

FLORA
OF
PACHMARHI & BORI RESERVES

DR. A.K. MUKHERJEE

BOTANICAL SURVEY OF INDIA

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Series 3

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सत्यमेव जयते

BOTANICAL SURVEY OF INDIA

Department of Environment

● Government of India, April, 1984

Price

Published by the Director, Botanical Survey of India,
Howrah-711103 and printed at Raje Printers,
3/25, Ramesh Nagar, New Delhi-110015

FOREWORD

Pachmarhi in Madhya Pradesh is Darjeeling of Bengal, Abu of Rajasthan or Nainital and Mussorie of Uttar Pradesh. The hills of Pachmarhi are the highest mountains in Central India, and their flora is botanically and phytogeographically unique.

The present work provides a systematic account of over 750 flowering plants belonging to 101 families. Representation of over one hundred families in even part of a political district is indicative of richness and diversity of flora.

Treatment of the flora of Bori Valley provides an opportunity of comparison and contrast between the flora of hills and valleys.

Several works are available on the flora of the plains regions of Madhya Pradesh, e.g. the recent work on Bhopal by Oomachan and several papers of Tiwari on grasses and other groups.

Mukherjee's work on Pachmarhi and Bori Valley will, therefore, fill a significant gap in our knowledge of the plants of the Central Indian region.

Above all, it will provide a handy manual for comparison of the floras of Himalayan mountains in north and northeast, the western ghats and Nilgiris in South with the Central Indian mountain flora.

Botanical Survey of India
Howrah
18-4-1984.

S.K. Jain

PREFACE

Pachmarhi and Bori forest ranges are very interesting botanically. University students often visit the area for plant collections. Some check-lists have been published on the area, but they lack proper treatment of nomenclature and reference to other Indian floras. There is no detailed flora for the area which can be consulted by the students and forest officials to assess the natural plant wealth and identify the plants of the area.

The main objective of this flora are (i) to provide a census of the rich resources and a means of identifying the plants of the area ; (ii) to give up to date nomenclature ; (iii) to record ecological conditions responsible for different types of forest vegetation ; (iv) to aid the conservation of flora.

The introductory section gives a brief resume of geographical features and topography, geology and soil, climate, survey of previous explorations and effects of biotic factors.

The flora deals with the systematic analysis of 778 species belonging to 452 genera and 101 families. In addition, data are provided on forest types, phytogeographical and statistical analysis.

The author expresses his deep sense of gratitude to Dr. S. K. Jain, Director ; Dr. A. S. Rao, former Joint Director and Dr. N. P. Balakrishnan, Deputy Director, Botanical survey of India for guidance and facilities.

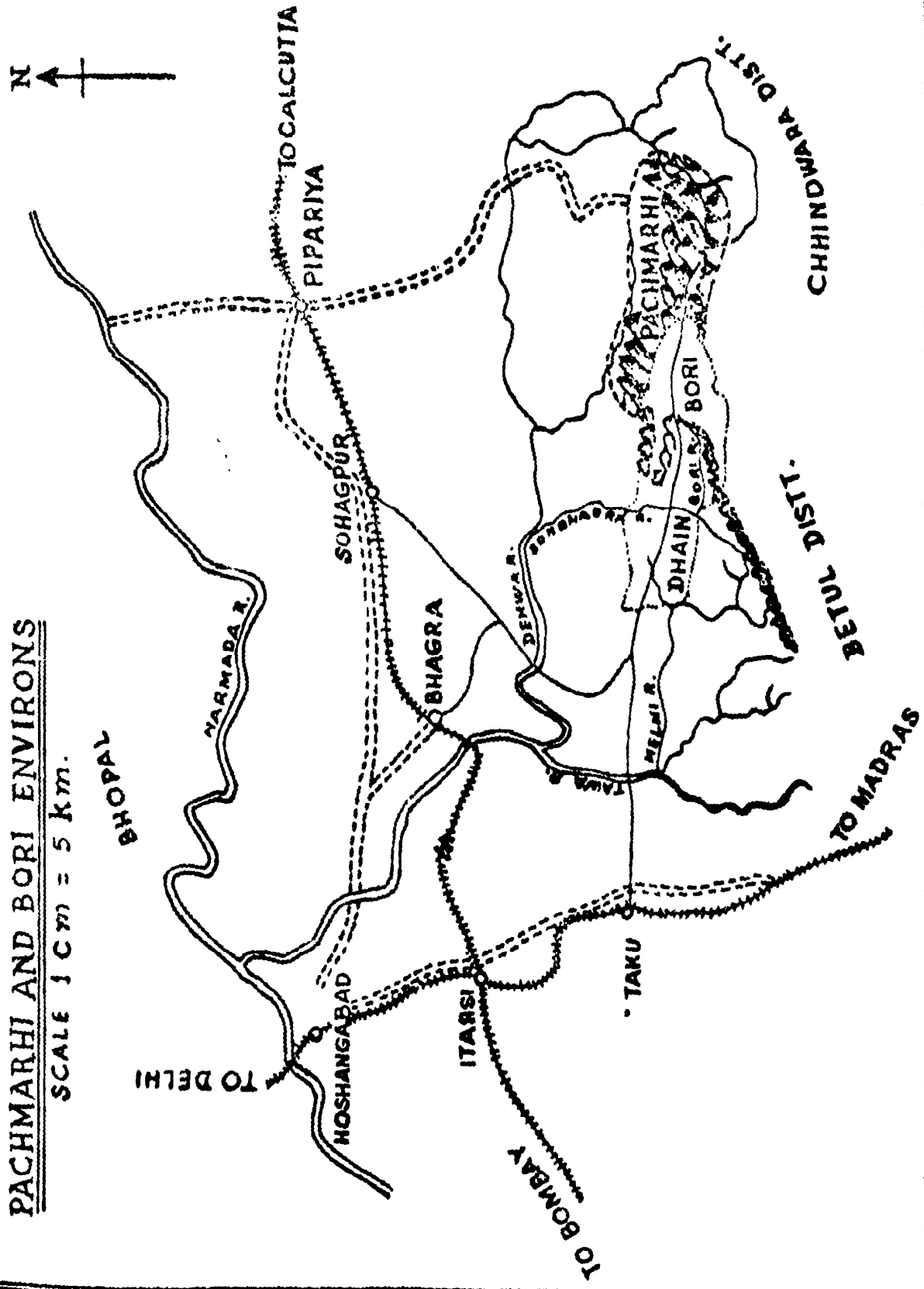
He is also indebted to the research scholars, officers and staff of the Central Circle, Botanical Survey of India, Allahabad for providing all types of help during the preparation of this work.

Botanical Survey of India
Allahabad
26th March, 1984

A. K. Mukherjee
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PACHMARHI AND BORI ENVIRONS

SCALE 1 CM = 5 km.



INTRODUCTION

Satpura National Park consists of two forest ranges namely, Pachmarhi Forest Range and Bori Forest Range.

Pachmarhi Forest Range is situated in the Pachmarhi Plateau of the Mahadev hills of Madhya Pradesh. Pachmarhi town is the only hill station of Madhya Pradesh which attracts tourists and students, being an excellent place for botanizing.

The Bori Forest Range lies in the valley of Bori River, which flows west from Dhupgarh, the highest point in the Madhya Pradesh, for a distance of about 20 km to join the Sonbhadra River. The valley is more or less wedge shaped, the point starts from the foot of the Mahadev hills among whose peaks lies the Pachmarhi Plateau and gradually widens as it extends westwards to the Sonbhadra River where the base of the wedge is about 12 km wide. The valley is bounded on the north by the precipitous sandstone scarp of a long spur running west from the main massif of the Mahadeo Range, and rising up to a height of 1150 m like a vast wall. The average elevation of the bottom of the valley is about 430 m. To the west of the valley the country is a flat plateau. Thus, Bori forest range lies in a long funnel like depression of about 100 sq. km. and provides contrast with the Pachmarhi forest range which lies on a Plateau of about 60 sq. km at an elevation of about 1,000 m surrounded by prominent peaks like Mahadeo (1,328m) on the south, Chauradeo (1,312 m) on the south - east and Dhupgarh (1,350 m) on the South - west. The remarkable feature in the configuration of the Plateau is the vast and unexpected ravines in the solid rock. The Pachmarhi and Bori forest ranges are situated between 22°15'-22°28' N latitude and 78°13'-78°26' E longitude. Pachmarhi town is about 51 km from Pipariya, the nearest railway station and Bori forest range is about 65 km from Sohagpur, the nearest railway station on Calcutta Bombay railway lines in the Hoshangabad district of Madhya Pradesh.

GEOLOGY AND SOIL

The rocks of Pachmarhi and Bori forest ranges belong to Upper and Lower Gondwana series. In Pachmarhi hills these rocks consist chiefly of coarse sand stones and conglomerates while in Bori valley these consist of sand stones and large masses of extruded or inter bedded trap besides sandy shales.

(ii)

CLIMATE

It is well known that the type of vegetation depends on climatic, edaphic and biotic factors. Thus high annual rainfall, high relative humidity, high temperature and small variations in these factors characterise the rather monotonous environment of the rich and luxuriant tropical flora.

Pachmarhi and Bori forest ranges because of their altitudinal and latitudinal location are much away from the dust storms and heat waves of the Indo-Gangetic Plains. The climate is comparatively cooler than the northern districts of the Vindhyan Plateau, with rainfall mainly confined to S.W. monsoon.

TEMPERATURE

The hottest months are May and June with 40°C as the average maximum and 22°C as the average minimum temperature. January and February are the coldest months with 8°C as the average minimum temperature.

RAINFALL

The pre-monsoon showers are usually experienced as early as the end of May and the heaviest rain come in July and August after which there is a gradual diminution till the monsoon ends in October. In most years there are occasional storms from December to February.

The peculiar configuration of the Bori valley, open as it is to the west and to some extent to the south and with abrupt obstacle to the S.W. monsoon winds by the Dhupgarh ranges accounts for the heavy rainfall received.

The average rainfall at Pachmarhi is about 200 cm and at Bori 250 cm. Due to the peculiar configuration of the valley heavy dew continue frequently up to March so that the forest remains green in Bori valley for a considerably longer period than does the ordinary teak forest of the Madhya Pradesh.

RELATIVE HUMIDITY

The relative humidity is highest during July and August and the lowest in April and May. The Bori valley, owing to its peculiar configuration, remains naturally more humid than that of the Pachmarhi plateau.

(iii)

Thus, the combined favourable factors of high rainfall, high relative humidity coupled with moderate temperature characterize the Pachmarhi and Bori forest ranges where the vegetation assumes tropical luxuriance. The Bori forest range where the soil derived from the trap is very fertile and which enjoys a long growing season harbours one of the finest teak forests in India.

PREVIOUS EXPLORATIONS

Captain Forsyth, the author of the most interesting book (The Highlands of Central India, 1871) was the first explorer of the area who reached Pachmarhi in 1862, built the first bungalow there, the famous 'Bison Lodge' and explored the Pachmarhi and Bori forests. Attracted by the descriptions and the informations given by Captain Forsyth, many botanists visited the area and made important contributions to the flora of the area namely, Stewart & Brandis (1874), Gamble (1892), Hole (1906), Witt (1916) Graham (1914-15), Haines (1916), Mukherjee (1923), Rao and Narayanaswami (1960), Kapoor & Yadav (1962), Joseph (1964) Panigrahi *et al.* (1965a, 1965b, 1966a, 1966b, 1967), Patel *et al.* (1962), Ram Lal & Panigrahi (1967), Shukla & Panigrahi (1967), Tiwari (1954, 1955, 1963, 1964), Tiwari & Maheshwari (1963, 1964, 1965) and Saxena (1973).

EFFECTS OF BIOTIC FACTORS

Before 1859 the Pachmarhi and Bori forest areas had been subjected to continuous shifting cultivation or *dahya* by the then considerable local population of Gonds and Korkus. In the *dahyas* some of the larger trees were left standing after pollarding and the rest of the forest ruthlessly cut down and burnt. In 1862 when the forests were taken over by the newly formed Forest Department, the *dhaya* cultivation was rigorously suppressed and systematic fire protection was introduced in 1884. In 1865, the Bori forest was notified as a Reserve under the Forest Act (first in India). The local population were induced to settle elsewhere and only two villages were settled in the Reserve. Thus Bori range has remained undisturbed by normal biotic factors for over one hundred years.

But biotic factors are more and more active in the Pachmarhi forest range owing to the establishment of the township and other development projects.

THE FLORA

GENERAL

Present Studies

The results presented in this flora are based on the collections of V. Narayanaswamy, August, 1949 (*CAL*) ; J. Joseph, September and October, 1960 and April, May & July, 1961 (*BSA* and *MH*) ; G. Panigrahi, December, 1962 and July, 1964 (*BSA*) ; P.C. Pant, February, 1978 (*BSA*) ; and publications made on Pachmarhi and Bori forest ranges specially by the officers of the Botanical Survey of India, viz. Rao & Narayanaswami (1960), Kapoor & Yadav (1962), Joseph (1964), Panigrahi *et al.* (1965a, 1965b, 1966a, 1966b, 1967), Patel *et al.* (1962), Ram Lal & Panigrahi (1967), Shukla & Panigrahi (1967), Tiwari (1954, 1955, 1963, 1964), Tiwari & Maheshwari (1963, 1964, 1965), Saxena (1973), and Verma & Chandra (1979 & 1981) have been consulted.

The plan

The families are arranged according to a modified system of Bentham & Hooker (1862-1883) as adopted by Kew and British Museum (N.H.) and reflected by the reorganisation of the Central National Herbarium (*CAL*) (See Table 1).

The genera within families and species within genera are arranged in alphabetical sequence and numbered serially. The keys are constructed for easy identification of the plants of Pachmarhi and Bori forest ranges.

The nomenclature contains the correct name with full reference of author(s), basionym, if any, and reference to the names accepted in the "Flora of British India" and to the local flora or monographs and taxonomic revisions, if any. Abbreviations of periodicals are according to the present usage.

Area of collection with approximate altitude, habitat with abundance, flowering and fruiting time follows the concise description of each species.

Forest types

There are broadly two types of forests in Pachmarhi and Bori forest ranges namely, I. Sub-tropical Hill Forests and II. Tropical Moist Deciduous Forests.

(v)

The first type is localised at high elevations around Pachmarhi receiving high rainfall over 175 cm. The forest is characterised by larger proportion of evergreen species like *Syzygium cumini* (L) Skeels, *Rhus ellipticus* J.E. Sm., *Melastoma malabathricum* L., *Murraya paniculata* (L.) Jack., *Dillenia pentagyna* Roxb., *Sterculia villosa* Roxb., *Mangifera indica* L., *Salix tetrasperma* Roxb. etc.

Flemingia bracteata (Roxb.) Wt. *F. macrophylla* (Willd.) Prain, *Sophora interrupta* Bedd. are common in the undergrowth. The important climbers are *Acacia torta* (Roxb.) Craib, *Clematis triloba* Heyne, *C. roylii* Rehder, *Milletia auriculata* Baker, *Butea superba* Roxb. etc.

Tree ferns namely, *Cyathea gigantea* (Wall.) Holt. and *C. latebrosa* (Wall.) Copel. are found in the deep gorges with perennial waters.

In lower elevations around Pachmarhi the second type of forest is found. This type occurs in locations having annual rainfall of 100 to 170 cm. The species which are characteristic of these forests are *Shorea robusta* Gaertn. f., *Kydia calycina* Roxb., *Lagerstroemia parviflora* Roxb., *Pterocarpus marsupium* Roxb., *Bridelia retusa* Spr. along with common forest species of Madhya Pradesh like *Terminalia alata* Heyne ex Roxb., *Bombax ceiba* L., *Emblia officinalis* Gaertn., *Hymenodictyon excelsum* (Roxb.) Wall., *Buchanania lanzan* Spr., *Diospyros melanoxylon* Roxb., *Ougeinia oojeinensis* Benth. etc.

Indigofera pulchella Roxb., *Desmodium* spp., *Crotalaria* spp., *Flemingia bracteata* (Roxb.) Wt. etc. are found as the undergrowth.

In Bori forest range *Tectona grandis* L.f. is the dominant species. The forest is well stocked and the height of the stand is over 25 meters. *Pterocarpus marsupium* Roxb., *Terminalia alata* Heyne ex Roth, *Ougeinia oojeinensis* Benth., *Aegle marmelos* Correa, *Adina cordifolia* Hook. f. *Anogeissus latifolia* (DC.) Wall. ex Bedd. are commonly found along with the common species of Madhya Pradesh. *Bauhinia vahlii* Wt. & Arn., *Butea superba* Roxb. and *Acacia pennata* (L.) Willd. are common climbers.

There are a number of interesting plants which do not occur elsewhere in Madhya Pradesh, except in Pachmarhi namely, *Melastoma malabathricum* L., *Murraya paniculata* (L.) Jack., *Holmskioldia sanguinea* Retz., *Blumea lanceolaria* (Roxb.) Druce and *Sophora interrupta* Bedd.

It is interesting to note that *Shorea robusta* Gaertn. f. is the dominant species of Pachmarhi, and apparently this is the western limit of distribution of the species in the midst of the teak areas of Madhya Pradesh, while teak (*Tectona grandis* L. f.) is absent from this plateau.

(vi)

On the contrary the teak is the dominant tree in the Bori valley. It flourishes on trap soil but is invariably poor and stunted on sandstones. The alluvial soil along the banks of the large streams and of the Bori river produces some exceptionally fine teak forest also but the low hills along both sides of the valley which have trap soil produces the best teak stands.

The above facts indicate that the teak is a moisture loving species and grows well in heavy soil usually up to an altitude of 900 m. On the other hand 'Sal' (*Shorea robusta* Gaertn. f.) favours well drained soil derived from sand stones and conglomerates as found at Pachmarhi and can grow at higher altitudes than that of teak. Moreover, *Shorea* being an element of a primitive family than that of *Tectona* (Takhtajan, 1969), it cannot compete with teak in the habitat suitable for teak. On the other hand soil moisture becomes the limiting factor for the growth of teak at Pachmari 'Sal' forest. Therefore, the distribution of 'Sal' and teak is so markedly distinct in Pachmarhi and Bori forest ranges and proves that the edaphic factor is very important for the distribution of certain plants.

TABLE 1. SEQUENCE OF FAMILIES AFTER
BENTHAM & HOOKER (1862-1883)

1. Ranunculaceae	52. Stylidiaceae
2. Dilleniaceae	53. Campanulaceae
3. Magnoliaceae	54. Plumbaginaceae
4. Menispermaceae	55. Primulaceae
5. Berberidaceae	56. Myrsinaceae
6. Papaveraceae	57. Sapotaceae
7. Brassicaceae	58. Ebenaceae
8. Capparaceae	59. Oleaceae
9. Violaceae	60. Apocynaceae
10. Flacourtiaceae	61. Asclepiadaceae
11. Cochlospermaceae	62. Loganiaceae
12. Polygalaceae	63. Gentianaceae
13. Caryophyllaceae	64. Menyanthaceae
14. Dipterocarpaceae	65. Boraginaceae
15. Malvaceae	66. Convolvulaceae
16. Bombacaceae	67. Solanaceae
17. Sterculiaceae	68. Scrophulariaceae
18. Tiliaceae	69. Lentibulariaceae
19. Linaceae	70. Gesneriaceae
20. Geraniaceae	71. Bignoniaceae
21. Oxalidaceae	72. Pedaliaceae
22. Balsaminaceae	73. Acanthaceae
23. Rutaceae	74. Verbenaceae
24. Burseraceae	75. Lamiaceae
25. Meliaceae	76. Amaranthaceae
26. Celastraceae	77. Chenopodiaceae
27. Rhamnaceae	78. Polygonaceae
28. Vitaceae	79. Lauraceae
29. Lecaceae	80. Loranthaceae
30. Sapindaceae	81. Santalaceae
31. Anacardiaceae	82. Euphorbiaceae
32. Papilionaceae	83. Ulmaceae
33. Caesalpiniaceae	84. Urticaceae
34. Mimosaceae	85. Moraceae
35. Rosaceae	86. Salicaceae
36. Droseraceae	87. Pinaceae
37. Combretaceae	88. Cupressaceae
38. Myrtaceae	89. Orchidaceae
39. Lecythidaceae	90. Zingiberaceae
40. Melastomataceae	91. Costaceae
41. Lythraceae	92. Musaceae
42. Onagraceae	93. Hypoxidaceae
43. Passifloraceae	94. Dioscoreaceae
44. Cucurbitaceae	95. Liliaceae
45. Begoniaceae	96. Commelinaceae
46. Cactaceae	97. Arecaceae
47. Aizoaceae	98. Araceae
48. Apiaceae	99. Eriocaulaceae
49. Araliaceae	100. Cyperaceae
50. Rubiaceae	101. Poaceae
51. Asteraceae	

TABLE 2. ARRANGEMENT OF TAXA OF PACHMARHI AND BORI
FOREST RANGES ACCORDING TO PHYLOGENETIC
CLASSIFICATION OF TAKHTAJAN, 1969.

Class-Magnoliatae

Sub-class A-G ; Super orders I—XV ; Orders 1—74.

Sl. no.	Family	No. of genera	No. of species	Occurrence
1	2	3	4	5
1. A I 1.	Magnoliaceae	1	1	Pachmarhi
2. A I 2.	Lauraceae	1	1	Pachmarhi & Bori
3. B II 9.	Menispermaceae	1	1	Pachmarhi
4. B II 9.	Ranunculaceae	3	3	Pachmarhi
5. B II 9.	Berberidaceae	1	2	Pachmarhi
6. B II 10.	Papaveraceae	1	2	Pachmarhi & Bori
7. C III 18.	Ulmaceae	1	1	Pachmarhi & Bori
8. C III 18.	Moraceae	2	12	Pachmarhi & Bori
9. C III 18.	Urticaceae	5	7	Pachmarhi & Bori
10. D IV 27.	Aizoaceae	2	3	Pachmarhi & Bori
11. D IV 27.	Cactaceae	1	1	Bori
12. D IV 27.	Caryophyllaceae	3	3	Pachmarhi & Bori
13. D IV 27.	Amaranthaceae	8	10	Pachmarhi & Bori
14. D IV 27.	Chenopodiaceae	1	1	Pachmarhi & Bori
15. D IV 28.	Polygonaceae	3	5	Pachmarhi
16. D IV 29.	Plumbaginaceae	1	1	Pachmarhi & Bori
17. E V 31.	Dilleniaceae	1	1	Pachmarhi
18. E V 33.	Dipterocarpaceae	1	1	Pachmarhi
19. E V 34.	Violaceae	2	2	Pachmarhi
20. E V 34.	Flacourtiaceae	2	2	Pachmarhi & Bori
21. E V 34.	Cochlospermaceae	1	1	Pachmarhi
22. E V 35.	Passifloraceae	1	1	Pachmarhi
23. E V 36.	Cucurbitaceae	7	10	Pachmarhi & Bori

Sl. no. 1	Family 2	No. of genera 3	No. of Species 4	Occurrence 5
24. E V 37.	Begoniaceae	1	2	Pachmarhi & Bori
25. E V 38.	Capparaceae	1	2	Pachmarhi & Bori
26. E V 38.	Brassicaceae	5	5	Pachmarhi & Bori
27. E V 40.	Salicaceae	1	1	Pachmarhi
28. E V 43.	Ebenaceae	1	1	Pachmarhi & Bori
29. E VI 43.	Sapotaceae	1	1	Pachmarhi & Bori
30. E VI 44.	Myrsinaceae	1	1	Pachmarhi
31. E VI 44.	Primulaceae	2	3	Pachmarhi
32. E VII 45.	Tiliaceae	3	12	Pachmarhi & Bori
33. E VII 45.	Sterculiaceae	4	5	Pachmarhi
34. E VII. 45.	Bombacaceae	1	1	Pachmarhi
35. E VII 45.	Malvaceae	6	14	Pachmarhi & Bori
36. E VII 46.	Euphorbiaceae	12	24	Pachmarhi & Bori
37. F VIII 49.	Rosaceae	3	3	Pachmarhi & Bori
38. F VIII 50.	Mimosaceae	4	9	Pachmarhi & Bori
39. F VIII 50.	Caesalpiniaceae	4	12	Pachmarhi & Bori
40. F VIII 50.	Fabaceae	31	66	Pachmarhi & Bori
41. F VIII 52.	Droseraceae	1	2	Pachmarhi
42. F IX 54.	Lythraceae	4	8	Pachmarhi & Bori
43. F IX 54.	Combretaceae	2	5	Pachmarhi & Bori
44. F IX 54.	Lecythidaceae	1	1	Pachmarhi
45. F IX 54.	Myrtaceae	1	1	Pachmarhi & Bori
46. F IX 54.	Melastomataceae	3	3	Pachmarhi
47. F IX 54.	Onagraceae	5	5	Pachmarhi & Bori
48. F X 56.	Anacardiaceae	5	5	Pachmarhi
49. F X 56.	Burseraceae	2	2	Pachmarhi

Sl. no. 1				Family 2	No. of genera 3	No. of Species 4	Occurrence 5
50.	F	X	56.	Rutaceae	3	4	Pachmarhi & Bori
51.	F	X	56.	Meliaceae	3	3	Pachmarhi
52.	F	X	57.	Sapindaceae	2	2	Pachmarhi
53.	F	X	58.	Linaceae	2	2	Pachmarhi
54.	F	X	58.	Oxalidaceae	2	6	Pachmarhi & Bori
55.	F	X	58.	Geraniaceae	1	1	Pachmarhi
56.	F	X	58.	Balsaminaceae	1	3	Pachmarhi & Bori
57.	F	X	59.	Polygalaceae	1	3	Pachmarhi
58.	F	X	60.	Araliaceae	1	1	Pachmarhi
59.	F	XI	60.	Apiaceae	7	12	Pachmarhi & Bori
60.	F	XII	61.	Celastraceae	2	2	Pachmarhi
61.	F	XII	62.	Rhamnaceae	4	7	Pachmarhi & Bori
62.	F	XII	62.	Vitaceae	3	4	Pachmarhi & Bori
63.	F	XII	62.	Leeaceae	1	2	Pachmarhi
64.	F	XII	63.	Oleaceae	2	5	Pachmarhi
65.	F	XII	64.	Santalaceae	1	1	Pachmarhi
66.	F	XII	64.	Loranthaceae	3	4	Pachmarhi & Bori
67.	G	XIV	68.	Loganiaceae	3	4	Pachmarhi & Bori
68.	G.	XIV	68.	Apocynaceae	5	6	Pachmarhi & Bori
69.	G	XIV	68.	Asclepiadaceae	10	12	Pachmarhi & Bori
70.	G	XIV	68.	Gentianaceae	4	8	Pachmarhi & Bori
71.	G	XIV	68.	Rubiaceae	16	22	Pachmarhi & Bori
72.	G	XIV	68.	Menyanthaceae	1	1	Bori
73.	G	XIV	69.	Convolvulaceae	4	11	Pachmarhi & Bori
74.	G	XIV	69.	Boraginaceae	6	10	Pachmarhi & Bori
75.	G	XIV	70.	Solanaceae	4	9	Pachmarhi & Bori
76.	G	XIV	70.	Scrophulariaceae	12	22	Pachmarhi & Bori

Sl. no. 1		Family 2	No. of genera 3	No. of Species 4	Occurrence 5
77.	G XIV 70.	Bignoniaceae	4	4	Pachmarhi & Bori
78.	G XIV 70.	Pedaliaceae	1	1	Bori
79.	G XIV 70.	Gesneriaceae	2	2	Pachmarhi & Bori
80.	G XIV 70.	Lentibulariaceae	1	6	Pachmarhi
81.	G XIV 70.	Acanthaceae	22	34	Pachmarhi & Bori
82.	G XIV 71.	Verbenaceae	10	12	Pachmarhi & Bori
83.	G XIV 71.	Lamiaceae	13	24	Pachmarhi & Bori
84.	G XV 72.	Stylidiaceae	1	1	Pachmarhi
85.	G XV 72.	Campanulaceae	3	3	Pachmarhi & Bori
86.	G XV 74.	Asteraceae	33	50	Pachmarhi & Bori
Class - Liliatae					
Sub - class A-D; Super order I-V ; Orders 75-94.					
87.	B II 79.	Hypoxidaceae	1	1	Pachmarhi
88.	B II 79.	Dioscoreaceae	1	7	Pachmarhi & Bori
89.	B II 79.	Liliaceae	6	7	Pachmarhi & Bori
90.	B II 81.	Musaceae	1	1	Pachmarhi
91.	B II 81.	Costaceae	1	1	Pachmarhi & Bori
92.	B II 81.	Zingiberaceae	5	6	Pachmarhi & Bori
93.	B II 82.	Orchidaceae	13	21	Pachmarhi
94.	C III 84.	Cyperaceae	8	39	Pachmarhi & Bori
95.	C IV 86.	Commelinaceae	4	9	Pachmarhi & Bori
96.	C IV 87.	Eriocaulaceae	1	5	Pachmarhi & Bori
97.	C IV 89.	Poaceae	57	102	Pachmarhi & Bori
98.	C V 90.	Arecaceae	1	3	Pachmarhi & Bori
99.	C V 92.	Araceae	5	5	Pachmarhi
Gymnosperms					
100.	Pinaceae		1	1	Pachmarhi
101.	Cupressaceae		1	1	Pachmarhi

TABLE 3. ANALYSIS OF TAXA OF PACHMRHI AND BORI
FOREST RANGES.

No. of families	No. of genera	No. of species		
101	452	778	Trees &	
			Shrubs	247
			Herbs	531

Ten dominant families

Sl. no.	Flora of Pachmarhi and Bori forest ranges	No. of genera	No. of species
1.	Poaceae	57	102
2.	Fabaceae (Papilionaceae Caesalpiniaceae & Mimosaceae)	39	87
3.	Asteraceae	33	50
4.	Cyperaceae	8	39
5.	Acanthaceae	22	34
6.	Euphorbiaceae	12	24
7.	Lamiaceae	13	24
8.	Rubiaceae	16	22
9.	Scrophulariaceae	12	22
10.	Orchidaceae	13	21
	Total	224	325
	Percentage of total :	49.5	41.7

Statistics

The flora of Pachmarhi and Bori forest ranges is made up of 101 families consisting of 452 genera and 778 species. The species consist of 247 trees and shrubs and 531 herbs (Table-3).

The 3rd position of Asteraceae and 7th position of Lamiaceae, which are more temperate in nature, indicates the semi-temperate nature of the vegetation. The monocotyledonous families namely, Poaceae, Cyperaceae and Orchidaceae account 50% species under the ten dominant families of the area. It indicates the dominance of monocotyledonous plants in the area (Table-3).

The flora of Pachmarhi and Bori forest ranges represent all the Subclasses and Super orders of Magnoliatae except Super order XIII Prot-aenae, (mostly Southern Hemispheric plants) and all the Subclasses and Super orders of Liliatae except Subclass A-Alismidae (mostly aquatic plants) according to phylogenetic classification of Takhtajan, 1962 (Table-2).

According to Jaccard (1912), the generic coefficient of a flora, i.e. the number of genera expressed as a percentage of the number of species provides information on the variety of habitats, or on the relative intensity of intergeneric and intrageneric competition in the area. The higher the generic coefficient the more varied are the habitats and intergeneric and intrageneric competition in the area.

The generic coefficient for the Flora of Pachmarhi and Bori Forest Ranges (Table-3) is : $G = \frac{452 \times 100}{778} = 58.0\%$. This high percentage of generic coefficient indicates that the present composition of the area is the result of intense intergeneric and intrageneric competition in varied types of microclimates which may be utilised for the introduction of species growing in similar microclimates elsewhere in the country. It is supported by the fact that these microclimates are naturally supporting both the tropical and temperate elements.

Out of 101 families of the flora of Pachmarhi and Bori forest ranges, 36 are restricted to Pachmarhi range and 4 to Bori range. Out of 36 families restricted to Pachmarhi range, 17 families are represented by only 1 genus (Table-2).

In the flora, out of 101 families, 31 are represented by 1 species, 13 by a 2 species and 11 by 3 species. In case of genera, 43 families are represented by 1 genus, 13 by 2 genera and 12 by 3 genera (Table-2).

Such a low number of species and genera in more than 50% families of the flora indicate its relict nature.

Darwin (On the Origin of species, 6th ed. 1876, p. 403) concluded that as a general rule, the number of species of each group gradually increases towards the maximum, and then, sooner or later, a gradual decrease of the species number occurs.

The area of Pachmarhi and Bori forest ranges is existing from the Gondwana time. The flora had undergone many changes during the past ages owing to migration to and fro during the past periods of glaciation, climatic changes, pressure of succession and intense biotic interference in the recent times. All the above factors together contributed to the relict nature of the flora.

Bews, J. W. (Studies in the Ecological Evolution of the Angiosperms: Wheldon & Wesley Ltd. London. 70. 1927) observed that while the species which appear relatively late in the plant succession are usually very rigid in their requirement and show a small range of variation in their physiological processes, the species which act as pioneers or appear early in the plant succession are much more plastic physiologically. But the climax species belong to more primitive types of plant form than the pioneer species. An increase of physiological plasticity, therefore, has been one of the trends of evolutionary development.

Out of 86 dicot families having 568 species the primitive 32 families have only 100 species (i.e. 37% primitive families having only 18% species). This indicates that the flora of the area is heavily disturbed by human interference and the primitive families are represented by relict species only.

The presence of many temperate elements of the area, common with the Himalayas, poses the problems of migration across the gangetic plain. W. T. Blanford, one of the greatest workers in the field of Indian geology and natural history, as quoted by Wadia (Geology of India 1957 ; P-379) says that a great portion of the temperate fauna and flora of the South Indian hills has inhabited the country from a much more distant epoch than the glacial period may be considered as almost certain, there being so many peculiar forms. It is possible that the species common to Ceylon, the Nilgiris and the Anamalai may have migrated at a time when the country was damper without the temperature being lower.

Bews (loc. cit. P. 289) says that the tropical rain forests has existed in certain tropical regions ever since the rise of the Angiosperms, when the climate of the world during Jurassic times, and at least until the close of the Cretaceous, was far more uniformly warm and moist than it is now, and the land surfaces were mostly reduced nearly to sea level, such conditions must have been much more widespread. With increasing climatic differentiation, however, with the advent of pronounced dry seasons, with

a general lowering of temperatures as the land surfaces of the world became upraised into great mountain ranges, the moist tropical belt became more and more contracted.

The distribution of fossil Cretaceous reptiles points to unrestricted inter-migration of land animals over Mesozoic Indo-African-American continent or archipelago. The northern frontier of this continent was washed by the waters of the Tethys. This southern continent persisted till the commencement of the Cainozoic age, when, collaterally with other physical revolution in India, (volcanic activities) large segments of it drifted away, or subsided, permanently, under the ocean, to form what are now the Bay of Bengal, the Arabian Sea, etc., thus isolating the Peninsula of India, with sea on all sides (Wadia, *loc. cit.* p. 173).

The angiosperms undoubtedly originated long before the Cretaceous period. The specialised character and astonishingly modern facies of many cretaceous angiosperms confirm the belief that they might have originated in the lower Mesozoic. (Takhtajan, 1969, P. 122).

Owing to higher evolutionary plasticity the angiosperms could adapt themselves to the sudden changes in physio-geographical conditions of upper cretaceous period (continental drift and volcanic activities) and were able to colonise not only mountains but also extensive areas of lowlands (Takhtajan, *loc. cit.* P. 131).

The present distribution of the more primitive living angiosperms leads to the conclusion that the original centre of distribution of the angiosperms was situated somewhere between eastern India and Polynesia, i.e. the south-east Asia of to-day (Takhtajan, *loc. cit.* p. 156).

The presence of entire phylogenetic series linking temperate forms with subtropical and tropical ones in the eastern Himalayas, Assam, Yunnan, Upper Burma, North Vietnam and Eastern Asia is evidence that this part of the Asian continent is the primary centre of origin of the temperate flora of the northern hemisphere (Takhtajan, *loc. cit.* p. 171).

The Rajmahal-Assam gap is of recent origin, the two being connected underground at a small depth. The downwarp which produced the Gangetic geosyncline must have started as a concomitant of the Himalayan elevation to the north somewhere in the mid-Eocene (Wadia, *loc. cit.* p. 391).

The Assam plateau must be regarded as a plateau of erosion, a detached outlying fragment of the Peninsula, connected with it through the intermittent Rajmahal hills (Wadia, *loc. cit.* P. 434).

The foregoing facts indicate that the present temperate elements of South India and Ceylon migrated from their place of origin in the South-

East Asia of to-day, i.e. the north-east portion of the Gondwana land of Cretaceous epoch, much earlier than the Pleistocene glaciation.

It is probable that they migrated in the Cretaceous period when Peninsular India and the adjacent areas were damper without the temperature being lower and were covered with tropical rain forest. With increasing climate differentiation with the advent of pronounced dry seasons, with a general lowering of temperatures as the land surfaces of the world became upraised into great mountain ranges, the moist tropical belt became more and more contracted in the Tertiary period when the temperate elements of the moist tropical forest had to take refuge to the hill tops of the Peninsular India and Ceylon. Thus it created a serious problem for the present phytogeographers to correlate the occurrence of these temperate elements both in the Himalayas and on the hill tops of Peninsular India and Ceylon.

Key to Groups of Seed Plants from Pachmarhi and Bori forest ranges.

1a. Seeds and ovules enclosed in megasporophyll (Carpel).

Stigma present :

2a. Flowers usually 4-5 merous. Venation usually reticulate. Stem with central pith and or surrounded by concentric rings of woody tissue, bark separable. Cotyledons usually 2 :

3a. Perianth absent (achlamydous) or uniseriate (monochlamydous)

Group 1

3b. Perianth biseriate or multiseriate :

4a. Petals all united, at least at base

Group 2

4b. Petals free or only some united :

5a. Ovary inferior or half-inferior

Group 3

5b. Ovary superior :

6a. Stamens more than twice as many as petals

Group 4

6b. Stamens twice as many as petals or fewer

Group 5

2b. Flowers usually 4-merous. Venation usually striate. Stem without central pith. Woody substance in scattered bundles. Outer rind firmly attached. Cotyledon 1

Group 6

1b. Seeds and ovules borne on surface of megasporophylls.

Stigma none

Group 7

GROUP 1. ACHLAMYDOUS AND MONOCHLAMYDOUS DICOTS

Key To Families

- 1a. Perianth none :
 - 2a. Flowers in cyathia ... EUPHORBIACEAE 82
 - 2b. Flowers in spikes ... SALICACEAE 86
- 1b. Perianth present :
 - 3a. Ovary inferior or apparently so, being tightly invested by persistent hypanthium :
 - 4a. Plants herbaceous :
 - 5a. Leaves alternate. Flowers unisexual. Ovary truly inferior ... BEGONIACEAE 45
 - 5b. Leaves opposite. Flowers bisexual, ovary appearing to be inferior ... LYTHRACEAE 41
 - 4b. Plants woody :
 - 6a. Plants parasitic ... LORANTHACEAE 80
 - 6b. Plants not parasitic :
 - 7a. Stamens 10, twice as many as calyx lobes ... COMBRETACEAE 37
 - 7b. Stamens 3 - 5, as many as calyx lobes ... SANTALACEAE 81
 - 3b. Ovary superior :
 - 8a. Anthers dehiscing by 2 or 4 upcurled lids ... LAURACEAE 79
 - 8b. Anthers not dehiscing by lids :
 - 9a. Pistils 2 or more (carpels free) :
 - 10a. Trees ... STERCULIACEAE 17
 - 10b. Herbs ... RANUNCULACEAE 1
 - 9b. Pistils solitary (carpels 1 or united) :
 - 11a. Ovary 2 - 5 locular :
 - 12a. Ovary axile ... EUPHORBIACEAE 82
 - 12b. Ovules all or mostly basal :
 - 13a. Herbs. Capsule circumscissile ... AIZOACEAE 47

13b. Woody. Capsule not circumscissile :

14a. Plants armed. Leaves simple, triplinerved ... RHAMNACEAE 27
(*Ziziphus*)

14b. Plants unarmed. Leaves compound, or if simple then not triplinerved ... SAPINDACEAE 30

11b. Ovary 1-locular :

15a. Plants twining (single petal in female flower ; corolline cupule in male) ... MENISPERMACEAE 4
(*Cissampelos*)

15b. Plants not twining :

16a. Herbs :

17a. Stipules ochreate ... POLYGONACEAE 78

17b. Stipules absent or not ochreate :

18a. Perianth and bracts scarious. Stamens often connate below ... AMARANTHACEAE 76

18b. Perianth and bracts not scarious. Stamens free :

19a. Flowers unisexual.
Style undivided.
Leaves triplinerved ... URTICACEAE 84

19b. Flowers bisexual.
Style 2 - more-branched.
Leaves pinnately veined ... CHENOPODIACEAE 77

16b. Woody plants :

20a. Leaves compound :

21a. Flowers regular ... MIMOSACEAE 34

21b. Flowers zygomorphic :

22a. Corolla papilionaceous ... PAPILIONACEAE 32

22b. Corolla not papilionaceous ... CAESALPINIACEAE 33

20b. Leaves simple :

23a. Stipules present :

24a. Style branched :

- 25a. Anthers inflexed and reversed in bud. Ovule 1, apical ... MORACEAE 85
- 25b. Anthers erect in bud :
 - 26a. Ovule solitary, apical ... ULMACEAE 83
 - 26b. Ovules 2, basal ... EUPHORBIACEAE 82 (*Antidesma*)
- 24b. Style undivided :
 - 27a. Placentation parietal ... FLACOURTIACEAE 10 (*Casearia*)
 - 27b. Placentation not so :
 - 28a. Ovule apical ... MORACEAE 85
 - 28b. Ovule basal ... URTICACEAE 84
- 23b. Stipules none ... FLACOURTIACEAE 10 (*Flacourtia*)

GROUP 2. SYNPE TALOID DICOTS

- 1a. Stamens more than corolla lobes :
 - 2a. Ovary inferior ... CACTACEAE 46
 - 2b. Ovary superior :
 - 3a. Leaves compound :
 - 4a. Flowers regular ... MIMOSACEAE 34
 - 4b. Flowers zygomorphic :
 - 5a. Corolla papilionaceous ... PAPILIONACEAE 32
 - 5b. Corolla not papilionaceous ... CAESALPINIACEAE 33
 - 3b. Leaves simple :
 - 6a. Corolla urceolate. Flowers usually unisexual ... EBENACEAE 58

- 6b. Corolla rotate to campanulate. Flowers bisexual ... SAPOTACEAE 57
- 1b. Stamens as many as petals or fewer :
 - 7a. Ovary partly or wholly inferior :
 - 8a. Tendril-bearing vines ... CUCURBITACEAE 44
 - 8b. Plants not tendriferous :
 - 9a. Anthers syngenesious :
 - 10a. Stamens 2 ... STYLIDIACEAE 52
 - 10b. Stamens more than 2 :
 - 11a. Flowers in involucre heads. Ovary 1-locular ... ASTERACEAE 51
 - 11b. Flowers not in heads. Ovary 2-more-locular ... CAMPANULACEAE 53
 - 9b. Anthers free :
 - 12a. Leaves opposite ... RUBIACEAE 50
 - 12b. Leaves alternate ... CAMPANULACEAE 53
 - 7b. Ovary superior :
 - 13a. Stamens opposite the petals :
 - 14a. Ovary 2-many-locular. Placentation axile :
 - 15a. Leaves compound. Stamens united by filaments ... LEEACEAE 29
 - 15b. Leaves simple. Stamens free from each other :
 - 16a. Corolla urceolate. Stamens free from petals. Flowers usually unisexual ... EBENACEAE 58
 - 16b. Corolla rotate. Stamens epipetalous. Flowers bisexual ... SAPOTACEAE 57
 - 14b. Ovary 1-locular. Placentation free-central :
 - 17a. Styles 5. Flowers long-tubular. Calyx with stalked glands ... PLUMBAGINACEAE 54
 - 17b. Style 1. Flowers rotate. Calyx not glandular :
 - 18a. Herbs. Leaves usually opposite. Perianth not gland-dotted. Fruit circumscissile ... PRIMULACEAE 55
 - 18b. Shurbs. Leaves alternate. Perianth gland-dotted. Fruit fleshy ... MYRSINACEAE 56

13b. Stamens alternate with the petals :

19a. Corolla irregular. Stamens 4 or 2 :

- 20a. Fruit elastically dehiscent. Seeds often on upcurved processes. Inflorescence usually with conspicuous bracts. ... ACANTHACEAE 73

20b. Not as above :

21a. Ovules and seeds few :

- 22a. Ovary 4-lobed. Style arising from between the lobes of the ovary ... LAMIACEAE 75

22b. Ovary entire. Style apical :

- 23a. Plants viscid-pubescent ... PEDALIACEAE 72

- 23b. Plants not viscid-pubescent ... VERBENACEAE 74

21b. Ovules and seeds many :

- 24a. Leaves compound. Seeds winged ... BIGNONIACEAE 71

24b. Leaves simple. Seeds not winged :

- 25a. Placentation free-central. Plants aquatic or of wet places, typically with small insectivorous bladders ... LENTIBULARIACEAE 69

25b. Placentation parietal or axile. Plants not insectivorous :

- 26a. Placentation axillary, solid and unbranched ... SCROPHULARIACEAE 68

26b. Placentation parietal, often intruded and meeting below middle of locule but branched or winged :

- 27a. Perianth 4-5 merous. Corolla contorted ... GENTIANACEAE 63

- 27b. Perianth 5-merous.
Corolla imbricate or valvate ... **GESNERIACEAE 70**
- 19b. Corolla regular. Stamens usually 5 :
 - 28a. Leaves alternate :
 - 29a. Ovules and seeds many :
 - 30a. Plants aquatic. Placentation parietal ... **MENYANTHACEAE 64**
 - 30b. Plants terrestrial. Placentation axile ... **SOLANACEAE 67**
 - 31a. Fruits capsular. Corolla usually plicate. Plants usually climbing...
... **CONVOLVULACEAE 66**
 - 31b. Fruits dry with 4 nutlets or drupaceous with 1-4-locular pyrene ... **BORAGINACEAE 65**
 - 28b. Leaves opposite :
 - 32a. Stamens 2, fewer than corolla lobes ... **OLEACEAE 59**
 - 32b. Stamens 4 or more, as many as the corolla lobes :
 - 33a. Carpels free at base. Sap usually milky :
 - 34a. Carpels united only at stigmatic disk. Pollen aggregated into masses which are connected in pairs to stigmatic glands ... **ASCLEPIADACEAE 61**
 - 34b. Carpels united by styles. Pollen not aggregated into pollinia ... **APOCYNACEAE 60**
 - 33b. Carpels entirely united :
 - 35a. Sap milky ... **APOCYNACEAE 60**
 - 35b. Sap clear :
 - 36a. Herbs :
 - 37a. Plants hispid. Ovary 4-locular, 4-ovuled ... **BORAGINACEAE 65**

- 37b. Plants glabrous. Ovary
1 locular,
many - ovulate ... GENTIANACEAE 63

36b. Plants woody :

- 38a. Ovules pendulous. Seeds
or pyrene
solitary.
Fruit drupaceous with
persistent
calyx ... VERBENACEAE 74

- 38b. Ovules axile.
Seeds 2 or
more ... LOGANIACEAE 62

GROUP 3. POLYPETALOID DICOTS WITH INFERIOR OVARY

- 1a. Stamens many, more than twice as many as petals :
- 2a. Styles more than one. Flowers unisexual ... BEGONIACEAE 45
- 2b. Style 1. Flowers bisexual :
- 3a. Petals many. Plants armed, succulent, virtually
leafless ... CACTACEAE 46
- 3b. Petals few. Plants unarmed, woody, leafy :
- 4a. Leaves opposite, gland-dotted ... MYRTACEAE 38
- 4b. Leaves alternate, not gland-dotted ... LECYTHIDACEAE 39
- 1b. Stamens few, twice as many as petals or fewer :
- 5a. Styles more than 1 :
- 6a. Herbs. Fruits of two mericarps ... APIACEAE 48
- 6b. Woody plants. Fruit drupaceous or capsular ... ARALIACEAE 49
- 5b. Style 1 :
- 7a. Herbs :
- 8a. Leaves cauline, alternate ; venation pinnate.
Anthers longitudinally dehiscent ... ONAGRACEAE 42

- | | | |
|--|-----|--------------------------|
| 8b. Leaves basal or opposite ; venation palmate. | | |
| Anthers poricidal | ... | MELASTOMATA -
CEAE 40 |
| 7b. Woody plants | ... | MELASTOMATA -
CEAE 40 |

GROUP 4. POLYPETALOID DICOTS WITH SUPERIOR OVARY AND MANY STAMENS

1a. Pistils more than 1 :

- | | | |
|--|-----|----------------|
| 2a. Stamens monadelphous | ... | MALVACEAE 15 |
| 2b. Stamens free : | | |
| 3a. Stamens perigynous (arising from hypanthium) | ... | ROSACEAE 35 |
| 3b. Stamens hypogynous (arising from receptacle) : | | |
| 4a. Perianth multiseriate | ... | MAGNOLIACEAE 3 |
| 4b. Perianth 2-3-seriate | ... | DILLENIACEAE 2 |

1b. Pistil 1 :

- | | | |
|--|-----|----------------------------------|
| 5a. Stamens perigynous (arising from hypanthium) : | | |
| 6a. Leaves opposite. Fruit a capsule | ... | LYTHRACEAE 41 |
| 6b. Leaves alternate. Fruit a drupe | ... | ROSACEAE 35
(<i>Prunus</i>) |
| 5b. Stamens hypogynous (arising from receptacle) : | | |
| 7a. Stamens monadelphous : | | |
| 8a. Leaves digitately compound | ... | BOMBACACEAE 16 |
| 8b. Leaves simple | ... | MALVACEAE 15 |
| 7b. Stamens free or polyadelphous : | | |
| 9a. Ovary stipitate (on gynophore) : | | |
| 10a. Stamens in 5 phalanges of 3 stamens each. | | |
| Venation palmate | ... | STERCULIACEAE 17 |
| 10b. Stamens free. Venation pinnate | ... | CAPPARACEAE 8 |
| 9b. Ovary sessile : | | |
| 11a. Flowers unisexual | ... | EUPHORBIACEAE 82 |
| 11b. Flowers bisexual : | | |
| 12a. Venation palmate : | | |
| 13a. Flowers axillary. Placensation | | |
| axile | ... | TILIACEAE 18 |

- 13b. Flowers terminal, Placensation
parietal ... COCHLOSPER-
MACEAE 11

12b. Venation pinnate :

- 14a. Sepals 2, caducous. Leaves
lacerate. Herbs ... PAPAVERACEAE 6

- 14b. Sepals 5, persistent. Leaves
entire-serrate. Woody ... DIPTEROCAR -
PACEAE 14

GROUP 5. POLYPETALOID DICOTS WITH SUPERIOR OVARY AND FEW STAMENS

1a. Ovary 1-locular :

2a. Leaves compound :

- 3a. Styles 3-4. Ovule 1 ... ANACARDIACEAE 31

3b. Style 1. Ovules more than 1 :

- 4a. Flowers regular ... MIMOSACEAE 34

4b. Flowers zygomorphic :

- 5a. Corolla papilionaceous ... PAPILIONACEAE 32

- 5b. Corolla not papilionaceous ... CAESALPINIACEAE 33

2b. Leaves simple :

6a. Ovules 1-2 :

- 7a. Flowers 3-merous, unisexual. Climbers MENISPERMA-
CEAE 4

- 7b. Flowers 4-6-merous, bisexual. Plants erect ... BERBERIDACEAE 5

6b. Ovules 5-many :

8a. Placentation free-central :

- 9a. Stamens alternate with petals ... CARYOPHYLLA-
CEAE 13

9b. Stamens opposite petals :

- 10a. Plants woody. Leaves alternate,
gland - dotted ... MYRSINACEAE
(*Embelia*) 56

- 10b. Herbs. Leaves opposite not gland-
dotted ... PRIMULACEAE 55

8b. Placentation parietal or marginal :

11a. Ovules marginal, on 1 ventral placenta :

12a. Flowers regular ... MIMOSACEAE 34

12b. Flowers zygomorphic :

13a. Corolla papilionaceous ... PAPILIONACEAE 32

13b. Corolla not papilionaceous ... CAESALPINIA-
CEAE 33

11b. Ovules parietal on 2 or more placentas :

14a. Plants insectivorous, covered with
glandular hairs : ... DROSERACEAE 3614b. Plants not insectivorous nor covered
with glandular hairs :15a. Plants with tendrils. Leaves
cordate ... PASSIFLORACEAE 4315b. Plants not climbing. Leaves
cuneate :16a. Ovary on elongate gyno-
phore ... CAPPARACEAE 8

16b. Ovary sessile :

17a. Anther connecti-
ves produced bey-
ond cells ... VIOLACEAE 917b. Anther connecti-
ves not produced ... FLACOURTIACEAE 10

1b. Ovary 2-more-locular :

18a. Herbs :

19a. Stamens tetradynamous, 4 long and 2 short ... BRASSICACEAE 7

19b. Stamens not tetradynamous :

20a. Leaves compound :

21a. Stamens monadelphous ... OXALIDACEAE 21

21b. Stamens free ... GERANIACEAE 20

20b. Leaves simple :

22a. Flowers irregular :

23a. Anthers sessile. Ovary 5-locular.
Ovules many ... BALSAMINACEAE 2223b. Anthers on split sheath. Ovary
2-locular. Ovule 1 per locule ... POLYGALACEAE 12

- 22b. Flowers regular :
 - 24a. Leaves opposite ... LYTHRACEAE 41
 - 24b. Leaves alternate :
 - 25a. Flowers unisexual ... EUPHORBIACEAE 82
 - 25b. Flowers bisexual :
 - 26a. Plants glabrous ... LINACEAE 19
 - 26b. Plants pubescent ... STERCULIACEAE 17
- 18b. Woody plants :
 - 27a. Leaves opposite ... CELASTRACEAE 26
 - 27b. Leaves alternate :
 - 28a. Stamens as many as and opposite petals or fewer :
 - 29a. Style short or none. Plants with tendril. Leaves compound or cordate. Petals thickened at apex. ... VITACEAE 28
 - 29b. Styles as many as locules. Plants without tendril. Leaves simple. ... RHAMNACEAE 27
 - 28b. Stamens as many as and alternate with petals or twice as many as petals :
 - 30a. Leaves pellucidly glandular-punctate ... RUTACEAE 23
 - 30b. Leaves not pellucid-punctate :
 - 31a. Leaves compound :
 - 32a. Disc extrastaminal. Flower often irregular ... SAPINDACEAE 30
 - 32b. Disc intrastaminal. Flower regular :
 - 33a. Filaments of stamens bifid at anther, often united beyond anthers ... MELIACEAE 25
 - 33b. Filaments of stamens not bifid, never united up to anthers :
 - 34a. Stamens as many as petals ... MELIACEAE 25 (*Toona*)
 - 34b. Stamens twice as many as petals ... BURSERACEAE 24

31b. Leaves simple :

35a. Flowers unisexual or bisexual :

36a. Ovules basal. Flowers staminate or bisexual... CELASTRACEAE 26

36b. Ovules axile. Flowers strictly unisexual ... EUPHORBIACEAE 82

35b. Flowers bisexual :

37a. Venation palmate :

38a. Stamens united below ... STERCULIACEAE 17

38b. Stamens free TILIACEAE 18
(*Triumfetta*)

37b. Venation pinnate CELASTRACEAE 26

GROUP 6. MONOCOTS

1a. Perianth not petaloid, reduced to scales or bristles or absent :

2a. Plants woody :

3a. Leaves pinnately divided ARECACEAE 97

3b. Leaves entire POACEAE 101

2b. Plants herbaceous :

4a. Inflorescence of heads or spikelets of florets in the axils of glumaceous bracts :

5a. Inflorescence a solitary head on spirally ribbed peduncle ERIOCAULACEAE 29

5b. Inflorescence various but not as above :

6a. Style 1. Seeds 2 - 3-angled CYPERACEAE 100

6b. Style 2. Seeds round POACEAE 101

4b. Inflorescence not in heads nor in glumaceous spikelets ARACEAE 98

1b. Perianth petaloid, at least in part :

7a. Flowers staminate :

8a. Plants climbing DIOSCOREACEAE 94

8b. Plants not climbing, herbaceous MUSACEAE 92

7b. Flowers pistillate or bisexual :

9a. Ovary superior :

10a. Perianth with 3 petaloid parts COMMELINACEAE 96

10b. Perianth with 6 petaloid parts :

11a. Perianth in 1 series HYPOXIDACEAE 9311b. Perianth in 2 series of 3 each LILIACEAE 95

9b. Ovary inferior :

12a. Plants climbing DIOSCOREACEAE 94

12b. Plants not climbing :

13a. Perianth tubular, split on one side.

Leaves over 2 m long MUSACEAE 92

13b. Perianth parts variously united but not in a split tube. Leaves less than 1 m long. Flowers regular :

14a. Fertile stamens 6 :

15a. Perianth in 1 series HYPOXIDACEAE 9315b. Perianth in 2 series of 3 each LILIACEAE 95

14b. Fertile stamens 1(2). Flowers irregular :

16a. Staminodia not petaloid. Stamen and style united in a column

ORCHIDACEAE 89

16b. Staminodia petaloid. Stamen and style separate :

17a. Aerial stem straight. Leaves 2-ranked ; sheaths open

ZINGIBERACEAE 90

17b. Aerial stem twisting. Leaves spirally arranged ; sheaths closed

COSTACEAE 91

GROUP 7. GYMNOSPERMS

1a. Leaves scale-like, less than 5 mm

CUPRESSACEAE 88

1b. Leaves needle-like, more than 100 mm

PINACEAE 87

FAMILIES

1. RANUNCULACEAE Juss.

- 1a. Leaves alternate. Petiole with stipule-like auricles. Erect herbs *Thalictrum* 3
- 1b. Leaves opposite. Petiole without basal auricle. Climbers :
- 2a. Terminal leaflet modified into a tendril. Petaloid staminode present *Naravelia* 2
- 2b. Terminal leaflet normal. Staminode absent *Clematis* 1

1. CLEMATIS L.

- 1a. Sepals erect with recurved tips. Filaments hairy *C. roylei* 1
- 1b. Sepals spreading from the base. Filaments glabrous *C. triloba* 2

1. *Clematis roylei* Rehder in Journ. Arn. Arb. 22 : 575. 1941 ; Babu, Herb. Fl. Dehra Dun 40. 1977. *Clematis nutans* Royle, Ill. Bot. Himal. 51. 1834 (*non* Crantz, 1763) ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 5. 1872.

Slender, petiolar climber. Leaves 3 foliolate to bipinnately compound, 10 - 20 cm long ; leaflets 2 - 3 cm long on twining petiolules, ovate - lanceolate, with a rounded or often oblique base, acute acuminate or 2 3 lobulate, glabrous or villous. Flowers white, in axillary pubescent or villous panicles ; pedicels up to 3 cm long. Sepals broadly oblong, tomentose outside. Filaments 1.5 - 2 cm long ; anthers mucronate. Achenes ovoid ellipsoid, silky ; styles plumose.

PACHMARHI : Rorighat (1000 m). In shady rocky places. Occasional.

Fl. & Fr. : December - April.

2. *Clematis triloba* Heyne ex Roth, Nov. Pl. Sp. 251. 1821 ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 3. 1872. "*Murhari*".

An extensive climber, villous or tomentose. Stems sulcate. Leaves opposite, simple or once ternate or lobed, ovate, acute or orbicular, base rounded, cuneate or cordate, 3 nerved ; petioles slender, twining, 2 - 8 cm long. Panicles many - flowered. Flowers white, 2 - 2.5 cm ; bracts leafy. Sepals 4 - 6, oblong or obovate, cuspidate. Stamens many, filaments ligulate, glabrous. Carpels many. Fruit a head of ovoid, compressed, villous achenes with long feathery styles.

PACHMARHI : Dhupgarh (1200 m). BORI : Reserve forest (460 m). On hill slopes as climber on shrubs. Common.

Fl. & Fr. : October December.

2. NARAVELIA Adans. mut. DC.

Naravelia zeylanica (L.) DC. Syst. Nat. 1 : 167. 1817 ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 7. 1872 ; Gandhi in Sald. & Nicol. Fl. Hassan 63. 1976. *Atragene zeylanica* L. Sp. Pl. 542. 1753.

Scandent or climbing woody shrubs. Roots tuberous. Leaves 3 foliolate, two opposite leaflets ovate cordate and the terminal one modified into 3 branched tendril. Flowers in panicles. Petaloid staminodes 10 - 14. Stamens many ; anthers with prominent connectives. Achenes red with long feathery styles.

PACHMARHI : Dhupgarh (1200 m). On hill slopes as climber on shrubs. Common.

Fl. & Fr. : November February.

3. THALICTRUM L.

Thalictrum foliolosum DC. Syst. Nat. 1 : 175. 1818 ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 14. 1872 ; Babu, Herb. Fl. Dehra Dun 44. 1977. "*Pilazari*".

Erect, rigid, perennial herbs, up to 2.4 m tall. Rootstocks fibrous. Leaves pinnately decompose ; leaflets 4 - 6 mm ; sub - orbicular. Flowers pale green or dingy purple, polygamous, in branched panicles. Filaments filiform ; anthers beaked. Achenes 2 - 5, 3.5 cm long, acute at both ends and sharply ribbed.

PACHMARHI : Mahadeo hills. (1100 m). 27 7 64, *Panigrahi* 4565 (BSA). On slopes of ravines. Rare.

Fl. & Fr. : July September.

It is a Himalayan species.

2. DILLENIACEAE Salisb.

DILLENIA L.

Dillenia pentagyna Roxb. Pl. Cor. 1 : 21, t. 20. 1795 ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 38. 1872 ; Hoogland in Blumea 7 : 117. 1952 ; Ramam. in Sald. & Nicol. Fl. Hassan 114. 1976. "*Aggai*".

A large deciduous tree, 10–15 m, with a straight cylindrical bole. Leaves up to 60 × 20 cm, oblong lanceolate with acute tip and narrow base, strongly serrate, densely hairy when young ; veins 40–50 pairs ; petiole 2.5–5 cm, winged at base. Flowers yellow, fragrant, 2.5 cm in diam. borne in umbels along thick leafless branches ; pedicels 3–5 cm, red. Sepals 5, orbicular, brown, thick, accrescent. Petals 5, obovate, bright yellow. 10 innermost stamens longer than the rest, recurved. Carpels 5, unilocular. Fruit indehiscent, covered with fleshy, yellow sepals.

PACHMARHI : Around (1000 m). On sandy loam in the sal forest. Occasional.

Fl. & Fr. : January–April.

3. MAGNOLIACEAE Juss.

MICHELIA L.

Michelia champaka L. Sp. Pl. 536. 1753 ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 42. 1872 ; Gandhi in Sald. & Nicol. Fl. Hassan 34. 1976. "*Champa*".

Tall evergreen trees, up to 30 m in height. Bark grey or brownish. Leaves ovate lanceolate, acute to acuminate, coriaceous, 15–20 × 7–9 cm. Flowers usually axillary, solitary, golden yellow or orange, fragrant. Perianth segments 9 or more, oblong, fleshy. Fruits 5–10 cm long ; ripe carpels ovoid or ellipsoid, woody. Seeds brown, angular, with pink fleshy aril.

PACHMARHI : Mahadev hill (1200 m).

Fl. & Fr. March–August.

Cultivated for the fragrant flowers which are sold in the flower market.

4. MENISPERMACEAE Juss.

CISSAMPELOS L.

Cissampelos pareira L. Sp. Pl. 1031. 1753. var. **hirsuta** (Buch. Ham. ex DC.) Forman in Kew Bull. 22 : 356. 1968. Gandhi in Sald. & Nicol. Fl. Hassan 66. 1976. *Cissampelos hirsuta* Buch. Ham. ex DC. Syst. 1 : 535. 1817. *Cissampelos pareira* sensu Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. Ind. 1 : 103. 1872, p. p. ; Babu, Herb. Fl. Dehra Dun 45. 1977. "*Akanadi*".

Slender, twining, softly tomentose, perennial, herbaceous climbers. Leaves ovate to orbicular, apiculate, peltate - cordate at base, 2.5 5.5 × 2.5 4 cm, densely hairy beneath ; venation obscure ; petiole equalling the leaf - blade or longer. Female inflorescence longer than the male, with many conspicuous, imbricate bracts. Flowers greenish white. Drupes ovoid subglobose, red, pilose, with sub basal persistent styler scars.

PACHMARHI : Mahadev hills (1200 m) ; BORI : Dhain (462 m). Climbers on hedges along the edges of forests. Abundant.

Fl. & Fr. : June November.

5. BERBERIDACEAE Juss.

BERBERIS L.

- | | | |
|---|-----|----------------------|
| 1a. Anthers truncate at apex. Leaves obovate,
oblong - obovate or elliptic | ... | <i>B. asiatica</i> 1 |
| 1b. Anthers apiculate. Leaves lanceolate
or oblanceolate | ... | <i>B. lycium</i> 2 |

1. **Berberis asiatica** Roxb. ex DC. Syst. Nat. 2 : 13. 1821 ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 110. 1872 ; Babu, Herb. Fl. Dehra Dun 47. 1977. "*Chitra*".

Spinescent shrubs with terete stem. Spines 1 3 cm long. Leaves thick, rigid, acute, mucronate. Inflorescence 15 20 flowered. Pedicels glabrous, red, 1.5 2.5 cm long. Outer sepals smaller than the inner. Petals obovate ; glands obovate. Berries oblong ovoid, black.

PACHMARHI : Vicinity (1050 m). Growing on hill slopes. Occasional.

Fl. & Fr. : March - June.

2. *Berberis lycium* Royle in Trans. Linn. Soc. Bot. 17 : 94. 1834 ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 110. 1872 ; Babu, Herb. Fl. Dehra Dun 47. 1977. "*Chatroi*".

Spinescent, bushy undershrubs ; stem subterete, internodes 2 2.5 cm long. Spines in clusters of 3, middle one longer, lateral ones 0.7 1.2 cm long. Leaves subsessile, obovate oblanceolate. Flowers yellow in axillary, subsessile, 5 7 cm long racemes. Pedicels 1 1.5 cm long. Outer sepals ovate, subobtuse, inner oblong rounded, obtuse. Petals obovate with a pair of glands inside. Berries ovoid, black.

PACHMARHI : Dhupgarh (1300 m). On hill slopes. Abundant.

Fl. & Fr. : April June.

6. PAPAVERACEAE Juss.

ARGEMONE L.

- | | | |
|---|-----|------------------------|
| 1a. Petals pale yellow or white, up to 3.5 × 2 cm. Stigma - lobes spreading | ... | <i>A. ochroleuca</i> 2 |
| 1b. Petals bright yellow, up to 2.5 × 1.5 cm. Stigma - lobes more or less appressed | ... | <i>A. mexicana</i> 1 |

1. *Argemone mexicana* L. Sp. Pl. 508. 1753 ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 117. 1872 ; Babu, Herb. Fl. Dehra Dun 49. 1977. "*Bhar band*".

Erect, prickly annual herbs with yellow and milky juice. Leaves sinuate pinnatifid, spinulose dentate, prickly on both surfaces, lower ones petioled, upper sessile, with base semi amplexicaule. Flowers terminal, solitary, shortly pedicelled ; bract leafy. Sepals 3, oblong, apex horned, back prickly. Petals obovate. Stigma subsessile, 3 6 lobed, dark red. Capsule oblong ellipsoid, 3 6 valved, spiny ; seeds numerous, reticulate ribbed.

PACHMARHI : Apsara Behar, Downfall, Jatashankar, Rajat Prapat. (900 1050 m). In waste places along road side. common.

Fl. & Fr. : January December.

2. *Argemone ochroleuca* Sweet, Brit. Fl. Gard 3 : t. 242. 1828 ; Ownb. in Mem. Torrey Bot. Cl. 21 : 29 31. 1958 ; Babu, Herb. Fl.

Dehra Dun 50. 1977. *Argemone mexicana* L. var. *ochroleuca* (Sweet) Lindl. Bot. Reg. 1343. 1830.

Erect, prickly, glaucous, annual herbs. Leaves sinuate pinnatifid, spinulose dentate, prickly on the nerves. Flowers sessile, stigma 5 lobed, spreading, dark red. Capsule ovate lanceolate or lanceolate, clothed with spines.

BORI : Reserve forest (450 m). In waste places along road side. Occasional.

Fl. & Fr. : January December.

7. BRASSICACEAE Burn.

1a. Fruit a silicle :

2a. Silicle 2 - seeded ... *Coronopus* 4

2b. Silicle many seeded ... *Cochlearia* 3

1b. Fruit a siliqua :

3a. Siliqua beaked. Lateral sepals saccate at base. Seeds 2 - seriate in each cell ... *Brassica* 1

3b. Siliqua not beaked. Lateral sepals not saccate at base. Seeds 1 - seriate or 2 - seriate in each cell :

4a. Siliqua turgid. Seeds 2 - seriate or irregularly 1 - seriate in each cell. ... *Rorippa* 5

4b. Siliqua compressed. Seeds 1 - seriate in each cell ... *Cardamine* 2

1. BRASSICA L.

Brassica napus L. Sp. Pl. 666. 1753 ; Babu, Herb. Fl. Dehra Dun 54, 1977. *Brassica campestris* L. subsp. *napus* (L.) Hook. f. & T. Anders. in Hook. f. Fl. Brit. Ind. 1 : 156. 1872. "*Tori*".

Erect, glaucous, annual herbs. Basal leaves lyrate pinnatipartite ; upper ones entire, dentate. Flowers yellow. Pods up to 10 cm long (incl. up to 2.5 cm. long beak).

PACHMARHI : Vicinity (1050 m). Cultivated as winter crop.

2. CARDAMINE L.

Cardamine scutata Thunb. in Trans. Linn. Soc. Lond. 2 : 339. 1794 ; Babu, Herb. Fl. Dehra Dun 57. 1977. *Cardamine hirsuta* L. var. *sylvatica* sensu Hook. f. & T. Anders. In Hook. f. Fl. Brit. Ind. 1 : 138. 1872.

Annual herbs with variable habit, size, shape and number of leaflets. Basal leaves orbicular - rounded, sinuate dentate to lobed leaflets ; upper ones ovate rounded to lanceolate, entire crenulate leaflets. Flowers in racemes. Pedicels erectopatent. Petals white, truncate. Stamens 4, rarely with 2 staminodes. Pods 2 2.5 cm long.

BORI : Reserve forest. (500 m). In moist localities among grasses. Abundant.

Fl. & Fr. : February April.

3. COCHLEARIA L.

Cochlearia cochlearioides (Roth) Sant. & Mahesh. in Journ. Bombay Nat. Hist. Soc. 54 : 804. 1957. *Alyssum cochlearioides* Roth, Nov. Pl. Sp. 322. 1821. *Cochlearia flava* Buch. Ham. ex Hook. f. & T. Anders. in Hook. f. Fl. Brit. Ind. 1 : 145. 1872.

Erect, glabrous, annual herbs. Roots long, fusiform. Leaves lanceolate, pinnatifid, lower petioled, upper smaller and auricled ; lobes sinuate toothed. Racemes many. Flowers yellow. Pods globose, smooth. Seeds many, rugose, with filiform funicles.

BORI : Dhain (450 m), 22 12 62, *Panigrahi* 6284 (BSA). Along the bank of streams. Rare.

Fl. & Fr. : December February.

4. CORONOPUS Zinn.

Coronopus didymus (L.) J. E. Smith, Fl. Brit. 2 : 691. 1804 ; Jafri in Fl. W. Pak. 55 : 62. 1973 ; Gandhi in Sald. & Nicol. Fl. Hassan 189. 1976. *Lepidium didymum* L. Syst. 2 : 433. 1759 & Mant. 1 : 92. 1767.

Prostrate annual biennial herbs. Stems covered with simple and bifid hairs. Leaves pinnatipartite pinnatifid ; uppermost part lanceolate, apiculate, entire. Flowers greenish, in racemes. Sepals ovate rounded. petals linear. Stamens 2. Pod small, notched, reticulate.

PACHMARHI : Vicinity (1000 m). Among the grasses, roadside. Occasional.

Fl. & Fr. : November June.

Native of South America ; naturalised.

5. RORIPPA Scop.

Rorippa indica (L.) Hiern, Cat. Afr. Pl. Welw. 1 : 26. 1896 ; Jafri in Fl. W. Pak. 55 : 189. 1973 ; Babu, Herb. Fl. Dehra Dun 61. 1977. *Sisymbrium indicum* L. Mant. 1 : 93. 1767. *Nasturtium indicum* (L.) DC. Syst. Nat. 2 : 199. 1818 ; Hook. f. & T. Anders. in Hook. f. Fl. Brit. Ind. 1 : 134. 1872, *p. p.* *Rorippa dufia* Hara, Fl. E. Himal. 110. 1966.

Erect, glabrous, annual biennial herbs. Leaves lyrate pinnatipartite or pinnatifid ; lower ones petioled, upper sessile with amplexicaul base, often lanceolate oblong. Flowers yellow in elongate racemes. Petals oblanceolate. Stigma subsessile. Pods erect or erecto patent, slightly curved, 1 2.5 cm. long. Seeds subreniform, minutely granulate.

BORI : Reserve forest (450 m). Along roadside, among the grasses. Occasional.

Fl. & Fr. : December July.

8. CAPPARACEAE Juss.

CLEOME L.

- | | | |
|--------------------------|-----|---------------------------|
| 1a. Stamens 6 | ... | <i>C. monophylla</i> 1 |
| 1b. Stamens more than 10 | ... | <i>C. simplicifolia</i> 2 |

1. **Cleome monophylla** L. Sp. Pl. 672. 1753 ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 168. 1872 ; Ramam. in Sald. & Nicol. Fl. Hassan 187. 1976.

Annual herbs with glandular pubescence. Leaves simple, ovate lanceolate, acute acuminate, subcordate. Petals purple to white. Capsule 5-8 cm long. Seeds black, tubercled.

BORI : Reserve forest (450 m). A roadside weed in the forest. Occasional.

Fl. & Fr. : May - August.

2. *Cleome simplicifolia* (Camb.) Hook. f. & Thoms. in Hook. f. *Fl. Brit. Ind.* 1 : 169. 1872. *Polanisia simplicifolia* Camb. in Jacq. *Voy. Bot.* 20. t. 20. 1844.

Much branched annuals. Stems angled. Leaves elliptic or obovate, hirsute. Flowers pink or purple, solitary, axillary. Capsule 2-2.5 cm long. Seeds muricate.

PACHMARHI : Town (1000 m). In waste places along the roads. Occasional.

Fl. & Fr. : June - September.

9. VIOLACEAE Batsch.

1a. Petals unequal in size. Sepals not produced below their insertion ...

Hybanthus 1

1b. Petals equal in size. Sepals produced below their insertion

Viola 2

1. HYBANTHUS Jacq.

Hybanthus enneaspermus (L.) F. v. Muell. *Fragm. Phyt. Austr.* 10 : 81. 1877 ; Babu, *Herb. Fl. Dehra Dun* 64. 1977. *Viola enneasperma* L. *Sp. Pl.* 937. 1753. *Viola suffruticosa* L. *Sp. Pl.* 937. 1753. *Ionidum suffruticosum* (L.) Roem. & Schult. *Syst. Veg.* 5 : 394. 1819 ; Ging. ex DC. *Prodr.* 1 : 311. 1824 ; Hook f. & Thoms. in Hook. f. *Fl. Brit. Ind.* 1 : 185. 1872. "*Ratanpurus*".

Annual perennial herbs with woody base. Leaves sessile, linear-lanceolate, entire or faintly serrate. Stipules, subulate, gland-tipped. Flowers deep pink, axillary, solitary. Capsule ovate, 3-valved. Seeds 3 in cell, pale yellow, ovoid, longitudinally striate.

PACHMARHI : Around (1000 m). In open grassy meadows and in the crevices of rocks. Common.

Fl. & Fr. : July December.

2. VIOLA L.

Viola betonicifolia J. E. Smith in Rees, Cyclop. 37, 1 : n. 7. 1819. subsp. **nepalensis** (Ging.) Becker, Bot. Jahrb. Beibl. 54 : 120. 167. 1917 ; Babu, Herb. Fl. Dehra Dun 65. 1977. *Viola partinii* var. *nepalensis* Ging. in DC. Prodr. 1 : 293. 1824. *Viola partinii* (auct. pl. non DC. 1824) ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 183. 1872, p . p.

Perennial herbs with woody rhizome. Leaves in a rosette, ovate triangular to lanceolate oblong, base cuneate to hastate, apex acute or obtuse, crenate ; petiole long, winged. Flowers lilac or blue. Sepals ovate lanceolate, acute or acuminate, short spurred, saccate. Stigma 3 lobed. Capsule ellipsoid. Seeds small.

PACHMARHI : Down fall (900 m), *Saxena* 8168. In damp shady valley. Rare.

Fl. & Fr. : March November.

10. FLACOURTIACEAE DC.

- | | | |
|---|-----|---------------------|
| 1a. Flowers bisexual. Fruit a capsule. Plants unarmed with pinnately veined leaves | ... | <i>Casearia</i> 1 |
| 1b. Flowers unisexual. Fruit a berry. Plants often armed, with subpalmately veined leaves | ... | <i>Flacourtia</i> 2 |

1. CASEARIA Jacq.

Casearia graveolens Dalz. in Hook. Kew Journ. 4 : 107. 1852 ; Brandis, For. Fl. N. W & C. Ind. 243. 1874 : Clarke in Hook. f. Fl. Brit. Ind. 2 : 592. 1879.

Shrubs or small trees, glabrous. Leaves elliptic, often narrower, little acuminate, rounded at the base ; petiole short. Flowers green, numerous with disagreeable odour ; pedicels jointed, pubescent below the articulation. Calyx pubescent at the base. Capsule ellipsoid, shining, 3 valved.

PACHMARHI : Mahadev hill (1200 m). BORI : Reserve forest (450 m). Common.

Fl. & Fr. : April August.

Fruits used as fish poison.

2. FLACOURTIA Comm. ex L' Herit.

Flacourtia indica (Burm. f.) Merr. Interpr. Rump. Herb. Amb. 377. 1917 ; Ramam. in Sald. & Nicol. Fl. Hassan 162. 1976. *Gmelina indica* Burm. f. Fl. Ind. 132. t. 39. f. 5. 1768. *Flacourtia ramontchi* L' Herit. Strip. Nov. 3 : 59. t. 30 & 30B. 1785 ; Hook. f. & Thoms. In Hook. f. Fl. Brit. Ind. 1 : 193. 1872. "*Bilangra*".

Shrubs or small trees, usually armed ; spines often branched at the base of the trunk. Leaves obovate - ovate, acute, acuminate or sometimes emarginate, crenate serrate. Tepals 4, connate below. Anthers versatile. Berry fleshy, globose, red when ripe.

PACHMARHI : Dhupgarh (1200 m). Along the margin of the forest. Common.

Fl. & Fr. : March September.

11. COCHLOSPERMACEAE Planch.

COCHLOSPERMUM Kunth

Cochlospermum religiosum (L.) Alston in Trimen, Handb. Fl. Ceylon 6 : 14. 1931 ; Ramam. in Sald. & Nicol. Fl. Hassan 171. 1976. *Bombax religiosum* L. Sp. Pl. 552. 1753. *Cochlospermum gossypium* DC. Prodr. 1 : 527. 1824 ; Hook. f. & Thoms. in Hook. f. Fl. Brit. Ind. 1 : 190. 1872. "*Kumbi*".

Deciduous trees. Leaves alternate, long petioled, palmately 5 lobed, cordate at base, 7 nerved ; lobes acute. Flowers in terminal panicle, up to 8 cm across ; petals golden yellow. Pedicels with grey pubescence. Anthers linear, falcate. Capsule up to 10 × 8 cm, obovoid, 5 valved. Seeds reniform, brown, woolly.

PACHMARHI : Karanjia (1000 m), Saxena 83510. On rocky slopes in sal forest. Rare.

Fl. & Fr. : January March.

Leafless at the time of flowering. Leaves appear in May.

12. POLYGALACEAE Juss.

POLYGALA L.

- 1a. Raceme much longer than leaves ... *P. elongata* 2
- 1b. Raceme shorter than or slightly longer than the leaves :
 - 2a. Petaloid sepals falcate. Caruncle with three appendages ... *P. arvensis* 1
 - 2b. Petaloid sepals obovate, symmetrical. Caruncle without appendages ... *P. persicariifolia* 3

1. *Polygala arvensis* Willd. Sp. Pl. ed 3, 2 : 876. 1802 ; Burt in Notes Roy. Bot. Gard. Edinb. 32 : 404. 1973 ; Babu, Herb. Fl. Dehra Dun 67. 1977. *Polygala chinensis* (auct. pl. non Linn. 1753) ; Bennett in Hook. f. Fl. Brit. Ind. 1 : 204. 1872. "Meradu".

Annual herbs, short hairy. Leaves very variable, obovate, sub-orbicular or linear oblong. Flowers yellow in axillary or extra axillary short, almost capitate, few flowered racemes. Bracts persistent. Outer sepals ovate, sharply acuminate, white margined. Petals obovate, keel with a bearded crest. Capsule broadly oblong orbicular, notched at apex, narrowly winged, oblique at the top, ciliate. Seeds black, patently hairy.

PACHMARHI : Jatashankar, Jambudeep (1000 m). On hill slopes and among the grasses along road side. Common.

Fl. & Fr. : July November.

2. *Polygala elongata* Klein ex Willd. Sp. Pl. 3 : 879. 1803 ; Bennett in Hook. f. Fl. Brit. Ind. 1 : 203. 1872 ; Ramam. in Sald. & Nicol. Fl. Hassan 412. 1976.

Erect herbs. Leaves subsessile, linear lanceolate, apiculate emarginate, hairy, membranous. Racemes usually terminal. Flowers yellow. Lateral petals obovate. Capsule oblique at tip with one locule longer.

PACHMARHI : Vicinity (1000 m). Growing amidst grasses on hill slopes and in waste places. Common.

Fl. & Fr. : August November.

3. *Polygala persicariifolia* DC. Prodr. 1 : 326. 1824 ; Bennett in Hook. f. Fl. Brit. Ind. 1 : 202. 1872 (*'persicariaefolia'*) ; Babu, Herb. Fl. Dehra Dun 68. 1977.

Erect, slender, annual herbs. Leaves sessile, linear lanceolate, shortly acute, hairy. Flowers in slender, terminal and axillary racemes, pink or rose. Petaloid sepal obovate, symmetrical. Seeds villous ; caruncle minute.

PACHMARHI : Vicinity (1000 m). Growing among the grasses along roadsides. Occasional.

Fl. & Fr. : October November.

13. CARYOPHYLLACEAE Juss.

- | | | |
|---|-----|----------------------|
| 1a. Sepals united into a distinct calyx tube. Petals long - clawed, inserted together with the stamens on a short gynophore | ... | <i>Vaccaria</i> 3 |
| 1b. Sepals free or connate at the base only. Petals subsessile, inserted together with the stamens on a disk : | | |
| 2a. Sepals thin, scarious throughout. Style 3 - fid | ... | <i>Polycarpaea</i> 1 |
| 2b. Sepals keeled, scarious only on margins. Style 3 - toothed | ... | <i>Polycarpon</i> 2 |

1. POLYCARPAEA Lamk.

Polycarpaea corymbosa (L.) Lamk. Tab. Encycl. 2 : 129. 1797 ; Edgew. & Hook. f. in Hook f. Fl. Brit. Ind. 1 : 245. 1874 ; Ramam. in Sald. & Nicol. Fl. Hassan 99. 1976. *Achyranthes corymbosa* L. Sp. Pl. 205. 1753.

Tomentose, branching annual or perennial herbs. Leaves fascicled at nodes, up to 1.1×0.1 cm, linear, with a small mucro at tip. Stipules fimbriate. Cymes terminal and axillary. Sepals scarious, silvery. Petals entire or erose, completely enclosed in calyx.

BORI : Reserve forest (550 m). On moist hill slopes. Occasional.

Fl. & Fr. : August December.

2. POLYCARPON L.

Polycarpon prostratum (Forsk.) Aschers. & Schweinf. Osterr. Bot. Zeitschr. 39. 128. 1889 ; Babu, Herb. Fl. Dehra Dun 72. 1977. *Alsine prostrata* Forsk. Fl. Aegypt. Arab. 207. 1775. *Hapalosa loeflingiae* Wall. ex Wt. & Arn. Prodr. 358. 1834. *Polycarpon loeflingiae* (Wall. ex Wt. & Arn.) Benth. & Hook. f. Gen. Pl. 1 : 153. 1862 ; Edgew. & Hook. f. in Hook. f. Fl. Brit. Ind. 1 : 245. 1874. "*Sireta*".

Decumbent or prostrate, annual biennial herbs. Stem subpubescent or clothed with simple and branched hairs. Leaves opposite ; lower ones crowded to simulate whorls of 4, obovate oblanceolate to spatulate. Flowers greenish white in dense, repeatedly forked cymes. Stamens 5. Capsule ovoid. Seeds reticulate.

PACHMARHI : Mahadev hill (1250 m). On rocky surfaces. Common.

Fl. & Fr. : April June.

3. VICCARIA Medik.

Viccaria pyramidata Medik. Phil. Bot. 1 : 96. 1789 ; Babu, Herb. Fl. Dehra Dun 76. 1977. *Saponaria viccaria* L. Sp. Pl. 409. 1753 ; Edgew. & Hook. f. in Hook. f. Fl. Brit. Ind. 1 : 217. 1874. "*Musna*"

Erect, glabrous, annual herbs. Stems corymbosely branched in the upper part. Leaves sessile, upper ones much smaller passing into bracts. Flowers pink or red in axillary and terminal corymbose cymes. Stamens