FLORA OF BHUTAN

INCLUDING A RECORD OF PLANTS FROM SIKKIM

VOLUME 1 PART 1

A.J.C. GRIERSON & D.G. LONG

ROYAL BOTANIC GARDEN, EDINBURGH.
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J.D. Hooker's *Flora of British India* (80)* published between 1875 and 1897 is the only Flora to date encompassing the plants of the whole of the Indian subcontinent, and since its publication has remained the most important reference work on Indian botany, as it doubtless will for many more years. Bhutan was included in that Flora as a result of some 1200 plants collected in 1838 by William Griffith, the first botanist to visit Bhutan. However, for political and geographical reasons, Bhutan has until very recently remained inaccessible to most botanists from the outside world, and no comprehensive Flora of the country has ever been written.

From 1914 onwards, however, a small number of privileged botanists and horticulturists, mostly British, were able to travel extensively in Bhutan and bring back to Britain large plant collections. The greatest of these collectors were undoubtedly Frank Ludlow and George Sherriff who made seven visits to Bhutan between 1933 and 1950 and amassed over 6000 herbarium specimens as well as large numbers of living plants and seeds.

In spite of the considerable collecting activity, almost none of the resulting information has been available to those in Bhutan, such as the forestry department, for whom the *Flora of British India* remains the only reference work. In contrast, neighbouring Sikkim has enjoyed much more intensive botanical exploration for many decades and numerous publications bear witness to its extremely rich flora.

The Royal Government of Bhutan not unreasonably felt that some of the information on their flora should be made available to them, and in 1974 they requested the Overseas Development Administration in London that a botanist be employed in Britain to prepare an inventory of the flora based on herbarium and living collections. The Royal Botanic Garden, Edinburgh, was invited to undertake this work, in view of its large collections and long association with the botany of the Himalayas, India and China; full time work on the project was begun in 1975 by the two authors. At that stage it was intended to produce a checklist similar to the Nepal enumeration (72,73) but the usefulness of such a list to Bhutan was questioned, in the absence of herbarium and library facilities there. It was therefore proposed to enlarge the project to that of a small Flora, including descriptions, keys and illustrations, in order that Bhutanese botanists and foresters could identify plants with their scientific names as well as providing a complete checklist of the flora. During a short visit to Bhutan in 1975 by the authors this proposal was made and was enthusiastically welcomed by the Forestry Department in Thimphu. Some months later the scope of the work was

*Numbers in brackets indicate bibliographic references; see p. 37.

further enlarged to include the plants of Sikkim for the sake of floristic completeness, and work began on writing the Flora in its present format.

Research on the flora is supported by the Overseas Development Administration, London, and the Department of Agriculture and Fisheries for Scotland, Edinburgh; expeditions to Bhutan are jointly financed by the ODA and by the Royal Government of Bhutan. Work is primarily carried out in the herbarium and library in Edinburgh with regular consultative visits to Kew and the British Museum (Natural History) in London. In addition, some external collaborators are contributing accounts for families in which they specialise.

It is planned to publish the work over the next few years in approximately ten parts which will constitute three volumes. A key to families and glossary of terms will appear in the final volume; each part will have its own index and there will be a cumulative index in the final part of each volume. Although primarily an identification manual of E Himalayan plants and a checklist of the Bhutanese flora with up-to-date nomenclature, it is hoped that the publication will have wider application for field botanists, foresters, horticulturists and taxonomists in India and elsewhere. It includes information on local names and uses of the plants, together with ecological and floristic notes, and pinpoints areas where more intensive collection or taxonomic research are needed. Printing and publishing costs will be kept to a minimum in the hope that the work will be inexpensive and readily available in Bhutan and India.

ACKNOWLEDGMENTS

The Bhutan Flora project was initiated in 1975 at the request of the Forestry Department, Royal Government of Bhutan, largely due to the foresight and efforts of S. Doley, formerly Director of Forests in Bhutan. This request met with an immediate and enthusiastic response from the Overseas Development Administration in London, in particular from A.W. Peers who has maintained constant interest and provided much administrative support for the project over the years, as have several other ODA staff: to K.R.M. Anthony, R.O. Kiernan and many members of their staff, we offer special thanks.

Since its conception, the project has enjoyed generous support from the Ministry of Trade, Industry and Forestry in Bhutan, and we wish to express our deepest gratitude to the Minister, HRH Prince N. Wangchuk, and the Director of Forests, Dasho C. Dorji, for allowing us to visit Bhutan and for the excellent facilities and generous assistance provided by them during these expeditions. On expeditions we have much appreciated the work done for us by S. Tshering and numerous Divisional Forest Officers and Range Officers throughout Bhutan. To the British High Commission in Delhi, in particular M. Jay and his staff, we express gratitude for hospitality and help with expedition arrangements.

The writing of the *Flora of Bhutan* has taken place largely in the Edinburgh Herbarium, but regular visits have been made to Kew and the British Museum

(Natural History); we wish to thank the Directors and Curators of these herbaria for providing facilities for study, for the use of their libraries and archives, and for numerous loans of specimens. Many members of staff of these three institutions have generously offered their time and expertise to assist us on the Flora; to the following we offer particular thanks: B.L. Burtt, J.F.M. Cannon, A.O. Chater, M.J.E. Coode, J. Cullen, P.S. Green, C. Grey-Wilson, D.M. Henderson, W. Marais, J. A. Ratter, N.K.B. Robson and W.T. Stearn.

BOTANICAL EXPLORATION OF BHUTAN AND SIKKIM

1. Sikkim. The following list includes the most important plant collectors to have visited Sikkim, Darjeeling and the Chumbi valley. Detailed information on many of these such as, for example, precise itineraries, numbers of collections, etc., is lacking but some relevant information is available in the literature references indicated. Specimens of almost all these collectors are to be found in the herbaria of K,BM and E, and probably of many of them in CAL. By far the most important collections are those of J.D. Hooker who collected about 3500 species in Sikkim (21a); many of these became type specimens of species described in the *Flora of British India* and duplicates were widely distributed from Kew to herbaria around the world.

It is clear that Sikkim has enjoyed an intensity of collection since Hooker's time equalled in few other parts of India or Asia, particularly in the later part of the 19th century and early 20th century when it was visited by influential botanists such as C.B. Clarke, G. King, G.H. Cave and J.M. Cowan. In the post-1940 period comparatively little collection has been done, except by H. Hara and his collaborators from Tokyo University.

Chronological list of important plant collectors in Sikkim, Darjeeling and Chumbi with relevant bibliographic references.

W. Griffith's collectors, 1843 (21a).
J.D. Hooker, 1848–50 (21a,74,75,76,77,78,79, 80,81,120).
T. Thomson, 1850, 1857 (21a,81).
T. Anderson, 1862–68 (1,21a).
W.S. Kurz, 1868 (21a).
C.B. Clarke, 1869–75, 1884 (21a,25,26).
J.S. Gamble, 1872–77, 1879–82 (21a,46,47,49).
W. Schlich, 1873.
W.J. Treutler, 1874.
G. King and collectors, 1878, 1886–92 (21a,84).
D. Brandis, 1879 (21a).
G. Watt, 1881 (21a).
R. Pantling, 1885, 1895, 1896 (21a,84).
G.A. Gammie and collectors, 1887–97 (21a, 50,51,52).
H.A. Cummins, 1888, 1893, (21a).
E.H. Walsh, 1888.
H.H. Haines, 1889–99 (21a).
J.H. Lace, 1902–03 (21a).
D. Prain, 1900–02 (21a).
F.E. Younghusband, 1903–04.
H.J. Walton, 1903–04.
B.B. Osmaston, 1904.
G.L. Searight, 1904–05.
G.H. Cave, 1903, 1912–16, 1919, 1922, 1947 (21a,113).
I.H. Burkill, 1906 (20,21,21a).

W.W. Smith, 1909–10 (21a,111,112,113).
Ribu & Rohmoo, 1909–10.
R.E. Cooper, 1913.
C.C. Lacaita, 1913 (85).
J.M. Cowan, 1916, 1918–23 (34,35).
D. Lowndes, 1943.
J. Sinclair, 1945.
K.P. Biswas, ?1940–54 (12,13,14,15).
B.N. Ghose, ?1951–57 (54,55).
R.S. Rao, 1955 (104).
H. Hara et al., 1960, 1963, 1964, 1967, 1969, 1972 (68,69,70,71,101).
B.S. Sharma & B. Gosh, 1966 (109).
Pradhan, Norbu & Naku, 1972.

2. Bhutan. In contrast to Sikkim comparatively few plant collectors have been to Bhutan. The following list includes, chronologically, all the important collectors, with dates of collection, districts in which plants were collected (see fig. 2), numbers of collections of vascular plants when known, some of the herbaria in which the specimens are preserved (abbreviated according to *Index Herbariorum*) and bibliographic references. Botanists visiting Bhutan have published considerable literature describing their travels and have often left accounts of their itineraries and plant collections in archives at K, BM and E. Thus the information assembled here for Bhutan is more detailed than that for Sikkim. The number of specimens collected from Bhutan is estimated to be in excess of 26,600, of which about 70% are represented in the British herbaria of E, BM and K.

Only a few of the expeditions to Bhutan, notably those of Griffith, the Botanical Survey of India, Tokyo University and Grierson & Long have been aimed purely at botanical and floristic studies; these collectors have tried to collect from all the main vegetation zones from subtropical forest to alpine hillsides. In contrast, the other major collections were made on expeditions to the temperate and alpine zones by collectors such as Ludlow & Sherriff who had strong horticultural interests; their collections very largely comprise herbaceous and shrubby plants, e.g. *Meconopsis*, *Primula* and *Rhododendron*; the woody and subtropical elements in the flora were often neglected on these expeditions.

Many specimens exist in herbaria labelled 'Bhutan' which did not in fact originate within that country. Firstly, those specimens collected by Thomas J. Booth between 1849 and 1851, which Ludlow (89) has shown to have been collected in Arunachal Pradesh east of Bhutan, and secondly, specimens labelled 'Bhutan' collected by C.B. Clarke, H.H. Haines, J.S. Gamble, G. King and others between 1870 and 1890. These specimens did not originate in Bhutan but in 'British Bhutan', a name at that time used for the Kalimpong district of West Bengal (see Long, 86a).

Although large areas of Bhutan still remain botanically unknown, e.g. the Sankosh, Manas and Dhansiri districts of S Bhutan, sufficient collections now exist to make the production of a checklist and Flora possible, in order that the Government of Bhutan may see some positive benefit from the expeditions they have permitted and supported in the past.

Considerable interest in the flora has developed in Bhutan in recent years; collections for the first time have been made by Bhutanese botanists (R. Nawang and S. Tshering) and a herbarium building has been constructed in Thimphu.

Plant collectors in Bhutan

	Period of visit	Districts visited	Specimens	Herbaria	Bibliography
1. W. Griffith	i–v 1838	S: Deothang, Chukka C: Tashigang, Mongar, Bumthang, Tongsa, Punakha, Thimphu	c 1200	K, CAL, BM, E, GH, NY, C, P, LE, W, U, M, S, etc.	21a,61,62,63 64,65,66 86
2. J.C. White	iv–vii 1906	C: Ha, Thimphu, Punakha, Tongsa, Bumthang	160+	CAL, E	111,127,128
	v–vi 1907	S: Deothang C: Tashigang, Mongar N: Upper Kuru Chu	90+		
		Total White =	250+		
3. R.E. Cooper	vi–xi 1914	S: Chukka C: Thimphu, Punakha, Tongsa, Bumthang N: Upper Mo Chu, Upper Bumthang Chu	2675	E,BM, THIMPHU NY	27,28,29 30,31,32, 33,86
	iv–x 1915	S: Chukka C: Thimphu, Punakha, Tongsa, Bumthang, Mongar, Tashigang N: Upper Bumthang Chu, Upper Kuru Chu	1283		
		Total Cooper =	3958		
4. F. Kingdon Ward	ii 1925	S: Deothang C: Tashigang	30	K,E	93
5. F.M. Bailey	ii–ix 1927	C: Ha, Thimphu, Punakha	?50+	E	3,4
6. B.J. Gould	v–viii 1938	C: Ha, Thimphu, Punakha, Tongsa, Bumthang N: Upper Mo Chu, Upper Bumthang Chu	1411	K,E,DD	41,42
	vii 1939	C: Ha	27	K	
		Total Gould =	1438		

Plant collectors in Bhutan (cont.)

	Period of visit	Districts visited	Specimens	Herbaria	Bibliography
7. F. Ludlow, G. Sherriff	v–viii 1933	C: Ha, Thimphu, Punakha, Tongsa, Bumthang, Mongar, Tashigang N: Upper Kuru Chu, Upper Kulong Chu	483	BM,E,A	36,44 45,67, 88,116, 122,123
F. Ludlow, G. Sherriff	ix–x 1933	C: Ha, Thimphu	8		
	vi–vii 1934	S: Deothang C: Tashigang, Sakden	111		
	viii–xi 1934	S: Deothang C: Tashigang, Sakden N: Upper Kulong Chu	241		
F. Ludlow, G. Sherriff, K. Lumsden	ii–iii 1936	S: Deothang C: Tashigang, Sakden	105		
	xi 1936	S: Deothang C: Tashigang, Sakden	44		
G. Sherriff	iv–viii 1937	S: Gaylegphug C: Tongsa, Punakha, Bumthang, Thimphu, Ha	662		
F. Ludlow, G. Sherriff, G. Taylor	xi 1938	S: Deothang C: Tashigang	190		
F. Ludlow, G. Sherriff, B. Sherriff, H. Elliot	v–vi 1947	S: Deothang C: Tashigang	24		
F. Ludlow, G. Sherriff, B. Sherriff, J.H. Hicks	iii–x 1949	S: Gaylegphug C: Ha, Thimphu, Punakha, Tongsa, Bumthang, Mongar, Tashigang N: Upper Mo Chu, Upper Pho Chu, Upper Mangde Chu, Upper Bumthang Chu, Upper Kuru Chu, Upper Kulong Chu	4310		

Plant collectors in Bhutan (cont.)

	Period of visit	Districts visited	Specimens	Herbaria	Bibliography
8. S. Nakao	vii–x 1958	C: Ha, Thimphu, Punakha, Tongsa, Bumthang N: Upper Mo Chu, Upper Bumthang Chu	c 750	KYO	99,121
9. G. Sen Gupta et al.	viii 1963–i 1964	S: Phuntsholing, Chukka, Samchi, Gaylegphug C: Ha, Thimphu	1633 (including cryptogams)	CAL	38,117
J.K. Maheshwari et al.	v–xi 1964	S: Samchi, Phuntsholing, Chukka, Gaylegphug C: Thimphu	1902 (including cryptogams)	CAL	
N.P. Balakrishnan et al.	iii–x 1965	S: Deothang C: Thimphu, Punakha, Mongar, Tashigang	2788 (including cryptogams)	ASSAM, CAL	
		Total Sen Gupta, Maheshwari, Balakrishnan et al. =	c 5000		
10. K. Nishioka	ix 1965–ix 1966	C: Thimphu, Tashigang N: Upper Mo Chu	?	TI	101
11. S. Bowes-Lyon	v–vi 1966	C: Ha, Thimphu, Punakha, Tongsa, Bumthang N: Upper Pho Chu, Upper Mangde Chu, Upper Bumthang Chu	468	BM	
	ix–x 1967	C: Ha, Thimphu, Punakha, N: Upper Mo Chu	212		
	vi–vii 1969	S: Chukka C: Thimphu, Punakha, Tongsa, Bumthang, Mongar	169		
	v 1971	C: Thimphu, Punakha, Tongsa, Bumthang, Mongar	85		
		Total Bowes-Lyon =	954		

Plant collectors in Bhutan (cont.)

	Period of visit	Districts visited	Specimens	Herbaria	Bibliography
12. H. Hara et al.	iv–vi 1967	S: Phuntsholing, Chukka C: Thimphu, Punakha, Tongsa N: Upper Mo Chu	1500+	TI,BM, E,NY	70,71,101
13. R. Bedi	v–xi 1971	C: Ha, Thimphu, Punakha N: Upper Mo Chu	c 1200	THIMPHU K,E	11
14. M. Würmli et al.	iv–vi 1972	S: Phuntsholing, Chukka C: Thimphu, Punakha, Tongsa	?	BAS	8,129
15. B. Bartholomew	ix 1974	C: Thimphu, Punakha	?	LA,BM	9
16. R. Nawang, S. Tshering	vii–viii 1973	N: Upper Mo Chu	c 80	THIMPHU E	
	viii–x 1974	S: Deothang C: Punakha, Tashigang	c 130		
		Total Nawang & Tshering =	c 210		
17. A.J.C. Grierson, D.G. Long	vi 1975	S: Phuntsholing, Chukka C: Thimphu, Punakha	359	E, THIMPHU	58,60,87
	v–vii 1979	S: Phuntsholing, Chukka, Sarbhang, Gaylegphug Deothang C: Thimphu, Punakha, Tongsa, Bumthang, Mongar, Tashigang	2150		
		Total Grierson & Long =	2509		

GEOGRAPHICAL OUTLINE OF BHUTAN

i. Physical features (see also Karan (83)). Bhutan is situated in the eastern Himalayan mountains extending from 88°45′ to 92°10′ east and from 26°40′ to 28°21′ north (fig. 1). It is 210 miles (340 km) long and 115 miles (185 km) wide and occupies an area of 16,000 square miles (41,000 square kilometres), equal to the area of Switzerland or twice that of Wales. The country is almost completely mountainous; on its southern frontier with India the boundary follows the line

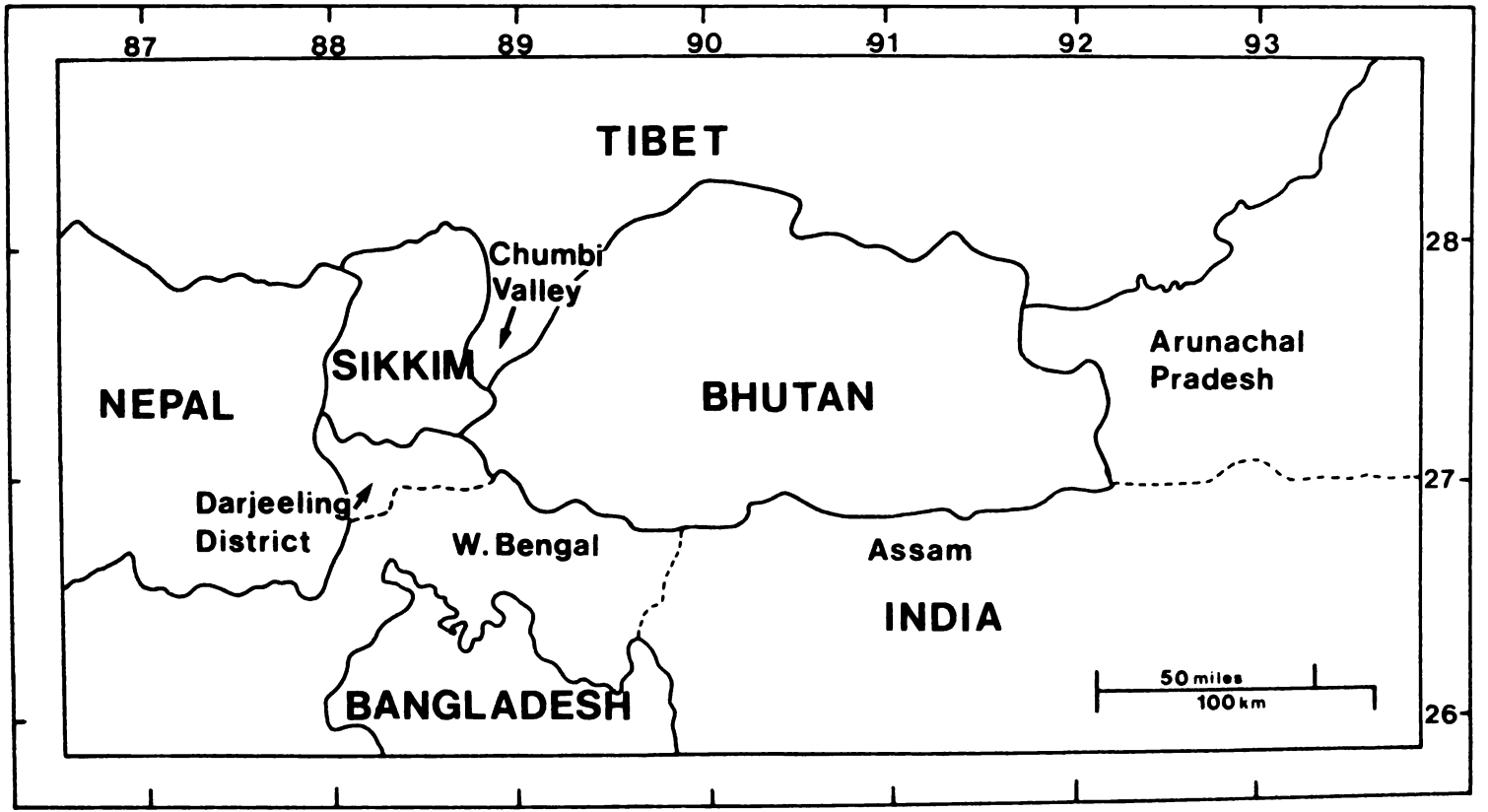

FIG. 1. Map of Bhutan in relation to surrounding countries.

where the foothills meet the Bengal plains, at about 150 m (500 ft) above sea level; only a few narrow strips of the plains (the 'duars', or where the forests become swampy, the 'terai') overlap into Bhutan. The northern border of Bhutan is the main Himalayan chain on the southern edge of the Tibetan plateau, with several mountain peaks over 6100 m (20,000 ft); the highest, Kula Kangri, is 7554 m (24,740 ft).

Between these altitudinal extremes the interior of the country is made up of a series of six major mountain ridges alternating with seven deep river valleys, the Amo Chu/Torsa River, Thimphu Chu/Raidak River, Mo Chu/Sankosh River, Mangde Chu, Bumthang Chu, Kuru Chu and Kulong Chu/Manas River, all of which run approximately from north to south. The mountain ridges extend southwards to varying distances, and because of their steepness they have in the past formed important natural barriers. The rivers of Bhutan eventually reach the Brahmaputra system in the plains of Assam; the four rivers of eastern Bhutan unite into the Manas River before leaving Bhutan. The large rivers, e.g. Mo Chu and Manas, have carved deep valleys far into the interior of the country, and at Punakha and Tashi Yangtsi the valley floor is as low as 1500 m (4900 ft).

Where the main rivers enter the plains the beds are wide and flat with extensive deposition of silt and shingle; in the foothills and again in the northern mountains these rivers are often fast-flowing torrents, cutting through deep gorges. In central Bhutan, as at Thimphu and Bumthang, the valleys are wide and open, the water more slowly flowing, causing deposition of agriculturally valuable alluvium. The main rivers originate in the permanent snow and glaciers of the main Himalayan chain in northern Bhutan, except in eastern Bhutan, where the Kuru Chu and Nyam Jang Chu enter Bhutan from Tibet and Arunachal Pradesh.

ii. Geology. A brief description and map of the geology of Bhutan are provided by Karan (83) as a result of researches by A. Gansser. Most of Bhutan is composed of a complex system of folded and metamorphosed rocks of pre-Cambrian and early Palaeozoic age, largely quartzite and gneiss, and dissected by faults running east–west. Sedimentary rocks are scarce, the oldest being of Devonian age in the Bumthang area, with later deposits in the Upper Mo Chu district (around Lingshi) and in a narrow band along the edge of the duars and in the Manas basin. The highest peaks of Chomo Lhari, Kula Kangri etc. are formed from granite. Large areas of Bhutan remain as yet unsurveyed in detail geologically.

iii. Climate. Only very limited meteorological data have been assembled for Bhutan and no accurate measurements of precipitation can be given. It is clear that the huge range in altitude, and diverse physiography produce a wide range of climatic types including great extremes of temperature and precipitation (see Karan, 83). The most important factor is the hot and humid monsoon airstream blowing northwards from the Bay of Bengal. Throughout the year, but par-

ticularly from June to September, this brings heavy rainfall to the foothills and to exposed slopes and valleys throughout the interior. The duars and foothills enjoy a subtropical climate, warm in winter, hot and extremely humid in summer. Towards the interior the climate becomes gradually more temperate, with cool or cold winters and hot summers and often heavy rainfall. Rainfall is heaviest on the steepest and most exposed slopes, where over 250 cm and possibly up to 500 cm per year may fall. Several main valleys, both at low and high altitude, are extremely dry most of the year and enjoy heavy rain only during the monsoon. Their gentle gradient produces very little direct rainfall (e.g. the Thimphu, Paro and Punakha valleys); their more steeply rising side valleys, receive a much higher rainfall. These dry valleys of the interior become very hot in summer, and very cold in winter (e.g. Paro has 71–76 cm of rain per year, July maximum temp. of 30°C and December minimum of −7°C). In the mountains of northern Bhutan summers are short and cool, and winters cold with considerable snowfall and frost. Climate is clearly a very important factor governing the types of vegetation throughout Bhutan and accurate meteorological data are highly desirable.

CLASSIFICATION OF THE VEGETATION OF BHUTAN

No detailed classification of the vegetation of Bhutan has yet been undertaken although Griffith (63) made many interesting observations on the vegetation during his journey through Bhutan in 1838, including lists of dominant species and diagrammatic transects, but without giving a formal classification. The only subsequent account of Bhutan's vegetation, based largely on the publications of Griffith and White and on observations of Ludlow & Sherriff, is given by Schweinfurth (107).

In contrast, the vegetation of the neighbouring Himalayan areas of E Nepal, Sikkim and Darjeeling has been described in considerably detail by Gamble in 1875 (46), Hooker in 1906 (80a), Cowan in 1929 (35), Champion in 1936 (22), Schweinfurth in 1957 (107), Kanai in 1967 (in Hara, 69) and Stainton in 1972 (114). The classifications of these authors vary considerably in detail, but essentially divide the forests into main altitudinal vegetation zones (see table 1). Some of these zones can be extrapolated to include Bhutan; others present in the Darjeeling district, e.g. Sal forest and Savannah forest, are completely absent from Bhutan, whilst several types absent or rare in Sikkim are well developed in Bhutan, particularly in the east, e.g. Blue pine forest, Spruce forest and Cool broad-leaved forest.

For the purposes of this Flora, detail such as Champion and Stainton provide is not essential, and considerable field work in eastern Bhutan would be needed for a comparable treatment. Hence, based largely on our own field experience, we have classified the major recognizable zones in Bhutan, equating them where possible with previous systems.

NOTES ON THE VEGETATION ZONES OF BHUTAN

i. Subtropical forest. True tropical rain forest does not exist in Bhutan; such forests are largely evergreen and require continuous rainfall throughout the year. The so-called 'tropical forests' of the E Himalaya are largely deciduous and have a very seasonal climate with a marked winter dry season and summer wet (monsoon) season. Although they contain many largely tropical genera and species, they lie well outside the tropics and should be considered as subtropical forests (cf. Richards, 104a). In Bhutan, the forest all along the foothills may be broadly classed as subtropical forest, forming dense jungle on steep slopes and river banks. In accessible areas, much clearing for timber and agriculture has occurred. Sal forest and Savannah forest as described by Gamble (46) are absent, although Sal (*Shorea robusta*) occurs as scattered trees in the Sarbhang district. Sal forests are found on the terai of Sikkim and to the south of Bhutan, e.g. in the Siliguri district, and may formerly have occurred within Bhutan; a small plantation exists at Phuntsholing.

ii. Warm broad-leaved forest. This is essentially a type of subtropical forest, but occurs at a higher altitude with a lower rainfall and contains a mixture of evergreen and deciduous broad-leaved tree species. Many of the tropical genera, e.g. *Duabanga*, *Pterospermum* and *Tetrameles*, are absent, and more temperate genera appear. The transition into zones above and below is a gradual one. In deeper valleys this formation occurs far into the interior, as in the Kulong Chu valley south of Tashi Yangtsi, 27°30'N. However, it is most abundant throughout southern Bhutan over 1000 m, e.g. on the hills N of Gaylegphug and Deothang and in the Shongar Chu valley. Patches of Warm broad-leaved forest are often cleared to produce grazing.

iii. Chir pine (Pinus roxburghii) forest (cf. 60). This is a low-altitude xerophytic forest occurring in the deeper dry valleys of Bhutan, viz. Mo Chu/Sankosh River, Kuru Chu and Kulong Chu/Dangme Chu systems. These valleys have a very long dry season during which burning is common, and heavy rain occurs only in the monsoon season when abundant herbs, especially grasses, appear. Grazing is widespread. The pines are resistant to burning but the shrub layer is more susceptible and therefore poorly developed. Almost no other tree species occur. The pines are tapped for turpentine, and the timber used for building; their rarity in some valleys (e.g. at Tashigang) may be due to excessive felling. Such forest is rare in the Darjeeling district but occurs in Sikkim in the Great Rangit and Tista valleys, where it is often mixed with Sal (34).

iv. Cool broad-leaved forest. On moist exposed slopes above the Warm broad-leaved forests one of two types of forest usually develops according to rainfall. The drier type contains a dominance of evergreen *Castanopsis* or *Quercus* species and is designated Evergreen oak forest (see below). The wetter type, Cool broad-

TABLE 1

Vegetation zones in Bhutan and terminology used for equivalent vegetation in some other classifications of neighbouring Himalayan areas.

Zone	Characteristic species	Alt.	Precipitation from Champion (22)	Gamble 1875 (46)	Cowan 1929 (35)	Champion 1936 (22)	Kanai 1967 (69)
i. Subtropical forest	Acrocarpus fraxinifolius, Ailanthus grandis, Bombax ceiba, Crateva religiosa, Dillenia pentagyna, Duabanga grandiflora, Gmelina arborea, Leea asiatica, Musa, Pandanus, Pterospermum acerifolium, Shorea robusta, Tetrameles nudiflora, Thunbergia	200–1000 (–1200) m	250–500 cm	Lower hill forest	Tropical forest	E sub-Himalayan wet mixed forest	Rain-green deciduous forest
ii. Warm broad-leaved forest	Alangium chinense, Altingia excelsa, Bischofia javanica, Callicarpa arborea, Castanopsis indica, Cordia obliqua, Dendrocalamus hookeri, Dichroa febrifuga, Engelhardia spicata, Entada pursaetha, Euodia fraxinifolia, Firmiana colorata, Helicia nilagrica, Macaranga pustulata, Maclura cochinchinensis, Maesa spp., Mussaenda roxburghii, Ostodes paniculata, Pouzolzia sanguinea, Rhaphidophora eximea, Schima wallichii, Stereospermum personatum, Trevesia palmata, Wendlandia puberula	1000–2000 (–2300) m	230–400cm	Middle hill forest	Sub-tropical forest	Bengal sub-tropical hill forest	Mixed broad-leaved forest
iii. Chir pine forest	Buddleja asiatica, B. bhutanica, Cycas pectinata, Cymbopogon flexuosus, Euphorbia royleana, Ficus oligodon, Grewia sapida, Indigofera dosua, Osyris lanceolata, Pinus roxburghii, Rhus paniculata, Securinega suffruticosa, Solanum erianthum, Woodfordia fruticosa, Zizyphus incurva	900–1800 (–2000) m	100–130 cm	—	—	Himalayan subtropical pine forest	—
iv. Cool broad-leaved forest	Acer campbellii, A. sterculiaceum, Betula alnoides, Brassaiopsis alpina, Chirita lachenensis, Corylopsis himalayana, Elatostema monandrum, E. obtusum, Exbucklandia populnea, Helwingia himalaica, Ilex fragilis, Lecanthus peduncularis, Lindera neesiana, L. pulcherrima, Persea clarkeana, Pilea bracteosa, Rosa moschata, Rubus lineatus, R. pentagonus, R. treutleri, Schisandra grandiflora, Symplocos dryophila	2000–2900 m	250–500 cm	—	Temperate forest (in part)	E Himalayan wet temperate forest (in part)	Temperate deciduous forest

NOTES ON THE VEGETATION ZONES OF BHUTAN

i. Subtropical forest. True tropical rain forest does not exist in Bhutan; such forests are largely evergreen and require continuous rainfall throughout the year. The so-called 'tropical forests' of the E Himalaya are largely deciduous and have a very seasonal climate with a marked winter dry season and summer wet (monsoon) season. Although they contain many largely tropical genera and species, they lie well outside the tropics and should be considered as subtropical forests (cf. Richards, 104a). In Bhutan, the forest all along the foothills may be broadly classed as subtropical forest, forming dense jungle on steep slopes and river banks. In accessible areas, much clearing for timber and agriculture has occurred. Sal forest and Savannah forest as described by Gamble (46) are absent, although Sal (*Shorea robusta*) occurs as scattered trees in the Sarbhang district. Sal forests are found on the terai of Sikkim and to the south of Bhutan, e.g. in the Siliguri district, and may formerly have occurred within Bhutan; a small plantation exists at Phuntsholing.

ii. Warm broad-leaved forest. This is essentially a type of subtropical forest, but occurs at a higher altitude with a lower rainfall and contains a mixture of evergreen and deciduous broad-leaved tree species. Many of the tropical genera, e.g. *Duabanga*, *Pterospermum* and *Tetrameles*, are absent, and more temperate genera appear. The transition into zones above and below is a gradual one. In deeper valleys this formation occurs far into the interior, as in the Kulong Chu valley south of Tashi Yangtsi, 27°30′N. However, it is most abundant throughout southern Bhutan over 1000 m, e.g. on the hills N of Gaylegphug and Deothang and in the Shongar Chu valley. Patches of Warm broad-leaved forest are often cleared to produce grazing.

iii. Chir pine (Pinus roxburghii) forest (cf. 60). This is a low-altitude xerophytic forest occurring in the deeper dry valleys of Bhutan, viz. Mo Chu/Sankosh River, Kuru Chu and Kulong Chu/Dangme Chu systems. These valleys have a very long dry season during which burning is common, and heavy rain occurs only in the monsoon season when abundant herbs, especially grasses, appear. Grazing is widespread. The pines are resistant to burning but the shrub layer is more susceptible and therefore poorly developed. Almost no other tree species occur. The pines are tapped for turpentine, and the timber used for building; their rarity in some valleys (e.g. at Tashigang) may be due to excessive felling. Such forest is rare in the Darjeeling district but occurs in Sikkim in the Great Rangit and Tista valleys, where it is often mixed with Sal (34).

iv. Cool broad-leaved forest. On moist exposed slopes above the Warm broad-leaved forests one of two types of forest usually develops according to rainfall. The drier type contains a dominance of evergreen *Castanopsis* or *Quercus* species and is designated Evergreen oak forest (see below). The wetter type, Cool broad-

TABLE 1

Vegetation zones in Bhutan and terminology used for equivalent vegetation in some other classifications of neighbouring Himalayan areas.

Zone	Characteristic species	Alt.	Precipitation from Champion (22)	Gamble 1875 (46)	Cowan 1929 (35)	Champion 1936 (22)	Kanai 1967 (69)
i. Subtropical forest	Acrocarpus fraxinifolius, Ailanthus grandis, Bombax ceiba, Crateva religiosa, Dillenia pentagyna, Duabanga grandiflora, Gmelina arborea, Leea asiatica, Musa, Pandanus, Pterospermum acerifolium, Shorea robusta, Tetrameles nudiflora, Thunbergia	200–1000 (–1200) m	250–500 cm	Lower hill forest	Tropical forest	E sub-Himalayan wet mixed forest	Rain-green deciduous forest
ii. Warm broad-leaved forest	Alangium chinense, Altingia excelsa, Bischofia javanica, Callicarpa arborea, Castanopsis indica, Cordia obliqua, Dendrocalamus hookeri, Dichroa febrifuga, Engelhardia spicata, Entada pursaetha, Euodia fraxinifolia, Firmiana colorata, Helicia nilagrica, Macaranga pustulata, Maclura cochinchinensis, Maesa spp., Mussaenda roxburghii, Ostodes paniculata, Pouzolzia sanguinea, Rhaphidophora eximea, Schima wallichii, Stereospermum personatum, Trevesia palmata, Wendlandia puberula	1000–2000 (–2300) m	230–400cm	Middle hill forest	Sub-tropical forest	Bengal sub-tropical hill forest	Mixed broad-leaved forest
iii. Chir pine forest	Buddleja asiatica, B. bhutanica, Cycas pectinata, Cymbopogon flexuosus, Euphorbia royleana, Ficus oligodon, Grewia sapida, Indigofera dosua, Osyris lanceolata, Pinus roxburghii, Rhus paniculata, Securinega suffruticosa, Solanum erianthum, Woodfordia fruticosa, Zizyphus incurva	900–1800 (–2000) m	100–130 cm	—	—	Himalayan subtropical pine forest	—
iv. Cool broad-leaved forest	Acer campbellii, A. sterculiaceum, Betula alnoides, Brassaiopsis alpina, Chirita lachenensis, Corylopsis himalayana, Elatostema monandrum, E. obtusum, Exbucklandia populnea, Helwingia himalaica, Ilex fragilis, Lecanthus peduncularis, Lindera neesiana, L. pulcherrima, Persea clarkeana, Pilea bracteosa, Rosa moschata, Rubus lineatus, R. pentagonus, R. treutleri, Schisandra grandiflora, Symplocos dryophila	2000–2900 m	250–500 cm	—	Temperate forest (in part)	E Himalayan wet temperate forest (in part)	Temperate deciduous forest

TABLE I *(Cont.)*

Zone	Characteristic species	Alt	Precipitation from Champion (22)	Gamble 1875 (46)	Cowan 1929 (35)	Champion 1936 (22)	Kanai 1967 (69)
v. Evergreen oak forest	Acer campbellii, Castanopsis hystrix, C. tribuloides, Elatostema hookerianum, E. sessile, Galeola lindleyana, Juglans regia, Pilea symmeria, Quercus lamellosa, Skimmia arborescens, Symplocos lucida	(1800–) 2000–2600 m	200–300 cm	Temperate oak forest	Temperate forest (in part)	E Himalayan wet temperate forest (in part)	Evergreen oak forest
vi. Blue pine forest	Arisaema consanguineum, Berberis asiatica, Berchemia edgeworthii, Ceratostigma griffithii, Cotoneaster griffithii, Elaeagnus parvifolia, Euonymus grandiflorus, Indigofera heterantha, Jasminum humile, Leptodermis scabrida, Lonicera quinquelocularis, Lyonia ovalifolia, Ophiopogon intermedius, Philadelphus tomentosus, Pinus wallichiana, Polygala sibirica, Prinsepia utilis, Quercus griffithii, Q. semecarpifolia, Rhododendron arboreum, Rosa sericea, Spiraea canescens, Zanthoxylum armatum	2100–3000 (–3100) m	70–120 cm	—	—	Lower blue pine forest	—
vii. Spruce forest	Acer cappadocicum, A. pectinatum, Berberis praecipua, Enkianthus deflexus, Larix griffithiana, Lindera heterophylla, Osmanthus suavis, Picea brachytyla, P. spinulosa, Pyrola sikkimensis, Ribes takare, Rosa macrophylla, Salix daltoniana, Salvia campanulata, Taxus baccata	(2500–) 2700–3100 (–3200) m	?50–100 cm	—	—	Eastern mixed coniferous forest	–
viii. Hemlock forest	Arundinaria griffithiana, Betula utilis, Buddleja colvilei, Daphne bholua, Gaultheria fragrantissima, Larix griffithiana, Litsea sericea, Maddenia himalaica, Magnolia globosa, Panax pseudo-ginseng, Rhododendron falconeri, R. hodgsonii, R. keysii, Rubus calophyllus, R. pentagonus, Sorbus thibetica, Tsuga dumosa, Viburnum mullaha	2800–3100 (–3300) m	?130–200 cm	—	—	Eastern oak-hemlock forest	Rhodo-dendron coniferous forest (in part)

TABLE I *(Cont.)*

Zone	Characteristic species	Alt.	Precipitation from Champion (22)	Gamble 1875 (46)	Cowan 1929 (35)	Champion 1936 (22)	Kanai 1967 (69)
ix. Fir forest	Abies densa, Arundinaria maling, Betula utilis, Bryocarpum himalaicum, Daphne bholua, Juniperus pseudosabina, Maddenia himalaica, Primula denticulata, Prunus rufa, Rheum acuminatum, Rhododendron cinnabarinum, R. hodgsonii, Ribes takare, Rubus fragarioides, Skimmia laureola, Sorbus foliolosa, Viburnum nervosum	(3100–) 3300–3800 m	?130 cm or more	—	—	Eastern oak-fir forest	Rhododendron coniferous forest (in part)
x. Juniper/ Rhododendron scrub	Gaultheria trichophylla, Juniperus recurva, J. squamata, Morina nepalensis, Pedicularis megalantha, Phlomis tibetica, Potentilla arbuscula, Primula sikkimensis, Rhododendron lepidotum, Thalictrum chelidonii, Trollius pumilus	3700–4200 m	?	—	—	Moist alpine scrub	Alpine scrub and meadows
xi. Dry alpine scrub	Aconitum orochryseum, Astragalus acaulis, Chesneya nubigena, Cremanthodium thomsonii, Ephedra gerardiana, Meconopsis simplicifolia, Picrorhiza scrophulariifolia, Primula calderiana, Rheum nobile, Rhododendron anthopogon, Salix lindleyana, Saussurea gossypiphora, S. obvallata, Saxifraga moorcroftiana, Tanacetum gossypinum, Thermopsis barbata	4000–4600 m	?	—	—	Dry alpine scrub	

leaved forest, is a more mixed forest in which oaks are less common, and other trees, both deciduous and evergreen, e.g. Lauraceae, *Exbucklandia* etc., are more abundant together with dense shrubs, climbers and many epiphytes. The two types intergrade with each other. In Bhutan Cool broad-leaved forest is extensive in some eastern districts, e.g. around Tshilingor and on the steep hillsides SE of Sengor. Apparently it is rare in Sikkim, where drier oak-dominated forests are more widespread.

v. Evergreen oak forest. These forests are a very characteristic feature of some parts of central Bhutan, especially around Tongsa and on the hills above Mongar. They apparently receive a lower rainfall than Warm broad-leaved forests, and composition varies according to altitude and rainfall. At lower levels *Castanopsis hystrix* and *C. tribuloides* are often dominant, higher up *Quercus lamellosa* becomes commoner; with increasing dryness more xerophytic *Quercus* species, e.g. *Q. lanata*, *Q. griffithii* and *Q. semecarpifolia*, and sometimes *Pinus wallichiana* appear. The shrub layer is often poorly represented, whilst the shady humid forest floor is dominated by small herbs, e.g. Urticaceae and bryophytes. Felling is mainly to create grazing land and for firewood; the oak forests of Bhutan are little exploited for timber.

vi. Blue pine (Pinus wallichiana) forest (cf. 60). This is the temperate equivalent of the Chir pine forest and occupies the inner dry valleys of Bhutan where rainfall is very low except during the monsoon season. Unlike Chir pine it is very susceptible to fire. It is best developed in the Ha, Paro and Thimphu valleys in west Bhutan and in the Bumthang and Gyetsa valleys farther east. It is apparently absent from Darjeeling and Sikkim. In these valleys it is often dominant and acts as a pioneer colonist of burnt or disturbed ground (22,114). The only tree species commonly associated is *Quercus griffithii* but many xerophytic shrubs occur, as do herbs which mostly appear during the monsoon. There is a gradual transition between this and Evergreen oak forest, and on the moister slopes above the main valleys, with Spruce, Hemlock and Fir forests, where the pines are more protected from fire and often attain a greater stature than in the valleys themselves. In the main valleys, where slopes are gentler, much Blue pine forest has been cleared for cultivation and for timber, and such a vigorous species lends itself to forestry planting.

vii. Spruce (Picea) forest. Spruce forest, together with the rather similar Hemlock and Fir forests, occupy the montane cloud-forest zone of Bhutan between the temperate broad-leaved forests and the tree-line. Although often two or all three of the dominant elements are mixed with each other or with pine, larch, oak, maple, birch etc. separate forest types can frequently be recognized.

Spruce forest is found at a lower altitude than the other two, and is apparently somewhat drier; it is more local in distribution but is found in the Thimphu district and is particularly well-developed in the Bumthang district (around Ura

and the Ura La). *Picea spinulosa* is the common dominant, but in E Bhutan *P. brachytyla* forms mixed stands with it. Rhododendrons are less frequent than in Hemlock and Fir forests.

viii. Hemlock (Tsuga dumosa) forest. This is similar to Spruce forest but appears to require a higher precipitation, which results both from mist condensation and a high rainfall, but no precise data are available. Shrubby and arborescent rhododendrons are frequent and the high humidity is ideal for dense growth of epiphytic and terrestrial ferns, lichens and bryophytes. Roadsides, landslips and cleared areas are often colonised by dense bamboo thickets. Mixed stands with the other montane conifers are common. In Bhutan, Hemlock forest is common on the main mountain ridges below the Fir forests, throughout the central and northern parts of the country.

ix. Fir (Abies densa) forest. Fir forest is characteristic of the highest forested ridges throughout Bhutan, where huge tracts are covered by virtually no other three species, apart from hemlock and birch in places. The dense canopy provides a humid environment for a luxuriant understory of *Rhododendron* and other shrubs, and the mossy ground layer supports many small herbs, e.g. *Primula* species and *Bryocarpum himalaicum*. As the tree-line is approached, at around 3600–3800 m, the firs become more stunted and are mixed with junipers and smaller *Rhododendron* species. As in Hemlock forest, in addition to the high rainfall, considerable mist-precipitation must derive from the frequent cloud cover. In parts of Bhutan areas of Fir forest have been cleared for cultivation and grazing; these areas if abandoned are rapidly colonised by bamboos.

x. Juniper/Rhododendron scrub. This is a moist scrub vegetation occurring above the tree line throughout N and C Bhutan. Typically it consists of scattered shrubs of *Juniperus*, *Rhododendron* and *Potentilla arbuscula* but with a rich herb layer appearing during the monsoon season. Damp grassy meadows are commonly found in this zone and more extensive grasslands may result from a long history of grazing. No detailed meteorological or ecological data are available for this vegetation, which is floristically extremely rich and contains many plants much prized in horticulture.

xi. Dry alpine scrub. This is a more xerophytic vegetation found at higher altitudes than the moist Juniper/Rhododendron scrub, and probably is widespread in N Bhutan and the higher ridges of C Bhutan (e.g. on the Black Mountain). The precise extent of its distribution and exact composition are unknown. It is clearly allied to the steppe vegetation of the Tibetan plateau of which genera such as *Caragana*, *Chesneya* and *Ephedra* are characteristic.

xii. Agriculture and forestry. Most cultivation in Bhutan occurs in the inner populated temperate valleys of the central belt, where rice and cereals are most

widely grown. Although dry, these valleys yield good crops on account of the high summer temperature and plentiful irrigation water from the rivers. In this belt, e.g. in the Ha, Paro, Thimphu and Bumthang valleys, considerable forest clearing has occurred for agriculture. In the warm temperate and subtropical zones, agriculture is less extensive and frequently occupies smaller areas of cleared forest. Throughout Bhutan terracing of the hillsides is utilised to increase the area of cultivated ground.

Forestry is a comparatively new industry in Bhutan which now has an active and expanding Forestry Department (Dorji, 39a). Only about 11% of Bhutan's land area has been cleared for agriculture, leaving about 67% of the country covered by indigenous forest, much of it completely undisturbed by man. Most forest clearance has been in the southern subtropical belt for export to India and in the central belt around towns and villages. Legislation has been introduced to protect these forests and the Forest Department has developed a vigorous forest survey and management policy with selective felling and replanting of important timber species (39a).

The list below includes some of the main fruit, vegetable and cereal crops; ornamental species are numerous and not included.

(a) *Warm temperate and subtropical crops*

Annona reticulata
Artocarpus heterophyllus
Areca catechu
Baccaurea ramiflora
Careya arborea
Carica papaya
Capsicum frutescens
Citrus aurantium
medica
Cucumis melo
Cynodon dactylon
Hibiscus esculentus
Litchi chinensis
Mangifera indica
Momordica charantia
Moringa oleifera
Musa sp.
Oryza sativa
Psidium guajava
Syzygium cumini
Tamarindus indicus
Zea mays
Zizyphus incurva

(b) *Cool temperate crops*

Allium cepa
Amaranthus hypochondriacus
Brassica juncea
oleracea
Canna edulis
Capsicum annuum
Cicer arietinum
Cucurbita moschata
Cyclanthera pedata
Ficus auriculata
Fagopyrum esculentum
tataricum
Hordeum vulgare
Lycopersicon lycopersicum
Malus baccata
Nicotiana tabacum
Oryza sativa
Phaseolus spp.
Pisum sativum
Prunus persica
Punica granatum
Pyrus pashia
Setaria italica
Solanum tuberosum
Triticum aestivum

(c) *Subtropical timber trees planted*

Aquilaria malaccensis
Bombax ceiba
Dalbergia sissoo
Eugenia formosa
Gmelina arborea
Pinus roxburghii
Pterospermum acerifolium
Shorea robusta
Tectona grandis
Terminalia bellirica
Tetrameles nudiflora

(d) *Temperate timber trees planted*

Cryptomeria japonica	Eucalyptus spp.	Thuja orientalis
Cupressus corneyana	Pinus wallichiana	

CONSERVATION OF THE BHUTANESE FLORA

As is well known, Bhutan has a very rich and diverse flora including numerous economically important plants such as timber trees and medicinal herbs, also many attractive and desirable horticultural groups such as Orchidaceae and Ericaceae. For Bhutan, its vegetation is one of the most important and valuable national assets, representing a huge long-term resource, of which only a small fraction is utilised at present. Economic uses apart, the vegetation and its constituent genera and species are of great scientific value to botanists and ecologists around the world, not only for their richness and diversity, but also because of the excellent state of preservation of most of the country's forests and mountain areas, in comparison to some other Himalayan areas in NW India, Nepal and Sikkim.

Much credit must be given to the Royal Family of Bhutan and the Royal Government and Forest Department of Bhutan for their very enlightened outlook regarding conservation of their country's flora and fauna. Practices such as clear felling and burning to improve grazing are strongly discouraged; whilst replanting cleared areas with indigenous species such as Blue pine is promoted. These authorities show commendable concern for all aspects of conservation of Bhutan's flora; in its present state Bhutan contains huge areas of undisturbed vegetation where many species endangered or nearing extinction in other parts of the Indian subcontinent survive and enjoy complete protection. We strongly support these policies and hope that they will continue in the future thereby ensuring survival of a great resource and providing an outstanding example to other developing countries.

PHYTOGEOGRAPHY OF THE BHUTAN AND SIKKIM FLORAS

In the description of the flora of the Indian subcontinent outlined by Hooker in 1906 (80a), the great floristic diversity was, together with geographic and climatic factors, largely attributable 'to the immigration of plants from widely different border countries, notably of Chinese and Malayan on the east and south, of Oriental, European and African on the west, and of Tibetan and Siberian on the north'. More locally, many such influences can be demonstrated within the E Himalayan flora, where the wide spectrum of climate and ecology supports plants of diverse floristic affinities.

The more important and interesting phytogeographic elements in the indigenous flora are outlined below, where a significant number of genera and

species can be shown to have strong connections with the flora of another part of the world. These elements are purely descriptive and do not imply any migration between these regions and the E Himalaya. A full assessment of floristic elements cannot be made until the external distributions of all taxa in the E Himalaya are worked out and analysed on a non-selective basis. The examples chosen here are highly selective, including only a small percentage of the total flora, but reflect the most obvious patterns and those described previously by other workers. Weedy species are excluded. Some of the distribution patterns may be a result of comparatively recent migration, e.g. along the Himalayan chain from China; but other disjunct distributions may reflect processes of contraction and isolation of formerly widespread taxa.

1. SE Asian-Malaysian element

This element is made up of genera and species which are typical of many parts of tropical SE Asia, including S Burma, Thailand, Indo-China, Malaya, Malaysia and Indonesia. As stated by Stainton (114) this element is more manifest in the east Himalaya and it gradually declines westwards. It is the dominant element in the Warm broad-leaved and Subtropical forests of Bhutan and Sikkim, and includes many trees, shrubs and climbers. The following taxa are typical; all occur in Burma and the Malayan peninsula, many range to Indo-China, a smaller number to the Malaysian Islands and Indonesia.

Acrocarpus fraxinifolius
Actinidia callosa
Alcimandra cathcartii
Ampelocissus barbata
Antidesma acuminatum
Baccaurea ramiflora
Bauhinia purpurea
Bischofia javanica
Brassaiopsis glomerulata
Calamus spp.
Carallia brachiata
Careya arborea
Crateva religiosa
Cycas pectinata
Debregeasia longifolia
Dendrobium aggregatum
Dendrocnide sinuata
Dipterocarpaceae
Dischidia benghalensis
Duabanga grandiflora
Engelhardia spicata
Eria paniculata
Euchresta horsfieldii
Exbucklandia populnea
Firmiana colorata
Garuga pinnata
Gnetum montanum
Hedychium coccineum
Helicia nilagirica
Heliciopsis terminalis
Hodgsonia macrocarpa
Hydrobryum griffithii
Lepisanthes senegalensis
Lithocarpus elegans
Macrosolen cochinchinensis
Maesa montana
Mangifera indica
Meliosma simplicifolia
Meyna spinosa
Michelia champaca
Mucuna nigricans
Musa balbisiana agg.
Myrica esculenta
Oroxylum indicum
Plectocomia spp.
Podocarpus neriifolius
Procris crenata
Pterolobium macropterum
Rauwolfia serpentina
Rhaphidophora peepla
Schoepfia fragrans
Solanum anguivii
Spondias pinnata
Talauma hodgsonii
Tetrameles nudiflora
Toona sureni
Trevesia palmata
Vernonia volkameriifolia

2. Himalayan-Chinese-Japanese elements

The close links between the temperate floras of the Himalaya, China and Japan have long been recognized, and demonstrated for many plant groups. Kanai (in Hara, 69) listed 295 species illustrating the close affinities of the Himalayan and Japanese floras, whilst Stearn (116a) stated that 'Geologically

the Himalaya is younger than the Chinese mountains eastward, whence much of its montane and alpine flora must have come'. Each of these three regions has numerous endemic taxa, and many other taxa extend over two or three of the regions, or are replaced by closely allied taxa in the others. The Himalayan region is typical in this respect in having both many endemic taxa and many others ranging east to China and Japan.

The endemic taxa of each region could be classed as 'Himalayan', 'Chinese' or 'Japanese' phytogeographic elements, but so many other taxa overlap between the regions that such boundaries appear to be quite arbitrary and have little meaning. Even within the Himalayas, as Stainton (114) has demonstrated, there are 'eastern' and 'western' elements; of the eastern, some range east only to Assam or south-east Tibet, others into China and a number as far as Japan, and similarly extend to varying degrees at their western limits. Thus the overall pattern is perhaps better pictured as a series of overlapping ranges than as clearly defined geographical elements within these regions.

In the eastern Himalaya, i.e. from E Nepal through Sikkim and Bhutan to south-east Tibet and upper Assam, the proportion of 'Chinese' species steadily increases towards the east and decreases towards the west. The western boundary of some of these species is often well-marked, e.g. *Geum aleppicum*, *Populus rotundifolia* and *Taxillus kaempferi* are not uncommon in Bhutan but absent from Sikkim and E Nepal.

The following are six selected examples of the main patterns of distribution within the Himalayan-Chinese-Japanese phytogeographic element found in Bhutan and Sikkim; other examples could be included, but the numbers of taxa listed probably reflect the proportional size of the groups. The largest two groups comprise those taxa restricted to the E Himalaya and those distributed between the E Himalaya and China. The pan-Himalayan taxa appear to be fewer in number than both these groups which suggests that, if the Himalayan-Chinese-Japanese element were to be subdivided, a division into W Himalayan and E Himalayan-Chinese elements would be more meaningful than attempting to distinguish purely Chinese and purely Himalayan elements.

The number of endemic genera in the E Himalaya is relatively few. Many of those listed by Chatterjee (22a) are now known to be more widespread and many have since been found in W China, e.g. *Cortia*, *Nardostachys*, *Diplarche*, *Aechmanthera* and *Eriophyton*. However, at the level of species many endemics occur, even within Bhutan and Sikkim, and a selection of Bhutan endemics is listed. It is likely that some of these will be found outside Bhutan with future exploration; phytogeographically they are better considered as 'E Himalayan taxa'. Species such as *Leucophysalis yunnanensis*, *Phtheirospermum tenuisectum*, *Lonicera adenophora*, *Pilea cavaleriei*, *Rubus preptanthus* and *Smilacina tatsienensis* are found only in Bhutan and W China; whether these represent true disjunctions or merely reflect lack of collection in between is not yet certain.

Most of the taxa listed below do not extend to other parts of Asia or the world and are restricted to the Himalayan-Chinese-Japanese area; a few do occur elsewhere but belong to a definite pattern within this area.

a. *Taxa distributed from NW Himalaya (Kashmir and W Nepal) to Japan*

Cardiocrinum
Cornus macrophylla
Fragaria indica
Houttuynia cordata
Hovenia
Hypoxis aurea
Luzula plumosa
Malus baccata
Monotropastrum humile
Pleurospermum
Quercus glauca
Rhus javanica
Streptolirion volubile
Symplocos paniculata

b. *Taxa distributed from NW Himalaya to China*

Acer oblongum
Acronema
Allium prattii
Alnus nepalensis
Anemone rupicola
Arisaema tortuosum
Astilbe rivularis
Benthamidia capitata
Berchemia edgeworthii
Carpinus viminea
Chamaesium
Circaeaster
Clematis connata
Coriaria nepalensis
Cornus oblonga
Cotoneaster microphyllus
Craniotome
Cremanthodium
Cyananthus lobatus
Daphne bholua
Desmodium elegans
Deutzia compacta
Dubyaea
Elsholtzia fruticosa
Eriophyton
Fragaria nubicola
Galeola lindleyana
Gaultheria trichophylla
Hedera nepalensis
Holboellia
Hydrangea anomala
Ilex dipyrena
Iris decora
Juniperus recurva
squamata
Leptocodon gracilis
Leycesteria formosa
Myrsine semiserrata
Nardostachys grandiflora
Neolitsea umbrosa
Ophiopogon intermedius
Paris polyphylla
Pegaeophyton
Photinia intergrifolia
Piptanthus nepalensis
Pleione praecox
Podophyllum hexandrum
Prinsepia utilis
Prunus cerasoides
Pyracantha crenulata
Pyrus pashia
Quercus semecarpifolia
Rhamnus virgatus
Rhus succedanea
Ribes takare
Rosa brunonii
sericea
Rubus biflorus
calycinus
pentagonus
Sabia campanulata
Saurauia napaulensis
Schefflera elata
Sinocrassula
Spiraea bella
Streptopus simplex
Toricellia
Triosteum himalayanum
Trollius pumilus

c. *Pan-Himalayan taxa distributed from NW to E Himalaya but absent from China and Japan*

Acer sterculiaceum
Actaea acuminata
Anisadenia saxatilis
Arcyosperma
Arisaema intermedium
Astragalus chlorostachys
Clematis tortuosa
Cortia depressa
Dalbergia sericea
Delphinium brunonianum
Deutzia staminea
Dodecadenia
Edgaria
Eriobotrya dubia
Fragaria daltoniana
Gardneria angustifolia
Gypsophila cerastioides
Jasminum nepalense
Lespedeza gerardiana
Lignariella
Lindera pulcherrima
Lonicera obovata
Mahonia napaulensis
Melioema dilleniifolia
Michelia kisopa
Pancratium verecundum
Pandanus nepalensis
Parnassia nubicola
Philadelphus tomentosus
Picrorhiza
Pinus roxburghii
wallichiana
Platystemma
Potentilla atrosanguinea
fulgens
Premna interrupta
Rhododendron anthopogon
barbatum
campanulatum
Rhus wallichii
Rosa macrophylla
Rubus nepalensis
paniculatus
Sanguisorba diandra
Schisandra grandiflora
Sorbus cuspidata
foliolosa
microphylla
Spiraea canescens
Thalictrum chelidonii
Thermopsis barbata
Tsuga dumosa

d. *Taxa distributed from the E Himalaya to Japan but absent from W Himalaya*

Aucuba
Choerospondias axillaris
Cornus controversa
Enkianthus
Helwingia
Ilex crenata var. thomsonii
Mucuna macrocarpa
Rodgersia
Rubus mesogaeus
Stachyurus
Taxillus kaempferi
Tiarella polyphylla
Trillium tschonoskii

e. *Taxa distributed from the E Himalaya to China, but absent from the W Himalaya and Japan*

Acer taronense
Adonis brevistyla
Aeschynanthus bracteatus
Allium sikkimensis
Aspidocarya uvifera
Betula alnoides
Biswarea
Brachystemma
Briggsia
Calathodes
Callicarpa rubella
Campylandra aurantiaca
Cardamine griffithii
Carlemannia
Cassiope selaginoides
Chrysosplenium griffithii
Cinnamomum obtusifolium
Cochlianthus
Coelogyne corymbosa
Colquhounia coccinea
Crawfurdia
Dalbergia mimosoides
Decaisnea
Desmodium williamsii
Diapensia himalaica
Diplarche
Dolichos tenuicaulis
Entada pursaetha
subsp. sinohimalensis
Euptelea pleiosperma
Eurya cavinervis
Gentiana stylophora
Helwingia himalaica
Hydrangea stylosa
Ilex fragilis
intricata
Itea macrophylla
Jasminum lanceolarium
Leucophysalis yunnanensis
Leycesteria gracilis
stipulata
Litsea cubeba
kingii
sericea
Lonicera adenophora
syringantha
thibetica
Loxostemon
Loxostigma
Luzula effusa
Lysimachia congestiflora
Maddenia
Magnolia campbellii
globosa
Meconopsis napaulensis
Merrilliopanax
Michelia doltsopa
Millettia cinerea
pachycarpa
Morina betonicoides
Neanotis ingrata
Neillia rubiflora
Notochaete
Osmanthus suavis
Panax pseudo-ginseng
Phlomis rotata
Phtheirospermum tenuisectum
Physospermopsis
Picea brachytyla
Pilea cavaleriei
Populus rotundifolia
Potentilla griffithii
Primula geraniifolia
sikkimensis
Pterocephalus hookeri
Rhododendron edgeworthii
maddenii
micromeres
neriiflorum
Ribes luridum
Rubus fockeanus
fragarioides
preptanthus
sumatranus
wardii
Salix sikkimensis
Salvia plectranthoides
Sarcococca wallichii
Sedum triactina
Shuteria hirsuta
Sibbaldia perpusilloides
Smilacina tatsienensis
Smilax ferox
Soroseris
Souliea vaginata
Tetracentron
Urtica mairei
Vaccinium gaultheriifolium

f. *Taxa restricted to the E Himalaya (E Nepal, Sikkim, Bhutan, N Assam and SE Tibet)*

Abies densa
Acanthus carduaceus
Actinidia strigosa
Agapetes incurvata
serpens
Agapetes sikkimensis
Alcimandra
Aristolochia griffithii
Astragalus stipulatus
Betula utilis
Bryocarpum
Butea buteiformis
Capparis sikkimensis
Chrysobraya
Corylus ferox

Cremanthodium bhutanicum
Dipsacus atratus
Elatostema caveanum
imbricans
Eriobotrya hookeriana
Gamblea
Geum macrosepalum
Habenaria juncea
Haplosphaera himalayensis
Herminium angustilabare
Ichnocarpus himalaicus
Impatiens longipes
Lagotis pharica
Larix griffithiana
Lepidostemon
Lindera heterophylla
Liparis perpusilla
Lloydia flavonutans
Maddenia himalaica
Meconopsis grandis
superba
villosa
Myricaria albiflora
Parajaeschkaea
Paroxygraphis
Pentasacme pulcherrima
Phtheirospermum
glandulosum
Pinus bhutanica
Pleurospermopsis
Polyura
Primula whitei
Pycnoplinthopsis
Rhododendron baileyi
camelliiflorum
ciliatum
Rhododendron falconeri
fulgens
glaucophyllum
grande
hodgsonii
keysii
lanatum
lindleyi
niveri
pendulum
smithii
succothii
wallichii
wightii
Rubus fragarioides
Saussurea conica
Sphaerosacme
Treutlera

g. *Species at present known only from Bhutan*

Agapetes bhutanica
Allium rhabdotum
Androsace hemisphaerica
Astragalus bhotanensis
Buddleja bhutanica
Ceratostigma griffithii
Ceropegia bhutanica
dorjei
ugenii
Corallodiscus bhutanicus
Corydalis aurantiaca
oxalidifolia
Corylopsis himalayana
Cupressus corneyana
Draba bhutanica
Elatostema longicaudatum
Euphorbia griffithii
Hoya bhutanica
Lilium sherriffii
Lobelia nubigena
Luculia grandifolia
Microula bhutanica
Onosma bhutanica
Pedicularis hicksii
imbricata
inconspicua
longipedicellata
ludlowii
mucronulata
perpusilla
porriginosa
xylopoda
Potentilla bhutanica
bryoides
Rhododendron papillatum
Rubus sengorensis
Saxifraga clivorum
deminuta
flavida
lepidostolonosa
serrula
sherriffii
thiantha
vacillans
Swertia grandiflora
pseudo-hookeri
Viola bhutanica

3. Deccan element

In comparison to the strong links with China, Burma and Malaya, the Bhutan flora has relatively little in common with that of peninsular India and Ceylon. Those links that do occur are concentrated in the Subtropical and Warm broad-leaved vegetational zones. The taxa in the following list are typical 'Deccan' species although some range in a more limited manner to other parts of tropical Africa and Asia.

Bauhinia vahlii
Capparis olacifolia
Casearia graveolens zeylanica
Chamabainia cuspidata
Dendrophthoe falcata
Euphorbia sect. Diacanthium
Ficus benghalensis drupacea
Leucas ciliata
Murraya koenigii
Paramignya monophylla
Plecospermum spinosum
Plumbago zeylanica
Pterolobium hexapetalum
Sophora wightii
Streblus zeylanicus
Tamarix indica
Thunbergia coccinea
Tylophora rotundifolia
Woodfordia fruticosa

4. Tibetan element

The Tibetan plateau supports a largely xerophytic vegetation very different from that of the main Himalayan mountains on account of the low rainfall and high altitude. In places throughout the Himalaya this type of vegetation extends over the main mountain chain; in such areas the flora includes many species with a distinctly Tibetan affinity. Those listed below extend into N Sikkim, the Chumbi valley and W Bhutan to the north-east of Chomolhari; many are absent from Bhutan east of 90°30′ E where the main Himalayan chain runs further to the north of the Bhutan-Tibet frontier.

Allium fasciculatum
Arabis glandulosa
Arenaria bryophylla
Axyris prostrata
Braya tibetica
Caragana jubata
Chesneya nubigena
Cortiella hookeri
Dracocephalum speciosum
Ephedra gerardiana
Gueldenstaedtia himalaica
Hippophae tibetana
Hypecoum leptocarpum
Juncus thomsonii
Kobresia schoenoides
Lagotis pharica
Lancea tibetica
Lonicera spinosa
Microgynoecium tibeticum
Milula spicata
Oxytropis sulphurea
Paraquilegia microphylla
Parrya platycarpa
Phlomis rotata
Phyllophyton pharicum
Plumbagella micrantha
Potentilla armerioides multifida
Przewalskia shebbearei
Ranunculus tricuspis
Rheum spiciforme
Ribes alpestre
Saussurea gossypiphora
Saussurea obvallata
Stellera chamaejasme
Stracheya tibetica
Torularia humilis
Urtica hyperborea

Some authorities have considered the Tibetan vegetation to be a subdivision of the Irano-Turanian vegetation type, essentially a desert and steppe vegetation characterised by extremes of temperature and low rainfall, typical of large parts of E Turkey, Iran, Afghanistan and east to W Pakistan. Others have treated it as a different region since many characteristic Irano-Turanian genera, e.g. *Acantholimon*, *Calligonum*, *Cousinia* and *Dionysia* are rare or absent from Tibet. It does, however, have many similarities to the Irano-Turanian vegetation type and species such as *Ephedra gerardiana* are widespread in both.

5. Euro-Siberian element

The Euro-Siberian region extends throughout the northern part of Eurasia, from W Europe to E Siberia; sometimes it is subdivided into eastern and western parts. The Himalayan region is separated from it by the Tibetan and central

Asian plateau but a number of its characteristic species and genera reappear in the temperate and alpine zones of mountain regions of S and E Asia; the following occur in Bhutan and Sikkim, and many in other parts of the Himalaya.

Carex echinata
Cimicifuga foetida
Coeloglossum viride
Cucubalus bacciferus
Epipactis helleborine
Erysimum hieracifolium
Euphrasia officinalis agg.
Goodyera repens
Hedera
Hippophae rhamnoides
Juncus inflexus
Lamium amplexicaule
Lithospermum officinale
Polygala sibirica
Potentilla anserina
Prunella vulgaris
Ranunculus sceleratus
Stellaria uliginosa
Thlaspi arvense
Verbascum thapsus
Veronica anagallis-aquatica
Viola biflora

6. Arctic-alpine element

This element consists of taxa widespread in Arctic regions and also found at high altitudes on some of the high mountain ranges of Europe and Asia, often in a very disjunct fashion. The following examples occur in Bhutan and Sikkim, and most in other parts of the Himalaya.

Androsace chamaejasme
Bistorta vivipara
Carex atrofusca
  microglochin
Diapensia
Juncus triglumis
Koenigia islandica
Myosotis alpestris
Oxyria digyna
Oxytropis lapponica
Pinguicula alpina
Poa alpigena
Sagina saginoides
Thalictrum alpinum

HORTICULTURAL INTRODUCTIONS OF BHUTANESE PLANTS

W. Griffith cannot be credited with any horticultural introduction resulting from his expedition to Bhutan and the first collector to send back seeds from that country was R.E. Cooper. He is on record (33) as having introduced *Primula chasmophila*, *Rhododendron rhabdotum* and *Viburnum grandiflorum*. Accession books for 1915 and 1916 at the Royal Botanic Garden, Edinburgh, contain lists of seeds collected by him. Many of them are recorded as having failed to germinate but others succeeded and the computer record of living plant holdings in this Garden dated 1973 listed 12 of his Bhutanese introductions, 9 of them rhododendrons. Cooper was collecting on behalf of the nurseryman A.K. Bulley of Ness, Cheshire, who was instrumental in sending the seed to the Edinburgh Garden. The success of the seed in Bulley's hands and the impact of any resulting introduction on horticulture have not been established.

The largest introductions of Bhutanese plants were undoubtedly made over the years by F. Ludlow & G. Sherriff and their associated collectors. Their last expedition in 1949 was particularly abundant both in regard to seed and in the number of plants that were flown into Britain by air. It is difficult to assess the

number of introductions resulting from these expeditions that are now in cultivation, no doubt it is still considerable; the 1973 print-out of live plant holdings at the Edinburgh Garden listed 52 from Bhutan.

With the co-operation of a number of gardens, both public and private, the results of the Ludlow & Sherriff and other plant collecting expeditions are recorded in considerable detail in the 'Survey of Recently Collected Plants' in *J. Roy. Hort. Soc.* 87 (1962). They show that although some species were only fleetingly in cultivation the majority had become reasonably established at least in some gardens. Of the latter, those recorded from Bhutan appear in the list below. It must be emphasised, however, that few of these species are Bhutanese endemics, the majority are also native elsewhere in the Himalayan range, SE Tibet or W China and many have additionally been introduced from these sources.

In more recent years introductions have been made by other collectors, e.g. B. Bartholomew and S. Bowes-Lyon, but no information on the extent or success of the introductions has been published. In 1975 and 1979 the present authors made a number of successful introductions, particularly of conifers, including *Cupressus corneyana*, *Pinus bhutanica* and *Cycas pectinata*, as well as the endemic *Buddleja bhutanica*.

The following list incorporates all the plants known to have been introduced from Bhutan (but not necessarily exclusively from Bhutan), mostly by Cooper and Ludlow & Sherriff. Few identifications have been checked, and the names used are those under which the plants have been grown. The rhododendron introductions are compiled from the *Royal Horticultural Society Rhododendron Handbook* (1967).

Aconitum fletcherianum
  pulchellum
Adonis brevistyla
Allium macranthum
  sikkimense
Androsace strigillosa
Anemone rupicola
Anthogonium gracile
Asparagus filicinus
Aster diplostephioides
  tongolensis
Berberis cooperi
  hookeri
  macrosepala
  parisepala
  zayulana
Bergenia purpurascens
Bistorta vacciniifolia
Briggsia muscicola
Bryocarpum himalaicum
Buddleja bhutanica
  colvilei
Cassiope fastigiata
  selaginoides
Ceratostigma griffithii
Codonopsis convolvulacea
Cotoneaster griffithii
Cremanthodium
  pseudo-oblongum
  reniforme
Cupressus corneyana
Cyananthus lobatus
Cycas pectinata
Cypripedium tibeticum
Delphinium muscosum
Diplarche multiflora
Erigeron multiradiatus
Euonymus tingens
Euphorbia griffithii
Gaultheria griffithiana
  hookeri
Gaultheria pyrolifolia
  semi-infera
  trichophylla
Gentiana tubiflora
Geranium lambertii
Incarvillea mairei
Jasminum humile
Larix griffithiana
Leptodermis stapfiana
Lilium nanum
  nepalense
  sherriffiae
Luculia grandifolia
Meconopsis discigera
  grandis
  paniculata
  sherriffii
  simplicifolia
  sinuata
  superba
  villosa

macrophyllum
Picea brachytyla
spinulosa
Picrorhiza scrophulariiflora
Pinus bhutanica
roxburghii
wallichiana
Primula bellidifolia
bracteosa
calderiana
capitata
caveana
chasmophila
concholoba
dickieana
dryadifolia
eburnea
flagellaris
geraniifolia
glabra
gracilipes
griffithii
jigmediana
jonardunii
kingii
nepalensis
normaniana
petiolaris
sapphirina
sherriffiae
smithiana
soldanelloides
strumosa
tsariensis
umbratilis
vernicosa
waddellii
whitei
xanthopa
Rhododendron anthopogon
arboreum
baileyi
barbatum
camelliiflorum
campanulatum
campylocarpum
ciliatum
cinnabarinum
dalhousiae
edgeworthii
epapillatum
eximium
falconeri
fragariiflorum
fulgens
glaucophyllum
grande
griffithianum
hirtipes
kendrickii
keysii
kingianum
lanatum
lepidotum
lindleyi
nivale
niveum
pendulum
phaeodropum
pogonophyllum
polyandrum
pumilum
ramsdenianum
rhabdotum
setosum
smithii
thomsonii
triflorum
tsariense
vaccinioides
virgatum
wallichii
wightii
xanthocodon
Ribes himalense
Rosa macrophylla
Saussurea gossypiphora
Saxifraga andersonii
brunoniana
sherriffii
Spiraea arcuata
Streptopus simplex
Thalictrum chelidonii
Tsuga dumosa
Vaccinium nummularia
Viburnum grandiflorum
Wardaster lanuginosus

NOTES ON TAXONOMIC TREATMENT

i. Descriptions and keys. The *Flora of Bhutan* is written primarily for foresters, and secondarily for horticulturists, field botanists and taxonomists with an interest in the E Himalayan flora. With these aims in mind, and considering that many users will have little or no formal botanical training, an effort has been made to adopt a style and terminology as simple as possible, avoiding esoteric technical terms where more familiar alternative wording exists; this is done as far as possible without loss of botanical accuracy. Abbreviations, both of botanical words and authorities, can be particularly confusing to non-botanists or users for whom English is a second language, and have therefore been reduced to a minimum. Those included are listed on page 34.

Throughout the Flora, descriptions, as concise as possible, are given of families, genera and species, and, where relevant, of varieties and subspecies. These have been drawn up from our own observations on herbarium material, and in some cases living plants or specimens preserved in spirit, in conjunction

with many Floras, monographs and miscellaneous literature (including illustrations). Within each family, bracket keys are given to genera, using readily-observed characters wherever possible; microcharacters such as placentation have been avoided where alternatives, more readily observed in the field, exist. Emphasis on foliage and other vegetative characters in many cases produces an 'unnatural' arrangement but we hope a more practical one.

Keys to all species are not normally provided; in most parts of S and E Asia the flora is still very incompletely known and species limits often unclear; it is therefore imperative in identifying plants from Bhutan that the species descriptions should always be used, rather than relying for identification on one or two selected characters in a key. In Bhutan such keys could lead to frequent misidentification as many hitherto unrecorded species are likely to be found. To facilitate identification in larger genera, keys to groups of species are provided; within each group of species the first species (usually a common, well-known one) is described in full; related species are given shorter comparative descriptions emphasising the important diagnostic characters.

ii. Supplementary information. Following the description of each species, information on distribution, ecology and altitude is given. All plant species reliably recorded from Bhutan are denoted 'Bhutan'; the distribution within Bhutan is given by districts in which the species is recorded, following the geographical subdivisions in fig. 2 (see p. 35). For rarer species more precise locality information is given. This is followed by the word 'Sikkim' if the plant has been reported for Sikkim or the Darjeeling district irrespective of its presence or absence in Bhutan. When a plant is unknown from Bhutan but recorded from an adjacent area, e.g. Sikkim, Chumbi valley, Assam terai, Arunachal Pradesh etc. this is indicated (see fig 1).

Ecological notes include information on the major vegetation zones in which the plant is known (see p. 15) together with more precise ecological detail if relevant. This is followed by the altitudinal range of the plant in Bhutan, or if absent from Bhutan, from Sikkim. Altitudes given by Hooker (80) are too imprecise and only rarely have been followed where no other information exists.

Following some descriptions miscellaneous notes are appended; these include short descriptions of varieties or subspecies, brief taxonomic notes, economic uses and any other pertinent information.

iii. Classification and nomenclature. The arrangement of families approximates to that of the Englerian system but where good evidence exists for uniting or, more commonly, subdividing families, this has been done. Arrangement of genera within each family usually corresponds with that of the *Flora of British India*. For taxonomic decisions regarding delimitation of genera and species, notice has been given to the work of specialists and monographers; these limits often differ from those in the *Flora of British India*, for example many tropical species in the Himalayan flora have been shown to be conspecific with Malaysian

taxa, and some widespread N hemisphere species, e.g. *Taxus baccata* have been divided into more local species or subspecies since Hooker's time.

For all taxa an effort has been made to use the correct scientific name; a large percentage of names adopted differ from those used in the *Flora of British India*. Synonyms from the latter work and other important literature follow the name in italics; synonymy not relevant to the E Himalayas is not included. In order to check the correct application of names, type material of as many species as possible has been seen (mostly from Kew, the British Museum and Edinburgh herbaria), as well as the authentic material at Kew used in the preparation of the *Flora of British India*.

Following synonyms, common names used in Bhutan are given where known. Many were collected by the authors in 1979, together with voucher specimens, others (followed by a bibliographic reference) are taken from the literature. The dialect abbreviations are listed below.

iv. Illustrations. Illustrations are provided for as many genera as possible within each family; the aim is to illustrate the diversity present, especially of those parts of the plant important in classification and identification.

v. Abbreviations and measurements. Abbreviations have been kept to a minimum but the following are included:

Authorities of botanical names: A. DC., Alphonse de Candolle; DC., Augustine de Candolle; Griff., W. Griffith; Hook. f., J. D. Hooker (filius); L., C. Linnaeus; L.f., C. Linnaeus (filius); Roxb., W. Roxburgh; Wall., N. Wallich.

Common names of plants: Dz, Dzongkha dialect (W Bhutan and official language); Eng, English; Med, Bhutanese medicinal name; Nep, Nepali; Sha, Shachop dialect (E Bhutan).

Distribution in Bhutan (see Fig. 2); S, southern Bhutan; C, central Bhutan; N, northern Bhutan.

Other abbreviations: agg., aggregate species; auct., of various authors (auctorum); cf, compare (confer); F.B.I., *Flora of British India* (80); nom. illeg., illegitimate name (nomen illegitimum); p.p., in part (pro parte); sensu, in the sense of the author indicated and not as originally intended; subsp., subspecies; var., variety.

Measurements: metric system units (m, cm, mm) are used. Dimensions of leaves etc are given as, e.g. 3 × 1 cm where the first figure indicates length and the second breadth. If only one measurement is given, e.g. fruit 2.5 cm, then this refers to length or height. Measurements in brackets are for specimens outside the average range, e.g. trees 20–40(–50) m indicates the normal range of height as 20 to 40 m, but exceptionally up to 50 m.

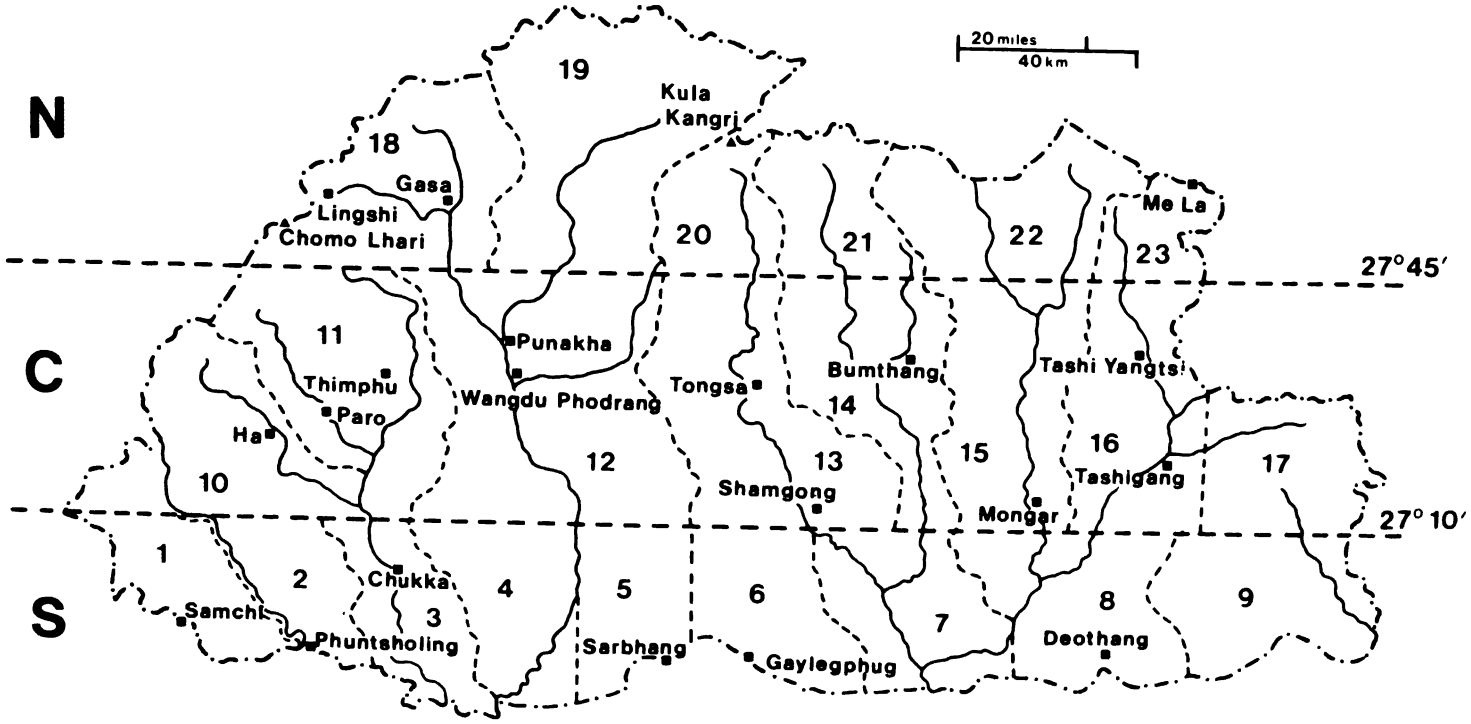

FIG. 2. Map of Bhutan showing important rivers and main towns, divided into three zones: south (S), central (C) and north (N), and into 23 botanical districts: 1 Samchi, 2 Phuntsholing, 3 Chukka, 4 Sankosh, 5 Sarbhang, 6 Gaylegphug, 7 Manas, 8 Deothang, 9 Dhansiri, 10 Ha, 11 Thimphu, 12 Punakha, 13 Tongsa, 14 Bumthang, 15 Mongar, 16 Tashigang, 17 Sakden, 18 Upper Mo Chu, 19 Upper Pho Chu, 20 Upper Mangde Chu, 21 Upper Bumthang Chu, 22 Upper Kuru Chu, 23 Upper Kulong Chu. Drawn by S. J. Mackay.

SCOPE OF THE FLORA

The Flora is designed to be a record of the flowering plants of Bhutan; as far as possible every species represented from Bhutan in British herbaria, and all reported in botanical literature (excepting dubious or ambiguous records) have been incorporated. Parts of Bhutan nevertheless remain very under-collected and many more taxa may remain to be discovered in future. In contrast, Sikkim and the Darjeeling district of W Bengal are probably the most intensively botanized parts of the Himalaya and many species unknown in Bhutan occur there. We have therefore, for floristic completeness, attemped to include all such species from Sikkim and Darjeeling.

Similarly, selected records from other regions adjacent to Bhutan, the Assam terai, Chumbi valley (Tibet) and Nyam Jang Chu (Arunachal Pradesh), have been included where relevant (fig. 1). Such species are often dealt with more briefly in the Flora. No doubt several records from Sikkim have been omitted because we have been unable to search Indian herbaria and may be ignorant of some of the vast, scattered literature relating to plants of Sikkim. Thus the *Flora of Bhutan* should serve as a complete checklist of the plants of both Bhutan and Sikkim, but not for other peripheral areas such as the Chumbi valley and Nyam Jang Chu for which only a tiny proportion of records is included.

Cultivated plants widely grown in Bhutan are treated, but few botanists have collected or recorded cultivated species so that only a proportion can be incorporated. Not all cultivated species reported from Sikkim have been included as many such records are very old and the plants may no longer be in cultivation.

GEOGRAPHICAL SUBDIVISION OF BHUTAN

No well-established geographical divisions suitable for describing plant distribution exist for Bhutan at the present time. A division of the country into twenty-three districts has therefore been devised. A grid system is quite unworkable in Bhutan at present because of the lack of an accurate and detailed map, the difficulty in recognising grid lines in the field and also the completely arbitrary nature of these in a country with so many easily-recognisable altitudinal, ecological and floristic zones and striking physiographic features. The subdivision we have adopted (fig. 2) attempts to serve as a useful indicator of distribution, to reflect altitudinal and vegetational zones, and to use boundaries (e.g. watersheds) which can be readily identified in the field.

Because the main physiographic features of Bhutan (mountain ridges and river valleys) run north–south, the boundaries in that direction are more natural. The east-west boundaries chosen are the latitudes of 27°10′N and 27°45′N. These latitudes were chosen to divide the country very approximately into southern subtropical (S), central temperate (C), and northern alpine (N) zones.

BOTANICAL BIBLIOGRAPHY OF BHUTAN AND SIKKIM

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GYMNOSPERMAE

Family 1. CYCADACEAE

Dioecious, palm-like, evergreen trees with short, thick, usually unbranched stems. Leaves in terminal crowns, oblong, pinnate, leaflets 1-nerved, entire. Male cones borne on peduncles near stem apex; scales imbricate, club-shaped, apex acuminate; anthers numerous, single-celled, in groups of 3–5. Female carpellary scales numerous, crowded in globose head around stem apex, narrow and stalk-like at base, broadened above into a flattened, toothed blade. Ovules 3–5 in notches on either side of stalk. Seeds ellipsoid, outer integument somewhat fleshy.

1. CYCAS L.

Description as for Cycadaceae.

1. C. **pectinata** Hamilton; *C. circinalis.* L. var. *pectinata* (Hamilton) Schuster. Sha: *Bongo*; Nep: *Thakal* (34). Fig. 4a–c.

Stems 1–2 m. Leaves 1.4–2 m, leaflets numerous, linear-lanceolate, 12–18 (–25) x 0.5–0.8 (–1) cm, stiffly coriaceous. Male cones ovoid-cylindric, 30–40 x 15 cm, scales 3.5–4 x 1–2.5 cm. Carpellary scales 15–18 (–20) cm, blade orbicular and inflexed at apex, 8–10 cm broad, brown tomentose, margin pectinate, teeth narrow, spine-tipped. Seeds orange, 4–5 x 3–4 cm, concealed by upwardly turned scale blades.

Bhutan: C–Tashigang district (Dangme Chu, N of Tashigang) and Mongar district (Lingmethang); **Sikkim**. Rocky slopes in dry valleys with Chir pine, or in subtropical forests with *Shorea*, 925–1050 m.

Stem pith used to produce sago; seeds sometimes ground into flour (34, 48).

Family 2. PINACEAE

Monoecious, occasionally dioecious, evergreen or deciduous trees. Leaves linear, sometimes needle-like, borne singly or in clusters on short shoots. Male cones short-lived, ovoid or globose, consisting of scales, each bearing 2 pollen sacs on the lower surface. Female cones with 2 ovules on the upper surface of their ovuliferous scales; scales becoming enlarged, woody and spreading at maturity, sometimes with bracts exserted between them. Seeds bearing an ovate-oblong, membranous wing.

1. Leaves on mature shoots in clusters or whorls of 3 or more 2
   Leaves on mature shoots always borne singly 4
2. Leaves always in clusters of 3 or 5 and sheathed by scales at the base at first; evergreen trees ..... **1. Pinus**
   Leaves on young terminal shoots borne singly, those on mature shoots in whorls of 10 or more, on short lateral shoots, not sheathed by bracts at the base; evergreen or deciduous trees 3

3. Female cones with persistent, leathery ovuliferous scales and narrower bract scales exserted between them; deciduous trees ..... **2. Larix**
   Female cones with deciduous ovuliferous scales and without exserted bract scales; evergreen trees ..... **3. Cedrus**
4. Old shoots with persistent prominent peg-like leaf bases; cones pendulous **4. Picea**
   Old shoots with scarcely prominent leaf bases or scars; cones pendulous or erect 5
5. Leaves acute at apex; female cones terminal, pendulous, remaining intact on the tree ..... **5. Tsuga**
   Leaves retuse at apex; female cones lateral, erect, disintegrating on the tree **6. Abies**

1. PINUS L.

Evergreen trees. Leaves triangular in section, borne in clusters of 3 or 5, sheathed at base by brown, membranous scales at first. Male cones in clusters at base of young shoots, cylindrical. Female cones ovoid or ellipsoid, subterminal; ovuliferous scales leathery or woody; bract scales not exserted; scales persistent.

1. Leaves in bundles of 5 ..... **Species 1 & 2**
   Leaves in bundles of 3 ..... **Species 3 & 4**

1. P. wallichiana A. B. Jackson; *P. excelsa* D. Don non Lamarck, *P. griffithii* McClelland nom. provis. Dz: *Tongphu*; Nep: *Dhupi* (34), *Sa-la*; Hindi: *Kail*; Eng: *Blue Pine.*

Trees 12–30 (–45) m with ± straight branches; young shoots greenish or weakly glaucous, glabrous. Leaves dark bluish-green, 11–18 cm, borne on thick, short shoots c 2 mm; sheathing scales entire; leaves evenly spreading around shoots, sometimes becoming pendulous, acuminate, margins minutely toothed. Male cones 8–10 x 3 mm, brownish. Female cones at first c 1.75 x 0.8 cm; mature cones ellipsoid, 10–15 cm long, c 3.5 cm broad before seeds are shed, but 5–9 cm broad when scales have spread; scales oblong, obtuse, c 2.5 mm broad, thinly woody and flexible, ± smooth at apex. Seeds ovoid, 6–10 x 5–6 mm, wing membranous, oblong, 1.5–3 cm, obliquely acute.

Bhutan: C–Thimphu to Tashigang districts, common; **Sikkim.** Forming extensive pure stands in dry inner valleys, also as scattered trees in moister temperate mixed forests; often cultivated, 1700–3300 m. April–May.

An important timber tree much used in house and dzong construction; regenerates vigorously and colonises fallow ground and scrub (48, 114).

2. P. bhutanica Grierson, Long & Page. Fig. 3c–e.

Similar to *P. wallichiana* but branches sinuous, often drooping; young shoots glaucous and brownish puberulous; leaves 12–28 cm, distinctly pendulous from base even when young, paler and more glaucous.

Bhutan: S–Deothang district (around Wamrung), C–Punakha, Mongar and Tashigang districts, commoner in east. Mixed cool broad-leaved forests, 1750–2440 m. April–May.

3. **P. roxburghii** Sargent; *P. longifolia* Roxb. non Salisbury. Nep: *Dhup* (34); Eng: *Chir Pine.*

Tree to 30 m, leaves drooping, 13–30 cm, bases surrounded by fimbriate-margined scales. Male cones in larger clusters; female cones sessile, ovoid, when mature 10–18 x 6–9 cm; scales thick, rigid and woody, 1.5–2 cm broad, reflexed and upwardly curved at apex; seeds c 8 x 5 mm, with wing c 15 mm.

Bhutan: S–Gaylegphug and Deothang districts, C–deep valleys of Punakha, Tongsa, Mongar and Tashigang districts; **Sikkim** (rare). Arid valleys, often forming pure stands, 900–2000m. March–May.

Timber useful; trees tapped for resin to produce turpentine (48).

4. **P. kesiya** Gordon; *P. insularis* Endlicher, *P. khasyana* Griff., *P. khasya* Hook. f. Eng: *Khasia Pine.*

Similar to P. *roxburghii* but leaves shorter, 10–20 cm; cones smaller, 7–8 x 4–5 cm, scales more bluntly pointed and less recurved at tip.

Sikkim: cultivated at Mungpoo (34). March–May.

Native of Khasia Hills, Burma and Philippine Islands. Produces high-quality timber and resin (16, 48).

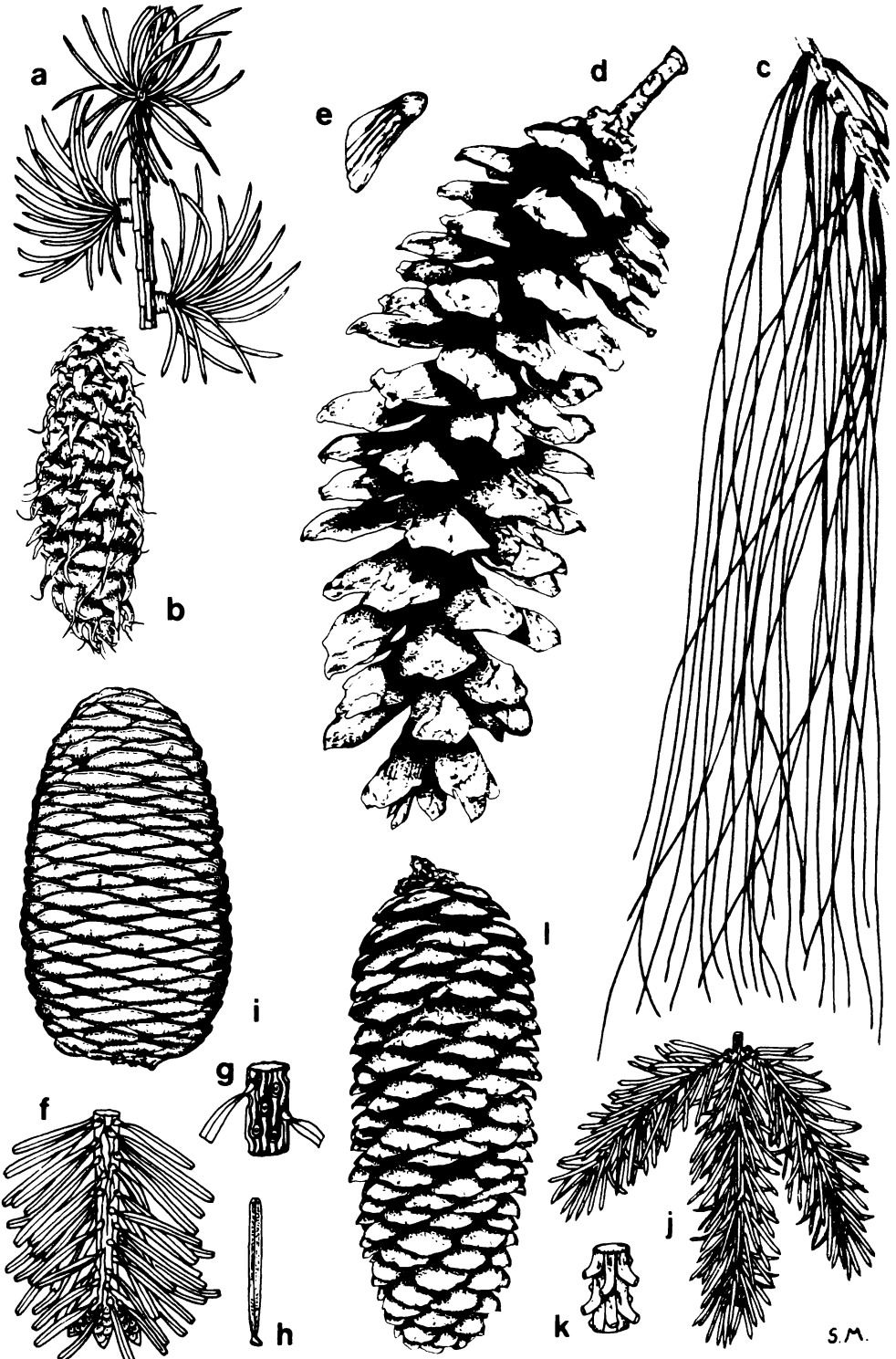
2. LARIX Miller

Deciduous trees with long, pendulous branches. Leaves linear, compressed, borne in whorls of 10–50 on short lateral shoots, but borne singly on young terminal shoots. Male cones ovoid; female cones ovoid, becoming ellipsoid when mature; ovuliferous scales leathery; bract scales exserted, scales persistent.

1. **L. griffithiana** Carrière; *L. griffithii* Hook. f. & Thomson. Dz: *Zashi*; Nep: *Barge Salla* (34), *Binyi* (34); Eng: *Sikkim Larch*. Fig. 3a, b.

Tree 10–20 m. Leaves 25–40 x 0.75 mm, subacute or obtuse, margins somewhat revolute. Male cones 1–1.3 x 0.7 cm, yellowish, directed towards shoot tips. Female cones when young c 3 x 1.5 cm, reflexed away from shoot tips; bract scales ovate, apiculate, purple, when mature 7–8 x 2.5–3 cm; ovuliferous scales 1–1.5 cm broad, rounded; bract scales cuspidate, exserted 0.75–1 cm, sharply reflexed. Seeds ovoid, 4–4.5 mm, wing broadly ovate, 5–6 x 4–5 mm.

FIG. 3. **Pinaceae.** a & b, *Larix griffithiana*: a, portion of leafy shoot; b, mature cone. c-e, *Pinus bhutanica*: c, portion of leafy shoot; d, mature, dry cone; e, seed. f–i, *Abies densa*: f, apex of leafy shoot; g, segment of shoot showing leaf scars; h, leaf (ventral surface); i, cone. j–l, *Picea spinulosa*: j, apex of branch; k, segment of shoot after leaf fall showing peg-like persistent leaf bases; l, mature, dry cone. All x ½, except g x 1; k x 2. Drawn by S. J. Mackay.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Bhutan: C–Ha to Mongar districts, N–Upper Mo Chu district; **Sikkim**. Hemlock, Spruce and cool-temperate mixed forests, often near streams, 2400–3600 m. April–May.

3. CEDRUS Trew

Dioecious or monoecious, evergreen trees. Leaves linear, in dense clusters of 15–25 on short lateral shoots, borne singly on young terminal shoots. Male cones erect, cylindrical. Female cones erect, broadly ellipsoid, sessile and truncate at base, rounded at apex; scales deciduous, obtriangular, thinly woody; bract scales not exserted.

1. C. **deodara** (D. Don) G. Don; *C. libani* A. Richard var. *deodara* (D. Don) Hook. f. Eng: *Deodar*.

Tree 60 m or more, young shoots pendulous. Leaves 2–5 cm, acuminate. Female cones 7–12 x 5–9 cm, scales 2.5–3.5 cm broad. Seeds triangular, c 1 cm long with wing c 1.5 x 2 cm.

Sikkim: cultivated at Darjeeling as an ornamental (34); produces very durable timber (48); wood reputed to have medicinal uses (13).

4. PICEA A. Dietrich

Evergreen trees. Leaves linear, flattened, spirally arranged, borne singly on prominent peg-like persistent bases. Male cones ovoid, drooping. Female cones terminal, pendulous, cylindric; ovuliferous scales thinly woody; bract scales not exserted; scales persistent.

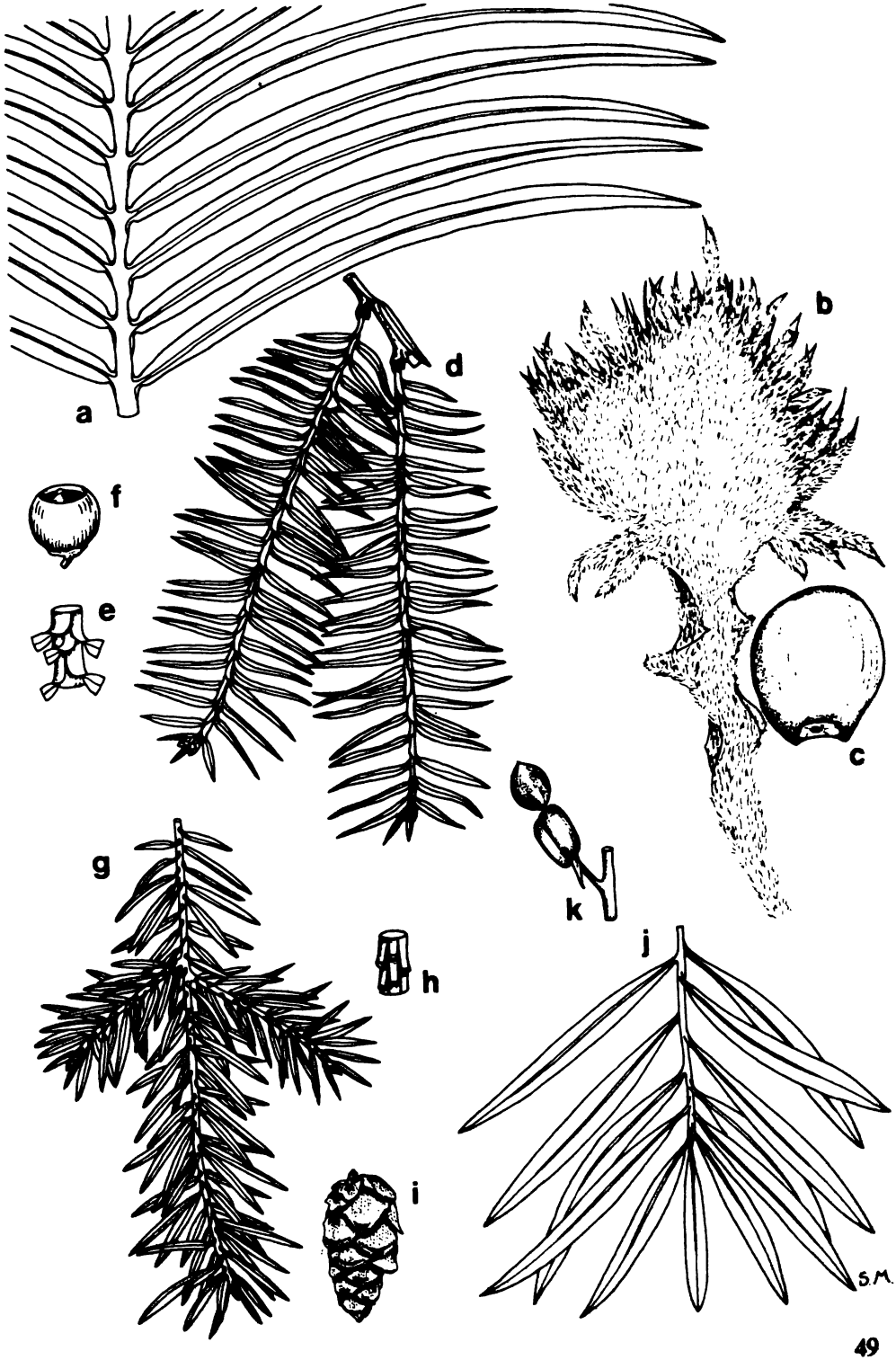
1. **P. spinulosa** (Griff.) Henry; *P. morinda* sensu F.B.I. p.p. non Link. Dz: *Seh Shing*; Eng: *E. Himalayan Spruce* (34). Fig. 3j–l.

Up to 60 m tall, branchlets pendulous, glabrous or pubescent. Leaves spreading evenly around shoots, 10–20 x 1.2–1.5 mm, sharply pointed, somewhat paler beneath with stomatal bands. Female cones 7–11 x 3–4.5 cm; scales obovate, broadly rounded and smooth at apex; seeds 3–5 x 2–3 mm, wing 7–10 mm long.

Bhutan: C–Ha to Tashigang districts, abundant, N–Upper Mo Chu and Upper Mangde Chu districts; **Sikkim**. Moist coniferous and mixed forests, often as pure stands, sometimes with Blue Pine, 2400–3600 m. April–May.

A useful timber species (48); records of the W. Himalayan *P. smithiana* (Wall.) Boissier from Bhutan (117) probably refer to this species.

FIG 4. **Cycadaceae, Taxaceae, Pinaceae and Podocarpaceae.** *Cycadaceae.* a–c, *Cycas pectinata*: a, segment of leaf; b, female carpellary scale in mature condition with seeds removed; c, seed. **Taxaceae.** d–f, *Taxus baccata* subsp. *wallichiana*: d, portion of branch; e, segment of shoot showing attachment of leaves; f, seed surrounded by fleshy aril. **Pinaceae.** g–i, *Tsuga dumosa*: g, shoot; h, portion of shoot after leaf-fall; i, cone. **Podocarpaceae.** j & k, *Podocarpus neriifolius*: j, tip of shoot; k, seed borne on fleshy peduncle. All x ½, except e, f, h × 2. Drawn by S. J. Mackay.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2. **P. brachytyla** (Franchet) Pritzel

Very similar to *P. spinulosa* but leaves strongly glaucous-white beneath; female cones scales ± rhombic, with bluntly triangular, undulate-striate apex.

Bhutan: C–Bumthang district (Gyetsa valley and around Ura and Ura La). Moist coniferous forests, usually in association with *P. spinulosa*; 3000–3500 m. April–May.

5. TSUGA Carrière

Evergreen trees. Leaves linear, flattened, spirally arranged but distichous due to twisting, borne on small, decurrent, cushion-like projections. Male cones in axils of shoots, ± globose. Female cones ovoid, terminal, pendulous; ovuliferous scales leathery, persistent; bract scales not exserted.

1. **T. dumosa** (D. Don) Eichler; *T. brunoniana* (Wall.) Carrière. Dz: *Ba Shing;* Nep: *Tengre Salla* (34); Eng: *Himalayan Hemlock.* Fig. 4g–i.

Tree 12–40 m, branchlets puberulous. Leaves 15–25 x 1.5–2 mm, green above, white beneath, obtuse or acute, margins inrolled and sometimes minutely toothed. Male cones 2–3 mm, consisting of a cluster of orbicular scales borne on slender stalks 5–6 mm. Female cones at first 5–6 mm, when mature becoming broadly ovoid, 1.5–2.5 cm, scales 0.75–1 cm broad, rounded. Seeds ovoid, compressed, c 4 x 2 mm, bearing an obtuse, elliptic wing c 6 x 3 mm.

Bhutan: C–Ha to Sakden districts, common, N–Upper Mo Chu and Upper Kulong Chu districts; **Sikkim.** Forming pure stands or mixed with Fir and *Rhododendron;* in many districts forming extensive forests, 2400–3300 m. May–June.

Timber sometimes used in house construction (34).

6. ABIES Miller

Evergreen trees. Leaves linear, flattened, spirally arranged but distichous due to twisting, borne on a disc-like base, leaving rounded depressions on branches after leaf-fall. Male cones catkin-like, borne in clusters near shoot tips. Female cones subterminal, later lateral, erect; ovuliferous scales rounded, thinly woody, deciduous; bract scales pointed, shortly exserted.

1. **A. densa** Griff.; *A. webbiana* sensu F.B.I. p.p., *A. spectabilis* auct. p.p. non (D. Don) Mirbel. Dz: *Dungshing;* Nep: *Gobre Salla* (34); Eng: *East Himalayan Fir.* Fig. 3f–i.

Tree up to 40 m, with wide-spreading branches. Leaves 20–40 x 2 mm, green above, white beneath, apex rounded and notched, margins somewhat inrolled. Male cones c 20 x 7 mm. Female cones at first ovoid, c 1 cm, when mature cylindrical, 10–15 x 3.5–7.5 cm; ovuliferous scales c 3 cm broad. Seeds ovoid, c 1 cm, bearing a rounded, oblong or spathulate wing, ± as long as the seed.

Bhutan: C–mountain ridges from Thimphu to Tashigang districts, N–Upper

Mo Chu district; **Sikkim.** Moist coniferous forests, commonly covering large areas as pure stands, often with an understory of *Rhododendron;* at lower levels mixed with Hemlock, at higher altitudes becoming dwarf and mixed with Juniper, 3000–4000 m. April–May.

Timber much used for roof shingles in Bhutan; leaves used medicinally (13).

Family 3. TAXODIACEAE

Monoecious, evergreen trees. Leaves needle-like, spirally arranged and spreading evenly. Male cones ovoid, subterminal on main shoots; female cones broadly ovoid or subglobose, terminal on short branches; ovuliferous scales 20–30, spirally arranged, woody, toothed at apex, partially fused to shortly exserted bract scales. Seeds 2–6 per scale, compressed, narrowly winged.

1. CRYPTOMERIA D. Don

Description as for Taxodiaceae.

1. **C. japonica** (L.f.) D. Don. Nep: *Dhupi* (34), *Tarpin* (34). Fig. 5e.

Tree to 40 m or more, branches spreading or drooping. Leaves inwardly-curved, 7–12 mm, 4-angular, acuminate, broadened and shortly decurrent at base. Male cones 7–10 x 3–4 mm. Female cones 1.3–1.5 cm; scales divided apically into 3–6 teeth, bract exserted, mostly adnate to scale but free at triangular apex. Seeds narrowly elliptic, 4 x 1.5 mm.

Bhutan: C–Thimphu district (cultivated at Thimphu); **Sikkim**: widely cultivated. March–April.

Native of Japan, cultivated as a fast-growing timber tree (34).

Family 4. CUPRESSACEAE

Monoecious or dioecious evergreen trees or shrubs. Leaves opposite and 4-ranked or in 3s, when juvenile needle-like and spreading; when adult scale-like and appressed, or needle-like, or dimorphic with scale-like leaves on branchlets and needle-like leaves on main shoots. Male cones cylindrical or ovoid with 2–20 anthers borne on peltate scales. Female cones with 4–12 scales in opposite pairs, dry and woody or fleshy when ripe. Seeds winged or not.

1. Leaves all needle-like and arranged in threes, or strongly dimorphic with needle-like leaves on main shoots and 4-ranked scale leaves on branchlets; female cones fleshy at maturity ..... **3. Juniperus**
   Leaves all scale-like and 4-ranked, weakly dimorphic with those of main shoots larger, more sharply pointed and more distantly spaced; female cones woody at maturity 2

2. Leaves of branchlets ovate or ovate-lanceolate, leaves of main shoots with spreading points; female cones globose, scales peltate, with squarish outer face.....**1. Cupressus**
Leaves of branchlets broadly ovate, leaves of main shoots closely appressed; female cones ovoid, scales flattened, elliptic .....**2. Thuja**

1. CUPRESSUS L.

Trees. Leaves of adult plants weakly dimorphic: on branchlets scale-like, 4-ranked, appressed and bluntly pointed, those of main shoots larger, more acute, decurrent at base, more distantly spaced and spreading. Female cones globose, consisting of 6–12 opposite, thick and woody, peltate scales with a squarish outer face, each with 4–6 basal ovules. Seeds small, winged.

1. C. **corneyana** Carrière; *C. funebris* sensu F.B.I. non Endlicher. Dz: *Chendey, Tsenden Shing*; Eng: *Weeping Cypress.* Fig. 5a–c.

Tree up to 30 m, with pendulous branches. Scale-like leaves of branchlets ovate, c 1 mm long, those of main shoots 1.5–2 mm long. Male cones oblong, c 3 x 1.5 mm, pale brown. Female cones, when young, globose, 3–4 mm diameter, on stalks 5–6 mm; when mature, 1.5–1.8 cm; scales 6–9 mm across their outer face; flat, or with a blunt peg at centre.

Bhutan: C–Punakha district (Pho Chu valley NE of Punakha, and W slopes of Pele La). Moist forests with Hemlock, Fir and Juniper. 2550–3000 m. May–July.

Endemic to Bhutan (87); commonly cultivated in Bhutan and Sikkim as a sacred tree around villages and religious buildings (87, 78). Timber very valuable for dzong construction; wood burned as incense. Records of *C. torulosa* D. Don from Bhutan (117) refer to this species.

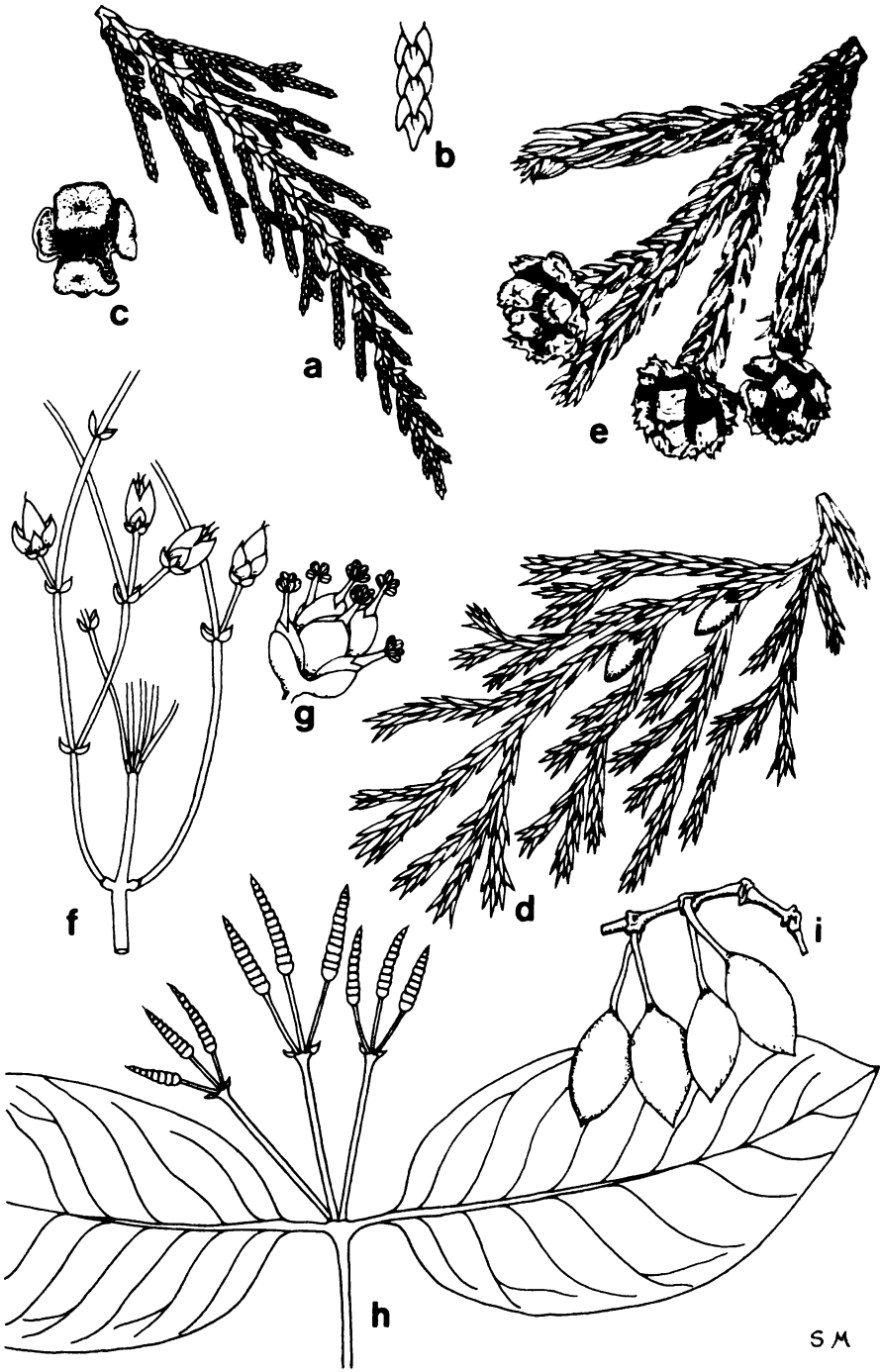
2. C. **cashmeriana** Carrière

Similar to *C. corneyana* but smaller; branchlets very pendulous; foliage strongly glaucous, leaves ovate-lanceolate; female cone scales bearing a leaf-like point at the centre.

Bhutan: C—Mongar district (Mongar). 1800 m.

Cultivated as an ornamental tree.

FIG 5. **Cupressaceae, Taxodiaceae, Ephedraceae and Gnetaceae. Cupressaceae.** a–c, *Cupressus corneyana*: a, portion of shoot with branchlets; b, segment of branchlet; c, mature cone in dry condition. d, *Juniperus recurva*: portion of shoot with branchlets and female cone. **Taxodiaceae.** e, *Cryptomeria japonica*: portion of shoot with mature cones in dry condition. **Ephedraceae.** f & g, *Ephedra gerardiana*: f, shoots bearing seeds enclosed by scales; g, cluster of male flowers. **Gnetaceae.** h & i, *Gnetum montanum*: h, tip of shoot with male catkins; i, part of fruiting spike. Scale: h, i x 3/5; c, d x 4/5; e, f x 1; a x 1½; g x 2½; b x 4. Drawn by S. J. Mackay.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2. THUJA L.

Similar to *Cupressus* but leaves of main shoots closely appressed. Female cones ovoid, scales thinly woody, basally attached, oblong-elliptic with a hook-like boss near the apex. Seeds wingless.

1. **T. orientalis** L. Eng: *Chinese Arbor-vitae* (48).

Shrub or tree up to 10 m. Leaves broadly ovate, those of branchlets c 1 mm, those of main shoots c 2 mm long. Female cones c 1.5 x 1 cm, blue-glaucous.

Bhutan: C–Thimpu district (Taba); **Sikkim**: Darjeeling.

A native of China and Japan cultivated as a timber tree (48).

3. JUNIPERUS L.

Trees or shrubs. Leaves of adult plants all needle-like and arranged in 3s, or strongly dimorphic with needle-like leaves on main shoots and 4-ranked scale-like leaves on branchlets. Female cones consisting of 3–8 scales which become fleshy and coherent forming a berry-like fruit. Seed usually solitary, thick and hard.

1. **J. recurva** D. Don. Dz: *Shup;* Sha, Tongsa: *Shupo Shing;* Eng: *Weeping Blue Juniper* (34). Fig. 5d.

Tree to 20 m, more rarely a prostrate shrub c 30 cm, with flaky brown bark; shoots long and recurved or pendulous. Leaves all needle-like, appressed, 0.75–1 mm broad, on main shoots 4–6 mm long and scarcely overlapping, on branchlets 3–4 mm long and densely crowded, producing slender leafy shoots 1.5–2.5 mm broad. Male cones oblong, 3–4 x 2 mm, of 10–15 ovate scales. Female cones globose, c 1.5 mm when young, globose or ovoid when ripe, 7–10 mm, black, usually with tips of 3 scales visible near apex.

Bhutan: C–Thimphu to Sakden districts, common, N–Upper Pho Chu district; **Sikkim**. Moist Fir forests and in montane shrub heath with *Rhododendron* etc. 2900–4200 m. April–August.

Plants with longer leaves, 4–7 mm, on the branchlets, occur in Sikkim, and belong to var. **coxii** (A. B. Jackson) Melville. Records of *J. fargesii* Komarov from Sikkim probably refer to this variety. Twigs and leaves are burned as incense in temples (34).

2. **J. squamata** D. Don; *J. recurva* D. Don var. *squamata* (D. Don) Parlatore

Similar to *J. recurva* but always shrubby, 30–100 cm; leafy shoots shorter and stouter, erect or weakly recurved, c 4 mm broad; leaves broader, 4–6 x 1.5 mm, midrib often more strongly developed.

Bhutan: C–Thimphu district, N–Upper Mo Chu and Upper Pho Chu districts; **Sikkim**. Montane dwarf shrub heath, 3200–4700 m. May–June.

A variable species, some specimens with very appressed leaves, others with more spreading leaves.

J. communis L., a West Himalayan species, has been recorded from Bhutan (71) possibly erroneously. It differs in being a shrub c 2 m; leaves spreading, 5–8 x 1.5–2 mm, slightly concave and whitish on upper surface, not decurrent, but stems swollen below leaf insertion; berries ovoid, 3-seeded, glaucous, with 3 rounded scales at apex.

3. **J. pseudosabina** Fischer & Meyer; *J. indica* Bertoloni, *J. wallichiana* Brandis nom. illeg. Eng: *Black Juniper* (34).

Shrub or tree up to 20 m. Leaves strongly dimorphic, those on main shoots in 3s, rather distant, needle-like, 4–5 x 1–1.3 mm, shortly decurrent at base; those of branchlets in 4 ranks, densely imbricated, ovate, 2.2–2.5 x 1.3 mm, obtuse. Male cones ovoid, 4–5 x 2 mm. Female cones when mature, black, ovoid, c 10 x 7.5 mm, containing 1 seed enveloped by 2 pairs of fleshy scales.

Bhutan: C–Thimphu district, N–Upper Mo Chu and Upper Bumthang Chu districts; **Sikkim**. Moist Fir forests or in montane shrub heath with *Rhododendron* etc., 3500–4700 m. May–July.

Family 5. PODOCARPACEAE

Dioecious evergreen trees. Leaves coriaceous, spirally arranged. Male cones solitary or clustered, catkin-like, containing numerous anthers. Female flowers consisting of a peduncle bearing 1–2 terminal ovuliferous scales, each surrounding a solitary ovule. In fruit peduncle becoming enlarged and fleshy; seed woody, surrounded by fleshy ovuliferous scale.

1. PODOCARPUS Persoon

Description as for Podocarpaceae.

1. **P. neriifolius** D. Don. Fig. 4j, k.

Tree 15–20 (–30) m. Leaves linear or narrowly elliptic, 5–12 x 0.8–1.5 cm, acuminate, base attenuate. Male cones c 2.5 x 0.4 cm. Fruiting peduncle enlarged, red and fleshy, 1–1.5 cm long, bearing 1–2 ovoid or globose seeds 7–8 mm surrounded by yellow or orange, fleshy ovuliferous scale.

Sikkim: Darjeeling foothills (Sivoke, Mungpong and Lopchu) (34). Subtropical forests, 900–1400 m.

Produces high-quality timber (16, 48).

Family 6. TAXACEAE

Dioecious evergreen trees. Leaves linear, spirally arranged but distichous due to twisting. Male cones of 6–15, lobed, peltate scales, each bearing c 6 pollen sacs beneath. Female flowers solitary or in pairs, axillary, composed of a single erect ovule surrounded by scales at base. Seed woody, surrounded by fleshy, cup-like scale (aril).

1. TAXUS Tournefort

Description as for Taxaceae.

1. T. baccata L.; *T. wallichiana* Zuccarini. Nep: *Dhengre Salla* (34); Eng: *Yew*. Fig. 4d–f.

Tree 5–12 m. Leaves 1.5–2.75 x 0.2–0.25 cm, usually curved, acuminate margins slightly inrolled, dark green above, paler beneath. Male cones ovoid, c 8 mm. Female flowers ovoid, 3–4 mm. Seeds ovoid, somewhat compressed, c 7 x 4 mm, fleshy aril red.

Bhutan: C—scattered localities from Ha to Mongar districts; **Sikkim.** Moist mixed coniferous forests or cool broad-leaved forests, 1800–2700 (–3500) m. March–April.

The E Himalayan plant, sometimes regarded as a distinct species, is best treated as subsp. **wallichiana** (Zuccarini) Pilger. Leaves sometimes poisonous to livestock (16); wood burned as incense (48); aril used medicinally (13).

Family 7. EPHEDRACEAE

Dioecious shrubs with creeping rhizomes and erect branches. Stems cylindrical, striate. Leaves opposite, decussate, scale-like. Male flowers 3–8, in opposite clusters, with a perianth of 2 united, rounded scales; anthers 6–10, subsessile on a short column. Female flowers in opposite, sessile pairs or several at each node, consisting of 2 ovoid ovules enveloped by two coats, the inner prolonged into a styliform tube.

1. EPHEDRA L.

Description as for Ephedraceae.

1. E. gerardiana Stapf; *E. vulgaris* sensu F.B.I. non Richard, *E. saxatilis* Florin. Med: *Tshe*. Fig. 5f, g.

Shrub 15–30 (–120) cm. Leaves ovate, 3–4 mm, uniting to form a sheath around stem at intervals of 2–3 (–5) cm. Ovules 3–4 mm, styliform tube 1–2 mm at apex. Seeds ovoid c 7 mm surrounded at base by red fleshy bracts.

Bhutan: C–Thimphu and Bumthang districts, N–Upper Mo Chu and Upper Bumthang Chu districts; **Sikkim**. Dry rocky montane slopes and screes, 2700–4500 m. April–June.

The E Himalayan plants belong to var. **sikkimensis** Stapf. An important medicinal plant containing the valuable alkaloid ephedrine, used in the treatment of asthma and other illnesses (13, 16).

Family 8. GNETACEAE

Large, dioecious, woody, evergreen climbers. Leaves opposite, entire; venation pinnate. Male flowers in axils of crowded, annular scales forming

catkins; anthers 2, exserted from a pair of minute perianth lobes. Female flowers in cymosely-branched spikes; ovules several (up to 8), in axils of cup-shaped bracts. Ovule surrounded by three integuments, the outer fleshy, the innermost elongated into a styliform tube. Seed fleshy.

1. GNETUM L.

Description as for Gnetaceae.

1. **G. montanum** Markgraf; *G. scandens* sensu F.B.I. p.p. non Roxb. Fig. 5h, i.
Leaves ovate-elliptic, 9–15 x 4–6 cm, acute, base rounded or cuneate, glabrous; petioles 5–15 cm. Male catkins 2–2.5 x 0.3 cm, few, in terminal cymes. Ovules ovoid, c 4 mm, only 1–2 per node developing. Fruiting spikes 15–20 cm; seeds ovoid, ellipsoid, 1.5–2.5 x 1–1.2 cm, fleshy, reddish, borne on stalks 1.5–2 cm long.
Bhutan: S–Phuntsholing district (Phuntsholing) and Gaylegphug district (Gaylegphug); **Sikkim**. Subtropical forests, 270–800 m. April–May.

ANGIOSPERMAE : DICOTYLEDONAE

Family 9. MYRICACEAE

Dioecious evergreen trees. Leaves alternate, simple, entire, exstipulate, aromatic-glandular beneath. Flowers unisexual in dense spikes or heads, each in axil of a rounded scaly bract, perianth absent. Male flowers with (2–) 4 stamens, female with 1-locular ovary, style short with 2 slender branches, ovule 1, basal. Fruit a drupe.

1. MYRICA L.

Description as for Myricaceae

1. **M. esculenta** D. Don; *M. nagi* sensu F.B.I. p.p. non Thunberg. Fig. 6i–m.
Tree 6–12 m. Leaves coriaceous, elliptic to oblanceolate, 7–15 x 2–3.5 cm acute, base attenuate, glabrous or sparsely pubescent on midrib beneath, glands yellowish, deciduous, leaving a minute pit when detached, petioles 5–10 mm. Male spikes 5–15 mm, cylindrical, numerous in axillary racemes 3–9 cm, bracts c 1 mm; female flowers in subglobose heads c 1.5 mm forming slender spikes 4–5 cm. Drupes ellipsoid, 8–10 x 6–9 mm, brownish hirsute at first, later becoming covered with fleshy red tubercles.
Bhutan: S–Gaylegphug district, C–Thimphu, Punakha and Tashigang districts. Warm broad-leaved forests, 1200–2100 m. September–March.
Fruit edible (117); bark used medicinally and yields a yellow dye and a fish intoxicant (16).

Family 10. JUGLANDACEAE

Monoecious rarely dioecious trees. Leaves deciduous, alternate, even- or odd-pinnate, exstipulate. Flowers unisexual, male flowers in pendulous catkins, perianth 3–6 lobed, adnate to bract, stamens 6–40; female flowers in catkins or short racemes, perianth of 4 segments borne on lobed bract or within involucre; ovary inferior, 1-locular, style 2-branched, ovule 1, basal. Fruit a large drupe or winged nut.

1. Leaves odd-pinnate; male flowers in simple axillary catkins, female flowers 1–3 in terminal racemes, fruit an unwinged drupe .....:.....**1. Juglans**
   Leaves even-pinnate; male flowers in branched axillary catkins, female flowers in axillar catkins, fruit a nut borne on much enlarged 3-winged bract **2. Engelhardia**

1. JUGLANS L.

Monoecious trees. Leaves odd-pinnate. Male flowers in simple, raceme-like catkins. Female flowers 1–3 in short terminal racemes, each with 4 lanceolate perianth segments adnate to brownish tomentose 4-toothed involucre, style branches plumose. Fruit an ovoid drupe, fleshy outside, hard shelled within, cotyledons lobed and folded.

1. J. regia L.; *J. sigillata* Dode. Dz: *Ta Shing,* (fruit) *Tago;* Sha: *Khe Shing;* Nep: *Okhar* (34); Eng: *Walnut*. Fig. 6 o-q.

Tree 6–25 m. Leaflets in 2–5 pairs, oblong-lanceolate, 5–15 x 2.5–7 cm, acuminate, base obliquely rounded, margins entire, glabrous except for tufts of whitish hairs in vein axils beneath. Male catkins 7–15 cm, each flower composed of 10–40 sessile anthers on short side branch 3–8 mm. Fruit 4–5 x 3–4 cm.

Bhutan: S–Chukka district, C–Thimphu to Mongar districts, not uncommon; **Sikkim**. Broad-leaved forests, also planted near habitation, 1800–2500 m. April–May.

Commonly cultivated both for its edible fruit and for its very valuable, durable and ornamental timber, used particularly for making furniture (16, 34); bark used as a dye and medicinally (13, 48).

2. ENGELHARDIA Blume

Monoecious, rarely dioecious trees. Leaves even-pinnate. Male catkins usually 3 in a short raceme, female flowers numerous in catkins, each with a 4-lobed perianth borne on a 3-lobed bract, style branches warted. Fruiting catkins elongating, fruit nut-like, densely hairy, borne on membranous 3-lobed bract.

1. E. spicata Blume; *E. acerifolia* (Reinwardt) Blume, *E. colebrookeana* Lindley. Sha: *Tshos Shing*; Nep: *Mauwa* (34), *Mawa* (117). Fig. 6n.

Tree 8–20 m. Leaves 25–40 cm, leaflets ovate-oblong 8–18 x 3–6.5 cm, obtuse or subacute, base rounded, oblique, often unequal, petiolules 2–10 mm, glabrous or pubescent beneath, petioles 3–7 cm. Male catkins 4–10 cm, each flower composed of 6–10 almost sessile anthers on short side branch c 2 mm. Female catkins 6–10 cm, bracts c 5 mm in flower. Fruiting catkins 15–40 cm, nut ovoid, 5–6 mm, mid lobe of bract largest, oblanceolate, 2–4.5 x 0.6–1.2 cm.

Bhutan: S–Gaylegphug district, C–Thimphu, Punakha, Mongar and Tashigang districts; **Sikkim**. Subtropical and Warm broad-leaved forests, 500–2100 m. April–May.

Three varieties have been recognised: var. **spicata** with leaflets petiolulate, var. **acerifolia** (Reinwardt) Koorders & Valeton (*E. acerifolia* (Reinwardt) Blume) with leaflets sessile and acuminate and var. **integra** (Kurz) Grierson & Long (*E. colebrookeana* Lindley) with leaflets sessile, obtuse or acute and pubescent. The first two are common in Bhutan, the third has been recorded but is apparently rare. Wood useful; bark used to produce a fish intoxicant (16), in E Bhutan used as a host for the lac insect.

Family 11. SALICACEAE

Dioecious or rarely bisexual trees and shrubs. Leaves alternate or rarely subopposite, entire or serrulate, teeth usually gland-tipped, pinnately-veined, sometimes palmately 3–5-veined at base, deciduous. Stipules free, usually small, deciduous, scale-like, rarely leafy. Flowers in erect or pendulous spikes or racemes (catkins). Catkins often sericeous or villous at least at first, terminal on short leafy lateral shoots or sessile, axillary. Flowers solitary in the axil of a membranous, deciduous or persistent bract. Perianth absent except for disc. Disc flat or cup-like or consisting of 2 glandular scales, anterior and posterior, or sometimes one scale (posterior). Male flowers with 2–many stamens; filaments free or united. Female flowers with ovary solitary, sessile or shortly stipitate, 1-locular; style short or very short, 2-branched, branches sometimes bifid; ovules numerous, parietal. Capsules ovoid, 2–4-valved. Seeds few or numerous, small, oblong, each with a tuft of long straight hairs.

1. Trees; leaves ovate or orbicular, petioles 3.5–10 cm; bracts of catkins deciduous, dentate or fimbriate; disc flat or cup-like.....**1. Populus**
   Trees or shrubs; leaves elliptic, lanceolate or broadly obovate, never ovate or orbicular, subsessile or on petioles up to 1.5 cm; bracts of catkins persistent, entire or notched at the apex; disc consisting of one or two scale-like glands **2. Salix**

1. POPULUS L.

Dioecious or sometimes bisexual trees. Leaves alternate, ovate or orbicular, venation pinnate, 3–5-nerved at base. Flowers in pendulous catkins, bracts quickly deciduous. Perianth absent. Disc flat or cup-shaped. Stamens numerous, filaments free. Style branches 2 or 4, broadened and lobed. Capsules 2–4-valved.

1. Leaves ovate, acuminate.....**Species 1–4**
Leaves broadly ovate or orbicular, shortly acute or apiculate.....**Species 5**

1. P. ciliata Royle. Fig. 6a, b.

Tree 20–25 m, leaf buds c 2.5 cm, viscid. Leaves ovate, 10–17 x 7–12 cm, acuminate, base usually strongly cordate, sometimes rounded, sparsely pubescent, margins closely and finely crenate-serrate, ciliate, sometimes with 2 small glands at base of midrib; petioles 5–10 cm. Male catkins 8–10 cm; bracts obovate, c 1 cm, fimbriate, glabrous. Female catkins 15–30 cm, disc flat or slightly concave, roundly toothed; ovary ovoid, c 5 mm; style branches broadened and bilobed, 3–4 mm. Capsule c 10 mm, glabrous.

Bhutan: C–Thimphu, Punakha, Tongsa and Bumthang districts; **Sikkim**. Cool broad-leaved forests, sometimes cultivated, 2100–3000 m. April.

Wood useful particularly for making match-sticks (16, 48).

2. P. gamblei Dode; *P. gamblei* Haines. Nep: *Pipalpate* (34), *Pilpile* (34).

Similar to *P. ciliata* but leaves usually truncate at base, margins more distantly dentate-serrate; catkins 8–10 cm, bracts ciliate, capsule glabrous.

Sikkim: Leech River, Darjeeling, Kalimpong and Mungpoo, 300–600 m.

Some specimens from Kalimpong have larger leaves weakly cordate at base, pubescent beneath and with conspicuous basal glands.

3. P. glauca Haines. Nep: *Pipalpate* (34), *Dude Malata* (34).

Similar to *P. ciliata* but leaves 18–25 x 15–20 cm, more broadly ovate, acute, weakly cordate at base, margins more sharply serrulate; flowers frequently bisexual, rachis densely white hairy; capsule subglobose, often 2-valved, white hairy.

Sikkim: Pankabari Ridge, Tonglo, 2750 m. April–June.

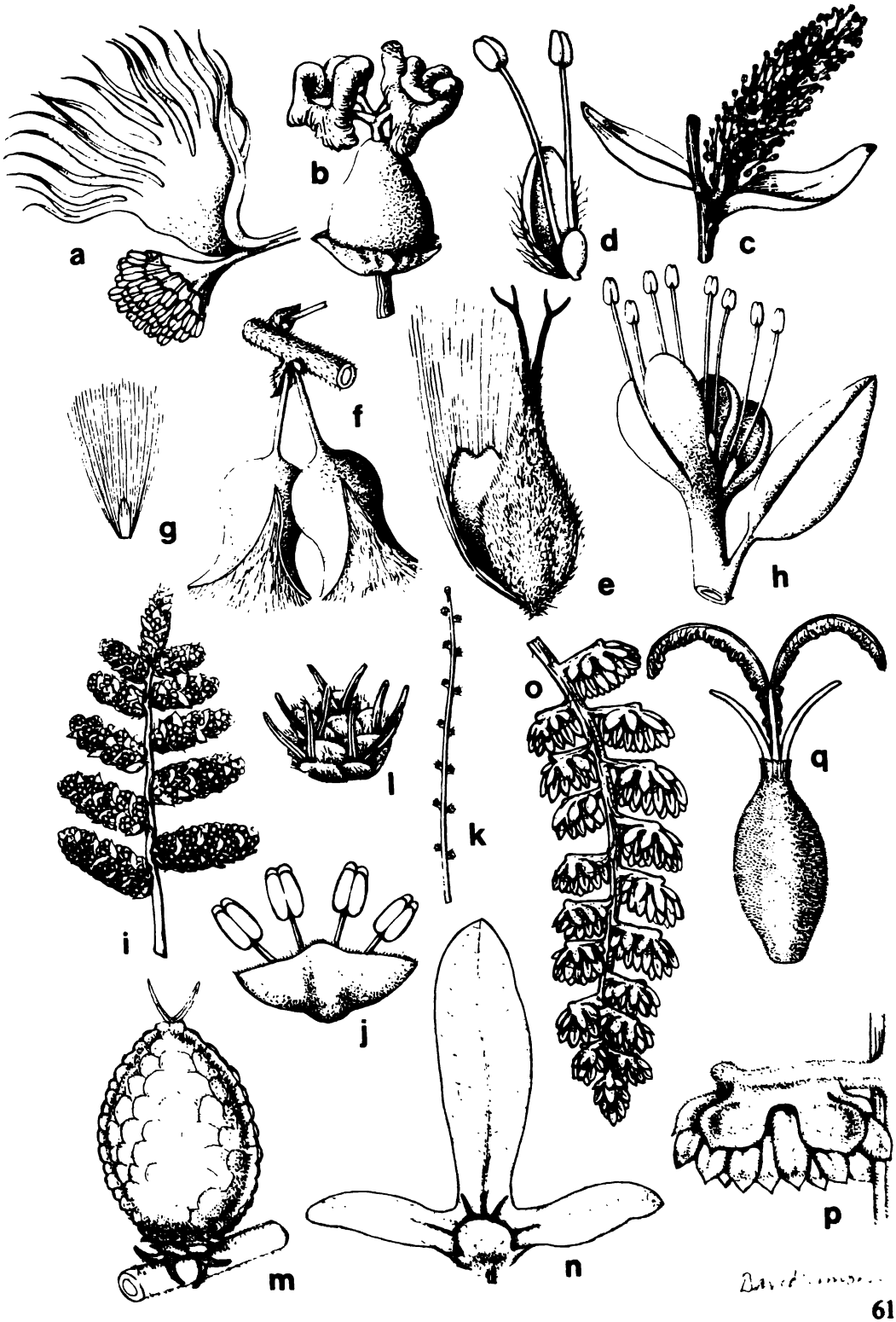
4. P. nigra L. Eng: *Lombardy Poplar.*

Similar to *P. ciliata* but leaves ovate-rhombic, (3.5–) 5–10 x (3–) 4–8 cm, base cuneate, pubescent, margins serrulate, basal glands absent; fruiting catkins 10–15 cm, capsules glabrous.

Bhutan: C–Thimphu and Punakha districts.

Cultivated as an ornamental. Trees with narrow columnar habit belong to the cultivar 'Italica'.

FIG 6. **Salicaceae, Myricaceae and Juglandaceae. Salicaceae.** a & b, *Populus ciliata*: a, male flower with fimbriate bract; b, ovary with disc. c & d, *Salix babylonica*; c, male catkin; d, male flower with bract. f & g, *S. tetrasperma*: f, portion of female catkin with mature capsules; g, seed. h, *S. lindleyana*: male catkin with leaf. **Myricaceae.** i–m, *Myrica esculenta*: i, male inflorescence; j, bract removed with stamens; k, female inflorescence; l, cluster of female flowers; m, mature fruit with aborted flowers at base. **Juglandaceae.** n, *Engelhardia spicata*: fruiting bract. o–q, *Juglans regia:* o, male catkin; p, male flower; q, female flower. Scale: k, n x 1; c, i, o x 1½; m, q x 2½; a, b, f, p x 3½; e, g, h x 6; d, l, j x 10. Drawn by D. Simon.


a
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5. P. rotundifolia Griff.; *P. microcarpa* Hook. f. & Thomson, *P. bonatii* Léveillé. Dz: *Ka Shing, Kashi.*

Shrub or tree 2–10 m, buds c 1 cm. Leaves broadly ovate or orbicular, 4–9 cm long and broad, shortly acute, base rounded or slightly cordate, glabrous, margins sinuate or with distinct rounded teeth, ciliate; petioles 3.5–5.5 cm. Male catkins unknown. Female catkins 5–10 cm, rachis pubescent; bracts brown, ovate, digitate, c 3.5 mm, deciduous,pilose with long straight white hairs. Disc cup-shaped, c 1.5 mm. Ovary ovoid, c 2 mm. Style bifid, broadened and digitately lobed. Capsule 2-valved, 3–6 mm, glabrous.

Bhutan: C–Thimphu, Punakha and Bumthang districts. Blue Pine forests, 2300–3050 m. April–May.

2. SALIX L.

Nep: *Bais*–this name applies to several species of *Salix*.

Dioecious trees or shrubs with erect or prostrate stems, sometimes with short ascending shoots, stems usually pubescent or silky villous at first, indumentum persistent or not on two-year old branchlets. Leaves alternate or rarely sub-opposite, elongate or short and narrowly or broadly elliptic or obovate; margins entire or glandular-serrulate, rarely deeply toothed; venation pinnate throughout, stipules usually present, minute, or ovate and semicordate, generally more strongly developed and more persistent on leading shoots. Flowers few or numerous in erect or pendulous, sessile or pedunculate catkins, peduncles bearing 1 or 2 small or minute glands at base. Male flowers usually with 2, sometimes 1, rarely 6–12 stamens. Female flowers with style bifid, sometimes deeply, branches simple or bifid. Capsule 2-valved.

It is well known that *Salix* is taxonomically a difficult genus. Added to this is the fact that, although elsewhere in the Northern Hemisphere hybridisation is known to play an important role in the genus, there is apparently no mention of hybridity in E Himalayan botanical literature. Hybridisation must certainly occur here, no doubt obscuring the limits of species. At present several species, e.g. *S. radinostachya* and *S. stomatophora* are known from one or very few collections and some of these taxa may prove to be hybrids of other species. Detailed field observation and careful collection, particularly of the taller growing species, are necessary before the problem can be resolved. Mature leaves as well as catkins (in flower and young fruit) must be preserved from the same plant and terminal as well as side shoots should be taken as the character of their foliage can differ.

1. Erect trees or shrubs more than 1m tall; adult leaves (3–)4–15 cm 2
   Prostrate or decumbent shrubs with main stems running at or below ground level, with or without ascending shoots; leaves 0.5–2 cm, sometimes 3–4 cm in *S. calyculata*.....9

2. Leaves subopposite ..... **Species 1**
Leaves alternate 3
3. Catkins sessile or shortly (up to 1 cm) pedunculate; peduncles naked or bearing small bract-like leaves 1 cm long or less, dissimilar to foliage leaves at stem apices 4
Catkins on peduncles 0.8–2(–5) cm, shorter in *S. babylonica* (on males 0–6 mm, females 5–10 mm); peduncles bearing small leaves 1.5–4.5 cm similar to foliage leaves at stem apices 6
4. Leaves serrulate, sometimes obscurely, occasionally entire in *S. wallichiana* **Species 6 & 7**
Leaves entire, sometimes with a few gland-tipped teeth near base in *S. sikkimensis* 5
5. Male bracts ovate or narrowly ovate, acute; filaments either completely free or fused to apex; ovary ovoid, shortly pointed at apex ..... **Species 2 & 3**
Male bracts obovate, obtuse, often notched at apex; filaments connate at base or up to middle; ovary narrowly ovoid, with long attenuate apex **Species 4 & 5**
6. Male catkins with 6–12 stamens at each bract; female catkins with capsules on pedicels 3–4 mm ..... **Species 8**
Male catkins with 2 stamens at each bract; female catkins with capsules sessile or on pedicels up to 1 mm 7
7. Mature leaves finely serrulate throughout ..... **Species 9 & 10**
Mature leaves entire or obscurely serrulate near apex 8
8. Leaves densely and persistently pubescent, not glaucous beneath **Species 11–13**
Leaves sparsely pubescent at first becoming glabrous, glaucous beneath **Species 14–17**
9. Catkins with many (more than 10) flowers 10
Catkins with few (less than 10) flowers 12
10. Leaves pubescent on veins beneath; catkins lax-flowered ..... **Species 18**
Leaves glabrous or glabrescent; catkins rather densely flowered at first 11
11. Leaves narrow, 1 cm broad or less ..... **Species 19**
Leaves more than 1 cm broad, sometimes 0.6 cm in *S. flabellaris* **Species 20–22**
12. Leaves toothed at apex ..... **Species 23**
Leaves entire ..... **Species 24**

1. S. salwinensis Handel-Mazzetti

Shrub or tree 3–4 m, branchlets brown glabrous. Leaves subopposite, 5–9 x 0.7–2.5 cm, acuminate, base rounded or cuneate, margins entire, green pubescent above, subsericeous beneath; petioles c 3 mm; stipules ovate, c 1 mm, glandular-serrulate. Catkins on peduncles 1–2 cm, appearing with young leaves, peduncles bearing a few short leaves. Male catkins c 4 cm; bracts obovate, 2–2.5 mm, obtuse, brownish, white villous; stamens 2, filaments free, woolly.

Female catkins 5–6 cm; bracts pale brownish, c 3 mm, white villous outside. Capsules narrowly ovoid, 2–2.5 mm, densely pubescent, sessile; styles c 1 mm, deeply divided, branches scarcely broadened apically.

Bhutan: N–Upper Kulong Chu district (Lao and Tobrang); **Sikkim**. *Rhododendron*/bamboo forest margins, 2450 m. May.

2. **S. myrtillacea** Andersson

Shrub or tree 1.5–5 m; branchlets angular, brown or blackish, glabrous, glossy. Leaves oblong-oblanceolate, 2.5–3.5 x 1–1.5 cm, obtuse or subacute, base rounded or cuneate, margins entire ± revolute, glabrous on both surfaces, ± glossy; petioles c 2 mm; stipules absent. Catkins precocious. Male catkins 1–3 x 0.7–1.5 cm, bracts narrowly ovate, 2–3 mm, acute, blackish, long white villous; filaments fused to apex, stamen apparently 1, with 2 anthers. Female catkins 2.5–3 (–7?) x 1–1.5 cm, bracts similar to male, ovary broadly ovoid, 2.5–3 mm, densely whitish tomentose, shortly pedicellate, style 1–1.5 mm, branches short, entire.

Bhutan: N–Upper Mo Chu district (Lingshi Dzong and Gasa) and Upper Kulong Chu district (Me La); **Sikkim**. Streamsides in alpine valleys, 3650–3800 m. May–June.

3. **S. obscura** Andersson

Tree 1–6 m; branchlets glabrous or sparsely pubescent, blackish. Leaves oblanceolate, 4–9 x 1–1.5 cm, acute, base cuneate, margins entire, revolute, brownish above when dry, sparsely pubescent on both surfaces or glabrous above; petioles 2–3 mm. Catkins precocious. Male catkins 1.5–2 x 1 cm, bracts ovate, c 1.5 mm, blackish, long white villous; stamens 2, filaments free, sparsely pubescent at base. Female catkins 3–4 cm, bracts similar to male, long white villous. Capsules ovoid, c 4 mm, sparsely pubescent, sessile; styles 1–1.5 mm, shortly divided, branches scarcely bilobed.

Bhutan: C–Thimphu, Tongsa and Bumthang districts, N–Upper Mo Chu district; **Sikkim**. Streamsides in Blue Pine Forests, 2900 m. April.

Differs from *S. myrtillacea* in its acute leaves, more broadly ovate male bracts, filaments quite free and sparsely pubescent ovary and capsule.

4. **S. sikkimensis** Andersson. Fig. 6e.

Shrub 1–3 m, branches stout, angular, blackish, finely pubescent. Leaves elliptic or oblanceolate, 2–7 x 1–3 cm, obtuse, base cuneate, margins entire or with a few glands near base, ± glabrous above, pale brown sericeous beneath; petioles c 5 mm. Catkins appearing with young leaves, on peduncles up to 1.5 cm. Male catkins 3–4 x 1.5 cm, bracts obovate, c 4 mm, notched at apex, pale, long whitish villous; stamens 2, filaments elongate, c 10 mm, connate at base, pubescent. Female catkins 6–9 x 1 cm, bracts as in male but blackish. Capsules narrowly ovoid, attenuate, c 5 mm, whitish pubescent, sessile; styles c 2 mm, divided almost to base, branches bifid.

Bhutan: C–Thimphu and Tongsa districts, N–Upper Mo Chu, Upper

Bumthang Chu and Upper Kulong Chu districts; **Sikkim.** Fir/*Rhododendron* forests, 3350–4000 m. May.

5. S. bhutanensis Floderus

Shrub 1.5–3 m; branchlets villous, becoming glabrous. Leaves elliptic, 3–5 x 1.5–2 cm, acute, base rounded or truncate, margins entire, green and, apart from white pubescent midrib, glabrous above, ± glaucous and glabrous beneath except for white woolly veins; petioles c 3 mm; stipules lanceolate c 2 mm, glandular serrulate. Catkins precocious. Male catkins 4–5 cm on peduncles c 5 mm, bracts obovate, c 2.5 mm, obtuse or retuse, white villous; stamens 2, filaments connate from middle to base, pubescent. Female catkins 5–7 x 2 cm, on peduncles c 1 cm, scales c 2 mm brown, long whitish villous. Capsule narrowly ovoid, attenuate, c 6 mm, glabrous, borne on pedicel c 1 mm; styles c 2 mm, shortly 4-fid at apex.

Bhutan: C–Tongsa district (Chendebi) and Bumthang district (Kyikyi La and Tang). Blue pine forest, 2300 m. April–May.

Differs from *S. sikkimensis* in its acute leaves and glabrous capsules.

6. S. wallichiana Andersson

Shrub or tree 2–10 m, branchlets pubescent. Leaves elliptic 5.5–14 x 2–5 cm, acuminate or acute, base cuneate or rounded, margins serrulate, sometimes obscurely, occasionally entire, glabrous or sparsely pubescent above, greyish pubescent beneath; petioles 0.5–1.5 cm; stipules sometimes present, ovate, semicordate, c 1 cm. Catkins precocious, sessile or on peduncles c 1 cm. Male catkins erect, 1.5–2.5 cm, bracts oblong-lanceolate, 1–2.5 x 0.5–1 mm, blackish, white villous; stamens 2, filaments free, glabrous. Female catkins drooping, 7–15 x 1 cm, bracts similar to male, often narrow. Capsules narrowly ovoid, attenuate, c 8 mm, densely pubescent, borne on pedicels c 1 mm; styles almost absent, with short, bilobed branches.

Bhutan: C–Thimphu, Punakha, Tongsa and Mongar districts. Evergreen oak forests, 2300–2600 m. April.

Entire-leaved forms may be distinguished from *S. myrtillacea* and *S. obscura* by the narrowly ovoid, attenuate capsules and oblong-lanceolate male bracts, from *S. sikkimensis* by the free stamens, narrow male bracts and very short styles and from *S. bhutanensis* by the free stamens, narrow male bracts and pubescent capsules. Var. **grisea** Andersson with leaves serrulate and subglabrous above appears to be the common variety in Bhutan. Branches sometimes used in basket making (48). A specimen collected near Byakar is similar but has denser indumentum persisting on the previous year's shoots and a longer and more thickly branched style as in *S. excelsa;* this specimen may represent a hybrid between *S. wallichiana* and another species.

7. S. stomatophora Floderus

Similar to *S. wallichiana,* but leaves (immature) 3–4 x 1–1.5 cm, densely pubescent along the midrib but otherwise glabrescent, minutely whitish punctate beneath; filaments pubescent; capsules more sparsely pubescent; style c 1 mm,

divided to middle, branches rather thick, undivided.

Bhutan: locality unknown.

8. **S. tetrasperma** Roxb. Fig. 6f, g.

Tree 6–15 m, branchlets dark brown or greyish pubescent. Leaves ovate-elliptic, 6–10 x 2–4 cm, acute or acuminate, base rounded or cuneate, margins glandular serrulate, dark green above with prominent veins, greyish, ± glaucous beneath, glabrous or sparsely pubescent; petioles 5–10 mm. Catkins appearing with young leaves, slender, borne on leafy peduncles 1–1.5 cm. Male catkins 8–12 cm, bracts elliptic, c 1.5 mm, densely white woolly; stamens 6–12, filaments pubescent at base. Female catkins 7–11 cm, bracts similar to male. Capsules ovoid, 3.5–6 mm, glabrous; pedicels 3–4 mm; styles very short, equally 4-lobed.

Sikkim: Darjeeling terai and foothills. Along streamsides in subtropical forests, 300–900 m. March–April.

Shoots made into baskets and foliage used for cattle fodder (48).

9. **S. babylonica** L. Eng: *Weeping Willow*. Fig. 6c, d.

Tree 4–20 m, branches pendulous; bark glabrous, brown, glossy. Leaves at stem apex narrowly elliptic or linear-lanceolate, 4.5–9 x 0.7–1.5 cm, acuminate, base cuneate, margins regularly serrulate, glabrous; petioles 5–7 mm. Catkins precocious, peduncles bearing a few small, entire-margined leaves 1–2 cm. Male catkins subsessile or on peduncles 2–6 mm, suberect, 2–3 x 0.5 cm; rachis tomentose; bracts oblong, c 1.5 mm, pale, glabrous or villous within; stamens 2, filaments free, pubescent at base. Female catkins on peduncles 5–10 mm, 2–3 x 0.5 cm; bracts lanceolate, otherwise similar to male. Capsules ovoid, c 2.5 mm, villous, sessile; style short, shortly 4-lobed at apex.

Bhutan: C–Ha, Thimphu and Bumthang districts; **Sikkim**, 2700–3800 m. April.

Cultivated in towns as an ornamental tree.

10. **S. excelsa** J. F. Gmelin

Similar to *S. babylonica* but leaves more broadly elliptic-oblanceolate, 4–11 x 1–2.5 cm, margins glandular-serrulate, becoming thickened and hardened, sericeous beneath at first, becoming glabrous; male catkins 4–5 cm, on peduncles 0.8–1.5 cm; bracts oblong-lanceolate, 3–4 mm; female catkins 5–7 cm, on peduncles 1–2 cm; capsules narrowly ovoid, 5–7 mm, glabrous, shortly pedicellate.

Bhutan: C–Ha district (Ha Dzong). 2745 m. May.

Cultivated as an ornamental tree.

11. **S. daltoniana** Andersson. Nep: *Bhera Kapasi* (34).

Shrub or tree 1–5 m; twigs dull black, ± glabrous. Leaves elliptic-oblanceolate, 3–6 x 1–2 cm, acute, base rounded or cuneate, margins entire or obscurely serrulate in upper half, blackish above when dry, pubescent on veins, densely white or brownish sericeous beneath; petioles 3–14 mm; stipules minute. Catkins appearing with young leaves, on peduncles 0.5–2 cm. Male

catkins 2.5–4.5 x 0.5–0.7 cm; bracts obovate, c 1.5 mm, rounded or notched at apex, pale, villous with long straight hairs especially on the inner surface; stamens 2, filaments free, pubescent. Female catkins 6–7 x 0.7 cm, bracts similar to male but somewhat broader and darker. Capsules narrowly ovoid, 4–5 mm, white silky, sessile; style divided to half its length, branches bifid.

Bhutan: C–Thimphu and Mongar districts, N–Upper Mo Chu and Upper Bumthang Chu districts; **Sikkim**. Fir forests, 3500–3950 m. May–June.

12. **S. psilostigma** Andersson; *S. eriophylla* Andersson, *S. viminalis* L. var. *smithiana* (Willdenow) Andersson

Similar to *S. daltoniana* but leaves often longer, 5–9 x 1.5–2 cm, margins quite entire; petioles shorter, 2–3 mm; stipules larger, c 2 mm, semicordate; capsules more broadly ovoid.

Sikkim: Darjeeling district.

13. **S. eriostachya** Andersson

Similar to *S. daltoniana* and *S. psilostigma* but shoots and leaves less densely pubescent; leaves more broadly elliptic, 7–9 x 2.5–3.5 cm; catkins borne on longer peduncles 2–5 cm; style branches longer, less deeply bifid; capsules borne on short pedicels c 1 mm.

Sikkim: Darjeeling district.

14. **S. longiflora** Andersson

Shrub or tree 2–6 m, branchlets dull, blackish, ± glabrous. Leaves elliptic, 3–7 (–15) x 1.5–2.5 (–4) cm, acute or acuminate, base rounded, margins entire, dark green or blackish above, grey almost glaucous beneath, ± glabrous; petioles 5–10 mm; stipules minute. Catkins appearing with young leaves on slender leafy peduncles. Male catkins 3–4 x 0.5 cm; bracts obovate, c 1 mm, pale, sparsely villous within; stamens 2, filaments free, pubescent. Female catkins 2–7 (–15) x 0.5–0.7 cm; bracts similar to male; rachis densely woolly. Capsule ovoid, c 4 mm, glabrous, shortly pedicellate; style c 1 mm, shortly divided, branches scarcely bifid.

Bhutan: C–Thimphu, Tongsa and Bumthang districts; **Sikkim**. Blue Pine forests, 2500–3100 m. April.

15. **S. oxycarpa** Andersson

Similar to *S. longiflora* but leaves 3–4 x 0.7–1.5 cm, pale above when dry, sparsely pubescent ± glaucous beneath; male catkins up to 6 cm, bracts blackish, filaments connate in the lower half, pubescent; capsules densely pubescent, styles shortly divided at apex, branches entire or bifid.

Bhutan: locality unknown; **Sikkim**: Darjeeling district, 2000 m. April.

16. **S. radinostachya** Schneider; *S. guebrantiana* Schneider

Similar to *S. longiflora* and *S. oxycarpa* but male catkins up to 7 cm, bracts oblong-elliptic, pubescent at base; female catkins up to 12 cm, bracts ovate-oblong; truncate; style c 1 mm, divided to middle, branches bifid.

Sikkim: Lachen, 2745 m.

17. S. sp.

Shrub or tree to 5 m; shoots black, glabrous. Leaves ovate-elliptic 3.5–8 x 2.5–4 cm, acute, base rounded, margins obscurely serrate, glabrous, blackish above when dry, pale almost glaucous beneath; petioles 1–1.5 cm. Male catkins c 3 cm, bracts obovate, c 2 mm, rounded, sparsely ciliate; stamens 2, filaments 3–4 mm, glabrous. Female catkins (fruiting) up to 9 cm, on peduncles 1.5–3 cm; capsules 4.5–5 mm, glabrous, sessile; style branches thick, entire or shallowly bilobed.

Sikkim: Lachen and Lachoong, 3050–3350 m.

In coloration of twigs and foliage and in details of male and female flowers this most closely resembles *S. calyculata* which is however a small shrub with differently shaped leaves and shorter catkins. Possibly the two specimens upon which the above description is based represent a hybrid between *S. calyculata* and another species.

18. S. thomsoniana Andersson

Dwarf shrub with stout ascending branchlets up to 30 cm. Leaves elliptic-oblanceolate, 1.3–2.5 (–4) x 0.6–0.8 (–1.2) cm, acute, base cuneate, margins remotely serrulate, narrowly revolute, green above, greyish and silky villous on veins beneath. Catkins on leafy shoots; bracts obovate, blackish-purple, long whitish villous. Male catkins 3.5–6 cm, ± lax flowered; stamens 2, filaments free, brownish-woolly at base. Female catkins at maturity up to 9 cm. Capsules ovoid-globose, c 2.5 mm, densely villous at first, sessile; styles c 1.25 mm, divided to base, branches shortly bifid.

Bhutan: C–Tongsa district (Chendebi); **Sikkim**: Lachung. 2440–3050 m.

19. S. serpyllum Andersson; *S. hylematica* Schneider, *S. fruticulosa* Andersson non La Croix

Stems and branches creeping and rooting. Leaves obovate or elliptic-lanceolate, 0.8–1.5 x 0.3–1.0 cm, acute, base cuneate, margins serrulate near apex, dark green above, pubescent at first, later glabrous and glaucous beneath; petioles 1–2 mm. Catkins on leafy shoots. Male catkins 0.8–1.2 cm; bracts rounded, cuneate, blackish-crimson, crisped hairy at first, later glabrous except for ciliate margins; stamens 2, filaments free, brownish-woolly. Female catkins 1–3 (–6) cm; bracts similar to male. Capsules ovoid-conical, glabrous, c 4 mm; styles 1.5–2 mm, divided to middle, branches capitate or bilobed.

Bhutan: C–Ha district (Cheli La) and Thimphu district (Barshong), N–Upper Mo Chu, Upper Bumthang Chu and Upper Kulong Chu districts; **Sikkim**. On screes and peat, 3200–3950 m. May.

20. S. flabellaris Andersson

Procumbent shrub, branchlets angular, reddish, glabrous. Leaves obovate or broadly spathulate, 1–3 x 0.6–1.8 cm, obtuse or acute, base cuneate, green and glabrous on both surfaces, sometimes slightly glaucous beneath, margins

crenulate-denticulate; petioles up to 8 mm. Catkins on short leafy shoots. Male catkins 1.2–2.5 cm; bracts oblong, c 1 mm, ± notched at apex, dark coloured, glabrous; stamens 2, free. Female catkins 1–1.5 cm when young, up to 4.5 cm at maturity; bracts purplish, otherwise similar to male. Capsules 4 mm, ovoid, glabrous, red, subsessile; style short c 0.5 mm, branches half as long, entire or bilobed.

Sikkim: Lachung.

21. **S. calyculata** Andersson

Decumbent shrub, branchlets ascending, up to 40 cm, dark brown, glabrous. Leaves obovate, 1–4 x 0.5–1.5 cm, obtuse or subacute, base cuneate, margins serrulate near apex, or entire, sometimes blackish when dry, long silky villous beneath at first, later glabrous; petioles 5–7 mm; stipules minute. Catkins terminal on leafy shoots, 2–6 cm. Male catkins 1–1.5 cm; bracts oblong, c 4 x 1 mm, reddish brown, glabrous or ciliate; stamens 2, filaments free, glabrous. Female catkins 1.5–2 cm; bracts obovate, c 3 x 2 mm, glabrous, otherwise similar to male; gland oblong c 1.5 mm. Capsules narrowly ovoid, c 4 mm, glabrous, shortly pedicelled; style c 1 mm, deeply divided, branches entire or shortly bifid.

Bhutan: C–Ha district, N–Upper Pho Chu, Upper Bumthang Chu and Upper Kulong Chu districts; **Sikkim**. Edges of streams on open hillsides, 3800–4570 m. June–July.

22. **S. pseudocalyculata** Kimura

Similar to *S. calyculata* but leaves thinner and glabrous from the first; male flowers mostly with one stamen; glands obovate, ± lobed at apex, often connate at least on one side, forming a disc-like structure around capsule.

Sikkim: Gamothang, 3800 m.

23. **S. oreophila** Andersson

Mat-forming shrub. Leaves oblong-elliptic, 5–10 x 2–5 mm, acute, base rounded or cuneate, sharply and rather deeply serrate at apex into 3–7 teeth, green and glabrous above, veins impressed, sparsely pubescent beneath at first with long straight hairs; petioles 2–4 mm; stipules apparently absent. Catkins on leafy shoots, 2–7-flowered. Male catkins c 5 mm; bracts oblong-elliptic, c 2.5 mm, entire or serrulate, pale, glabrous; stamens 2, filaments free, glabrous. Female catkins c 6 mm, flowers subumbellate; bracts similar to male. Capsules conical, 3–4 mm, glabrous, glossy, subsessile; style very short, branches entire.

Bhutan: N–Upper Pho Chu district (Chojo Dzong), Upper Bumthang Chu district (Marlung) and Upper Kulong Chu district (Me La); **Sikkim**. Rocky hillsides, 4250–4700 m. June–July.

Plants from alpine Sikkim with very small (c 2 mm) leaves, 2–4-flowered catkins and dentate bracts have been distinguished as var. **secta** (Andersson) Andersson.

24. **S. lindleyana** Andersson; *S. acuminatomicrophylla* Hao, *S. ovatomicrophylla* Hao. Fig. 6h.

Prostrate rooting shrub. Leaves elliptic-oblanceolate, 3–8 (–12) x 1.5–4 (–7) mm, acute, base cuneate, margins entire, rarely serrulate at apex, inrolled, sparsely villous; petioles 1–3 mm. Catkins on leafy shoots, 4–10 mm, sometimes only 2–3-flowered. Male catkins with yellowish oblanceolate bracts c 2.5 mm, glabrous; stamens 2, filaments free, glabrous. Female catkins with crimson bracts c 3 mm. Capsule narrowly ovoid, c 4 mm, dark brown, glabrous, shortly pedicelled; style c 1.5 mm, divided to below middle; branches bilobed.

Bhutan: C–Tongsa district (Black Mountain), N–Upper Mo Chu (Yari La) and Upper Kulong Chu (Me La) districts; **Sikkim**. On rocks, 3950–4880 m. June–July.

Plants having leaves with deeply impressed midribs and revolute margins have been segregated as var. **microphylla** Andersson.

Family 12. BETULACEAE

Monoecious, deciduous trees or shrubs. Leaves alternate, simple, stipulate. Male flowers in pendulous, bracteate catkins, perianth minute, 4-fid or absent, stamens 2–20; female flowers in erect or catkinate, bracteate spikes or in clusters, perianth minute or absent, ovary superior or inferior, 2-locular, styles 2, simple, ovules usually 1 per cell, pendulous. Fruit a winged achene borne in a catkin, or nutlike and enclosed in a bract borne in spikes or clusters.

1. Leaves entire or serrulate; stamens 4; scales of female spikes becoming woody and persistent ..... **2. Alnus**
   Leaves serrate; stamens 2–20; scales of female spikes leafy or thin usually deciduous with fruit 2
2. Fruit a winged achene, borne in spikes or catkins, falling free of scales; stamens 2, subtended by 3-lobed scales ..... **1. Betula**
   Fruit a wingless nut or achene, borne in loose spikes or clusters, falling attached to a bract; stamens 3–20, subtended by simple scales 3
3. Female flowers in clusters of 6–8; fruit a nut enclosed by a lacerate or spinous bract; scales of male catkins densely pubescent ..... **3. Corylus**
   Female flowers in short leafy spikes; fruit an achene enfolded by the base of an oblique, toothed bract; scales of male catkins sparsely pubescent **4. Carpinus**

1. BETULA L.

Trees. Leaves ovate, serrate. Male catkins solitary or few, axillary, borne towards shoot tips and appearing with young leaves; scales orbicular, concave, each bearing several flowers, perianth minute, 4-lobed; stamens 2, anthers divided at apex. Female spikes erect or pendulous, terminal on side shoots; scales with 3

deep, linear lobes, each with 1–3 ovaries at base; perianth absent; styles 2, filiform, simple. Fruit a compressed, winged achene, concealed by bracts which are deciduous at maturity.

1. **B. utilis** D. Don. Dz: *La Tap*; Nep: *Bhujapat* (34). Fig. 7i–m.

Tree to 15 m, bark white or pinkish, peeling in papery sheets, branchlets often warty glandular. Leaves ovate, 3–10 x 2–8 cm, acute, base rounded or truncate, margins regularly serrate, at first pubescent on veins above, pubescent on veins and glandular beneath; petioles 1–2.5 cm; stipules ovate-elliptic, c 1.2 cm, deciduous. Male catkins solitary, axillary, 6–12 x 0.5–0.8 cm, scales 2.5 mm. Female spikes 2–4 (–6) x 1–1.5 cm, scales c. 3 mm, with 1–3 ovaries at base. Fruit with obovate embryo, c 2.5 x 1.5 mm, with scarious wings c 0.75 mm.

Bhutan: C–Thimphu, Tongsa, Bumthang and Tashigang districts, N–Upper Mo Chu and Upper Kulong Chu districts; **Sikkim**. Moist coniferous forests, especially in Fir/*Rhododendron* forest, 3000–4200 m. April–June.

Bark sometimes used as paper and also medicinally (13), leaves as cattle-fodder and timber for building (48).

2. **B. alnoides** D. Don; *B. cylindrostachya* Wall. Dz: *Tap*; Nep: *Saur* (34).

Similar to *B. utilis* but bark reddish and flaking in vertical strips or silvery and papery, shoots glabrous or tomentose but not warty. Leaves ovate, 6–13 x 3–8 cm, acuminate, rounded at base, margins unequally serrate, subglabrous above, except on midrib, often more pubescent beneath. Male catkins more slender, c 4 mm broad; female catkins 1–4 in a short raceme, each 4–7 x 0.6–0.8 cm; scales simple, lanceolate, c 3.5 mm, narrower than the broadly winged achenes; embryo elliptic, c 2 x 1 mm, wings 1.5–2 mm broad.

Bhutan: S–Phuntsholing and Gaylegphug districts, C–Thimphu, Punakha and Tongsa districts, N–Upper Mo Chu and Upper Bumthang Chu districts; **Sikkim**. Warm and Cool broad-leaved forests, 800–2500 m. January–April.

Two varieties occur: var. **alnoides** with silvery, papery bark, more narrowly ovate, almost glabrous leaves on glabrous petioles often 2 cm long, at higher altitudes in C and N Bhutan and Sikkim; var. **cylindrostachya** (Wall.) Winkler *(B. cylindrostachya* Wall.) with pink or red bark flaking in vertical strips, leaves broader, often subcordate, more pubescent beneath; petioles shorter, 1–1.5 cm, tomentose; at lower altitudes in S Bhutan and the Darjeeling foothills.

2. ALNUS Miller

Trees. Leaves elliptic, entire or serrulate. Male catkins in terminal panicles, linear, pendulous; bracts 3-lobed, each bearing 3 flowers; perianth 4-toothed; anthers 4. Female spikes erect, 6–10 in axillary racemes below male inflorescence, linear and rigid when young; each bract bearing 2 flowers; perianth absent, styles 2, short. Fruiting spikes becoming ovoid-ellipsoid, cone-

like, with woody, persistent scales. Fruit a compressed achene with 2 minute wings.

1. **A. nepalensis** D. Don. Dz: *Gama;* Nep: *Utis* (34). Fig. 7a–d.

Tree up to 20 m. Leaves broadly elliptic, 9–15 x 4–9 cm, acute, base rounded or cuneate, minutely brown-glandular beneath, pubescent on veins; petiole 1–2 cm; stipules oblong, c 1 cm, auriculate. Male catkins 5–7 x 0.3–0.4 cm. Female spikes c 1 x 0.2 cm when young, becoming c 1.5 x 0.8 when mature; scales obpyramidal, 3 mm. Achenes triangular, embryo elliptic, bearing wings c 1 mm at each side of apex.

Bhutan: S–Gaylegphug district (N of Gaylegphug), C–Thimphu to Tashigang districts, scattered, N–Upper Mo Chu district (Gasa); **Sikkim**. Warm broad-leaved forests, 1600–2300 m, often in secondary forest, abandoned cultivation etc., more rarely in Cool broad-leaved forest up to 3300 m. July–October.

Sometimes used as fuel (16).

3. CORYLUS L.

Small trees. Leaves serrate, lateral veins numerous and parallel. Flowers precocious. Male catkins pendulous, with numerous bracts subtending solitary flowers; perianth absent; stamens c 10. Female flowers inconspicuous, 6–8 in small scaly bud; perianth adnate to ovary; ovary inferior, styles 2, linear, red, exserted. Fruit an ovoid woody nut, surrounded by a leafy, toothed or spiny involucre.

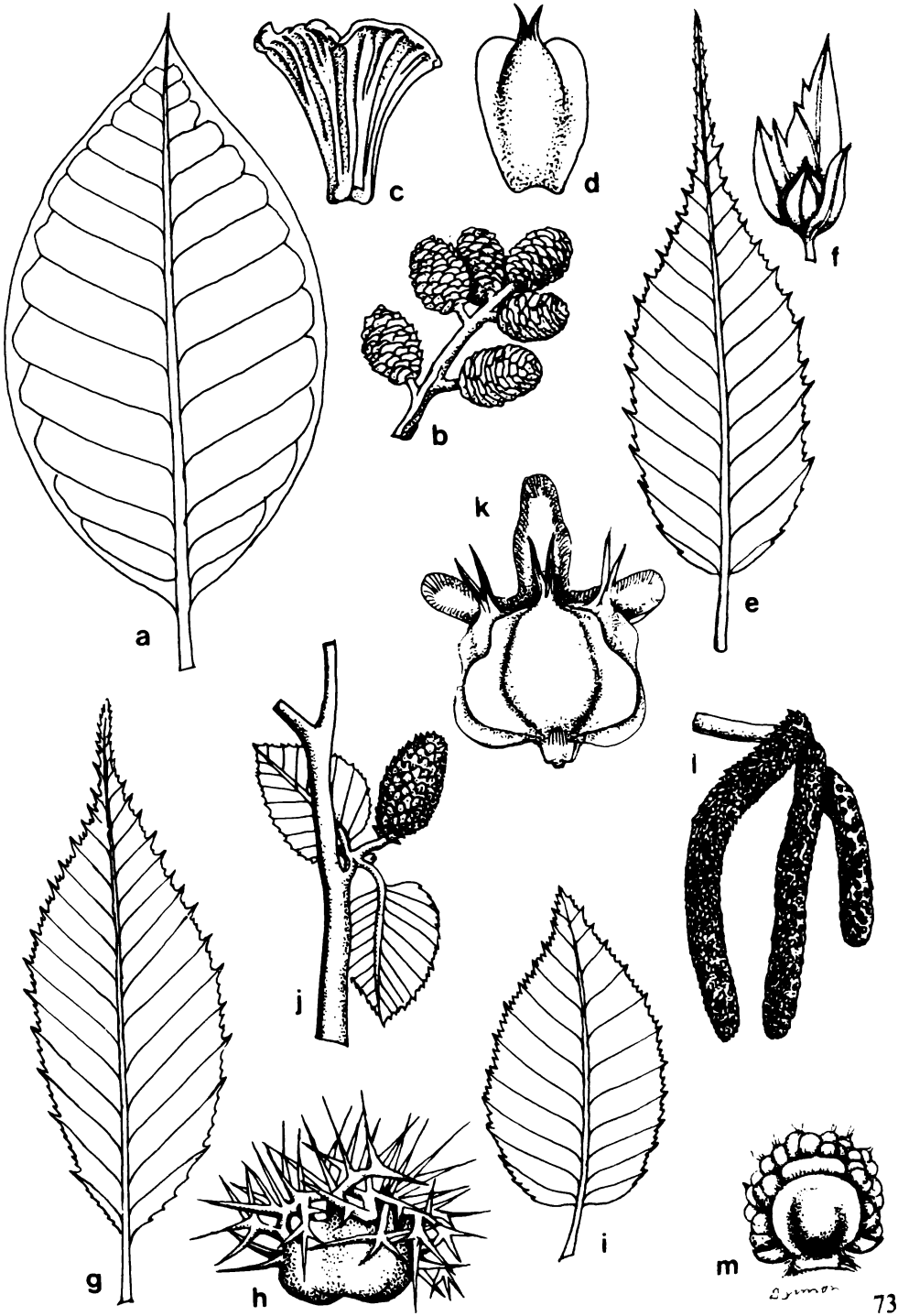
1. **C. ferox** Wall. Nep: *Lekh Katus* (34). Fig. 7g, h.

Tree 5–10 m. Young shoots appressed silky-pubescent. Leaves ovate or elliptic, 7–12 x 3–5 cm, finely acuminate, base rounded, margins finely and sharply serrate, sparsely pubescent above, shortly glandular-hairy and pubescent beneath; veins prominent, 11–15 pairs; petioles 9–15 mm, eglandular, appressed pubescent. Male catkins 3–5 (–7) cm; scales ovate, c 2 mm, shortly pointed, densely pubescent; stamens crimson; anthers pilose at apex. Female bud scales densely pubescent. Fruit in dense clusters; nut broadly ovoid, c 1.5 cm, slightly compressed; involucre bearing branched spines on upper margin.

Bhutan: C–Bumthang district (Bumthang valley), N–Upper Mo Chu district (Gasa); **Sikkim**. Cool broad-leaved forest, 2100–2500 m. November–December.

Nuts edible (48).

FIG 7 **Betulaceae**. a–d, *Alnus nepalensis*: a, leaf; b, female spikes in fruit; c, scale of fruiting spike; d, seed e & f, *Carpinus viminea*: e, leaf; f, involucral bract with immature fruit. g & h, *Corylus ferox*: g, leaf; h, fruiting involucre i–m, *Betula utilis*: i, leaf; j, shoot with female spike; k, scale from female spike bearing three flowers; l, cluster of male catkins; m, scale from male catkin bearing several flowers. Scale: a, b, e, g, i, j x ⅔; h, l x 1; f x 1⅓; c, d, m x 6½; k x 8. Drawn by D. Simon.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2. C. sp.

Similar to *C. ferox* but young shoots appressed silky-pubescent and spreading glandular-bristly; leaves larger, 12–18 x 6–8 cm, base subcordate, veins 8–9 pairs, pubescent on both surfaces but with long-stalked glandular hairs beneath, petioles 2–3 cm, densely pubescent and spreading glandular-bristly; male catkins similar to those of *C. ferox;* female flowers and fruit unknown.

Bhutan: C–Paro district (Bela Dzong) and Thimphu district (near Chapcha). Cool broad-leaved forest, 2500–3000 m. November.

This species appears to be distinct from all Himalayan *Corylus* species but its leaves are similar to some specimens of *C. chinensis* Franchet from W China. Fruit is required to determine its true affinities.

4. CARPINUS L.

Trees. Leaves serrate with close parallel veins. Male catkins pendulous, bracts ovate, perianth absent; stamens 10–12 crowded at base of conspicuous bract; anthers pilose at apex, anther cells shortly stalked. Female spikes erect, bearing deciduous, lanceolate scales, each scale subtending 2 slender involucral bracts and 2 ovaries; perianth minute, toothed, adnate to inferior ovary; styles 2, filiform. Fruit a ribbed nutlet subtended by much enlarged, toothed, involucral bract.

1. C. **viminea** Lindley. Dz: *Ruto Shi*; Sha: *Lung Shing*. Fig. 7e, f. .

Tree up to 12 m; branchlets glabrous. Leaves ovate-lanceolate, 4.5–9.5 x 2–4 cm, caudate-acuminate, base rounded, margins irregularly serrate with longer teeth at vein ends; veins 10–12 pairs, prominent, glabrous except when young; petioles 7–16 mm; stipules linear, c 2 cm, deciduous. Male catkins 2–6 cm; scales ovate-lanceolate, 4–5 mm. Female spikes 3–5 cm, scales c 1 cm, deciduous. Fruiting spike 6–15 cm, involucral bracts 2–2.5 x 0.8–1 cm, obliquely ovate, toothed on broader margin, entire and without submarginal vein or narrower margin, but with a short toothed lobe at base which enfolds ovoid nutlet, c 4 x 3 mm.

Bhutan: S–Chukka and Deothang districts, C–Punakha, Tongsa and Mongar districts, N–Upper Mo Chu district (near Gasa); **Sikkim**: Warm broad-leaved forests, 1500–2200 m. April–May.

2. C. **faginea** Lindley

Similar to *C. viminea* but branchlets greyish pubescent; leaves shortly acuminate, margins regularly serrate, thinly pubescent beneath; veins 12–16 pairs, petioles 2–9 mm; fruiting spikes with broader involucral bracts, which on the entire side have a parallel submarginal vein, basal lobe much smaller, entire.

Bhutan: C–Thimphu district (Dochu La) and Punakha district (N of Punakha). Cool broad-leaved forests, 2700 m. March–April.

Family 13. FAGACEAE

Monoecious trees or shrubs. Leaves alternate, simple, pinnately veined, stipulate. Male flowers in spikes, sometimes catkinate, perianth 4–6-lobed, united at base, stamens 6–20, rudimentary ovary (pistillode) sometimes present. Female flowers solitary in a scaly involucre, perianth minute or absent, 4–6-lobed, tube adnate to apparently inferior ovary, ovary 3–7-celled, ovules 1–2 per cell, staminodes sometimes present. Fruit a nut (acorn), wholly or partially enveloped by an involucre (cupule) of connate woody bracts.

1. Male and female flowers on separate shoots, male flowers in clustered, pendulous, catkinate spikes, female flowers solitary or few in short spikes **1. Quercus**
   Male and female flowers in same inflorescence of rigid, erect, simple or paniculately branched spikes 2
2. Cupules 1–3 at base of otherwise male spikes; male flowers without pistillode; cupules containing 3 flowers with 6–9 filiform styles ... **2. Castanea**
   Male and female flowers usually on separate spikes of inflorescence; males with pistillode; cupules usually containing 1 flower with 3 short columnar styles 3
3. Bracts lanceolate, equalling or exceeding male flower clusters; cupule and acorn symmetrical, at least apex of acorn visible; cupule scaly, indehiscent; leaf margins entire ..... **3. Lithocarpus**
   Bracts obtuse or broadly acute, obscure or shorter than male flower clusters; cupule and acorn asymmetrical, acorn completely enclosed; cupule spiny, sometimes unarmed and smooth, usually dihiscent; leaf margins entire or serrate ..... **4. Castanopsis**

1. QUERCUS L.

Evergreen or deciduous trees or shrubs. Leaves dentate or serrate, rarely entire. Male flowers in drooping, simple, often clustered catkins, stamens 6–12, pistillode absent; female flowers solitary or in few-flowered erect spikes, styles 3, thick, recurved. Acorns solitary, partly enclosed by cupule bearing scales or annular lamellae.

1. Cupules bearing concentric lamellate ring-like scales; bracts of male catkins longer than flowers; evergreen ..... **Species 1–5**
   Cupules bearing linear or ovate-lanceolate scales united at base; bracts of male catkins more or less as long as flowers; evergreen or deciduous 2
2. Scales of cupules free and recurved in upper half; deciduous ..... **Species 6**
   Scales of cupules free only at apex; evergreen or deciduous ..... **Species 7–11**

1. **Q. glauca** Thunberg. Dz: *Thonp*; Sha: *Thongpa Shing*; Nep: *Musre Phalant* (34). Fig. 8d.

Tree 7–20 m. Leaves elliptic, 7–15 x 3–5 cm, acuminate, base cuneate, margins sharply toothed in upper half, silky hairy on both surfaces at first, becoming glabrous above, greyish appressed pubescent beneath, veins 9–12 pairs; petioles 1–3 cm. Male spikes 4–6 cm, flowers c 3 mm, ± globose, each in axil of linear-lanceolate bract 5–6 mm, female flowers 2–4 on short axillary shoots 1–2 cm. Cupule 1–1.5 cm diameter covering lower half or third of acorn, bearing 6–7 overlapping annular lamellae, appressed silky pubescent. Acorns ellipsoid, 1.5 x 1 cm, apex conical.

Bhutan: S–Chukka and Deothang districts, C–Punakha and Tashigang districts; **Sikkim**. Warm broad-leaved forests, 1100–2100 m. March–April.

The Himalayan plants have been referred to subsp. **annulata** (Smith) Camus. Timber used for fuel (16).

2. **Q. oxyodon** Miquel; *Q. lineata* Blume var. *oxydon* (Miquel) Wenzig

Similar to *Q. glauca* but leaves glaucous beneath, veins 16–21 pairs, margins toothed almost to base; cupule 1.5–2 cm diameter, acorn subglobose c 1.5 cm tall.

Bhutan: C–Thimphu district (N of Thimphu), Punakha district (SW of Wangdu Phodrang) and Tongsa district (E side of Pele La). Evergreen oak forest, 2400–2700 m. June.

3. **Q. thomsoniana** A.DC.; *Q. lineata* Blume var. *thomsoniana* (A.DC.) Wenzig. Nep: *Phalant* (34).

Similar to *Q. glauca* but leaves 7–12 x 2–3.5 cm, margins sharply toothed in upper half, whitish tomentose beneath, veins 14–20 pairs; cupule c 3 cm diameter; acorn c 2 cm tall, turbinate, broader than tall.

Bhutan: locality unknown; **Sikkim**.

4. **Q. semiserrata** Roxb.

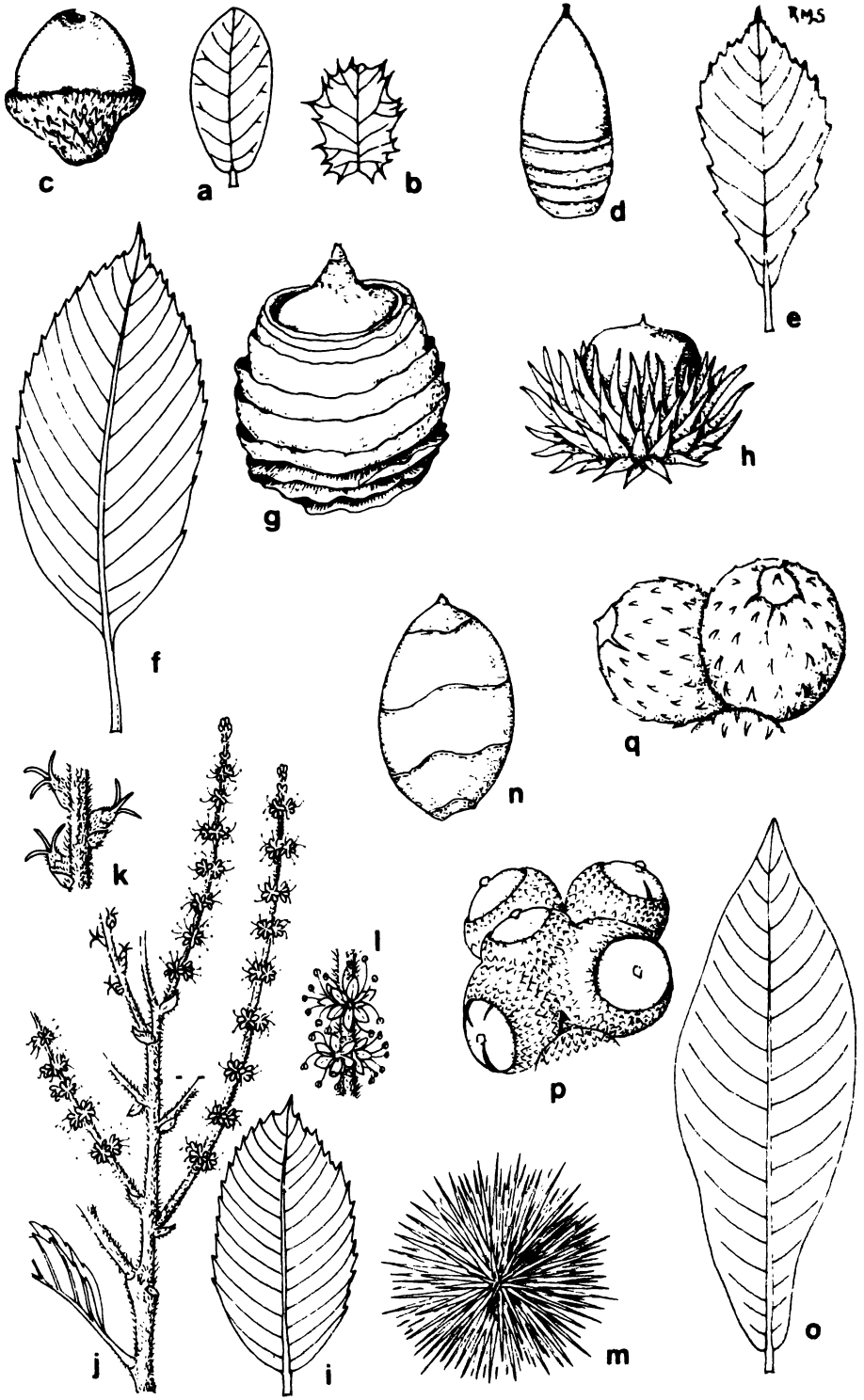
Similar to *Q. glauca* and its allies but leaves longer and more narrowly oblong-lanceolate, 13–22 x 2–5 cm, margins bluntly serrate only near apex, veins 12–14 pairs. Cupule 2.5–3.5 cm diameter, villous.

Bhutan: locality unknown; **Sikkim**: cultivated. June.

5. **Q. lamellosa** Smith. Dz: *Bangka*; Nep: *Bajrant* (34). Fig. 8f, g.

Similar to *Q. glauca* and its allies but leaves ovate or oblong, 15–40 x 4–12 cm, margins toothed almost to base, glaucous and glabrous beneath, veins 15–25 (–30) pairs; cupule 4–7 cm diameter, very woody, enclosing all but apex

FIG. 8. **Fagaceae**. a–c, *Quercus semecarpifolia*: a, entire-margined leaf; b, spinous-margined leaf; c, cupule with acorn. d, *Q. glauca*: cupule with acorn. e, *Q. griffithii*: leaf. f & g, *Q. lamellosa*: f, leaf; g, cupule with acorn. h, *Q. acutissima*: cupule with acorn. i–m, *Castanopsis indica*: i, leaf; j, portion of inflorescence with male and female flowers; k, female flowers; l, male flowers; m, cupule enclosing nut. n, *C. lanceifolia*: cupule enclosing nut. o & p, *Lithocarpus elegans*: o, leaf; p, fused cluster of cupules and acorns. q, *L. fenestratus*: cupules and acorns. a, b, c, f, i, o x ¼; k, l x 2; c, d, g, h, j, m, n, p, q x 1. Drawn by R. M. Smith.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of acorn, 3–4 cm tall with 8–10 lamellae; acorn turbinate or subglobose,3–4 cm diameter, 2–3 cm tall.

Bhutan: S–Chukka and Deothang districts, C–Punakha, Mongar, and Tashigang districts; **Sikkim**. Evergreen oak forest, sometimes dominant, 1800–2600 m. April–May.

Timber hard and durable, used in furniture and house construction and as a fuel (16, 34, 48).

6. **Q. acutissima** Carruthers; *Q. serrata* sensu F.B.I. non Thunberg. Fig. 8h.

Leaves oblong-elliptic, 10–18 x 3–7 cm, acuminate, base rounded or cuneate, margins coarsely serrate almost to base, teeth ending in a fine subulate point 2–7 mm, pubescent when young, becoming glabrous, veins 12–20 pairs; petioles 2–5 cm. Male catkins 10–15 cm, flowers 2–3 mm, bracts ovate, perianth lobes ovate c 2 mm. Cupules enclosing lower third of acorn, 2–3 cm diameter, bearing multiseriate linear woody scales recurved at apex. Acorn ellipsoid or subglobose,1.5–2 cm tall, mucronate.

Bhutan: C–Thimphu district (Thimphu Chu, N of Thimphu) and Tongsa district (near Tongsa). Cool broad-leaved forests, 2000–2500 m. March–April.

The Indo-Himalayan plants belong to subsp. **roxburghii** (A.DC.) Camus.

7. **Q. lanata** Smith; *Q. lanuginosa* D. Don. Dz: *Ghum;* Tongsa: *Guma Seng;* Sha: *Betsanang Shing;* Nep: *Banj.*

Evergreen tree 10–23 m. Leaves coriaceous, ovate-elliptic or obovate, 7–15 x 3–9 cm, acute often broadly, base rounded, margins shallowly or rather coarsely serrate, glabrous above, pale tomentose beneath, veins 10–14 pairs prominent on upper surface when dry; petioles 1–2 cm. Male catkins 5–7 cm. Cupule covering lower half of acorn, c 1 cm diameter, scales small, ovate-lanceolate, appressed, pubescent. Acorn ovoid-ellipsoid, 1–1.3 cm tall, turbinate at apex with tomentose stylar remains.

Bhutan: S–Chukka and Deothang districts, C–Thimphu, Punakha and Mongar districts. Warm broad-leaved forests, 1500–2200 m. April–June.

8. **Q. leucotrichophora** Camus; *Q. incana* Roxb. non Bartram

Similar to *Q. lanata* but leaves more narrowly ovate-elliptic or lanceolate, more sharply serrate, more narrowly acute or acuminate, veins 13–20 pairs.

Sikkim: Darjeeling, cultivated. April.

Native of West Himalaya.

9. **Q. griffithii** Miquel. Dz: *Si-Si;* Tongsa: *Pe Seng;* Sha: *Beynang Shing;* Nep: *Kasru.* Fig. 8e.

Deciduous tree 10–25 m. Leaves clustered at ends of shoots, obovate, 15–25 x 7–14 cm, acute or subacuminate, base cuneate, margins shallowly or coarsely serrate, glabrous above, subglabrous or finely pale tomentose beneath, subsessile or with petioles up to 1 cm. Male catkins c 10 cm. Acorns similar to those of *Q. lanata* but cupule less pubescent.

Bhutan: S–Gaylegphug district, C–Thimphu to Tashigang districts, common; **Sikkim**: cultivated. Drier slopes in broad-leaved forests, or in Blue pine forest, often forming pure stands, 1300–2500 m. April.

Buds of this species are sometimes attacked by insects causing rounded galls 2–3 cm, covered with linear-lanceolate scales, to form at branch ends. Timber valuable, strongly-grained (16).

10. Q. semecarpifolia Smith. Fig. 8a–c.

Low shrub 1–2 m or tree up to 25 m, evergreen or sometimes deciduous. Leaves coriaceous, oblong to broadly elliptic 3–10 x 2–5 cm, obtuse, base rounded or cordate, margins revolute, entire or spinous toothed, glabrous above, shortly stellate tomentose at first beneath, glabrous or shortly tomentose later, subsessile. Male catkins c 6–12 cm. Cupules c 1.5 cm diameter, 1 cm tall at first, clasping only the base of acorn, becoming flattened. Acorns subglobose, 2–2.5 cm, turbinate or mucronate.

Bhutan: C–Thimphu to Tashigang districts, common, especially around Thimphu, where plants bearing both entire and spinous-dentate leaves occur. Absent from Sikkim. Often forming dense xerophytic scrub on dry slopes under Blue pine, becoming arborescent in mixed broad-leaved forests, 2400–3200 m. May–June.

Wood used as fuel (48).

11. Q. senescens Handel-Mazzetti

Similar to *Q. semecarpifolia* but leaves always densely long-stalked stellate tomentose beneath; cupule c 7.5 mm diameter, c 1 cm tall, covering lower half of acorn.

Chumbi: reported from Pa-roo, Chumbi valley.

2. CASTANEA Miller

Deciduous trees. Leaves serrate. Spikes erect, unbranched, unisexual or with male flowers above, female below; male flowers with 6–18 stamens, pistillode absent; female with 6–9 linear styles. Cupule subglobose, densely spiny, dehiscing into 4 lobes, completely enclosing 1–3 nuts.

1. C. sativa Miller. Eng: *Sweet Chestnut, Spanish Chestnut.*

Leaves ovate-elliptic, 12–25 x 3–7 cm, coarsely and sharply serrate. Cupule 5–6 cm diameter, including spines 1–1.5 cm.

Sikkim: cultivated at Mungpoo. May–June.

Native of S Europe, cultivated for its edible nuts.

3. LITHOCARPUS Blume

Evergreen trees. Leaves entire. Spikes erect, simple or paniculate, unisexual or with male flowers above, female below; stamens usually 12, pistillode

present; female with spreading styles. Acorn solitary, partly or almost entirely enclosed by scaly cupule, cupules often united at bases.

1. L. elegans (Blume) Soepadmo; *Quercus spicata* Smith non Humboldt & Bonpland, *L. grandifolius* (D. Don) S.N. Biswas var. *gracilipes* (Miquel) S.N. Biswas, *L. chittagonga* (King) Merrill. Sha: *Shakor Shing*; Nep: *Arkaula* (34). Fig. 8o, p.

Tree 10–20 m. Leaves coriaceous, elliptic to oblanceolate or obovate, 8–35 x 3–10 cm, acute or acuminate, base cuneate to rounded or cordate, glabrous, sessile or on petioles up to 1.5 cm. Spikes 8–23 cm, pubescent, male flowers in clusters of 3–6 subtended by a triangular bract c 2 mm, female flowers in clusters of 10–12. Cupules fused at base, each 2 cm across, c 7 mm tall. Acorns ovoid or subglobose, 1.7–2 cm tall, apiculate, lower third enclosed by cupule.

Bhutan: S–Phuntsholing to Deothang districts, C–Tongsa, Mongar and Tashigang districts; **Sikkim**. Subtropical and Warm broad-leaved forests, 900–2200 m. April–July.

2. L. pachyphyllus (Kurz) Rehder; *Quercus pachyphylla* Kurz. Nep: *Sungure Katus* (34).

Similar to *L. elegans* but leaves elliptic, 8–20 x 3–5 cm, caudate-acuminate, glabrous; panicle branches 5–10 cm, clusters of male flowers subtended by ovate, subulate, spreading bracts 2–3 mm, female flowers usually in 3s, cupules 1.5 cm tall, c 3 cm diameter, completely fused together, enclosing half or more of acorns, scales thick; acorns ovoid 2–2.5 cm tall, turbinate, glabrous.

Bhutan: S–Gaylegphug district (Rani Camp); **Sikkim**. Warm broad-leaved forests, 1650 m. January–May.

Sometimes used for fuel (16), or in construction (48).

3. L. fenestratus (Roxb.) Rehder; *Quercus fenestratus* Roxb. Nep: *Arkaula* (34). Fig. 8q.

Similar to *L. elegans* but leaves elliptic, 9–25 x 3–8 cm; cupules often united in 3s when young, often only one developing, 2–2.5 cm diameter, consisting of fused scales of which only the lanceolate 1–2 mm tips are free, leaving upper ¼ or less of acorn exposed. Acorns ovoid or subglobose, 2–2.5 cm tall, mucronate, glabrous, breaking through upper part of cupule at maturity.

Bhutan: S–Gaylegphug district (Sham Khara) and Deothang district (N of Deothang); **Sikkim**. Subtropical and Warm broad-leaved forests, 1000–1800 m. September–December.

4. L. dealbatus (Miquel) Rehder; *Quercus dealbata* Miquel

Similar to *L. fenestratus* but leaves pale, minutely scaly beneath, only up to 18 x 6 cm; acorns subglobose up to 1.5 cm, puberulous, two-thirds enclosed by cupule, scales of which are free only at apex.

Bhutan: S–Gaylegphug district (between Rani Camp and Tama, N of Gaylegphug). Subtropical forests, 1350–1650 m. June.

5. **L. listeri** (King) Grierson & Long; *Quercus listeri* King

Similar to *L. elegans* but leaves elliptic, 20–30 x 7–10 cm, on petioles 1.5–5 cm; panicles 12–20 cm with short branches 1–3 cm; mature fruit unknown.

Bhutan: C–Tongsa district (near Shamgong). Evergreen oak forest, 2000 m. June.

4. CASTANOPSIS Spach

Evergreen trees. Leaves entire or serrate. Spikes erect, simple or paniculate, unisexual, male flowers with usually 12 stamens around villous pistillode, female with 3 cylindric styles. Nuts 1–4, completely enclosed by cupule which dehisces into 3–4 lobes, or ruptures irregularly, bearing dense branching spines, or almost smooth with wavy bands.

1. Cupules smooth, unarmed, with 4–6 wavy bands ..... **Species 6**
   Cupules spiny 2
2. Spines dense, obscuring surface of cupule ..... **Species 1 & 2**
   Spines in bands, not obscuring surface of cupule ..... **Species 3–5**

1. **C. indica** (Roxb.) A.DC. Dz: *Sokey*; Nep: *Aule Katus* (34), *Dalne Katus* (34). Fig. 8i–m.

Tree 3–20 m. Leaves oblong-elliptic, 10–25 x 4–10 cm, acute or acuminate, base rounded or cuneate, margins serrate, teeth often subulate, glabrous above, finely brownish pubescent beneath, lateral veins 12–19 pairs, prominent; petioles 5–20 cm. Spikes often paniculate, 10–15 cm, densely brownish tomentose, suberect, male spikes several, below 1–2 terminal female spikes. Male flowers in clusters 2–3 mm across in axils of minute bracts. Female flowers usually solitary, densely tomentose. Cupule globose, c 2.5 cm diameter, including branching needle-like spines 5–10 mm, splitting irregularly into 3–4 segments at maturity. Nuts ovoid, c 1.25 x 1 cm, pubescent at apex around mucronate stylar remains.

Bhutan: S–Samchi to Deothang districts; widespread; **Sikkim**. Subtropical forests, 400–1500 m. September–May.

Nuts edible (16).

2. **C. hystrix** A.DC. Sha: *Tshe Shing;* Nep: *Katus* (34).

Similar to *C. indica* but leaves ovate-lanceolate, 6–10 x 2–3 cm, acute, more or less entire, glabrous above, finely reddish tomentose beneath, sometimes glabrescent, lateral veins 9–13 pairs; petioles 0.5–1.5 cm; spikes drooping to suberect; female flowers less tomentose; cupule globose, 3–5 cm including dense spines 7–10 mm; nut 1 per cupule, ovoid, c 1 cm.

Bhutan: C–Punakha district (W of Wangdu Phodrang) and Tongsa district (near Shamgong); **Sikkim**. Evergreen oak forest, 2000–2300 m. April–June.

Timber used in house construction, fruit edible (48).

3. C. **tribuloides** (Smith) A.DC. Tongsa: *Tongpa Shing;* Nep: *Musre Katus* (34), *Patle Katus* (34).

Similar to *C. indica* but leaves ovate-lanceolate, 8–15 x 2–5 cm, acuminate, margins entire or bluntly serrate near apex, glabrous, veins 6–13 pairs, petioles 1–2 cm; spikes more slender and more sparsely flowered, densely pale pubescent, cupules 2–2.5 cm diameter, including spines 5–8 (–15) mm, branched from a broadened base and arranged in 4 bands around cupule; nut solitary (or sometimes 3), ovoid, mucronate, c 1 cm.

Bhutan: C–widespread from Punakha to Tashigang districts; **Sikkim**. Warm broad-leaved forests, 1200–2400 m. April–June (–September).

This species is variable in the development of the spines and details of leaves, some extremes have been segregated as species or varieties: C. **ferox** (Roxb.) Spach (syn. *C. tribuloides* var. *ferox* (Roxb.) King) with larger (up to 1 cm) and stouter cupular spines; C. **echidnocarpa** A.DC. (syn. *C. tribuloides* var. *echidnocarpa* (A.DC.) King) with leaves serrately crenate above and spines 1.5–2 mm; C. **wattii** (King) Camus (syn. *C. tribuloides* var. *wattii* King) with leaves brownish pubescent beneath, cupules with short spines 1–2 mm, walls densely reddish tomentose within. Only C. **echidnocarpa** has been recorded from Bhutan, the other being known from Sikkim.

4. C. **clarkei** King

Distinguished from *C. tribuloides* by its leaves serrate almost to base, pale puberulous beneath, veins 16–18 pairs; cupules with spines 2–6 mm.

Sikkim: Kalimpong district. Warm broad-leaved forests, 1500–2000 m. May.

5. C. **armata** Spach

Very close to some forms of *C. tribuloides*, but cupules larger, 2.5–3.5 cm diameter, spines shorter and stouter.

Sikkim: Darjeeling district. Subtropical forests, 600–900 m. September.

6. C. **lanceifolia** (Roxb.) Hickel & Camus; *Quercus lanceifolia* Roxb. Nep: *Patle Katus* (34). Fig. 8n.

Medium-sized or large tree. Leaves ovate-lanceolate or oblong, 8–22 x 2.5–7.5 cm, acuminate, base cuneate, margins entire, glabrous; petioles 0.5–2 cm. Spikes slender, finely tomentose, often branched, female spikes usually terminal. Male flowers in clusters of 2–3 subtended by a minute bract. Cupules ovoid, asymmetric 2–3 x 1.5–2 cm, thin, completely enveloping nut, smooth with 4–6 wavy bands, rupturing irregularly at maturity. Nut ovoid, 1.5–3 x 1–1.5 cm, brown, glabrous but with a few reddish hairs at apex.

Sikkim: Darjeeling foothills. Subtropical forests, 300–1500 m. November–February.

Family 14. ULMACEAE

Evergreen or deciduous trees or shrubs, sometimes dioecious. Leaves alternate, simple, usually serrate and with oblique bases, pinnately veined, sometimes also 3–5-veined at base, stipulate. Inflorescence of axillary clusters, racemes or cymes. Flowers unisexual or bisexual, more or less actinomorphic. Perianth segments 4–8, free or connate. Stamens as many as, and opposite to, perianth segments. Ovary superior, carpels 2 united, styles 2, simple, ovule solitary, apical. Fruit a samara or drupe.

1. Leaves with 10–15 pairs of veins, all ± uniformly developed 2
   Leaves with 2–7 pairs of veins, the lowermost ones often more strongly developed 3
2. Flowers bisexual, fruit a samara ..... **1. Ulmus**
   Flowers unisexual, fruit a drupe ..... **2. Gironniera**
3. Leaves sparsely pubescent on veins; monoecious; drupes 5–6 mm ..... **3. Celtis**
   Leaves velutinous or rough with papillae; dioecious; drupes c 2 mm .. **4. Trema**

1. ULMUS L.

Evergreen trees. Leaves distichous, pinnately veined; stipules scarious, deciduous. Flowers in axillary clusters. Perianth cup-shaped, 5–6-lobed. Ovary compressed with 2 broad, oblique styles at apex. Fruit a thin, broadly elliptic samara.

1. U. lanceifolia Roxb. Nep: *Aule Pipli* (34), *Sandan Pipli* (34), *Chamlayo* (34). Fig. 9b, c.

Tree to 45 m, shoots puberulous. Leaves oblong or ovate, 3–8 x 1.5–3 cm, acuminate, base rounded or cuneate, margins finely serrate, ± glabrous; petiole c 5 mm; stipules linear, 7–9 mm. Flowers in clusters of 6–12, on pedicels 5–6 mm. Perianth 2.5–3 mm, borne on a stipe 1–2 mm, articulated with pedicel. Filaments c 3 mm. Ovary elliptic, 3 mm. Samaras papery, broadly elliptic, 2–3 x 1.5–2 cm, 2-lobed above; seed elliptic, 8 x 5 mm.

Bhutan: S–Chukka district (Choonsam) and Deothang district (Deothang); **Sikkim**. Subtropical forests, 650–1050 m. October–February.

2. GIRONNIERA Gaudichaud

Dioecious evergreen or partly deciduous trees. Leaves pinnately veined; stipules connate, sheathing bud, deciduous. Flowers 5-merous; males in cymes at base of young growth. Female flowers solitary, axillary; ovary sessile, styles filiform. Drupe ovoid-ellipsoid, bearing perianth segments at base and persistent styles at apex.

1. **G. cuspidata** (Blume) Kurz; *G. lucida* Kurz, *G. reticulata* Thwaites, *G. thomsonii* A.M. & J.M. Cowan, *Aphananthe cuspidata* (Blume) Planchon. Nep: *Sukar* (34). Fig. 9a.

Tree 15–30 m. Leaves ovate, 10–25 x 5–8 cm, acuminate, base rounded, margins entire or serrulate, glabrous; petiole 1–1.5 cm. Male flowers c 2 mm across, in short cymes 1.5–2 cm; perianth segments oblong. Drupe orange, 1.5 x 0.7–1 cm, with ovate perianth segments 3–5 mm at base.

Bhutan: S–Chukka district (Marichong and Chukka); **Sikkim.** Subtropical forests, 300–1200 m. March–June.

Fruit edible (34), timber useful (48).

3. CELTIS L.

Monoecious, evergreen or deciduous trees. Leaves pinnately veined but often strongly 3-veined at base. Flowers unisexual or bisexual, 4 or 5-merous; males in short racemes or clusters, usually with a hairy pistillode; bisexual or functionally female flowers solitary or few, axillary; ovary ovoid. Fruit a drupe.

1. **C. tetrandra** Roxb. Sha: *Phantang Shing*; Nep: *Khari* (34). Fig. 9g, h.

Tree up to 25 m. Leaves deciduous, ovate, 5–8 x 2.5–4 cm, acuminate, base oblique, rounded or cuneate, margins crenately serrate, pubescent usually only on veins beneath and sometimes in vein axils; petioles 4–9 mm. Male racemes 1.5–2 cm, perianth segments 4, elliptic, c 2 mm. Bisexual or functionally female flowers with ovary c 2 mm; styles thick, 3 mm. Drupes ovoid-ellipsoid, 5–6 mm, bearing a tuft of pubescence at base and apex.

Bhutan: C–Punakha district (W of Wangdu Phodrang, N of Punakha, Rinchu); **Sikkim.** Warm broad-leaved forests, 1500–3000 m. February–April.

A valuable fodder species (16).

2. **C. timorensis** Spanoghe; *C. cinnamomea* Planchon

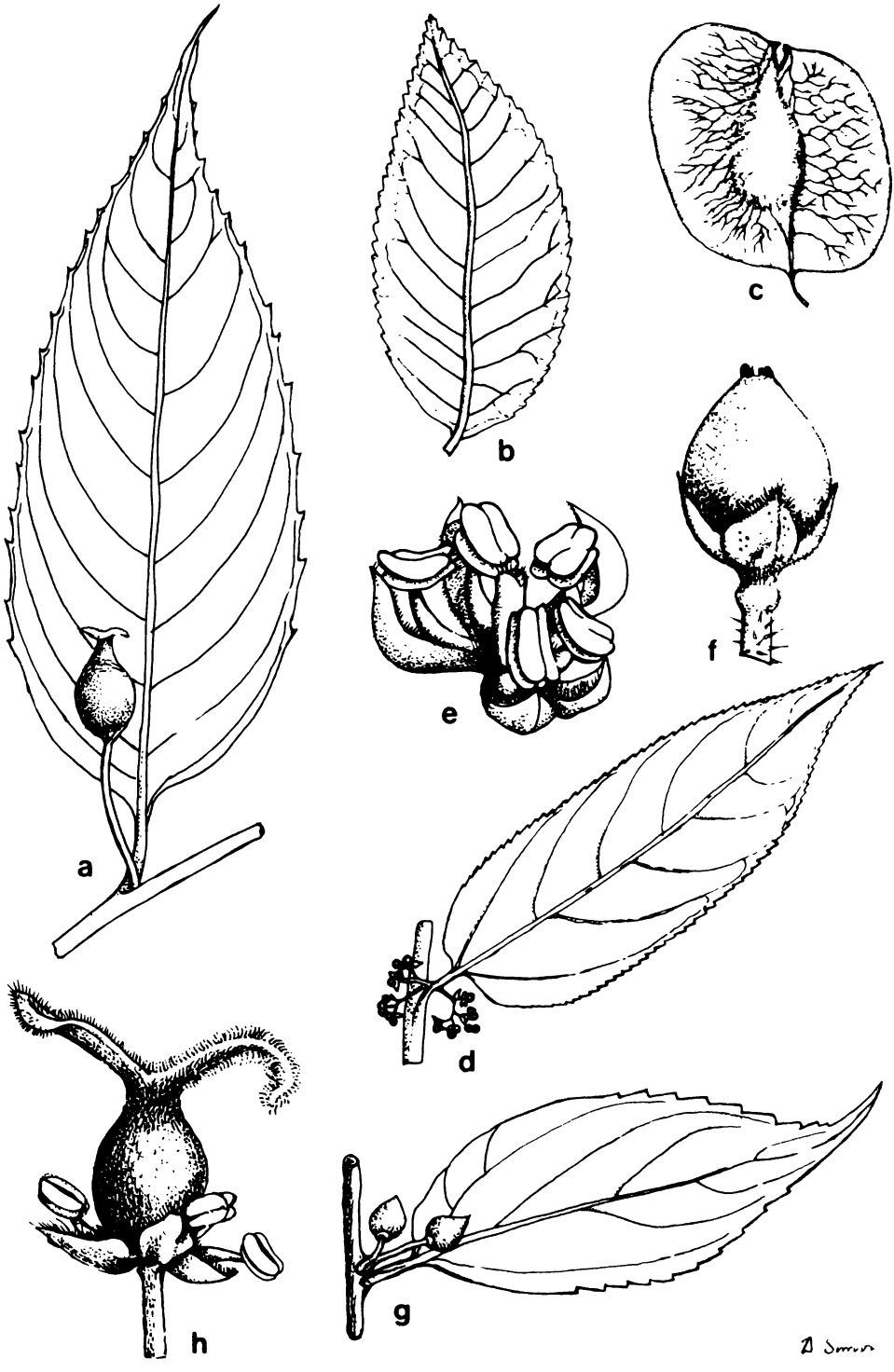
Very close to *C. tetrandra* but leaves evergreen, more strongly 3-veined, flowers 5-merous, female flowers and fruit in cymes.

Sikkim: Darjeeling foothills. Subtropical forests, 300–600 m. March–April.

4. TREMA Loureiro

Dioecious, evergreen trees or shrubs. Leaves pinnately veined, usually strongly 3-veined at base; stipules deciduous. Flowers in axillary cymes, 4–5-merous, perianth segments free. Male flowers sometimes containing a pistillode. Female flowers with sessile ovary; style bifid. Fruit a drupe.

FIG 9. **Ulmaceae**. a, *Gironniera cuspidata*: leaf with develcping fruit. b & c, *Ulmus lanceifolia*: b, leaf; c, fruit. d–f, *Trema politoria*: d, leaf with male inflorescence; e, male flower; f, fruit. g & h, *Celtis tetrandra*: g, leaf with immature fruit; h, flower. Scale: a, b, d, g x ⅓; c x 2; h x 7; e, f x 10. Drawn by D. Simon.


a
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1. T. **politoria** Planchon. Sha: *Sok Sokpa, Seng Sokpa;* Dz: *Sokum;* Nep: *Kuail* (34). Fig. 9d–f.

Scabrid shrub or tree 2–7 m. Leaves ovate-lanceolate, 4–13 x 2–5 cm, acuminate, base + equally rounded, margins finely serrate, dark green when dry, rough with minute whitish papillae above, paler green beneath; petioles 5–10 mm. Flowers numerous in cymes 0.5–1.5 cm. Male flowers with perianth segments linear-lanceolate, c 1 mm; stamens c 1 mm. Female perianth segments somewhat narrower, ovary ovoid, 1 mm; styles c 1 mm. Drupes ovoid, 2 mm, blackish.

Bhutan: S–Sarbhang and Deothang districts, C–Punakha, Mongar and Tashigang districts; **Sikkim**. Dry valleys, often in Chir pine forest, 1200–1800 m. May–August.

Leaves used as sand-paper for wood turning; bark used to make ropes (34). The distinction between this and *T. cannabina* Loureiro is uncertain.

2. T. **tomentosa** (Roxb.) Hara; *T. amboinensis* sensu F.B.I. non (Willdenow) Blume. Nep: *Kuail* (34).

Softly pubescent shrub to 7 m, similar to *T. politoria* but leaves larger, up to 18 x 8 cm, gradually acuminate, cordate at base, scarcely rough above, densely velutinous beneath.

Bhutan: S–Chukka and Deothang districts, C–Punakha and Tongsa districts; **Sikkim**. Subtropical forests, 600–1500 m. April–June.

3. T. **orientalis** (L.) Blume, distinguished by its silvery adpressed pubescent leaves, replaces *T. tomentosa* on the plains of India and has been recorded from the Sikkim foothills (34). The two may only be subspecifically distinct.

Family 15. MORACEAE

Monoecious or dioecious trees, shrubs or woody climbers with milky latex. Leaves alternate, rarely opposite, simple, sometimes lobed, venation pinnate but often palmately 3–15-veined at base; stipules 2, usually deciduous and often leaving an annulate scar. Flowers minute, in heads, racemes or catkinate spikes, sometimes aggregated in hollow receptacles (figs), unisexual, actinomorphic. Perianth segments (2–)4(–6), united or free, sometimes reduced or absent, often becoming fleshy in fruit. Stamens 1–4, opposite perianth lobes. Ovary usually superior, 1-locular, ovule solitary, pendulous; style bifid or simple, filiform. Fruit an achene.

1. Flowers lining inner wall of hollow, globose, ellisoid or obovoid receptacles (figs) ..... **1. Ficus**
   Flowers partially sunk into surface of solid, globose or oblong receptacles, or borne in catkins, racemes or globose heads, rarely solitary 2

2. Monoecious trees; flowers partially sunk into surface of globose or oblong receptacles; stamen solitary ..... **2. Artocarpus**
   Dioecious shrubs, climbers or trees; flowers in catkins, racemes, globose heads or rarely solitary; stamens 4 3
3. Scandent shrubs bearing abundant stout spines, male and female flowers in globose heads 4
   Erect unarmed shrubs or trees, flowers in catkins, racemes, globose heads or solitary (except *Broussonetia kurzii*, scandent but unarmed, and *Streblus zeylanicus*, armed erect shrub but flowers in racemes) 5
4. Leaves shortly apiculate to acuminate; peduncles short and stout, 3–7 mm long 0.7–1 mm thick; perianth parts thickened and readily visible in fruit; achenes numerous ..... **6. Maclura**
   Leaves obtuse to subacute; peduncles long and slender, 5–15 mm long, 0.5 mm or less thick; perianth parts connate, individual segments not or scarcely visible in fruit; achenes few ..... **7. Plecospermum**
5. Leaves elliptic or obovate with cuneate base, subsessile; armed or unarmed shrubs or trees; female flowers solitary or 2–4 in short racemes ..... **5. Streblus**
   Leaves ovate or oblong, broadly rounded or cordate at base, on petioles 1–12 cm; unarmed shrubs or trees; female flowers numerous in capitate heads or cylindrical spikes 6
6. Shoots leafless at flowering time; female flowers in globose heads, 3–4 borne in short racemes ..... **3. Broussonetia** *(B. kurzii)*
   Shoots at least with young leaves when flowering; female flowers in solitary, axillary heads or spikes 7
7. Leaves strongly scabrid above, margins crenately serrate; petioles 3–6 cm; stipules conspicuous, ovate; female flowers in globose heads 1–1.5 cm diameter ..... **3. Broussonetia** *(B. papyrifera)*
   Leaves smooth or weakly scabrid above, margins sharply serrate; petioles 1–3.5 cm; stipules inconspicuous, linear-lanceolate; female flowers in spikes 0.5–6 cm ..... **4. Morus**

1. FICUS L.

Monoecious, rarely dioecious trees, shrubs or creepers, sometimes epiphytic. Leaves alternate, rarely opposite, unlobed or lobed; venation pinnate, sometimes palmately 3–5 veined at base; stipules enclosing terminal bud, often caducous and leaving a scar. Flowers enclosed within fleshy, globose, ellipsoid or obovoid receptacles (figs) borne in axils on branches or rarely on scaly leafless shoots from trunk or major branches. Figs with a mouth (ostiole) at apex more or less closed by small bracts, sometimes bracts scattered over surface of fig or 3 in a whorl at base or on peduncle. Flowers of three kinds; male, female and gall flowers (sterile, short styled female flowers). Perianth 2–6-lobed or-partite or

absent; male flowers with 1–3 stamens; female flowers with straight or oblique ovary, style simple, becoming excentric or lateral after fertilisation. Achenes enclosed within figs.

Ficus species depend for pollination on the movements of fig wasps; the life cycles of the two organisms are closely linked, the wasp larvae depending for nourishment on the production of gall flowers. As there generally has to be a supply of figs for this purpose, the cycle of fig production is to some extent independent of the seasons of the year, thus no flowering times have been given.

1. Leaves opposite, sometimes some alternate in *F. conglobata*.....**Species 1–3**
   Leaves alternate or spirally arranged, sometimes some opposite in *F. fistulosa* 2
2. Leaves strongly asymmetric, unequal and oblique at base .....**Species 4–6**
   Leaves symmetric, base equal or slightly oblique in *F. subulata* and *F. tinctoria* 3
3. Figs mostly borne on scaly, leafless, usually short branches on trunk or major limbs of tree, these branches elongate and prostrate in *F. prostrata* 4
   Figs mostly borne on leafy branches, either in leaf axils of current year's growth or in axils of fallen leaves on previous year's growth; in some forms of *F. fistulosa* also borne on trunk of tree.....5
4. Fig-bearing branches short, 5–17 cm long .....**Species 7–9**
   Fig-bearing branches elongate, 2–4 m long, trailing or prostrate ..**Species 10**
5. Leaves narrowly elliptic or oblanceolate, 5–6 times as long as broad **Species 11**
   Leaves proportionally broader, elliptic, ovate, or rhombic 6
6. Leaves with several coarse teeth or small acute lobes near apex, otherwise entire .....**Species 12**
   Leaves entire or serrulate, sometimes shallowly and bluntly toothed near apex, or deeply and broadly lobed in lower part of leaf 7
7. Leaf margins regularly serrulate throughout, sometimes deeply 3–5-lobed **Species 13**
   Leaf margins entire or with a few blunt teeth near apex, unlobed 8
8. Figs sessile or subsessile with peduncles 1–3 mm, sometimes up to 5 mm in *F. neriifolia* and *F. sagittata* 9
   Figs borne on peduncles mostly 5–20 mm, sometimes sessile in *F. sarmentosa* or sometimes as short as 3 or 4 mm in *F. subincisa*, *F. heteropleura* and *F. sarmentosa* 17
9. Leaves broadly ovate or triangular, broadest at base, which is usually truncate or weakly cordate .....**Species 14 & 15**
   Leaves ovate, elliptic or obovate, narrowed at base, broadest towards or above mid-leaf, base rounded or cuneate, cordate only in *F. sagittata* 10

10. Lateral veins indistinct, close, parallel and numerous, major and minor veins little differentiated; leaves coriaceous 11
Lateral veins conspicuous, often prominent beneath, 5–15 pairs, strongly differentiated from minor veins; leaves membranous or coriaceous 14
11. Stipules large and conspicuous, 10–20 cm long ..... **Species 16**
Stipules inconspicuous, 1–2 cm 12
12. Leaves obtuse ..... **Species 17**
Leaves sharply or bluntly apiculate or abruptly acuminate 13
13. Figs small, 5–8 mm diameter, crowded on previous year's wood .. **Species 18**
Figs 8–20 mm diameter, borne mostly in leaf axils on current year's wood **Species 19–21**
14. Leaves membranous, more than twice as long as broad, lanceolate, oblanceolate, ovate-elliptic or oblong, mostly 3–8 cm broad; figs 5–15 mm, but 35–40 mm in *F. pubigera* 15
Leaves coriaceous, less than twice as long as broad, (sometimes narrower in *F. sagittata*), ovate or broadly elliptic, mostly 7–18 cm broad; figs 15–25 mm, but 6–12 mm in *F. geniculata* and *F. sagittata* 16
15. Figs 5–8 mm diameter; leaves oblanceolate or elliptic-lanceolate **Species 22 & 23**
Figs 12–40 mm diameter; leaves ovate-elliptic to oblong ..... **Species 24 & 25**
16. Leaves rather sharply apiculate with point 1–2 cm; lateral veins 8–13 pairs; figs either 6–12 mm or 20–25 mm ..... **Species 26–28**
Leaves obtuse or shortly (up to 5 mm) and bluntly apiculate; lateral veins 5–8 pairs; figs 12–25 mm ..... **Species 29–31**
17. Fig peduncles with bracts only at or near base, or scabrid and completely without bracts ..... **Species 32–34**
Fig peduncles bearing bracts above middle or at apex (sometimes only scars visible) 18
18. Figs obovoid, attenuate at base; leaves often strongly serrate near apex, caudate-acuminate ..... **Species 35**
Figs subglobose, rounded at base; leaves entire or shallowly sinuate-dentate, acute, apiculate or shortly acuminate 19
19. Leaves ovate; lateral veins 3–5 pairs ..... **Species 36 & 37**
Leaves ovate-elliptic, elliptic, oblong or oblanceolate; lateral veins 5–11 pairs 20
20. Figs 6–7 mm diameter, basal bracts deciduous ..... **Species 38**
Figs 10–15 mm diameter, basal bracts persistent ..... **Species 39–41**

1. **F. hispida** L.f. Nep: *Koksa* (34).

Tree to 10 m. Leaves opposite, coriaceous, elliptic or obovate, 13–35 x 6–20 cm, acute or acuminate, base truncate or rounded, scabrid above, coarsely hirsute beneath, margins serrulate or sometimes crenate, veins 5–7 pairs; petioles 2–10 cm. Figs solitary or several, axillary or in short racemes on leafy current year's shoots or leafless previous year's shoots, globose, 1.5–2 cm, hirsute;

apical scales rounded, prominent and with several scales on sides of figs; subsessile or on peduncles up to 2 cm.

Bhutan: S–Samchi district (Samchi); **Sikkim**. Subtropical forests, 300–1200 m.

Foliage used as fodder (48), figs edible (34).

2. **F. conglobata** King

Similar to *F. hispida* but figs 1–1.5 cm, long-peduncled, almost smooth, borne at the base of stem at or below ground level on much-branched leafless bracteate panicles.

Bhutan: locality unknown; **Sikkim**.

3. **F. squamosa** Roxb.; *F. saemocarpa* Miquel

Shrub c 1 m. Leaves opposite, narrowly elliptic or oblanceolate, 5.5–15 (–25) × 1–2.5 (–5.5) cm, gradually acuminate, base attenuate, margins entire or serrate, hispid on both surfaces; petioles 0.5–1(–3.5) cm; stipules lanceolate, c 1 cm, often persistent. Figs ellipsoid or obovoid, 3–3.5 × 2–2.5 cm, longitudinally 5–8-ribbed, pubescent and warted, bearing scales on the sides.

Bhutan: S—Chukka district (Marichong); **Sikkim**: Tista valley. Riverbanks in subtropical forest, up to 900 m.

4. **F. cyrtophylla** Miquel; *F. obscura* sensu F.B.I. non Blume. Sha: *Sang Sokpa;* Nep: *Kasreto, Kasru* (34).

Tree 6–25 m, shoots densely brown pubescent. Leaves asymmetrically ovate-lanceolate, 10–22 x 6.5–9 cm, acuminate, often caudate, base obliquely rounded or cordate, margins serrate, sometimes with large coarse teeth near apex, pilose especially beneath, minutely rough papillose above; petioles 5–10 mm. Figs subglobose, 1–1.5 cm, borne in axils on previous year's wood, more rarely on major branches, crimson when ripe, and densely rough hirsute; bracts scattered on surface of fig and on peduncle.

Bhutan: S–Chukka district (Marichong) and Deothang district (Deothang); **Sikkim**. Subtropical forests, 600–1100 m.

5. **F. semicordata** J. E. Smith; *F. cunia* Roxb. Nep: *Khaniun* (34), *Honaiyo, Khanium*.

Small tree to 6 m. Leaves membranous, distichous, ovate-lanceolate, 12–31 x 3.5–12 cm, acuminate, base very obliquely cordate, lower margin auriculate,

FIG 10. **Moraceae**. a–e, *Ficus oligodon*: a, shoot with two leaves and stipule-covered bud; b, cluster of figs borne on leafless shoot, one fig sectioned to show interior; c, male flower; d, female flower; e, gall flower. f & g, *Maclura cochinchinensis*: f, female head in flower; g, fruiting head sectioned to show mature achenes. h, *Morus australis*: female inflorscence. i–k, *Streblus asper*: i, male inflorescence and leaves; j, young male flower with inflexed anthers; k, female flower. l–q, *Artocarpus heterophyllus*: l, section of fruiting head showing achenes surrounded by fleshy perianth immersed in a mass of sterile flowers; m, male flower; n, female flower; o, three sterile female flowers; p, mature achenes surrounded by fleshy perianth; q, achene removed from perianth (l–q redrawn after *Botanical Magazine* t. 2834). Scale: a, b, l, o, p, q x ⅓; g x 1; f x 1½; i x 2½; m, n x approx. 3; h, k x 4; c, d, e, j x 6½. Drawn by P. Burbidge.


a
b
c
d
e
f
g
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l
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o
p
q
Philip Burdick

hirsute especially beneath and rough with minute papillae above, margins entire or serrulate; petioles 1–1.5 cm; stipules 1.5–3 cm, lanceolate, deciduous. Figs globose, 1.5–1.7 (–2) cm, pubescent and with scales on the surface, sessile or on peduncles c 5 mm, numerous on scaly leafless shoots borne on branches or main stems, those near the base descending to ground where figs become buried.

Bhutan: S–Chukka district (Marichong) and Deothang district (Keri Gompa), C–Punakha district (common around Punakha and Wangdu Phodrang); **Sikkim**. Subtropical forests and arid hillsides, 600–1500 m.

Figs used in treatment of leprosy (13).

6. **F. heterophylla** L.f.; *F. repens* Willdenow

Creeping shrub, stems pubescent at first. Leaves broadly ovate, 2–9 x 1.5–7 cm, acute, base obliquely cordate, unlobed or 1–5 lobed, denticulate, scabrid above, softly pubescent beneath; petioles 0.5–4 cm. Figs solitary, axillary, obovoid, 2–3 x 1.3–2 cm, pubescent at first, borne on peduncles 0.5–2 cm.

Sikkim: Darjeeling district. Subtropical forests.

This description refers to var. **assamica** (Miquel) Corner (var. *repens* (Roxb.) King).

7. **F. auriculata** Loureiro; *F. roxburghii* Miquel. Sha: *Chongma*; Nep: *Nebharo* (34), *Newara* (117), *Nepharo*.

Tree 3–10 m. Leaves broadly ovate, 15–30 x 10–25 cm, acute, base cordate, margins shallowly or coarsely toothed, veins 5–7 pairs, prominent beneath, 5-veined at base, inner basal pair straight forming an acute angle with midrib, glabrous above, softly pubescent beneath; petioles 7–10 cm; stipules triangular, peduncles 2–3 cm on short, thick, leafless branches 5–10 cm from trunk and major branches.

Bhutan: S–Chukka and Gaylegphug districts; C–Tongsa and Tashigang districts; **Sikkim**. Subtropical and Warm broad-leaved forests, sometimes cultivated, 900–2000 m.

Cultivated for its edible figs, leaves used as fodder (48).

8. **F. oligodon** Miquel; *F. pomifera* King. Sha: *Chongma Shing*; Nep: *Timil* (34). Fig. 10a–e.

Similar to *F. auriculata* but leaves suborbicular, 10–20 x 8–19 cm, somewhat thicker, acute or obtuse, margins entire or obscurely toothed, whitish pubescent especially beneath, veins less prominent but 3-veined at base, lateral veins more arched and forming a more obtuse angle with midrib; figs obovoid, flattened apically, 3.5–4 x 2.5–3 cm, densely reddish pubescent.

Bhutan: C–Mongar district (Lhuntse and Mongar) and Tashigang district (Gamri Chu); **Sikkim**. Arid valleys and Chir pine forests, 1100–1750 m.

Figs edible (34).

9. F. racemosa L.; *F. glomerata* Roxb. Nep: *Dumri* (34).

Similar to *F. auriculata* and *F. oligodon* but leaves more coriaceous, ovate-elliptic, 6–15 x 3–7 cm, base rounded, sometimes cuneate, margins entire, glabrous; figs borne on longer more slender lateral leafless shoots 8–17 cm, rarely axillary, subglobose, 2–3 cm, glabrous or pubescent.

Sikkim: foothills and terai. Subtropical forests.

Figs edible; timber useful (48); leaves used as fodder (34).

10. F. prostrata Miquel

Small tree, twigs appressed pubescent. Leaves elliptic-oblanceolate, 12–20 x 4–7 cm, acuminate, base rounded, margins entire, sparsely pubescent at first, veins 9–12 pairs; petioles 1–2 cm, pubescent. Figs borne on trailing leafless shoots 2–4 m, solitary or in pairs, obovoid, 1–1.5 cm, bearing a few warty scales on the sides; peduncles 0.5–1 cm.

Sikkim: locality unknown. Subtropical forest, 600 m.

11. F. ischnopoda Miquel; *F. pyriformis* sensu F.B.I. p.p. non Hooker & Arnott

Shrub 1–2 m, shoots pubescent when young. Leaves membranous, oblanceolate, 7–12 x 1.5–3 cm, acuminate, base attenuate, veins 12–14 pairs, glabrous or pubescent beneath, with a pair of glands near base; petioles 5–10 mm. Figs solitary, axillary, pyriform, glabrous or pubescent when young, becoming subglobose c 1.5 cm, borne on peduncles 1–1.3 cm.

Bhutan: S–Gaylegphug district (Tama). Subtropical forest, 1400 m.

12. F. gasparriniana Miquel; *F. bhotanica* King

Shrub 1–4 m, shoots stout, pilose when young. Leaves broadly oblanceolate or obovate-oblong, 7–15 x 2.5–5 (–8) cm, acuminate, sometimes caudate, base cuneate or rounded, margins with 1–4 pairs of coarse teeth or small acute lobes near apex, scabrid and sparsely minute strigose above, puberulous beneath, veins 5–7 pairs; petioles c 5 (–15) mm. Figs in axillary pairs, globose, 5–7 mm, pubescent, peduncle stout, 2 mm.

Bhutan: S–eastern duars, locality unknown.

The Bhutan plant belongs to var. **laceratifolia** (Léveillé & Vaniot) Corner.

13. F. hirta Vahl. Nep: *Kashreto* (34), *Kashari* (34), *Dusu* (34), *Kasrey Hatchi Paile.*

Shrub or tree 3–4 m, brownish hirsute throughout. Leaves broadly ovate, 13–40 x 8–34 cm, unlobed or 3–5-lobed, acuminate, base cordate or rounded, scabrid above, densely hirsute beneath, margins regularly serrulate throughout; petioles 3–15 cm. Figs in axillary pairs, sessile, ovoid or globose, 2–4.5 cm, densely brown hirsute.

Bhutan: S–Deothang district (N of Deothang); **Sikkim**: Badamtam, Kalimpong etc. Subtropical forests, 300–1200 m.

Figs edible (34).

14. F. rumphii Blume. Nep: *Pakkar* (34).

Tree to 20 m, often epiphytic. Leaves broadly ovate, triangular or sometimes

rhombic, 10–20 x 6–12 cm, acuminate with point 1–2 cm, base truncate, more rarely cordate or cuneate, 3–5 veined at base, lateral veins 5–7 pairs, margins entire, undulate, glabrous; petioles 5–9 cm. Figs globose, 1–1.5 cm, 1–2 per axil on leafy shoots, green and pale-spotted when young, becoming blackish.

Bhutan: S–Deothang district (Deothang); **Sikkim**: uncommon (34). Subtropical forests, 200–600 m.

Sometimes used as a host plant for the lac insect; foliage used as fodder (48).

15. F. religiosa L. Dz, Sha: *Jangchhu Shing;* Nep: *Pipli* (34); Hindi: *Pipal* (34).

Similar to *F. rumphii* but leaves more abruptly and longer caudate-acuminate, acumen 3–6 cm, lateral veins 8–12 pairs, margins sinuate; petioles slender, up to 15 cm; figs smaller, 8–12 mm diameter, purplish when ripe.

Bhutan: S–Phuntsholing district (Phuntsholing) and Deothang district (Samdrup Jongkhar); **Sikkim**: terai and duars. Cultivated and naturalised in towns, 300–500 m.

Planted as a sacred tree; sometimes used as a host for the lac insect (48).

16. F. elastica Hornemann. Sha: *Brong Shing;* Nep: *Labar* (34); Hindi: *Bor* (34); Eng: *Indian Rubber Tree.*

Tree up to 20 m, often epiphytic, rarely with aerial roots. Leaves ovate-elliptic, sometimes obovate, 11–33 x 5–15 cm,acute or apiculate, base rounded or cuneate, usually glabrous, glossy, veins numerous, fine; petioles 2–7 cm; stipules conspicuous, 10–20 cm. Figs oblong-ellipsoid, 10–12 x 5–7 mm, sessile, basal bracts ellipsoid, deciduous to leave a basal rim.

Bhutan: S–Chukka district (Chukka), C–Punakha district (Wangdu Phodrang and Punakha); **Sikkim**. Warm broad-leaved and Chir pine forests, 1300–1500 m.

Once an important source of rubber (48); formerly cultivated in the Tista Valley (34). The Bhutan plants sometimes have leaves more obovate than usual and sometimes the stipules, young shoots and immature figs are puberulous.

17. F. curtipes Corner; *F. obtusifolia* sensu F.B.I. non Humboldt, Bonpland & Kunth

Large tree. Leaves obovate, coriaceous, 10–16 x 4–7 cm, obtuse, base cuneate, margins entire, glabrous, veins numerous, inconspicuous; petioles 1–2 cm. Figs globose, 10–16 mm, yellowish when ripe, borne mostly in axils of fallen leaves.

Sikkim: Darjeeling district; **W Bengal**: Buxa district. Subtropical forests, 250 m.

18. F. concinna Miquel; *F. glabella* Blume. Sha: *Phy Shing.*

Tree c 25 m, shoots mostly leafy at apex. Leaves elliptic, 7–10 x 2–4 cm, shortly acuminate, base cuneate, margins entire, glabrous; petioles slender, 1–2 cm, with a few glands at junction with lamina. Figs globose, c 5 mm, clustered on previous year's wood, surface sometimes brown-dotted; peduncles 1–3 mm.

Bhutan: C–Punakha district (Punakha and Lobeysa) and Tashigang district

(Tashigang); **Sikkim.** Warm broad-leaved forests, 1300–1400 m.

19. F. benjamina L. Nep: *Kabra* (34).

Tree up to 20 m with drooping branches. Leaves ovate-elliptic, 6–12 x 4–6 cm, abruptly acuminate, base rounded or cuneate, glabrous, veins numerous, fine, parallel, not 3-veined at base; petioles 1–2 cm. Figs globose, c 2 cm when mature, axillary, sessile, orange; basal bracts 3, very small (c 1 mm).

Bhutan: **S**–Deothang district (Deothang); **Sikkim**: Darjeeling district. Subtropical forest, 1000 m.

Sometimes cultivated as a shade plant (16); the Bhutan and Sikkim plants belong to var. **nuda** (Miquel) Barrett (var. *comosa* (Roxb.) Kurz).

20. F. maclellandii King; *F. rhododendrifolia* (Miquel) Miquel non Kunth & Bouché

Similar to *F. benjamina* but leaves slightly larger, 10–12 x 4–5 cm, gradually and shortly acuminate, 3-veined at base; petioles shorter, 0.5–1.5 cm; figs smaller, 1–1.2 cm diameter, reddish purple when ripe.

Bhutan: **S**–locality unknown (80); **Sikkim**: Dalka-jhar (34). Subtropical forests.

The Bhutan and Sikkim plants belong to var. **rhododendrifolia** (Miquel) Corner.

21. F. microcarpa L.f.; *F. retusa* sensu F.B.I. non L., *F. nitida* sensu F.B.I. non Thunberg

Similar to *F. benjamina* and *F. maclellandii* but branches bearing aerial roots; leaves elliptic-obovate, 4–8 x 3–6 cm, bluntly apiculate, strongly 3-veined near base; petioles 1–2 cm; figs 0.8–1 cm diameter, black when ripe.

Bhutan: locality unknown; **Sikkim**: Darjeeling foothills. Subtropical forests.

Sometimes cultivated as a shade plant (16).

22. F. neriifolia J. E. Smith; *F. nemoralis* Miquel. Nep: *Dudhila, Dudila* (34).

Small tree or shrub, 3–10 m, branchlets reddish. Leaves lanceolate or elliptic-lanceolate, 7–15 x 2–5 cm, gradually acuminate, base cuneate, rarely rounded, lateral veins 10–12 pairs, conspicuous, often strongly reticulate beneath, glabrous; petioles 1–2 cm, smooth; stipules lanceolate, c 2 cm. Figs globose or ellipsoid, 5–8 mm diameter, with 3 small scales at base, sessile or on peduncles 2–3 mm.

Bhutan: **C**–Mongar district (slopes above Mongar); **Sikkim**: Darjeeling district; **Arunachal Pradesh**: Nyam Jang Chu. Warm and cool broad-leaved forests, 1500–2400 m.

Leaves used as cattle-fodder (34). A variable species, particularly in leaf shape and peduncle length.

23. F. subulata Blume; *F. sikkimensis* Miquel

Similar to *F. neriifolia* but shoots greenish brown; leaves oblanceolate, abruptly acuminate, base sometimes slightly oblique, veins 5–7 pairs, less

distinctly reticulate beneath; petioles c 0.5 cm, scurfy; stipules shorter, c 6 mm; figs 6–7 mm, with a few warty scales on the sides, orange-red when mature; peduncles c 2 mm.

Bhutan: C–Mongar district (Shongar Chu Valley); **Sikkim**. Warm broad-leaved forest, 1150–1500 m.

24. F. virens Aiton; *F. infectoria* sensu F.B.I. non Roxb. Sha: *Phi Shing;* Nep: *Kabra* (34), *Pakkar* (34), *Dumbri.*

Small tree to 15 m, often epiphytic, glabrous. Leaves elliptic-oblong, 11–17 x 4–7 cm, abruptly acuminate, base cuneate or rounded, margins entire, glossy, lateral veins 6–9 pairs, 3-veined at base; petioles 3–8 cm, jointed at apex. Figs subglobose, 12–15 mm, purplish when ripe; basal bracts 3, broadly ovate, c 5 mm.

Bhutan: S–Deothang district (Deothang); **Sikkim**: Darjeeling foothills. Subtropical forests and *Shorea* plantations, sometimes cultivated, 300–1000 m.

Cultivated as an ornamental and shade tree (16, 34). The Bhutan and Sikkim plants belong to var. **sublanceolata** (Miquel) Corner.

25. F. pubigera Miquel; *F. foveolata* Miquel var. *maliformis* King, var. *oleaeformis* King. Nep: *Dude Lahara* (34).

Similar to *F. virens* but a climbing shrub with pubescent shoots; leaves ovate-elliptic, 12–20 x 4–8 cm, gradually acuminate, base rounded, often brownish pubescent beneath, sometimes glabrous, lateral veins 6–9 pairs; petioles shorter, 1–1.5 cm, pubescent; figs larger, 3.5–4 cm, brownish pubescent or tomentose, warted, sessile or on peduncles up to 3 mm.

Bhutan: S–Gaylegphug district (Rani Camp) and Deothang district (S of Riserboo); **Sikkim**. Warm broad-leaved forests, 900–2100 m.

Closely allied to *F. sarmentosa* which differs in its smaller leaves and figs borne on peduncles; the two may be forms of one species. The Bhutan and Sikkim plants have been placed under var. **maliformis** (King) Corner.

26. F. drupacea Thunberg; *F. mysorensis* Roth. Sha: *Jaba Shing.*

Tree or climbing shrub, stems often softly pubescent. Leaves broadly elliptic, 12–22 x 7–13 cm, apiculate, base rounded or narrowly cordate, often brownish tomentose beneath, sometimes glabrous, lateral veins 10–13 pairs, palmately 5–7-veined at base; petioles 1–3 cm. Figs oblong-obovoid, 2–2.5 cm long, brown tomentose when young, orange-red when ripe.

Bhutan: C–Tashigang district (Dangme Chu, N of Tashigang); **Sikkim**: Darjeeling district. Dry valleys, 1000 m.

These plants belong to var. **pubescens** (Roth) Corner.

27. F. geniculata Kurz

Similar to *F. drupacea* but glabrous, leaves broadly elliptic or broadly ovate, 8–15 x 6–10 cm, lateral veins 8–12 pairs, 3-veined at base; petioles much longer, 6–10 cm; figs very small, 6–8 mm, reddish and warted when ripe.

Sikkim: Darjeeling foothills. Subtropical forests.

28. F. sagittata Vahl; *F. ramentacea* Roxb.

Similar to *F. drupacea* but usually climbing; leaves usually ovate-elliptic, 15–20 x 6–10 cm, rarely elliptic-oblong, 4–5 cm broad, sharply apiculate or acuminate, base narrowed, rounded or cordate, lateral veins 8–10 pairs, 5-veined at base; figs subglobose, 5–12 mm diameter, sessile or on peduncles 2–4 mm.

Sikkim: locality unknown.

29. F. benghalensis L. Sha: *Jangchhu Shing;* Nep: *Bar* (34), *Barahar* (34); Eng: *Banyan Tree.*

Wide branching tree to 30 m with numerous aerial roots from branches forming additional props, often epiphytic. Leaves ovate, 9–21 x 8–16 cm, obtuse or bluntly apiculate, base rounded or subcordate, finely puberulous beneath at first, glabrous and shiny above, lateral veins 5–6 pairs, 5–7-veined at base; petioles 1.5–6 cm; stipules ovate-lanceolate, 2–2.5 cm. Figs subglobose, 1.5–2 cm, solitary or in axillary pairs, sessile, finely pubescent; basal bracts 3, rounded, c 5 mm.

Bhutan: **S**–Phuntsholing district (Phuntsholing); **Sikkim**: Darjeeling district, 200–1200 m.

Often cultivated on roadsides and in villages (34); timber used for furniture (48).

30. F. altissima Blume

Similar to *F. benghalensis* but aerial roots few or none; leaves elliptic, sometimes broadly, 10–15 x 6–10 cm, bluntly apiculate, base rounded or broadly cuneate, usually 3-veined at base; figs similar but enclosed when young by a deciduous sheath, when ripe bearing 3 pubescent, obtuse basal bracts 2–3 mm long.

Bhutan: locality unknown (80); **Sikkim**: Pankabari etc. Subtropical forest, 400 m.

31. F. hookeriana Corner; *F. hookeri* Miquel non Sweet. Nep: *Nebharo* (34).

Similar to *F. benghalensis* but without aerial roots; leaves broadly elliptic, 12–25 x 10–18 cm, bluntly apiculate, base rounded, lateral veins 6–8 pairs, 3-veined at base; petioles longer, 6–11 cm; stipules linear-lanceolate, 3.5–9 cm; figs obovoid, depressed at apex, 1.5–2.5 cm diameter; basal bracts conspicuous, connate into a cup enclosing lower third of fig.

Sikkim: Darjeeling district. Subtropical and Warm broad-leaved forests, 300–1800 m.

32. F. tinctoria Forster f.; *F. parasitica* Willdenow, *F. gibbosa* Blume var. *cuspidifera* (Miquel) King

Epiphytic shrub or tree to 10 m. Leaves elliptic or rhombic-elliptic, 9–15 x 3–8 cm, shortly acuminate, acumen 0.5–1 cm, base cuneate, sometimes rounded, usually oblique, entire, minutely roughened beneath; lateral veins 5–7 pairs, 3-veined at base, veins and reticulations pale and prominent beneath;

petioles 0.5–1 cm. Figs globose, 5–8 mm, finely scabrid, without basal bracts; peduncles 5–7 mm, hispid, bracteate only at base.

Bhutan: C–Mongar district (Kuru Chu valley); **Sikkim**: Darjeeling district. Subtropical forest, 300–900 m.

The Bhutan and Sikkim plants belong to subsp. **parasitica** (Willdenow) Corner.

33. F. heteropleura Blume; *F. urophylla* Miquel, *F. rostrata* Lamarck var. *urophylla* (Miquel) Koorders & Valeton

Similar to *F. tinctoria* but leaves elliptic-obovate, abruptly caudate-acuminate with acumen 1–2 cm, base equal or slightly oblique, lateral veins fewer, 3–5 pairs; figs and peduncles very rough with strigose bristles; peduncles ebracteate.

Bhutan: locality unknown (80).

34. F. nervosa Roth

Similar to *F. tinctoria* and *F. heteropleura* but leaves oblong-elliptic, often larger, up to 20 x 8 cm, abruptly acuminate or apiculate with point 1–1.5 cm, glabrous and smooth beneath, veins more numerous, 8–12 pairs; petioles 1–2.2 cm; figs larger c 1.5 cm, smooth when mature; peduncles deflexed, smooth, 7–13 mm, bracteate at base.

Bhutan: locality unknown (80); **Sikkim**: Darjeeling district. Subtropical forests.

35. F. subincisa J. E. Smith; *F. chincha* Roxb., *F. clavata* Miquel. Sha: *Gugai Chongma;* Nep: *Lute Khaniun* (34).

Shrub or tree 2–6 m. Leaves elliptic-oblanceolate, 5–11 x 2–4 cm, caudate acuminate, acumen 1.5–2.5 cm, base attenuate, margins usually with several coarse teeth near apex, glabrous, lateral veins 4–7 pairs; petioles 4–8 mm. Figs obovoid, 10–20 x 10–15 mm, attenuate at base, minutely strigose when young, glabrescent, yellow at maturity; peduncles 5 mm.

Bhutan: S–Chukka district (Chukka and Marichong) and Gaylegphug district (Dakpai), C–Mongar district (Lhuntse and Mongar); **Sikkim**. Subtropical and warm broad-leaved forests, 1000–1500 m.

The Bhutan and Sikkim plants all belong to var. **subincisa** with obovoid figs.

36. F. hederacea Roxb.; *F. scandens* sensu F.B.I. non Lamarck

Climbing shrub. Leaves coriaceous, ovate, 5–10 x 3–7 cm, acute or subacute, base broadly cuneate or rounded, margins entire, glabrous but slightly rough, lateral veins 3–5 pairs; petioles 0.5–1.5 cm. Shoots creeping on ground, rooting at nodes, with membranous, cordate leaves. Figs subglobose, 1–1.3 cm, minutely roughened, glabrous, on peduncles 6–10 mm.

Bhutan: S–Samchi district (Samchi), C–Punakha district (Punakha); **Sikkim**. Subtropical and warm broad-leaved forests up to 1500 m.

37. F. laevis Blume

Small tree or climber. Leaves broadly ovate, 10–16 x 7–14 cm, shortly

apiculate, base rounded or shallowly cordate, margins entire or shallowly sinuate-dentate near apex, glabrous or pubescent beneath, lateral veins 4–5 pairs; petioles 2–6 cm. Figs subglobose, 1.5–3 cm, on peduncles 1.5–2 cm.

Sikkim: Darjeeling district. Warm broad-leaved forests, 900–1500 m.

38. F. glaberrima Blume. Nep: *Karpoa* (34).

Tree to 25 m, shoots puberulous at first, later glabrous. Leaves oblong-elliptic, 8–20 (–25) x 3–9 cm, acuminate, base rounded or cuneate, margins entire, lateral veins 7–10 pairs, puberulous beneath at first; petioles 2–3 cm. Figs globose, 6–7 mm, orange, glabrous, on peduncles 1–1.5 cm, basal bracts deciduous.

Bhutan: S–Chukka district (Marichong), C–Tashigang district (Bamri Chu); **Sikkim.** Subtropical forests, 900–1400 m.

39. F. sarmentosa J. E. Smith; *F. foveolata* Miquel var.*foveolata*

Climbing shrub with pubescent shoots. Leaves ovate-elliptic, 6–15 x 2.5–5 cm, shortly acuminate, base rounded or cuneate, margins entire, lateral veins 7–10 pairs, reticulation thick and prominent beneath, usually pubescent beneath; petioles 1–2 cm. Figs subglobose, 1–1.5 cm diameter, reddish pubescent when young, on peduncles 0.5–1.5 cm.

Bhutan: C–Tashigang district (Tashi Yangtsi); **Sikkim.**

Closely allied to *F. pubigera* which differs in its larger leaves and sessile figs; the two may be forms of one species.

40. F. lamponga Miquel; *F. lepidosa* Kurz

Similar to *F. sarmentosa* but a small tree; leaves elliptic-oblong, 9–18 x 3.5–7 cm, appressed pilose beneath; figs ellipsoid or globose.c 1.5 x 1–1.5 cm, pilose below, smooth and glabrous near apex, on peduncles 5–12 mm.

Sikkim: Darjeeling Duars.

A poorly known species which may not be specifically distinct from *F. sarmentosa.*

41. F. fistulosa Blume

Similar to *F. sarmentosa* but a shrub or small tree; leaves opposite or alternate, elliptic-oblanceolate 12–25 x 5–10 cm, glabrous, lateral veins 4–8 pairs; figs similar but borne either in leaf axils or on short shoots on major branches and trunk, 1–2 cm diameter, on peduncles 0.5–2.5 cm.

Sikkim: Darjeeling terai.

A variable species; the Sikkim plant is the form bearing figs on branches (34).

2. ARTOCARPUS Forster

Monoecious evergreen or deciduous trees. Leaves large, alternate, unlobed, juvenile foliage often pinnately lobed, stipules lateral or amplexicaul. Flowers crowded into fleshy subglobose or oblong heads. Male flowers with tubular

2–4-lobed or -partite perianth and solitary stamen. Female flowers immersed in receptacle, perianth tubular, style central or lateral. Fruit a large syncarp.

1. Deciduous trees; syncarps subglobose ..... **Species 1 & 2**
   Evergreen tree; syncarps oblong or club-shaped ..... **Species 3**

1. A. chama Hamilton; *A. chaplasha* Roxb. Sha: *Yitsu Shing;* Nep: *Lathar* (34), *Saur;* Hindi: *Chaplash* (16).

Erect deciduous tree to 40 m, shoots brownish hispid. Adult leaves obovate, 15–25 x 10–15 cm, acute or acuminate, margins entire or serrate near apex, hispid pubescent especially beneath; petioles 1–2 cm; stipules amplexicaul leaving an annulate scar; juvenile leaves up to 1 m long, deeply pinnatifid. Flower heads ellipsoid or subglobose, 1.5–3 x 1–3 cm, solitary in leaf axils. Male heads covered in flowers and peltate bracts c 0.5 mm across, perianth 2 mm, bilobed. Female heads with deciduous peltate scales, ovaries with a simple exserted style. Fruiting head subglobose, 6–10 cm, yellowish, achenes oblong, 1.5–2 cm, enclosed by fleshy perianth and surrounded by sterile female flowers hardened above to form rough short points.

Bhutan: S–Deothang district (Deothang); **Sikkim**: terai and foothills. Subtropical forests, 300–1500 m. March–April.

A rapid-growing tree often cultivated for its valuable, durable timber, used to make furniture (16, 34); foliage used as fodder; fruit edible.

2. A. lacucha Hamilton; *A. lakoocha* Roxb. Nep: *Borhar* (34), *Dewa;* Hindi: *Lakooch* (16).

Similar to *A. chama* but leaves elliptic-obovate, up to 35 x 20 cm, glabrous and rather glossy above; petioles 1–5 cm; stipules lateral, not amplexicaul, and scars not annulate; juvenile leaves shallowly pinnatifid; syncarps similar but irregularly lobed and smooth.

Sikkim: Darjeeling district and terai. Subtropical forests up to 1200 m. February–April.

Fruit edible, often cultivated around villages; timber valuable and resistant to white ants (48).

3. A. heterophyllus Lamarck; *A. integrifolius* sensu F.B.I. non L.f. Sha: *Dremling Shing*; Nep: *Rukh Kathar* (34); Eng: *Jack Tree.* Fig. 10 l–q.

Evergreen tree, shoots glabrous. Leaves ovate, elliptic to obovate, 10–15 x 6–9 cm, apiculate, base cuneate, glabrous; petioles 1–2 cm; stipules broadly ovate, 2–8 cm, amplexicaul, scars annulate; juvenile leaves elongate with 1–2 pairs of lateral lobes. Male heads club-shaped, 2.5–7 x 0.5–2.5 cm, on peduncles 1–5 cm. Syncarps oblong or club-shaped, 30–75 x 20–30 cm or more, surface rough with sharp perianth points formed from the tips of elongated sterile female flowers which surround the achenes, the latter enclosed by sweet fleshy perianths.

Bhutan: S–Phuntsholing district (Phuntsholing) and Deothang district

(Deothang); **Sikkim**: terai and foothills. Cultivated around villages, 200–500 m. February–April.

Cultivated for its edible fruits, the pulp eaten raw and the seeds roasted (34); wood yields a yellow dye and can be used for furniture making (48).

3. BROUSSONETIA Ventenat

Dioecious, deciduous trees or woody unarmed climbers. Leaves alternate, undivided, or sometimes lobed; stipules lateral, deciduous. Male flowers in axillary catkinate spikes, perianth 4-lobed, stamens 4. Female flowers in globose heads, perianth tubular, 4-toothed, style elongate, undivided, puberulous. Fruiting heads fleshy, achenes sessile or stipitate, bracts and perianth persistent.

1. **B. kurzii** (Hook. f.) Corner; *Allaeanthus kurzii* Hook. f.

Large woody climber, leafless at flowering time. Leaves distichous, oblong or ovate-oblong, 8–13 x 2.5–5 cm, acuminate, base rounded, ± glabrous, margins dentate, venation pinnate to base, veins 6–8 pairs; petioles 5–12 cm. Male catkins paired, 2–4 cm. Female heads c 5 mm, usually 3–4 in short racemes, style exserted c 5 mm. Fruiting heads yellow to red, 1–2 cm diameter at maturity, achenes sessile.

Bhutan: S–Gaylegphug district (Gaylegphug); **Sikkim**. Subtropical forests, 270–600 m. March–April.

2. **B. papyrifera** Ventenat. Eng: *Paper Mulberry*.

Shrub or tree, deciduous but leafy at flowering time. Leaves ovate, 8–15 x 7–10 cm, shortly acuminate, base rounded, margins crenately serrate, unlobed or deeply 3-lobed, scabrid above, pubescent beneath, pinnately veined above, palmately 3-veined at base; petioles 3–6 cm; stipules ovate-acuminate 1–1.5 cm. Male catkins solitary, 5–15 cm, on peduncles 2–3 cm. Female heads solitary, 1–1.5 cm diameter, styles exserted 4–6 mm; peduncles 1–2 cm. Fruiting heads red, achenes stipitate, exserted.

Sikkim: Sukna, Munsong and Dumsong, up to 1800 m. Cultivated and naturalised (34). March–June.

Paper and cloth can be made from the bark fibres of this species (48).

4. MORUS L.

Dioecious trees or shrubs. Leaves alternate, undivided or 3-lobed; venation pinnate but 3–5-nerved at base; stipules linear-lanceolate, small, lateral, caducous. Male flowers in axillary catkinate spikes, perianth 4-partite, stamens 4. Female spikes shorter, perianth segments 4, becoming succulent in fruit; style bifid, filiform.

1. **M. australis** Poiret; *M. indica* sensu F.B.I. non L. Nep: *Sanu Kimbu* (34), *Kimba* (13); Eng.: *Mulberry*. Fig. 10h.

Deciduous shrub or tree to 10 m. Leaves ovate, 3–9 x 2.5–6 cm, caudate-acuminate, base rounded or cordate, margins coarsely serrate, sometimes deeply 3-lobed, minutely appressed strigose above, pubescent beneath; petioles 1–2 cm; stipules c 1 cm. Flowers appearing with young leaves. Male spikes 2–2.5 cm, on peduncles 1–1.5 cm, perianth segments c 2 mm, stamens c 4 mm. Female spikes at first 5–10 mm on peduncles 3–5 mm; perianth segments ovate, c 1 mm, overlapping and enclosing ovary, style 4–5 mm, bifid to middle. Fruiting spikes 0.75–2 x 0.75 cm, succulent perianth segments red at first, becoming blackish-purple.

Bhutan: S–Phuntsholing and Gaylegphug districts, rare, C–Thimphu, Punakha, Tongsa, Mongar and Tashigang districts, common, N–Upper Mo Chu district (Gasa); **Sikkim**: Tista valley etc. Subtropical (rarely) to cool broad-leaved forests, 200–2600 m. March–April.

Sometimes cultivated to feed silkworms (48); fruit edible (34); all parts of the plant used medicinally (13).

2. **M. macroura** Miquel; *M. laevigata* Brandis. Dz: *Tshende;* Sha: *Sengden Shing;* Nep: *Kimbu* (34), *Bola.*

Similar to *M. australis* but a large tree up to 20 m; leaves larger, 8–20 x 6–14 cm, usually unlobed, margins finely serrate, sparsely soft pubescent; petioles 2–3.5 cm; stipules c 1.5 cm; male catkins much longer, 6–12 cm; female catkins 4–6 cm in flower, up to 12 cm in fruit, styles c 2 mm, bifid almost to base, perianth segments pubescent, becoming yellowish-white and fleshy at maturity.

Bhutan: S–Chukka district (Chukka) and Deothang district (Wamrung); C–Punakha district (Ratsoo) and Tongsa district (Byiti Sam near Shamgong); **Sikkim**. Warm broad-leaved forests, 900–2000 m. March–April.

Timber durable, used for house-building and furniture (34, 48).

5. STREBLUS Loureiro

Dioecious shrubs or trees, sometimes spinous. Leaves alternate, unlobed, pinnately-veined to base; stipules small, lateral, deciduous. Male flowers in globose heads or cylindrical catkins, perianth 4-partite, stamens 4. Female flowers solitary or few in short racemes, perianth 4-partite, style bifid. Achenes subglobose, enclosed by perianth.

1. **S. asper** Loureiro. Nep: *Kakshi* (34). Fig. 10 i–k.

Unarmed evergreen shrub or tree to 12 m, shoots pubescent at first. Leaves elliptic-obovate, 3.5–8 x 2–4 cm, acute, base cuneate, margins sinuate or weakly serrate, scabrid; sessile or on petioles c 2 mm. Male clusters c 5 mm, perianth yellowish, segments ovate, c 2 mm, pubescent. Female flowers ovoid, c 2 mm at first; ovary enclosed by 4 ovate perianth segments and bearing 2 small bracts at base, style filiform, terminal, exserted c 4 mm. Achenes 3–4 mm diameter, surrounded by accrescent perianth.

Bhutan: S–Phuntsholing district (Phuntsholing); **Sikkim**: terai and duars.

Subtropical forests, often on roadsides and near villages. 200 m. March–April.

Timber useful (48); fruit edible (16), twigs used as toothbrushes (34) and leaves as sandpaper (16).

2. **S. zeylanicus** (Thwaites) Kurz; *Taxotrophis zeylanicus* Thwaites

Similar to *S. asper* but shoots usually bearing straight spines; leaves elliptic, 7–15 x 3–4 cm, acuminate, glabrous; male catkins cylindrical, c 1.5 cm; female flowers 2–4 in short racemes, style terminal at first, becoming lateral; fruit obliquely subglobose, fleshy on one side, perianth persistent at base.

W Bengal: Makrapura, near Bhutan frontier.

6. MACLURA Nuttall

Dioecious climbing shrubs, spinous. Leaves alternate, entire; stipules lateral, caducous. Flower heads 1–2 per axil, globose, on short, stout peduncles, perianth 4-partite. Male flowers with 4 stamens, filaments straight in bud. Female flowers with larger perianth enclosing ovary; style filiform, simple or shortly bifid. Fruit a globose syncarp, perianth parts enlarged, fleshy and readily visible; achenes numerous, small, concealed.

1. **M. cochinchinensis** (Loureiro) Corner; *Cudrania javanensis* Trecul. Nep: *Maidal Kanra* (34). Fig. 10 f, g.

Stems with spreading or somewhat deflexed axillary spines 1–3 cm, sparsely pubescent. Leaves elliptic-obovate, 3–9 x 1.5–4.5 cm, broadly and shortly apiculate or acuminate, base cuneate, glabrous, margins entire; petioles 0.5–1 cm. Flower heads 5–7 mm diameter on short, stout peduncles 3–7 mm long, 0.7–1 mm thick, perianth segments oblong, 2–3 mm. Fruiting heads c 2 cm diameter.

Bhutan: **S**–Chukka district (Marichong); **C**–Tongsa district (Yoormu, Mangde Chu) and Tashigang district (Shali); **Sikkim**. Warm broad-leaved forests, 900–1700 m. April–June.

Easily confused with *Plecospermum spinosum*. Sometimes cultivated as a hedge plant (34); wood yields a yellow dye (16) and fruit edible (48).

7. PLECOSPERMUM Trecul

Spinous climbing shrub similar to *Maclura* but flower heads on longer, more slender peduncles; male flowers with filaments inflexed in bud; fruiting perianth segments connate into a fleshy mass, individual segments not or scarcely visible; achenes few.

1. **P. spinosum** Trecul

Similar to *Maclura cochinchinensis* but spines up to 5 cm long; leaves obovate, obtuse to subacute; flowers heads on longer more slender peduncles 5–15 mm long, 0.5 mm or less thick; fruiting heads c 1 cm diameter.

Sikkim: Darjeeling district. Subtropical forests, up to 1500 m. January–March.

Wood yields a yellow dye (48).

Family 16. URTICACEAE

Herbs or shrubs, rarely trees, sometimes bearing stinging hairs, stems often fibrous. Leaves simple, alternate or opposite, rarely whorled, palmately 3-veined at base or pinnately veined, surface with punctate or linear cystoliths which become especially visible on drying, usually stipulate, stipules free and lateral or connate and axillary. Flowers minute, usually in clusters or heads, sometimes aggregated into cymes or panicles or on an enlarged receptacle, usually unisexual, actinomorphic, 3–5-merous. Male flowers with perianth usually deeply lobed, stamens opposite lobes, with rudimentary ovary. Female flowers with deeply divided or tubular, shortly-toothed perianth which is sometimes adnate to ovary, rarely absent; ovary superior, 1-celled, style simple, deciduous or persistent, or stigma sessile and brush-like; ovule 1, basal. Fruit an achene, free or enclosed by dry persistent perianth, rarely drupaceous with fleshy persistent perianth.

1. Plants with stinging hairs (in *Dendrocnide* conspicuous only on inflorescences); cystoliths punctate 2
   Plants without stinging hairs; cystoliths linear or punctate 5

2. Leaves opposite ..... **2. Urtica**
   Leaves alternate 3

3. Leaves deeply palmately lobed ..... **5. Girardinia**
   Leaves unlobed 4

4. Annual herb; leaves serrate; achenes reflexed against winged pedicels **3. Laportea**
   Shrub or small tree; leaves entire, crenate or sinuate; achenes not reflexed, pedicels unwinged ..... **4. Dendrocnide**

5. Leaves pinnately veined to base, lowermost lateral veins not stronger than others 6
   Leaves 3-veined at base, sometimes pinnately veined in upper part but then lowermost lateral veins distinctly stronger than others 9

6. Small herb up to 50 cm, leaves linear, in whorls of 3 or 4 **6. Pilea** *(P. ternifolia)*
   Subshrubs, shrubs, small trees or woody climbers, 50 cm or more, leaves elliptic, alternate 7

7. Succulent-stemmed subshrub 0.5–2 m, with minute, caducous, opposite leaves when young, leaves shallowly crenate-serrate in upper half, petioles 5–7 mm ..... **9. Procris**
   Shrub, small tree or woody climber, 5 m or more, without minute opposite leaves, leaves entire, petioles 1.5–9 cm 8

8. Shrub or small tree; leaves with punctate cystoliths; flower clusters up to 3 mm diameter, forming small cymes 1–3 cm long, stigma brush-like, sessile
14. Oreocnide *(O. rubescens)*
Large woody climber; leaves with linear cystoliths; flower clusters 3–15 mm diameter, forming robust cymes 2.5–5 cm long, style linear
1. Poikilospermum

9. Leaves usually asymmetric and oblique at base; cystoliths linear; stipules usually axillary; female perianth with often 3 or sometimes 4–5 unequal segments, rarely absent in some *Pilea* species 10
Leaves symmetric, not oblique at base; cystoliths punctate; stipules usually lateral, or if axillary then deeply bifid, absent in *Parietaria*; female perianth tubular, minutely 2–4 toothed, dry or fleshy, reduced to a fleshy basal cup in *Oreocnide* and absent in *Maoutia* 12

10. Leaves alternate, rarely with minute opposite leaves (modified stipules); flowers borne on bracteate, often fleshy, receptacles, more rarely in cymes
8. Elatostema
Leaves opposite, sometimes in unequal pairs (but then flowers in panicles); flowers in cymes or panicles, more rarely in globose heads or subumbellate, in *Lecanthus* on broad flat receptacle 11

11. Flowers borne in fleshy, plate-like receptacle on long, simple peduncle
7. Lecanthus
Flowers in axillary dichotomous cymes or panicles, more rarely in globose heads or subumbellate ..... **6. Pilea**

12. Herbs, often prostrate or decumbent, less than 1 m tall, leaves usually opposite, alternate only in *Pouzolzia* 13
Erect shrubs or trees 1 m or more tall, leaves usually alternate, opposite only in *Boehmeria* 15

13. Leaf margins serrate ..... **11. Chamabainia**
Leaf margins entire 14

14. Diffuse weak herbs; leaves petiolate, always opposite; flowers subtended by linear bracts; stigma brush-like, sessile ..... **17. Parietaria**
Decumbent or suberect often wiry herbs, leaves sessile or sometimes petiolate, opposite or alternate, flower clusters with ovate bracts; style filiform
12. Pouzolzia

15. Underside of leaves white tomentose or densely white pubescent 16
Underside of leaves green or pale green, never white 22

16. Flower clusters sessile, axillary or forming simple spikes 17
Flower clusters forming cymes or panicles, never sessile and axillary or in simple spikes 18

17. Leaves shallowly crenulate or serrulate; flower clusters borne only on leafless spikes, never axillary; style persistent in fruit ..... **10. Boehmeria** *(B. rugulosa)*
Leaves sharply serrate; flower clusters mostly axillary, sometimes also forming leafless spikes; style deciduous in fruit
12. Pouzolzia *(P. sanguinea* var. *fulgens)*

18. Leaves suborbicular, apiculate; flower clusters in lax cymes 3–9 cm long ...19
Leaves elliptic, narrowly ovate or lanceolate, acuminate; flower clusters in short cymes 1–4 cm long or rather rigid panicles 4–7 cm 20

19. Shrub with coarsely crenate-serrate leaves; style filiform, persistent; achenes enclosed by dry perianth ..... **10. Boehmeria** *(B.nivea)*
Tree with sinuate-dentate leaves; stigma brush-like, sessile; achenes enclosed by fleshy perianth ..... **15. Debregeasia** *(D. wallichiana)*

20. Leaves ovate-elliptic, coarsely dentate-serrate; perianth absent in female flowers; achenes dry ..... **16. Maoutia**
Leaves lanceolate or elliptic-lanceolate, margins serrulate; female flowers with tubular or campanulate perianth which becomes fleshy and persistent in fruit 21

21. Leaves 3-veined to apex with a few lateral veins only at apex; inflorescence of panicles 4–7 cm long ..... **13. Sarcochlamys**
Leaves 3-veined only to middle, pinnately veined in upper half; inflorescence of cymes 0.5–1.5 cm ..... **15. Debregeasia** *(D. longifolia)*

22. Flowers borne on old wood, clusters sessile or forming cymes; stigma sessile, brush-like; perianth persistent as a fleshy cup around base of achene
14. Oreocnide
Flowers borne amongst leaves, clusters sessile, axillary or aggregated into simple, leafless spikes, perianth dry, enclosing achene 23

23. Style not jointed on to ovary, persistent in fruit ..... **10. Boehmeria**
Style jointed on to ovary, deciduous in fruit ..... **12. Pouzolzia** *(P. sanguinea)*

1. POIKILOSPERMUM Miquel

Dioecious woody climbers with clinging roots. Leaves alternate, entire, pinnately veined, with linear cystoliths, long-petioled; stipules connate, axillary deciduous. Flowers in globose heads borne in axillary cymes. Male flowers with deeply 4-lobed perianth; female flowers with shortly 4-lobed perianth and ovoid ovary bearing a short simple style. Achenes ovoid, surrounded by somewhat fleshy persistent perianth.

1. **P. lanceolatum** (Trecul) Merrill; *Conocephalus suaveolens* sensu F.B.I. p.p. non Blume. Fig. 11g–i.

Leaves broadly elliptic, 15–30 x 8–15 cm, acute, base cuneate, glabrous above, pubescent beneath; petioles 3–9 cm; stipules ovate, c 1.5 cm long, acuminate. Male cymes 2.5–5 cm across, bearing numerous flower heads 3–5 mm diameter. Female cymes bearing 6–9 flower heads, each 1–1.5 cm diameter; perianth c 2.5 mm long. Achenes 3.5–4.5 mm long, apex exserted from persistent perianth.

Bhutan: C–Mongar district (Shongar); **Sikkim**: Darjeeling duars. Subtropical forests, 200–1000 m. January–April.

2. **P. naucleiflorum** (Roxb.) Chew; *Conocephalus suaveolens* sensu F.B.I. p.p. non Blume. Fig. 11j.

Similar to *P. lanceolatum* but leaves ovate-elliptic, 10–30 x 6–18 cm, acute or obtuse, base rounded or subcordate, completely glabrous; female flower heads 1–2 cm diameter; achenes c 2 x 1 mm, completely enclosed by perianth.

Bhutan: S–Chukka district (Marichong). Subtropical forests, 900 m. February –March.

Records for *P. suaveolens* (Blume) Merrill (*Conocephalus suaveolens* Blume) from Bhutan and Sikkim probably refer to one of these species.

2. URTICA L.

Monoecious, rarely dioecious perennial herbs, sometimes woody at base, with stinging hairs. Leaves opposite, serrate or crenate, pinnately veined above, palmately 3–5-veined at base; cystoliths punctate; stipules free or connate and interpetiolar. Flowers in axillary clusters of drooping panicles. Male flowers with deeply 4-lobed perianth and 4 stamens. Female flowers with 4-lobed perianth, segments in dissimilar pairs, ovary ovoid, stigma sessile, brush-like. Achenes compressed, enclosed by 2 enlarged perianth segments.

1. Stipules 4 at each node, lateral ..... **Species 1 & 2**
   Stipules 2 at each node, interpetiolar 2
2. Leaves simply serrate or crenate ..... **Species 3**
   Leaves doubly or triply serrate ..... **Species 4 & 5**

1. **U. dioica** L. Eng: *Stinging Nettle*

Plants 1–1.5 m tall, monoecious, rarely dioecious, all parts bearing scattered white stinging hairs. Leaves ovate-lanceolate, 2–8 x 1–4 cm, acuminate, base rounded or cordate, margin coarsely and sharply serrate; petioles 1–4 cm; stipules lanceolate, 6–7 mm long. Panicles 2–5 cm long. Male flowers 2 mm diameter, perianth segments orbicular. Female flowers c 1.5 mm diameter, perianth of 2 ovate and 2 lanceolate segments. Achenes ovoid or ellipsoid, 1–2 mm, whitish.

Bhutan: C–Thimphu district (Tashi Cho Dzong and Pajoding), N–Upper Mo Chu district (Lingshi); **Sikkim**. Around habitations and on disturbed ground,

2400–3900 m. June–September.

The plants from Lingshi and Sikkim belong to subsp. **gracilis** (Aiton) Selander, with larger leaves 4–8 x 2–4 cm, and male flowers borne in lower cymes, female in upper, fruiting perianth c 2 mm broad. The Thimphu plants belong to var. **atrichocaulis** Handel-Mazzetti, a slender almost glabrous plant with small leaves 2–3 x 1 cm and flower clusters containing both sexes; fruiting perianth c 1 mm broad.

2. U. **hyperborea** Weddell

Similar to *U. dioica* subsp. *gracilis* but leaves more broadly ovate, acute, often deflexed, margins with fewer, broader teeth, subsessile; fruiting perianth much enlarged, 4–6 mm diameter.

Sikkim: E Tibet N of Sikkim. Mountain slopes, 5000 m. June–July.

3. U. **parviflora** Roxb.

Monoecious herb, often woody at base, 1.5–2.5 m tall, sparsely pubescent with short hairs and stinging bristles, especially on petioles and inflorescences. Leaves ovate-lanceolate or lanceolate, rarely ovate, 8–13 x 2–5 cm, acuminate, base cordate or rounded, rarely cuneate, surface smooth, glabrous or bristly on veins beneath, margins finely or coarsely crenate or serrate, petioles slender, 2.5–6 cm, stipules ovate-lanceolate, acute or acuminate, c 10 x 4 mm. Flowers in short, lax panicles, 5–9 cm long. Perianth in fruit c 1 mm diameter, segments broadly ovate.

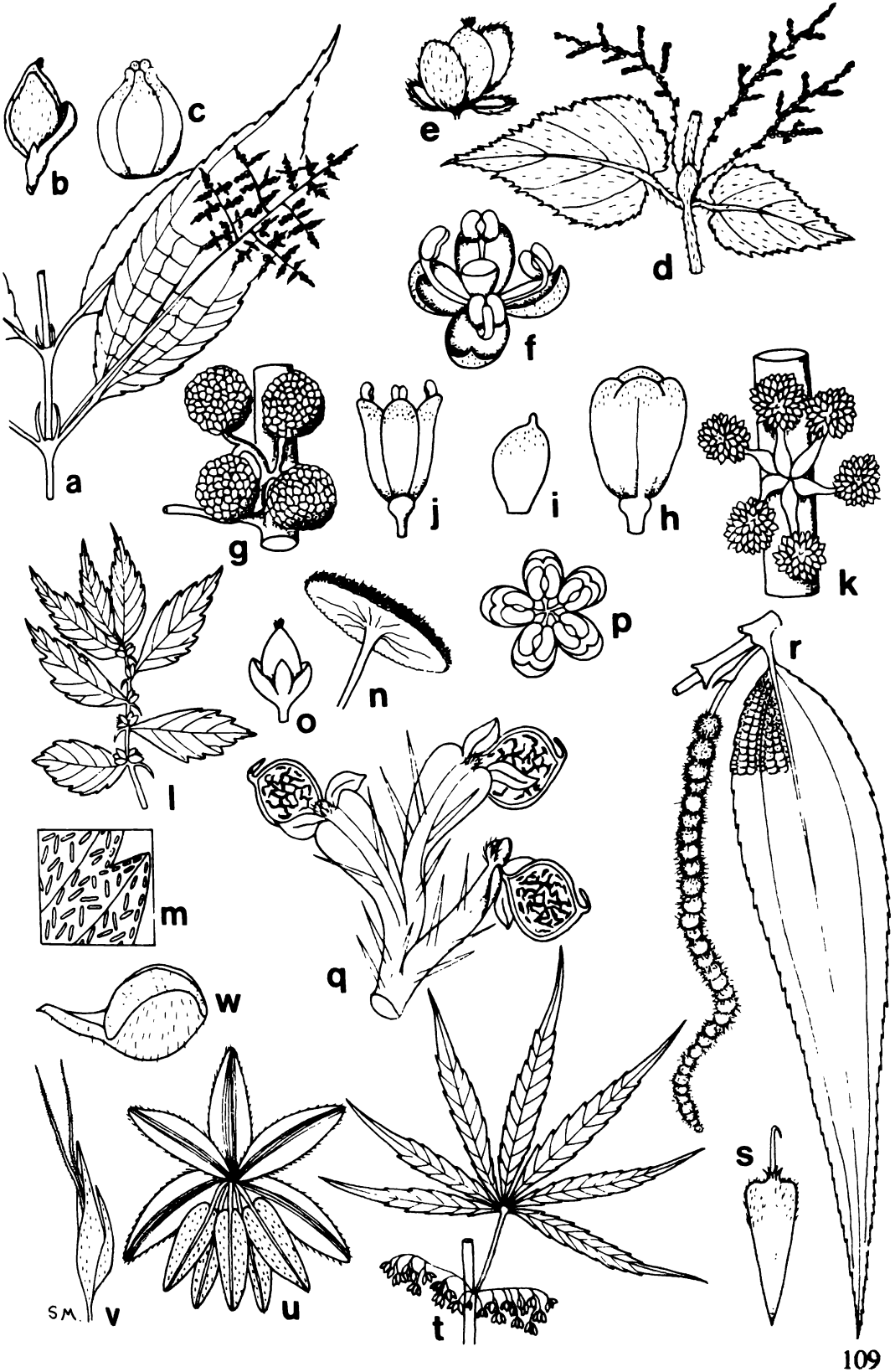
Bhutan: S–Phuntsholing district (Phuntsholing) and Sarbhang district (above Sarbhang); **Sikkim**: Darjeeling district. Subtropical forests, 600–2000 m. May–August.

The specimens from S Bhutan have broader leaves and more abundant stinging hairs.

4. U. ardens Link; *U. himalayensis* Kunth & Bouché. Dz: *Zocha*; Sha: *Jazu*. Fig. 11d–f.

Similar to *U. parviflora*, but densely covered in all parts with short hairs and stouter bristles; leaves ovate, often broadly, acuminate, base cordate, rarely

FIG 11. **Urticaceae and Cannabaceae. Urticaceae.** a–c, *Pilea symmeria*: a, portion of shoot with panicle; b, female flower; c, male flower in bud. d–f, *Urtica ardens*: d, portion of shoot with panicles; e, female flower; f, male flower with rudimentary ovary. g–i *Poikilospermum lanceolatum*: g, female inflorescence in leaf axil; h, female flower; i, young achene removed from female flower. j, *P. naucleiflorum*: male flower. k, *Procris crenata*: female inflorescence in fruit. l & m, *Elatostema monandrum*: l, upper part of leafy shoot; m, part of leaf with cystoliths. n–p, *Lecanthus peduncularis*: n, flowering receptacle; o, female flower; p, male flower with anthers in inflexed position. q, *Laportea terminalis*: part of inflorescence with winged pedicels and achenes. r & s, *Boehmeria penduliflora*: r, leaf and female spike; s, female flower. **Cannabaceae.** t–w, *Cannabis sativa*: t, leaf with male panicles; u, open male flower; v, female flower; w, achene and persistent perianth. Scale: a, d, g, l, r, t x ½; n x 1; j x 2; k, q x 3; h, m, w x 5; i, u x 6; c, p, s x 8; e, f, o, v x 10; b x 15. Drawn by S. J. Mackay.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rounded, surface conspicuously wrinkled, margins sharply and doubly serrate; petioles usually shorter, 1–2 (–4) cm; stipules large, ovate-oblong 1–1.5 (–2) x 0.5–0.7 cm, obtuse or subacute.

Bhutan: C–Punakha district (E of Wangdu Phodrang and below Lometsawa); **Arunachal Pradesh**: Nyam Jang Chu. Warm broad-leaved forests, 1800–2000 m. May–July.

5. **U. mairei** Léveillé.

Closely allied to *U. ardens* but leaves larger, suborbicular, 11–17 x 12–16 cm, acute or shortly acuminate, truncate or cordate at base; margins very coarsely triply serrate.

Bhutan: C–Thimphu district (between Tzatogang and Dotanang); **Arunachal Pradesh**: Nyam Jang Chu. Cool broad-leaved forests, 2700–3200 m. May–August.

3. LAPORTEA Gaudichaud

Monoecious annual herb with stinging hairs. Leaves alternate, serrate, pinnately-veined but 3-veined at base, cystoliths punctate, stipules connate, axillary, deciduous. Inflorescence of panicles, male axillary, female terminal and more widely-branched. Male flowers 4–5-merous, globose. Female flowers with 4 unequal perianth segments, the lateral pair longer; style linear, reflexed. Achenes obliquely ovoid, compressed, stipitate, partly enclosed by perianth segments and reflexed against winged pedicels.

1. **L. terminalis** Wight; *L. bulbifera* auct. p.p. non (Siebold & Zuccarini) Weddell, *L. oleracea* Weddell. Nep: *Patle Sisnu* (34). Fig. 11q.

Plants up to 2 m tall, bearing sparse, long, white stinging hairs throughout. Leaves ovate, 9–15 x 3.5–8 cm, acuminate, base rounded, margins regularly and sharply serrate; petioles 3–8 cm; stipules lanceolate, 2-fid, 8–11 mm long. Male panicles 3–8 cm, flowers c 2 mm diameter. Female flowers with ovary c 1 mm bearing slender style c 3 mm. Achenes c 4 x 2.5 mm, borne on winged fruiting pedicels 5–8 x 2–3 mm.

Bhutan: S–Chukka and Deothang districts, C–Punakha, Tongsa, Bumthang and Tashigang districts; **Sikkim**. Hemlock and Fir forests, more rarely in moist, Warm and Cool broad-leaved forests, on wet banks and in ravines, 900–3300 m. June–August.

Sometimes eaten as a green vegetable (34).

4. DENDROCNIDE Miquel

Dioecious shrub or small tree with stinging hairs. Leaves alternate, pinnately veined but 3–5-nerved at base, margins entire, crenate or sinuate, cystoliths punctate, stipules connate, axillary, deciduous. Inflorescence of spreading axillary panicles. Flowers 4-merous. Female flowers with unequal perianth

segments; style slender. Fruit an oblique, compressed achene, sessile.

1. **D. sinuata** (Blume) Chew; *Laportea crenulata* Weddell. Sha: *Phronglo;* Nep: *Morungey, Moringe* (34).

Shrub 2–4 m tall or small tree up to 10 m, stinging hairs most abundant on inflorescences. Leaves ovate or elliptic, 20–35 (–65) x 8–18 (–35) cm, acute or acuminate, base rounded or cordate, with sparse stinging hairs beneath; petioles 4–12 (–20) cm; stipules ovate, 1.5–2 cm long. Panicles 5–18 cm long, females larger than males. Male flowers 2–3 mm. Female flowers with ovary 1.5–2 mm, beaked at apex, style 4–5 mm. Achenes obliquely ovate, 3–5 x 2.5–4.5 mm, white.

Bhutan: S–Samchi to Deothang districts, common; **Sikkim**. Subtropical forests, 300–1050 m. April–August.

Causes very painful stings; stems produce good fibres for rope-making (34), pollen also very irritant (16).

5. GIRARDINIA Gaudichaud

Dioecious perennial herb bearing stinging hairs throughout. Leaves alternate, palmately 3–7-lobed, sometimes lower leaves unlobed, strongly 3-nerved at base, coarsely serrate; cystoliths punctate; stipules connate, axillary, deciduous. Male panicles spreading, axillary; flowers with 4 free perianth segments. Female panicles condensed, spike-like, prickly; perianth united, sac-like, 3-toothed; style subulate. Fruit a compressed, suborbicular achene.

1. **G. diversifolia** (Link) Friis; *G. palmata* Weddell nom. illeg., *G. heterophylla* Decaisne. Sha: *Gom Jazu*; Nep: *Sisnu* (34), *Ulla* (34), *Bhyangrey Shishnu* (117).

Herb up to 2 m tall. Leaves broadly-ovate, shallowly or deeply lobed, 10–20 x 8–20 cm, acuminate, base rounded; petioles 3–10 cm; stipules ovate, 2–2.5 cm. Male flowers c 1.5 mm diameter. Female flowers c 1.5 mm, perianth becoming split on one side. Achenes blackish, c 2.5 mm diameter.

Bhutan: S–Phuntsholing, Chukka, Gaylegphug and Deothang districts, not uncommon, C–Thimphu district (Dotanang). Subtropical and Warm broad-leaved forest, more rarely in Cool broad-leaved forest, 850–2750 m. July–September.

Fibres much used to make ropes, bow-strings and coarse cloth (34).

6. PILEA Lindley

Monoecious or dioecious herbs or subshrubs, rarely climbing. Leaves opposite in equal or unequal pairs, rarely whorled, sometimes asymmetric, strongly 3-veined, rarely pinnately veined, serrate or entire, cystoliths linear; stipules usually membranous, 2 at each node, axillary, rarely interpetiolar, deciduous or persistent. Flowers in axillary dichotomous cymes or panicles, more rarely in

globose heads or subumbellate. Male flowers (2–) 4-merous. Female flowers with 3 minute, unequal perianth segments, stigma sessile, brush-like. Fruit compressed.

1. Leaves in whorls of 3 or 4, pinnately-veined ..... **Species 16**
   Leaves in opposite pairs, strongly 3-veined 2
2. Leaves of each pair strongly dissimilar in size ..... **Species 13–15**
   Leaves of each pair equal or subequal 3
3. Herbs or subshrubs, rarely climbing, stems 30–200 cm, occasionally smaller 4
   Weak herbs, stems usually less than 15 cm, rarely up to 20 cm 7
4. Leaves entire, rarely with a few minute teeth near apex ..... **Species 1**
   Leaves serrate or crenate 5
5. Stipules interpetiolar, 1.5–2 cm, herbaceous, deciduous ..... **Species 2**
   Stipules axillary, minute or up to 1 cm, membranous, deciduous or persistent (sometimes with small additional herbaceous interpetiolar stipules) 6
6. Stipules lanceolate or narrowly ovate, 2–5 mm long, deciduous or inconspicuous ..... **Species 3–5**
   Stipules ovate or oblong-lanceolate, 5–10 mm long, conspicuous, often persistent ..... **Species 6–8**
7. Leaves serrate or crenate ..... **Species 9–11**
   Leaves entire ..... **Species 12**

1. P. glaberrima (Blume) Blume; *P. smilacifolia* Weddell

Dioecious, rarely monoecious, herb 0.5–2 m, woody at base, glabrous; stems angular. Leaves elliptic-oblong, asymmetric, 12–25 x 4–8 cm, acuminate, base cuneate; petioles 1.5–4.5 cm; stipules axillary, ovate, c 3 mm. Panicles diffuse, 1–3 cm long. Male flowers globose, 1–1.5 mm. Female flowers with ovary 0.5 mm. Achenes ovate, c 1 mm, smooth.

Bhutan: S–Sarbhang district (NW of Sarbhang) and Deothang district (N and S of Deothang); **Sikkim**. Warm broad-leaved forests, on shady banks, 1100–1400 m. April–June.

2. P. hookeriana Weddell

Shrub 2 m or more, sometimes climbing, glabrous. Leaves ovate or broadly elliptic, 10–20 x 5–12 cm, shortly acuminate or apiculate, base rounded, margins crenate-serrate with broad teeth; petioles 5–12 cm, stipules oblong, 1.5–2 cm long, green and herbaceous, deciduous, leaving a scar between leaves. Male flowers in globose heads c 4 mm diameter in axillary racemes. Female flowers in short panicles 1–2 cm long. Achenes ovate, c 1 mm, smooth or granular.

Bhutan: S–Deothang district (Deothang), C–Mongar district (Kori La) and Tashigang district (Jiri Chu); **Sikkim**. Subtropical and Warm broad-leaved forests, 750–2000 m. November.

3. **P. scripta** (D. Don) Weddell. Nep: *Sheta Gaglata* (117).

Monoecious or dioecious herb up to 1 or 1.5 m, woody at base, glabrous, stems succulent, swollen above nodes. Leaves elliptic or lanceolate, often slightly asymmetric, 9–23 x 3.5–6 cm, acuminate, base tapering but rounded at insertion, margins finely serrate, lateral veins numerous, conspicuous, reticulations interruptedly thickened; petioles 2.5–5 cm; stipules lanceolate, c 3 mm. Male panicles often large and spreading, up to 15 cm, in lower axils. Female panicles up to 6 cm long, in upper axils. Achenes ovate, c 0.75 mm, minutely roughened, with rim smooth, thickened.

Bhutan: S–Chukka district (Marichong) and Gaylegphug district (Betni and Rani Camp), C–Punakha district (near Tinlegang); **Sikkim**. Warm broad-leaved forests, on moist shady slopes, 1000–1900 m. July–September.

Some plants from Sikkim and Arunachal Pradesh (Nyam Jang Chu) have broader leaves and approach very closely **P. trinervia** Wight, a S Indian species which may be better regarded as a subspecies of *P. scripta*.

4. **P. symmeria** Weddell; *P. wightii* sensu F.B.I., p.p. non Weddell. Fig. 11a–c.

Similar to *P. scripta*, but a smaller plant 15–30 (–50) cm, with more ovate leaves 6–12 x 3–4.5 cm, base less tapering and more rounded, margins with fewer but coarser teeth, often blotched whitish between veins, reticulations less conspicuous and without interrupted thickenings; sometimes sparsely pilose above; petioles often shorter, 0.5–2 (–4) cm. Panicles often smaller, 2–10 cm. Achenes almost smooth.

Bhutan: C–Thimphu to Mongar districts, common, N–Upper Mo Chu and Upper Bumthang Chu districts; **Sikkim**. Moist Hemlock/*Rhododendron* and Evergreen oak forests, on shaded banks and by streams, 2200–3300 m. May–July.

The commonest form, found in Hemlock forests, has ovate, coarsely serrate leaves; plants from Evergreen oak forests are more robust and have more elliptic, shallowly serrate leaves. A form with smaller leaves occurs at much lower altitude in Chukka district (Marichong).

5. **P. martinii** (Léveillé) Handel-Mazzetti

Closely allied to *P. symmeria* but plants larger, up to 1 m, with larger leaves up to 20 x 10 cm, always coarsely serrate.

Bhutan: C–Tashigang district (Tashigang and Tashi Yangtsi). Moist forests, 2100–2300 m. July–August.

A single collection from Thimphu district (Barshong) resembles *P. martinii* and large forms of *P. symmeria* but differs from both in its conspicuously pubescent leaves.

6. **P. umbrosa** Blume

Herb 30–50 cm, usually pubescent throughout. Leaves ovate, often broadly, 6–15 x 4–8 cm, caudate-acuminate, acumen untoothed, up to 2 cm long, base rounded or subcuneate, margins coarsely and broadly serrate, teeth sometimes

blunt; petioles 1.5–5 cm; stipules 5–6 mm long. Male panicles wide-branched, 10–15 cm; female panicles shorter, up to 6 cm. Achenes c 1 mm long, smooth.

Bhutan: N–Upper Mo Chu district (Kencho); **Arunachal Pradesh**: Nyam Jang Chu; **Sikkim**. 2000 m. May–September.

7. P. bracteosa Weddell

Glabrous herb 30–50 cm. Leaves broadly ovate, 6–12 x 2–7 cm, acuminate, base rounded, margins and acumen sharply serrate; petioles 1–6 cm, stipules ovate-oblong, conspicuous, 7–10 mm long. Panicles spreading, 6–10 cm.

Bhutan: S–Phuntsholing and Deothang districts, C–Punakha, Bumthang and Mongar districts; **Sikkim**. Warm and Cool broad-leaved forests, 1200–2700 m. May–August.

A variable taxon which may comprise more than one species. The plants from central Bhutan (1800–2700 m) belong to var. **oxydon** (Weddell) Hara, distinguished by their small, more coarsely serrate leaves.

8. P. cordifolia Hook. f.

Similar to *P. bracteosa* but a larger plant up to 1.5 m, with larger leaves up to 20 x 12 cm, cordate at base, often oblique, margins coarsely serrate; stipules c 1 cm; panicles large, 10–22 cm long.

Sikkim: Darjeeling district, 300–2100 m. July–September.

9. P. racemosa (Royle) Tuyama; *P. wightii* Weddell var.? *roylei* Hook.f.

Weak monoecious herb with erect stems 4–9 (–15) cm. Leaves crowded on upper 2 or 3 nodes, ovate or broadly-elliptic, 1–1.5 x 0.5–1.25 cm, subacute or obtuse, base rounded, margins with 4–6 blunt teeth on either side; the lowest pair of leaves often suborbicular and entire; petioles 0.5–1 cm; stipules minute, c 1 mm. Male flowers subumbellate on peduncles 1–2 cm borne from upper leaf axils. Female flowers in capitate heads on short slender peduncles 2–6 mm borne in axils of lowest leaves or rudimentary leaves. Achenes ovoid, c 1.5 mm, tuberculate.

Bhutan: C–Thimphu district (Barshong) and Bumthang district (above Lami Gompa), N–Upper Bumthang Chu district (Pangotang) and Upper Kulong Chu district (Shingbe); **Sikkim**. Hemlock and Fir forests, on mossy rocks in ravines, 3140–4260 m. May–August.

10. P. approximata Clarke

Weak erect herb similar to *P. racemosa* but apparently dioecious, sometimes taller, 8–15 (–20) cm, bearing 2–4 crowded pairs of leaves at top of stem. Leaves ovate or lanceolate, larger, 1.5–3 x 1–2 cm, acute or acuminate, margins more strongly and sharply serrate with 6–11 teeth on either side. Female flowers few, subsessile, axillary.

Bhutan: C–Mongar district (above Sengor and near Namning), N–Upper Pho Chu district (Lunana); **Sikkim**. Fir/*Rhododendron* and Cool broad-leaved forests, on wet mossy rock faces in ravines, 2500–3700 m. June–July.

11. **P. peploides** (Gaudichaud) Hooker & Arnott

Similar to *P. racemosa* but leaves suborbicular or almost rhombic, 0.7–2 cm long; weakly sinuate-crenate in upper part; minor veins interruptedly swollen and dark-coloured; stipules absent. Inflorescences subsessile, globose, c 5 mm diameter, containing male and female flowers. Achenes ovate, c 0.5 mm long.

Sikkim: Darjeeling terai. March–July.

Flowers clustered in short cymes 1–2 cm long, females in lower axils, males in upper. Achenes minutely warted.

Bhutan: C–Mongar district (Lhuntsi) and Tashigang district (Tashigang). Amongst shrubs in dry rocky valleys, 1350–1400 m. August.

13. P. **anisophylla** Weddell

Dioecious herb with creeping stems and erect or scrambling leafy shoots up to 1 m; young stems and petioles pubescent. Leaves ovate-lanceolate, asymmetric, the larger ones 10–15 x 3–5 cm, acuminate, base cordate or subcordate, margins entire or with a few small teeth near apex; petioles 1–2 cm; stipules minute; smaller leaves 2–3 x 1–1.5 cm, cordate, sessile or on short petioles. Panicles axillary, 3–8 cm long. Achenes ovate, c 1 mm, smooth.

Bhutan: S–Deothang district (Keri Gompa), C–Tongsa district (near Tongsa and Shamgong), N–Upper Mo Chu district (Gasa); **Sikkim**. Warm broad-leaved forests, on wet rocks and streamsides, 1050–2100 m. July–October.

14. **P. insolens** Weddell

Similar to *P. anisophylla* but a smaller plant with leafy shoots up to 30 cm, glabrous; leaves more ovate, 5–9 x 2.5–6 cm, base distinctly peltate or in smaller leaves cordate, apex caudate-acuminate with a few serrulations; lateral veins U-shaped at base; stipules oblong, c 2 mm, persistent.

Bhutan: S–Deothang district (Khaling), C–Mongar district (Sengor and below Namning). Cool broad-leaved forests; on wet rocks, 2300–2600 m. June–July.

15. **P. clarkei** Hook. f.

A much smaller plant than *P. anisophylla* and *P. insolens* with weak stems up to 15 cm; leaves ovate-lanceolate, asymmetric, 1–2.5 × 0.4–1.2 cm, obtuse or subacute, base cordate, obscurely serrate; petioles 5–10 mm; stipules minute.

Bhutan: C—Tashigang district (Ghunkarah); **Sikkim**: Tchonpong. Warm broad-leaved forests, 1050–1500 m. November.

blunt; petioles 1.5–5 cm; stipules 5–6 mm long. Male panicles wide-branched, 10–15 cm; female panicles shorter, up to 6 cm. Achenes c 1 mm long, smooth.

Bhutan: N–Upper Mo Chu district (Kencho); **Arunachal Pradesh**: Nyam Jang Chu; **Sikkim**. 2000 m. May–September.

7. **P. bracteosa** Weddell

Glabrous herb 30–50 cm. Leaves broadly ovate, 6–12 x 2–7 cm, acuminate, base rounded, margins and acumen sharply serrate; petioles 1–6 cm, stipules ovate-oblong, conspicuous, 7–10 mm long. Panicles spreading, 6–10 cm.

Bhutan: S–Phuntsholing and Deothang districts, C–Punakha, Bumthang and Mongar districts; **Sikkim**. Warm and Cool broad-leaved forests, 1200–2700 m. May–August.

A variable taxon which may comprise more than one species. The plants from central Bhutan (1800–2700 m) belong to var. **oxydon** (Weddell) Hara, distinguished by their small, more coarsely serrate leaves.

8. **P. cordifolia** Hook. f.

Similar to *P. bracteosa* but a larger plant up to 1.5 m, with larger leaves up to 20 x 12 cm, cordate at base, often oblique, margins coarsely serrate; stipules c 1 cm; panicles large, 10–22 cm long.

Sikkim: Darjeeling district, 300–2100 m. July–September.

9. **P. racemosa** (Royle) Tuyama; *P. wightii* Weddell var.? *roylei* Hook.f.

Weak monoecious herb with erect stems 4–9 (–15) cm. Leaves crowded on upper 2 or 3 nodes, ovate or broadly-elliptic, 1–1.5 x 0.5–1.25 cm, subacute or obtuse, base rounded, margins with 4–6 blunt teeth on either side; the lowest pair of leaves often suborbicular and entire; petioles 0.5–1 cm; stipules minute, c 1 mm. Male flowers subumbellate on peduncles 1–2 cm borne from upper leaf axils. Female flowers in capitate heads on short slender peduncles 2–6 mm borne in axils of lowest leaves or rudimentary leaves. Achenes ovoid, c 1.5 mm, tuberculate.

Bhutan: C–Thimphu district (Barshong) and Bumthang district (above Lami Gompa), N–Upper Bumthang Chu district (Pangotang) and Upper Kulong Chu district (Shingbe); **Sikkim**. Hemlock and Fir forests, on mossy rocks in ravines, 3140–4260 m. May–August.

10. **P. approximata** Clarke

Weak erect herb similar to *P. racemosa* but apparently dioecious, sometimes taller, 8–15 (–20) cm, bearing 2–4 crowded pairs of leaves at top of stem. Leaves ovate or lanceolate, larger, 1.5–3 x 1–2 cm, acute or acuminate, margins more strongly and sharply serrate with 6–11 teeth on either side. Female flowers few, subsessile, axillary.

Bhutan: C–Mongar district (above Sengor and near Namning), N–Upper Pho Chu district (Lunana); **Sikkim**. Fir/*Rhododendron* and Cool broad-leaved forests, on wet mossy rock faces in ravines, 2500–3700 m. June–July.

11. **P. peploides** (Gaudichaud) Hooker & Arnott

Similar to *P. racemosa* but leaves suborbicular or almost rhombic, 0.7–2 cm long; weakly sinuate-crenate in upper part; minor veins interruptedly swollen and dark-coloured; stipules absent. Inflorescences subsessile, globose, c 5 mm diameter, containing male and female flowers. Achenes ovate, c 0.5 mm long.

Sikkim: Darjeeling terai. March–July.

12. **P. cavaleriei** Léveillé

Monoecious herb with creeping stems, somewhat woody; bearing short erect leafy shoots 10–15 (–20) cm. Leaves slightly fleshy, ovate to rhombic-lanceolate, 1–2.5 × 0.7–1.5 cm, obtuse, acute or acuminate, base cuneate; lower leaves becoming suborbicular and obtuse; lamina with round glands where veins anastomose, especially near margin; petioles 0.5–1.5 cm; stipules minute.

Flowers clustered in short cymes 1–2 cm long, females in lower axils, males in upper. Achenes minutely warted.

Bhutan: C–Mongar district (Lhuntsi) and Tashigang district (Tashigang). Amongst shrubs in dry rocky valleys, 1350–1400 m. August.

13. P. anisophylla Weddell

Dioecious herb with creeping stems and erect or scrambling leafy shoots up to 1 m; young stems and petioles pubescent. Leaves ovate-lanceolate, asymmetric, the larger ones 10–15 x 3–5 cm, acuminate, base cordate or subcordate, margins entire or with a few small teeth near apex; petioles 1–2 cm; stipules minute; smaller leaves 2–3 x 1–1.5 cm, cordate, sessile or on short petioles. Panicles axillary, 3–8 cm long. Achenes ovate, c 1 mm, smooth.

Bhutan: S–Deothang district (Keri Gompa), C–Tongsa district (near Tongsa and Shamgong), N–Upper Mo Chu district (Gasa); **Sikkim**. Warm broad-leaved forests, on wet rocks and streamsides, 1050–2100 m. July–October.

14. **P. insolens** Weddell

Similar to *P. anisophylla* but a smaller plant with leafy shoots up to 30 cm, glabrous; leaves more ovate, 5–9 x 2.5–6 cm, base distinctly peltate or in smaller leaves cordate, apex caudate-acuminate with a few serrulations; lateral veins U-shaped at base; stipules oblong, c 2 mm, persistent.

Bhutan: S–Deothang district (Khaling), C–Mongar district (Sengor and below Namning). Cool broad-leaved forests; on wet rocks, 2300–2600 m. June–July.

15. **P. clarkei** Hook. f.

A much smaller plant than *P. anisophylla* and *P. insolens* with weak stems up to 15 cm; leaves ovate-lanceolate, asymmetric, 1–2.5 × 0.4–1.2 cm, obtuse or subacute, base cordate, obscurely serrate; petioles 5–10 mm; stipules minute.

Bhutan: C—Tashigang district (Ghunkarah); **Sikkim**: Tchonpong. Warm broad-leaved forests, 1050–1500 m. November.

16. P. ternifolia Weddell

Erect, dioecious herb, 20–50 cm, glabrous. Leaves linear, 4–8 × 0.3–0.8 cm, attenuate, base rounded, margins serrate, subsessile or on petioles up to 5mm. Flowers in weak axillary cymes 1–2cm.

Sikkim: Senchal, Karponang, Darjeeling etc., 1800–2400 m. June–August.

7. LECANTHUS Weddell

Dioecious herb with creeping stems and erect leafy shoots. Leaves opposite, in unequal pairs, often asymmetric, strongly 3-veined from above base, serrate; cystoliths linear; stipules connate, axillary, deciduous. Flowers borne on surface of fleshy plate-like receptacle on long, simple peduncle. Male flowers 4–5-merous; female flowers with perianth divided into 3 unequal lobes, stigma sessile, brush-like; larger sterile flowers also present bearing staminodes and rudimentary ovaries. Achenes ovoid, compressed.

1. L. peduncularis (Royle) Weddell; *L. wightii* Weddell. Fig. 11n–p.

Leafy shoots 20–40 cm, sometimes smaller, as little as 3 cm. Leaves ovate, larger ones 5–12 x 3–6 cm, sometimes as small as 1.5 x 1 cm, acuminate, obliquely rounded or cuneate at base, margins coarsely and sharply serrate, with scattered pilose hairs above and on veins beneath; petioles up to 6 cm; stipules c 5 mm. Flowers reddish-green, receptacles (0.4–) 1–2.5 cm diameter, on peduncles up to 27 cm long. Achenes c 1 mm, minutely warted.

Bhutan: S–Gaylegphug and Deothang districts, C–Punakha, Tongsa and Mongar districts, N–Upper Mo Chu district; **Sikkim**. Warm and Cool wet broad-leaved forests, on wet banks and rocks by streams, 1200–2500 m.

8. ELATOSTEMA J. R. & J. G. A. Forster

Monoecious or dioecious, erect, decumbent or creeping herbs or subshrubs. Leaves apparently alternate, sometimes with minute, caducous, opposite leaves; normal leaves distichous, oblique and unequal-sided, 3-veined from base, serrate or crenate, rarely entire; cystoliths linear; stipules membranous, 2 at each node, one axillary and one lateral or leaf-opposed, sometimes axillary stipule rudimentary or absent. Flowers crowded on peduncled or sessile, bracteate, often fleshy receptacles, or borne in lax or condensed cymes. Male flowers 4–5-merous. Female flowers with perianth divided into 3–5 unequal lobes, stigma brush-like. Achenes ovoid, compressed.

1. Flowers in lax or condensed cymes, never on a fleshy receptacle, 5-merous; perianth of female flowers large, equalling ovary and achene ...**Species 1 & 2**
   Flowers densely aggregated on fleshy bracteate receptacles; male flowers 4- or 5-merous, female flowers 3-merous; perianth of female flowers minute, much shorter than fruit.....2

2. Leaves 8–26 cm long (sometimes as small as 5 cm in *E. grandidentatum*, *E. lineolatum* and *E. nasutum*), strongly acuminate or caudate 3
   Leaves 1–6 cm long (sometimes up to 9 cm in *E. hookerianum*), obtuse, acute or shortly acuminate 8
3. Flower heads sessile in both sexes or on very short peduncles 2–3 mm 4
   Male flower heads borne on peduncles 1–15 cm (sometimes shorter in *E. nasutum*), female heads sessile or peduncled 7
4. Leaves coarsely and sharply serrate with teeth 3–8 mm deep ....**Species 3 & 4**
   Leaves crenate, bluntly serrate or entire, or if sharply serrate then teeth 1–3 mm deep 5
5. Leaves broadly ovate-elliptic, base strongly cordate or auriculate on one side **Species 5**
   Leaves elliptic (usually narrowly) or lanceolate, base cuneate or rounded on one side, never cordate or auriculate 6
6. Leaf margins entire or with few coarse teeth in upper part, acumen entire **Species 6–8**
   Leaf margins finely serrate from below middle, acumen serrate .....**Species 9**
7. Young shoots glabrous .....**Species 10–13**
   Young shoots rusty-puberulous or pale pubescent .....**Species 14–16**
8. Leaves with 1–4 blunt teeth or entire, obtuse or subacute .....**Species 17 & 18**
   Leaves with 5 to many sharp or blunt teeth, usually acute or acuminate, obtuse or subacute in *E. reptans* and *E. cuneatum*.....9
9. Leaves acuminate.....10
   Leaves acute or obtuse 11
10. Leaves oblong-elliptic or oblanceolate, crenate or shallowly serrate above middle; never with small opposite leaves .....**Species 19 & 20**
    Leaves ovate or elliptic, sharply serrate from middle or often below middle to apex; often with rudimentary leaves (modified stipules) opposite normal ones .....**Species 21–23**
11. Leaves with numerous sharp teeth from below middle to apex..... **Species 24 & 25**
    Leaves serrate or crenate only at apex .....**Species 26 & 27**

1. E. heterolobum (Weddell) Hallier f.; *Pellionia heteroloba* Weddell, *P. griffithiana* Weddell, *E. griffithianum* (Weddell) Hallier f.

Monoecious or dioecious herb 40–60 cm, young shoots pubescent. Normal leaves alternate, without small opposite leaves, asymmetrically elliptic-oblanceolate, 8–16 x 2.5–5 cm, acuminate, base oblique, cordate on one side, margins crenate-serrate, venation pinnate with more numerous veins on broader half of leaf, pubescent on veins beneath; sessile or on petioles up to 1 cm; stipules 2 at each node, lanceolate-subulate, 8–14 mm, lateral stipule simple, axillary one bifid. Cymes axillary, one at each node; male cymes lax, 1.5–3 cm diameter, pubescent, borne on simple peduncle 4–7 cm; perianth segments bearing a subulate horn. Female cymes condensed, subcapitate, 1–1.5 cm

diameter, subsessile or on peduncles up to 3 cm; perianth segments linear, with long subulate horn. Achenes ellipsoid, c 1 mm, warted.

Sikkim: Yoksun. Warm broad-leaved forest, 1500 m. February.

2. **E. longicaudatum** Grierson & Long

Similar to *E. heterolobum* but glabrous, stems up to 1 m, bearing normal and minute rudimentary opposite leaves; normal leaves often larger (9–) 14–25 x (2.5–) 4–8 cm, caudate-acuminate with acumen 2–5 cm, base obliquely cuneate, margins finely serrate in upper half, unequally 3-veined at base with vein on narrower side of leaf extending almost to apex; stipules more broadly pointed, the leaf-opposed stipule at each node bearing a rudimentary ovate leaf, 1–3.5 x 1 mm, near its base; cymes subsessile, 2 borne at each node in axils of stipules; perianth segments shortly beaked in female flowers, unbeaked in males; achenes broadly ellipsoid, minutely roughened.

Bhutan: S–Deothang district (between Deothang and Samdrup Jongkhar). Subtropical forests, on shady banks, 550 m. June.

3. **E. sessile** Forster

Dioecious herb, 25–60 cm, stems creeping at base. Leaves asymmetrically elliptic, 8–20 x 3–7 cm, acuminate with entire acumen 2–3 cm, base obliquely cuneate, margins coarsely and sharply serrate, sparsely appressed pilose, subsessile. Stipules oblong, 1–1.5 cm, deciduous. Flower heads sessile or very shortly peduncled, 1 or several per axil, 0.3–1.5 cm diameter; margin of receptacle with short, acute bracts. Male flowers with oblong perianth segments 1–1.5 mm, spurred at apex. Female flowers hispid, intermixed with linear bracteoles. Achenes ellipsoid, angular, c 0.5 mm.

Bhutan: S–Chukka district (Raidak Valley), C–Tashigang district (Tobrang, Tashi Yangtsi Chu) and Mongar district (above Mongar), N–Upper Mo Chu district (Gasa); **Sikkim**. Warm and Cool broad-leaved forests, on wet rocks by streams, 1200–2600 m. May–August.

The plants from C and N Bhutan belong to var. **sessile** which has only 1 large flower head at each node; the specimen from S Bhutan belongs to var. **polycephalum** Weddell which has 6–8 smaller flower heads clustered at each node.

4. **E. grandidentatum** W. T. Wang

Very closely allied to *E. sessile*, but leaves smaller, 5–9 x 2–3.5 cm, margins with fewer but coarser serrations; stipules ovate, 4–5 x 2–3 mm; involucral bracts with lanceolate spur.

Bhutan: C–Mongar district (above Mongar) and Tongsa district (Yuto La); **Sikkim**. Evergreen oak, Fir and Hemlock forest, on wet rocks by streams, 2300–3300 m. June–August.

Possibly only a variety of *E. sessile*.

5. **E. platyphyllum** Weddell. Nep: *Gaglata* (117), *Gogleto*.

Large herb 1–2 m tall. Leaves broadly ovate-elliptic, strongly asymmetric, 17–26 x 6–11 cm, cuspidate-acuminate, base very oblique, strongly cordate or

auriculate on one side, margins and acumen finely serrate, pilose on veins and reticulations beneath, subsessile or on petiole up to 1 cm. Stipules lanceolate 2–2.5 (–3.5) cm. Flower heads 2–3 at each node, each 5–10 mm diameter, borne on short peduncle 2–3 mm, margin of involucre shortly lobed. Achenes ellipsoid, 0.7 mm, ribbed.

Bhutan: S–Samchi, Gaylegphug and Deothang districts, C–Punakha, Tongsa and Mongar districts; **Sikkim**. Subtropical and Warm broad-leaved forests, on shady rocks by streams, 300–1600 m.

The var. **polycephalum** Hara, from Punakha district (Tinlegang and Rinchu) differs in having more numerous, small heads at each node.

6. **E. lineolatum** Wight. Sha: *Drimon*; Nep: *Chhotey Gaglota* (117), *Gogleto, Mirgey Ghar.*

Subshrub 0.4–1 m with slender wiry branches. Leaves very variable, asymmetrically elliptic, (4–) 8–15 x (1.5–) 2–3 (–5) cm, caudate acuminate with acumen 1–3 cm, base obliquely cuneate, serrate or crenate in upper half, sometimes with only 2–4 teeth at apex, texture rather rigid, with abundant very conspicuous large cystoliths on upper surface, sessile. Stipules lanceolate, 4–6 mm, caducous. Flower heads usually solitary, 3–12 mm diameter. Achenes ellipsoid, 0.5 mm long.

Bhutan: S–Samchi to Gaylegphug districts, common, C–Tongsa district (lower Mangde Chu valley) and Punakha district (Mo Chu N of Punakha); **Sikkim**. Subtropical and Warm broad-leaved forests, on shady slopes and rocky river banks, 300–1800 m. May–June.

A very variable species; in Bhutan the commonest form is var. **lineolatum** with conspicuously but shallowly crenate or serrate leaves; the plants from Punakha district belong to var. **majus** Weddell, with larger more coarsely serrate leaves; a third variety, var. **integrifolium** Hook. f., with leaves bearing only 1–3 very shallow teeth near the apex, occurs in Sikkim and near Shamgong in Bhutan.

7. **E. integrifolium** (D. Don) Weddell; *E. sesquifolium* (Blume) Hasskarl

Probably only a variety of *E. lineolatum*, most closely allied to var. *integrifolium* from which it differs in its quite entire leaves and in often having 2–4 smaller flower heads at each node.

Bhutan: S–Deothang district (Narfong); **Sikkim**: Darjeeling. Warm broad-leaved forests, 1500 m. March.

8. **E. acuminatum** (Poiret) Brongniart

Similar to some forms of *E. lineolatum* but leaves more membranous, 8–13 x 2–3 cm, margins coarsely crenate-serrate from below middle, linear cystoliths invisible.

Bhutan: C–Mongar district (above Mongar). Evergreen oak forest, on shady banks, 2300 m. May–June.

9. E. rupestre (D Don) Weddell

Small erect subshrub with woody pubescent stems 15–30 cm. Leaves asymmetrically elliptic-lanceolate, 7–15 x 1.5–3.5 cm, acuminate, base obliquely cuneate, finely serrate from below middle, acumen 1–2 cm, serrate, texture rigid, weakly 3-veined at base, conspicuously pinnate-veined above base, veins pubescent, cystoliths linear, abundant on upper surface. Petioles 2–5 mm. Stipules lanceolate, 8–12 mm. Flowers in dense, solitary, globose heads 1–1.5 cm diameter, involucre composed of orbicular, imbricate bracts c 1 cm diameter, united only at base.

Bhutan: S–Chukka district (Chasilakha); **Sikkim**: Darjeeling terai. Subtropical and Warm broad-leaved forests, 300–1500 m. April–May.

10. E. dissectum Weddell

Monoecious or dioecious herb 20–60 cm. Leaves asymmetrically elliptic or oblanceolate, 10–18 x 3–7 cm, acuminate, base cuneate, margins coarsely crenate, glabrous, subsessile. Stipules subulate, 5–10 mm. Male heads on peduncles 2–6 cm, globose, 1–2 cm diameter, with deeply-lobed flat receptacle fringed with oblong bracts, flowers conspicuous, c 3 mm diameter, borne on short pedicels. Female heads sessile. Achenes smooth.

Bhutan: C–Punakha district (Rinchu); **Sikkim**. Warm broad-leaved forests, 1500–1700 m. May–June.

11. E. ficoides Weddell; *E. mariannae* Clarke

Similar to *E. dissectum* but a much larger plant, 1–2 m tall, with large obovate leaves 15–20 x 5–7 cm, caudate-acuminate, base rounded on one side, venation pinnate, sparsely pilose on upper surface. Stipules oblong, c 7 x 2 mm; male receptacles on peduncles 12–15 cm, pyriform or globose, splitting irregularly, when open 2.5–4 cm diameter, ebracteate; achenes ribbed.

Sikkim: Darjeeling district, Senchal etc. Warm broad-leaved forests, 1800–2100 m. August.

12. E. treutleri Hook. f.

Similar to *E. dissectum* but leaves entire or shallowly serrate in upper half, on petioles 8–12 mm, stipules lanceolate, 1–1.5 cm; male heads 1–2 cm diameter, on peduncles 2–3 cm, two outer receptacular bracts bearing a stout exserted horn 5–7 mm long; female heads subsessile or on peduncles c 1 cm, with horned outer bracts.

Sikkim. 1500 m. July.

13. E. nasutum Hook. f.

Similar to *E. dissectum* and its allies but smaller, 20–30 cm, decumbent, leaves smaller but broadly ovate-elliptic, 7–9 x 2.5–4 cm, shortly acuminate, base very oblique, auriculate on one side, margins coarsely and sharply serrate, stipules oblong, 8–12 x 3 mm. Male heads c 1 cm diameter, on peduncle

0.5–1.5 cm, outer receptacular bracts with conspicuous flattened horns, female heads sessile, with horned outer bracts.

Bhutan: N–Upper Mo Chu district (Gasa); **Sikkim**. Warm broad-leaved forest, 1700–2100 m. August.

14. E. papillosum Weddell

Suberect herb 20–30 cm, young stems densely pale pubescent. Leaves asymmetrically elliptic, 8–13 x 2.5–4 cm, acuminate, base cuneate, margins crenate-serrate, pubescent on veins beneath, cystoliths inconspicuous. Petioles c 5 mm. Stipules lanceolate, 3–5 mm. Male heads peduncled, receptacular bracts not horned. Female heads sessile, 5–8 mm diameter. Achenes ribbed.

Bhutan: C–Mongar district (Shongar Chu below Zimgaon). Warm broad-leaved forest, 1300 m. July.

15. E. sikkimense Clarke

Similar to *E. papillosum* but stems rusty puberulous; leaves more sharply serrate, one margin strongly toothed from below or at middle, the other margin with only 3–7 teeth near the apex, glabrous; stipules oblong-lanceolate, 8–12 mm; male and female heads 8–12 mm diameter, borne on slender peduncles 3–7 cm, outer 2 receptacular bracts with conspicuous horns 2–4 mm.

Sikkim. Mungpu etc. On wet rocks, 1000–2400 m. July–August.

16. E. stellatum Hook. f.

Very closely allied to *E. sikkimense* but receptacular bracts with numerous stellately-arranged horns.

Sikkim: Rungbee, 1500 m. September.

17. E. obtusum Weddell

Slender dioecious herb with creeping stems 10–20 cm, stems retrorsely pubescent and minutely red glandular. Leaves asymmetrically obovate, 7–16 x 5–9 mm, obtuse, base cuneate on one side, auriculate on other side, margins with 3–4 blunt teeth near apex, 2-veined at base, veins pubescent beneath, subsessile. Stipules solitary at each node, lateral, linear-lanceolate, 2–3 mm. Male heads on peduncles 1–2 cm of 3–4 flowers surrounded by 4 bracts c 4 mm long, 2 broadly ovate, apiculate, 2 oblong; flowers subglobose, c 2 mm diameter, with 3 obovate, horned perianth segments. Female flowers and fruit unknown.

Bhutan: C–Thimphu, Tongsa, Bumthang and Tashigang districts; **Sikkim**. Cool broad-leaved, Evergreen oak, Spruce and Hemlock forests, on shaded mossy banks, 2450–3000 m. May–July.

18. E. pusillum Clarke

Erect annual herb 2.5–15 cm. Leaves elliptic, 1–2.5 x 0.3–0.7 cm, obtuse or subacute, base obliquely cuneate, entire or with 1–3 blunt teeth near apex, glabrous or puberulous, sessile; minute opposite leaves sometimes present.

Flower heads sessile, 2–4 mm diameter, bracts free, oblong or lanceolate. **Sikkim**: Tumtok, 3000 m. October.

19. E. hookerianum Weddell

Erect dioecious herb 20–30 cm with creeping rhizomes, glabrous. Leaves borne on upper part of stem, asymmetrically oblong-elliptic, 6–9 x 1–2 cm, acuminate, base very oblique, cordate-auriculate on lower margin, acumen and margins in upper half of leaf shallowly serrate, strongly asymmetrically 3–5 veined from base, linear cystoliths conspicuous at leaf margin, sessile. Stipules 2 at each node, one axillary, minute, the other lateral, linear, 4–6 mm, persistent, flower heads sessile, 3–8 mm diameter, bracts of male heads free, those of female fused into a receptacle. Achenes ellipsoid, ribbed.

Bhutan: S–Phuntsholing to Deothang districts, locally common, C–Tongsa district (Tongsa and Tashiling), **Sikkim**. Warm and Cool broad-leaved and Evergreen oak forests, on damp shady banks and wet rocks, 900–2700 m. April–June.

20. E. caveanum Grierson and Long; *E. hookerianum* var.? *peduncularis* Hook. f.

Similar to *E. hookerianum* but leaves less asymmetric, oblanceolate, 5–7 x 1–2 cm, base cuneate on both sides, margins crenate in upper half, acumen subentire, linear cystoliths conspicuous all over upper surface, less strongly and more symmetrically 3-veined from base; male heads borne on peduncles 5–10 mm.

Bhutan: S–Sarbhang district (Loring Falls); **Sikkim**: Rishap and Sureil. Warm broad-leaved forests, on wet rocks, 1200–1800 m. June–August.

21. E. monandrum (D. Don) Hara; *E. surculosum* Wight. Fig. 11 l, m.

Erect monoecious or dioecious herb (4–) 7–15 (–25) cm, stems glabrous or rusty-puberulous. Leaves apparently alternate but with a small leaf opposite each normal leaf; normal leaves usually ovate or elliptic, 2–5 x 0.7–1.8 cm, acuminate or acute, base cuneate on upper margin; rounded on lower margin, shallowly or deeply serrate in upper half, glabrous or ciliate, sessile. Lower leaves often becoming smaller, subentire and fleshy. Stipule axillary, minute. Small opposite leaves (enlarged herbaceous stipules) borne laterally in a single row, oblong, entire, up to 1 cm long. Male flower heads sessile or on peduncles up to 2 cm, enclosed by broad, free bracts sometimes horned at apex. Female receptacles sessile with connate bracts. Achenes fusiform, 0.7 mm.

Bhutan: S–Chukka and Deothang districts, C–Thimphu to Tashigang districts, N–Upper Mo Chu district (Kencho); **Sikkim**. Warm and Cool broad-leaved forests, on mossy rocks and boulders, 400–2600 m. May–August.

A species very variable in size, leaf shape and degree of serration.

22. E. subincisum Weddell

Similar to some larger forms of *E. monandrum* but without small opposite

leaves; normal leaves oblong-lanceolate, 2–3 x 1 cm, deeply serrate; stipules linear-lanceolate, 4–5 mm long.

Sikkim: Senchal, etc. 2100–2300 m.

23. **E. stracheyanum** Weddell

Similar to *E. monandrum* and *E. subincisum* but a larger plant with creeping stems up to 1 m long and erect shoots 10–20 cm; minute opposite leaves present; normal leaves strongly asymmetric, ovate, 4–6 x 1.5–2.5 cm, base cuneate on upper margin, rounded on lower margin, margins more finely serrate almost to base; male heads subsessile, 6–8 mm diameter.

Bhutan: C–Tongsa district (Ritang). 2700 m.

24. **E. reptans** Hook. f.

Trailing herb with pubescent stems. Leaves ovate-elliptic, 1.5–3 x 1–1.5 cm, acute or obtuse, base strongly and obliquely cordate, margins sharply serrate, pubescent beneath especially on veins, sessile. Stipules linear-lanceolate 2–4 mm. Male heads sessile, female heads unknown.

Bhutan: S–Phuntsholing district (Phuntsholing) and Sarbhang district (above Sarbhang); **Sikkim**: Darjeeling foothills. Subtropical forests, on shady rocks and soil, 200–1000 m. July.

25. **E. cornutum** Weddell

Very closely allied to *E. reptans* but stems glabrous, leaves puberulous only on veins beneath; male heads borne on peduncles 2–6 cm long.

Sikkim: Darjeeling foothills. Subtropical forest, 300–1200 m. June.

26. **E. imbricans** Dunn

Decumbent herb, stems 15–30 cm, brown scaly. Leaves regularly distichous, oblong, 2–3 x 0.6–0.8 cm, acute, base very oblique, cuneate on upper margin, cordate on lower margin, margins entire but with usually 5 sharp teeth at apex, palmately 4-veined from base, sessile. Each node with an oblong lateral stipule 5–7 mm and sometimes a minute axillary stipule. Flower heads sessile, 3–4 mm diameter. Achenes ellipsoid, strongly ribbed.

Bhutan: S–Deothang district (Chungkar and Riserboo). Warm broad-leaved forests, on shady banks, 2000–2150 m. June–July.

27. **E. cuneatum** Wight

Small erect herb 10–15 cm, sometimes with small leaves opposite normal ones. Normal leaves obovate, asymmetric, 1.5–4 x 1–1.5 cm, obtuse or subacute, base cuneate but narrowly auricled on lower margin, entire below but crenate or bluntly serrate at apex. Flower heads sessile, bracts of female heads horned.

Sikkim: Darjeeling district, 1800 m. August.

9. PROCRIS Jussieu

Dioecious or monoecious succulent-stemmed, glabrous subshrubs, often

epiphytic. Leaves apparently alternate, but with minute caducous leaves opposite normal ones. Normal leaves pinnately-veined; cystoliths linear; stipules minute, axillary, deciduous. Male flowers in subsessile axillary clusters; female flowers in dense globose heads on very short peduncles, heads several per axil. Flowers 4–5-merous, stigma linear, caducous. Achenes ovoid, compressed.

1. P. crenata C. B. Robinson; *P. laevigata* sensu F.B.I. p.p. non Blume. Fig. 11k.

Little-branched subshrub 0.5–2 m. Normal leaves elliptic-oblanceolate, often slightly asymmetric, 6–13 x 2–3 cm, acuminate, base cuneate, slightly oblique, margins shallowly crenate-serrate in upper half; petiole 5–7 mm. Small leaves elliptic, 5–15 x 2–3 mm. Male flower clusters 3–5 mm diameter; female heads 4 mm diameter, 3–10 heads per axil. Achenes c 1 mm, minutely dotted.

Bhutan: S–Chukka district (Marichong), C–Punakha district (Tinlegang); **Sikkim**. Warm broad-leaved forests, often epiphytic, 1050–1950 m. April.

10. BOEHMERIA Jacquin

Monoecious or dioecious shrubs or small trees. Leaves alternate or opposite, serrate or crenate, strongly 3-veined at base, cystoliths punctate. Stipules lateral, free, two at base of each petiole. Flowers in dense unisexual clusters forming spikes or panicles. Male flowers 4–5-merous, perianth segments free. Female perianth tubular, 2–4-toothed, style filiform, persistent. Achenes enclosed by persistent dry perianth.

1. Flower clusters sessile and often distantly spaces on leafy shoots **Species 1 & 2**

   Flower clusters crowded into spike-like, sometimes branched, leafless inflorescenses 2

2. Leaves all alternate, softly white pubescent or white tomentose beneath **Species 3 & 4**

   Leaves opposite, sometimes a few alternate, green or pale green beneath, never white 3

3. Leaves narrowly lanceolate, usually 15–30 cm long, rigid and rugose **Species 5**

   Leaves ovate to orbicular, 4–25 cm long, membranous or subcoriaceous, rarely rugose, lanceolate in *B. hamiltoniana* but then 9–16 cm long **Species 6–9**

1. B. glomerulifera Miquel; *B. malabarica* Weddell. Nep: *Kamley.*

Monoecious shrub 1–3 m, branches softly pubescent. Leaves alternate, ovate, 12–21 x 5–10 cm, acuminate, base rounded, margins bluntly serrulate or crenulate, slightly rugose and glabrous above, softly pubescent beneath; petioles 2–6 cm. stipules lanceolate, 6–8 mm. Flowers in globose clusters 4–8 mm diameter, pubescent, borne rather distantly on older shoots, male clusters towards base, females above. Female flowers c 1 mm diameter.

Bhutan: S–Sarbhang district (above Sarbhang) and Gaylegphug district

(Tatapani and above Dakpai); **Sikkim**. Subtropical and Warm broad-leaved forests, 700–1650 m. March–June.

Fibre used to make ropes (34).

2. B. clidemioides Miquel; *B. sidaefolia* Weddell

Similar to *B. glomerulifera* but a weaker shrub, whitish pilose throughout: leaves smaller, 4–10 x 2–4 cm, margins more strongly serrate, appressed pilose above, spreading-pilose and pubescent beneath; flower clusters more numerous and closely spaced, female flowers c 0.5 mm diameter, styles very persistent.

Bhutan: S–Samchi district (Samchi) and Gaylegphug district (Gaylegphug), C–Punakha district (Punakha); **Sikkim**. Subtropical and Warm broad-leaved forests, 300–1400 m. July–September.

Very similar to some forms of *Pouzolzia sanguinea* which differ in being usually less pubescent, with flower clusters borne mostly in axils of or amongst existing leaves, and styles deciduous in fruit.

3. B. rugulosa Weddell. Sha: *Dongtsong Shing*; Nep: *Dar* (34).

Small dioecious tree up to 10 m. Leaves coriaceous, ovate-lanceolate, 10–18 x 3–6.5 cm, shortly acuminate or acute, base rounded or subcuneate, margins crenulate, strongly 3-veined to apex, upper surface glabrous, smooth or rugulose, lower surface softly whitish pubescent; petioles 1–4 cm; stipules ovate, c 6 mm, deciduous. Flower clusters 5–7 mm diameter, borne in elongate simple spikes 7–15 cm, 1–3 per axil. Male flowers globose, c 1.7 mm diameter, female flowers c 1 mm, borne amongst brown bracteoles and whitish hairs, perianth becoming ovoid, compressed, white pilose.

Bhutan: S–Deothang district (Tsalari Ċhu), C–Tashigang district (Lunter Zampa); **Sikkim**. Subtropical and Warm broad-leaved forests, 300–1200 m. September–December.

Similar to some forms of *Pouzolzia sanguinea* which differs in its more coarsely serrate leaves with basal veins that do not extend to the apex, and in its deciduous styles. Wood used to make bowls and other utensils (48).

4. B. nivea Hooker and Arnott. Eng: *Ramie Grass* (16), *Rhea Grass* (16).

Readily distinguished from *B. rugulosa* by its shrubby habit, leaves sub-orbicular, 12–22 x 8–20 cm, apiculate, margins coarsely crenate-serrate, white felty-tomentose beneath, flower clusters 3–4 mm broad, densely aggregated into lax cymes 3–9 cm long.

Sikkim: cultivated in Darjeeling duars. November–February.

Cultivated as a fibre crop (16).

5. B. penduliflora Long; *B. macrophylla* D. Don non Hornemann. Nep: *Kamli* (34), *Chipley* (117). Fig. 11r, s.

Monoecious shrub 1–3 m. Leaves lanceolate, 13–20 x 2–4.5 cm, tapering to acuminate apex, base cuneate, margins sharply serrulate, often strongly rugose, glabrous but roughened above, softly pubescent beneath; petioles 5–15 mm, stipules lanceolate, 1.5–2 cm. Male spikes borne below, 5–12 cm

long, clusters few-flowered. Female spikes borne above, 15–35 cm, flowers numerous in dense globose often contiguous clusters 5–8 mm broad; perianth compressed-oblanceolate, shed with stipitate achene which bears a persistent, exserted, hooked style.

Bhutan: S–Samchi, Phuntsholing, Gaylegphug and Deothang districts, C–Punakha district (Samtengang); **Sikkim**. Riverbanks in Subtropical and Warm broad-leaved forests, 300–1500 m. August–December.

Fibre used to make ropes and fishing lines (34).

6. B. macrophylla Hornemann; *B. platyphylla* D. Don. Nep: *Kamli* (34).

Monoecious or dioecious subshrub, 1–3 m. Leaves membranous, ovate to elliptic or suborbicular, 7–25 x 4–15 cm, acuminate, sometimes cuspidate, base rounded, sometimes subcuneate or cordate, margins serrate or dentate with teeth 2–3 mm broad and deep, of uniform size throughout, minor veins inconspicuous, arching upwards; subglabrous, pubescent, strigose or tomentose, smooth or rugose; petioles slender, 3–10 cm; stipules lanceolate, up to 1 cm, deciduous or subpersistent. Male spikes 7–10 cm, paniculately branched at base. Female spikes usually simple, solitary, 10–15 or up to 30 cm, slender or stout, sometimes pendulous; flower clusters 3–5 mm diameter. Achenes ellipsoid, 0.7 mm, bearing hooked style.

Bhutan: widespread in S and C Bhutan; **Sikkim**. Subtropical and Warm broad-leaved forests, 300–2200 m. April–August.

Fibre used to make ropes (34). An exceedingly variable taxon which may be divided into a number of varieties, some of which are distinctive, but intermediates between them do occur.

var. **macrophylla**; *B. platyphylla* D. Don var. *platyphylla, B. platyphylla* var. *macrostachya* (Wight) Brandis

Leaves ovate, often broadly, apex cuspidate, membranous, glabrous or pubescent on both surfaces with short hairs; spikes long and slender, often pendulous, up to 30 cm long.

Bhutan: S–Gaylegphug district (Gaylegphug) and Deothang district (S of Khaling), C–Punakha district (Rinchu); **Sikkim**: Darjeeling foothills. 300–2200 m.

var. **canescens** (Weddell) Long; *B. platyphylla* var. *canescens* (Weddell) Weddell

Similar to var. *macrophylla* but leaves softly appressed whitish pubescent with longer hairs.

Bhutan: C–Tongsa district (above Dakpai near Shamgong) and Mongar district (near Mongar); **Sikkim**. 1000–1800 m.

var. **tomentosa** (Weddell) Long; *B. platyphylla* var. *tomentosa* (Weddell) Weddell

Distinguished by its more coriaceous leaves, often smaller, with acuminate apex, densely villous or tomentose on both surfaces; spikes stouter and shorter, 4–10 cm long.

Sikkim. 1200–1500 m.

var. **scabrella** (Roxb.) Long; *B. platyphylla* var. *scabrella* (Roxb.) Weddell

Leaves usually ovate, apex gradually acuminate, texture rather rigid, surface rugose, stiffly hispid above, pubescent beneath; spikes rigid, mostly 5–15 cm long.

Sikkim. 300–1000 m.

7. **B. ternifolia** D. Don; *B. platyphylla* var. *rotundifolia* Weddell, non *B. rotundifolia* D. Don, *B. cuspidata* Clarke non Blume. Dz: *Natsim.*

Similar to *B. macrophylla* but leaves orbicular or suborbicular, 7–20 x 5–16 cm, rounded and abruptly cuspidate at apex, base rounded, margins coarsely crenate-serrate or dentate with teeth 0.3–3 cm deep and 0.3–2 cm broad, the teeth usually becoming larger towards leaf apex, densely appressed pubescent; spikes usually slender and flexuose.

Bhutan: S–Chukka district (Chukka), C–Punakha district (Lometsawa, Lobeysa and Gyom Jana) and Tongsa district (near Shamgong); **Sikkim.** Warm broad-leaved forests, 900–2150 m. April–July.

Like *B. macrophylla* this is a variable species, some forms having rather shallow teeth, others becoming very deeply toothed towards the leaf apex.

8. **B. hamiltoniana** Weddell. Nep: *Kamley* (117), *Chipley* (117).

Similar to *B. macrophylla* var. *macrophylla* but leaves lanceolate, 9–16 x 3–8 cm, tapering to narrow acuminate point, base cuneate or narrowly rounded, margins finely serrulate or crenulate throughout, glabrous or sparsely pubescent on veins beneath; flower spikes very slender, up to 20 cm long.

Bhutan: S–Phuntsholing, Gaylegphug and Deothang districts; **Sikkim.** Subtropical forests, 750–1500 m. September–November.

Foliage used as fodder (117).

9. **B. polystachya** Weddell. Nep: *Phusre Kamli* (34).

Similar to *B. macrophylla* var. *macrophylla* but leaves always ovate, 12–27 x 8–15 cm, base rounded or cordate, margins regularly serrate, paler beneath, secondary veins conspicuous, numerous, parallel, spreading from main veins; petioles stout, 3–8 cm; spikes forming short, dense, much-branched panicles 5–10 cm long.

Bhutan: C–Thimphu district (Paro and Dotanang), N–Upper Mo Chu district (Gasa); **Sikkim.** Warm and Cool broad-leaved forests, 1200–2500 m. August–November.

11. CHAMABAINIA Wight

Monoecious or dioecious diffuse herbs. Leaves opposite, serrate, 3-veined from base, cystoliths punctate. Stipules lateral, free, two at base of each petiole. Flowers in sessile axillary clusters, male above, female below. Male flowers 4-merous, perianth deeply divided. Female flowers with tubular, minutely 4-toothed perianth enclosing ovary, style ovate, fimbriate, persistent. Achenes enclosed by persistent dry perianth.

1. **C. cuspidata** Wight. Fig. 12a, b.

Weak herb, creeping or densely tufted, stems 15–45 cm. Leaves ovate, 2–4 x 1.5–2.5 cm, acute or shortly acuminate, base rounded or broadly cuneate, margins sharply serrate, subsessile or on petioles up to 1 cm; stipules conspicuous, broadly ovate, mucronate, 3–5 mm long. Flower clusters up to 1 cm diameter.

Bhutan: S–Chukka district (Pasikha) and Deothang district (near Khaling and Wamrung), C–Mongar district (Namning); **Sikkim**. Wet Cool broad-leaved forests, on rocky banks and roadsides, 1900–2600 m. May–August.

12. POUZOLZIA Gaudichaud

Monoecious or dioecious shrubs or herbs. Leaves opposite or alternate, entire or sometimes serrate, 3-veined from base, upper leaves sometimes becoming smaller and bract-like, cystoliths punctate. Stipules lateral, free, 2 at base of each leaf but connate and interpetiolar in *P. hirta*. Flowers in axillary clusters, sometimes forming almost leafless spikes. Male flowers 4–5-merous, perianth deeply lobed. Female flowers with tubular, 2–4-toothed perianth enclosing ovary; style filiform, jointed to ovary, exserted, deciduous. Achenes enclosed by persistent dry perianth.

1. Shrub with serrate leaves ..... **Species 1**
   Herbs with entire leaves ..... **Species 2–4**

1. **P. sanguinea** (Blume) Merrill; *P. viminea* Weddell. Sha: *Yongjiba, Yongeebu;* Nep: *Chiple* (34).

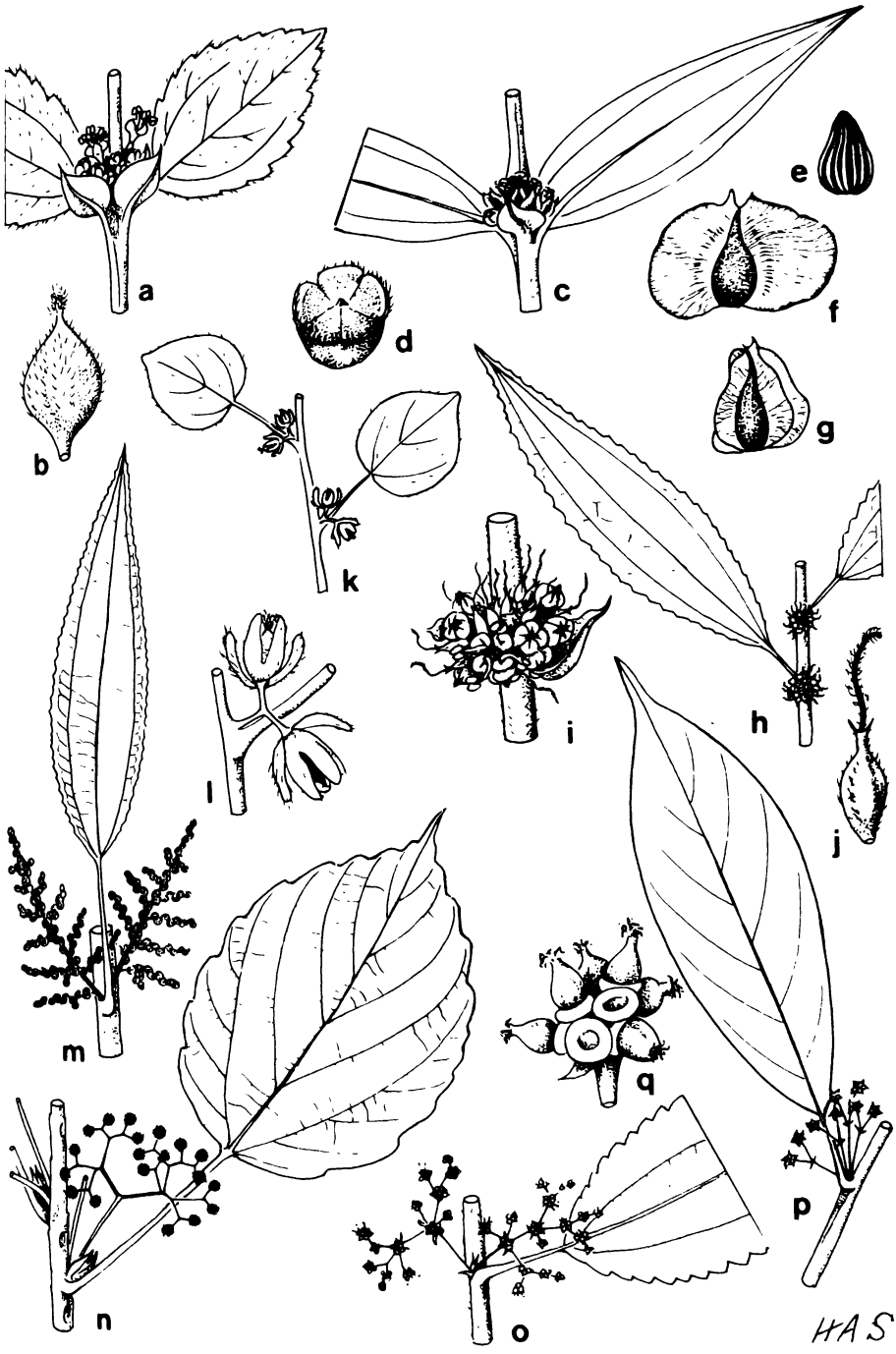
Shrub 1–3 m tall with reddish stems, sometimes scrambling. Leaves alternate, lanceolate to ovate, 5–15 x 1–5 (–8) cm, acuminate, rounded or cuneate at base, margins serrate or crenate, usually glabrous above, pubescent or appressed white tomentose beneath; petioles 0.5–2.5 cm; stipules lanceolate, 3 mm. Flower clusters either unisexual or with male and female flowers mixed, globose, reddish, 5–7 mm diameter, mostly axillary but sometimes forming almost leafless lateral spikes. Achenes ellipsoid, c 1.5 mm, compressed.

var. **sanguinea**

Leaves ovate-lanceolate, green and pubescent beneath, flower clusters all axillary.

Bhutan: S–Gaylegphug and Deothang districts, C–Punakha, Tongsa, Mongar and Tashigang districts; **Sikkim**. Warm broad-leaved forests and amongst scrub in dry valleys, 1300–1900 m. June–August.

FIG. 12. **Urticaceae**. a & b, *Chamabainia cuspidata*: a, part of shoot with male flower cluster; b, female flower. c–g, *Pouzolzia hirta*: c, leaves and flower cluster; d, male flower in bud; e–g, 10-ribbed, 2-winged and 4-winged achenes. h-j, *P. sanguinea* var. *fulgens*: h, part of shoot with flower clusters; i, flower cluster; j, female flower. k & l, *Parietaria micrantha*: k, part of shoot with female flowers; l, female flowers. m, *Sarcochlamys pulcherrima*: leaf and female panicles. n, *Debregeasia wallichiana*: leaf and female inflorescences. o, *Maoutia puya*: leaf and male cymes. p & q, *Oreocnide rubescens*: p, leaf with female inflorescence; q, female flower cluster with two achenes removed to show fleshy perianth cups. Scale: m, n x ¼, h, o, p x ½, c x 1; a x 1½; k x 2; l x 3; d, e, f, g, l, q x 6; j x 8; b x 12 Drawn by H. A. Salzen.



HAS

var. nepalensis (Weddell) Hara

Leaves ovate, often larger than in var. *sanguinea*, green and pubescent beneath; flower clusters both axillary and on almost leafless lateral shoots.

Bhutan: S–Chukka district (near Takhti Chu) and Deothang district (between Morong and Narfong); **Sikkim**. Warm broad-leaved forests, 1600–2050 m. June–July.

var. fulgens (Weddell) Hara; *P. viminea* Weddell var. *fulgens* Weddell. Nep: *Chipley*. Fig. 12h–j.

Leaves lanceolate, usually smaller than in other varieties, minutely appressed silvery-white tomentose beneath. Flower clusters axillary or on almost leafless lateral shoots.

Bhutan: S–Sarbhang, Gaylegphug and Deothang districts, common; **Sikkim**. Subtropical forests, 700–1050 m. May–September.

The var. *sanguinea* is very similar to *Boehmeria clidemioides* which has more hirsute leaves, flower clusters mostly borne in axils of fallen leaves, and persistent styles on the achenes.

2. **P. hirta** (Blume) Hasskarl; *Gonostegia hirta* (Blume) Miquel, *Hyrtanandra hirta* (Blume) Miquel. Fig. 12c–g.

Monoecious or dioecious prostrate or suberect herb with shoots up to 50 cm or more. Leaves all opposite, ovate to lanceolate, 1.5–10 x 0.7–3 cm, acuminate, sometimes shortly, base rounded or subcordate, sessile, 3-veined almost to apex, veins unbranched, subglabrous or appressed-pubescent; stipules connate, interpetiolar, ovate, acute, 3 mm long. Flowers borne around nodes in globose clusters 1–1.5 cm diameter, consisting of one or both sexes, glabrous or sparsely pubescent. Male flowers subglobose but distinctly flattened on top, 5-merous, segments angled transversely bearing cilia along angle. Female perianth ovoid, 2.5 mm, bearing 10 ribs or 2–4 broad wings in fruit.

Bhutan: S–Chukka, Gaylegphug and Deothang districts, C–Thimphu, Punakha and Tongsa districts; **Sikkim**. Warm and Cool broad-leaved forests, on streamsides and rocky roadside banks, 1000–2650 m. June–August.

Roots used medicinally for bone dislocations and fractures (13).

3. **P. zeylanica** (L.) Bennett & Brown; *P. indica* (L.) Gaudichaud

Similar to *P. hirta* but leaves opposite and alternate, usually smaller, 1.7–4 x 1–2.5 cm, rounded or cuneate at base, 3-veined at base but veins branched above; petioles up to 2 cm; stipules free, lateral; flower clusters smaller, 3–5 mm diameter, strigose with straight or hooked hairs; male flowers globose, segments convex, not angled.

Bhutan: S–Deothang district (N of Samdrup Jongkhar), C–Thimphu district (Paro); **Sikkim**: Darjeeling district. Rocky banks and walls, 300–2000 m. May–September.

4. **P. pentandra** (Roxb.) Bennett & Brown

Similar to *P. hirta* but leaves opposite below, alternate above, near apex and

on flowering shoots suddenly becoming much smaller and more closely-spaced; lower leaves 3–7 x 0.5–1 cm, acute, base rounded, 3-veined with unbranched veins, glabrous or rather scabrid, sessile; stipules free, lateral; male flowers as in *P. hirta* but borne on pedicels 1–3 mm; fruiting perianth broadly 3-winged.

Sikkim: Darjeeling terai.

13. SARCOCHLAMYS Gaudichaud

Dioecious shrubs. Leaves alternate, lanceolate, white beneath, strongly 3-veined to apex, serrulate; cystoliths punctate; stipules axillary but deeply bifid, one per axil. Flower clusters forming axillary panicles, interrupted in male, almost continuous in female. Male flowers 5-merous, perianth deeply divided. Female perianth ovoid-campanulate, unequally 4-lobed, ovary oblique with sessile, brush-like stigma. Achene oblique, enclosed by enlarged fleshy perianth.

1. **S. pulcherrima** Gaudichaud. Nep: *Tusarey*. Fig. 12 m.

Shrub 2–4 m tall. Leaves narrowly lanceolate, 10–25 x 1.5–7.5 cm, acuminate, base rounded, green and rugose above, conspicuously reticulate and minutely white-tomentose beneath; petioles 2–7 cm; stipules 6–8 mm. Panicles 4–7 cm; male clusters 1.5 mm diameter; female clusters 2–3 mm diameter. Achenes compressed,c 0.5 mm long.

Bhutan: S–Sarbhang district (above Sarbhang) and Gaylegphug district (Thewar Khola); **Sikkim**: Darjeeling district. Subtropical forests, 300–950 m. May–June.

14. OREOCNIDE Miquel

Dioecious shrubs or small trees. Leaves alternate, borne only at branch-ends, 3-veined from base or pinnately veined, entire or serrate; cystoliths punctate; stipules lanceolate, lateral, two at base of each petiole, deciduous. Flowers in small clusters, solitary or forming short cymes, borne in axils of fallen leaves. Female flowers with ovoid ovary with adnate perianth forming a fleshy basal cup, surrounded by ovate bracteoles, stigma sessile, brush-like. Achenes compressed-ovoid, borne on a fleshy, whitish cup.

1. **O. frutescens** (Thunberg) Miquel; *Villebrunea frutescens* (Thunberg) Blume. Nep: *Kirma* (34).

Shrub 2–3 m or small tree. Leaves ovate or ovate-lanceolate, 8–15 x 3.5–5 cm, acuminate, base rounded, margins finely serrate, strongly 3-veined, pubescent and often pale beneath; petioles 1.5–7 cm; stipules 6–12 mm. Male heads subsessile, 5–10 mm diameter. Female clusters smaller, 2–4 mm diameter, subsessile or forming short cymes up to 1 cm long.

Bhutan: C–Punakha district (Tinlegang, Punakha and Ritang), Tongsa district (Tashiling and Shamgong) and Tashigang district (Tashi Yangtsi Dzong); **Sikkim**.

Warm broad-leaved forests, 1450–2300 m. March–May.
Fibre used to make ropes (34).

2. **O. rubescens** (Blume) Miquel; *Villebrunea integrifolia* Gaudichaud. Nep: *Lipe* (34). Fig. 12p, q.

Similar to *O. frutescens* but a large shrub or tree 5–10 m; leaves elliptic-obovate, 18–25 x 6–9 cm, caudate-acuminate, base cuneate, margins entire, strongly pinnately-veined, flower clusters of both sexes forming cymes, in male compact c 1 cm diameter, in female lax, 2–3 cm long.

Bhutan: S–Chukka district (Marichong) and Deothang district (near Narfong); **Sikkim**. Subtropical forests, 600–1600 m. February–August.

Stem fibre used to make ropes, nets, coarse cloth and bowstrings (34).

15. DEBREGEASIA Gaudichaud

Monoecious or dioecious shrubs or trees. Leaves alternate, 3-veined at base, pinnately-veined in upper part of leaf, serrate or sinuate-dentate, finely white tomentose beneath; cystoliths punctate, stipules one per axil, deeply bifid. Flower clusters forming axillary cymes. Male flowers usually 4-merous, perianth deeply divided. Female flowers with ovoid or obovoid perianth enclosing ovary; stigma brush-like, sessile. Achene enclosed by fleshy, adnate perianth.

1. **D. longifolia** (Burman f.) Weddell; *D. velutina* Gaudichaud. Nep: *Tusare* (117).

Large shrub 2–8 m tall. Leaves elliptic-lanceolate, 8–20 x 2–6 cm, acuminate, base rounded, margins finely serrate, 3-veined at base but with 3–7 lateral veins on each side in upper part of leaf, green and minutely rugose above, white tomentose beneath, brown pubescent on veins; stipules 5–8 mm; petioles 0.5–3 cm. Male clusters forming compact cymes 0.5–1 cm diameter. Female clusters forming cymes 1–1.5 cm diameter, flowers and achenes c 0.75 mm long.

Bhutan: S–Samchi, Gaylegphug and Deothang districts, C–Punakha and Tongsa districts; **Sikkim**. Subtropical and Warm broad-leaved forests, 600–2100 m. May–September.

Stem fibre used to make rope and fishing nets (34).

2. **D. wallichiana** Weddell. Nep: *Bahuni Lahara* (34). Fig. 12n.

Tree 6–10 m. Leaves broadly ovate or suborbicular, 14–27 x 8–21 cm, apiculate, base rounded or cordate, margins sinuate-dentate, 3-veined at base but with 4–7 pairs of parallel lateral veins in upper part of leaf, secondary veins numerous and parallel, green and glabrous above, white tomentose beneath; stipules 1–1.5 cm petioles 4–15 cm. Female cymes lax, 2.5–8 cm diameter, borne on peduncles 3–8 cm; flower clusters red, 5–7 mm diameter.

Bhutan: S–Chukka district (Raidak valley) and Sarbhang district (above Sarbhang); **Sikkim**: Kurseong etc. Subtropical forest slopes, 600–1200 m. May–June.

16. MAOUTIA Weddell

Dioecious or sometimes monoecious shrub. Leaves alternate, 3-veined from base, dentate-serrate, white tomentose beneath; cystoliths punctate; stipules deeply bifid, one borne in each leaf axil. Flower heads small, forming lax axillary cymes. Male flowers 5-merous, perianth deeply divided. Female flowers without perianth, ovary bearing sessile brush-like stigma. Achenes ovoid, compressed.

1. M. puya (Hooker) Weddell. Nep: *Pua* (34). Fig. 12 o.

Shrub 2–3 m, stems whitish hirsute. Leaves ovate-elliptic, 8–18 x 4–8 cm, acuminate, base rounded or cuneate, margins coarsely dentate-serrate, sparsely pilose and often strigose above, soft white tomentose beneath; stipules 9–12 mm; petioles 1–6 cm. Cymes 2–4 cm long, clusters borne terminally and along slender branches; male clusters 4–7 mm diameter, female clusters c 2 mm diameter. Achenes c 1.25 mm, strigose.

Bhutan: S–Deothang district (Temri Chu); **Sikkim**. Subtropical forests, amongst scrub, 300–1200 m. June–October.

Fibre used to make rope, cloth and nets (34).

17. PARIETARIA L.

Weak monoecious annual herb. Leaves alternate, 3-veined, entire; stipules absent. Flowers in compact axillary cymose clusters, unisexual or polygamous; flowers subtended by linear bracts. Male flowers 3–4-merous, perianth deeply divided. Female flowers with tubular 4-fid perianth, ovary ovoid; stigma brush-like, sessile. Achenes ovoid, enclosed by papery perianth.

1. P. micrantha Ledebour; *P. debilis* sensu F.B.I. non Forster. Fig. 12k, l.

Diffuse herb with stems up to 40 cm. Leaves broadly ovate, 0.7–3 x 0.5–2 cm, acute or obtuse, base cuneate, pubescent or almost glabrous; petioles up to 2 cm. Flowers c 1.5 mm diameter, in few-flowered clusters. Achene ovoid, glossy, c 1 mm, splitting through persistent perianth at maturity.

Sikkim: Lingmuthang etc. Rocky mountain slopes, 3000–4000 m.

Family 17. CANNABACEAE

Dioecious, erect annual herbs. Leaves alternate or opposite at base, palmately compound, stipulate. Male flowers in short pendulous panicles, perianth of 5 free segments, stamens 5. Female flowers sessile, crowded in short leafy spikes, perianth unlobed, closely enveloping ovary, beaked at apex; ovary sessile, 1-locular; style deeply 2-fid, filiform; ovule solitary, pendulous. Fruit an achene enclosed by persistent perianth.

1. CANNABIS L.

Description as for Cannabaceae.

1. C. sativa L. Sha: *Phagpa Nam*; Nep: *Bhang* (16); Eng: *Hemp*. Fig. 11t–w.

Herb 1–1.5 m. Leaves with 3–9 (–11) narrowly elliptic or lanceolate leaflets, each 4–18 x 0.3–1.5 cm, narrowly acuminate, base attenuate, margins serrate, minutely scabrid above, finely pubescent beneath; petioles 1–7 cm; stipules linear, 5–6 mm long. Male panicles 1–5 cm long; perianth segments elliptic, c 3 mm. Female spikes 2–3 cm, flowers minutely resinous-glandular. Achenes ovoid, 3–3.5 mm, greenish-brown, reticulate with pale lines.

Bhutan: S–Chukka and Gaylegphug districts, C–Thimphu, Tongsa and Tashigang districts, N–Upper Mo Chu district (Gasa); **Sikkim**. Streamsides and waste ground, 300–3000 m. June–August.

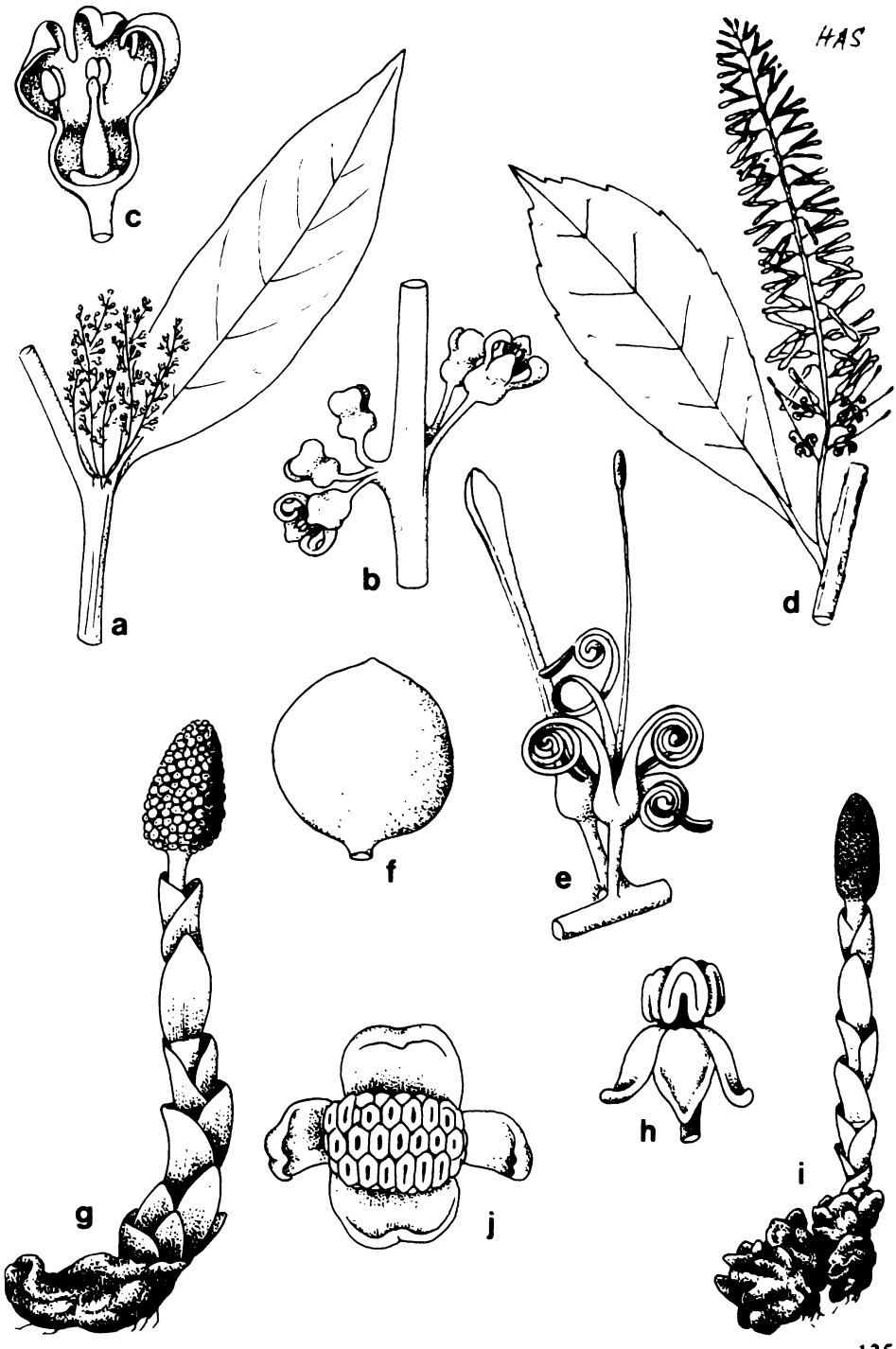
Used as a source of fibre and oil and also of an intoxicating resin. Two subspecies occur: subsp. **sativa** yielding fibre and oil, with taller, elongate, sparsely-branched stems with long, hollow internodes, the common plant in Sikkim and Bhutan; subsp. **indica** (Lamarck) Small & Cronquist which yields greater quantities of resin especially on young leaves and inflorescences; this is usually a smaller plant, much-branched and with short, solid internodes; in Bhutan it occurs in Tashigang district (Gamri Chu).

Family 18. PROTEACEAE

Evergreen trees, sometimes dioecious. Leaves alternate, simple, pinnately veined, glabrous, exstipulate, entire or serrate on mature plants, sometimes deeply pinnatisect on juvenile plants. Flowers actinomorphic, hermaphrodite or functionally unisexual, in slender, unbranched, axillary racemes. Perianth tubular and clavate in bud, segments 4, reflexing and separating to base. Stamens 4, adnate to perianth lobes. Ovary superior, with 4 basal disk-glands. 1-locular; style long and slender with clavate stigma; ovules 2, basal or apical. Fruit a globose or ellipsoid drupe or nut.

1. Leaves entire or serrate, never deeply pinnatisect, surface dull, lateral veins arching from midrib; fruit a globose drupe, pericarp coriaceous not woody within ..... **1. Helicia**
   Leaves entire, sometimes deeply pinnatisect on juvenile plants, surface glossy, lateral veins straight, arching near leaf margin; fruit an ellipsoid nut, pericarp externally coriaceous, fibrous and woody within ..... **2. Heliciopsis**

FIG. 13. **Opiliaceae, Proteaceae and Balanophoraceae. Opiliaceae.** a–c, *Lepionurus sylvestris*: a, leaf and axillary racemes; b, portion of raceme; c, flower with part of corolla removed. **Proteaceae.** d–f, *Helicia nilagirica*: d, leaf and axillary raceme; e, flower bud and open flower; f, seed. **Balanophoraceae.** g–i, *Balanophora dioica*: g, male plant; h, male flower; i, female plant. j, *B. polyandra*: male flower. Scale: a, d x ½; f, g, i x 1; h, j x 2.5; e x 3.5; b x 10; c x 20. Drawn by H. A. Salzen.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1. HELICIA Loureiro

Leaves simple, unlobed, regularly serrulate or almost entire, dull-green above, becoming yellowish when dry, lateral veins arching upwards from midrib. Flowers numerous, borne singly or in clusters of 2–3 in axils of minute, broadly-ovate, ciliate bracts; pedicels spreading or slightly deflexed, bearing an ovate bracteole. Flowers hermaphrodite, fragrant, ovary glabrous. Fruit a globose drupe, with green coriaceous pericarp and purplish seed.

1. **H. nilagirica** Beddome; *H. erratica* Hook. f. Sha: *Photor Shing;* Nep: *Bandre* (34). Fig. 13d–f.

Small tree up to 10 m. Leaves elliptic to obovate, 12–20 x 4.5–8 cm, acute, base attenuate, petioles 5–12 mm. Racemes 15–20 cm; pedicels c 2 mm, glabrous or sparsely reddish-pubescent. Perianth yellow, 1.5–1.7 cm in bud. Fruit 2.5–3.5 cm diameter, 1–2 per raceme.

Bhutan: S–Chukka to Deothang districts, common, C–Mongar district (near Mongar) and Tongsa district (near Shamgong); **Sikkim**. Subtropical and Warm broad-leaved forests, 750–2000 m. May–July.

Records of *H. robusta* (Roxb.) R. Brown from Bhutan and Sikkim are based on specimens of this species. Leaves yield a yellow dye.

2. HELICIOPSIS Sleumer

Similar to *Helicia* but functionally dioecious; leaves entire, or on juvenile plants deeply pinnatisect, glossy above, becoming blackish when dry; lateral veins straight, arching only near leaf margin, reticulations prominent on both surfaces; bracts and bracteoles lanceolate; flowers functionally unisexual; fruit an ellipsoid nut, pericarp externally coriaceous, fibrous and woody within.

1. **H. terminalis** (Kurz) Sleumer; *Helicia terminalis* Kurz

Tree 8–10 m. Leaves oblanceolate or narrowly obovate, 14–23 x 4–8 cm, subacute or obtuse, on petioles 1–2 cm. Juvenile leaves 30–60 x 20–30 cm, deeply pinnatisect with 3–9 pairs of oblong, acute lobes, borne on petioles up to 5 cm. Flowers as in *Helicia nilagirica* but borne on reddish appressed-pubescent pedicels, functionally unisexual although apparently hermaphrodite. Fruit broadly ellipsoid, 3.5–4 x 2.5–3 cm, 4–7 per raceme.

Bhutan: S–Gaylegphug district (Sham Khara) and Sarbhang district (hills N of Sarbhang). Subtropical forests, 1000–1450 m. May–June.

Family 19. OLACACEAE

Trees, shrubs or woody climbers. Leaves alternate, simple, pinnately-veined, glabrous, entire, exstipulate. Flowers in axillary cymes, racemes or spikes, rarely solitary, actinomorphic, hermaphrodite. Calyx tube adnate to ovary, limb absent, or cup-like, or 3–5-lobed. Corolla of 3–5 free petals or 3–5-lobed with

tubular base. Stamens 3–5, antipetalous, borne on corolla, sometimes with 6 staminodes. Annular disk present. Ovary semi-inferior or superior, 1–3 (–5)-locular, loculi often incompletely formed above, style simple, ovules 1–5, pendulous. Fruit a drupe, bearing calyx scar near apex.

1. Tendrillar climbing shrub; leaves slightly peltate and strongly 3-veined at base, long-petioled; flowers in spreading cymes; corolla minute, c 1 mm
2. Erythropalum

Erect shrubs or trees without tendrils; leaves not peltate, pinnately veined throughout, shortly petioled or sessile; flowers in short racemes, spikes or solitary; corolla conspicuous, 6–10 mm 2

2. Shrubs; bracts absent or solitary at pedicel base; calyx limb cup-like; petals 3, free or weakly connate, borne at base of ovary; stamens 3; staminodes 6
1. Olax

Small trees; each flower subtended by 3–4 small bracts, calyx limb absent; corolla tubular, shortly 4–5-lobed, borne near apex of ovary; stamens 4–5, staminodes 0 ..... **3. Schoepfia**

1. OLAX L.

Shrubs. Leaves shortly petioled or sessile. Flowers in short axillary racemes, or solitary; pedicels ebracteate or bearing a single bract at base. Calyx cup-like around ovary, truncate. Petals 3, free or weakly connate at base, inserted near base of ovary. Stamens 3, staminodes 6. Ovary 3-celled below, 1-celled above, stigma 3-lobed. Drupe enclosed by fleshy, accrescent calyx.

1. **O. acuminata** Bentham. Fig. 14h, i.

Shrub 1–3 m. Leaves ovate-elliptic, 6–8 x 1.7–3 cm, acute, base cuneate, petioles 1–3 mm. Racemes c 1 cm, bearing 3–7 flowers. Pedicels 1–2 mm bearing a small bract at base. Calyx cup 0.5 mm; petals yellow, oblong, c 5 mm. Drupe ovoid c 1.5 x 1.2 cm, fleshy.

Bhutan: S?–locality unknown. March–April.

2. **O. nana** Bentham

Similar to *O. acuminata* but shrubby with a stout stock and annual branches; leaves elliptic-lanceolate, 2–6 x 0.5–1.5 cm, obtuse, subsessile; flowers solitary, axillary, on ebracteate pedicels 5–10 mm; drupe subglobose, c 8 x 6 mm.

Sikkim: Darjeeling foothills. Dry scrub, 200–1000 m. April.

2. ERYTHROPALUM Blume

Climbing shrubs with axillary tendrils. Leaves subpeltate and strongly 3-veined at base, pinnately veined above, long-petioled. Flowers minute in spreading, dichotomous, bracteate cymes on long, axillary peduncles. Calyx tube adnate to ovary, 5-lobed above. Corolla of 5 short lobes borne on upper part of ovary.

Stamens 5, epipetalous. Ovary semi-inferior, stigma minute. Fruit an ellipsoid, fleshy drupe.

1. **E. scandens** Blume; *E. vagum* (Griff.) Masters. Sha: *Dakor Meji.* Fig. 14j–l.
Leaves ovate to broadly ovate, 8–22 x 5–16 cm, acute, rounded or cordate at base; petioles 2–4 cm. Cymes 2–6 cm across, borne on slender peduncle 4–8 cm. Flowers greenish, c 2 mm diameter, corolla lobes triangular, c 1 mm. Fruit c 2.5 x 1.5 cm.
Bhutan: S–Chukka, Sarbhang, Gaylegphug and Deothang districts; **Sikkim**. Subtropical forest, 600–1650 m. May–June.

3. SCHOEPFIA Schreber

Trees. Leaves shortly petioled. Flowers in axillary spikes or racemes, each flower subtended by 3–4 unequal bracts. Calyx completely fused to ovary, limb absent. Corolla borne on upper part of ovary, tubular, with 4–5 short lobes. Stamens 4–5, epipetalous, staminodes absent. Ovary semi-inferior, style bearing capitate stigma. Fruit ellipsoid, fleshy.

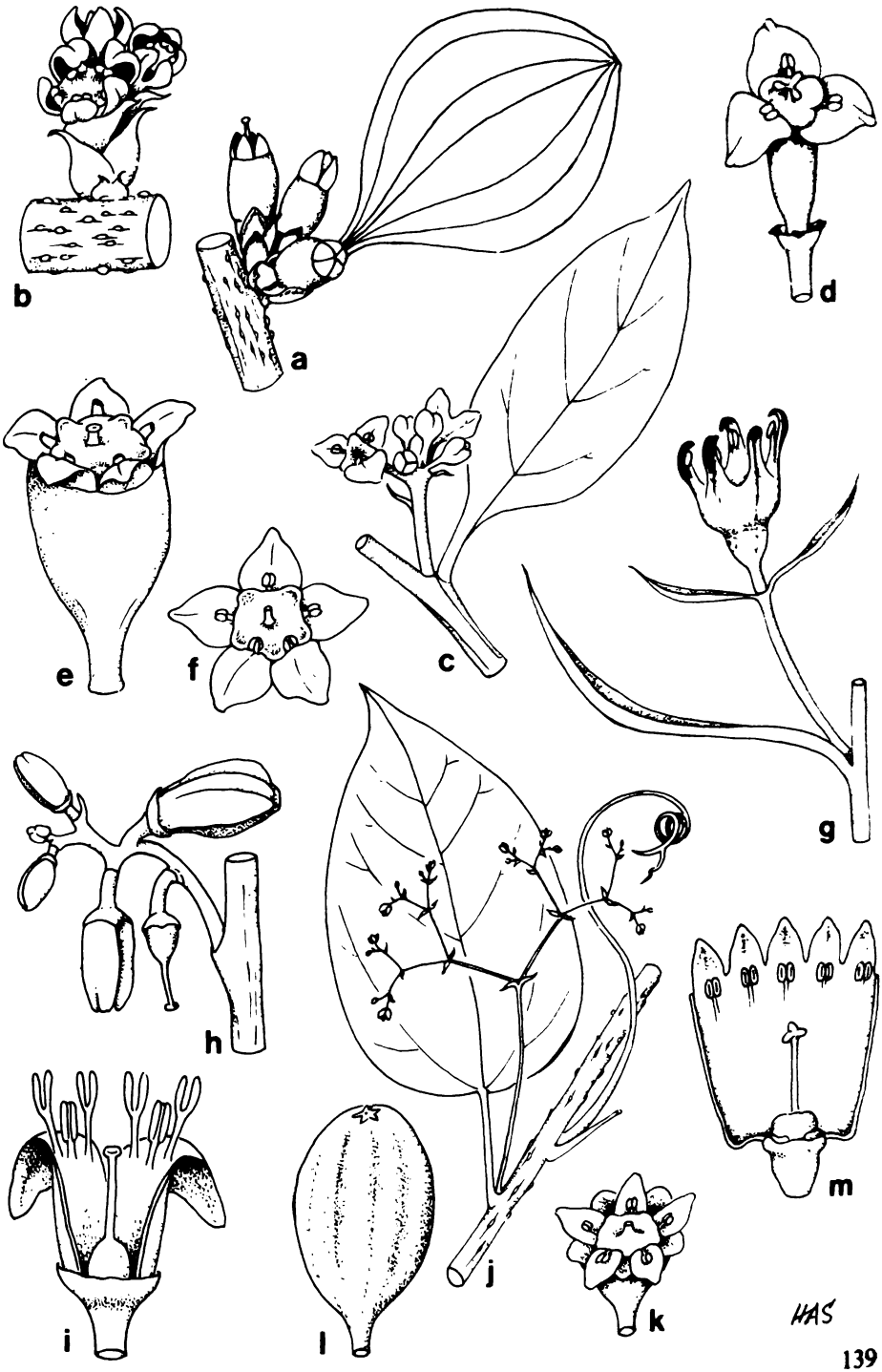
1. **S. griffithii** van Steenis. Fig. 14m.
Tree up to 12 m. Leaves ovate, 3–6 x 1.5–2.5 cm, shortly acuminate, rounded at base, on petiole 1–3 mm. Flowers sessile in axillary spikes 2–3 cm, pedicels flattened, ebracteate at base, floral bracts caducous. Corolla yellowish-green, tube 6–7 mm, lobes c 2 mm. Fruit c 10 x 7 mm, red or orange becoming black when ripe, borne on elongated flattened peduncle 2–3 cm.
Bhutan: C–Punakha to Tashigang districts, scattered localities. Moist broad-leaved forests, 1700–2200 m. April–May.

2. **S. fragrans** Wall.
Similar to *S. griffithii* but leaves larger and more elliptic, 6–11 x 2.5–4 cm, cuneate at base; flowers in axillary racemes 2–4 cm, with small persistent bracts at base of peduncle; pedicels 6–10 mm; corolla white; fruit 8–9 x 7 mm with persistent bracts at base.
Bhutan: C–Mongar district (near Mongar).450 m. August.

Family 20. OPILIACEAE

Shrubs or small trees. Leaves alternate, simple, distichously arranged, pinnately veined, glabrous, entire, exstipulate. Inflorescence of axillary, clustered,

FIG 14. **Santalaceae and Olacaceae. Santalaceae.** a & b, *Dufrenoya granulata*: a, cluster of female flowers in leaf axil; b, cluster of male flowers. c & d, *Osyris lanceolata*: c, male cyme in leaf axil; d, female flower with ring of bracts. e & f, *Pyrularia edulis*: e, female flower; f, male flower. g, *Thesium emodi*: flower with bract and bracteoles. **Olacaceae.** h & i, *Olax acuminata*: h, raceme; i, flower with one petal removed. j–l, *Erythropalum scandens*: j, part of shoot showing leaf, axillary cyme and tendril; k, flower; l, drupe. m, *Schoepfia griffithii*: dissected flower. Scale: j x ½; l x 1; e x 2½; a, h x 3; m x 3½; c, f, g x 5; i x 6; b, d, k x 7. Drawn by H. A. Salzen.



HAS

unbranched racemes, bearing clusters of minute flowers. Flowers hermaphrodite, actinomorphic. Calyx absent, corolla with a cup-shaped tube and 4–5 triangular lobes. Stamens 4–5, borne on corolla tube, antipetalous; staminodes absent. Disk glands alternating with stamens. Ovary superior, conical, 1-locular, with sessile stigma; ovule solitary. Fruit a drupe.

1. LEPIONURUS Blume

Description as for Opiliaceae.

1. L. sylvestris Blume; *L. oblongifolius* (Griff.) Masters. Nep: *Khorsane* (34). Fig. 13a–c.

Shrub or small tree. Leaves narrowly ovate or lanceolate, 10–20 x 2.5–9 cm, acuminate, base attenuate, subsessile or on petioles 1–3 mm. Racemes slender, 2–4 cm. Flowers greenish, c 1.5 mm long, on slender pedicels 1–1.5 mm. Fruit ellipsoid, c 1.7 x 1 cm, orange-red, on enlarged peduncle 2–5 cm.

Sikkim: Darjeeling foothills; **W. Bengal Duars**: Buxa district close to S frontier of Bhutan. Subtropical forests, 200–600 m. April–May.

Family 21. SANTALACEAE

Trees, shrubs or herbs, sometimes stem- or root-parasites, often dioecious. Leaves alternate, simple, entire, pinnately or palmately veined, exstipulate. Inflorescence of racemes, cymes, panicles, clusters or solitary flowers. Flowers usually unisexual, sometimes hermaphrodite, actinomorphic. Perianth tubular, tube reduced in male, in female partly or completely adnate to ovary, bearing 3–6 lobes. Stamens 3–6, borne on or at base of perianth lobes. Disk epigynous or perigynous. Ovary inferior or semi-inferior, 1-locular; style simple; ovules 1–3, borne on a central column. Fruit an indehiscent nut or drupe.

1. Herbs up to 25 cm; leaves linear; flowers hermaphrodite..... **1. Thesium**
   Shrubs or trees, 1–10 m; leaves elliptic, ovate, obovate or orbicular; dioecious, but flowers usually bearing rudiments of opposite sex.....2

2. Shrubs parasitic on tree trunks and branches; leaves palmately 5–9-veined from base..... **4. Dufrenoya**
   Terrestrial shrubs or trees, sometimes root parasites, leaves pinnately veined.3

3. Deciduous shrub or tree up to 10 m; leaves 10–18 x 3–8 cm, pubescent beneath ..... **2. Pyrularia**
   Evergreen shrub up to 3 m; leaves 2.5–4 x 0.5–2 cm, glabrous..... **3. Osyris**

1. THESIUM L.

Perennial, decumbent or erect, herbaceous root-parasites, woody at base. Leaves linear. Flowers hermaphrodite, in terminal racemes, each borne on a slender

pedicel bearing a linear bract and 2 bracteoles. Perianth campanulate, adnate below to ovary, divided above into 5 linear, acute lobes, each hooded at apex and bearing a whitish anther. Ovary inferior. Fruit a weakly ribbed nut bearing withered perianth.

1. **T. emodi** Hendrych; *T. himalense* sensu F.B.I. p.p. non Edgeworth. Fig. 14g.
Little-branched, suberect herb, 5–25 cm. Leaves 7–27 x 1.5–2 mm, sharply pointed, sessile, glabrous. Pedicels slender, 5–9 mm, bearing a leaf-like bract 6–12 mm long at base and two small bracteoles 3–4 mm long at apex; bracteoles equalling or shorter than flowers. Perianth campanulate, c 5 x 2.5 mm, divided to middle. Fruit ellipsoid, c 4 x 3 mm.
Bhutan: N–Upper Mo Chu district (Laya) and Upper Pho Chu district (Lunana). Open mountain pastures, 3500–4000 m. May–June.
The following two species may prove to be conspecific with *T. emodi*.

2. **T. jarmilae** Hendrych
Closely allied to *T. emodi* but decumbent; bracts longer, 15–25 mm, bracteoles 5–8 mm; fruit subglobose, 5–6 mm diameter.
Chumbi Valley: Yatung. Mountain pastures, 3300 m. June.

3. **T. pachyrhizum** A.DC.; *T. himalense* Edgeworth var. ? *pachyrhizum* (A.DC.) Hook. f.
Closely allied to *T. emodi* but stems woody at base, much-branched and decumbent.
Sikkim: Tungu; **Chumbi valley**. Mountain pastures, 3300–3600 m. July.

2. PYRULARIA Michaux

Dioecious, deciduous shrub or small tree. Leaves elliptic, pinnately veined. Young shoots and inflorescences whitish-hirsute. Male flowers in leafy panicles; perianth 5-lobed, each lobe bearing a stamen at base; disk lobed between perianth segments; ovary and style rudimentary. Female flowers in few-flowered racemes; perianth tube adnate to ovary, ovary inferior, stamens sterile. Fruit a subglobose drupe tapering at base and bearing withered perianth lobes at apex.

1. **P. edulis** (Wall.) A.DC. Nep: *Amphi* (34). Fig. 14e, f.
Up to 10 m tall. Leaves 10–18 x 3–8 cm, acute or shortly acuminate, base cuneate, whitish pubescent on veins beneath; petiole 5–10 mm. Male panicles 10–15 cm long, perianth limb c 6 mm diameter, lobes triangular, c 1.5 mm. Female racemes 2–5 cm, bearing 3–7 flowers. Drupes black, c 3 cm diameter, with tapering base c 2 cm long.
Bhutan: S–Chukka and Gaylegphug districts, C–Thimphu, Tongsa and Tashigang districts; **Sikkim**. Warm broad-leaved forests, 900–2000 m. March–April.
Fruit edible; timber hard and white, used to manufacture butter-making

implements (34). Reports that this plant is spiny and monoecious (117) appear to be erroneous.

3. OSYRIS L.

Dioecious, evergreen shrub with ribbed branches. Leaves ovate-elliptic, pinnately veined. Male flowers in axillary umbellate cymes or short terminal panicles, each with a 3–4-lobed perianth, each lobe bearing a single stamen at base, and alternating with lobes of disk. Female flowers solitary, axillary, similar to males but perianth tube adnate to ovary, anthers sterile; style short, stigma minutely 3–4-lobed. Fruit a globose drupe bearing an apical scar.

1. **O. lanceolata** Hochstetter & Steudel; *O. arborea* DC., *O. wightiana* Graham, *O. quadripartita* Decaisne. Sha: *Gogotshalu.* Fig. 14c, d.

Shrub 1–3 m, glabrous. Leaves 2.5–4 x 0.5–2 cm, acute or mucronate, attenuate and subsessile at base, coriaceous. Male cymes c 1 cm, 5–10 flowered, buds globose 2.5–3 mm on pedicels 2 mm. Perianth lobes triangular, 1 mm long. Female flowers on pedicels 4–8 mm, buds obovoid, c 2 mm broad. Drupes 6–7 mm diameter, becoming yellow when ripe.

Bhutan: C–Punakha district (Punakha and Wangdu Phodrang), Mongar district (Kuru Chu valley from Lhuntse to Mongar) and Tashigang district (Dangme Chu valley). Scrub in dry valleys, locally abundant, 900–1400 m. April–June.

Leaves sometimes used as a tea substitute.

4. DUFRENOYA Chatin

Small, dioecious shrubby parasites of tree trunks and branches. Leaves coriaceous, palmately 5–9-veined from base. Male flowers in sessile or shortly-peduncled clusters; perianth of 5–6 triangular lobes, each bearing an anther at base and surrounding a circular disk. Female flowers solitary or clustered; perianth tube adnate to ovary, 5–6-lobed; ovary obovoid, inferior; style minute. Fruit a small obovoid, fleshy drupe.

1. **D. granulata** (A.DC.) Stauffer; *Henslowia granulata* A.DC. Tongsa: *Phurchu*; Nep: *Ajeru* (34), *Ainjeru.* Fig. 14a, b.

Shrub 30–50 cm or more with warted stems. Leaves broadly-elliptic or obovate, 2.5–4 x 1.2–2 cm, obtuse or mucronate, attenuate into shortly petioled base. Male flowers in clusters, sessile or on short scaly peduncles c 2 mm; perianth lobes c 1 mm. Female flowers solitary on short, scaly peduncles c 4 mm, with obovoid ovary c 3 mm, bearing perianth lobes c 1 mm. Drupe c 1 cm diameter, red or dark purple.

Bhutan: S–Gaylegphug district (Rani Camp), C–Tongsa district (Changkha and Kinga Rapden) and Tashigang district (Balfi and Yonpu La); **Sikkim.** Moist broad-leaved and Evergreen oak forest, parasitic on *Rhododendron* and *Quercus* species, e.g. *Q. lanata,* 1500–2400 m. April–May.

2. **D. platyphylla** (Sprengel) Stauffer; *Henslowia heterantha* A.DC. Nep. *Ajeru* (34).

A larger plant than *D. granulata*, 1–4 m tall, with stems less warted; leaves larger, 3.5–10 x 2–7 cm, base more abruptly attenuate; male flowers sessile in scaly clusters of 4–5, each cluster on almost naked peduncle 2–5 mm; female flowers in clusters of 3–10, each flower on a pedicel c 5 mm, scaly only at base and apex.

Bhutan: S–Phuntsholing district (Kamji) and Chukka district (Chukka and Marichong); **Sikkim**. Subtropical and Warm broad-leaved forests. parasitic on *Quercus* etc, 300–1200 m. April–June.

Family 22. LORANTHACEAE

Nep: *Ajeru* (34)–this name applies to most genera and species in Loranthaceae.

Shrubby, rarely herbaceous, stem-parasites of trees, shrubs or other Loranthaceae. Leaves opposite, sometimes alternate, simple, entire, often coriaceous, pinnately or rarely palmately veined, exstipulate, sometimes stellate-hairy, sometimes leaves absent. Flowers in spikes, racemes, umbels or clusters, unisexual or hermaphrodite, actinomorphic, often subtended by 1 or more bracts. Calyx absent or forming a reduced epigynous rim, rarely lobed. Petals 3–6, free or united into a tube. Stamens 3–6 borne on or at base of petals. Ovary inferior, 1-celled, style simple or absent, ovule solitary, axile. Fruit a 1-seeded drupe, seed often sticky.

1. Leaves present, pinnately veined (occasionally somewhat 3-veined at base); flowers hermaphrodite, calyx usually present as a small rim, corolla usually conspicuous, more than 5 mm except in *Loranthus*.....2
   Leaves absent, or if present, palmately (3–) 5-veined; flowers unisexual, minute, calyx absent, corolla inconspicuous 1 mm or less.....8
2. Bracts conspicuous, c 15 mm long, arranged in involucres of 3–4 enclosing 3–4 flowers.....**6. Tolypanthus**
   Bracts inconspicuous, 1–3 mm long, scale-like, 1–3 at base of ovary or forming a cup-like rim on rachis of inflorescence.....3
3. Corolla 5–6-lobed; bracts 3, scale-like at base of ovary, or bract solitary and forming a cup-like rim on rachis of inflorescence 4
   Corolla 4–5-lobed; bract solitary, scale-like at apex of pedicel.....5
4. Corolla 8–45 mm; bracts scale-like, 3 at base of each ovary.....**7. Macrosolen**
   Corolla 2–4 mm; bract solitary, forming a cup-like rim on rachis at base of each flower .....**1. Loranthus**
5. Corolla 5–9 mm, straight, divided to base into 4 or 5 petals....**2. Helixanthera**
   Corolla 10–65 mm, curved, deeply split on one side, lobes 4 or 5 not divided below middle 6

6. Flowers numerous in dense racemes, 5-merous .....**5. Dendrophthoe**
Flowers 3–10 in short racemes or umbels, 4-merous 7

7. Flowers in true racemes, ovary and fruit attenuate at base .....**3. Scurrula**
Flowers in sessile or peduncled umbels, ovary and fruit rounded at base **4. Taxillus**

8. Plants leafy, or leafless and constricted at nodes, with flattened internodes 1.5–5 cm, decussately orientated; perianth lobes 4, deciduous.....**8. Viscum**
Plants leafless, internodes flattened and constricted, all in one plane, those of branches mostly 1 cm or less; perianth lobes 3, persistent.....**9. Korthalsella**

1. LORANTHUS Jacquin

Leaves elliptic or obovate. Flowers sessile in short spikes, each ovary sunk into a cavity on the rachis and surrounded by a cup-like bract. Calyx rim-like around apex of ovary; petals 6, short, divided to base; style stout, equalling petals. Fruit globose.

1. **L. odoratus** Wall.; *Hyphear odoratum* (Wall.) Danser. Fig. 15a.

Small shrub with purplish foliage forming clumps 1 m or more in diameter. Leaves elliptic, 5–9 x 2.5–4 cm, acute, base attenuate, glabrous, on petioles up to 5 mm. Spikes 3–4 cm; flowers sweet-scented, ovary ovoid, petals spathulate, 3–4 mm long, yellow.

Bhutan: S–Deothang district (Tschilingor); **Sikkim**: Darjeeling. Evergreen oak forest, parasitic on *Lithocarpus* etc., 2000–2500 m. May–June.

2. **L. europaeus** Jacquin; *Hyphear europaeum* (Jacquin) Danser

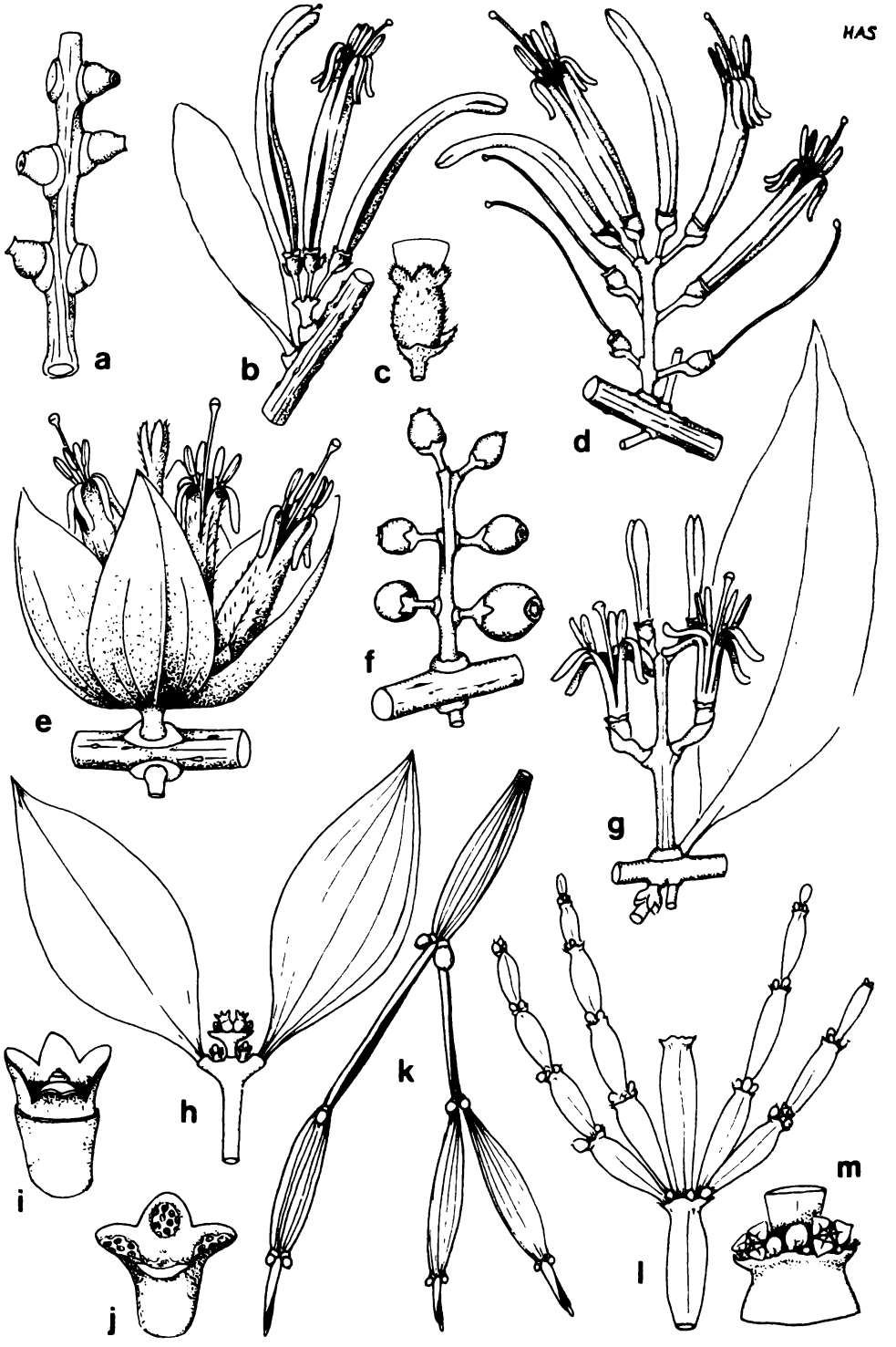
Small shrub up to 50 cm. Leaves obovate, 3–5 x 1–2 cm, obtuse, attenuate at base, pinnate-veined but somewhat 3-veined at base. Flowers as in *L. odoratus* but petals c 2 mm. Fruit up to 1 cm diameter.

Sikkim: Darjeeling, 2300 m. June–July.

2. HELIXANTHERA Loureiro

Leaves ovate to lanceolate. Flowers shortly pedicellate in racemes, each with a scale-like bract below ovary. Calyx a low rim on ovary; corolla straight, divided to base into 4 or 5 narrow petals. Style slender, capitate.

FIG 15 **Loranthaceae**. a, *Loranthus odoratus*: portion of spike bearing immature fruit. b & c, *Taxillus kaempferi*: b, leaf and axillary umbel; c, detail of ovary showing bract. d, *Scurrula elata*: raceme; e, *Tolypanthus involucratus*: cluster of four flowers surrounded by bracts. f, *Macrosolen cochinchinensis*: raceme with young fruit. g, *Helixanthera ligustrina*: leaf and axillary raceme. h–j, *Viscum monoicum*: h, leaves and terminal flower cluster; i, female flower; j, male flower. k, *V. nepalense*: terminal portion of leafless shoot with fruit. l & m, *Korthalsella japonica*: l, portion of leafless shoot with young fruit; m, involucre with male and female flowers. Scale: h x ¾; d x 1; b, l x 1¼, f x 1½, a, e, g x 2½; c, m x 4; i, j x 7½. Drawn by H. A. Salzen.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1. **H. ligustrina** (Wall.) Danser; *Loranthus ligustrinus* Wall. Fig. 15g.

Up to 2 m tall. Leaves narrowly ovate or lanceolate, 3–8 x 1–2.5 cm, acute, base cuneate, brownish-mealy beneath, becoming glabrous; petioles c 5 mm. Racemes short, 1–4 cm, bearing 2–8 flowers in opposite pairs. Pedicels 1–2 mm. Ovary oblong, c. 1.5 mm, minutely brown-scaly. Petals 4, yellow or red, c 8 mm, reflexing from middle. Fruit ovoid, c 5.5 × 3 mm, truncate at apex.

Bhutan: S–Gaylegphug district (N of Gaylegphug); **Sikkim**.

Subtropical forests, parasitic on *Cryptocarya amygdalina* in Bhutan, elsewhere reported on *Castanopsis, Eurya, Persea, Phyllanthus, Pinus* and *Saurauia,* 600–1500 m. April–June.

2. **H. parasitica** Loureiro; *Loranthus pentapetalus* Roxb. Nep: *Sanu Aijaru.*

Similar to *H. ligustrina* but leaves ovate, 7–11 x 2.5–5.5 cm, glabrous; petioles 1–2 cm; racemes longer and stouter, 8–11 cm, many flowered; petals 5, bright red, c 5 mm long, inflated and strongly angular at base; style jointed at middle, angular in lower half; fruit ellipsoid, c 8 x 4 mm.

Sikkim: Darjeeling foothills. Warm broad-leaved forests, parasitic on *Acer, Quercus, Dillenia* etc., 700–1100 m. April–May.

3. SCURRULA L.

Leaves ovate to elliptic, often stellate-tomentose. Flowers in solitary or clustered axillary racemes, each shortly pedicelled and bearing a small, ovate bract below ovary. Ovary obovoid, tapering at base, with narrow calyx rim; corolla tubular, curved, deeply split on one side, shortly 4-lobed, lobes reflexing to one side, each bearing one stamen. Style long and slender. Fruit turbinate or obovoid, attenuate at base.

1. **S. parasitica** L.; *Loranthus scurrula* L. Nep: *Ajiru* (117).

Shrub 1–3 m tall. Young branches densely brown stellate-tomentose. Leaves ovate, sometimes elliptic, 5–12 x 2–6 cm, acute or subacute, base rounded to cuneate, densely brown-stellate on both surfaces when young, becoming glabrous above and pale-tomentose beneath when mature. Petioles 7–10 mm. Racemes short; 5–10-flowered, on peduncles usually less than 1 cm. Pedicels 2–3 mm. Flowers brownish stellate, ovary 2–3 mm; corolla 1.5–2 cm, tube red, lobes greenish, 5–6 mm. Fruit club-shaped, 6–7 mm, including narrowly tapering base.

Bhutan: S–Gaylegphug and Deothang districts, C–Thimphu, Punakha, Tongsa and Mongar districts; **Sikkim**. Moist Warm broad-leaved forests, parasitic on a wide range of hosts; in Bhutan recorded on *Quercus* sp., *Indigofera dosua, Pinus roxburghii* and *Piptanthus nepalensis,* 1300–2400 m. May–August.

2. **S. gracilifolia** (Schultes) Danser; *Loranthus scurrula* L. var. *graciliflorus* (DC.) Kurz

Similar to *S. parasitica* but leaves smaller and elliptic, 3–7 x 2–3 cm, glabrous on both surfaces when mature; flowers similar but with a very slender corolla tube.

Bhutan: locality unknown; **Sikkim.** Hosts not recorded, 600 m.

3. **S. elata** (Edgeworth) Danser; *Loranthus elatus* Edgeworth. Fig. 15d.

Similar to *S. parasitica* but leaves always broadly ovate, usually larger, 7–11 x 4–6 cm, more thickly coriaceous, glabrous on both surfaces when mature; petioles longer, 1.5–2.5 cm; racemes larger, with stouter peduncles 1–2 cm; flowers larger, with corolla 2.5–3.5 cm, red at base, green at apex, shortly brownish pubescent in bud, but becoming glabrous; fruit obovoid, only tapering slightly at base.

Bhutan: C–Thimphu to Tashigang districts, widespread, N–Upper Mo Chu district (Gasa); **Sikkim.** Cool broad-leaved and Evergreen oak forests, parasitic on a variety of hosts: in Bhutan recorded on *Lindera pulcherrima, Lyonia ovalifolia, Populus, Quercus* and *Salix* species, 2100–3200 m. April–June.

4. **S. pulverulenta** (Wall.) G. Don; *Loranthus pulverulentus* Wall.

Closely allied to *S. elata* in its large ovate, glabrous leaves, but distinguished from that and other *Scurrula* species by its large racemes with peduncles 1.5–2.5 cm and large flowers with greenish corolla 3.5–4 cm long, the whole inflorescence densely white tomentose with long branched hairs; fruit obovoid, whitish hirsute.

Bhutan: S–Samchi district (Sangura), C–Tashigang district (S of Tashigang); **Sikkim.** Warm broad-leaved forests. Hosts not reported, 1300–1500 m. September–November.

4. TAXILLUS van Tieghem

Similar to *Scurrula* but leaves always glabrous when mature; flowers in sessile or peduncled umbels; ovary and fruit ellipsoid, rounded at base.

1. Leaves obovate-elliptic, obtuse, 2–3 cm long ..... **Species 1**
   Leaves ovate to elliptic, acute or subacute, 6–11 cm long ..... **Species 2 & 3**

1. **T. kaempferi** (DC.) Danser; *Viscum kaempferi* DC. Dz: *Lam Deka.* Fig. 15b, c.

Shrub up to 1 m. Leaves obovate-elliptic, 2–3 x 0.5–1 cm, obtuse, attenuate at base, sessile. Umbels 2–3-flowered, sessile or on short peduncles 1–3 mm. Pedicels 1–3 mm. Ovary ellipsoid, pubescent, bearing a lobed and ciliate calyx rim. Corolla c 3 cm, red at base, green at apex; lobes reflexed, 8–10 mm. Fruit orange, c 5 x 3 mm.

Bhutan: C–Thimphu to Mongar districts, locally common. Blue pine, Hemlock and mixed coniferous forests. Parasitic on *Pinus, Tsuga* and occasionally on *Picea spinulosa*, 2100–3600 m. May–July.

2. **T. umbellifer** (Schultes) Danser; *Loranthus umbellifer* Schultes, *Scurrula umbellifera* (Schultes) Danser

Shrub up to 1 m, shoots glabrous. Leaves narrowly ovate or elliptic, 8–12 x 2.5–5 cm, acute or subacute, base cuneate, coriaceous, on short petioles 5–10 mm. Umbels 2–4-flowered, glabrous, sessile or on peduncles 2–10 mm. Pedicels 4–6 mm, bearing a suborbicular, ciliate bract at apex. Ovary glabrous with low, entire, ciliate calyx rim. Corolla 2.5–3 cm, red. Fruit c 6.5 x 4.5 mm, glabrous.

Bhutan: C–Punakha district (Lometsawa) and Tashigang district (Bamri Chu and Kulong Chu valleys); **Sikkim**. Warm broad-leaved forests, hosts unknown, 600–1500 m. December–February.

3. **T. sericus** Danser

Similar to *T. umbellifer* but young shoots and inflorescences brownish-stellate-pubescent; calyx rim obscure but with 4 short teeth; fruit pubescent.

Sikkim: Burmiak; **Arunachal Pradesh**: Nyam Jang Chu valley, 1200–2000 m. November–December.

5. DENDROPHTHOE Martius

Leaves elliptic, glabrous. Flowers numerous in dense, often curved racemes. Pedicels short, bearing a single round bract below ovary. Ovary oblong bearing a conspicuous, entire calyx rim. Corolla a long, curved tube splitting on one side, bearing 5 reflexed lobes. Fruit ellipsoid with apical collar.

1. **D. falcata** (L.f.) Ettingshausen; *Loranthus longiflorus* Desrousseaux

Leaves 8–15 x 2.5–7 cm, obtuse, base cuneate or attenuate; petioles 5–10 mm. Flowers secund in racemes 5–10 cm long. Ovary 3 mm. Corolla 3–5 cm, red at base, green at apex; lobes black, c 12 mm. Fruit c 10 x 6 mm.

Bhutan: S–Gaylegphug district (Rani Camp); **Sikkim**: Darjeeling foothills. Subtropical forest, parasitic in Sikkim on *Shorea* and *Albizzia*, 1600–1800 m. November–March.

6. TOLYPANTHUS (Blume) Blume

Leaves ovate, glabrous. Flowers in solitary or fascicled, sessile clusters; each cluster of 3–4 flowers surrounded and almost hidden by an involucre of 3–4 large, ovate, almost free bracts. Ovary oblong, brownish-villous, bearing a 4-toothed calyx. Corolla a straight tube divided to middle into 5 linear lobes reflexed near apex. Fruit oblong, villous, hidden by persistent bracts.

1. **T. involucratus** (Roxb.) van Tieghem; *Loranthus involucratus* Roxb. Fig. 15e.

Shrub up to 1 m with tomentose young shoots. Leaves 6–17 x 4–6 cm, acute, base rounded or cordate; petioles c 1 cm. Bracts reddish, c 15 x 8 mm. Ovary 2 mm. Corolla red, c 13 mm long. Fruit c 5 mm long.

Bhutan: S–Gaylegphug district (Gaylegphug); **Sikkim.** Subtropical forests; hosts in Bhutan unknown, elsewhere recorded on *Lagerstroemia, Litsea, Styrax* etc., 300–600 m. March–May.

7. MACROSOLEN (Blume) Blume

Leaves elliptic or ovate, glabrous. Flowers in spikes, racemes or peduncled umbels, each flower subtended by 3 unequal, scale-like bracts. Ovary oblong bearing an entire calyx-rim. Corolla straight, tube 5–6-angled at base, 5–6-lobed. Fruit globose.

1. **M. cochinchinensis** (Loureiro) van Tieghem; *Loranthus ampullaceus* Roxb., *L. globosus* Roxb. Fig. 15f.

Shrub 0.5–1 m. Leaves coriaceous, 5–12 x 1.2–5 cm, bluntly pointed, acute or shortly acuminate, base cuneate, lateral veins sometimes obscure; petioles 5–15 mm. Racemes up to 5 cm long, flowers sessile or on pedicels up to 5 mm; bracts ovate, unequal, connate at base, the largest equalling ovary. Ovary 2–3 mm with low calyx rim. Corolla 8–10 mm long, tube greenish, lobes red or orange. Fruit yellow or orange, 5 mm diameter.

Bhutan: S–Gaylegphug district (Rani Camp), C–Mongar district (Lhuntse) and Tashigang district (Gamri Chu and Kulong Chu valleys); **Sikkim.** Warm broad-leaved forests, often parasitic on *Schima wallichii,* 1100–1700 m. April–May.

2. **M. psilanthus** (Hook. f.) Danser; *Loranthus psilanthus* Hook. f.

Distinguished from *M. cochinchinensis* by having flowers almost sessile in umbellate clusters of 4 on a peduncle 1.5–2 cm; ovary oblong, c 3 mm, bearing a large calyx rim c 2 mm, and subtended by keeled bracts; corolla red, c 4.5 cm, including yellowish, reflexed lobes c 2 cm.

Bhutan: S–Chukka district (Sinchu La) and Gaylegphug district (Sham Khara); **Sikkim.** Subtropical forests, 1500–1600 m. October–January.

8. VISCUM L.

Monoecious or dioecious, leafy shrubs with terete stems or leafless shrubs with jointed, flattened internodes. Leaves, when present, elliptic or obovate, palmately (3–) 5-veined from base. Flowers unisexual, minute, solitary or clustered in axils or at nodes, or terminally, subtended by small bracts. Male flowers with 3–4-lobed perianth, each lobe bearing an anther. Female flowers with inferior ovary and 4-lobed perianth, stigma sessile. Perianth lobes deciduous in both sexes. Fruit globose or ellipsoid.

1. Leafy shrubs with terete stems ..... **Species 1–3**
   Leafless shrubs with jointed stems and flattened internodes ..... **Species 4 & 5**

1. **V. monoicum** DC. Fig. 15h–j.

Shrub 30–40 cm tall. Leaves elliptic, asymmetric, 5–10 x 1.5–3 cm, acuminate, base attenuate, thinly coriaceous, palmately 5-veined from base, subsessile. Flower clusters axillary, aggregated at nodes, each cluster of 3–5 flowers borne within a boat-shaped pair of connate, acute bracts c 1 mm. Outer flowers of each cluster male, inner female, 1–1.5 mm. Fruit ellipsoid, c 5 x 3 mm, smooth.

Bhutan: S–Samchi district (Dorokha) and Deothang district (Wamrung), C–Tashigang district (Gamri Chu valley); **Sikkim**. Subtropical forest or dry valleys, parasitic in Bhutan on *Meyna spinosa*, 600–1200 m. June.

2. **V. ovalifolium** DC.

Similar to *V. monoicum* but leaves obovate, obtuse, very coriaceous; ovary and fruit warted, globose.

Bhutan: S–reported (117) from Chukka district (Chasilakha) and Gaylegphug district (Sham Khara). Subtropical forests, hosts not recorded, 1500–1660 m.

3. **V. album** L. Nep: *Harchur* (34); Eng: *Mistletoe.*

Similar to *V. monoicum* and *V. ovalifolium* but dioecious; leaves obovate, obtuse, coriaceous, with usually 5 prominent nerves when dry; flowers terminal at branch dichotomies; male flowers in clusters of 3; female flowers in bracteate clusters of 3–5; fruit globose, 4–8 mm, white.

Sikkim: Darjeeling, parasitic on *Acer* etc, 2000 m. November–December.

The E Himalayan race of this species is subsp. **meridianum** (Danser) Long. (*V. costatum* Gamble). Several medicinal uses reported (13).

4. **V. nepalense** Sprengel; *V. articulatum* Burman f. var *dichotomum* Kurz. Dz: *Ngenshithup;* Nep: *Harchur* (34). Fig. 15k.

Shoots up to 1 m, terete only near base, di- or trichotomously branched above, constricted at nodes; internodes flattened, decussate, oblong but tapering towards base, when mature 2–7 x 0.4–1 cm. Inflorescences borne at nodes, each composed of 1–3 female flowers, each flower subtended by a pair of connate cup-shaped bracts, c 1 mm, and several male flowers on either side. Fruit globose, yellowish, 5–6 mm diameter.

Bhutan: S–Deothang district (near Tschilingor), C–Punakha district (Punakha); **Sikkim**. Moist broad-leaved forests, parasitic on other Loranthaceae (e.g. *Scurrula*) and on *Quercus*, 1400–2400 m. May–August.

5. **V. liquidambaricolum** Hayata; *V. articulatum* sensu F.B.I. p.p. non Burman f., *V. articulatum* var. *liquidambaricolum* (Hayata) R. S. Rao

Similar to *V. nepalense* but differing in having narrower stem internodes, 3–5 mm broad and oblong or ellipsoid fruits.

Bhutan: C–Tashigang district (Tashi Yangtsi); **Sikkim**.

Some authorities unite this species and *V. nepalense* with the tropical *V. articulatum* Burman f.; these three entities may be better treated as subspecies of one species.

9. KORTHALSELLA van Tieghem

Small herbaceous, leafless, monoecious parasites with flattened, jointed internodes, with up to 6 or 8 branches per node, internodes flattened in one plane. Flowers borne in cup-like involucres at the apex of internodes, each involucre containing several male and female flowers intermixed with short brown hairs. Male flowers with 3 triangular perianth lobes; stamens 3, connate. Female flowers with an inferior ovary and persistent 3-lobed perianth. Fruit obovoid, explosive.

1. **K. japonica** (Thunberg) Engler; *Viscum japonicum* Thunberg, *Korthalsella opuntia* (Thunberg) Merrill nom. illeg. Fig. 15 1, m.

Herb up to 10 or 15 cm, internodes of branches 5–10 x 2–3 mm, tapering towards base, those of main shoots up to 2 cm long. Flowers 1 mm or less. Fruit c 1.5 mm long.

Bhutan: C–Thimphu district (Tsalimaphe near Thimphu), N–Upper Mo Chu district (Gasa). Arid inner valleys, parasitic on *Quercus semecarpifolia*, 2100–2400 m. May–August.

Family 23. BALANOPHORACEAE

Monoecious or dioecious, glabrous, fleshy herbs with tuberous rootstocks, lacking chlorophyll, parasitic on roots of trees. Stems stout, short, erect, naked or bearing scale-like leaves, with a terminal club-shaped flower head. Flowers numerous, minute. Male flowers with a subentire or 3–6-lobed actinomorphic or zygomorphic perianth; stamens 3–5 or many, united into a column. Female flowers with perianth absent or shortly 2-lipped and adnate to ovary; ovary 1-celled, bearing 1 or 2 slender styles; ovule solitary, pendulous. Fruit a small nut-like achene.

1. Monoecious or dioecious; stems bearing scale-like leaves; stamens 3–5 or many, forming an ovoid, globose or flattened column; style 1 ... **1. Balanophora**
   Dioecious; stems leafless but sometimes warted; stamens 3, forming an elongate column; styles 2 ..... **2. Rhopalocnemis**

1. BALANOPHORA J. R. & J. G. A. Forster

Monoecious or dioecious herbs with waxy rootstock. Stems bursting through rootstock, bearing scale-like leaves. Male flowers with 3–5-lobed perianth and 3–5 or many stamens united into an ovoid, globose or flattened column. Female flowers mixed with club-shaped bodies, perianth absent; ovary ellipsoid bearing a single slender style.

1. Leaves 2–4, connate at base, borne in a single whorl at mid-stem; male flowers 3-merous ..... **Species 4**
   Leaves 6–12, free, in 2 or 4 rows along stem; male flowers 4–5-merous 2

2. Dioecious.....**Species 1 & 2**
Monoecious .....**Species 3**

1. **B. dioica** Royle. Fig. 13g–i.

Plants yellowish or reddish, 5–15 cm, bearing rows of overlapping leaves. Leaves oblong, 1–2.5 x 1 cm, obtuse, sheathing at base. Male heads ovoid, 2–3 x 1–1.5 cm, flowers actinomorphic, perianth segments c 2 x 1 mm, all alike; staminal column subglobose, anther loculi conduplicate. Female heads ellipsoid, 3.5–4 x 1.5 cm, flowers concealed by club-shaped bodies.

Bhutan: S–Gaylegphug district (Rani Camp) and Deothang district (Narfong and Deothang); **Sikkim**. Warm broad-leaved forests; hosts unknown, 1400–2000 m. September–December.

2. **B. polyandra** Griff. Fig. 13j.

Similar to *B. dioica* but leaves in 4 rows; male heads ellipsoid, 3–7 x 1–3 cm, flowers zygomorphic with broad and narrow perianth segments; staminal column broad and flat-topped, surface divided into numerous anther cells; female heads ellipsoid, 2–4 x 1–2.5 cm.

Bhutan: S–Chukka district (Chukka and Marichong); **Arunachal Pradesh**: Nyam Jang Chu valley; **Sikkim**. Subtropical and Warm broad-leaved forests, 1000–2000 m. September–December.

3. **B. abbreviata** Blume

Plants creamy-white or yellow, 5–10 cm. Leaves 2-ranked, ovate, 1–2 x 1 cm, obtuse. Heads ovoid, c 1.5 x 1 cm, bearing female flowers above and males below. Male flowers slightly zygomorphic with dissimilar perianth segments; staminal column broadly ovoid with numerous parallel loculi.

Sikkim: Kalimpong and Darjeeling districts. Subtropical and Warm broad-leaved forests, 1000–2000 m. October–December.

4. **B. involucrata** Hook. f.

Plants monoecious or dioecious, yellowish or reddish, 8–15 cm. Leaves 2–4, ovate, 2–3 x 1–1.5 cm, connate in a single whorl around middle of stem. Heads ovoid or subglobose, 2–3.5 x 1–3 cm, when bisexual, male flowers borne below female. Male flowers usually 3-merous, staminal column depressed-globose, anthers dehiscing transversely.

Sikkim: Lachen, Zemu valley, Darjeeling etc., not uncommon. Cool broad-leaved and coniferous forests, c 2000–3000 m June–October.

The rhizomes form large woody knots on tree roots; these are used for manufacture of drinking-bowls.

2. RHOPALOCNEMIS Junghuhn

Dioecious herb with large tuberous rootstock. Stems bursting through rootstock, leafless but often warted. Flowering heads large, ellipsoid or cylindric, when young covered with hexagonal peltate bract-scales which are

shed in irregular crusts. Flowers mixed with numerous hairs. Male flowers with tubular perianth, entire or shortly and irregularly lobed; stamens 3, united into an elongate column. Female flowers with perianth adnate to ovary, shortly 2-lipped; ovary bearing 2 slender styles.

1. **R. phalloides** Junghuhn

Plants yellowish, 3–15 cm. Heads brownish, 7–20 x 5–7 cm, females usually larger than males. Peltate bract-scales c 4 mm diameter. Staminal column 8–10 mm, exserted.

Sikkim. Cool broad-leaved forests, 2000–2500 m. July–September.

Family 24. POLYGONACEAE

Herbs, subshrubs or climbers, sometimes spinous. Leaves simple, entire, margins rarely sinuate or serrulate, alternate or rarely subopposite, venation pinnate; stipules usually united around stem to form sheath (ocrea). Flowers in racemes, panicles or clusters, actinomorphic, bisexual, sometimes unisexual, jointed on to pedicel; inflorescence rarely bulbiliferous; perianth segments 3–6, usually connate below, sometimes enlarging in fruit, membranous, fleshy or coriaceous. Stamens 1–9, adnate to perianth. Ovary superior, unilocular; styles 2–3, simple, minutely capitate, rarely hooked or fimbriate; ovule solitary, basal. Fruit a trigonous, flattened or biconvex achene.

1. Twining annual herbs; achenes enclosed by persistent winged perianth **6. Fallopia**
   Erect or scrambling herbs or subshrubs; achenes not enclosed by winged perianth 2
2. Racemes very long (20–30cm) and slender; styles 2, persistent, hardened and terminally hooked ..... **4. Antenoron**
   Racemes, if present, seldom more than 10 cm; styles 2–3, sometimes persistent but not hardening and terminally hooked 3
3. Scrambling herbs; stems and petioles bearing reflexed, hooked prickles or bristles ..... **3. Persicaria**
   Erect or scrambling herbs; stems and petioles without hooked prickles 4
4. Perianth 3–5-partite 5
   Perianth 6-partite 12
5. Perianth 4-partite, 2 outer segments smaller, becoming reflexed, inner 2 erect, flattened against compressed, winged achene ..... **11. Oxyria**
   Perianth 3–5-partite, if 4-partite, not as above; achenes biconvex or trigonous, not winged 6
6. Lower leaves deltoid; achenes at least twice as long as perianth **8. Fagopyrum**
   Lower leaves variously shaped, not deltoid; achenes shorter than or equalling perianth 7

7. Flowers in spike-like racemes, or ovoid or capitate heads, rarely leafy 8
Flowers in panicles, axillary few-flowered clusters, or terminal leafy flat-topped corymbs.....10
8. Racemes ovoid or subglobose .....**3. Persicaria**
Racemes elongate, spike-like 9
9. Basal leaves usually present; ocreae split; racemes often densely flowered; bracts ovate, entire, amplexicaul, sheathing peduncle.....**5. Bistorta**
Basal leaves usually absent; ocreae tubular; racemes often slender, ± sparsely flowered; bracts truncate, usually ciliate, cylindric, encircling peduncle.....**3. Persicaria**
10. Flowers in narrow or widely branched panicles; perianth often becoming fleshy in fruit .....**1. Aconogonon**
Flowers in axillary clusters or in terminal flat-topped clusters surrounded by subopposite leaves; perianth not fleshy in fruit 11
11. Leaves narrowly elliptic-oblanceolate, articulated at base.....**7. Polygonum**
Leaves broadly elliptic, ovate or orbicular, not articulated at base
2. Koenigia
12. Stamens 6; outer perianth segments smaller, inner ones accrescent, enveloping triquetrous achene .....**10. Rumex**
Stamens 7–9; perianth not accrescent; achene 3-winged.....**9. Rheum**

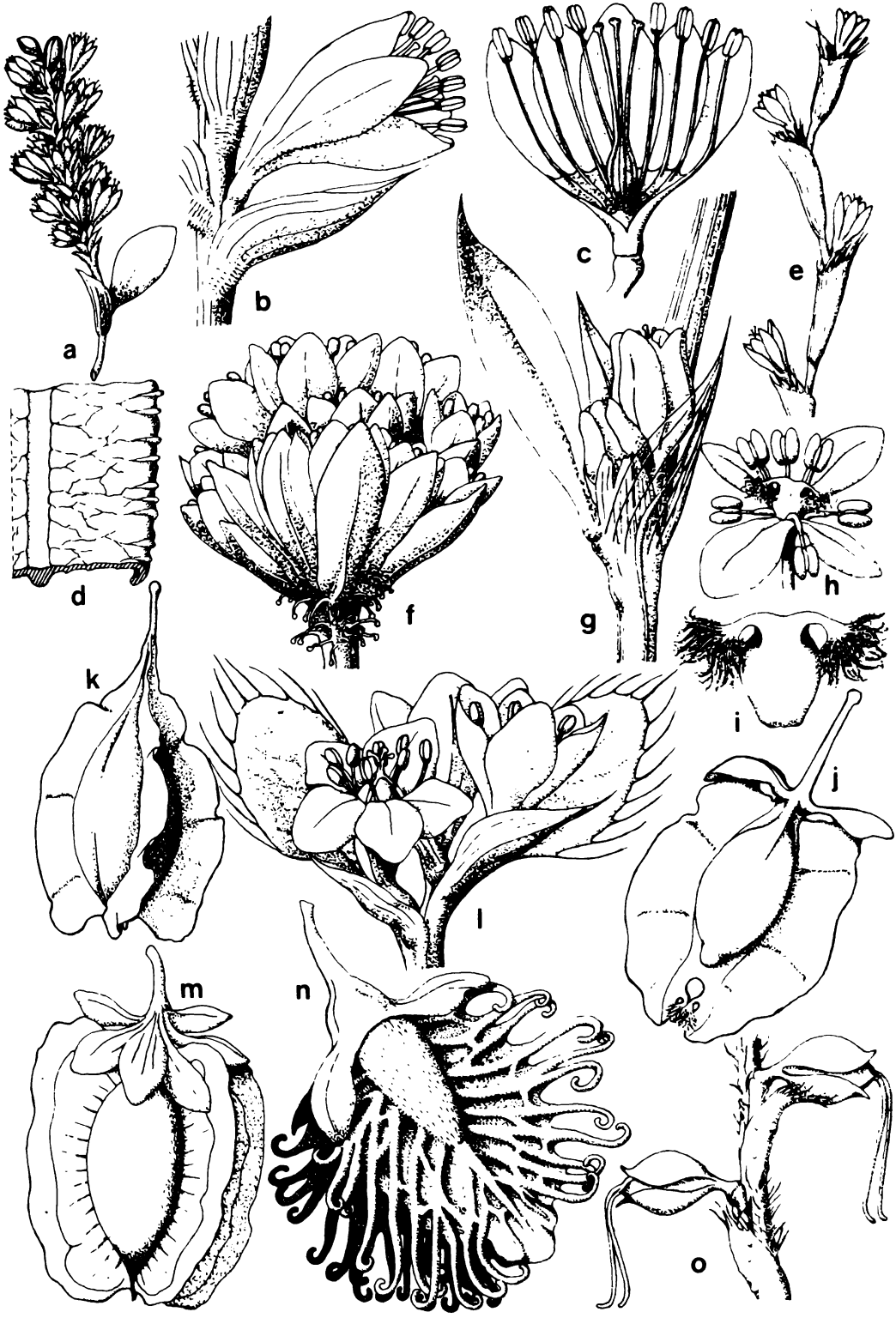
1. ACONOGONON (Meisner) Reichenbach

Herbs or subshrubs, rarely dioecious. Leaves elliptic or ovate; ocreae cylindrical, truncate or lanceolate, membranous. Flowers in panicles. Perianth 5-partite, connate in lower half or near base. Stamens 7–8. Styles 2–3, short, capitate. Achenes trigonous or biconvex, enclosed by persistent perianth.

1. Herbs or subshrubs 30cm or more tall; basal leaves usually absent
Species 1–4
Small herb up to 15cm (rarely to 30cm) tall; basal leaves usually present
Species 5

1. A. campanulatum (Hook. f.) Hara; *Polygonum campanulatum* Hook. f.
Prostrate or suberect herb, 0.3–1m. Leaves elliptic-ovate, 5–12 × 2–5cm, acuminate, base rounded, appressed pilose above, closely white or brownish tomentose beneath; petioles up to 2cm; ocreae 7–12mm, truncate, sparsely pubescent. Flowers in sparsely branched panicles. Perianth campanulate, c

FIG 16. **Polygonaceae**. a–c, *Bistorta vacciniifolia*: a, inflorescence; b, bract and flower; c, dissection of flower. d, *B. macrophylla*: margin of leaf. e, *Persicaria posumbu*: part of inflorescence. f, *P. runcinata*: inflorescence. g, *Polygonum aviculare*: leaf and flower cluster. h–j, *Oxyria digyna*: h, flower; i, detail of ovary; j, fruit. k, *Fallopia dumetorum*: fruit. l, *Koenigia forrestii*: infloresence. m, *Rheum acuminatum*: fruit. n, *Rumex nepalensis*: fruit. o, *Antenoron filiforme*: part of fruiting inflorescence. Scale: a x 1½; o x 3½; d, e, f, g, k, l, m x 5; b, c, j, n x 6½; h x 8; i x 16. Drawn by P. Burbidge.


a
b
c
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5mm, pink, pedicels c 3mm, scarcely exserted from acute bracts. Achenes strongly trigonous, c 5.5mm, slightly exserted from perianth.

Bhutan: C–Ha, Thimphu, Tongsa and Bumthang districts, N–Upper Pho Chu and Upper Kulong Chu districts; **Sikkim.** Hemlock and Fir forests, on damp ground, 2900–4100m. June–September.

2. **A. tortuosum** (D. Don) Hara; *Polygonum tortuosum* D. Don

Erect, divaricately branched subshrub, 25–40cm. Leaves ovate-elliptic, 2–3.5 × 1–2cm, acute or obtuse, base rounded, pubescent on both surfaces, subsessile; ocreae 7–15mm, acute, pubescent. Flowers in dense terminal panicles; bracts ovate, acute. Perianth whitish, 5mm; pedicels c 3.5mm. Styles thick. Achenes c 5mm, pale brown.

Bhutan: N–Upper Mo Chu district (near Lingshi); **Sikkim.** Stony hillsides, 3650–4100m. June–July.

3. **A. molle** (D. Don) Hara; *Polygonum molle* D. Don. Sha: *Chokoma, Kochoma*; Tongsa: *Thrumbula*; Nep: *Thothney* (34).

Subshrub, 1–2.5m. Leaves elliptic, 10–18 × 3–6.5cm, acuminate, base cuneate, rounded or subcordate, appressed pubescent on both surfaces, more densely beneath; petioles up to 2.5cm; ocreae 4–5cm, membranous, lanceolate, appressed pubescent, readily broken. Panicles richly branched. Perianth cream-coloured, c 3mm, white, segments oblong-elliptic; pedicels 1–1.5mm, scarcely exserted from rounded bracts. Achenes c 2.5mm, enclosed in blackish, fleshy perianth.

Bhutan: S–Phuntsholing, Chukka and Deothang districts, C–Ha to Mongar districts, N–Upper Mo Chu and Upper Pho Chu districts; **Sikkim.** Warm and Cool broad-leaved forests, 900–4250m. May–November.

Tender young shoots eaten as a vegetable and used in preparing condiments. Resembles *A. polystachyum*, which differs in its flowers being exserted from among the bracts and in its obovate perianth segments. Three varieties are recognised in Bhutan:

var. **molle**, with stems pubescent with appressed ascending hairs; the most widespread variety.

var. **rude** (Meisner) Hara; *Polygonum rude* Meisner. Stems pubescent with appressed, deflexed hairs, especially at nodes. From Ha, Tongsa and Bumthang districts.

var. **frondosum** (Meisner) Hara; *Polygonum paniculatum* Blume. Completely glabrous; leaves usually broader and firmer in texture. More tropical than the other varieties; from Phuntsholing, Chukka and Deothang districts, also Tongsa district.

4. **A. polystachyum** (Meisner) Haraldson; *Polygonum polystachyum* Meisner, *Persicaria polystachya* (Meisner) H. Gross

Subshrub, 0.6–2m, glabrous or pubescent. Leaves ovate-elliptic, 10–20 × 2–8cm, acuminate, base rounded or cuneate, glabrous or pubescent above, usually pubescent beneath, sometimes densely so, subsessile or on petioles up to 1.5cm; ocreae 3–4cm, membranous, pubescent. Flowers in branching racemose panicles, exserted on pedicels 4–5mm from membranous bracts. Perianth cream-coloured, 3–3.5mm, segments obovate. Achenes trigonous, c 3.5mm, brown.

Bhutan: C–Ha district (Ha) and Thimphu district (Shodug), N–Upper Bumthang Chu district (Chamka); **Sikkim.** Damp ground amongst shrubs, 3000–3950m. July–September.

5. A. hookeri (Meisner) Hara; *Polygonum acaule* Hook. f. non Boissier

Dioecious perennial with thick woody rootstocks, acaulous or stems up to 15(–30)cm. Leaves mostly basal, elliptic-oblanceolate, 3–5(–7) × 0.7–2(–4)cm, obtuse, base cuneate or rounded, sparsely to densely white hirsute on both surfaces, subsessile or on petioles 5(–15)mm; ocreae 1–1.5cm, obtuse. Flowers in slender terminal panicles, 4–5(–9)cm; bracts minute, pedicels 2–3mm. Perianth crimson or lobes green, obtuse. Achenes c 2mm.

Bhutan: C–Thimphu district (Tremo La), N–Upper Pho Chu district (Chojo Dzong) and Upper Bumthang Chu district (Chamka); **Sikkim.** Alpine meadows and screes, 4400–4570m. June–September.

2. KOENIGIA L.

Weak annual or perennial herbs with creeping stems and rhizomes. Leaves ovate, obovate or orbicular, lower ones alternate, upper ones beneath inflorescence often subopposite; ocreae cylindric. Flowers in sessile, axillary clusters or small flat-topped corymbs surrounded by upper leaves; peduncle absent. Perianth segments 3–5, connate at base, not enlarged in fruit. Stamens 1–8. Styles 2–3, short, capitate. Achenes biconvex or trigonous, angles rounded.

1. Flowers in axillary clusters ..... **Species 6**
   Flowers in terminal flat topped corymbs surrounded by leaves 2

2. Leaves acute ..... **Species 1 & 2**
   Leaves rounded, obtuse ..... **Species 3–5**

1. K. nepalensis D. Don; *Polygonum filicaule* Meisner

Stems spreading, 10–30cm, bearing sparse appressed, yellowish, deflexed pilose hairs which always form a ring at base of ocreae. Leaves ovate, 5–25 × 3–10mm, acute, rounded at base, sparsely appressed pilose on both surfaces; petioles of lower leaves up to 7mm, upper ones sessile; ocreae 2–4mm, obliquely cup-shaped, membranous, pilose. Flowers in terminal flat-topped corymbs. Perianth white or pink, c 1.5mm, segments 5, connate at base. Stamens c 0.5mm.

Styles 3, very short (c 0.1mm), minutely capitate. Achene c 1.5mm, trigonous.

Bhutan: C–Ha to Tongsa districts, common, N–Upper Pho Chu to Upper Kulong Chu districts; **Sikkim.** Banks and hillsides in cloud forest, 3050–3800m. June–September.

var. **villosa** Hedberg, a more robust plant with stems covered with dense golden hairs and densely appressed pilose leaves is known from Tongsa district (Pele La) and Sikkim.

2. K. pilosa Maximowicz; *Polygonum pilosum* (Maximowicz) Forbes & Hemsley

Similar to *K. nepalensis* but stems and leaves sparsely hairy with weak whitish hairs; ocreae tending to become lacerate.

Sikkim: Dotha, 3650m. September.

3. K. forrestii (Diels) Měsíček & Soják; *Polygonum forrestii* Diels. Fig. 161.

Creeping herb, sometimes minute. Stems up to 15cm, appressed ascending pubescent. Leaves broadly ovate or orbicular, 2–15(–25)mm long and broad, rounded, base cordate, margins ciliate, pubescent on veins beneath; petioles 5–15mm; ocreae up to 5mm. Flowers in dense, flat corymbs surrounded by a few sessile leaves. Perianth segments 5, white or red at base, 2.5–4mm. Stamens 8, anthers blackish. Styles 3, short (c 0.2mm). Achenes c 2mm, brown, trigonous, angles rounded.

Bhutan: N–Upper Mangde Chu, Upper Bumthang Chu, Upper Kuru Chu and Upper Kulong Chu districts; **Sikkim.** Rhododendron scrub and screes, 3950–4870m. July–September.

4. K. nummulariifolia (Meisner) Měsíček & Soják; *Polygonum nummulariifolium* Meisner

Similar to *K. forrestii* but always dwarf, stems shortly trailing, 1–2cm tall; leaves up to 5mm long and broad, sparsely pubescent at margins and beneath; perianth white, 1.5–2mm; stamens 5; styles 2; achenes biconvex, 1.5mm, brown.

Bhutan: N–Upper Pho Chu district (Lunana) and Upper Kulong Chu district (Pang La); **Sikkim.** Stony ground on mountainsides, 3350–4570m. July – August.

5. K. islandica L.; *Polygonum islandicum* (L.) Hook. f.

Glabrous herb; stems 0.5–8cm. Leaves broadly elliptic or obovate, 3–4 × 2–3mm, obtuse, base rounded, obscurely punctate; petioles 1.5–4mm; ocreae 1–2mm, brown. Corymbs 10–15-flowered, terminal. Perianth segments 3, ovate, 0.75mm, white. Stamens 1–3. Styles 2, minutely capitate. Achenes 1–1.5mm, biconvex, brown.

Bhutan: C–Thimphu district (Shodug to Barshong), N–Upper Kulong Chu district (Me La); **Sikkim.** Moist stony ground on mountainsides, 3900–4575m. May–August.

Material of this species from northern and arctic regions has trimerous flowers, but the East Himalayan plants generally have four perianth segments and often only one stamen. The number of parts may vary among the flowers within a single cluster.

6. K. delicatula (Meisner) Hara; *Polygonum delicatulum* Meisner

Slender annual, 5–15(–30)cm. Leaves all alternate, ovate, 3–10 × 1.5–5mm, acute, base rounded, subsessile, glabrous; ocreae 1.5–2mm, weakly pubescent. Flowers 3–4 in axillary clusters. Perianth white, 4-partite, c 1.5mm. Stamens 4. Styles 3. Achenes trigonous, c 2mm.

Bhutan: C–Thimphu district (Pajoding and Sinchu La) and Bumthang district (Yuto La); **Sikkim.** Marshy ground on mountains, 2750–3950m. August–September.

3. PERSICARIA L.

Annual or perennial herbs with branching stems, sometimes bearing short recurved spines, without basal leaves at flowering time. Leaves ovate, elliptic or lanceolate, rarely deltoid, ocreae cylindric. Flowers in racemes, spikes or capitate heads. Perianth 4–5-partite. Stamens 5–8. Styles 2–3, elongate, capitate. Achenes biconvex, compressed or trigonous.

1. Racemes spike-like, cylindrical to filiform, sometimes branched 2
   Racemes ovoid or subglobose, capitate, sometimes more elongate in *P. sibirica* 7
2. Stems, petioles and sometimes leaf margins and veins beneath bearing recurved spines 3
   Stems and petioles without recurved spines 4
3. Ocreae, at least in part, herbaceous .....**Species 1 & 2**
   Ocreae membranous .....**Species 3–5**
4. Ocreae thick with a herbaceous limb at the apex when young .....**Species 6**
   Ocreae membranous, sometimes ciliate.....5
5. Ocreae eciliate at mouth.....**Species 7–9**
   Ocreae ciliate at mouth 6
6. Leaves eglandular, sometimes whitish dotted but not obviously glandular **Species 10–12**
   Leaves gland-dotted, at least beneath .....**Species 13–15**
7. Scrambling subshrubs with divaricate branches .....**Species 16**
   Herbs, sometimes woody at base, erect or prostrate 8
8. Leaves runcinate pinnatifid; petioles auriculate at base.....**Species 17**
   Leaves entire; petioles auriculate at base or not 9

9. Medium-sized herbs; stems 10cm or more ..... **Species 18–21**
Dwarf herbs; stems 1–8(–20)cm ..... **Species 22 & 23**

1. P. perfoliata (L.) H. Gross; *Polygonum perfoliatum* L.

Climbing herb; stems, petioles, leaf margins and veins beneath bearing recurved spines c 1.5mm. Leaves deltoid, 2–4 × 2–6cm, acute, sometimes peltate, base truncate or sometimes slightly cordate, lobes rounded, glabrous; petioles 1.5–7cm; ocreae 1–3cm, herbaceous, ovate or rounded, perfoliate. Racemes 1.5–2cm, solitary at branch ends. Perianth white or pink, c 5mm. Stamens 7. Styles 3. Achenes obovoid, rounded, 3.5mm, blue-black.

Bhutan: C–Tashigang district (Tashigang); **Sikkim.** Marshy ground in dry valleys, 1500m. May–October.

2. P. thunbergii (Siebold & Zuccarini) H. Gross; *Polygonum arifolium* sensu F.B.I. non L.

Climbing herb up to 1m. Stems bearing small recurved spines. Leaves hastate, 2.5–7 × 2–8cm, acuminate, basal lobes spreading, acute, pubescent and setose on both surfaces; petioles 1–5cm; ocreae 5–7mm, herbaceous at the tip. Flowers few (c 5), in terminal clusters; peduncles 1–2cm. Perianth white, c 4mm. Styles 3. Achenes trigonous, 4mm, pale brown.

Sikkim: Kurseong. Amongst shrubs in Warm broad-leaved forest, 1800–2100m. June–July.

3. P. strigosa (R. Brown) Nakai; *Polygonum strigosum* R. Brown, *Polygonum pedunculare* Meisner

Scandent herb up to 1m. Stems angular, bearing minute recurved spines on angles at least at base of ocreae. Leaves oblong-lanceolate, 5–12 × 0.7–2cm, acute or acuminate, base rounded, margins and midribs beneath bearing recurved spines; petioles up to 1cm; ocreae 1.5–2.5cm, ciliate at mouth. Flower heads cylindrical, 0.5–1cm, usually 2–3 at branch ends; bracts ciliate. Perianth pink, c 3mm. Styles 3. Achenes trigonous, rounded, c 3mm, black.

Bhutan: C–Punakha district (Rinchu); **Sikkim:** terai. Marshy ground, 1500m. July.

4. P. sagittata (L.) H. Gross; *Polygonum sagittatum* L.

Suberect annual, 15–30cm, rarely subscandent. Stems angular, bearing sparse, minute, recurved spines. Leaves oblong-ovate, 2–4 × 0.5–1cm, acute, base cordate-sagittate with acute lobes, margins entire, smooth, bearing a few hooked spines on midrib beneath; petioles up to 1.5cm; ocreae 5–7mm. Flower heads solitary, c 7mm diameter, 5–10-flowered; bracts eciliate. Perianth pink, c 4mm. Stamens 5. Styles 3. Achenes trigonous, c 2.5mm, pale brown.

Bhutan: C–Thimphu district (Paro). Amongst shrubs in Cool broad-leaved forest, 2500m. July–October.

5. P. praetermissa (Hook. f.) Hara; *Polygonum praetermissum* Hook. f.

Very similar to *P. sagittata* but stems more densely spinous; leaves up to 8 × 1.5cm, unarmed or spinous beneath; ocreae 1–1.5cm; flowers slender, flexuose, interrupted racemes; peduncles glandular pubescent; flowers 2–3 within each shortly ciliate bract; perianth white; achenes trigonous or biconvex, c 2mm, brown.

Bhutan: C–Punakha district (Samtengang). Moist situations, 2000m. June–September.

6. P. orientalis (L.) Spach; *Polygonum orientale* L.

Densely pubescent herb, 1–3m. Leaves ovate, 9–12 × 4–7cm, acuminate, base rounded or cordate; petioles 3–5cm; ocreae 1.5–2cm, straw-coloured, herbaceous at apex at first. Racemes 3–4 at branch ends, spike-like, 3–7cm, peduncles as long as racemes. Flowers in small fascicles subtended by a rounded, hirsute bract. Perianth white or pink, c 4mm. Stamens 7. Styles 2, ± as long as perianth. Achenes biconvex, orbicular, c 3mm, blackish.

Bhutan: S–Gaylegphug district (Gaylegphug). Marshy ground, 270m. April–December.

7. P. amphibia (L.) S. F. Gray; *Polygonum amphibium* L.

Glabrous aquatic perennial growing in up to 2m of water; emergent stems up to 15cm. Leaves oblong-ovate, 5–10 × 1.25–3.5cm, acute, base rounded or cordate; petioles 2–8cm; ocreae 1.5–2cm. Racemes dense, 1.5–4cm, on peduncles 3–8cm, solitary or sometimes 2. Flowers whitish or pink. Perianth c 5mm. Stamens 5. Styles 2, c 3mm. Achenes biconvex, c 3mm, base of style forming a persistent beak.

Bhutan: N–Upper Pho Chu district (Gafoo La). In ponds and lakes, 3950m. July.

8. P. glabra (Willdenow) Gomes de la Maza; *Polygonum glabrum* Willdenow

Glabrous herb, c 1m. Leaves lanceolate, 9–13 × 1–3cm, acuminate, base cuneate, minutely reddish glandular; petioles 1–1.5cm; ocreae 1–2.5cm, glabrous or minutely ciliate at mouth. Racemes slender, 3–10cm, 3–7 at branch ends. Perianth pink, c 3.5mm, eglandular. Stamens 6–8. Styles 2, c 2mm. Achenes biconvex, c 2.5mm, style base persistent.

Sikkim: Darjeeling district. Ditches and river banks.

9. P. lapathifolia (L.) S. F. Gray; *Polygonum lanigerum* Brown

Similar to *P. glabra* but stems c 5–2.5m, lanate; leaves lanceolate, 6–17 × 1–2cm, sparsely lanate above, more densely white lanate beneath; ocreae 1–2cm, sparsely lanate; racemes often drooping, racemosely arranged; flowers c 2mm, white or pink; stamens 5; styles 2, c 1mm; achenes c 2mm, compressed, concave, blackish, persistent style base forming a beak.

Bhutan: C–Punakha district; **Sikkim.** Marshy ground, 2000m. July–

September.

This description applies to var. **lanata** (Roxb.) Hara.

10. P. barbata (L.) Hara; *Polygonum barbatum* L.

Erect robust herb, 30–60(–90)cm. Leaves elliptic-lanceolate 7.5–13 × 1–2cm, acuminate, base attenuate, appressed setulose on both surfaces and at margins; ocreae c 2mm, ribbed, densely setulose, mouth ciliate with stiff bristles as long or somewhat longer than ocreae. Racemes narrow, spike-like, 5–6 at branch ends, 3–5cm, on peduncles 2–4cm. Perianth glandular, whitish, c 2mm, bracts ciliate, glabrous. Stamens 6. Styles 3. Achenes trigonous, c 2mm, beaked with persistent style base.

Bhutan: S–Phuntsholing to Deothang disticts, C–Punakha and Tashigang districts; **Sikkim.** Ditches and damp ground, 270–2000m. August–December.

The above description applies to the typical var. **barbata.** Two other varieties occur: var. **stagnina** (Meisner) Grierson (*Polygonum stagninum* Meisner) with stems, leaves and ocreae more densely and greyish strigose-pubescent, from Sikkim; and var. **gracilis** (Danser) Hara (*Polygonum serrulatum* Lagasca) with weak slender stems, narrower leaves 7–12mm broad which are glabrous or sparsely setulose, and narrower racemes, 1–3 borne at branch ends, from Punakha and Tashigang districts.

11. P. dolichopoda (Ohki) Sasaki; *Polygonum persicaria* L.

Similar to *P. barbata* but an ascending annual, stems 20–40cm; leaves elliptic-lanceolate, 4–8 × 0.5–1cm, acuminate, base attenuate, subsessile, often with a dark blotch near middle above, margins and veins beneath setulose; ocreae 6–15mm, mouth with shorter cilia 3–7mm; racemes 2–3 at branch ends, 1–3cm; flowers eglandular, greenish white or pink, shortly exserted.

Bhutan: C–Punakha district (Lobeysa). Ditches and marshy ground, 1600m. June.

12. P. posumbu (D. Don) H. Gross; *Polygonum caespitosum* Blume. Fig. 16e.

Slender flaccid herb, 15–60cm, stems glabrous. Leaves ovate-elliptic, 3–7 × 1–1.5cm, acuminate, base cuneate, sparsely pilose on both surfaces, sometimes minutely whitish dotted beneath; ocreae 6–10mm, appressed pilose, cilia at mouth ± the same length. Racemes very slender, interrupted, 5–7cm, on peduncles 5–7cm. Perianth eglandular, white or pink, c 2.5mm. Stamens 5. Styles 3. Achenes trigonous, c 2.5mm long.

Bhutan: S–Samchi to Deothang districts; **Sikkim.** Damp ground, 600–1500m. April–December.

13. P. hydropiper (L.) Spach; *Polygonum hydropiper* L.

Weak ascending perennial, 15–45(–75)cm. Leaves lanceolate, 2–8 × 0.5–1.5cm, acuminate, base attenuate, lower ones shortly (c 7mm) petiolate,

glabrous, reddish punctate-glandular on both surfaces, setulose at margins; ocreae 5–15mm, glabrous, cilia at mouth 1–4mm. Racemes slender, 3–7cm, interrupted, bracts minutely ciliate. Perianth c 4mm, minutely glandular. Stamens 6. Styles 2. Achenes biconvex, c 3mm, dark brown.

Bhutan: S–Phuntsholing and Chukka districts, C–Ha, Punakha and Tashigang districts. Marshy ground, 200–2750m. April–September.

14. P. pubescens (Blume) Hara; *Polygonum flaccidum* sensu F.B.I. non Roxb., *Polygonum hydropiper* L. var. *flaccidum* Steward

Similar to *P. hydropiper* but more robust; stems up to 75cm; leaves larger, 3.5–10 × 0.7–2cm, pubescent or setulose on veins beneath; ocreae 10–15mm, setulose, cilia at mouth 8–10mm; racemes very slender, up to 15cm, drooping; perianth ± gland-dotted; achenes usually trigonous.

Bhutan: S–Gaylegphug district (Gaylegphug), C–Thimphu district (Paro) and Punakha district (Rinchu); **Sikkim.** Shady streamsides, 270–2000m. April–August.

The above description applies to var. **acuminata** (Franchet & Savatier) Hara.

15. P. tenella (Blume) Hara; *P. kawagoeana* (Makino) Nakai, *Polygonum minus* sensu F.B.I. non Hudson

Weak herb, 10–25cm, sometimes prostrate. Leaves narrowly elliptic-lanceolate, 2.5–7 × 0.4–0.6cm, acuminate, base attenuate, subsessile, margins and veins beneath sparsely setulose, bearing minute scale-like glands beneath; ocreae 8–10mm, sparsely setulose, cilia at mouth 2–3mm. Racemes slender, 2–5, terminal. Perianth eglandular, c 1.5mm, pink. Stamens 5. Styles 2. Achenes biconvex, c 1.5mm, black.

Bhutan: S–Phuntsholing and Gaylegphug districts, C–Punakha district (Punakha, Samtengang, Rinchu); **Sikkim.** Marshy ground, 270–2000m. April–December.

The above description refers to var. **kawagoeana** (Makino) Hara.

16. P. chinensis (L.) H. Gross; *Polygonum chinense* L.

Large scrambling subshrub. Leaves ovate, 2.5–12 × 1–7cm, acuminate, base rounded or cordate, margins entire or minutely thick-serrulate, glabrous or sparsely pilose on veins beneath, rarely more densely pilose and ciliate; petioles up to 1.5cm, sometimes with a rounded auricle up to 7mm broad at base; ocreae 1–2cm, membranous, lanceolate, sheathing, rarely truncate above. Flowers in ovoid or rounded heads 0.5–1.5cm diameter, solitary or 3–5 or more at branch ends, peduncles glabrous, setose or glandular-setose. Perianth white or pink, 4–5mm, connate at base, scarcely exserted from among ovate, membranous bracts. Stamens 7–8. Styles 3. Achenes trigonous, c 4mm, enclosed within slightly accrescent, fleshy, red or black perianth.

Bhutan: S–Phuntsholing to Deothang districts, C–Thimphu to Tashigang districts; **Sikkim.** Warm and Cool broad-leaved forests, 270–2600m.

May–November.

A very variable species in which a number of varieties have been created. Although there is some correlation between the prescence of auricles and glandular setose peduncles as Hara (69) has pointed out, the other characters which he uses to distinguish var. *ovalifolia* (Meisner) Hara from var. *chinensis* seem not to be well correlated.

17. P. runcinata (D. Don) H. Gross; *Polygonum runcinatum* D. Don. Nep.: *Jongroma* (117). Fig. 16f.

Prostrate or ascending herb. Leaves runcinate-pinnatifid, terminal lobe rhombic-ovate, c 0.7cm long and broad, lateral lobes linear-oblong, 1–4 pairs, 3–15 × 1–7mm, glabrous or sparsely pubescent, sometimes with a dark V-shaped blotch on the terminal lobe; petioles 0.5–3.5cm, usually rounded auriculate at base; ocreae 5–8mm, membranous, truncate at apex. Flowers in globose heads, solitary or 2–3, terminal or axillary on peduncles 1.5–7cm. Perianth white or pink, 3–4mm. Stamens 5–8. Styles 3. Achene ovoid, rounded, c 2.5mm, slightly trigonous at apex, remaining enclosed within papery perianth.

Bhutan: S–Samchi to Gaylegphug districts, C–Ha to Tashigang districts, N–Upper Mo Chu to Upper Kuru Chu districts; **Sikkim.** Roadsides and cliff faces, 1000–3800m. May–October.

18. P. nepalensis (Meisner) H. Gross; *Polygonum nepalense* Meisner, *Polygonum alatum* Sprengel

Prostrate or suberect annual, stems simple or branched, 10–45cm, distantly leafy, internodes 2–6cm. Leaves ovate or elliptic, sometimes with a dark blotch near centre, 1–5 × 0.7–3.5cm, acute, base rounded, lamina decurrent; petioles up to 1.5cm and usually auriculate at base, glabrous or sparsely pubescent, punctate with scattered yellow glands beneath; ocreae 6–10mm, membranous, trunctate, sparsely pubescent. Flowers in globose heads 7–10mm diameter, solitary or several from uppermost leaf axils; peduncles up to 2cm, glandular pubescent at apex, usually with an involucral leaf immediately subtending the head. Perianth pink, sometimes white, 2.5–3.5mm, trigonous or biconvex, strongly pitted, black, enclosed within slightly accrescent papery perianth.

Bhutan: S–Phuntsholing to Deothang districts, C–Ha to Tashigang districts, N–Upper Kulong Chu district (Lao); **Sikkim.** Roadsides and damp places in Warm and Cool broad-leaved forests and Chir pine forests, 750–3050m. April–October.

19. P. humilis (Meisner) Hara; *Polygonum humile* Meisner

Similar to *P. nepalensis* but smaller, stems 5–15cm; leaves 8–20 × 3–10mm, acute, subsessile or base narrowed to a broad petiole, not usually glandular punctate; flower heads 5–6mm, on slender, eglandular peduncles, without involucral leaf; perianth greenish, shorter than bracts; achenes biconvex, densely

pitted.

Bhutan: C–Upper Bumthang Chu district (Kopub); **Sikkim.** 2900–3350m. July–September.

20. P. capitata (D. Don) H. Gross; *Polygonum capitatum* D. Don

Similar to *P. nepalensis* but always decumbent; stems densely leafy, internodes 1–2(–4)cm, pubescent; leaves ovate-elliptic, 1.5–4 × 1–2.3cm, acute, base rounded or cuneate, sparsely pubescent or stipitate glandular, margins ciliate; petioles 2–3mm, with small rounded auricles at base; ocreae 5–8mm, truncate, pubescent; flower heads usually solitary, on peduncles 1–4cm, glandular pubescent near apex; perianth pink; achenes trigonous.

Bhutan: S–Samchi to Gaylegphug districts, C–Thimphu to Tashigang districts; **Sikkim.** Roadsides, etc., in Warm and Cool broad-leaved forests, 1200–2500m. March–September.

21. P. microcephala (D. Don) H. Gross; *Polygonum microcephalum* D. Don

Very similar to *P. nepalensis* but perennial and more woody at base. Leaves ovate, 2.5–8 × 1–3.5cm, acuminate, base rounded or cordate; petioles 1–2cm, usually winged by decurrent lamina, auricled at base; ocreae 5–10mm, truncate, ciliate at apex. Flower heads 5–7mm, globose, usually 2–3 from axils of deeply cordate, amplexicaul upper leaves, on peduncles 1–4cm, without an involucral leaf immediately beneath the flower head. Perianth white, c 3mm. Stamens 8. Styles 2–3. Achenes biconvex or trigonous.

Bhutan: S–Samchi, Phuntsholing and Gaylegphug districts, C–Thimphu, Tongsa and Mongar districts; **Sikkim.** Roadsides, etc., in subtropical forests, 300–1600m. April–December.

The var. **wallichii** (Meisner) Hara (*Polygonum wallichii* Meisner) from Sikkim differs in having petioles unwinged.

22. P. glacialis (Meisner) Hara; *Polygonum glaciale* Meisner

Dwarf annual. Stems 1–8cm. Leaves broadly ovate, 5–15 × 3–12mm, subacute, base rounded, glabrous; petioles 5–10mm; ocreae 3–4mm, sparsely pubescent. Flower heads 3–4mm diameter, solitary or few, on peduncles up to 1cm. Perianth pink, c 2mm. Achenes trigonous, c 1mm, brown.

Sikkim: Llonakh district. Alpine gravel, 4400m. July.

23. P. sibirica (Laxmann) H. Gross; *Polygonum sibiricum* Laxmann, *Aconogonon sibiricum* (Laxmann) Hara

Dwarf glabrous herb with long simple roots, acaulous or with stems up to 20cm. Leaves somewhat fleshy, oblong, 1–4 × 0.3–1cm, obtuse, base shortly hastate-lobed, tapering into a broad petiole, 1–3cm; ocreae membranous, truncate. Flowers in capitate whorls or sometimes short racemes; bracts cylindric; pedicels 4–5mm. Perianth c 2mm, greenish yellow. Stamens and styles crimson. Achenes c 2.5mm, brown.

Sikkim: Llonakh district. Sand and gravel by alpine streams, 4400–4900m. July–September.

4. ANTENORON Rafinesque

Rhizomatous herbs. Leaves elliptic-obovate; ocreae tubular. Flowers in a slender spicate raceme. Perianth 4-partite, connate in lower half. Stamens 5, alternating with sessile glands. Styles 2, hooked at apex and persistent in fruit. Achenes biconvex.

1. A. filiforme (Thunberg) Roberty & Vautier; *Polygonum virginianum* sensu F.B.I. non L., *Persicaria virginiana* auct. non (L.) Gaertner, *Tovara filiformis* (Thunberg) Nakai. Fig. 16 o.

Stems up to 60cm. Leaves elliptic-obovate, 10–17 × 3.5–7cm, shortly acuminate, base rounded, densely appressed brownish strigose on both surfaces; petioles c 1cm; ocreae 1–2cm, shaggily brown strigose. Racemes 20–30cm, interrupted; bracts truncate, strigose-ciliate, each subtending 2–3 flowers. Perianth red, c 4mm; pedicels 2–3mm, scarcely exserted from bract. Styles 2.5–3mm, becoming exserted from perianth and deflexed in fruit. Achenes c 4mm, brown.

Bhutan: S–Chukka district (Marichong) and Gaylegphug district (Dakpai); **Sikkim.** Margins of subtropical forests, 1050–1650m. July–October.

These strigose plants are referred to var. **kachina** (Niewland) Li.

5. BISTORTA (L.) Adanson

Herbs or dwarf shrubs. Rootstock creeping, woody or herbaceous. Stems usually simple. Basal leaves ± rosetted, ovate, elliptic or lanceolate, margins usually crenulate with thickened veins; ocreae split obliquely, lacerate or entire. Flowers in spike-like racemes. Perianth 5-partite, not enlarged in fruit. Stamens 8 (4 in *B. perpusilla*). Styles 2–3, elongate, minutely capitate. Achenes biconvex or trigonous.

1. Trailing subshrubs with wiry stoloniferous stems ..... **Species 1 & 2**
   Suberect herbs with relatively stout underground rhizomes 2
2. Upper leaves several, ovate, cordate, amplexicaul ..... **Species 3 & 4**
   Upper leaves few, narrow, linear-lanceolate, never cordate; sometimes ovate in *B. griffithii* 3
3. Lower part of racemes bulbiliferous ..... **Species 5**
   Racemes not bulbiliferous 4
4. Racemes 0.5cm or less broad ..... **Species 10**
   Racemes (0.8–)1–2cm broad 5
5. Petioles of basal leaves 4–15cm; leaves pubescent beneath ..... **Species 6–8**
   Basal leaves sessile or on short petioles up to 2cm; leaves glabrous .. **Species 9**

1. B. vacciniifolia (Meisner) Green; *Polygonum vacciniifolium* Meisner. Fig. 16a–c.

Prostrate subshrub with trailing stoloniferous stems; flowering shoots suberect, up to 15cm. Leaves ovate-elliptic, 1–2 × 0.6–1cm, acute, base cuneate, glabrous, sessile; ocreae c 1cm, veined, lacerate. Racemes terminal, sometimes branched, 3–8cm, sparsely flowered. Perianth c 6mm, pink. Stamens and styles shortly exserted. Achenes c 2mm, brown.

Bhutan: C–Ha, Thimphu, Tongsa, Bumthang and Mongar districts, N–Upper Bumthang Chu district; **Sikkim.** Fir/*Rhododendron* forest margins, 3200–4400m. August–September.

2. B. emodi (Meisner) Hara; *Polygonum emodi* Meisner

Weak prostrate subshrub with slender elongate branches. Leaves grass-like, linear-lanceolate, 5–13 × 0.3–2cm, acuminate, base attenuate, subsessile, margins inrolled when young, veins prominent, fine and parallel, glabrous; ocreae 2–3.5cm, brown, many-veined, lacerate. Racemes 3–4cm, lax-flowered, on slender peduncles 6–8cm. Perianth deep red, 4–5mm. Stamens not exserted. Achenes c 3mm, brown, glossy.

Bhutan: C–Thimphu district (Dotanang), N–Upper Mo Chu district (Lingshi) and Upper Bumthang Chu (Shimithang); **Sikkim.** Rocky slopes and river banks, 2550–3050m. July–September.

3. B. amplexicaulis (D. Don) Greene; *Polygonum amplexicaule* D. Don

Erect herb with thick rhizomes, stems 30–75cm, sometimes branched. Leaves ovate, 6–10(–25) × 3–6(–13)cm, acuminate, base cordate; petioles of lower leaves up to 15cm, upper ones sessile, amplexicaul, glabrous; ocreae 1.5–5cm, brown, membranous, entire. Racemes 2–7cm, borne on slender peduncles 3–8cm, flowers numerous. Perianth c 6mm, pink or purple; pedicels 6–8mm. Stamens not exserted. Achenes 5–6mm, brown.

Bhutan: locality unknown; **Sikkim.** Meadows and streamsides, 3000–4000m. July–September.

The var. **pendula** Hara, with racemes distinctly pendulous and leaves papillose on veins beneath, occurs in Ha district (Kang La to Ha).

4. B. suffulta (Maximowicz) H. Gross; *Polygonum suffultum* Maximowicz

Similar to *B. amplexicaulis* but smaller (15–40cm) and more slender; leaves glabrous or weakly pubescent above; racemes slender, 1–5cm, sometimes branched, flowers 4–15; perianth c 3mm, white.

Bhutan: C–Ha, Thimphu, Tongsa, Bumthang and Sakden districts, N–Upper Mo Chu and Upper Bumthang Chu districts; **Sikkim.** Fir/*Rhododendron* forests, 2700–3200m. May–June.

5. B. vivipara (L.) S. F. Gray; *Polygonum viviparum* L. Med: *Pangram.*

Erect herb with thick, fibrous rhizomes. Stems simple, 8–30cm. Lower leaves ovate, 1.5–11 × 0.5–2cm, acute, base rounded or cordate, usually finely pubescent beneath; petioles 2.5–12cm; ocreae 0.5–4cm, brown, acute, entire; upper leaves linear, sessile. Racemes 2–7cm, bulbiliferous in lower part; bulbils ovoid, 3–4mm, beaked at apex. Flowers white or deep pink; perianth c 3mm. Stamens shortly exserted. Achenes c 1.5mm, brown (sterile?).

Bhutan: C–Thimphu, Bumthang and Mongar districts, N–Upper Mo Chu to Upper Kulong Chu districts; **Sikkim.** Hillsides and forest clearings, 3350–3950m. May-September.

6. B. macrophylla (D. Don) Soják; *Polygonum macrophyllum* D. Don, *P. sphaerostachyum* sensu F.B.I. non Meisner. Fig. 16d.

Rootstocks thick, fibrous. Stems 4–30cm, bearing 2–4 leaves. Lower leaves ovate-lanceolate, 4–12 × 2–3cm, acute, or sometimes linear and 3–10 × 0.1–0.6cm, margins often strongly inrolled, marginal veins prominent, base rounded or cordate, pubescent beneath; petioles 4–12cm; upper leaves lanceolate or linear, sessile; ocreae 1–5cm, brown, acute, entire. Racemes 2–7cm, remaining erect. Perianth 2–5mm, pink; pedicels 1–4mm. Achenes 2–3mm, brown.

Bhutan: C–Ha district (Damthang) and Thimphu district (Tremo La, Cheli La and Pajoding), N–Upper Mo Chu and Upper Bumthang Chu districts; **Sikkim.** Damp ground and alpine meadows, 3000–4870m. May–September.

The plants with narrow linear leaves and smaller flowers may represent a high alpine form; they generally grow at over 4000m, and appear to be connected by intermediates to larger flat-leaved forms.

7. B. griffithii (Hook. f.) Grierson; *Polygonum griffithii* Hook. f., *P. calostachyum* Diels

Similar to some forms of *B. macrophylla* but always a large plant, 20–40cm tall; basal leaves usually broader, 7–15 × 3–6cm, densely pubescent beneath; racemes 6–10cm becoming downwardly curved; perianth larger, 5–8mm and dark crimson.

Bhutan: C–Thimphu and Tashigang districts, N–Upper Mangde Chu, Upper Bumthang Chu and Upper Kulong Chu districts. Rocky mountainsides, 3950–4250m. July–September.

8. B. milletii Léveillé

Similar to broad-leaved forms of *B. macrophylla*; stems 20–30cm; lower leaves lanceolate, 8–15 × 0.7–4.5cm, gradually acuminate, base of lamina abruptly narrowed and decurrent on petiole up to 15cm, margins flat, veins scarcely prominent; upper leaves sessile; ocreae up to 10cm; racemes 2.5–6cm; perianth 5–6mm, crimson, pedicels c 3mm; achenes c 4mm.

Bhutan: N–Upper Mangde Chu (Jiu La). Cliff ledges and sandy banks, 4700m. November.

This specimen differs from typical Chinese *B. milletii* in having a thicker rhizome, leaves densely pubescent beneath, margins inrolled and with thickened veins. It is possibly intermediate between this species and *B. subscaposa* (Diels) Petrov from W China but differs from the latter in having narrowly oblong leaves.

9. B. affinis (D. Don) Greene; *Polygonum affine* D. Don

Tufted glabrous perennial herb with prostrate woody rootstocks; flowering stems erect, 15–30cm. Leaves elliptic-lanceolate, 4–8 × 0.7–1.5cm, acute, base attenuate, glabrous, sometimes glaucous beneath; sessile or with petioles up to 2 cm; ocreae 1–3cm, brown, many-nerved, lacerate. Racemes dense, terminal, 3–6cm. Perianth c 5mm, bright red. Stamens and styles shortly exserted. Achenes c 2.5mm, brown.

Sikkim: Llonakh Valley. Rocky hillsides, 4550m. June–September.

10. B. perpusilla (Hook. f.) Greene; *Polygonum perpusillum* Hook. f.

Dwarf perennial, 1–3cm tall with thick rhizomes. Leaves elliptic, 7–15 × 2–4mm, tending to become inrolled; petioles 4–8mm. Racemes 4–5mm. Perianth red or white, 2mm; pedicels c 1.5mm. Stamens 4 (1–3 fertile). Styles 2 or 3, shortly exserted, c 1mm. Achenes c 2mm, brown, trigonous or biconvex.

Bhutan: C–Tongsa district (Rinchen Chu), N–Upper Mangde Chu, Upper Kuru Chu and Upper Kulong Chu districts; **Sikkim.** Alpine turf and screes, 4100–4700m. July–August.

6. FALLOPIA Adanson

Twining annual herbs. Leaves ovate, acuminate, base hastate or cordate; ocreae short, oblique, entire. Flowers in axillary fascicles, sometimes forming leafy racemes. Perianth segments 5, inner 2 thinner, flat, outer 3 cucullate and keeled or winged, increasing in size in fruit and tightly enveloping achene. Stamens 8. Styles short. Achene trigonous.

1. F. convolvulus (L.) Holub; *Polygonum convolvulus L., Tiniaria convolvulus* (L.) Webb & Moquino

Puberulous herb. Leaves 2.5–4 × 1.5–2.5cm; petioles 1–2.5cm; ocreae c 4mm, membranous. Flowers few, in axillary fascicles or forming leafy racemes. Perianth pink, c 3mm, outer segments keeled or narrowly (c 0.2mm) winged, increasing to 4–5mm in fruit. Pedicels c 2mm. Achenes black.

Bhutan: C–Thimphu district (Paro and Pangri Zampa) and Tashigang district (Tashigang); **Chumbi valley.** Weed of roadsides and cultivation, 1100–2500m. June–September.

2. F. dumetorum (L.) Holub; *Polygonum dumetorum* L. Fig. 16k.

Similar to *F. convolvulus* but leaves up to 9 × 5cm. Flowers greenish, c 4mm,

outer perianth segments winged, increasing to c 5mm in fruit, tapering abruptly to slender base, up to 8mm to articulation with pedicel; wings 1–1.5mm broad, entire or toothed; pedicels 2–3mm.

Bhutan: S–Deothang district (Gomchu). Roadsides and forest margins, 2400m. August–November.

3. **F. pterocarpa** (Meisner) Holub; *Polygonum pterocarpum* Meisner, *Bilderdykia pterocarpa* (Meisner) Greene

Similar to *F. convolvulus* but leaves up to 6 × 4cm, on petioles up to 6cm. Flowers c 7mm, outer perianth segments winged, increasing to 1.8–2cm in fruit; wings c 2mm broad, entire, rounded at apex, tapering gradually and winged to base; pedicels 4–5mm.

Bhutan: S–Samchi district (Sangura) and Chukka district (Choonsam); **Arunachal Pradesh:** Nyam Jang Chu; **Sikkim.** Roadsides in subtropical forest, 1050–1500m. September–November.

7. POLYGONUM L.

Prostrate herbs. Leaves narrow, elliptic; petioles articulate; ocreae 2-lobed, membranous, becoming lacerate. Flowers 2–5 in axillary clusters. Perianth 4–5-partite. Stamens 4–5. Styles 2–3. Achenes trigonous or biconvex.

1. **P. aviculare** L. Fig. 16g.

Prostrate or ascending annual; stems up to 30cm. Leaves elliptic 10–25 × 2–7mm, acute or obtuse, base cuneate or attenuate, glabrous; ocreae c 6mm, membranous, with few ribs. Flowers 2–5 in axillary clusters, scarcely exserted. Perianth white or pink, 3–5mm. Achenes c 3mm.

Bhutan: C–Thimphu district (Thimphu valley and Drugye Dzong) and Punakha district (E of Dochu La); **Sikkim.** Weed of cultivation and waste ground, 2500m. May–September.

2. **P. plebeium** R. Brown

Similar to *P. aviculare* but smaller, internodes often shorter than leaves; leaves linear or oblanceolate, 5–15 × 1–2mm, obtuse, glabrous; ocreae c 2mm, hyaline, lacerate into hair-like segments; perianth c 2mm, white or pink; achenes dark brown, c 1.5mm, glossy.

Bhutan: S–Phuntsholing district (Torsa River) and Gaylegphug district (Birti), C–Thimphu district (Thimphu); **Sikkim.** Waste ground and river banks 200–2500m. March–May.

8. FAGOPYRUM Miller

Erect annual herbs. Leaves ovate, acute or acuminate, base cordate, hastate or deltoid; ocreae oblique, entire. Flowers in dense cymes or branching spike-like racemes. Perianth segments 5, connate near base, not accrescent. Stamens 3, attached near base of perianth and alternating with prominent glands. Styles 3, recurved, persistent, capitate. Achenes ovoid, trigonous, at least twice as long as perianth.

1. F. esculentum Moench. Dz: *Bjo;* Sha: *Bremu;* Tongsa: *Gerey;* Nep: *Phaper* (117); Eng: *Buckwheat.*

Stems up to 1m, often reddish. Lower leaves usually deltoid, 3–6cm long and broad at base; petioles up to 9cm; ocreae c 0.5cm; upper leaves usually cordate, sessile, semiamplexicaul. Flowers in dense terminal and axillary cymes; perianth segments pink, 2.5–3mm. Achenes c 6mm, sharply trigonous, surface flat or concave.

Bhutan: S–Samchi, Chukka and Gaylegphug districts, C–Ha and Tongsa districts; **Sikkim.** 270–1400m. May–September.

Cultivated in paddy fields. Achenes ground to make flour.

2. F. dibotrys (D. Don) Hara; *F. cymosum* (Treviranus) Meisner. Sha: *Khala, Kala;* Nep: *Titi Phapar.*

Similar to *F. esculentum* but stems sometimes up to 2–3m; lower leaves broadly deltoid, up to 13cm long and broad; ocreae 2–3.5cm, brown; flowers in slender branching, spike-like racemes; perianth segments c 3mm, white; achenes ovoid, c 7mm, sharply trigonous, surfaces flat or concave.

Bhutan: S–Chukka district, C–Ha to Mongar districts; **Sikkim.** Roadside ditches and margins of cultivation, 1400–3050m. June–October.

Young shoots sometimes eaten in spring.

3. F. tataricum (L.) Gaertner. Dz: *Bjo;* Sha: *Kala;* Tongsa: *Brema.*

Similar to *F. esculentum* but leaves broadly deltoid, up to 8cm long and broad; ocreae 0.75–1.2cm, acute, brown; flowers in branching racemes; perianth segments c 2mm, greenish; achenes 5–6mm, angles rounded at base, surface grooved.

Bhutan: S–Gaylegphug district (Birti and Tama), C–Tongsa district (Tongsa); **Sikkim.** April–May.

Cultivated and used like *F. esculentum.*

9. RHEUM L.

Perennial herbs with thick roots. Leaves large, ovate, entire or sinuate; ocreae membranous, sometimes large. Flowers in racemes or panicles. Perianth segments 6, connate at base. Stamens 7–9, borne on a ring adnate to perianth.

Ovary triquetrous; styles 3, very short, rounded. Achenes 3-winged, larger than unchanged perianth.

1. Large herbs, stems 0.5–4m ..... **Species 1–3**
   Small or dwarf herbs, stems less than 30cm 2

2. Inflorescence a spike or narrow panicle ..... **Species 4 & 5**
   Inflorescence globose ..... **Species 6**

1. R. acuminatum Hook. f. & Thomson. Fig. 16m.

Stems 0.5–1m, branched above. Basal leaves ovate, 15–30cm long and broad, shortly acuminate, base cordate, sparsely pubescent beneath; upper leaves smaller; petioles 15–30cm; ocreae 5–10cm, brown. Flowers in axillary or terminal panicles. Perianth segments oblong-ovate, c 3mm, dark red; pedicels 6mm, jointed near base. Fruits orbicular, 7–8mm long and broad, notched at base and apex, achene itself 6–7 × c 3mm, wing c 3mm broad.

Bhutan: C–Thimphu district (Barshong and Bela La) and Mongar district (Thrumse La), N–Upper Mo Chu to Upper Kulong Chu districts; **Sikkim.** Fir/*Rhododendron* forests, 3400–4100m. June–September.

2. R. australe D. Don; *R. emodi* sensu F.B.I. p.p. non Meisner

Similar to *R. acuminatum* but taller, up to 3m; basal leaves up to 35 × 30cm, acute; perianth segments c 2mm; fruits ovate, c 10 × 8mm, rounded or acute at apex, achene itself c 8 × 5mm, wings 1–1.5mm broad.

Bhutan: C–Thimphu district (Shingkarap, Paro Chu); **Sikkim:** (80). Alpine slopes, 4080m.

Used medicinally (13).

3. R. nobile Hook. f. & Thomson. Med: *Chhuka Dongpo;* Dz: *Chhuka.*

Stems simple, 1–1.5m, densely covered in pale reflexed bracts. Leaves broadly ovate or orbicular, up to 30cm long and broad, obtuse, base rounded or cordate, sparsely pubescent beneath, often tinged red especially below; petioles 15–20cm; ocreae ± as long. Bracts similar to leaves but smaller, yellow or white. Racemes or panicles 15–20cm, concealed by bracts. Perianth greenish, c 3mm. Fruits ovate, c 6 × 5mm, apex acute or rounded, achene itself c 5 × 3mm, wings c 1mm broad.

Bhutan: C–Thimphu district (Pajoding, Bela La and Somana, Paro Chu), N–Upper Bumthang Chu district (Marlung) and Upper Kulong Chu district (Me La); **Sikkim.** Rocky hillsides, 4250–4600m. June–August.

4. R. spiciforme Royle

Leaves all basal, ovate, 10–25 × 8–20cm, obtuse, rounded or cordate at base, sparsely pubescent beneath; petioles 5–10cm, ocreae ± as long, brown. Flowers in narrow, spike-like racemes up to 25cm, arising from among leaves; pedicels 3–4mm. Perianth segments 1.5–2mm, yellowish or red; stamens red.

Fruit ovoid, c 8 × 7mm, acute or rounded at apex, achene itself c 8 × 5mm, wings c 1mm broad.

Bhutan: N–Upper Mo Chu district (near Lingshi Dzong and Laya); **Sikkim.** Alpine hillsides, 4250m. May–July.

5. **R. delavayi** Franchet

Dwarf perennial with thick rootstocks; stems 7–30cm, erect, simple. Leaves mostly basal, somewhat fleshy, ovate, 1.5–4(–7) × 1–3.5(–5)cm, obtuse, base cordate, margins irregularly sinuate, glabrous above, pubescent with short thick hairs beneath; petioles 1.5–4cm, pubescent; lower stem leaves 1–2, smaller; ocreae 0.7–1cm. Panicle narrow. Perianth crimson within, greenish outside, 2.5–3mm, segments oblong-ovate, pedicels c 3mm. Achenes 5–6 × 2.5–3mm, ovoid, wings crimson, 2.5–3mm broad.

Bhutan: N–Upper Mo Chu district (near Lingshi). Gravelly alpine slopes, 4570m. July.

6. **R. globulosum** Gage

Dwarf herb with rootstocks 5–6mm thick. Leaves few, usually solitary, reniform or orbicular, 2–5cm long and broad, rounded, base cordate, margins entire or obscurely lobed, glabrous, upper surface minutely bullate; petioles 1–2cm. Inflorescence globose, 1.5–2cm, densely flowered, borne on peduncles 1.5–5cm; flowers shortly pedicellate. Perianth segments c 3mm, green edged with white, tinged red or red throughout. Mature fruits unknown.

Sikkim: Lungnak La. Grassy mountain slopes, 3960–5200m. June–July.

10. RUMEX L.

Erect annual or perennial herbs. Leaves ovate, lanceolate or hastate; ocreae membranous, deciduous. Flowers bisexual or unisexual, in axillary clusters or in whorls, forming simple or panicled racemes. Perianth segments 6, the outer 3 smaller, not accrescent, the inner 3 larger, accrescent and enveloping fruit. Stamens 6. Ovary trigonous; styles 3, fimbriate. Achenes sharply angular.

1. **R. nepalensis** Sprengel. Tongsa: *Shambali.* Fig. 16n.

Perennial herb. Stems 0.5–1.5m. Leaves oblong-ovate, lower ones 8–20 × 4–10cm, obtuse or subacute, base cordate, puberulous beneath; upper ones smaller; petioles 6–15cm; ocreae 2–4cm. Outer perianth segments oblanceolate, 2–2.5mm, entire; inner ones ovate, c 3 × 2mm in flower, toothed in lower half, 5–6 × 4mm in fruit, one of them usually with an oblong median tubercle, prominently veined and surrounded by hook-tipped bristles c 2mm long. Achenes 3–4 × 2mm.

Bhutan: S–Chukka district, C–Thimphu, Tongsa, Mongar and Tashigang

districts, N–Upper Mo Chu district; **Sikkim.** 1500–2500m. May–July.
The leaves are reportedly used in the treatment of eczema (117).

2. R. dentatus L.
Similar to *R. nepalensis* but annual or biennial; inner perianth segments dentate about the middle with straight teeth or sometimes subentire, all three segments bearing an ovoid tubercle at centre.
Sikkim: near Tonglo and Gangtok. 300m.

Two subspecies are recorded from Sikkim: subsp. **klotzschianus** (Meisner) Rechinger f. with perianth segments broad, strongly dentate with 3–5 teeth up to 2mm long, and subsp. **nigricans** (Hook. f.) Rechinger f. (*R. nigricans* Hook. f.) with perianth segments narrow, entire or with 1–2 short teeth.

3. R. trisetifer Stokes; *R. maritimus* sensu F.B.I. p.p. non L.
Similar to *R. nepalensis* but annual; leaves lanceolate, 12–18 × 2.5–5cm, attenuate at base into petiole; panicle leafy; inner perianth segments unarmed or with a needle-like tooth 3–4mm on each side, all three segments with an ovoid tubercle occupying much of their surfaces.
Bhutan: S–Phuntsholing district (Phuntsholing). Waste ground and weed of cultivation, 200m. April.

4. R. acetosella L. Eng: *Sheep's Sorrel.*
Dioecious perennial with creeping rootstock. Stems slender, 10–20(–60)cm, simple. Leaves hastate, 1.5–7 × 0.3–1.5cm, acute, basal lobes acute, spreading, glabrous; petioles up to 6cm; ocreae membranous, pointed or lacerate, 0.8–1.5cm; upper leaves smaller, sessile. Flowers in racemes or panicles; pedicels jointed near middle. Perianth reddish, c 1.5mm. Male flowers with erect segments; female flowers with outer segments reflexed, inner ones erect around ovary, broadly ovate or orbicular, c 3mm at maturity, margins entire; ovary triquetrous, styles lateral on angles of ovary, fimbriate. Achenes c 2.5mm, glossy, surrounded by enlarged inner perianth segments.
Sikkim: Darjeeling district. 2100–2400m.
Probably an introduction from Europe.

11. OXYRIA Hill

Erect perennial herbs. Leaves basal, broadly ovate or suborbicular, cordate at base; ocreae broad, sheathing. Flowers in branched terminal racemes. Perianth segments 4; the 2 outer smaller, becoming reflexed; the 2 inner larger, erect, scarcely accrescent in fruit. Stamens 6. Ovary elliptic, flattened; styles 2, fimbriate. Fruit subcompressed, surrounded by a broad wing.

1. O. digyna Hill. Fig. 16h–j.

Stems 5–60cm. Leaves 2–8cm, acute or obtuse; petioles 3–25cm; ocreae 0.75–1.5cm, brown, acute, brittle. Perianth segments obovate or oblanceolate, outer ones c 1.5 × 0.5mm, inner ones c 2 × 1mm. Fruit orbicular, notched at apex; embryo ovate, 2.5–3 × 1.5mm, surrounded by a brown, membranous wing 1–1.75mm.

Bhutan: C–Thimphu district (Somana, Paro Chu), N–Upper Mo Chu, Upper Bumthang Chu, Upper Kuru Chu and Upper Kulong Chu districts; **Sikkim.** Moist hillsides and screes, 3650–4500m. May–August.

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