, *S. rhombifolia*, *Smilax zeylanica*, *Solanum indicum*, *S. nigrum*, *S. surattense*, *Sphaeranthus indicus*, *Spilanthes acmella*, *Sterculia urens*, *Stereospermum suaveolens*, *Strychnos nux-vomica*, *S. potatorum*, *Syzygium cuminii*, *Tamarindus indica*, *Tectona grandis*, *Tephrosia purpurea*, *Terminalia arjuna*, *T. bellirica*, *T. chebula*, *Thalictrum foliolosum*, *Thespesia lampas*, *Tinospora cordifolia*, *Trewia nudiflora*, *Tribulus terrestris*, *Tridax procumbens*, *Uraria picta*,

Urginea indica, *Vanda tessellata*, *Vernonia cinerea*, *Vetiveria zizanioides*, *Vitex negundo*, *V. peduncularis*, *Woodfordia fruticosa*, *Xeromphis spinosa*, *Ziziphus mauritiana* and *Z. oenoplia*.

4. Plants of miscellaneous use :

- (i) **Aquaria plants** are *Hydrilla verticillata* and *Vallisneria natans*.
- (ii) **Bamboo sticks and poles** from *Bambusa* spp., *Cephalostachyum pergracile* and *Dendrocalamus strictus*.
- (iii) **Baskets, hats and mats etc.** from *Arundo donax*, *Calamus* spp., *Cyperus pangorei*, *Dendrocalamus strictus*, *Diospyros melanoxylon*, *Fimbristylis globulosa*, *Indigofera cassioides*, *Phoenix acaulis*, *P. sylvestris*, *Phragmites karka*, *Scirpus grossus* and *Typha angustata*.
- (iv) **Beverages and drinks** from *Cassia occidentalis*, *Madhuca longifolia* var. *latifolia*, *Oryza sativa*, *Phoenix sylvestris* and *Tamarindus indica*.
- (v) **Bidi rolling** from leaves of *Bauhinia vahlii* and *Diospyros melanoxylon*.
- (vi) **Brooms** from *Arundo donax*, *Dendrocalamus strictus*, *Phoenix acaulis*, *Sida acuta* and *Thysanolaena maxima*.
- (vii) **Cotton** from various species and hybrids of *Gossypium*, and silk cotton from *Bombax ceiba*.
- (viii) **Detergent** for washing hairs from powdered pods of *Acacia sinuata* known as Shikakai and liquid obtained after soaking fruits of *Sapindus emarginatus* in water.
- (ix) **Dye** from *Acacia catechu*, *Butea monosperma*, *Curcuma* spp., *Lawsonia inermis*, *Mallotus philippensis*, *Nyctanthes arbortristis*, *Pterocarpus marsupium*, *Toona ciliata*, *Woodfordia fruticosa* and *Wrightia tinctoria*.
- (x) **Fibre** from *Abelmoschus* spp., *Abutilon* spp., *Agave americana*, *Bauhinia purpurea*, *B. vahlii*, *Butea monosperma*, *Calotropis gigantea*, *C. procera*, *Corchorus* spp., *Crotalaria juncea*, *Eulaliopsis binata*, *Grewia* spp; *Helicteres isora*, *Hibiscus cannabinus*, *H. radiatus*, *H. sabdariffa*, *Marsdenia tenacissima*, *Melochia corchorifolia*, *Sida* spp., *Soymida febrifuga*, *Triumfetta rhomboidea*, *Typha angustata* and *Urena lobata*.
- (xi) **Fish poison** from fruit pulp of *Acacia sinuata*, *Casearia elliptica*, *Cleistanthus collinus*, *Gardenia turgida* and *Xeromphis spinosa*, roots of *Millettia extensa* and bark of *Barringtonia acutangula*.
- (xii) **Floss** for stuffing pillows and seats from *Bombax ceiba*, *Calotropis gigantea*, *C. procera*, *Cochlospermum religiosum* and *Gossypium* spp.
- (xiii) **Gum** from *Acacia ferruginea*, *A. nilotica* ssp. *indica*, *A. senegal*, *Anogeissus latifolia*, *Boswellia serrata*, *Cochlospermum religiosum*,

- Gardenia gummifera*, *Lannea coromandelica*, *Sterculia urens* and *Woodfordia fruticosa*.
- (xiv) **Insect repellent oil** from leaves of *Azadirachta indica* and *Cymbopogon martinii*.
- (xv) **Jaggery** from stem sap of *Phoenix sylvestris*.
- (xvi) **Kattha** (Catechu) from Wood of *Acacia catechu*.
- (xvii) **Khus tatties** from roots of *Vetiveria zizanioides*.
- (xviii) **Oil** (for paints, varnishes, lubrication, tanning, soap, massaging and illumination etc.) from *Argemone mexicana*, *Boswellia serrata*, *Buchanania lanzan*, *Casearia graveolens*, *Celastrus paniculata*, *Cochlospermum religiosum*, *Gossypium* spp., *Guizotia abyssinica*, *Jatropha curcas*, *Litsea monopetala*, *Madhuca longifolia* var. *latifolia*, *Mallotus philippensis*, *Nyctanthes arbor-tristis*, *Pongamia pinnata*, *Putranjiva roxburghii*, *Ricinus communis*, *Schleichera oleosa*, *Semecarpus anacardium*, *Shorea robusta*, *Sterculia urens*, *Tamarindus indica* and *Ventilago denticulata*.
- (xix) **Paper pulp** from *Boswellia serrata*, *Dendrocalamus strictus*, *Eucalyptus* spp., *Kydia calycina* and *Pterocarpus marsupium*.
- (xx) **Perfume** from essential oil from *Cymbopogon* spp., *Jasminum* spp., *Michelia champaca* and *Vetiveria zizanioides*.
- (xxi) **Pith** (for cutting microscopic sections) from *Aeschynomene aspera* and *A. indica*.
- (xxii) **Platters and bowls** from leaves of *Bauhinia vahlii*, *Butea monosperma*, *Madhuca longifolia* var. *latifolia*, *Musa* spp. and *Shorea robusta*.
- (xxiii) **Ply-wood** from various soft timber spp.
- (xxiv) **Thatching** of huts from *Oryza sativa*, *Phoenix acaulis*, *P. sylvestris*, *Saccharum spontaneum* and *Typha angustata*.
- (xxv) **Weighing** (Ratti- the jeweller's weight) with seeds of *Abrus precatorius*.
- (xxvi) **Wood** (for toys, combs, decorations, matchsticks, packing cases, splinters, pencil and scale etc.) *Aeschynomene* spp., *Ailanthus excelsa*, *Boswellia serrata*, *Erythrina suberosa*, *Holarrhena antidysenterica*, *Holoptelia integrifolia*, *Kydia calycina*, *Mallotus philippensis*, *Toona ciliata* and *Wrightia tinctoria*.

MATERIALS AND PRESENTATION

The specimens deposited in the Herbarium of the Botanical Survey of India, Central Circle, Allahabad (BSA) have been the main source of material for writing the present Flora. The Herbarium contains all the plant collections made by the institution since its inception in July, 1962. The

exploration and plant collection tours were planned to several parts of Madhya Pradesh in different seasons, covering various vegetation types, altitudinal ranges, reserved and protected forests, wastelands, cultivated fields, road-sides, river-banks, stream-beds and all other conceivable ecological niches. Plant survey and collection is something that can never be achieved in full. Changes in floristic composition in any area due to biotic pressures and several other environmental stresses and plant migration, is a well-known phenomenon. Besides, there is always a likelihood of missing some plants during the plant collection trips. However, a total of about 40,000 field numbers, collected as above from Madhya Pradesh give a good spectrum of flora of the state. In addition to these, the authors have also consulted various other herbaria, like Central National Herbarium, Howrah (CAL), Regional herbaria of the Botanical Survey of India at Pune (BSI) and Coimbatore (MH), Herbarium of the State Forest Research Institute, Jabalpur, and National Botanical Research Institute, Lucknow. These have in general yielded in some additional distribution data. These are then the specimens studied, and the authors bear responsibility for their correct identity, descriptions and notes. There have also been a few taxa which have been reported from Madhya Pradesh by some earlier workers but of which the specimens have not been seen by the authors. These have been included giving reference to the publication, the details of which are given in the list of References.

The Flora generally includes correct botanical name, basionym, if any, and a very few selected synonyms, with original references, and a references to the Flora of British India by J.D. Hooker (1872-1897). Local names, if available, have been given in the same paragraph, italicized and separated by a hyphen. This is followed by a botanical description, and notes on habitat, distribution within the State (district-wise) and phenology. Concised notes on economic/medicinal uses from the field notes on the herbarium specimens or published literature have also been added. Keys to identification of genera and species have been given at appropriate places. A large number of research papers, monographs, revisions and other Floras have also been consulted for writing this Flora of Madhya Pradesh but these have not been mentioned with a view to save space.

The enumeration of the Flora starts with an account of the Pteridophytes. It includes 102 species belonging to 51 genera and 36 families and have been mainly classified according to the system proposed by Pichi-Sermolli (1977). The whole credit and responsibility of compiling account of this interesting assemblage of ferns and fern allies goes to one of the editors, Dr. R.D. Dixit.

The systematic treatment of Angiosperms broadly follows the classification provided by Bentham and Hooker (1862-1883) with some

deviations according to modern concepts and trends. This first volume contains an account of 83 families, from Ranunculaceae to Plumbaginaceae, with 874 species belonging to 407 genera. Several authors have contributed in this task and their names have been given below each family. It ends with an index to botanical and local names.

The remaining account of about 1500 species of Angiosperms, and a few Gymnosperms, mainly planted, is to be published subsequently with a general index to botanical and local names at the end.

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