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**High Altitude Flowering Plants  
of  
West Himalaya**

**HIGH ALTITUDE  
FLOWERING PLANTS OF  
WEST HIMALAYA**

**M. A. RAU**



**सत्यमेव जयते**

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## P R E F A C E

The fascinating flora of the high altitudes in the Himalaya has attracted worldwide attention. Royle's *Illustrations of the Botany of the Himalayan Mountains* published more than 125 years ago was, perhaps, the first book to give an extensive account of the flora of the western Himalaya. There have been many more publications since then including the illustrated works of Coventry and of Blatter on the flowering plants of Kashmir. These books are now out of print and are so rare that they are not easily available even for students of specialist interest. Hooker's *Flora of British India* published during the closing quarter of the nineteenth century described all the plants known from the area at that time. Since the publication of this *magnum opus* of Indian Botany, there have been numerous additions to the Flora and in recent years the application of the International Code of Botanical Nomenclature has resulted in the change of many established names of these Himalayan plants. An extensive literature has been built up on the subject which is too technical for the average reader. The Himalayan flora is not familiar to most people in our country though they may have heard of the beauty of the plants of these heights. There is, therefore, a great need for a popular publication on the subject which would bring these charming plants within the comprehension of the general reading public, students of Botany, travellers and other lovers of Nature.

The author has been studying the flora of the western Himalaya during the past ten years. As Head of the Northern Circle of the Botanical Survey of India, he has had the opportunity of exploring the high altitude valleys and mountain slopes in Lahul, Kulu, Kangra, Chamba, Mahasu, Tehri-Garhwal, Garhwal and Kumaon. He has, therefore, made an attempt to write a popular account of this flora. The subject is too vast, the area covered extensive and the plants involved are so many that the present effort can be best described as only an introduction to the subject. In the writing of the introductory chapters information available from published literature is largely made use of besides the personal observations made by the author during his collection tours. A list of reference works consulted is given at the end. A glossary of technical terms used in the text is also appended; some of these terms are illustrated with suitable diagrammatic sketches.

In the systematic part which follows the popular descriptions of the families, the keys have been constructed based on standard works on the subject. As far as possible, only easily observable characters are utilised though in the case of families like, Umbelliferae, Boraginaceae and Gramineae, it is not possible to devise suitable keys without introducing detailed characteristics of individual parts of the flower, fruit etc. The list of species given under each genus is compiled from literature as well as from a study of the specimens extent in the Herbaria of the Forest Research Institute, Dehra Dun and the Northern Circle of the Botanical Survey of India.

The line diagrams of plants illustrated are drawn from the dried specimens preserved in the Northern Circle Herbarium and are thus original. Mr. G. N. Madhwal made these diagrams and the author wishes to express his thanks to him for this assistance. The photograph of *Corydalis crassissima* was also taken by Mr. Madhwal while the other four photographs were taken by the author.

During the writing of this book, the excellent library and herbarium facilities of the Forest Research Institute were at all times freely available to the author and he takes this opportunity to thank the President and other officers of the Institute for this generous help.

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## Chapter 1

### INTRODUCTION — PHYSICAL FEATURES — CLIMATE

A hundred million years ago the landscape and life on our planet were very different from what they are today. The Indian Peninsula formed part of the great Asian Continent but was separated from the rest of the land mass by an eastward extension of the ancient Central Mediterranean Ocean, also known as the Sea of Tethys, which formed the northern border for the Peninsula. According to palaeoclimatologists, the climate was temperate to warm even at higher latitudes. Fossil evidence indicates that giant reptiles among other strange animals roamed about on land and the lush vegetation of the times was dominated by the conifers, cycads, ginkgo, ferns and others. This was the Cretaceous Age, which according to recent estimates is said to have lasted some 72 million years beginning about 136 million years ago and ending with the onset of the Tertiary Period. The Cretaceous Age witnessed many striking changes in the distribution of land and sea and in its fauna and flora, particularly, towards the end of the era. The event of great significance to the Indian sub-continent was the gradual shallowing and filling up of the stretch of the Sea of Tethys which later formed the site for the emergence of the great Himalayan mountain chain. The fauna and flora also underwent dramatic changes and by the end of the Cretaceous Age, the giant reptiles had almost disappeared from the scene and the flowering plants were on the way to becoming the dominant group in the world's flora.

The great Himalayan uplift which consisted of a series of violent movements of the earth's crust was spread over a considerable length of time during the Tertiary Period which is estimated to have lasted for about 64 million years. The Tertiary Period has been divided into the Palaeocene, Eocene, Oligocene, Miocene and Pliocene epochs in the order of sequence following the Cretaceous Age. The marine sediments which were accumulating in the sea bed along the northern border of the Indian Peninsula and in Tibet since the Permian Period of the Palaeozoic era, had almost filled up the stretch of the Tethys giving it a contour marked by ridges and basins by the close of the Cretaceous Age. A significant upheaval appears to have taken place during the upper Eocene epoch. The Eocene also saw the appearance of the Angiosperms (flowering plants) as the world's dominant flora and the development of the placental animals which had first appeared in the Palaeocene. A very powerful upward thrust of the earth's crust occurred during the middle Miocene followed by a further upheaval towards the close of the Pliocene. During the Miocene epoch, whales, apes and grazing animals appeared in the world at large and the Pliocene was marked by the presence of large carnivorous animals.





The Alaknanda valley in north Garhwal

The final phase in the uplift of the great Himalayan massif which gave its present contour appears to have taken place in the Pleistocene epoch. This epoch which lasted for about a million years was notable for the intermittent glacial conditions that existed in both the hemispheres. In particular, large areas in the northern hemisphere were covered by extensive ice sheets. This epoch is often referred to as the 'Ice Age'. The glaciation had its effect on the Himalayan mountain system also in the form of widespread snowfields and huge glaciers. It has been considered that the glaciers must have descended to altitudes as low as 2000 m above s.l. The glacial epoch in the Himalaya has left its mark in the form of "U-shaped valleys, truncated spurs, amphitheatres" and moraines which are seen in several sectors of the mountain system at present. According to anthropological estimates, early Man appeared during this epoch and must have "seen the last of the Himalayan uplift" It is said that the Himalaya has risen by about 2000 m since the coming of Man.

According to another school of thought, India formed part of the great southern continent (Gondwanaland) and broke off from it, drifting northwards, until it collided with the Asian land mass. The Himalaya rose as a result of this collision which is said to have taken place about sixty million years ago.

With an origin as described above, the Himalaya of the present times is among the greatest of all mountain systems of the world with its famed peaks, precipitous slopes, gorges, innumerable glaciers and the great river valleys. The main rock components are of crystalline and metamorphic nature together with sedimentary deposits dating back to the Paleozoic Age. The gneisses and schists met with are the metamorphosed products of violent igneous activity at the beginning of the Tertiary Period. The great rivers of the area, Indus, Sutlej, Beas, Parvati, Bhagirathi, Alaknanda, Pindar and others have all cut deep gorges through the mountain and it is a common sight to see the extensively eroded valleys in every sector of the Himalaya. The present course of some of these great rivers suggests that "the rivers must have existed even before the great upheaval took place during which the erosion of the valleys must have proceeded alongside with the result that an extensive valley system had already built by the time the mountain finally emerged to its present heights." The awe inspiring gorges and the precipitous mountain slopes are impressive in the extreme and some of the transverse gorges in the western Himalaya are at places as deep as 2000 to 3000 m and are so narrow that the width is only 10 to 30 km between the summits of the mountain on the sides (Wadia, pp. 29-30).

The western Himalaya also presents many glaciers and glacial morainic beds. The present day glaciers are, however, considered to be only "shrunk remnants" of the extensive snowfields and ice flows of

the Pleistocene epoch. The most important of them are the Pindari and Milam glaciers in Kumaon, the Kedarnath and Gangotri glaciers in Garhwal and Tehri-Garhwal, the last named being the biggest of the group, about 25 km in extent. The glaciers in Kashmir are more numerous and extensive and some of them descend very low reaching a lower limit of about 2400 m above s.l. Recent studies have indicated that the Himalayan glaciers are in retreat. The morainic deposits left by the retreating glaciers in course of time get a cover of vegetation and form an important habitat for alpine\* plants. The picturesque lakes met with at high altitudes, as for example, the lake Hemkund in Garhwal also remind us of the glacial conditions of ancient times. The morainic slopes around such lakes of glacial origin are rich in alpine herbs. In addition, the high altitude slopes, screes and rocky crevices found above the tree line and up to the level of permanent snow form habitats for the present day alpine flora.

In an area which includes such a mighty mountain system with its gorges, river valleys and glaciers and with altitudes reaching as high as 7500 m above s.l., the climate is certain to vary considerably from place to place. The vegetation of the alpine heights is influenced by various climatic factors like rainfall, humidity, ultra-violet radiation, temperature and winter precipitation apart from the topographical considerations like the direction and precipitousness of the slopes, exposure etc. The steep slopes in many places do not permit the formation of a fully matured soil as the mineral soil is easily washed away along with the humus layer. The physical characters of the substratum, therefore, assume greater importance than even the chemical composition in determining the vegetation on such slopes. The water holding capacity of the substratum is of the greatest significance. In some areas, soil erosion is alarming. This is particularly noticeable in the dry northern valleys of Lahul, Garhwal and other localities. Anne Davis, a mountaineer, has graphically described the conditions in Zaskar stating that the area is "rapidly becoming a Himalayan dust-bowl"

Rainfall is rather scanty at high altitudes. The moisture bearing winds from the plains are drained of their moisture by the successively higher ranges of mountains. The innermost ranges as well as the trans-Himalayan regions have very little rainfall. In some of these places, particularly, in the northwestern sectors of western Himalaya, almost desert conditions exist. Such dreary places which may be called alpine deserts are seen in Zaskar, Ladakh, Rupshu, Lahul, Spiti and Kinnaur. Detailed rainfall data are lacking for most inner valleys and passes but the limited data available indicate that in some high passes, the rainfall during the three months of the monsoon period may be as low as 10 to

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\*The term 'alpine' here and in the following pages is used in a general sense to refer to high altitudes.

12 cm while during winter, the precipitation is very heavy and, very often, the snow may block the entire valley. It has been recorded that the snowfall may exceed on an average 10 m at altitudes of 4500 m and much more at higher elevations. During summer heavy rainfall, on occasions, has been experienced at altitudes of even 4500 m. Describing the conditions on a midsummer day on Panchchuli in western Kumaon, Thomas Weir, the mountaineer, writes "on the 26th July at 15,000 ft., the monsoon clouds had won the race, the blackness of thunder filling the glen. In such conditions, we turned for home, the deluge beginning as we reached the lower glacier". On another occasion, he writes of the thunder and lightning and heavy rain in the night at an altitude of 4800 m. Though such heavy showers are known at high altitudes, in general, the rainfall is rather scanty and winter snow constitutes the major part of the annual precipitation. Winter snow remains for a long period in such localities.

In regard to temperature, it is well known that it falls with increasing altitude. Based on available records, it has been estimated that in the western Himalaya, a variation of about 1° C for each 180 m rise is generally seen and the mean annual temperature at 3500 m would be about 6° to 8° C. There is, however, considerable variation in this regard not only in various sectors but even in different places within the same valley. The daily fluctuation in temperature is also variable but in the extreme northwest Himalaya, it has been recorded that it averages 5°C. The intense sun radiation prevalent at high altitudes has been described by many mountaineers—"the sun blazed from a caerulean sky", "the sun shone pitilessly", "a brilliant sun shone day after day" and so on. Harligkofer of the Nanga Parbat Expedition of 1953 writes about the considerable sun radiation in the higher camps so that "at altitudes above 14,600 ft., any mountaineering work was impossible between the hours 10 A.M. to 1 P.M.". Thomas Weir describes the excessive heat and glare which added to the effects of altitude and loss of appetite and calls it "the poison of the heights".

Snow storms, blizzards and extremely frigid conditions at night are other factors which operate at such heights. In spite of all these adverse climatic conditions, it is remarkable that a flourishing alpine flora exists and it is with such a flora that we are mostly concerned in this book.

## Chapter 2

### THE ALPINE FLORA

The alpine flora of western Himalaya as it exists today has had a long history. The question of its origin does not offer an easy solution and its study is beset with many difficulties. It is presumed that the Himalayan mountain had its own flora even before the Pleistocene epoch. During the intermission between the periods of glaciation, warm conditions probably prevailed in which plants and animals must have thrived though many of them may have perished with each glaciation. In the Himalaya, the glaciers did not reach the foothills with the result that the vegetation of the lower belt was not affected. Migration of floras, survival of relicts, evolution of new species by an intermixing of different floras and by mutation and acclimatisation of species from the lower altitudes must have all had a role in determining the present day composition and distribution of the Himalayan alpine flora. One of the effects of glaciation and its resultant climatic changes was to "telescope up the floristic and climatic zones rather than to eliminate the higher values". The well known plant geographer, Good, has stated further that "by this kind of migration the movement by which independently originating floras become mixed so as to consist of or show elements derived from various directions". Polunin, another authority on plant geography, writes in a similar vein and describes the effects of such migration and consequent mixture of floras. The prepleistocene southward migration and persistence through the pleistocene epoch are possibilities which would help to explain the existence of 'arctic' plants on mountains far to the south. In other instances, "the similarity to arctic conditions evidently enabled properly acclimatised plants to retreat to the mountain tops, even as they were able to persist near the margin of the ice and follow it north".

A study of the alpine flora of western Himalaya also reveals that a large number of species and most genera of the lower alpine belt in the Garhwal-Kumaon sector and eastwards appear to come from Tibet, west China and adjoining northeast Asia. Further west, the northwestern sector of the Himalaya has been subject to considerable influence from the adjoining floristically rich areas located in the Karakoram, Pamir and further north in the Tien Shan range of mountains. Shivaram Kashyap who conducted a number of explorations in the alpine zone of west Himalaya and in the Tibetan highlands is of the opinion "that the floras of the Himalaya, Tibet and west China have had a common origin and differentiation gradually took place as Himalaya and the Tibetan plateau rose from the sea level to become the highest region in the world".

Regarding the present day distribution of the alpine flora, in the central and eastern sectors, William Stearn has recently discussed certain

general patterns of distribution based on a study, in particular, of two genera, *Allium* and *Mithula*. According to him the distribution of these members has considerable bearing on the plant geography of the Himalaya. His conclusions have found general support by other monographic studies conducted in recent years on genera like, *Epilobium*, *Aster* and others. Stearn distinguishes ten categories of range for montane and alpine Himalayan species, of which the following are relevant to the flora of western Himalaya: (a) species of western, central and northern Asia extending into (i) Kashmir, (ii) all along the western Himalaya; (b) species confined to western Himalaya; (c) species of western China extending along the whole Himalaya to or into Kashmir and (d) species of western China extending from Yunnan along the eastern Himalaya over much of Nepal and in some instances beyond it into the Kumaon Himalaya. Stearn has also drawn attention to the need for a study of the Chinese species along with the Himalayan ones because much of the Himalayan flora must have come from the Chinese mountains eastward which are older than the Himalaya. An arbitrary line of demarcation between the western and eastern Himalayan floras has been drawn by him along 83° E Long. This has been generally found acceptable for several other genera which have been studied from the phytogeographic point of view. These studies have revealed the various possibilities regarding the entry of floristic elements into the Himalayan heights from the north, west and east. Species whose main area of distribution is to the north of the Himalaya are known to have entered the Himalaya either from the west or from the east. Some of the species which were widespread in Asia in preglacial times and had a more northern location than their present day stations migrated south into the mountains of western China and into western Himalaya before spreading further and colonising the entire area.

It is also possible that the ancestors of some of the species which have only a scattered distribution at present may have flourished extensively during the upheaval of the Himalaya but later, due to competition or other adverse climatic conditions, most of them may have perished leaving only the few scattered survivors. On the other hand, there are also instances of plants which occurred before the Pleistocene glaciations having survived the glacial epochs in unglaciated areas or in mountain pockets and which may have given rise to related species in course of time and whose descendants spread to form the present range of distribution.

An analysis of the present day alpine flora in western Himalaya indicates that there are more than 1000 species occurring at altitudes above 3300 to 3600 m, the arbitrary lower limit set for the alpine zone in this work. The families of flowering plants represented in this zone are Compositae (146 species), Gramineae (135), Cruciferae (76), Scrophu-

lariaceae (66), Leguminosae (66), Rosaceae (61), Ranunculaceae (60), Cyperaceae (51), Saxifragaceae (43), Umbelliferae (45), Gentianaceae (42), Caryophyllaceae (42), Labiatae (39), Boraginaceae (37), Primulaceae (35), Polygonaceae (30), Liliaceae (25), Fumariaceae (20) and 46 other families with less than 20 species. Among the genera, *Astragalus*, *Carex*, *Corydalis*, *Gentiana*, *Pedicularis*, *Polygonum*, *Potentilla*, *Primula*, *Saussurea* and *Saxifraga* are the largest with 20 or more species.

While some of the species like *Thlaspi andersonii*, *Chorispora sabulosa*, *Biebersteinia odora*, *Christolea himalayensis*, *Heracleum thomsonii*, *Cremanthodium nanum* and others have a restricted distribution being found only in western Himalaya or in adjacent Tibet, there are others like, *Thalictrum alpinum*, *Ranunculus hyperboreus*, *R. pygmaeus*, *Potentilla multifida*, *Saxifraga flagellaris* (sensu lato), *Sedum rosea*, *Oxyria digyna*, *Triglochin palustre* and several others which enjoy a world-wide distribution in both the alpine and arctic localities. Some species like, *Thylacospermum rupifragum*, *Cicer soongaricum*, *Physochlaina praealta* and *Lamium rhomboideum* extend northwards to the Central Asian highlands. *Senecio coronopifolius*, *Nepeta supina* and a few others are distributed westwards to Afghanistan, Iran and the Caucasus. There are many species distributed all along the Himalaya from west to east. *Gueldentia himalaica*, *Astragalus strictus*, *Saussurea leontodontoides*, *Cicerbita macrorhiza*, *Picrorhiza kurrooa* and others are in this category. *Aletris pauciflora*, *Anemone rupicola* and *A. vitifolia* are among the species which are found in west China and also throughout the Himalaya as far as west Kashmir.

## Chapter 3

### THE ALPINE HABITATS

In the present work, the lower limit of the alpine zone has been arbitrarily taken as 3300 to 3600 m above sea level. On account of the widely different conditions that prevail in the various sectors of western Himalaya, it is very difficult to say at what altitude the alpine zone begins. In some localities where the glaciers descend to lower levels as in Kashmir or where the winter snow remains in deep pockets, alpine flora may be seen even at altitudes of 3000 m or less. At the upper limit, plant life is seen generally up to 5600 m though, exceptionally, some plants may occur even higher. Flowering plants have been collected on occasions at altitudes above 6000 m. The record for western Himalaya is perhaps held by a cruciferous plant, *Christolea himalayensis*, a specimen of which was collected at an altitude of 6300 m by Gurdial Singh during the Mt. Kamet Expedition of 1955. This small crucifer was found on loose micaceous sandstone on the sunny aspect of a ridge. Flowering plants have also been seen at altitude of 6000 m or more in the Mt. Everest region. Zimmerman who accompanied the Swiss Everest Expedition of 1952 has been quoted as having seen an *Arenaria*, a tufted *Androsace* and another small *Saxifraga* or *Sedum* at the foot of the Lhotse glacier and he believed that "he had collected the highest plants in the world".

The alpine zone is generally considered to begin where the tree zone ends. This is also called the 'timber line'. A fringe of shrubs may be seen in some places and in others, continuous or scattered dwarf or gnarled trees may be present immediately above the tree line. In the absence of tree cover, the vegetation is exposed to the fury of cold winds, blizzards and snow storms and as such the stunted trees often show a characteristic wind-swept or snow-swept appearance. Birches, Rhododendrons and willows, among others, may be seen in such situations.

The high level conifers, species of *Abies*, *Picea*, *Cedrus* and *Pinus* reach their highest limit at altitudes around 3600 m above s.l. Among the broad leaved trees, the oak (*Quercus semecarpifolia*) and the birch (*Betula utilis*) which are often found as associates in conifer forests also reach this altitude. Above this altitude, in many localities, *Betula utilis* may be found in pure stands or in association with a Rhododendron (*R. campanulatum*). The shrubs found above the tree line are usually species of *Berberis*, *Myricaria*, *Lonicera*, *Rhododendron*, *Salix* and a dwarf conifer, *Juniperus*. In the more favourable areas where adequate water is available, the Rhododendrons are frequently seen along with *Berberis*, *Lonicera* and others. In the drier inner valleys where the vegetation is of a scrub type, the chief components are species of *Artemisia*, *Astragalus*, *Caragana* and *Ephedra*. The Junipers are generally seen on





An alpine scrub in Kumaon



The Himalayan Birch (*Betula utilis* D. Don) at the entrance to the Valley of Flowers in north Garhwal (alt. 3600 m)

limestone. In extreme northwest Garhwal, in the bleak northern Lahul valley, in the interior of the Sutlej valley and in Spiti where precipitation is very scanty, the vegetation is closely similar to that of the Tibetan highlands; more so is the case with the Trans-Himalayan sectors of Ladakh and Zaskar. In the alpine shrubby zone, it is common to see the very dwarf recumbent shrubs with large number of long prostrate branches spreading over a considerable area; often they are closely packed together. Topography and disposition of the slopes are important factors in determining the composition and extent of distribution of the shrubby species. In northern Kumaon, for example, *Rhododendron anthopogon*, an aromatic shrub, is particularly common on the northern slopes whereas the vegetation on the southern slopes is more xeric in character with the presence of *Cotoneasters*, *Ephedra*, *Juniperus* and others. A similar topographic distribution has also been recorded by Polunin in west Nepal where the north facing slopes are forested with *Abies* and *Betula* and the dry and sunny southern slopes support herbs, grasses and scattered bushes of *Juniperus*.

Above the tree line is usually present a grassy belt with lush meadows, grassy slopes and flower laden pastures. One often finds many prostrate shrubby species like willows, heathers and, here and there, grassy tussocks with bare soil between them. These pastures, meadows and grassy slopes form an important habitat for alpine species, and may occur higher than the shrubby zone or alongside it. The herbs are dominant here and include many species well known for their attractive flowers. These herbs are mostly perennial and show well marked preference for altitudes. They exhibit also a very interesting cycle of growth. Referring to the Valley of Flowers in Garhwal, Smythe, the well known mountaineer has written, "in the Bhyundhar Valley, I saw ground that was so closely packed with fritillaries that it seemed impossible that other plants could grow, yet when the fritillaries had died down, they were succeeded by other plants such as *Potentilla* which grew equally densely. And this cycle persisted throughout the summer, one plant being replaced by another with perfect precision". This is true of many other localities. At alpine heights, with the melting of snow late in May or early in June, a profusion of early summer flowering herbs appear, among them, several Crucifers, Primulas, Anemones, and Saxifragas and later in summer and towards autumn appear the Gentians, Swertias and others with the *Saussureas* attaining their best development late in autumn.

Another aspect of interest is the strange association of some plants. Smythe queries, "the purple *Orchis* loves the near presence of thistles?" Describing *Lamium rhomboideum*, Moddie says "they hid in coy clusters on the north facing slopes of the Khingur in the shelter of rock or *Caragana* bush and there was nothing prettier here". This was at Khingur Pass (alt. 5000 m) in north Kumaon. The present author saw a similar

association, in north Garhwal, of the beautiful, delicate blue *Corydalis* (*C. cashmeriana*) growing in the midst of tussocks of a grass (*Danthonia* sp.) which is not grazed by cattle.

The alpine grassy meadows form a lush carpet in many localities. One of the prettiest examples of such mead was in north Garhwal is Lakshmiban on the right bank of the Alaknanda river facing the Vasudhara waterfall. During the summer months this green expanse is a lovely sight, the main components of the meadow being the grasses, *Phleum alpinum* and *Poa alpina* with a multitude of colourful herbs like Anemones, Gentians, Potentillas and Primulas.

In Kashmir, the lush grassy meadows are locally known as the 'margs'. The sub-alpine margs are found at altitudes of nearly 3000 m especially on the ridges and in the inner valleys. The meadows are extensive and slopy and often possess plants of the bushy habit besides a rich carpet of grasses and sedges in association with beautiful herbs. *Osmunda* (*Osmundastrum*) *claytoniana*, *Berberis* spp., and *Euphorbia wallichii* are among the larger plants while the turf is composed of species of *Alchemilla*, *Anemone*, *Astragalus*, *Barbarea*, *Cardamine*, *Cerastium*, *Plantago*, *Poa*, *Viola* and others. These pastures are usually found up to the snow line. At higher altitudes hundreds of handsome herbs are found, among them, species of *Arenaria*, *Aster*, *Callianthemum*, *Draba*, *Gagea*, *Gypsophila*, *Lagotis*, *Leontopodium*, *Primula*, *Ranunculus*, the sedges, *Carex* and *Kobresia* and the grasses, *Hierochloe*, *Poa* and *Trisetum*. These alpine pastures are heavily grazed and this often results in the growth and spread of toxic plants. In some areas, extensive patches of *Adonis chrysocyathus*, *Iris kumaonensis* and *Stipa sibirica* are seen because these are not eaten by the animals.

In Garhwal and Kumaon, the high altitude pastures and grassy slopes are locally known as 'bugyals'. These are generally found at altitudes above 3500 m and the graceful herbs occur in great profusion on the gentle mountain slopes or sometimes along the ridges. In a locality called Joharpatti in Kumaon, a continuous stretch of green meadows is seen offering a wide variety of alpine herbs. The distribution pattern of the 'bugyal' flora is largely determined by the local edaphic and climatic conditions. In Garhwal, similar picturesque bugyals or alps are seen at Bishtola, Baidni, Ali and Bajmora in the Nandakini basin. It is on such bugyals that the cycle of growth of the picturesque alpine herbs is most vividly seen.

The alpine marshes, stream banks and similar watery situations are favoured by another set of herbs. In many localities, the melting of snow leaves small depressions or gullies which are water-filled. These form marshy tracts. The hill streams form a criss-cross system in many higher valleys. Near Badrinath in north Garhwal, on the eastern side of Mt. Nilakantha, the Charanapaduka Valley is a typical example of a stream-

filled valley. Numerous high altitude herbs characteristic of moist situations are found in this valley. Among them are *Pinguicula alpina*, the insectivorous plant (butter wort), various colourful species of *Corydalis*, *Primula*, *Pedicularis*, *Polygonum* and the rush, *Juncus leucomelas*.

The marsh marigold, *Caltha palustris*, is a very common herb along water margins. Yellow patches of flowering scapes set against the green foliage attract the attention of travellers. In the Chandra Valley in Lahul, this herb is abundant on the grassy slopes and one can locate the hill streams even from a distance by noticing the yellow strings of *Caltha*. Near hill streams in Lahul and elsewhere is usually seen another very conspicuous herb, the bright purple flowered, *Pedicularis punctata* with its peculiar beaked corolla. An interesting association of the white flowered, *Parnassia nubicola* with the clumps of *Pedicularis* was noticed in Lahul. Other species found near the water margins are those of *Androsace*, *Arabis*, *Gentiana*, *Polygonum*, *Ranunculus* and *Saxifraga*.

At the higher limits of vegetation, the habitats are varied. Conditions are severe and exposure to cold and blizzards prevent many herbs from occupying exposed situations. The herbs are generally restricted to sheltered slopes, rock crevices and beneath rock ledges. The commonest adaptation seen in this zone is the cushion habit. Cushion-like plants also predominate in the cold scree desert, stony waste and rubble of the exposed drier localities. Species of *Androsace*, *Draba*, *Paraquilegia*, *Saxifraga* and *Sedum* form soft cushions. Rigid mat forming shrubs, often spinescent, are represented by the species of *Acantholimon*, *Arenaria*, *Astragalus*, *Caragana*, *Thylacospermum* and others.

The most curious of all flowering plants are, however, the woolly Compositae, *Saussurea graninifolia*, *S. gossypiphora*, *S. simpsoniana* and *Sorosaris glomerata*. Some species of *Anaphalis*, *Leontopodium* and *Tussilago* have also soft white hairs but they do not attain the extensive development of wool that one sees in the species named above.

The high alpine grasslands generally show mixed association of grasses, sedges and colourful herbs belonging to various families but in some localities, pure formation of grasses may occur. *Helictotrichon virescens*, *Danthonia* spp., and *Stipa orientalis* are among the grasses which occur in such pure communities.

## Chapter 4

### SOME ATTRACTIVE HERBS OF WEST HIMALAYA

The main characteristic features of the alpine flora and the habitats have been described in the previous chapters. It is proposed to give here brief descriptions of some selected high altitude herbs which are outstanding for their attractive flowers. The descriptions are mostly based on the specimens present in the collections of the northern Circle of the Botanical Survey of India. Many of these herbs have also been studied in their natural habitats by the author. The general distribution and some representative localities of recent collection of each of these species are mentioned. The species have been arranged in the alphabetical order.

#### ***Aconitum balfourii* Stapf (Ranunculaceae)**

A tall erect herb. Roots tuberous, usually paired, daughter tubers often divided. Stem 1-2 m high, simple. Leaves scattered, 6-10, 3-partite, divisions in turn variously lobed, the entire leaf nearly 10 cm across; petioles 4-6 cm long. Inflorescence straight up to 30 cm long. Flowers blue, arranged in a dense raceme; carpels 5, follicles 1.5 cm long.

This attractive herb is known from various localities in Garhwal and Kumaon extending to Nepal at altitudes, 3600-4000 m.

Garhwal (Nar Parbat); Kumaon (Darma Valley).

*Flowers:* July-September. *Fruits:* September-October.

#### ***Aconitum falconeri* Stapf**

An erect herb up to a metre high. Roots biennial, paired, daughter tuber conical with a broad base. Leaves about 10, cordate-reniform, 5-partite, lobes finely cut. Inflorescence 20-25 cm long, flowers large, blue; carpels 5.

Tehri-Garhwal; Garhwal (Valley of Flowers), 3500-4000 m.

*Flowers:* July-September. *Fruits:* September-October.

#### ***Aconitum violaceum* Jacq. ex Stapf**

One of the most attractive of all monkshoods of western Himalaya. A much smaller herb with the stem often very much reduced. Roots paired, tuberous, small, ovoid or fusiform, 1-2 cm long. Leaves few, lower long petioled, deeply 5-partite, almost to the base, lobes further divided into narrow, linear segments, 1-2 cm long. Flowers in short racemes or corymbs often reduced in number to one, large for the size of the plant, 2 cm by 1.5 cm, violet-blue; carpels 5.

This charming herb is distributed all along the Himalaya west of Kumaon. It flowers during August-September and is particularly common

along the Rohtang Pass during the autumn months. It is known among other places from the Bandipur Nala in Kashmir, Kibar in Spiti, Sangla Valley in Bashahr, Hemkund region in Garhwal and Gangotri in Tehri-Garhwal at altitudes above 3000 m.

**Adonis chrysoeyathus** Hook. f. & Thoms. (Ranunculaceae)

A perennial, erect, tufted herb with prominent sheaths at base. Leaves radical, very much dissected, ultimate lobes filiform. Flowers solitary on leafy scapes, golden yellow, 5-6 cm diam.; sepals 5-8, petals, many in whorls, prominently linear-veined; stamens many; carpels with curved style; achenes on a globose head; 1.5 cm long; style curved.

Western Himalaya in the alpine region, 3500-5000 m.

Kashmir (Sheshnag, Apharwat); Kumaon (Lebung Pass).

*Flowers and fruits:* July-September.

**Allium carolinianum** DC. (*A. blandum* Wall.) (Liliaceae)

A tall, stout herb, up to 60 cm high. Bulb large, elongated, 10-12 cm by 3-4 cm; foetid smelling. Scales entire. Leaves flat, 30 cm long, 1.5 cm wide. Flowering scape, longer than the leaves, up to 50-60 cm; flowers arranged in dense heads, 4-5 cm diam. Flowers pink.

Western Himalaya, Afghanistan, Central Asia.

Kashmir (Sonamarg Glacier); Lahul (Tandi); Kumaon (Milam), 3700-4000 m.

*Flowers:* June-August. *Fruits:* September-October.

**Androsace globifera** Duby (Primulaceae)

A soft, cushion forming herb. Stem short, erect or prostrate. Leaves in globose rosettes, about 1 cm in diam., the rosettes softly silky. Flowers 0.5-0.75 cm diam., white or pale lilac, solitary on short scapes, 1-1.5 cm high.

An attractive rock plant, the globose rosettes presenting yellowish to orange-red coloration against the greenish background of the outer whorls, during the autumn months.

Western Himalaya, alpine zone, 3600-4500 m.

Garhwal (Hemkund); Kumaon (Bogdiar, Martoli).

*Flowers:* June-August. *Fruits:* September-October.

This species belongs to a group of cushion forming *Androsaces* of the alpine zone among which, *A. chamaejasme*, *A. poissonii* and *A. villosa* also occur in west Himalaya.

**Anemone obtusiloba** D. Don (Ranunculaceae)

A tufted hairy herb with thick, fibrous rootstock which is covered by old leaf sheaths. All vegetative parts of the plant covered by soft, whitish

hairs. Radical leaves many, long-petioled, petioles broad, grooved, 8-10 cm long, leaves 3-foliolate, lobes rhomboidal, crenate-margined, hairy on both surfaces. Flowers white, bluish or yellow, 2.5-3 cm diam., on hairy, flattened scapes. Involucral leaves, sessile, lobed, lobes linear and narrow. Sepals 5-6, oval or obovate, obtuse. Stamens many, filaments flattened, narrowing towards apex; carpels many, achenes covered by stiff hairs.

The white and bluish coloured flowers are common at altitudes, 2500-3500 m and the yellow ones above 3500 m.

Throughout temperate and alpine Himalaya.

Kashmir (Bhadrawah, Bannihal, Jai Hills, Sheshnag); Chamba (Satrundi, Sach Pass); Lahul; Kulu (Rohtang Pass); Simla (Hattu); Garhwal (Bishtola); Kumaon (Garbyang).

*Flowers:* May-July. *Fruits:* August-September.

**Anemone narcissifolia** Linn. var. **polyanthes** Finet & Gagnep.

A large hairy herb up to 60 cm high. Rootstock woody, fibrous. Radical leaves on long hairy petioles (25 cm long), deeply 5-lobed, 10-12 cm across, each lobe in turn divided into 3, margin toothed, hairy on both surfaces. Scape stout, 30-40 cm long with a crown of involucral leaves, 3-lobed, lobes linear-oblong, crenately 3-lobed at the tip. Umbels of 5-6 flowers, large, 2-3 cm diam., white; sepals 5-8, elliptic, pedicels 4 cm, hairy. Achenes with hooked style.

Himalaya: Kulu (Rohtang Pass), Garhwal (Hemkund); Kumaon (Panch Chuli, Milam, Pindari).

*Flowers:* June-August. *Fruits:* September-October.

**Aquilegia pubiflora** Wall. ex Royle (Ranunculaceae)

A large, very much branched herb, somewhat hairy. Leaves ternately decomposed, petiole sheathing at base. Upper leaves on the panicle sometimes entire. Flowers large, purple, 4-6 cm diam. Sepals large, broad, tapering towards the apex, sometimes attenuated. Petals shorter, broad with sharply curved spurs. Carpels with long hooked styles. Achenes loosely arranged with rough hairs on the pericarp. Style persistent.

Western Himalaya, 2000-3600 m.

Kashmir (Chandanwari); Chamba (Sach Pass, Satrundi); Tehri-Garhwal; Garhwal; Kumaon (Kalamuni Pass).

*Flowers and fruits:* June-September.

**Archangelica himalaica** Edgew. (Umbelliferae)

A tall perennial herb. Stem 2-3 m high, nearly 5 cm diam., at its stoutest part. Lower leaves large bi- or tri-pinnate, base with a prominent sheath. Leaflets up to 15 cm long, 6 cm broad, terminal leaflet 3-lobed, toothed. Inflorescence, a large compound umbel, peduncles 30 cm long, umbels numerous as many as 20, each with 30-40 pedicels. Bracteoles



many, linear, ovate or toothed. Flowers white. Fruiting umbels very large, spreading, 30 cm across. Fruits, 1 cm long, oblong, lateral ridges flattened.

Himalaya, 3000-3800 m.

Kashmir (Desu, Tulin Lake).

*Flowers:* July-August. *Fruits:* September-October.

**Aster diplostephioides** (DC.) C.B. Clarke (Compositae)

An erect, perennial herb up to 50 cm high. Rhizome covered by fibrous remains of leaves. Stem unbranched. Leaves elongated up to 15-18 cm long (incl. petiole), blade oblanceolate, teeth minute, distant along the margin. Flowering head solitary, 5 cm across, rays lilac, disc dark brown.

A beautiful Aster known from Kashmir (Lidder Valley), Kulu, Bashahr, Garhwal (Valley of Flowers) and Kumaon, among other places in western Himalaya in the altitude range, 3300-4800 m and extending eastwards to Nepal, Sikkim, Bhutan and China.

*Flowers and fruits:* June-September.

**Bergenia stracheyi** (Hook. f. & Thoms.) Engl. (*Saxifraga stracheyi* Hook. f. & Thoms.) (Saxifragaceae)

A perennial herb with stout rhizome, 3-4 cm diam., covered by dried leaf bases. Leaves oblong or obovate, rounded at apex, smooth on both surfaces, 6-16 cm long and 4-10 cm wide. Margin entire or crenate. Leaves turn into various shades of orange and red during the autumn months. Inflorescence, an asymmetric panicle on a thick scape, up to 25 cm long, the scape emerging from amidst the dried leaf bases; inflorescence axis and calyx lobes glandular-hairy. Flowers many, crowded, mildly fragrant, white or pink in colour; style long becoming reddish and conspicuous in fruit.

A very conspicuous herb amidst rocks and boulders at high altitudes throughout west Himalaya in the altitude range, 2000-4500 m, extending westwards to Afghanistan and Central Asia.

Kashmir (Apharwat); Chamba (Sach Pass); Kulu (Rohtang Pass); Spiti (Kunzam Pass); Bashahr; Tehri-Garhwal (Gangotri, Jumnotri); Garhwal (Alkapuri Base); Kumaon (Milam).

*Flowers:* June-August. *Fruits:* August-October.

**Calamagrostis emodensis** Griseb. (Gramineae)

A tall grass, up to a metre high. Leaves 30 cm long, 1 cm wide, stiff, surface coriaceous, pale green in colour; sheaths purplish. Inflorescence, silky, shining, purplish or greenish, 16-18 cm long, 5-6 cm wide, of closely set spikelets.

Throughout the Himalaya in temperate and sub-alpine zone. Garhwal (Valley of Flowers); Kumaon (Dwali).

*Panicles:* August-September.

***Clematis montana* Buch.-Ham. ex DC. (Ranunculaceae)**

A woody climber, climbing over the Himalayan birch and other shrubs at high altitudes. Leaves 3-foliolate, fascicled at nodes. Petioles up to 6 cm long. Leaflets shortly stalked, ovate, serrate, acute, variable in shape and serration. Flower stalks longer than leaves, naked. Flowers white or cream-coloured, fragrant, 8 cm diam. Sepals 4, large, oval, obtuse, strongly net-veined, purplish-silky outside. Stamens indefinite; carpels many, styles plumose. Achenes, oval, flat, 5 mm long; style feathery nearly 2.5 cm long in fruit.

Throughout the Himalaya up to 3600 m.

Kashmir; Simla; Tehri-Garhwal (Jumnotri); Garhwal; Kumaon.

*Flowers:* April-June. *Fruits:* July-October.

***Codonopsis ovata* Benth. (Campanulaceae)**

A weak herb, decumbent or tall erect. Leaves alternate or opposite, ovate, 3 cm by 1.5 cm. Flowers terminal on long peduncles, bell-shaped, drooping. Calyx lobes elliptic-oblong, 1.5 by 0.75 cm. Corolla lobes 3 cm by 1.5 cm, blue, net-veined. Capsule obconic.

Western Himalaya up to 3600 m. Common.

Kashmir (Sheshnag); Lahul (Tandi); Chamba (Dhanachu).

*Flowers:* June-July. *Fruits:* September.

***Corydalis cashmeriana* Royle (Fumariaceae)**

A delicate, bulbous herb, 10-15 cm high; bulb fusiform, 1.5-2 cm long. Lower leaves long-petioled, upper almost sessile. Leaves palmately divided into narrow linear lobes. Flowers in short terminal racemes. Flowers 2 cm long, bright violet-blue, spurred; spur curved. Capsules linear, oblong.

Western Himalaya: 3000-4000 m.

Kashmir (Lidder Valley); Garhwal (Bishtola Alp, Valley of Flowers, Hemkund); Kumaon (Pindari).

*Flowers and fruits:* June-September.

***Corydalis crassissima* Jacq. ex Camb.**

A perennial herb with thick rootstock. Stem very much reduced. Leaves large, thick, metallic bluish-grey in colour; lamina almost orbicular in outline, 15-18 cm broad, 3-lobed or 3-partite, the lobes often overlapping or in turn lobed; petiole 8-12 cm, flattened. Flowers in dense racemes, 8-10 cm long. Flowers 2 cm long, pale purple in colour. Fruits oval, inflated, 1.75 cm by 1.2 cm.

This most unusual species of *Corydalis* has a very restricted distribution in northwest Himalaya and neighbouring Karakoram and Hindukush



*Corydalis crassissima* Jacq. ex Camb. near Amarnath in Kashmir  
(alt. 3600 m)

mountains. It is particularly seen on gravel in the Panchtarni Valley on the way to the sacred shrine of Amarnath in Kashmir.

*Flowers and fruits:* August-September.

**Cyananthus lobatus** Wall. ex Benth. (Campanulaceae)

An erect or decumbent herb, branched from the base; branches 40-50 cm long. Leaves alternate, 2.5 cm by 1.5 cm, narrowed towards the base, somewhat 3-lobed towards the apex. Flowers solitary at the ends of branches. Corolla bright blue, tubular, funnel-shaped, 3-4 cm wide at the top. Calyx covered by shaggy, dark brown or blackish hairs.

The genus *Cyananthus* is exclusively Himalayan in distribution. *C. lobatus* is the most well known among its species and it is found in Bashahr (Kalpa, Sangia); Kulu (Rohtang Pass); Garhwal (Kedarnath, Nar Parbat, Valley of Flowers) and Kumaon (Pindari).

*Flowers and fruits:* August-October.

**Cypripedium elegans** Reichb. f. (Orchidaceae)

An erect herb up to 25 cm high. Root fibrous. Leaves opposite, sessile, only one pair on the stem in its upper third part, lamina 4-8 cm long and 3-6 cm wide. Flower solitary, terminal, nodding; bract leafy, linear, 2-4 cm by 0.5-1.2 cm. Sepals greenish, lip inflated, purple-veined.

This small lady's slipper orchid is unusual among the Indian members in having only one pair of opposite leaves. It has recently been recorded from west Himalaya but it is fairly common in the Valley of Flowers during the month of June. It is also found in Sikkim.

*Flowers:* June.

**Delphinium cashmerianum** Royle (Ranunculaceae)

A perennial, erect herb. Stems tall up to 50 cm high, hairy. Leaves scattered, lower with long petioles, up to 15 cm long, hairy; upper petioles shorter. Leaves palmately lobed, lobes further divided. Flowers few in a short racemose cluster, large, 3-4 cm, blue-purple; spur straight, conical, more than a cm long. Follicles 3-7, hairy.

Himalaya: 3000-5000 m.

Kashmir; Garhwal; Kumaon (Pindari).

*Flowers and fruits:* September-October.

**Delphinium pyramidale** Royle

A large perennial herb. Stem up to 2 m high, 1 cm thick. Lower leaves, large, petioles 15-20 cm long, hairy; upper leaves smaller, petioles 2-3 cm long, hairy; lamina deeply 3-5-lobed. Flowers many in a raceme, the flower bearing axis nearly 40 cm long; pedicels 2-3 cm long. Flowers dark blue, spur 1.5 cm, curved at the tip. Follicles 3, glabrous.

Western Himalaya up to 3600 m.

Kashmir, Garhwal (Mandakini Valley). Kumaon.

*Flowers:* August-September.

***Epilobium latifolium* Linn. (Onagraceae)**

An erect herb, about 30 cm high. Leaves alternate, linear-elliptic, 6-8 cm long, 1.5-3 cm broad, surface sometimes purplish-tinged. Flowers large nearly 5 cm across, purple, in axils of upper leaves. Corolla lobes asymmetric. Fruits cylindric, narrow, 8-10 cm long on stalks, 2-3 cm, splitting open exposing the comose seeds.

This is one of the most attractive herbs of the glacial zone in many localities of western Himalaya, often forming large gregarious patches. Two subspecies, based on some differences in the hairiness of stem and base of style, are recognized among the plants found in western Himalaya.

Himalaya: 3000-5000 m. widespread in north temperate regions. Kashmir (Kolohai); Lahul (Chattru); Tehri-Garhwal (Gaumukh); Garhwal (Valley of Flowers, Kedarnath); Kumaon (Milam, Shelang glaciers).

***Eremurus himalaicus* Baker (Liliaceae)**

An erect herb, 2-3 m high. Basal leaves very long up to 60 cm in length, 4-6 cm in width. Inflorescence axis, 40-60 cm long, very densely flowered. Flowers white, 2-3 cm diam. on slender pedicels, 3 cm long. Fruits, 1 cm wide.

A stately herb, seen particularly on the dry slopes of Lahul Valley.

Western Himalaya at altitudes up to 3600 m.

Kashmir (Sonamarg); Lahul (Tandi); Bashahr (Chini).

*Flowers:* May-June.

***Euphorbia pilosa* Linn. (Euphorbiaceae)**

A tall perennial herb up to a metre high. Stems erect, branched. Leaves alternate, almost sessile, linear-elliptic up to 12-14 cm long, 2.5 cm wide. Floral leaves similar or oblong, 5-8 in number whence 5-8 rays spread out, longer than the floral leaves. Involucral leaves yellow in colour, rounded, 1.5 cm diam., involucre small between the leaves.

Western Himalaya up to 3600 m.

Kashmir (Panchtarni); Garhwal (Mandakini Valley); Kumaon: Chamba (Satrundi); Tehri-Garhwal (Jumnotri).

*Flowers and fruits:* June-September.

***Gaultheria trichophylla* Royle (Ericaceae)**

A wiry, profusely branched, perennial spreading on rocks and hill slopes. Leaves small, oblong, rigid, 0.75 cm long, 0.3-0.4 cm wide. Flowers

axillary, small, pink-white. Fruits with succulent calyx, globose, bright sky-blue, 1 cm diam., very conspicuous.

Himalaya in the high temperate and alpine zone, 3000-5000 m.

Kashmir (Apharwat); Lahul; Kulu (Rohtang Pass); Kangra (Laca Glacier); Chamba (Satrundi); Garhwal (Kedarnath, Nar Parbat, Valley of Flowers); Kumaon (Martoli, Pindari).

*Flowers and fruits:* July-October.

***Gentiana stipitata* Edgew. (Gentianaceae)**

A perennial herb with a rosette of leaves at the base amidst which erect leafy branches arise. Leafy branches 10-12 cm high. Leaves opposite, small elliptic, 0.75 by 0.4 cm, hairy on both surfaces. Flowers bell-shaped, 2.5-3 cm long, nearly 2 cm wide at the top, solitary at the ends of branches. Calyx lobes green, hairy, corolla bluish, folded between lobes, folds coloured dark purple at the back.

An attractive Gentian appearing late in autumn and forming gregarious patches on the grassy slopes.

Western Himalaya: 3500-4000 m.

Bashahr (Sangla Valley); Tehri-Garhwal (Gaumukh); Garhwal (Nar Parbat, Valley of Flowers).

*Flowers:* September-October.

***Gentiana venusta* Wall. ex Griseb.**

A small herb with a reduced stem; erect leafy branches arise each season. Leaves elliptic-oblong 0.75 by 0.5 cm, obtuse. Flowers 1-3 at the ends of branches, brilliant sky-blue in colour, tubular, 2 cm long by 0.8 cm wide. Capsule half emerging out of the persistent calyx.

An alpine species of western Himalaya reaching an altitude of 5400 m.

Bashahr (Rupan Pass); Tehri-Garhwal (Gaumukh); Garhwal (Hemkund).

*Flowers and fruits:* September-October.

***Geranium collinum* Stephan. ex Willd. (Geraniaceae)**

An erect herb, 20-24 cm high. Stem hairy. Leaves 4-5 cm across, palmately, deeply 5-lobed, lobes further dissected; petioles 5 cm long. Flowers few at the end of long peduncles. Calyx hairy, sepals with a short awn at the apex. Corolla 4 cm diam., purple, petals spreading.

Himalaya extending westwards to Afghanistan.

Lahul; Spiti (Kunzam Pass); Garhwal (Kuari Pass).

*Flowers and fruits:* July-September.

***Geranium pratense* Linn.**

A tall herb, up to a metre high. Rootstock stout, fibrous. Leafy branches arising from the base; basal leaves long-petioled, deeply 5-

7-partite, 6-8 cm wide. Flowers 1-3 at the ends of leafy branches; pedicels glandular-hairy. Calyx hairy, sepals with awns 2 mm long. Corolla purple, 3-4 cm diam. Fruit slender, 3 cm long, projecting out of persistent calyx. Stigma of 5 slender lobes.

Western Himalaya: 3000-4000 m.

Lahul; Chamba; Bashahr (Sangla Valley); Garhwal (Valley of Flowers); Kumaon (Lebung Glacier).

*Flowers and fruits:* June-September.

**Hackelia uncinata** (Benth.) C.E.C. Fischer (*Paracaryum glochidiatum* Benth.) (Boraginaceae)

An erect perennial herb. Rootstock thick. Stem up to a metre high, simple. Leaves ovate-cordate, 6-15 cm by 3-10 cm, acute; basal leaves long-petioled, petioles often as long as 20 cm. Flowers 1 cm across in lax, spreading, very much branched inflorescences. Corolla bright blue. Fruits 0.5 cm, rounded, covered by numerous gland-tipped hairs.

Western Himalaya: 2000-4500 m. Common.

Kashmir (Chandanwari); Chamba; Lahul; Kangra (Laca Glacier); Kulu (Rohtang Pass); Tehri-Garhwal (Jumnotri); Garhwal (Kedarnath, Valley of Flowers); Kumaon (Pindari).

*Flowers and fruits:* July-October.

**Hedysarum cachemirianum** Benth. ex Baker (Leguminosae)

An erect perennial herb, 30-40 cm high. Leaves, pinnate, long-petioled, 10-12 cm long, leaflets oblong, 1.5-1.75 cm long, 0.5 cm wide, sessile. Stipules membranous, ochrea-like, lanceolate, 1 cm long. Flowers in terminal racemes; racemes 8-10 cm long, flowers closely arranged. Flowers 2.5 cm long, corolla pink-red. Fruit, a lomentum with 1-3 joints.

A conspicuous herb recorded from several localities in Kashmir (Thajwas, Amarnath), at altitudes up to 3800 m.

*Flowers and fruits:* June-August.

**Hemiphragma heterophyllum** Wall. (Scrophulariaceae)

A prostrate, trailing herb. Stem wiry, spreading. Leaves of two kinds, one ovate, crenate, 2 cm long almost as wide, shortly petiolate and oppositely placed on the axis; the other kind on short axillary branches, very finely dissected into short linear lobes which are in tufts. Flowers axillary, pink, appearing generally amidst the tufted leaves. Fruits spherical, 0.75-1 cm diam., bright red, fleshy, ultimately becoming black and splitting.

A very characteristic herb on account of its peculiar dimorphic leaves. Common on rocks.

Himalaya up to 3600 m.

*Flowers and fruits:* April-October.

**Hierochloë laxa** R. Br. ex Hook. f. (Gramineae)

An elegant grass of high altitudes. Rhizome slender, spreading with erect leafy shoots, 30-40 cm high. Leaves 12-20 cm by 1 cm, ensiform, pale green in colour, prominently linear-veined. Panicles 6 cm long, spreading, spikes on slender axes; spikelets shining.

Western Himalaya: 3000-4000 m.

Kashmir; Lahul; Garhwal (Valley of Flowers); Kumaon (Milam Glacier).

*Panicles:* June-August.

**Inula grandiflora** Willd. (Compositae)

An erect, perennial herb up to 60 cm high. Stem hairy, particularly towards the upper region. Leaves linear-elliptic, 6-12 cm long, 1.5-3 cm wide, glandular-toothed along margin. Head terminal, solitary, 6-8 cm diam.; rays many, bright yellow, disc dense, orange-yellowish.

A conspicuous herb, common in many localities, particularly, along stream banks.

Western Himalaya: 2300-3800 m.

Kashmir (Kistawar); Chamba (Pangi Valley); Bashahr (Sangla Valley); Kulu; Tehri-Garhwal (Gangotri); Garhwal (Valley of Flowers); Kumaon (Dwali).

*Flowers:* August-October.

**Iris kumaonensis** Wall. ex G. Don (Iridaceae)

A creeping rhizomatous herb. Leaves linear, thick prominently linear-veined, up to 36 cm long, 1.2 cm wide, ensiform, sheathed at the base. Flowers solitary on an axis shorter than the leaves, spathaceous. Flower large, bright lilac in colour; tube 3-4 cm, lobes 6, spreading, prominently veined, with yellowish hairs forming a crest on the outer lobes. Fruit, a capsule, 5 cm by 2.5 cm, covered by the sheath and topped by the dried up perianth tube.

Western Himalaya: 2000-4500 m.

Kashmir (Kolohai); Chamba; Lahul (Khoksar); Bashahr; Kangra (Laca Glacier); Garhwal (Vasudhara); Kumaon (Martoli, Suryakund).

*Flowers:* April-July. *Fruits:* July-October.

**Lagotis cashmeriana** (Royle) Rupr. (Selaginaceae)

A small, rhizomatous herb, fleshy. Leaves long petioled, spatulate, lamina 4-8 cm long, 1.5-2.5 cm broad, crenate. Flowering scapes 5-20 cm long, leafy in the upper half, leaves sessile. Flowers bright blue in dense spikes, 4-6 cm long. Bracts prominent and spathaceous in fruit. Fruiting axes very much elongated.

Alpine Western Himalaya: 3500-4500 m.



Kashmir (Kungwattan); Chamba (Manimahesh Glacier), Kulu (Rohtang Pass).

*Flowers:* June-July. *Fruits:* August-September.

**Lamium rhomboideum** Benth. (Labiatae)

A dwarf, velvety herb, profusely, softly hairy, greyish white in colour. Leaves large, rhomboidal in outline up to 10 cm wide. Flowers large, 3-4 cm, purple. Anthers hairy.

A rare plant of high altitudes in west Himalaya.

Spiti (Kibar); Lahul; Chamba (Pangi); Kumaon (Kali Valley).

*Flowers:* August-September.

**Ligularia amplexicaulis** DC. (Compositae)

A robust herb. Stem up to a metre high. Leaves large, cordate, ovate-hastate, closely toothed along the margin. Lower leaves with thick petiole, petiole up to 20 cm long, lamina 16-18 cm across, upper leaves with a prominent sheathed, amplexicaul base. Heads in corymbs, branched spreading on a stout peduncle, 30 cm long. Flowering heads yellow in colour, rays wrinkled.

Western Himalaya: 3000-4000 m.

Chamba (Pangi Valley); Garhwal (Hemkund); Kumaon (Furkia).

**Lilium polyphyllum** D. Don (Liliaceae)

A tall herb, nearly a metre high. Leaves linear, lanceolate, 10-12 cm by 1-1.75 cm. Flowers in whorls or in axils of leaves towards the apex of stem. Flowers large, stalk, 10-12 cm long; lobes of perianth elongated, spreading, 6-8 cm long, 1-1.5 cm wide, tip knob-like, pale yellowish in colour but mottled with numerous purple streaks. Fruit elliptic, 6 cm long, 1.5 cm wide.

Western Himalaya: 2000-3600 m.

Tehri-Garhwal (Jumnotri).

*Flowers and fruits:* May-July.

**Lindelofia longiflora** (Benth.) Baill. (*L. spectabilis* Lehm.) (Boraginaceae)

A hairy herb, branched from the base, often forming clumps. Branches 20-40 cm high. Basal leaves petioled, stem leaves, alternate, sessile, hairy on both surfaces, linear-elliptic, up to 10 cm long, 4 cm wide, variable. Flowers in panicles at the ends of branches. Corolla deep blue.

A spectacular herb when in flowers.

Western Himalaya: 3000-3800 m.

Kashmir; Chamba; Lahul; Garhwal (Kedarnath).

*Flowers:* May-September.

**Lomatogonium carinthiacum** (Wulf.) Reichb. (*Pleurogyne carinthiaca* Griseb.) (Gentianaceae)

A small annual herb, branched from the base. Radical leaves, ovate, 2 cm long. Branches many, 6-20 cm high. Leaves on branches few, stem-clasping, ovate, 1 cm long. Flowers light blue at the ends of branches on long stalks, 2 cm diam., with greenish nerves on the petals. Capsules oblong.

Western Himalaya: 3000-4500 m.

Kashmir (Sonamarg); Lahul (Khoksar); Spiti (Kunzam Pass); Bashahr; Tehri-Garhwal (Gaumukh); Garhwal (Valley of Flowers); Kumaon (Pindari).

*Flowers:* September-October.

**Meconopsis aculeata** Royle (Papaveraceae)

A prickly herb. Stem stout at base, 40-60 cm high, with prickles all over. Leaves pinnatifid up to 20 cm long, basal leaves petioled, petioles 5-6 cm long, stem leaves sessile, lobes rounded with numerous prickles arising from the surface and along the margins. Flowers racemously arranged at the apex. Flowers large, nearly 6 cm across, generally of the finest shade of blue; anthers yellow; pedicels of flower 5-6 cm long, prickly. Fruit, a prickly capsule.

The famed Himalayan blue poppy, the Queen of Himalayan flowers. The petals are extremely delicate and wither very quickly.

Western Himalaya: 3000-4500 m.

Kashmir; Lahul (Khoksar); Chamba (Satrundi); Garhwal (Valley of Flowers); Kumaon.

*Flowers and fruits:* June-October.

**Meconopsis robusta** Hook. f. & Thoms.

A tall, stout herb, nearly a metre high. Stem glabrous, not prickly. Stem leaves sessile, deeply, pinnately lobed, 10-15 cm long, prickles slender, sparse on surface and along the margin. Flowers solitary in the axils of leaves. Pedicels slender, 5-6 cm long. Corolla 5-6 cm across, the four lobes bright yellow in colour. Fruit elongated, 2 cm by 0.75 cm, profusely bristly. Style nearly 1 cm long.

Western Himalaya: 3000-3600 m. Garhwal eastwards to Nepal.

Garhwal (Mandakini Valley); Kumaon (Furkia).

*Flowers:* July-August. *Fruits:* October.

**Megacarpaea polyandra** Benth. (Cruciferae)

A large erect herb. Stem fleshy, nearly 3 cm diam., hollow. Leaves 20 cm long, deeply pinnately lobed, stem-clasping. Inflorescence, a large branched racemose panicle, nearly 12 cm across; a number of such

panicles terminate the branches reaching about the same level at the top which gives a striking appearance to the plant when it is in bloom. Panicles densely flowered. Flowers white. Fruits winged, large, nearly 5 cm in diam.

Western Himalaya: above 3000 m.

Kashmir (Kishenganga Valley); Kumaon (Bogdiar).

*Flowers:* June-July. *Fruits:* October.

The stem is stated to be edible (local name: *Rooki*).

**Morina coulteriana** Royle (Dipsacaceae)

A tall, spinescent herb. Stem erect, 50-60 cm high, smooth. Basal leaves many, linear, 8-20 cm long, gradually narrowed towards the base, spinescent-toothed; axial leaves in whorls of 4, linear, spinescent-toothed. Flowers yellow in whorls towards the top of the stem and arranged in a spike. Flower 4 cm long with a tube and curved corolla. Stamens 2. Fruiting sepals and involucels prominent and spinescent.

Western Himalaya in the sub-alpine zone, 3000-3800, often on dry slopes. The closely similar *M. longifolia* Wall. with bright pink flowers is also widely distributed in western Himalaya.

Kashmir (Sheshnag); Lahul (Sissu); Bashahr (Baspa Valley).

*Flowers and fruits:* June-October.

**Nepeta connata** Royle (Labiatae)

An erect herb. Rootstock fusiform, divided. Stem 30-40 cm high. Leaves opposite, sessile, connate, linear uniformly broad, 6-10 cm long, 1-2 cm broad. Spikes cylindric up to 8 cm long. Flowers 2.5 cm long, bright blue.

An attractive herb. Roots stated to be edible.

Western Himalaya: 3300-4000 m.

Kashmir (Bannihal Ridge).

*Flowers:* September.

**Nepeta govaniana** Benth.

A tall herb, nearly a metre high. Leaves opposite, petioled, linear ovate, crenate, 6-16 cm by 2-8 cm. Flowers yellow, tube far exerted from the short calyx.

Western Himalaya up to 3600 m.

Kashmir (Khillanmarg); Kulu (Rahla); Garhwal (Rambara).

*Flowers:* September.

**Nomocharis oxypetala** (Royle) Balf. f. ex W. E. Evans (*Fritillaria oxypetala* Royle) (Liliaceae)

A bulbous herb, 60-70 cm high; bulb deep-seated. Leaves alternate sessile, linear-elliptic, 6 cm by 1.5 cm, more crowded towards the apex,

Flower terminal, solitary, nodding 6-10 cm diam., yellow; lobes 3-5 cm by 1-2 cm, linear-oblong. Fruit broad, 3 cm by 2 cm.

Western Himalaya: 3000-4000 m. Common on grassy slopes.

Tehri-Garhwal (Jumnotri); Garhwal (Badrinath, Valley of Flowers); Kumaon (Bogdiar, Garbyang).

*Flowers:* June-July. *Fruits:* August-September.

**Onosma hispidum** Wall. ex D. Don (Boraginaceae)

A profusely hairy, greyish herb, up to 60 cm high. Rootstock woody, gives a purple coloration. Basal leaves of various lengths clustered together, linear up to 25 cm long, 1.25 cm wide, hairy on both surfaces. Stem leaves, sessile, linear, 6 cm by 0.75 cm. Flowers in racemes at the apex of the stem, often two or three branches occurring together, somewhat curved. Calyx profusely hairy, corolla 3-4 cm, cylindric, slightly broader at the apex. Stamens included. Fruits included within the persistent calyx but the filiform style projecting.

Western Himalaya: 2000-3600 m.

Kashmir (Aharbal); Lahul (Sissu); Chamba; Tehri-Garhwal; Kumaon.

*Flowers:* June-July. *Fruits:* August.

**Orchis latifolia** Linn. (Orchidaceae)

A terrestrial orchid, 30-60 cm high. Tubers palmately divided, lobes, 2-3 cm long, 0.75 cm thick. Roots fibrous. Leaves alternate, linear-elliptic or linear-lanceolate, up to 15 cm long, 4-5 cm wide. Flowers purple arranged in a dense cylindric spike, up to 12 cm long. Bracts green, conspicuous. Spurs slender, 2 cm long, straight or curved.

On grassy slopes in west Himalaya at altitudes, 2500-4000 m.

Kashmir (Khillanmarg, Sheshnag, Thajwas); Chamba (Satrundi); Bashahr (Sangla); Lahul (Sissu); Garhwal (Badrinath, Valley of Flowers); Kumaon (Bogdiar).

*Flowers and fruits:* June-October.

**Paraquilegia anemonoides** (Willd.) Ulbr. (*Isopyrum grandiflorum* Fisch. ex DC.) (Ranunculaceae)

A densely tufted, soft, cushion-forming herb. Rootstock stout, covered by rigid bristles. Leaves long petioled. Scapes 6-10 cm. Flower solitary, 2 cm diam., white or pale blue.

Western Himalaya: 3600-4500 m.

Kashmir; Lahul; Garhwal (Valley of Flowers); Kumaon.

**Parnassia nubicola** Wall. ex Royle (Saxifragaceae)

A perennial rhizomatous herb. Radical leaves long-petioled, cordate-ovate, 6-8 cm by 3-4 cm; petioles 6-10 cm, expanded. Flowering scapes

erect, 30-40 cm long with a solitary, sessile leaf at about the lower third of the axis. Flower, solitary, white, 2-3 cm diam.; petals 5, obovate, stamens 5, staminodes 5, tri-lobed. Fruit, 1 cm long, wedge-shaped.

Throughout Himalaya: 2000-3600 m.

Kashmir (Chandanwari); Chamba (Dhanachu); Lahul (Sissu); Bashahr; Kulu (Rahla); Garhwal (Badrinath); Kumaon (Pindari).

*Flowers:* July-September.

***Pedicularis pectinata* Wall. (Scrophulariaceae)**

A tall, erect herb, 60-80 cm high. Basal leaves long-petioled, pinnate, pinnae, 3 cm, pinnatifid-dentate. Stem leaves in whorls of 3, petioled, up to 10 cm long. Flowers in dense spikes at the end of the stem, spike 8-10 cm long. Flowers 2 cm, purple with a prominent, long twisted beak. Fruiting axis elongated; fruits oval, 1 cm by 0.75 cm covered by the inflated calyx.

One of the large species of the genus with attractive flowers, common in many localities and widely distributed in western Himalaya at 2500-4000 m.

Kashmir (Bannihal Ridge); Chamba (Satrundi); Lahul (Tandi); Garhwal (Kedarnath, Valley of Flowers); Kumaon (Milam, Pindari).

*Flowers and fruits:* June-October.

***Pedicularis hoffmeisteri* Klotzsch**

An erect herb with a thick rootstock and long tap root. Stem, 30-50 cm high, branched. Leaves pinnatifid, lobes crenate, petioled, 12-16 cm long (incl. petiole), 4-5 cm wide. Flowers in racemes at the ends of branches; corolla bright yellow with a long, narrow tube, 2-3 cm, very much longer than the length of the calyx; corolla lobes of the lower lip rounded. Fruiting axis very much elongated; fruits linear-oblong, 2.5 cm by 0.6 cm with a projecting tip; stalk of fruits slender, 1-1.25 cm long.

Western Himalaya: Abundant on moist slopes in many localities. A very attractive herb when in flower, occupying large patches of grassy slopes at 2000-3600 m alt.

Bashahr; Tehri-Garhwal; Garhwal (Mandakini Valley, Bhyundar Valley); Kumaon (Dwali).

*Flowers:* July-September. *Fruits:* September-October.

***Phlomis bracteosa* Royle ex Benth. (Labiatae)**

A large hairy, erect herb. Stem up to 40-60 cm high, branched. Leaves large, cordate-ovate, 6-12 cm long, 4-9 cm wide, but variable in size and shape; hairy on both surfaces, crenate-margined; petioles 2-3 cm long. Flowers in whorls towards the ends of branches, the whorls dense and hairy between the leaves. Flowers 2 cm long, corolla bright blue-purple.

A tall attractive herb widely distributed in western Himalaya at altitudes up to 3600 m.

Kashmir (Lidderwat, Kolohai); Chamba; Lahul (Khoksar); Kulu (Rohtang Pass); Bashahr; Tehri-Garhwal; Garhwal (Bhyunder Valley); Kumaon (Bogdiar).

*Flowers and fruits:* June-September.

**Picrorhiza kurrooa** Royle (Scrophulariaceae)

A scapigerous herb. Rootstock spreading along the ground, covered by the dried leaf bases. Erect flower-bearing shoots arise from the rootstock. Leaves radical, sessile, spatulate, 8-10 cm long, 2-2.5 cm wide, serrate. Flowering scapes 1 or 2 from each shoot, 10-16 cm long, with a few reduced, leaf-like structures on the axis below the spike. Spike 4-6 cm long, densely flowered. Corolla blue; stamens far projecting; spike elongates when in fruit. Capsule 1.5 cm long, ovoid, splitting into short-beaked segments.

Himalaya, high temperate and alpine zone reaching 4500 m altitude in some places.

Kashmir (Apharwat); Chamba (Satrundi); Tehri-Garhwal (Jumnotri); Garhwal (Nar Parbat, Valley of Flowers); Kumaon (Milam, Pindari).

*Flowers:* May-July. *Fruits:* August-October.

The rootstock is bitter and is reputed to possess important medicinal properties.

**Pinguicula alpina** Linn. (Lentibulariaceae)

A small herb with a basal rosette, 3-5 cm wide. Roots fibrous. Leaves elliptic, pale green in colour forming the rosette. Scape 3-8 cm long arising amidst the rosette, leafless, bearing a single spurred flower. Corolla bilipped, white, yellow-spotted; spur short, blunt.

In moist places at high altitudes, flowering during June. The pale green colour of the leaves and the scapes bearing nodding flowers present a striking appearance.

Western Himalaya: Garhwal (Badrinath); Kumaon (Milam).

**Pleurospermum candollei** (DC.) C.B. Clarke (Umbelliferae)

An erect herb. Stem 20-40 cm high, thick, 2 cm diam. at base; basal part covered by dried leaf sheaths. Leaves 8-12 cm long including the basal sheath, sheath 4-5 cm long, 2 cm wide. Leaves pinnate, pinnae 1-2 cm, toothed or pinnatifid. Umbels on long axes arising from the stem, axes several, as many as 20, up to 20 cm long. Umbels globular 2-3 cm diam., many flowered, conspicuous by the large white bracts; bracts 1-2 cm by 0.75-1.5 cm, obovate to rotund. Fruits 3-4 mm, dark brown ridges prominent.

A strongly scented, most attractive herb.

Western Himalaya: 3000-4500 m.

Chamba (Sach Pass); Bashahr (Rupan Pass); Tehri-Garhwal (Sivaling Base); Garhwal (Hemkund); Kumaon.

*Flowers and fruits:* July-October.

**Polygonum affine** D. Don (Polygonaceae)

A tufted perennial herb. Rootstock spreading, bearing erect, leafy, flowering shoots, 30 cm high. Basal leaves crowded, linear-lanceolate, 6-12 cm long, 0.75-1.5 cm wide, shortly petioled, often pinkish in colour. Spikes at the ends of leafy axes; leaves few, sessile, stipules 1-2 cm, often wrinkled or split. Racemes very dense, cylindrical, 4-10 cm high, 1-2 cm diam., bright pink in colour.

A very conspicuous element of the alpine zone, the bright pink inflorescences standing out against the rocky background.

Western Himalaya, alpine zone. 3000-4500 m.

Kashmir; Lahul (Chattru); Spiti (Kunzam Pass); Kulu (Rohtang Pass); Chamba; Bashahr; Tehri-Garhwal (Gaumukh); Garhwal (Hemkund, Valley of Flowers); Kumaon (Milam, Pindari).

*Flowers and fruits:* June-October.

**Polygonum polystachyum** Wall. ex Meissn.

A large herb, almost shrubby, up to 2 m high. Stem profusely branched. Leaves large, linear oblong-elliptic, acuminate, 10-18 cm long, 3-7 cm wide; stipules foliaceous; petioles 1 cm. Panicles large, spreading at the ends of branches, very conspicuous on account of the abundant white flowers.

Himalaya: 2400-3800 m.

Chamba (Pangi Valley); Lahul; Bashahr; Garhwal (Kedarnath, Khiraun Valley, Valley of Flowers); Kumaon (Loharkhet).

*Flowers and fruits:* July-October.

**Potentilla atrosanguinea** Lodd. (Rosaceae)

A tall, erect perennial herb. Leaves long-petioled, many from the base; petioles up to 25 cm long. Stem leaves shortly stalked. Leaves trifoliate, leaflets 2-8 cm long, 1.5-4 cm wide, asymmetric, silky-white underneath. Flowers many in cymose panicles. Corolla crimson-red, 2-3 cm diam. Pedicels long, 3-4 cm.

One of the characteristic herbs of the alpine meadows. *P. argrophylla* Wall. is very similar but with bright yellow flowers.

Western Himalaya: 2500-4000 m.

Chamba; Lahul; Kulu (Rohtang Pass); Bashahr (Kalpa); Tehri-Garhwal (Jumnotri); Garhwal (Kedarnath, Valley of Flowers); Kumaon (Pindari).

*Flowers:* June-October.

**Potentilla fulgens** Wall. ex Hook. f.

An erect, perennial herb. Leaves many from the top of the rootstock. Leaves up to 20 cm long, pinnate, many pairs of large leaflets interspersed with small leaflets, large ones, 3 cm by 0.7 cm and the smaller ones, 0.5 cm long or less. All leaflets closely serrate, softly silky-white underneath. Flowers many in cymose panicles at the end of leafy axis. Flowers yellow, 1 cm diam.

A very characteristic herb, conspicuous by its silky-white leaves and the peculiar arrangement of leaflets.

Himalaya in the altitude range, 2000-4000 m.

Tehri-Garhwal (Nag Tibba); Garhwal (Bishtola Alp); Kumaon (Pindari).

*Flowers and fruits:* June-October.

**Primula macrophylla** D. Don (Primulaceae)

An erect, scapigerous herb. Roots fibrous, often coloured red. Radical leaves with sheathing bases, linear, oblanceolate, 10-25 cm long by 2-3 cm wide, entire or minutely toothed. Scape thick, 0.6 cm wide, longer than the leaves, 30 cm high bearing numerous bright purple flowers in umbellate clusters. Flowers shortly pedicelled, corolla 3 cm long, lobes spreading.

Western Himalaya, alpine zone.

Chamba (Mani Mahesh Glacier, Satrundi); Kashmir (Kolohai); Tehri-Garhwal (Jumnotri); Garhwal (Valley of Flowers); Kumaon (Milam, Pindari).

*Flowers:* June- July. *Fruits:* August-September.

*P. stuartii* Wall. is very similar to the above in habit but bears bright yellow flowers.

**Primula reidii** Duthie

A small scapigerous herb. Leaves 2-4, radical, oblong-spathulate, dentate, petiole, 2 cm long, lamina, 3-5 cm long, 1.5-2.5 cm wide. Scape 8-10 cm long with 2-3 nodding flowers. Calyx wide, campanulate, expanding in fruit. Corolla ivory-white, 1.5 cm long. Fruit globose covered by the persistent calyx.

A rare primula known only from a few collections in Garhwal and Kumaon at 3000-4000 m alt. A dainty herb.

Western Himalaya: Garhwal (Mandakini Valley, Hemkund); Kumaon (Ralam Valley).

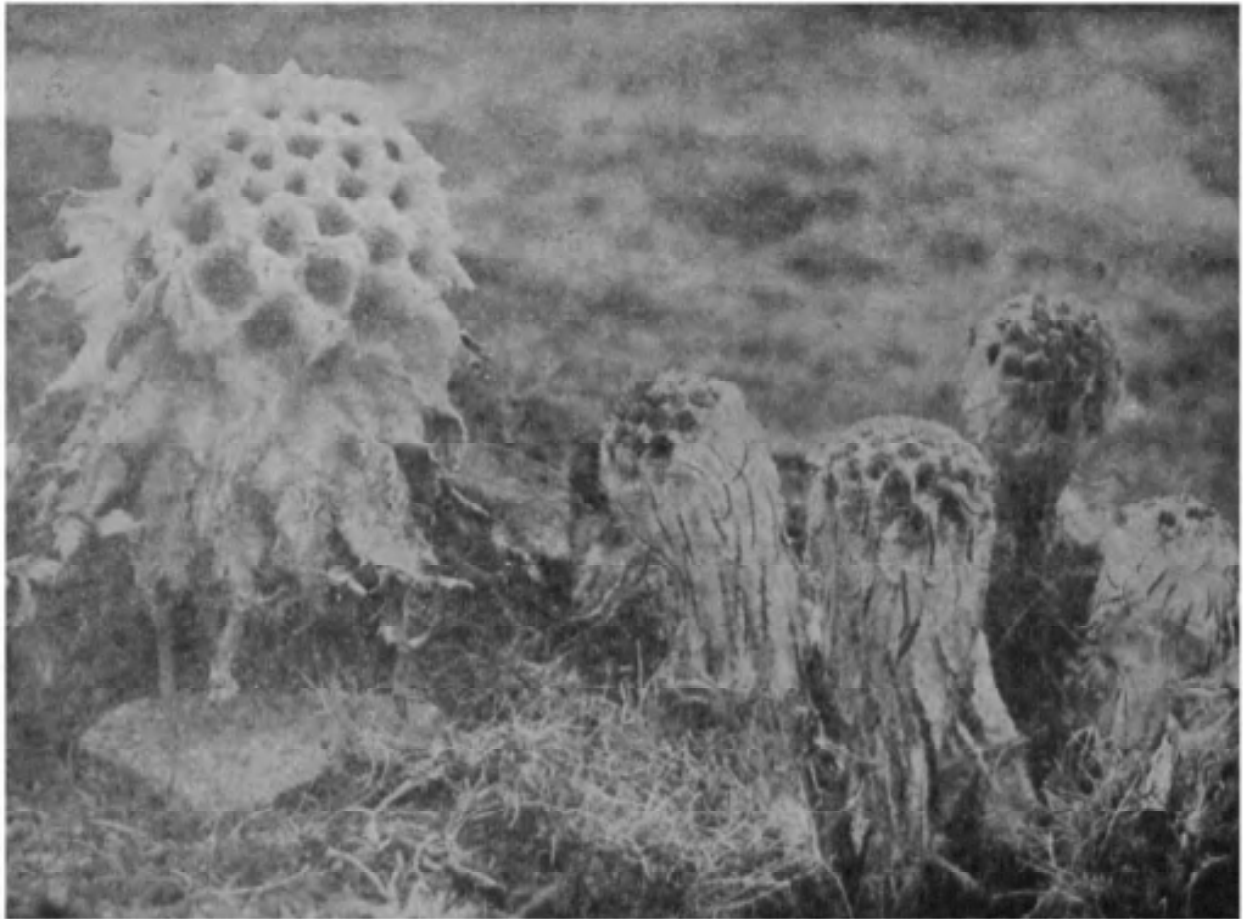
*Flowers:* August. *Fruits:* September.

**Saussurea gossypiphora** D. Don (Compositae)

An erect herb, entire plant about 20 cm high. Stem covered by fibrous leaf remains at the base, hollow, expanded at the top. Basal leaves many, sessile, 10-18 cm long, 2.5 cm wide, pinnatifid, toothed, narrowed towards



M. A. RAU



*Saussurea gossypiphora* D. Don and *S. simpsoniana* (Field and Gardn.) Lipsch.  
Near Lake Hemkund in north Garhwal (alt. 4200 m)

the base; stem leaves numerous, profusely hairy on the under surface; expanded top of the stem is wide, 8-12 cm across, covered by dense matted wool amidst which a large number of heads, as many as 50, are found. Only the tops of heads are visible amidst the wool as also the upper portions of the stem leaves. Heads dark purple.

A remarkably strange looking plant of the alpine zone in Himalaya reaching an altitude of 5200 m.

Kashmir; Chamba (Sach Pass); Tehri-Garhwal; Garhwal (Kedarnath, Hemkund); Kumaon.

*Flowers and fruits:* September-October.

*S. simpsoniana* (Field & Gardn.) Lipsch. (= *S. sacra* Edgew.) is a much smaller plant up to 15 cm high, the expanded top of the stem is 5-8 cm; the wool is soft and pinkish and the leaves are very slender, pinnatifid. The distribution of the herb is the same as above, the two species often occurring together.

#### ***Saussurea obvallata* (DC.) Sch.-Bip.**

An erect herb, 40-60 cm high. Stem simple, stout, basal leaves with sheathing stalks; dried remains of these sheaths cover the basal part of stem; upper leaves sessile; lamina linear-elliptic or oblong, 10-20 cm long, 3-5 cm wide, margin irregularly toothed. Heads terminal, dark purple in colour, stout, enclosed by large greenish-white, very thin floral leaves. Floral leaves up to 10 cm long, 4 cm broad, prominently veined and form a bladderly covering for the heads.

The famed Brahma-Kamal of the high Himalaya. A plant striking in its appearance and generally occurring near the glacial zone.

Himalaya at 3000-4800 m.

Kashmir; Bashahr (Rupan Pass); Tehri-Garhwal (Sivaling Base); Garhwal (Kedarnath, Hemkund, Valley of Flowers); Kumaon (Pindari).

*Flowers and fruits:* August-October.

#### ***Saxifraga diversifolia* Wall. ex DC. var. *parnassifolia* (D. Don) Engl. (Saxifragaceae)**

An erect glandular herb, 20-40 cm high. Stem simple with numerous glands. Radical leaves long-petioled, 4-8 cm long, 2-5 cm broad, ovate-cordate, prominently nerved from the base, margin entire. Flowers in corymbs at the ends of leafy axes; stem leaves, sessile, ovate, 2-3 cm by 1-2 cm; stem and calyx glandular-hairy; corolla 1.5 cm diam., yellow.

A widely distributed herb, particularly, in moist localities throughout the Himalaya at 2000-4000 m alt.

Chamba (Sach Pass); Bashahr (Rupan Pass); Kulu (Rohtang Pass); Garhwal (Kedarnath, Nar Parbat, Hemkund); Kumaon (Pindari).

*Flowers and fruits:* August-October.

**Saxifraga odontophylla** Hook. f. & Thoms.

A hairy herb, 12-20 cm high. Leaves radical, reniform, cordate, crenate, lobes rounded, 4 cm wide; petioles hairy, 4-6 cm long. Flowers few, nearly 2 cm across, at the ends of a long scape; scape with few leaves, short-petioled. Corolla white.

West Himalaya reaching 4000 m in some places.

Chamba (Gaurikund); Garhwal (Hemkuna); Kumaon (Pindari).

*Flowers:* July-September.

**Scabiosa speciosa** Royle (Dipsacaceae)

An erect herb, 25-60 cm high. Stem branched. Leaves opposite, linear-oblong, 5 cm by 1 cm, hairy, sessile. Heads terminal, 5 cm diam. Involucral bracts leaf-like, 1-2 cm long. Rays radiating, corollas prominent, bright mauve coloured, disc flowers smaller. Fruiting heads bristly on account of the persistent calyx.

West Himalaya up to 3600 m.

Kashmir (Bannihal Ridge); Lahul (Dadarphu).

*Flowers:* September.

**Scutellaria prostrata** Jacq. (Labiatae)

A dwarf perennial herb, with woody stem and numerous branches. Leaves opposite, 1-2 cm long, 0.7-1.5 cm broad, crenate, hairy on both surfaces. Flowers in a spike towards the apex. Bracts prominent; calyx short, corolla 1.5-2 cm long, bright yellow, tipped with purple.

Western Himalaya up to 4000 m.

Kashmir (Chandanwari); Chamba; Kumaon (Milam).

*Flowers:* June-September.

**Sedum ewersi** Ledeb. (Crassulaceae)

A much branched low herb, often forming tufts, with soft, fleshy, ovate-obovate leaves, apex round. Flowers in dense hemispherical, cymose clusters at the ends of branches, the entire inflorescence, 5-6 cm diam. Flowers rose-purple.

A very attractive rock plant of western Himalaya reaching very high altitudes, as high as 5200 m.

Kashmir (Lidderwat); Lahul (Khoksar); Spiti (Shitkar); Bashahr (Sangla Valley); Tehri-Garhwal (Gangotri); Garhwal (Badrinath); Kumaon (Milam).

*Flowers:* September-October.

**Sedum wallichianum** Hook. (*S. asiaticum* C. B. Clarke non DC.)

A fleshy herb with a stout rootstock, base covered by scales; branches many, erect up to 25 cm long. Leaves alternate, sessile, linear, 2 cm long, very narrow, toothed. Corymbs, 2-3 cm diam., consisting of dense cymes of reddish yellow flowers.

Himalaya up to 4800 m. Common.

Kashmir (Kolohai); Chamba (Sach Pass); Bashahr (Sangla Valley); Garhwal (Kedarnath, Hemkund); Kumaon (Milam, Pindari).

*Flowers:* June-September.

**Senecio graciliflorus** DC. (Compositae)

A large erect herb. Stem branched, up to 2 m high. Leaves large, 12-20 cm long, 6-9 cm wide, deeply pinnately lobed, lobes 4-6 cm long, 1-1.5 cm broad, toothed. Inflorescence, a large branched panicle of corymbosely arranged heads. Head 1.5 cm long, 1 cm wide, bright yellow in colour.

A large handsome herb, widely distributed in the Himalaya at altitudes, 2500-4000 m.

Kulu; Bashahr (Kalpa); Garhwal (Khiraun Valley, Valley of Flowers); Kumaon (Pindari).

*Flowers:* August-September.

**Swertia alternifolia** Royle (Gentianaceae)

An erect herb up to a metre high. Stem hollow. Leaves alternate, linear elliptic, up to 20 cm long, 7 cm wide, prominently nerved from the base, base sheathing and enveloping the node. Inflorescence axillary and terminal, cymes paniced, bracts large. Flowers on long pedicels (4 cm long), bluish-green in colour; calyx margin gland-dotted; corolla lobes 2 cm by 0.75 cm, oblong.

A striking species, characterised by its alternate leaves and large flowers.

Western Himalaya: 2300-3600 m.

Lahul: Kulu (Rahla); Garhwal (Kedarnath).

*Flowers:* August-September.

**Tanacetum longifolium** Wall. ex DC. (Compositae)

An erect, perennial herb, 20-40 cm high. Stem simple. Basal leaves very long, 30 cm by 3 cm, pinnatisect, lobes very finely dissected. Heads yellow, arranged in a corymbose fashion at the top of the stem often covered by woolly hairs at the base.

Western Himalaya: 3000-4000 m.

Kashmir (Kolohai); Bashahr (Rupan Pass); Kulu (Rohtang Pass); Garhwal (Kedarnath).

*Flowers:* July-September.

**Thermopsis barbata** Royle (Leguminosae)

A perennial herb, 20-40 cm high, densely hairy. Stem branched. Leaves sessile, trifoliate, leaflets, 4 cm long, 1.5 cm wide, oblong or obovate, obtuse, mucronate. Stipules prominent, similar in shape to

leaffets. Flowers at the ends of branches, bracts conspicuous, hairy; calyx hairy; corolla deep purple-blue. Pods flat, oblong, 4 cm long, 1.5 cm wide with a sharp-pointed tip.

Himalaya: High temperate and alpine regions at 3000-3800 m. Kashmir (Jai Hills); Kulu (Rohtang Pass); Tehri-Garhwal (Gangotri); Garhwal (Valley of Flowers); Kumaon (Milam).

*Flowers:* May-July. *Fruits:* August-September.

**Trollius acaulis** Lindl. (Ranunculaceae)

A perennial herb. Rootstock covered by thick fibrous remains of petioles. Basal leaves long-petioled, petioles up to 10 cm long, lamina palmately divided into 5 lobes, the lobes in turn cut or incised. Flowering scapes 4 to 10 cm, fruiting ones much longer, with a few sessile or short stalked leaves. Flowers solitary, terminal, 5 cm diam., bright golden yellow; sepals 5-6 and petals, 10-12, brightly coloured, petals oval, 2-2.5 cm by 1-1.25 cm, rounded at apex. Achenes 1 cm long with stiff persistent styles.

Western Himalaya: 3500-4500 m.

Kashmir (Amarnath, Sheshnag); Kulu (Rohtang Pass); Kumaon (Milam, Suryakund).

*Flowers:* May-June. *Fruits:* July-August.

**Waldheimia tomentosa** (Decne.) Regel (*Allardia tomentosa* Decne.)  
(Compositae)

A woolly herb, 10-20 cm high. Leaves pinnately dissected, up to 10 cm long, covered by grey to silvery-white soft wool. Heads solitary, terminal, 5 cm diam. Ray florets linear, 2 cm long, lilac, disc purplish.

An attractive herb of the alpine zone, in western Himalaya reaching an altitude of 5000 m.

Kashmir (Kolohai); Spiti (Kunzam Pass); Kumaon (Suryakund, Shelang Glacier).

*Flowers:* July-September.

## Chapter 5

### BOTANICAL EXPLORATION IN WEST HIMALAYA

With such an attractive assemblage of herbs on its heights it is no wonder that the western Himalaya should have attracted the attention of botanical collectors from many lands. It was not, however, till the beginning of the 19th century that any significant collection was done in the area. Extensive botanical work during this century resulted in the flora of the high Himalaya being well known by the end of the century (See Burkill, 1965, for a detailed account). In this great task, administrators, army officers, missionaries, surgeons and survey officers contributed most for the advancement of our knowledge of the flora. Burkill has recently given a comprehensive account of the botanical history of the country including the Himalayan region up to 1900. It is proposed to give here only a brief account of the botanical activity of this period in the high western Himalaya. Thomas Hardwicke was perhaps the first to collect plants in the interior of the Himalaya, in the Alaknanda Valley, in 1798. He was followed by many others. In Kashmir, the names of Jacquemont, Baron von Huegel, Vigne, Falconer, Winterbottom and Thomas Thomson stand foremost among the explorers of the first half of the 19th century. The last named travelled extensively in northern Kashmir and must have gathered "practically all the flowering plants that occur in the parts he visited." On the western side of Kashmir, beautiful collections were made by Winterbottom in 1846. Royle also sent his collectors to Kashmir. Royle's publication of the 'Illustrations of the Botany of the Himalayan Mountains and of the Flora of Cashmere' in 1839 was an outstanding event of the period. During the second half of the century, significant collections were made by Clarke, Duthie and his collectors. In Ladakh and adjacent areas, the Schlagintweit brothers (one of whom was killed) and Stoliczka, the geologist (who also died in Leh) made collections. During this period, several collections were made by officers attached to political missions, boundary commissions and relief expeditions, as for example, the Yarkand Mission, Chitral Relief Expedition and the Afghan Boundary Commission. During the last decade of the century, Duthie published important accounts of his travels in Kashmir.

The flora of the mountainous districts of Chamba, Kinnaur and other areas now forming part of Himachal Pradesh has been known through the pioneering efforts of the Gerard brothers, Inglis, Edgeworth, Lt. Maxwell, Prince Waldemar of Prussia, Werner Hoffmeister and others in the first half of the 19th century and in later years, Clarke and more particularly, Lacey and Gammie carried out important explorations in Chamba.

The picturesque Kangra and Kulu Valleys and the remote areas in Lahul and Spiti, all forming part of Himachal Pradesh at present had numerous visitors ever since William Moorcroft made his historic "dash" in 1821 across the Himalaya by way of Kangra and Kulu into Lahul and then to Leh returning to the Kashmir Valley through the Zoji La. Lance, a friend of Edgeworth, Edgeworth himself and Watt are among the explorers of this sector of the Himalaya during the 19th Century. One of the missionaries, Rev. Jaeschke of the Moravian Mission, collected extensively in Lahul, an account of which was published by Atkinson in 1868.

The most attractive, perhaps, of all the sectors of the west Himalaya from the scenic as well as the floristic points of view, the part of the mountain range lying in Tehri-Garhwal, Garhwal and Kumaon divisions of Uttar Pradesh, had its first collector in Thomas Hardwicke who, as already mentioned, visited the valley of Alaknanda in 1798. William Moorcroft, Trail in Kumaon, Lindsay in the uplands of Pithoragarh District and Edward Madden in Pindari Glacier were the other collectors in this area during the earlier years. The most extensive and perhaps the best collection to be made at any time in the west Himalaya was that of the two survey officers, Strachey and Winterbottom, a list of which was published by Duthie in 1882. George King, the first Director of the Botanical Survey of India made some collections while temporarily employed in the forest service in Kumaon. Duthie and his collectors, year after year, made long exploration tours in this area towards the end of the century.

In addition to the collectors named above, specimens were also obtained by native collectors employed by Wallich, Falconer, Royle, Drummond and Duthie and of these collectors, the names of Inayat (Kashmir and Kumaon) and Harsukh (Chamba) are the foremost.

With the turn of the century, the initiative for collection passed on to the forest officers, university teachers and specialist collectors sponsored by foreign herbaria, botanical gardens and other institutions of higher learning. Two important publications by Duthie on the Orchids of northwestern Himalaya and a revised list of plants of Kumaon and Garhwal (based on the collections of Strachey and Winterbottom, Falconer, Duthie and others) appeared in 1906. Notable collections were made by Keshavanand in Kashmir, Bor in Lahul and by other forest officers, Champion, Laurie and Parkinson. A.E. Osmaston published his 'Forest Flora for Kumaon' in 1927. An officer of the Indian Civil Service, H. A. C. Gill, made excellent collections in the remote Spiti Division. In Kashmir, the extensive collections of Hallberg were prepared for publication by Blatter. Coventry brought out his illustrations of wild flowers of Kashmir in three volumes. The late Shivaram Kashyap, one of the most active and knowledgeable of all collectors made several visits

to the inner Himalayan ranges and to the trans-Himalayan regions and beyond and in his Presidential Address to the Indian Science Congress Association in 1932, gave a vivid account of the high alpine flora of western Himalaya and adjoining territories. Several foreign expeditions sponsored by the British Museum, the Roerich Foundation, mountaineering institutes, individual collectors on behalf of botanical gardens and herbaria, naturalists and tourists have all made collections in the high alpine regions of western Himalaya. Some of their observations and finds have been recorded in miscellaneous publications which are scattered in journals published all over the world. Among all the collections of the first half of the present century, the gatherings of Koelz from Ladakh and Rupshu and of Bor from Lahul are outstanding.

The reorganization of the Botanical Survey of India in the early fifties of this century and the establishment of a regional station in Dehra Dun in the year 1956 gave fresh impetus for botanical work in the area, particularly, in the various sectors of the western Himalaya. The present account is mainly based on the fresh gatherings made by the author and his colleagues and on the collections housed in the Herbarium of the Forest Research Institute in Dehra Dun. Among the prominent localities from which plants have been examined are the following:

**JAMMU AND KASHMIR:** Alpathar Glacial Lake, Amarnath and environs, Bhadrawah, Bannihal Ridge, Jai Hills, Kishenganga Valley, Kishtwar, Kolohai Glacier, Konsernag, Ladakh, Upper Lidder Valley, Patani Top, Rupshu, Sheshnag, Sonamarg Glacier, Thajwas, Tilail, Tulian Lake and Zanskar.

**HIMACHAL PRADESH:** Chamba: Mani Mahesh Glacial Lake, Pangi Valley, Sach Pass; Kinnaur: Rupin Pass, Sangla Valley, Shipke, Upper Sutlej Valley (Bashahr); Mahasu: Hattu, Chor; Lahul and Spiti: Chandra Valley, Khoksar, Keylong, Jispa, Bara Lacha La, Zing Zing Bar, Kunzam Pass, Chandra Tal, Shitikar, Losar, Kibar, Kaza; Kulu: Rohtang Pass; Kangra: Chota Banghal, Bada Banghal, Laca Glacier.

**UTTAR PRADESH:** Tehri-Garhwal: Bandarpunch base, Gangotri, Gaumukh, Shivaling, Kedarnath Dome, Jumnotri, Rhudughaira, Srikantha; Garhwal: Alaknanda Valley, Arwa-Saraswathi Basin, Badrinath and environs, Baidni, Bajmora and Bishtola Bugyals, Bhyundhar Valley (Valley of Flowers), Lake Hemkund, Valleys around Mt. Kamet, Nilgiri Parbat and Mt. Nilakantha, Kedarnath Glacial Valley, Upper Nandakini Valley, Panchchuli, Rupkund and environs, Tungnath; Kumaon: Milam, Pindari and Shelang Glaciers and their morainic environs, Suryakund, Trisuli Basin, Garbyang, Lebung Pass, Darma Valley, Byans, Barjikang Pass, Ralam Valley and Upper Gori Valley.



The great variety of flowering plants occurring in the above localities of the alpine zone of western Himalaya are briefly described under their respective families in the next chapter.

## Chapter 6

### FAMILIES OF FLOWERING PLANTS

An artificial key based on easily observable characters is provided for the families and under each family to the genera of flowering plants occurring in the area and brought within the scope of this work. By use of the key, the reader is enabled to ascertain to what family and within the family, to what genus, an unknown specimen belongs. A description in semi-technical language draws attention to the important floristic features of each family. A list of species known to occur in the area is given under each family. No attempt is made to provide a key for the species for the following reasons. The list of species has been compiled from various published works and representative specimens of all these species were not available for study in the herbaria consulted by the author. Some of these species are also not adequately known as they are based on insufficient data or on just single collections. As an arbitrary limit has been set up for determining the alpine zone in this work, there is always the possibility of some borderline species being missed for consideration. Recent monographic studies are also lacking for many of these families and genera. In view of these considerations, a satisfactory keying of the species would not have been possible.

The names of the species have been carefully checked and, as far as possible, the latest names considered valid under the International Code of Botanical Nomenclature are given. Where a name change is involved, to facilitate easy reference, the corresponding name appearing in Hooker's Flora of British India is given in parenthesis immediately after the currently valid name. Those species which have been newly described or recorded from the area subsequent to the publication of Hooker's Flora are indicated by an asterisk. The distribution within the area comprising this work is given for each species and strikingly high altitudes recorded for some of them are also mentioned. The altitudes thus mentioned, in most cases, represent the highest altitude attained by these species in the area. It will be noticed that the range of distribution given here for many species shows an extension from that recorded by Hooker in his Flora. This is because recent explorations in the area have brought to light the existence of these species in new localities, in some cases, for the first time in western Himalaya.

#### KEY TO THE FAMILIES

#### ANGIOSPERMS—FLOWERING PLANTS

1. Leaves net-veined; parts of the flower mostly in fours or fives, rarely in threes. Plants with two cotyledons

DICOTYLEDONS

1. Leaves usually with parallel veins; parts of the flower mostly in threes. Plants with one cotyledon

MONOCOTYLEDONS

### DICOTYLEDONS

1. Calyx and corolla both present:
  2. Floral parts (other than ovary) in series of three (trimerous) BERBERIDACEAE
  2. Floral parts in fours or fives (tetra or pentamerous)
  3. Corolla of free or nearly free petals (poly-petalous)
  4. Stamens hypogynous (inserted at base on receptacle)
  5. Flowers regular
    6. Stamens more than 10
      7. Carpels free; fruits of achenes RANUNCULACEAE
      7. Carpels fused; fruit, a capsule opening by valves at top or side PAPAVERACEAE
    6. Stamens 10 or less than 10
      8. Corolla cruciform; stamens 6; fruit, a siliqua CRUCIFERAE
      8. Corolla not cruciform; stamens 5 to 10
      9. Ovary 1-locular; placentation basal or free-central
        10. Leaves scale-like; fastigiate shrubs with racemose spikes TAMARICACEAE
        10. Leaves not scale-like; flowers in cymose dichotomies CARYOPHYLLACEAE
      9. Ovary 3-5 locular; placentation axile
        11. Fruits capsular
          12. Anthers opening by apical pores ERICACEAE
          12. Anthers opening by longitudinal slits (*Pyrola*)
        13. Stipules present GERANIACEAE
        13. Stipules absent LINACEAE
      11. Fruits follicular CRASSULACEAE

- 5. Flowers irregular
  - 14. Sepals 2; stamens 2, branched; petals spurred or gibbous FUMARIACEAE
  - 14. Sepals 4-5; stamens more than 2
    - 15. Stamens more than 10 RANUNCULACEAE
    - 15. Stamens 10 or less than 10
      - 16. Carpel 1; stamens 10, free or (9)-1; fruit, a legume LEGUMINOSAE
      - 16. Carpel more than 1
        - 17. Ovary 1-celled; capsule 3-valved; anterior petal spurred VIOLACEAE
        - 17. Ovary 5-celled; capsule 5-valved, loculicidal; posterior sepal spurred, lateral petals fused in pairs BALSAMINACEAE
- 4. Stamens perigynous [borne on the lining of the calyx cup or at the summit of an inferior ovary (epigynous)]
  - 18. Ovary partially superior or partly coalescent with the calyx cup
    - 19. Stamens more than 10 ROSACEAE
    - 19. Stamens 5 to 10
      - 20. Carpels few to many, free; fruits achenes or drupes ROSACEAE
      - 20. Carpels 2; fruits capsular SAXIFRAGACEAE
  - 18. Ovary inferior
    - 21. Ovary 1-locular; fruit, a berry GROSSULARIACEAE
    - 21. Ovary 2 to 5 locular; fruits schizocarpic or drupaceous
      - 22. Flowers in umbels
        - 23. Fruit schizocarpic of 2 indehiscent, 1-seeded mericarps UMBELLIFERAE
        - 23. Fruit drupaceous, 4-5 carpelled, ridged on back ARALIACEAE
      - 22. Flowers in spikes or racemes; ovary 4-celled ONAGRACEAE
- 3. Corolla of fused petals (gamopetalous)
  - 24. Flowers hypogynous; ovary superior
    - 25. Corolla regular
      - 26. Stamens twice as many as corolla lobes ERICACEAE

26. Stamens equal to number of corolla lobes or less
27. Stamens 2; trees OLEACEAE
27. Stamens equal in number to corolla lobes. Not trees
28. Plants parasitic, twining round host CONVOLVULACEAE (*Cuscuta*)
28. Plants not parasitic
29. Ovary 1-celled; stamens opposite corolla lobes
30. Seeds many; fruits capsular
31. Carpels separating in fruit into follicles; seeds comose ASCLEPIADACEAE
31. Carpels not as above
32. Placentation free central; stigma 1 PRIMULACEAE
32. Placentation parietal; stigmas 2 GENTIANACEAE
30. Seed solitary; fruit, a nut PLUMBAGINACEAE
29. Ovary 2, 3 or 4-celled; stamens alternating with corolla lobes
33. Corolla 4-lobed; capsule opening by lid at top PLANTAGINACEAE
33. Corolla 5-lobed; capsule opening by longitudinal valves or separating into 1-seeded nuts or a berry
34. Fruit of 4 nutlets BORAGINACEAE
34. Fruit, a capsule or a berry
35. Ovary 3-celled; fruit, a loculicidal capsule POLEMONIACEAE
35. Ovary 2-celled
36. Flowers in ebracteate cymes or solitary SOLANACEAE
36. Flowers in bracteate racemes or spikes SCROPHULARIACEAE
25. Corolla irregular or nearly so
37. Stamens twice as many corolla lobes ERICACEAE (*Rhododendron*)

37. Stamens as many or less than corolla lobes, usually 4 or 2
38. Ovary 2-celled; stamens in 2 pairs (didynamous)
39. Fruit capsular
40. Capsule many seeded SCROPHULARIA-  
CEAE
40. Capsule 2-seeded SELAGINACEAE
39. Fruit of 4 nutlets; style gynobasic LABIATAE
38. Ovary 1-celled; stamens not didynamous
41. Corolla not spurred. Parasitic herbs OROBANCHACEAE
41. Corolla spurred. Insectivorous herbs LENTIBULARIACEAE
24. Flowers epigynous; ovary inferior
42. Flowers aggregated in heads with involucre
43. Anthers not coalesced along their margins DIPSACACEAE
43. Anthers coalesced along their margins (syngenesious) COMPOSITAE
42. Flowers not aggregated in involucrate heads
44. Plants woody shrubs or trees CAPRIFOLIACEAE
44. Plants herbaceous
45. Fruit of indehiscent achenes or drupes with stones
46. Ovary 3-celled, 1-ovuled; fruit an achene. Herbs with aromatic rhizomes VALERIANACEAE
46. Ovary 2-5 celled; fruit not an achene
47. Fruit didymous; ovary 2-celled. Rambling herbs RUBIACEAE
47. Fruit, a drupe of nutlets ADOXACEAE
45. Fruit a dehiscent capsule CAMPANULACEAE
1. Corolla absent; only one whorl of perianth representing the calyx usually present
48. Herbs, submerged aquatics; leaves verticillate; stamen 1, carpel 1 HIPPURIDACEAE

48. Herbs non aquatic
49. Flowers bisexual
50. The flowers highly reduced, fascicled amidst a rosette of leaves; very small herbs **CIRCAEASTERACEAE**
50. The flowers not as above
51. Stamens more than 10; ovary of free carpels **RANUNCULACEAE**
51. Stamens 10 or less than 10; ovary of 1-5 fused carpels
52. Ovary with one ovule; fruit, a nut or utricle
53. Leaves with sheathing stipules; fruit, a nut **POLYGONACEAE**
53. Leaves exstipulate; fruit, a utricle **CHENOPODIACEAE**
52. Ovary with more than 1 ovule; fruit capsular
54. Capsules dehiscent at top crosswise **SAXIFRAGACEAE**  
(*Chrysosplenium*)
54. Capsules dehiscent by valves
55. Style simple; capsules 5-valved **PRIMULACEAE**  
(*Glaux*)
55. Styles 2-4 free from base; capsules 2-6 valved **CARYOPHYLLACEAE**  
(*Arenaria, Minuartia*)
49. Flowers unisexual
55. Plants parasitic. Minute herbs on bark of coniferous trees **LORANTHACEAE**  
(*Arceuthobium*)
55. Plants not parasitic
56. Habit of plants herbaceous
57. Flowers minute, naked, arranged in characteristic cyathia **EUPHORBIACEAE**
57. Flowers in axillary clusters of unisexual flowers, paniculate. Herbs with stinging hairs **URTICACEAE**
56. Habit of plants, woody, shrubs or trees
58. Flowers in axillary cymose clusters (male) or solitary (female). Shrubs with shining scales **ELAEAGNACEAE**
58. Flowers in pendulous spikes (catkins)

59. Fruits indehiscent  
 60. The fruit, a nut (acorn) FAGACEAE  
 (*Quercus*)  
 60. The fruit, a winged nut BETULACEAE  
 59. Fruits dehiscent, capsules  
 with comose seeds SALICACEAE

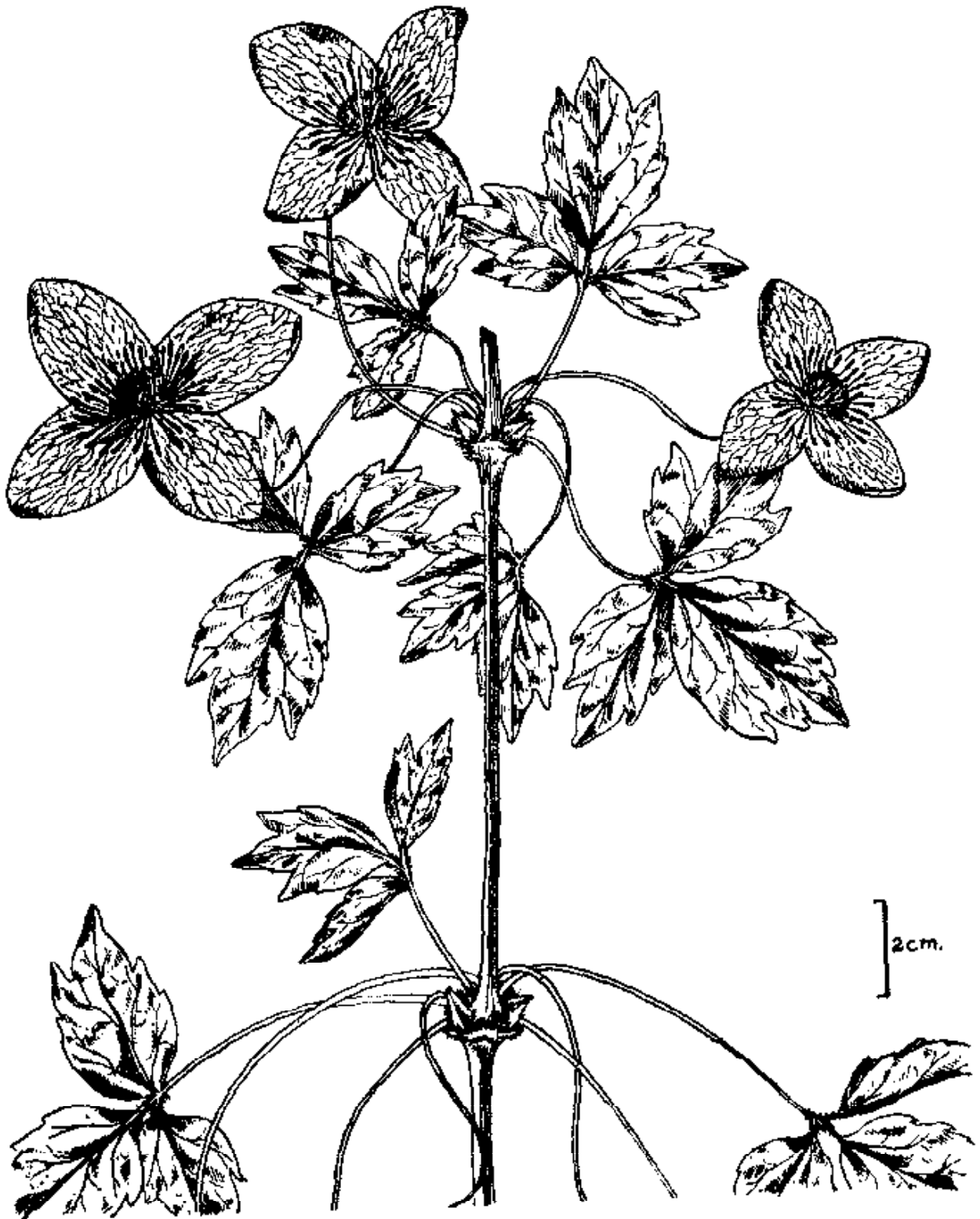
## MONOCOTYLEDONS

1. Submerged aquatic herbs  
 2. Flowers bisexual; perianth of 4 free lobes POTAMOGETO-  
 NACEAE  
 2. Flowers unisexual; perianth reduced, cup-like ZANNICHELLI-  
 ACEAE
1. Terrestrial or marshy herbs  
 3. Perianth reduced to scales or flowers enclosed  
 in chaffy scales or bracts  
 4. Ovary 1-carpelled; fruit 1-seeded, indehis-  
 cent; flowers in close-set spikes or  
 spikelets  
 5. Each flower enclosed in 2 scales  
 (lemma and palea); seed coat  
 coalesced with pericarp (caryopsis) GRAMINEAE  
 5. Each flower subtended by a single  
 bract; seed coat not coalescent with  
 pericarp (utricle) CYPERACEAE  
 4. Ovary 3-carpelled; fruit, a dehiscent cap-  
 sule; flowers in axillary or terminal  
 cymes JUNCACEAE
3. Perianth not scale-like, often petaloid  
 6. Lobes of perianth herbaceous, 3-6 decidu-  
 ous. Marshy scapigerous herbs JUNCAGINACEAE  
 6. Lobes of perianth petaloid, prominent  
 7. Ovary superior LILIACEAE  
 7. Ovary inferior  
 8. Stamens 3; pollinia absent IRIDACEAE  
 8. Stamen 1, united with style on  
 column; pollinia present ORCHIDACEAE

## RANUNCULACEAE

The family includes the well known anemones, butter-cups, columbines, larkspurs, marsh marigolds, monkshoods and many other attractive herbs which form an important part of many an alpine landscape in the northern hemisphere. There are several representatives of the family in the alpine zone of western Himalaya. These plants are charac-





*Clematis montana* Buch-Ham. ex DC.

terised by the possession of free 1-celled carpels in their flowers. The colours exhibited by the flowers of members of the family range from violet to red with various shades of lilac, purple, pink and blue in addition to white. The flowers may be regular as in anemones and butter-cups or irregular as in larkspurs and monkshoods. Some of them like anemones and species of *Clematis* lack in petals but their sepals assume bright colours and provide the attraction. Columbines and larkspurs have spurred petals and sepals. The fruits of the family may be 1-seeded achenes, some provided with feathery styles or they may be many seeded follicles.

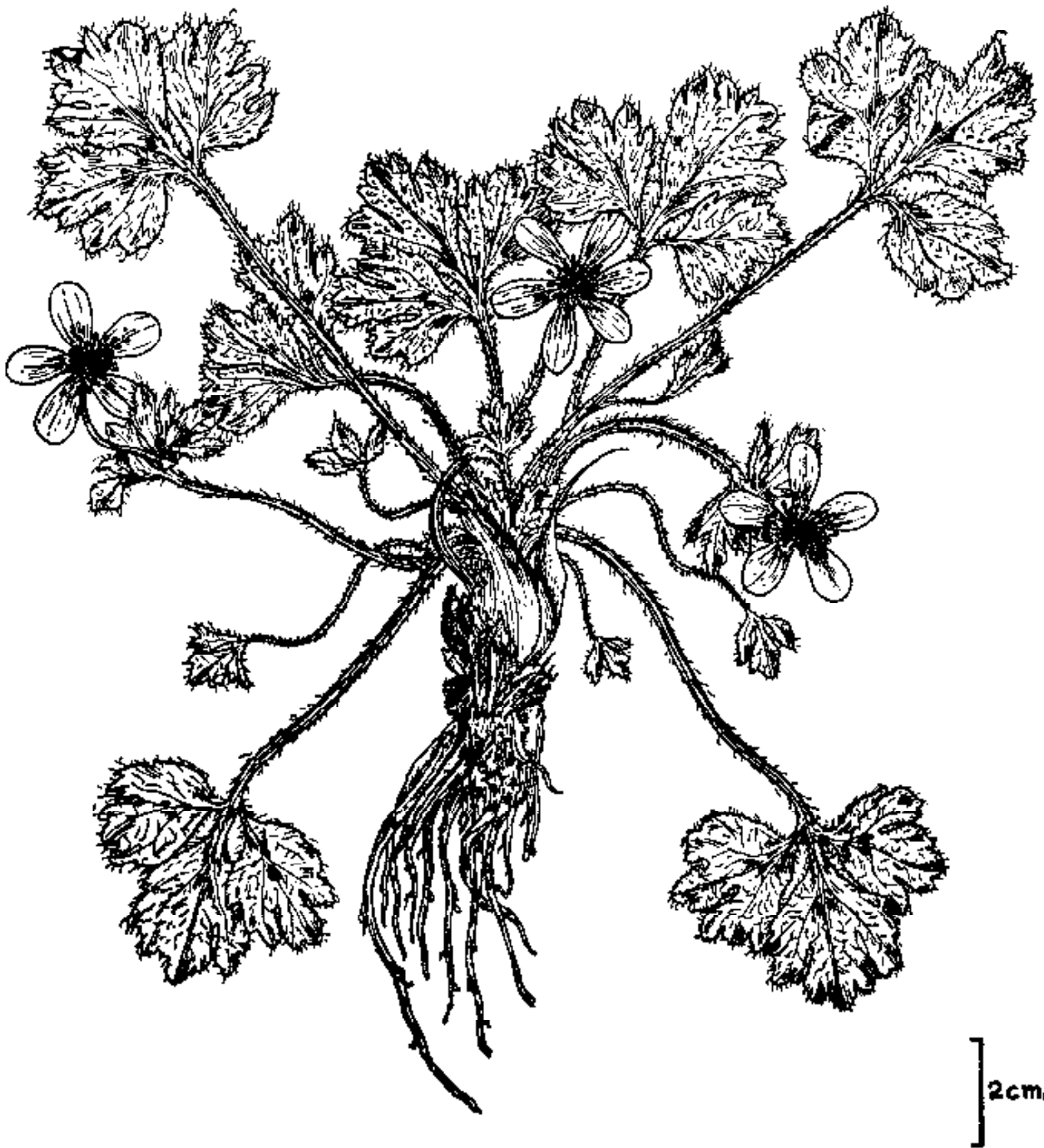
*Clematis* is a genus of woody climbers, popularly known as virgin's bowers. The yellow-flowered, *C. orientalis* has a wide distribution in the dry inner valleys and one of its varieties has been collected in Rupshu at an altitude as high as 4500 m. Other species like *C. barbellata* and *C. montana* with purple-backed white flowers reach the sub-alpine zone, often climbing on birches and the high altitude oak. The flowers are mildly fragrant in all the above species of *Clematis*.

The anemones are represented by five species in the alpine zone of which *A. obtusiloba* is the most widely distributed. Many hill slopes and alpine meadows are often carpeted with the blue and white-flowered forms of this species. At high altitudes, as for example, along the Rohtang Pass, the sulphur-yellow-flowered form is found. Some of the anemones are more robust and often profusely hairy. These bear large umbels of white flowers. Among such species are *A. narcissifolia* (var. *polyanthes*) and *A. tetrasepala* which are generally seen on rock ledges in various sectors of the western Himalaya at altitudes above 3000 m.

While most genera of the Ranunculaceae have large and conspicuous flowers, the genus *Thalictrum* is characterised by the possession of small, inconspicuous, greenish or yellow-white flowers. The foliage of many of these is striking being pinnately or ternately compound and their leaflets variously divided or cut. At alpine heights are found six species, one of which enjoys a worldwide distribution. This species, *T. alpinum*, is found in the alpine zone of all northern continents and also in the Arctic. In west Himalaya it reaches an altitude of 5000 m.

The butter-cups (*Ranunculus* spp.) are characteristic herbs of the marshy and semi-aquatic localities. Most of them have yellow flowers except the aquatic, *R. aquatilis* (var. *trichophyllus*) which has white flowers. This aquatic member is usually found at lower elevations but there is a record of its having been collected at an altitude of 4500 m. in Ladakh. One of the butter-cups, *R. lobatus*, was found at an altitude of nearly 6000 m on Mt. Kamet in Garhwal Himalaya. *R. pulchellus*, *R. hyperboreus* and *R. hirtellus* are the other species which reach very high altitudes.

The columbines (*Aquilegia* spp.) are charming herbs with long-spurred flowers. The corolla is white, purple or yellow and each petal is produced into a spur at the base.



*Anemone obtusiloba* D. Don.

The larkspurs (*Delphinium* spp.) and the monkshoods (*Aconitum* spp.) possess highly modified flowers. In the former, one of the dorsal sepals and two dorsal petals develop a spur. The flowers are usually bluish or bluish grey and one of the species, *D. densiflorum*, is found in the Garhwal-Kumaon ranges at very high altitudes. On the morainic slopes above Lake Hemkund, this herb is fairly common. Some of the Himalayan larkspurs are very large and in Garhwal Himalaya, the author has seen some plants which were nearly 2.5 m high, the flowering spike itself being 0.5 m. Among the Himalayan larkspurs, *D. cashmerianum* is a most attractive species with large blue flowers.

The monkshoods are thus named on account of the peculiar modification of their flowers. The petaloid posterior sepal is vaulted and helmet-shaped and encloses the two posterior clawed and hooded petals. There are white, yellow and blue-flowered species among the aconites. One of them, which flowers in late autumn, is a small herb with deeply cut leaves and very pretty blue flowers. This species, *A. violaceum*, may be seen on Rohtang Pass and on the morainic slopes around Lake Hemkund during the months, September-October. *A. falconeri* with dense racemes up to 30 cm long of blue flowers is a common herb in the Valley of Flowers. Some of these aconites are reputed to be extremely poisonous and they are locally known as 'bis' or 'zahar'. *A. heterophyllum*, locally known as 'atees', is, however, non-poisonous and is much valued for its medicinal properties. The roots of some species are also eaten by the local people.

The marsh marigold, *Caltha palustris*, adorns many hill slopes during the summer months with its bright yellow flowers. This herb is particularly common around marshy places and along the banks of streams. Large gregarious patches can be seen in the Chandra Valley in Lahul.

One of the most beautiful herbs belonging to this family and which forms densely tufted cushions at very high altitudes is *Paraquilegia anemonoides*. On high alpine screes, these cushions with their waxy white flowers are highly conspicuous. Describing this plant, Smythe writes "it would be difficult to find a more genuine rock plant than this. One blast of cold wind should suffice to wither and shrivel it, a single frost to burn its tender foliage. Yet it grows, a miracle of growth battered by storm, scorched by sun, the prey of hail, storm and blizzard. Heaven knows how it grows and I think that is the correct answer".

#### KEY TO GENERA

1. Plants shrubby, woody climbers
1. Plants herbaceous, not climbers
  2. Carpels 1-ovuled; fruits achenes
  3. Calyx petaloid, corolla absent

*Clematis*

- |   |                      |
|---|----------------------|
| 4. Leaves all radical, lobed or divided; flowers on scapes, sepals brightly coloured, large | <i>Anemone</i>       |
| 4. Leaves compound; flowers in racemes or panicles; sepals without bright colours, small    | <i>Thalictrum</i>    |
| 3. Calyx and corolla both present   |                      |
| 5. Herbs, stemless, perennial   |                      |
| 6. Sepals 5, deciduous; petals 5-15, white  | <i>Callianthemum</i> |
| 6. Sepals 5, persistent, enlarged after flowering; petals 10-15, yellow                     | <i>Oxygraphis</i>    |
| 5. Herbs with stem, annual or perennial   |                      |
| 7. Petals 5-16, yellow or red; glands absent  | <i>Adonis</i>        |
| 7. Petals usually 5, yellow (white in <i>R. aquatilis</i> ); glands present                 | <i>Ranunculus</i>    |
| 2. Carpels many ovuled; fruits follicles  |                      |
| 8. Calyx petaloid, yellow, rarely white; petals absent                                      | <i>Caltha</i>        |
| 8. Calyx and corolla both present   |                      |
| 9. Flowers regular  |                      |
| 10. Inflorescence, a panicle or flowers solitary  |                      |
| 11. Flowers without spurs   |                      |
| 12. Perianth yellow; stems simple with incised leaves                                       | <i>Trollius</i>      |
| 12. Perianth white or pale blue; dense herbs often forming cushions                         | <i>Paraquilegia</i>  |
| 11. Flowers with spurs  | <i>Aquilegia</i>     |
| 10. Inflorescence racemose  |                      |
| 13. Racemes short; fruit, a berry   | <i>Actaea</i>        |
| 13. Racemes long; fruit follicular  | <i>Cimicifuga</i>    |
| 9. Flowers irregular  |                      |
| 14. The flowers spurred   | <i>Delphinium</i>    |
| 14. The flowers not spurred, hoodlike   | <i>Aconitum</i>      |

*Note:* The genera, *Halerpestes* Greene and *Batrachium* S. F. Gray also represented in the area are separated from *Ranunculus* Linn., the former characterised among other things by the absence of any proper stem and its achenes having thin texture and striate surface; *Batrachium* by its aquatic habit with all submerged leaves and yellow flowers.

## LIST OF GENERA AND SPECIES

## ACONITUM LINN.

- \*A. **balfourii** Stapf  
Garhwal, Kumaon (3600 to 4200 m).
- \*A. **chasmanthum** Stapf ex Holmes  
Kashmir (up to 3600 m).
- \*A. **deinorrhizum** Stapf  
Bhadrawah, Bashahr (3600 m).
- \*A. **falconeri** Stapf  
Tehri-Garhwal, Garhwal (4000 m).
- A. **heterophyllum** Wall. ex Royle  
Throughout up to 4000 m.
- \*A. **kashmiricum** Stapf ex Coventry  
Kashmir (Apharwat, 4000 m).
- A. **laeve** Royle (*A. lycocotum* auct. non Linn.)  
Kashmir to Kumaon up to 3600 m.
- \*A. **moschatum** (Brühl ex Duthie) Stapf  
Kashmir (3600 m).
- \*A. **rotundifolium** Kar. & Kir.  
Zaskar, Lahul (4800 m), Bashahr.
- \*A. **violaceum** Jacq. ex Stapf  
Kashmir to Kumaon (4500 m in Spiti).

## ACTAEA LINN.

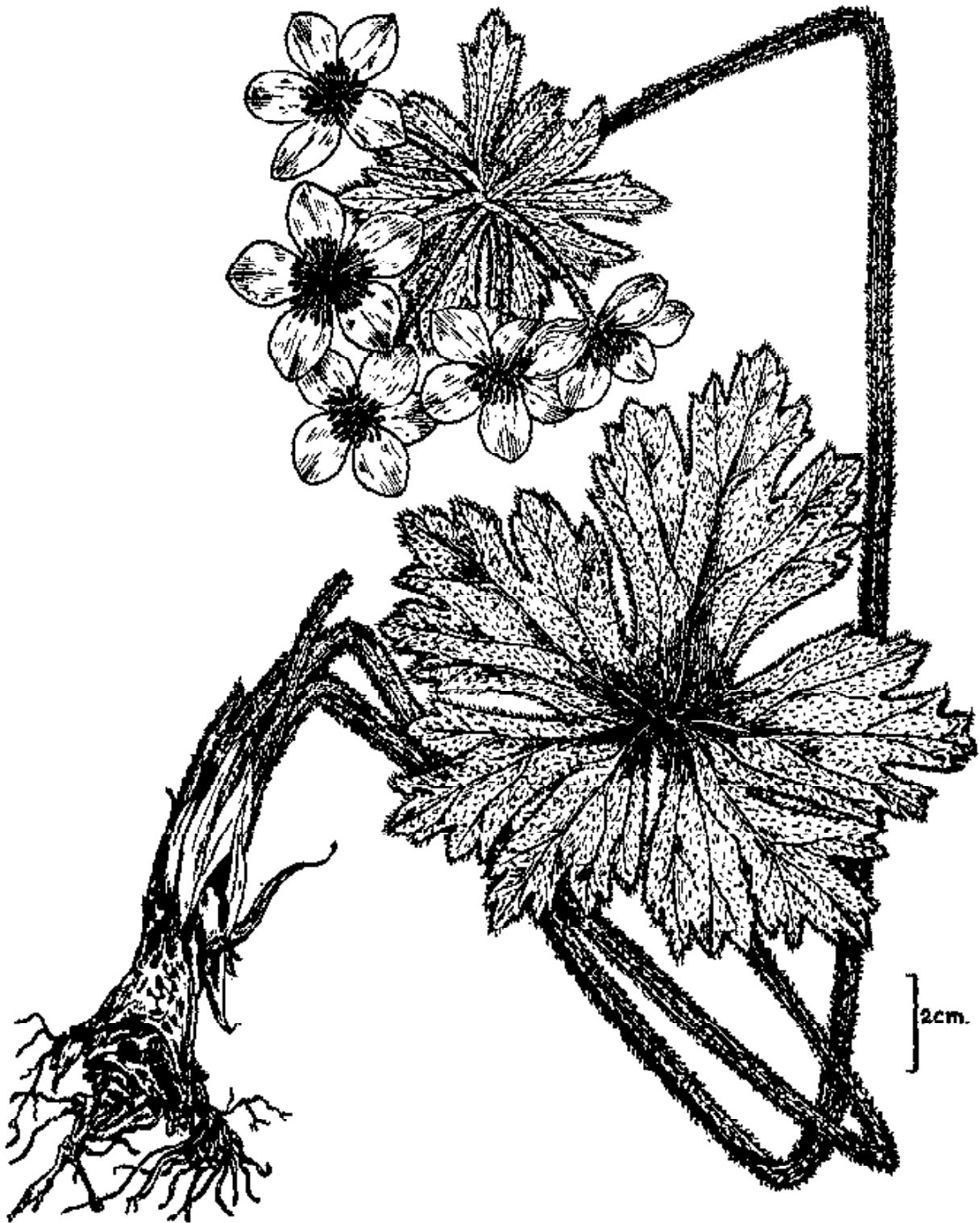
- A. **spicata** Linn.  
Kashmir to Kumaon up to 3900 m.

## ADONIS LINN.

- A. **chrysocyathus** Hook. f. & Thoms.  
Kashmir to Kumaon (5200 m).

## ANEMONE LINN.

- A. **narcissifolia** Linn. var. **polyanthes** Finet & Gagnep.  
Kashmir to Kumaon (4000 m).
- A. **obtusiloba** D. Don  
Kashmir to Kumaon up to 4500 m.
- A. **pulsatilla** Linn. (*A. albana* Stev.)  
Ladakh (4500 m), Chamba, Lahul
- A. **rupicola** Camb.  
Kashmir to Kumaon (up to 4500 m).
- A. **tetrasepala** Royle  
Kashmir, Chamba (4000 m).



*Anemone narctissifolia* Linn. var. *polyanthes* Finet & Gagnep.

## AQUILEGIA LINN.

- A. *fragrans* Benth. [*A. vulgaris* Linn. var. *pyrenaica* (DC.) Hook. f. & Thoms. p.p.]  
Kashmir (3600 m).
- A.  *jucunda* Fisch. & Mey.  
Kashmir (3900 m).
- A. *moorcroftiana* Wall. ex Royle (*A. vulgaris* var. *pyrenaica* p. p.)  
Kashmir (3600 m).
- \*A. *nivalis* Falc. ex Baker  
Kashmir, Chamba, Tehri-Garhwal (3900 m).
- A. *pubiflora* Wall. ex Royle (*A. vulgaris* var. *pubiflora* Hook. f. & Thoms.)  
Kashmir, Spiti, Garhwal (4000 m).

## BATRACHIUM S. F. GRAY

- \*B. *flavidum* Hand.-Mazz.  
Ladakh (4300 m).

## CALLIANTHEMUM C. A. MEY.

- C. *pimpenelloides* (D. Don ex Royle) Hook. f. & Thoms (*C. cachemirianum* Camb.)  
Kashmir, Chamba, Kumaon (5400 m).

## CALTHA LINN.

- C. *palustris* Linn. [and var. *alba* (Jacq.) Hook. f. & Thoms. in Kashmir].  
Kashmir to Kumaon (4000 m).

## CIMICIFUGA LINN.

- C. *foetida* Linn.  
Kashmir, Kumaon (3600 m).

## CLEMATIS LINN.

- C. *barbellata* Edgew.  
Tehri-Garhwal (3300 m), Kumaon.
- C. *montana* Buch.-Ham. ex DC.  
Kashmir to Kumaon up to 3300 m.
- C. *orientalis* Linn. (s.l.)  
Rupshu (4500 m), Kumaon.

## DELPHINIUM LINN.

- D. *brunonianum* Royle  
Kashmir, Ladakh (5400 m), Tehri-Garhwal (5200 m), Kumaon.



## DELPHINIUM LINN.

- D. caeruleum** Jacq. ex Camb.  
Kumaon (4000 m).
- D. cashmerianum** Royle  
Kashmir, Lahul (4800 m), Kumaon.
- \***D. densiflorum** Duthie ex Maxim  
Garhwal, Kumaon (5600 m).
- \***D. kumaonense** Huth  
Kumaon (4500 m).
- D. pyramidale** Royle  
Kashmir to Kumaon (3500 m).
- \***D. roylei** Munz  
Kashmir (up to 5000 m).
- D. vestitum** Wall. ex Royle  
Kashmir to Kumaon (up to 4000 m).

## HALERPESTES GREENE

- H. sarmentosa** (Adams) Kom. & Klob (*Ranunculus cymbalariae* Hook. f. & Thoms. p.p. non Pursh.)  
Kashmir, Lahul (4800 m), Kumaon.
- \***H. tricuspis** (Maxim.) Hand.-Mazz.  
Kashmir, Ladakh, Rupshu (4800 m), Lahul.

## OXYGRAPHIS BUNGE

- O. glacialis** (Fisch. ex DC.) Bunge  
Kumaon (4500 m).
- O. polypetala** (Royle) Hook. f. & Thoms.  
Kashmir to Kumaon (up to 4500 m).

## PARAQUILEGIA J. R. DRUMM. &amp; HUTCH.

- P. anemonoides** (Willd.) Ulbr. (*Isopyrum grandiflorum* Fisch. ex DC.)  
Kashmir, Lahul (4200 m), to Kumaon.
- P. microphylla** (Royle) J. R. Drumm. & Hutch. (*Isopyrum microphyllum* Royle)  
Kashmir, Rupshu (4500 m), Lahul.

## RANUNCULUS LINN.

- R. aquatilis** Linn. var. *trichophyllus* (Chaix) Hook. f. & Thoms.  
Ladakh (4500 m), Kumaon.
- R. brotherusi** Freyn  
Kumaon (3300 m).
- R. hirtellus** Royle  
Kashmir to Kumaon (4800 m).

## RANUNCULUS LINN.

- R. hyperboreus** Rottb. var. **natans** Regel  
Kashmir, Tehri-Garhwal (4500 m), Kumaon.
- R. laetus** Wall.  
Kashmir (up to 3600 m).
- R. lobatus** Jacq. ex Camb.  
Kashmir, Lahul (4800 m), Garhwal.
- \***R. munroanus** Drumm. ex Dunn  
Kashmir, Lahul (4000 m).
- R. pulchellus** C. A. Mey.  
Kashmir to Kumaon (4800 m).
- R. radicans** C. A. Mey.  
Kashmir (4000 m).

## THALICTRUM LINN.

- T. alpinum** Linn.  
Throughout up to 4800 m.
- T. cultratum** Wall. subsp. **platycarpum** (Hook. f. & Thoms.)  
Brühl (*T. platycarpum* Hook. f. & Thoms.)  
Garhwal, Kumaon (3300 m).
- T. elegans** Wall. ex Royle  
Kashmir to Kumaon (4000 m).
- T. foetidum** Linn. (*T. minus* Linn. var. *foetidum* Hook. f. & Thoms.)  
Lahul, Spiti (4000 m), Tehri-Garhwal, Garhwal, Kumaon.
- T. minus** Linn. var. **majus** (Jacq.) Hook. f. & Thoms.  
Spiti (4000 m), Chamba.
- T. pauciflorum** Royle  
Kashmir to Kumaon (3900 m).

## TROLLIUS LINN.

- T. acaulis** Lindl.  
Kashmir to Kumaon (4000 m).
- T. pumilus** D. Don  
Kumaon (4100 m).

## BERBERIDACEAE

The barberry family is represented by a few species of the genus, *Berberis*, in the alpine zone of western Himalaya. These species form compact, dense shrubs on dry rocky ridges and, generally, in other dry localities. One of them, *B. jaeschkeana*, frequently seen in Lahul, has 3-fid spines and oblong-ovoid, red berries. On the dry bleak heights of Ladakh, another species, *B. ulicina* occurs and this, perhaps, is the one to attain the highest altitude known for a barberry in western Himalaya.

A herbaceous member of the family, *Podophyllum*, is commonly

known as the May apple. The Himalayan representative, *P. hexandrum*, is a perennial herb with two or three cauline leaves and a single terminal white flower. The fruit is large, oval and reddish with numerous seeds embedded in the pulp. It is edible. This herb is found in the undergrowth of birch forest and also under the shade of rocks. It has attracted considerable attention in recent years for its medicinal use and is now in cultivation in some areas.

#### KEY TO GENERA

- |   |                    |
|---|--------------------|
| 1. Plants woody; leaves simple, fascicled in the axils of 3-5 partite spines; flowers yellow; berries small                   | <i>Berberis</i>    |
| 1. Plants not woody, scapigerous herbs; leaves large, palmately lobed; flowers white or pale rose; berries large, many seeded | <i>Podophyllum</i> |

#### LIST OF GENERA AND SPECIES

##### BERBERIS LINN.

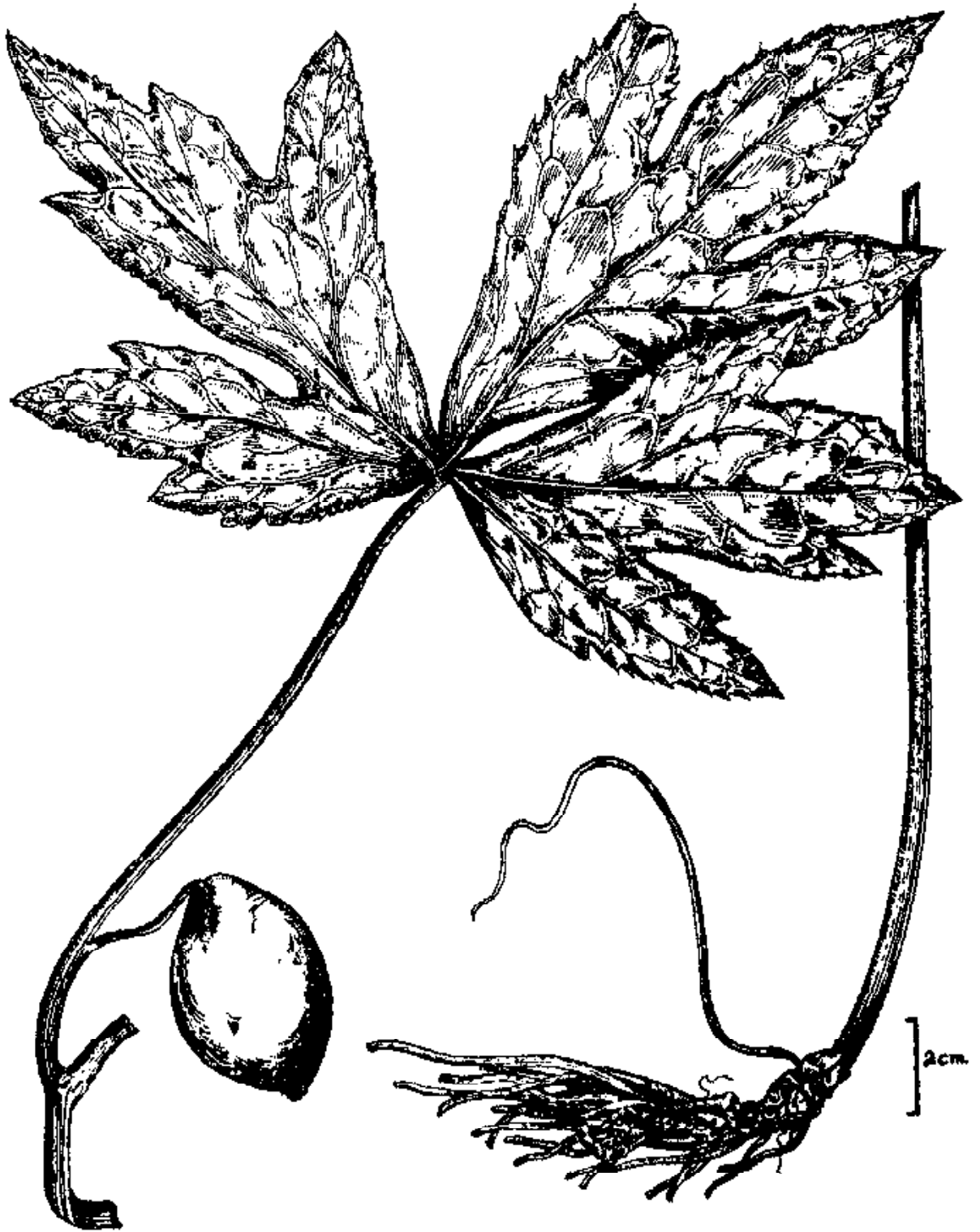
- 7\*B. *garhwalensis* Schneid.  
Kumaon (Milam, 3800 m).
- \*B. *jaeschkeana* Schneid.  
Kashmir to Kumaon up to 3600 m.
- \*B. *kashmirana* Ahrendt  
Kashmir (3400 m).
- \*B. *kumaonensis* Schneid.  
Garhwal, Kumaon (3900 m).
- B. *ulicina* Hook. f. & Thoms.  
Ladakh (4800 m).
- B. *umbellata* Wall. ex G. Don  
Garhwal (3600 m), Kumaon.
- \*B. *zabeliana* Schneid.  
Kashmir (4000 m).

##### PODOPHYLLUM LINN.

- P. *hexandrum* Royle (*P. emodi* Wall. ex Hook. f. & Thoms.)  
Kashmir to Kumaon (4500 m in Tehri-Garhwal).

##### CIRCAEASTERACEAE

This family accommodates a single species, *Circaeaster agrestis* of obscure affinities. It is considered to be a highly reduced relative of the Berberidaceae. The plant has received attention from plant anatomists in recent years on account of the peculiar open dichotomous venation of its leaves. The herb grows in gregarious patches under the shade of larger



*Podophyllum hexandrum* Royle

shrubs and is distributed in the western Chinese provinces and in the eastern Himalaya. It was known from only one locality in Kumaon in the western Himalaya till very recently. It is now known to occur further west in the Garhwal Himalaya at elevations of 3300 m. The entire plant is about 8 cm high with the elongated hypocotyl bearing a terminal rosette of obovate, dentate-spinulate leaves. A peculiar feature of the vegetative body is the presence of a pair of linear and persistent cotyledons below the rosette of crowded leaves. In the centre of the rosette of leaves, a condensed terminal inflorescence composed of numerous minute flowers is found. These minute flowers are very reduced and consist of 2 to 3 tepals, 1 to 3 stamens and 1 to 3 carpels. The carpels develop into fruits which are covered by hooked, unicellular hairs.

#### CIRCAEASTER MAXIM.

##### C. *agrestis* Maxim.

Garhwal, Kumaon (3600 m).

#### PAPAVERACEAE

The poppy family is best known for the blue-poppies belonging to the genus, *Meconopsis*. One of its species, *M. aculeata*, enjoys a wide distribution in western Himalaya being found in the alpine zone from Kashmir to Kumaon. In spite of its rough, repellent exterior, on account of the prickly stem and leaves, the plant bears such exquisitely charming flowers of the finest shade of blue that it has earned for it the name, 'Queen of Himalayan flowers'. On dry rocky slopes and amidst boulders one can see this tall erect herb. The flowers are extremely delicate and wither away so quickly that the plant makes very poor herbarium specimens. There are also purple and yellow-flowered species of *Meconopsis*. Other genera of the family found in the area are *Papaver* and *Stylophorum*. The latter is represented by a single species, *S. lactuoides*, which is found on the ridges beyond Garbyang in Kumaon. It is a perennial herb with yellow juice and bears large yellow flowers, nearly 5 cm in diameter. It is, however, a rare plant of the area.

#### KEY TO GENERA

- |  |                    |
|--|--------------------|
| 1. Capsules opening by pores or by short valves only at the top  |                    |
| 2. Stigmas sessile on disc at top of ovary                       | <i>Papaver</i>     |
| 2. Stigmas sessile on top of ovary but decurrent on top of style | <i>Meconopsis</i>  |
| 1. Capsules opening by valves throughout the length              | <i>Stylophorum</i> |



*Meconopsis aculeata* Royle

## LIST OF GENERA AND SPECIES

## MECONOPSIS VIG.

- M. aculeata** Royle  
Kashmir to Kumaon (4500 m).
- \***M. latifolia** Prain  
Kashmir.
- M. paniculata** (D. Don) Prain (*M. napaulensis* auct. non DC.)  
Garhwal, Kumaon (3600 m).
- M. robusta** Hook. f. & Thoms.  
Kumaon (3600 m).

## PAPAVER LINN.

- P. nudicaule** Linn. subsp. **rubroaurantiacum** (DC.) Fedde var. **corydalifolium** Fedde  
Kashmir (Kolohai, 3600 m), Ladakh (5000 m).

## STYLOPHORUM NUTT.

- S. lactucoides** Hook. f. & Thoms.  
Kumaon (3300 m).

## FUMARIACEAE

The fumitory family has several species of the genus, *Corydalis* distributed in the alpine zone of western Himalaya. Most of them bear yellow flowers but one of them, the blue *Corydalis*, *C. cashmeriana*, has very pretty sky-blue flowers. This is a small bulbous herb, 10 to 15 cm high and bears a raceme of blue flowers. The flowers are 1 to 2 cm long in which the posterior petal has a curved spur at the base. Among the yellow-flowered species, *C. govaniiana* is not only an attractive herb but is also medicinally useful. As in all other species of the genus, the leaves are lobed or finely cut and the flowers are gibbous or spurred. *C. vaginans* is another yellow-flowered member occurring at high altitudes, often found in semi-aquatic situations or sometimes rooted to rocks even in fast running streams.

A very characteristic species with large rotund or lobed, obtuse leaves and bearing a leafy scape of white or yellow-purple variegated flowers is met with in Kashmir, Ladakh and Lahul at altitudes above 4000 m. This species, *C. crassissima*, is a conspicuous herb of the rocky heights at the approach to the holy shrine of Amarnath in Kashmir.



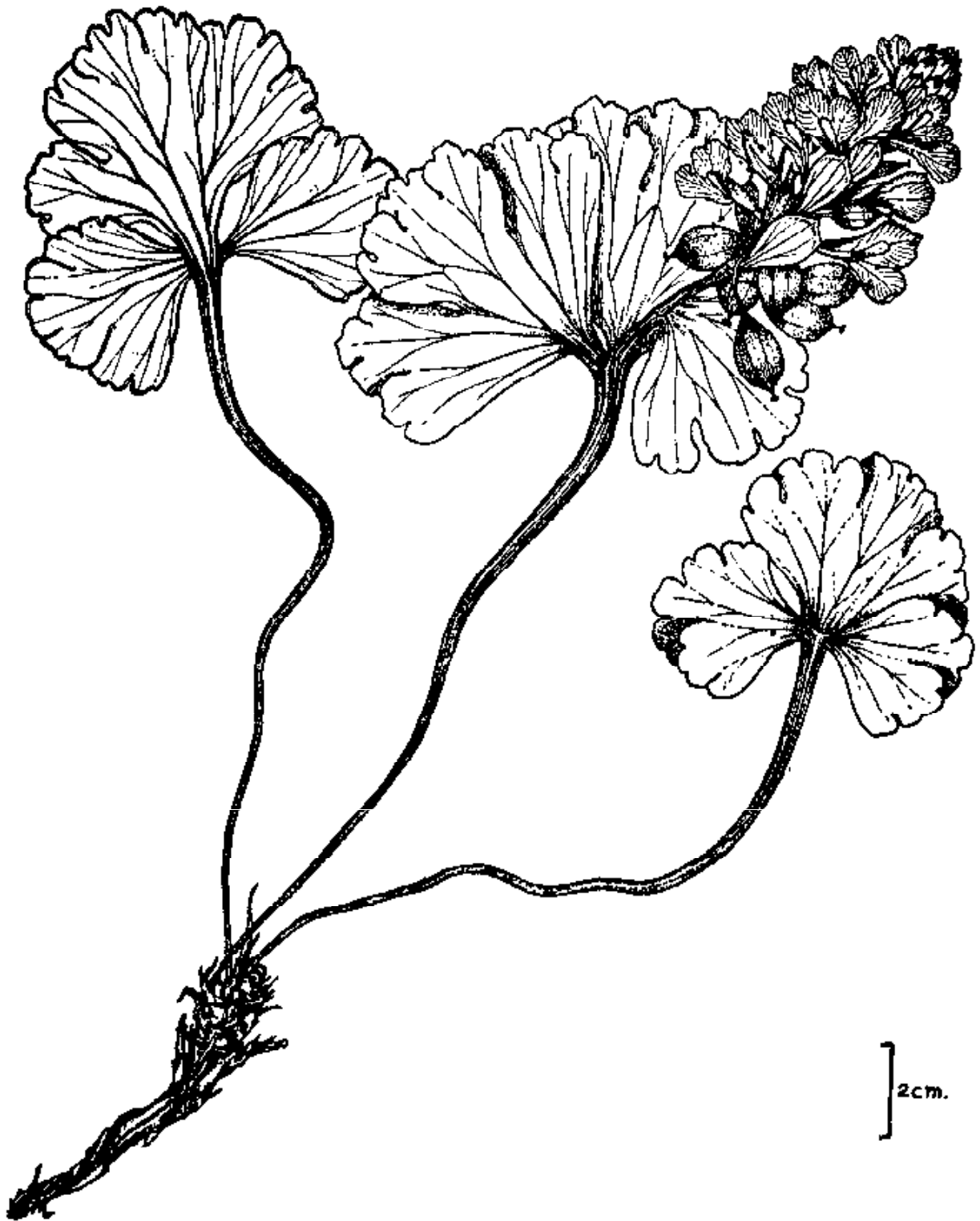
*Corydalis cashmiriana* Royle



## LIST OF GENERA AND SPECIES

## CORYDALIS DC.

- C. adiantifolia** Hook. f. & Thoms.  
Zanskar (4000 m).
- \***C. howeri** Hemsl.  
Kumaon (3600 m).
- C. cashmeriana** Royle  
Kashmir to Kumaon (4200 m).
- C. clarkei** Prain  
Kashmir (4200 m).
- C. crassifolia** Royle  
Kumaon (4000 m).
- \***C. crassissima** Camb.  
Kashmir, Ladakh, Lahul (4800 m).
- C. crithmifolia** Royle  
Tehri-Garhwal, Garhwal, Kumaon (4000 m).
- C. diphylla** Wall. (*C. rutaefolia* Sibth.)  
Chamba, Kumaon (3300 m).
- C. elegans** Wall. ex Hook. f. & Thoms.  
Kumaon (4500 m).
- C. flabellata** Edgew.  
Garhwal, Kumaon (3900 m).
- C. govaniana** Wall.  
Kashmir to Kumaon (4500 m in Tehri-Garhwal).
- C. meifolia** Wall.  
Lahul, Chamba, Tehri-Garhwal, Garhwal, Kumaon (4800 m).
- C. moorcroftiana** Wall. ex Hook. f. & Thoms.  
Kumaon (4200 m).
- \***C. nana** Royle  
Kumaon (5400 m).
- \***C. nana** var. *jacquemontii* Fedde  
Tehri-Garhwal, Garhwal, Kumaon.
- C. pauciflora** Pers.  
Kashmir to Kumaon.
- \***C. sikkimensis** (Prain) Fedde  
Kashmir (3900 m).
- C. stricta** Steph. ex DC.  
Rupshu (4500 m), Ladakh.
- C. thyrsoflora** Prain (*C. gortschakovii* Hook. f. & Thoms. non Schrenk)  
Kashmir, Chamba, Lahul (4800 m).
- C. vaginans** Royle (*C. ramosa* Wall. ex Hook. f. & Thoms. non O. & B. Fedtsch).  
Kashmir to Kumaon (4800 m).



*Corydalis crassissima* Camb.

## CRUCIFERAE

(nom. altern. BRASSICACEAE)

The plants belonging to this well known family which includes the radishes, mustards, cabbages and others are all herbs characterised by the possession of a cruciform corolla in their flowers. The 4 sepals are in 2 whorls and the 4 petals are placed crosswise in alternation with the sepals. There are 6 stamens arranged in 2 whorls, an outer of 2 short and an inner of 4 long stamens. The ovary is made of 2 carpels which develop into a characteristic fruit known as the siliqua.

The family is well represented in the alpine zone and, in fact, the plant that has been collected at what is perhaps the highest altitude recorded for a flowering plant in the western Himalaya, is a member of this family. *Parrya*, *Christolea*, *Arabis*, *Draba* and *Chorispora* have some or most of their species reaching an altitude of more than 5000 m. *Christolea himalayensis* has been collected on Mt. Kamet at 6300 m and *C. stewartii* with cream-coloured fragrant flowers was gathered in Rupshu at 5700 m. Among the species of *Arabis*, *A. tibetica* is generally restricted to altitudes above 4500 m in the dry, cold heights of Lahul and north Kashmir.

*Draba* is a very interesting genus of tufted herbs. Many of them form compact cushions on rock faces at high altitudes. The flowers may be white or yellow and are borne in racemes or corymbs. The pods are usually short and ovoid in shape. *D. oreades*, a species widely distributed in the alpine regions of Europe and west Asia and in the arctic regions is known to reach an altitude of 5700 m in the Himalaya. *Braya* and *Aphragmus* are other genera showing the tufted habit. These bear white flowers.

The ubiquitous shepherd's purse, *Capsella bursa-pastoris* is also met with generally in the alpine zone of west Himalaya as also the other well known weed of cultivation, *Thlaspi arvense*. The common radish, *Raphanus sativus*, is seen in cultivation up to an altitude of 4500 m in this region.

*Chorispora sabulosa* is a perennial herb with a thick, fleshy fusiform root and tufted radical leaves. The flowers are large, yellowish or purplish, borne on racemes arising from amidst the leaves. The pods are torulose. This herb occurs at high altitudes and is known from Kumaon, Spiti, Kashmir and Rohtang Pass.

## KEY TO GENERA

1. Pods indehiscent

2. The pods elongate, more than 2-seeded

3. Pods straight, thick, continuous within

3. Pods torulose

*Raphanus**Chorispora*

2. The Pods short, 1 or 2-seeded
4. Pods 2-seeded, large, didymous *Megacarpaea*
4. Pods 1-seeded
5. Pods jointed, upper joint 1-celled,  
lower seedless and forming stalk *Crambe*
5. Pods not jointed, 1-celled, 1-seeded *Tauscheria*
1. Pods dehiscent
6. The pods short, compressed laterally at  
right angles to septum
7. Pods many seeded, valves not winged,  
obcordate, cuneate *Capsella*
7. Pods few seeded, valves winged
8. Seed solitary in each cell; pods orbi-  
cular-oblong *Lepidium*
8. Seeds 4 to 8 in each cell *Thlaspi*
6. The pods long or short, not compressed at  
right angles to septum
9. Seeds 2-seriate
10. Herbs with erect simple stems; pods  
narrow, linear *Turritis*
10. Herbs with tufted stems, simple or  
branched; pods compressed or  
turgid, oblong, ovoid or lanceolate,  
rarely linear
11. The herbs tufted, hoary-tomen-  
tose; stem present, simple or  
branched
12. Filaments of stamens with  
appendages *Alyssum*
12. Filaments of stamens simple
13. Pods erect, linear or elli-  
ptic-lanceolate, curved *Braya*
13. Pods short, elliptic-ob-  
long or ovoid
14. Petals entire *Draba*
14. Petals 2-fid *Erophila*
11. The herbs glabrous, stemless
15. Pods globose or ovoid, turgid *Cochlearia*
15. Pods cylindric, curved *Arcyosperma*
9. Seeds 1-seriate
16. Pods torulose, sub-torulose or curved
17. Flowers white or lilac, pods torulose *Torularia*
17. Flowers yellow

- |   |                    |
|---|--------------------|
| 18. Pods cylindric, sub-torulose, pedicels slender, valves 1-nerved | <i>Descurainia</i> |
| 18. Pods slender, curved, pedicels stout, valves 3-nerved           | <i>Sisymbrium</i>  |
| 16. Pods not torulose or curved                                     |                    |
| 19. Pods 4-angled   |                    |
| 20. Herbs tufted perennials   |                    |
| 21. Seeds flattened with a membranous wing                          | <i>Parrya</i>      |
| 21. Seeds flattened without border or wing                          | <i>Christolea</i>  |
| 20. Herbs with diffuse branches                                     |                    |
| 22. Lower leaves lyrate-pinnate, base auricled, stem-clasping       | <i>Barbarea</i>    |
| 22. Lower leaves oblong, sinuate-toothed, base never auricled       | <i>Erysimum</i>    |
| 19. Pods not 4-angled but terete or flattened                       |                    |
| 23. Leaves simple, entire or toothed                                |                    |
| 24. Pods cylindric, hard  | <i>Malcolmia</i>   |
| 24. Pods slender, long, compressed                                  |                    |
| 25. Valves of the fruit flat  | <i>Arabis</i>      |
| 25. Valves of the fruit convex                                      | <i>Arabidopsis</i> |
| 23. Leaves pinnate  | <i>Cardamine</i>   |

*Note:* The genus *Microsisymbrium* O.E. Schulz is separated from *Sisymbrium* Linn. on the basis of the prominent stigma of the latter in contrast to the minute depressed stigma of the former. The genus *Aphragmus* Andr. is distinguished from *Braya* Sternb. & Hoppe by the former's confluent nectariferous glands.

#### LIST OF GENERA AND SPECIES

##### ALYSSUM LINN.

- A.** *canescens* DC.  
Kumaon (5000 m).

##### APHRAGMUS ANDRZ.

- \***A.** *himalaicus* O.E. Schulz  
Kashmir (4200 m).  
\***A.** *obscurus* (Dunn) O.E. Schulz  
Kashmir (3500 m).  
**A.** *oxycarpus* (Hook. f. & Thoms.) Jafri (*Braya alpina* Hook. f. & Thoms. non Sternb. & Hoppe)  
Kashmir, Rupshu (4800 m), Lahul, Spiti, Tehri-Garhwal.

## ARABIDOPSIS HEYNH.

- A.** *himalaica* (Edgew.) O.E. Schulz (*Sisymbrium himalaicum* Edgew.)  
Kashmir, Garhwal, Kumaon (3900m).
- \***A.** *himalaica* var. *kunawarensis* (Royle) O.E. Schulz  
Kumaon (3900m).
- mollissima** (C.A. Mey.) O.E. Schulz var. *dentata* O.E. Schulz  
(*Sisymbrium mollissimum* Hook. f. & T. Anders. non C.A. Mey.  
p. p.)  
Kashmir to Kumaon (up to 4000m).
- \***A.** *mollissima* var. *thomsonii* (Hook. f.) O.E. Schulz  
Kashmir, Ladakh (4500m).
- A.** *thaliana* (Linn.) Heynh. (*Sisymbrium thalianum* Gay & Mann.)  
Kumaon (5000 m).

## ARABIS LINN.

- A.** *amplexicaulis* Edgew.  
Kashmir to Kumaon (3600 m).
- A.** *auriculata* Lamk.  
Kashmir.
- A.** *glandulosa* Kar. & Kir.  
Rupshu (4900 m).
- A.** *pterosperma* Edgew.  
Kashmir to Kumaon (4300 m).
- A.** *saxicola* Edgew.  
Garhwal.
- \***A.** *tenuirostris* O. E. Schulz  
Lahul (4500 m).
- A.** *tibetica* Hook. f. & Thoms.  
Lahul (4800 m).

## ARCYOSPERMA O.E. SCHULZ

- A.** *primulifolium* (Toms.) O.E. Schulz (*Euterna primulaefolium*  
Hook. f. & Thoms.)  
Kashmir, Simla, Garhwal (3600 m), Kumaon.

## BARBAREA R. BR.

- B.** *intermedia* Boreau [*B. vulgaris* R. Br. var. *sicula* (Presl)  
Hook. f. & T. Anders.]  
Chamba, Tehri-Garhwal (3500 m).
- B.** *vulgaris* R. Br.  
Kashmir to Kumaon (3600 m).

## BRAYA STERNB. &amp; HOPPE

- B. thomsonii** Hook. f. (*B. alpina* Hook. f. & T. Anders. non Sternb. & Hoppe P. P.)  
Spiti, Kumaon (4500 m).

## CAPSELLA MEDIK.

- C. bursa-pastoris** (Linn.) Medik.  
Throughout up to 4800 m.  
**C. procumbens** (Linn.) Fries (*C. elliptica* C.A. Mey.)  
Ladakh (4500 m).  
**C. thomsonii** Hook. f. [*Hedinia tibetica* (Thoms.) Ostenf.]  
Rupshu 5100 m.

## CARDAMINE LINN.

- C. impatiens** Linn.  
Throughout up to 3600 m.  
\***C. inayatii** O.E. Schulz  
Garhwal (3300 m).  
**C. macrophylla** Wild.  
Throughout up to 3600 m.  
**C. pratensis** Linn.  
Tehri-Garhwal, Kumaon (4500 m).

## CHORISPORA R. BR. EX DC. NOM. CONS

- C. sabulosa** Camb.  
Kashmir to Kumaon (4800 m).  
**C. sibirica** DC.  
Kashmir (Burzil pass, 3600 m).

## CHRISTOLEA CAMB. ES JACQ.

- C. albiflora** (T. Anders.) Jafri (*Cheiranthus albiflorus* T. Anders.)  
Zanskar (4800 m).  
**C. crassifolia** Camb.  
Rupshu (4800 m), Spiti, Kumaon.  
**C. himalayensis** (Camb.) (*Cheiranthus himalayensis* Camb.)  
Lahul, Spiti, Garhwal (6300 m), Kumaon (4800 m).  
\***C. lanuginosa** (Hook. f. & Thoms.) Jafri (*Parrya lanuginosa* Hook  
f. & Thoms.)  
Rupshu (5700 m).  
\***C. parkeri** (O.E. Schulz) Jafri  
Kashmir (3900 m).

**\*Christolea scaposa** Jafri

Kashmir (5000 m).

- C. **stewartii** (T. Anders.) Jafri (*Cheiranthus stewartii* T. Anders.)  
Rupshu (5700 m), Lahul (4800 m).

## COCHLEARIA LINN.

- C. **scapiflora** Hook. f. & Thoms.  
Kumaon (4800 m).

## CRAMBE LINN.

- C. **cordifolia** Stev.  
Kinnaur (4000 m).

## DESCURAINIA WEBB. &amp; BERTH. NOM. CONS.

- D. **sophia** (Linn.) Webb. ex Prantl (*Sisymbrium sophia* Linn.)  
Kashmir to Kumaon.

## DRABA LINN.

- D. **altaica** (C.A. Mey.) Bunge (*D. fladnitzensis* Hook. f. & Thoms. non Wulf.)  
Kashmir, Rupshu (4900 m), Lahul, Kumaon (4900 m).
- \*D. **amoena** O.E. Schulz  
Kumaon (4500 m).
- D. **cachemirica** Gandoger (*D. glacialis* Hook. f. & Thoms. p.p. non Adams).  
Lahul, Spiti (5300 m).
- \*D. **falconeri** O.E. Schulz  
Kashmir (3900 m).
- \*D. **glomerata** Royle  
Kashmir, Lahul (4800 m).
- \*D. **glomerata** var. **dasycarpa** O.E. Schulz  
Kashmir, Kinnaur (4200 m).
- D. **gracillima** Hook. f. & Thoms.  
Kumaon (5400 m).
- D. **lasiophylla** Royle  
Lahul (4800 m), Tehri-Garhwal (4500 m), Kumaon.
- D. **lanceolata** Royle  
N. Kashmir 4500 m.
- D. **lasiophylla** var. **lelocarpa** (Pamp.) O.E. Schulz  
Tehri-Garhwal (5000 m).



**\*Draba ludlowiana** Jafri

Ladakh (4800 m).

**\*D. nubigena** O.E. Schulz

Kashmir, Kumaon (4500 m).

**D. olgae** Regel & Schmalh.

N. Kashmir, above Skardu, 4500 m.

**D. oreades** Schrenk (*D. alpina* Hook. f. & T. Anders p.p. non Linn.)

Kashmir (4800 m), Rupshu (5000 m) to Kumaon (5000 m).

**D. radicans** Royle

Tehri-Garhwal (3600 m).

**D. setosa** Royle (*D. glacialis* Hook. f. & T. Anders. p.p. non Adams)

Kashmir, Lahul (4600 m), Kinnaur.

**D. stenocarpa** Hook. f. & Thoms. (*D. linearis* Hook. f. & T. Anders. non Boiss.)

Kashmir, Lahul (3900 m).

**D. tibetica** Hook. f. & Thoms. (incl. var. *Winterbottomii*)

Kashmir (4000 m).

**\*D. trinervis** O.E. Schulz

Kashmir.

## EROPHILA DC. NOM. CONS.

**E. verna** (Linn.) E. Mey. (*E. vulgaris* DC.)

Lahul (4500 m).

## ERYSIMUM LINN.

**E. hieracifolium** Linn.

Kashmir to Kumaon up to 3600 m.

**E. pachycarpum** Hook. f. & Thoms.

Kashmir (3600 m).

## LEPIDIUM LINN.

**L. capitatum** Hook. f. & Thoms.

Ladakh, Lahul, Kumaon (4200 m).

## MALCOLMIA R. BR. CORR. SPRENG. NOM. CONS.

**M. africana** R. Br.

Kashmir, Ladakh (3800 m).

## MEGACARPAEA DC.

**M. polyandra** Benth.

Kashmir, Kumaon (Pindari Glacier, 3600 m).

## MICROSISYMBRIUM O.E. SCHULZ

- M. axillare** (Hook. f. & Thoms.) O.E. Schulz subsp. **brevipedicellatum** Jafri (*Sisymbrium axillare* Hook. f. & Thoms.)  
Lahul (3600 m).

## PARRYA R. BR.

- P. macrocarpa** R. Br.  
Ladakh (5300 m), Rupshu (5000 m), Kumaon (4800 m).

## RAPHANUS LINN.

- R. sativus** Linn.  
Throughout, cult.

## SISYMBRIUM LINN.

- S. bracciforme** C. A. Mey. (*S. columnae* Hook. f. & T. Anders. non Jacq.)  
Spiti (3900 m), Kumaon.

## TAUSCHERIA FISCH. EX DC.

- T. lasiocarpa** DC.  
Kumaon.

## THLASPI LINN.

- T. andersonii** (Hook. f. & Thoms.) O.E. Schulz (*Iberidella andersonii* Hook. f. & Thoms.)  
Kashmir to Kumaon (4800 m).  
**T. arvense** Linn.  
Throughout up to 4000 m.  
**T. cochleariforme** DC. (*T. alpestre* Hook. f. & T. Anders. p.p. non Linn.)  
Kashmir to Kumaon (4500 m).  
**T. cochlearioides** Hook. f. & Thoms.  
Kashmir to Kumaon (4800 m in Lahul).

## TORULARIA O.E. SCHULZ

- T. humilis** (C.A. Mey.) O.E. Schulz (*Sisymbrium humile* C.A. Mey.)  
Kashmir, Ladakh (4500 m), Lahul to Kumaon.  
**\*T. humilis** var. **piasezkii** (Maxim.) Jafri  
Rupshu (4650 m).

## TURRITIS LINN.

- T. glabra** Linn. (*Arabis glabra* Crantz)  
Kashmir to Kumaon.

## VIOLACEAE

The violets are popular garden plants. The well known pansy of the gardens belongs to this family. The violets have a characteristically modified flower in which the lower largest petal is either spurred or is saccate at the base. The connectives of some of the anthers may also be spurred at the base. The fruit is usually a 3-valved capsule. Among the wild members of the family, the yellow-flowered *Viola biflora* is the commonest at high altitudes. The purple-flowered, stemless herb with tufted leaves, *V. kunawarensis* has been collected in Kashmir at altitudes above 4000 m. This species is also known to occur in swampy habitats.

## LIST OF GENERA AND SPECIES

## VIOLA LINN.

- V. *biflora* Linn.  
Kashmir to Kumaon (3900 m).
- V. *kunawarensis* Royle  
Kashmir to Kumaon (4500 m).
- V. *rupestris* F. W. Schum.  
N. Kashmir (Deosai).
- V. *serpens* Wall.  
Lahul (4200 m).

## CARYOPHYLLACEAE

The pinks which are favourite garden plants belong to this family. The family has many representatives in the alpine zone among which are the species of *Arenaria*, *Cerastium*, *Dianthus*, *Gypsophila*, *Lychnis*, *Minuartia*, *Sagina*, *Silene* and *Stellaria*. These are mostly herbs with opposite, decussate leaves and variously coloured flowers, often with fringed petals and inflated calyx. The ovary is superior and characteristically 1-celled with one to many ovules on a free central placenta. The plant with a very peculiar habit is a monotypic genus, *Thylacospermum* and its single species, *T. rupifragrum*, forms large hemispheric mounds which are often half a metre wide. The leaves are narrow, densely imbricate and tufted. This is not a common plant and is met with only in the dry inner valleys near the high Himalayan passes. It is known from Rhudughera in Tehri-Garhwal (alt. 4800 m) but in Rupshu, it occurs at much higher altitudes. This plant is also commonly seen in Ladakh. Another plant with a similar habit which also forms large rigid mats or tufts at high altitudes is *Arenaria perlevis*. It bears sessile, solitary flowers. This plant has also been recorded from Rupshu at 5400 m. In the eastern sector, it is known from an altitude of 6000 m on Everest. Other species of the genus, *A. glandulifera*, *A. festucoides* and *A. stracheyi* are known to occur

at very high altitudes. The first named is generally restricted to the altitude range, 4000 to 5700 m. It is a glandular, pubescent herb with solitary pinkish flowers. *A. festucoides* forms dense tufts of crowded, pungent, rigid, curved leaves. *Minuartia*, closely related to *Arenaria*, has also representatives in the alpine zone. This genus is differentiated from *Arenaria* in the number of capsular valves being the same as the number of styles whereas in *Arenaria*, the valves are twice as many as the styles.

Among the species of *Silene* and *Lychnis*, which are popularly known as the champions or catch-flies, the alpine representatives are seen to reach altitudes as high as 4800 m in Lahul and one of them, *L. brachy-petala*, has been collected in Ladakh at 5200 m. These genera have usually an inflated calyx and are again separated from each other on the basis of the nature of capsular dehiscence.

#### KEY TO GENERA

1. Sepals fused
  2. Calyx tubular, or campanulate, not inflated
    3. Disc, a long stalked gynophore *Dianthus*
    3. Disc small *Gypsophila*
  2. Calyx tubular or campanulate, more or less inflated
    4. Capsules dehiscing by teeth equal to number of styles *Lychnis*
    4. Capsules dehiscing by twice as many teeth as there are styles *Silene*
1. Sepals free or connate only at the base
  5. Petals present
    6. Each petal bipartite or deeply bifid
      7. Capsule cylindrical with twice as many short valves as styles *Cerastium*
      7. Capsule short, splitting at base into as many valves as there are styles *Stellaria*
    6. Each petal entire
      8. Carpels 4-5 *Sagina*
      8. Carpels 2-3
        9. Ovary of 2 carpels; capsule globose or inflated opening by 2 valves *Lepyrodiclis*
        9. Ovary of 3 carpels; capsule ovoid to cylindrical, never inflated *Thylacospermum*
  5. Petals absent
    10. Capsule opening by as many valves as styles *Minuartia*
    10. Capsule opening by twice as many teeth or valves as styles *Arenaria*

## LIST OF GENERA AND SPECIES

## ARENARIA LINN.

- A. *ciliolata* Edgew.  
Tehri-Garhwal, Garhwal, Kumaon (5200 m).
- A. *festucoides* Benth.  
Lahul (4800 m), Chamba, Tehri-Garhwal, Kumaon.
- A. *glanduligera* Edgew.  
Kashmir to Kumaon (5400 m).
- A. *kumaonensis* Maxim.  
Kumaon (Ralam Valley).
- A. *perlevis* (Williams) Hand.-Mazz. (*A. musciformis* Edgew.)  
Rupshu, Lahul to Kumaon (5000 m).
- A. *serpyllifolia* Linn.  
Throughout, reaching 3600 m in some places.
- A. *stracheyi* Edgew.  
Ladakh (4500 m).

## CERASTIUM LINN.

- C. *cerastioides* (Linn.) Britton (*C. trigynum* Vill.)  
Ladakh (5400 m), Lahul, Spiti.
- C. *dahuricum* Fisch.  
Kashmir to Kumaon (3900 m).
- C. *thomsonii* Hook. f.  
Kashmir to Kumaon (3600 m).
- C. *vulgatum* Linn.  
Tehri-Garhwal (3900 m).

## DIANTHUS LINN.

- D. *angulatus* Royle  
Kashmir, Lahul, Spiti (4200 m).

## GYPSOPHILA LINN.

- G. *cerastloides* D. Don  
Kashmir to Kumaon (4000 m).
- G. *sedifolia* Kurz.  
Zaskar (4000 m).

## LEPYRODICLIS FENZL.

- L. *holosteoides* (C.A. Mey.) Fenzl. ex Fisch. & Mey. (*Arenaria holosteoides* Edgew.)  
Ladakh (4300 m), Kumaon (Milam Glacier).

## LYCHNIS LINN.

- L. apetala** Linn.  
Kashmir to Kumaon (4500 m).
- L. brachypetala** Hort.  
Ladakh (5200 m), Chamba, Kumaon (4500 m).
- L. himalayensis** (Rohrb.) Edgew.  
Kashmir, Lahul (4500 m), Kumaon (4500 m).
- L. indica** Benth.  
Ladakh, Lahul, Tehri-Garhwal, Garhwal (4000 m).
- L. macrorhiza** Benth.  
Kashmir, Ladakh, Lahul (4800 m), Kumaon.
- L. nigrescens** Edgew.  
Spiti, Tehri-Garhwal, Garhwal, Kumaon (4500 m).
- L. nutans** Benth.  
Lahul, Kulu, Tehri-Garhwal, Kumaon (3600 m).
- L. pilosa** Edgew.  
Tehri-Garhwal, Garhwal, Kumaon (4500 m).

## MINUARTIA LOEFL. EX LINN.

- M. biflora** (Linn.) Sch. & Th.  
Kashmir (Deosai up to 4800m).
- M. lineata** (C. A. Mey.) Bornm. (*Arenaria foliosa* Royle ex Edgew. & Hook. f. and *A. kashmerica* Edgew.)  
Kashmir to Kumaon (up to 4200 m).

## SAGINA LINN.

- S. saginoides** (Linn.) Karsten (*S. procumbens* Edgew. & Hook. f. non Linn.)  
Throughout up to 4500 m.

## SILENE LINN.

- S. kunawarensis** Royle  
Kumaon (4000 m).
- S. persica** Boiss. subsp. *moorcroftiana* (Rohrb.) Chaudhuri (*S. moorcroftiana* Wall.)  
Ladakh (4800 m), Lahul, Garhwal, Kumaon.
- S. tenuis** Willd.  
Kashmir, Chamba, Lahul (4500 m).
- S. vulgaris** (Moench) Garcke (*S. inflata* Sm.)  
Throughout up to 3600 m.

## STELLARIA LINN.

- S. alsine** Grimm (*S. uliginosa* Edgew. & Hook. f. non Linn.)  
Kashmir, Kumaon.
- S. cherleriae** (Fisch.) Williams (*S. decumbens* Edgew.)  
Kashmir to Kumaon (5200 m).
- S. depauperata** Edgew.  
Tehri-Garhwal (4500 m).
- S. himalayensis** Majumdar (*S. latifolia* Benth. non Pers.)  
Garhwal, Kumaon (3300 m).
- S. media** (Linn.) Vill.  
Throughout up to 3600 m.
- S. monosperma** Buch.-Ham. ex D. Don (*S. crispata* Wall.)  
Kashmir to Kumaon up to 3600 m.
- S. monosperma** var. **paniculata** (Edgew.) Majumdar (*S. paniculata*  
Edgew.)  
Tehri-Garhwal (3900 m).
- S. palustris** Retz. (*S. glauca* With.)  
Lahul (4500 m), Spiti.
- S. patens** D. Don (*S. longissima* Wall.)  
Kashmir to Kumaon (4200 m).
- S. subumbellata** Edgew.  
Kashmir to Kumaon (4500 m).

## THYLACOSPERMUM FENZL.

- T. rupifragum** Schrenk  
Rupshu (5400 m), Ladakh, Tehri-Garhwal (4800 m).

## TAMARICACEAE

This is a characteristic family with its members having an ericoid habit. The leaves are scaly or needle-like and are usually spirally arranged. The plants are found in arid areas, along rivers and on cold deserts. The genus, *Myricaria* of this family includes fastigate shrubs which are distributed in the temperate and alpine zones generally in cold, bleak and exposed habitats. They are particularly common along dry river banks and in stream beds. Two species are met with in the area. *M. elegans* is restricted to west Himalaya but the other species, *M. germanica* extends to Sikkim and China in the east and to Europe on the west. The *Myricarias* bear lateral or terminal spikes of closely set pinkish flowers.

## MYRICARIA DESV.

**M. elegans** Royle

Ladakh, Rupshu (4300 m), Tehri-Garhwal, Garhwal, Kumaon.

**M. germanica** Desv. var. **prostrata** (Benth. & Hook. f.) T. Dyer

Lahul (4500 m) to Kumaon.

## LINACEAE

The linseed family is largely known for its economically important species, *Linum usitatissimum*, which is widely cultivated in the country. A high altitude member of the genus, *L. perenne*, is known to occur in Kashmir and Lahul. It is a tall herb with large bluish flowers which are borne in few-flowered cymes at the ends of branches.

## LINUM LINN.

**L. perenne** Linn.

Kashmir (3900 m), Lahul.

## GERANIACEAE

The wild geraniums (*Geranium* spp.) are colourful herbs, some of which have showy, purple or purple-lined flowers. Most species of the genus are confined to the temperate zone in west Himalaya but a few reach alpine heights among which are *Geranium pratense* and *G. collinum*. *G. pratense* has large blue-purple flowers which are nearly 5 to 6 cm across. This species is known to occur in Lahul, Spiti and Kumaon. *G. collinum* has a distribution extending over the entire range of western Himalaya from Kashmir to Kumaon and is also found in Nepal and Sikkim in the east and in Afghanistan and south Russia on the west. This species possesses large flowers and has been gathered at an altitude of 4800 m in Lahul along the Baralacha La.

*Erodium* is another genus of this family which is characterised by the possession of five perfect stamens and five staminodes in its flowers and thus differs from *Geranium* which has all ten perfect stamens. *E. tibetanum* is a rare plant found in Ladakh and Rupshu.

Another member of the family, *Biebersteinia emodi*, is a true alpine being found only above 4000 m. This plant occurs in Ladakh and Lahul at altitudes above 4800 m. The flowers are yellow and are mildly fragrant.

## KEY TO GENERA

- |                                    |                      |
|------------------------------------|----------------------|
| 1. Carpels indehiscent, not beaked | <i>Biebersteinia</i> |
| 1. Carpels dehiscent, beaked       |                      |
| 2. Stamens 10                      | <i>Geranium</i>      |
| 2. Stamens 5, staminodes 5         | <i>Erodium</i>       |



## LIST OF GENERA AND SPECIES

## BIEBERSTEINIA STEPHAN EX FISCH.

- B. odora** Steph. (*B. emodi* Jaub. & Spach.)  
Ladakh (5100 m), Lahul (4800 m).

## ERODIUM L'HERIT.

- E. tibetanum** Edgew.  
Rupshu (4500 m).

## GERANIUM LINN.

- G. collinum** Stephan ex Willd.  
Kashmir (4200 m) to Kumaon.
- G. grandiflorum** Edgew.  
N. Kashmir.
- G. grevilleanum** Wall.  
Kumaon (3300 m).
- \* **G. kishtwariensis** R. Knuth.  
Kistwar.
- G. pratense** Linn.  
Kashmir to Kumaon (4000 m).
- G. sibiricum** Linn.  
Ladakh.
- G. wallichianum** Sw.  
Throughout up to 4000 m.

## BALSAMINACEAE

The balsams are soft-stemmed herbs with thin-textured, simple leaves. The flowers are white, yellow, pink or purple and are borne in scapes in umbels or racemes. One of the sepals is large, petaloid and is produced into a pouch or a hollow spur. The fruit is an elongated capsule which often explodes when ripe. Many species of balsams are met with in the country but only a small number reach the temperate and sub-alpine zones in the Himalaya. Of these, the most conspicuous one is the gigantic annual herb, *Impatiens gigantea*, which attains a height of nearly 3 m. This species is generally considered to be only a variant of the more widely distributed, *I. roylei*. Both have pink flowers. In the Valley of Flowers, these balsams are abundant. Smythe has referred to the possible effect of the extensive grazing on the smaller and tenderer plants which are soon eliminated and in whose place spring up the tall balsams to the great detriment of the pasture land.

## LIST OF GENERA AND SPECIES

## IMPATIENS LINN.

- I. **amplexicaulis** Edgew.  
Kulu to Kumaon (3600 m).
- I. **gigantea** Edgew.  
Throughout.
- I. **glandulifera** Royle (*I. roylei* Walp.)  
Throughout up to 3800 m.
- I. **thomsonii** Hook. f.  
Spiti, Garhwal, Kumaon (3600 m).

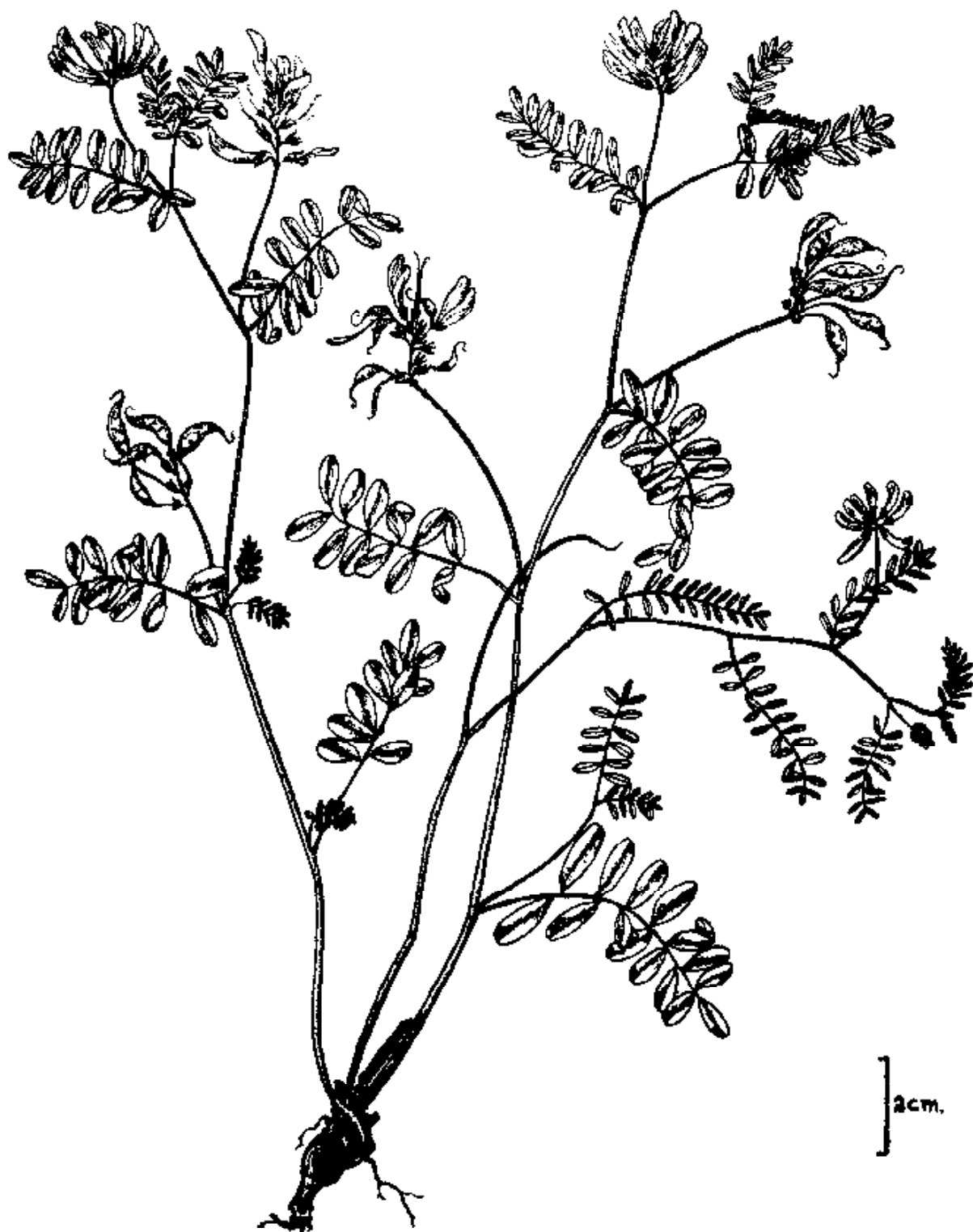
## LEGUMINOSAE

## (nom. altern. FABACEAE)

The large pea family, Papilionoideae of the Leguminosae, is characterised by the possession of a highly modified corolla which consists of a large 'standard' petal, two wings and a bilobed keel. This kind of flower is specially adapted for insect pollination. The lucernes (*Medicago* spp.), clovers (*Trifolium* spp.), alfalfas (*Melilotus* spp.) and fenugreeks (*Trigonella* spp.) belong to this family and some representatives of these genera reach the alpine zone. One of the clovers, *Trifolium repens*, has been seen at an altitude of nearly 6000 m in some sectors of western Himalaya. *Melilotus officinalis*, *Medicago falcata* and *Trigonella emodi* also reach the alpine zone.

The genera which are widely distributed in the alpine zone are, however, *Astragalus*, *Caragana* and *Oxytropis*. *Caragana* is a genus of low shrubs in which the leaf rachises and stipules are usually hardened and end in spines. The calyx is campanulate but very obliquely placed. The genus attains its best development in the Central Asian highlands but in the Himalaya, five species are known to occur in the alpine zone. *C. pygmaea* is the most widely distributed among them. It is found in Lahul, Spiti, Tehri-Garhwal and other sectors of west Himalaya. It is particularly conspicuous on the dry bleak slopes of the extreme northern ranges. The plant bears reddish-yellow flowers. A species found in Ladakh, *C. cuneata*, has rose-lavender flowers.

*Astragalus* is a large genus of several hundred species. More than 25 species are known to occur in the alpine zone of west Himalaya. The leaf-rachis often ends in a spine but the flowers possess a uniform tubular calyx and in this respect the genus differs from *Caragana*. The astragali are perennial spreading herbs though one of them, *A. chlorostachys*, grows into a large erect shrub. The species of *Astragalus* bear purplish-blue or yellow flowers which are arranged in racemes or heads. Some



*Astragalus himalayanus* Klotzsch

species possess dense, black, silky hairs on the calyx. The pods are linear or oblong, usually turgid, often curved or torulose and many seeded. *A. munroi* has been found in Ladakh at 5100 m and *A. melanostachys* at 4800 m in Kumaon and these are among the species attaining the highest altitude in western Himalaya.

A closely allied genus but differing from *Astragalus* in its appendiculate keel petals is *Oxytropis*. These plants are also found in the same habitats as *Astragalus* and are particularly common in Lahul. The flowers in this genus may be purple or yellow.

*Hedysarum cachmerianum* is an attractive red-flowered herb occurring in Kashmir and *Thermopsis barbata*, with blue flowers is found all along from Kashmir to Kumaon.

## KEY TO GENERA

1. Stamens free
  2. Leaves 3-foliolate; soft hairy herbs *Thermopsis*
  2. Leaves pinnate, leaflets 11-17; spinescent shrub *Sophora*
1. Stamens diadelphous (filaments of 9 fused forming a tube, tenth stamen free)
  3. Leaflets 3
    4. Pods minute, rounded, indehiscent
      5. Flowers in dense heads *Trifolium*
      5. Flowers in long racemes *Melilotus*
    4. Pods elongate
      6. Corolla yellow; flowers in racemes or heads
        7. Pods spirally twisted *Medicago*
        7. Pods straight *Trigonella*
      6. Corolla blue; flower solitary, axillary *Parochetus*
  3. Leaflets more than 3
    8. Leaves with 5 leaflets, lower pair from base of petiole *Lotus*
    8. Leaves with more than 5 leaflets; pinnate
      9. Pinnate leaves ending in tendril *Cicer*
      9. Pinnate leaves not ending in tendril
        10. Pods jointed, joints 1-3, indehiscent; flowers red or yellow in axillary racemes *Hedysarum*
        10. Pods not jointed, turgid, continuous within, dehiscent
          11. Calyx oblique; spinescent shrubs; flowers solitary or 1-3 on short peduncles *Caragana*
          11. Calyx not oblique

- |  |                        |
|--|------------------------|
| 12. Keel short; softly silky, perennial herbs                              | <i>Gueldenstaedtia</i> |
| 12. Keel long; stiff hairy, rigid or spinescent, perennial herbs or shrubs |                        |
| 13. Apex of keel blunt or obtuse   | <i>Astragalus</i>      |
| 13. Apex of keel pointed or produced into a beak                           | <i>Oxytropis</i>       |

## LIST OF GENERA AND SPECIES

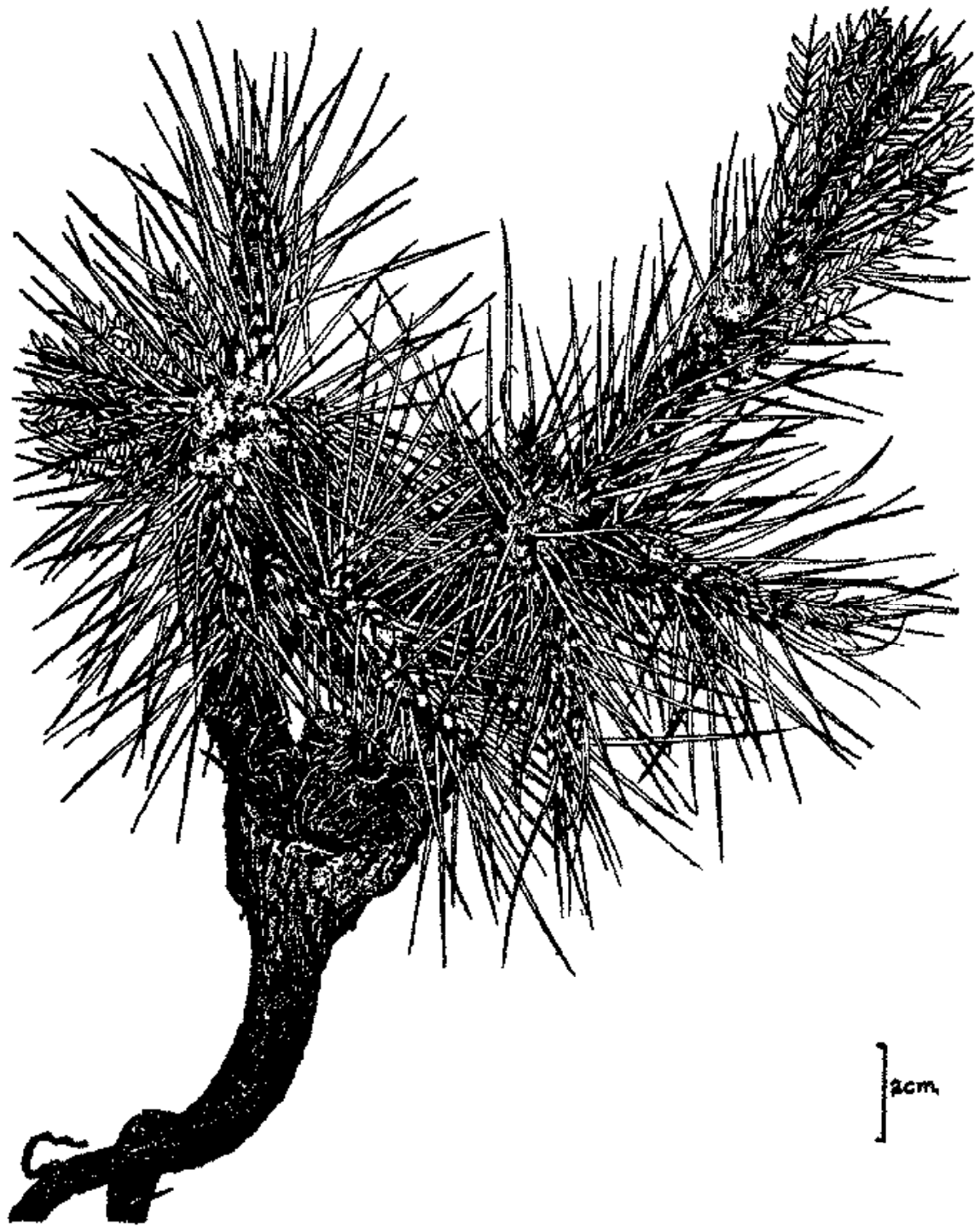
## ASTRAGALUS LINN.

- \*A. **aegacanthoides** Parker  
Kumaon (4200 m).
- A. **amberstianus** Benth.  
Chamba, Kinnaur, Tehri-Garhwal (3900 m).
- A. **candolleanus** Royle  
Chamba, Lahul (4800 m). Spiti.
- A. **chlorostachys** Lindl.  
Kashmir to Kumaon (3600 m).
- \*A. **coluteocarpus** Boiss. var. **glaber** Ali  
Kashmir, Spiti (3500 m).
- A. **densiflorus** Kar. & Kir.  
Ladakh, Lahul, Kumaon (4800 m).
- A. **frigidus** (Linn.) Bunge  
Lahul, Kumaon (3700 m).
- A. **gracilipes** Benth. ex Bunge  
Zanskar (4000 m).
- A. **graveolens** Buch.-Ham. ex Benth.  
Kashmir to Kumaon.
- A. **heydei** Baker  
Rupshu (4800 m).
- A. **himalayanus** Klotzsch  
Kashmir to Kumaon (3900 m).
- A. **hoffmeisteri** (Klotzsch) Ali (*A. adesmaefolius* Benth. ex Bunge)  
Ladakh, Spiti, Bashahr (4500 m).
- A. **jacquemontii** Bunge (*A. leptocentrus* Bunge and *A. multiceps* Royle non Wall.)  
Lahul, Spiti (4200 m), Garhwal, Kumaon.
- A. **ladakensis** Balak. (*A. strictus* Grah. ex Benth. non Siev. & Fisch.)  
Ladakh, Lahul (4800 m) to Kumaon.
- A. **lessertoides** Benth. ex Bunge  
Tehri-Garhwal, Kumaon (3900 m).
- A. **macropterus** DC.  
Zanskar, Ladakh.
- A. **malacophyllus** Benth. ex Baker  
Lahul (4500 m).

- Astragalus maxwellii** Royle ex Benth. (*A. ciliolatus* Benth. ex Bunge)  
Kashmir (3900 m).
- A. melanostachys** Benth. ex Bunge  
Kashmir, Lahul, Kumaon (4500 m).
- A. munroi** Benth. ex Bunge  
Ladakh (5100 m), Lahul, Spiti.
- A. oplites** Benth. (*A. cicerifolius* Royle ex Bunge)  
Lahul (4500 m), Garhwal.
- A. oxyodon** Baker  
Kumaon (5000 m).
- \***A. pindreeensis** (Benth. ex Baker) Ali  
Kashmir, Garhwal, Kumaon (3600 m).
- A. polyacanthus** Royle ex Benth.  
Garhwal, Kumaon.
- A. prainii** Duthie  
Kumaon (4500 m).
- A. rhizanthus** Royle  
Lahul, Spiti, Chamba (4500 m), Kumaon.
- A. strobiliferus** Royle  
Kashmir, Spiti, Kinnaur (3600 m).
- A. subuliformis** DC. (*A. subulatus* M. Bieb.)  
Ladakh (3600 m).
- A. thomsonianum** Benth. ex Baker (*A. nivalis* Baker non Kar. & Kir.)  
Zaskar, Ladakh (4800 m), Lahul (4500 m), Spiti.
- A. tibetanus** Benth. ex Bunge  
Kashmir, Chamba, Lahul (4500 m), Spiti, Kumaon.
- A. tribulifolius** Benth. ex Bunge  
Hanle, Rupshu (4400 m).
- A. webbiana** Grah. ex Benth.  
Kinnaur, Kumaon (4200 m).
- A. zanskariensis** Benth. ex Bunge  
Zaskar (4200 m).

## CARAGANA FABR.

- C. cuneata** Baker  
Ladakh (4500 m), Spiti.
- C. gerardiana** Royle  
Spiti (3600 m), Garhwal, Kumaon.
- C. nubigena** Bunge (*C. crassicaulis* Benth. ex Baker)  
Tehri-Garhwal, Garhwal, Kumaon (4200 m).
- C. polyacantha** Royle  
Garhwal, Kumaon (3600 m).
- C. pygmaea** (Linn.) DC.  
Lahul (4500 m), Spiti, Tehri-Garhwal, Garhwal.



*Astragalus strobiliferus* Royle

## CICER LINN.

- C. soongaricum** Stephan  
Lahul, Spiti, Kumaon (up to 4500 m).

## GUELLENSTAEDTIA FISCH.

- G. himalaica** Baker  
Tehri-Garhwal, Garhwal, Kumaon (3700 m).

## HEDYSARUM LINN.

- H. astragaloides** Benth. ex Baker  
Lahul (4300 m).  
**H. cachemirianum** Benth. ex Baker  
Kashmir (3600 m).  
**H. kumaonense** Benth. ex Baker  
Kumaon.  
**H. laxiflorum** Benth. ex Baker  
Kashmir.  
**H. microcalyx** Baker  
Kashmir, Lahul, Tehri-Garhwal, Garhwal (3600 m).

## LOTUS LINN.

- L. corniculatus** Linn.  
Throughout reaching 3600 m in some places.

## MEDICAGO LINN.

- M. falcata** Linn.  
Kashmir, Ladakh, Spiti (3700 m).  
**M. lupulina** Linn.  
Throughout reaching 3600 m in some places.

## MELILOTUS MILL.

- M. officinalis** Lamk.  
Ladakh (3600 m).

## OXYTROPIS DC. NOM. CONS.

- O. cachemirica** Camb.  
Kashmir, Ladakh (4500 m), Lahul (4800 m).  
**\*O. collettii** Prain & Duthie  
Tehri-Garhwal, Kumaon (5100 m).  
**O. microphylla** DC.  
Ladakh, Lahul (4800 m), Spiti.



- Oxytropis lapponica** (Wahlb.) Gaud.  
Lahul (4800 m), Spiti.
- O. lapponica** var. **humifusa** (Kar. & Kir.) Baker  
Spiti, Kumaon (3600 m).
- O. mollis** Royle  
Lahul (4800 m), Kumaon.
- O. tatarica** Jacq. ex Baker  
Ladakh, Lahul (4500 m), Spiti, Kumaon (4500 m).
- O. thomsonii** Benth. ex Baker  
Ladakh, Lahul (3900 m).

PAROCHETUS BUCH.-HAM. EX D. DON

- P. communis** Buch.-Ham. ex D. Don  
Kulu, Simla, Garhwal, Kumaon up to 3300 m.

SOPHORA LINN.

- S. moorcroftiana** (Benth.) Benth. ex Baker  
Ladakh (3600 m).

THERMOPSIS R. BR.

- T. barbata** Royle  
Kashmir to Kumaon up to 3600 m.
- T. inflata** Camb.  
Ladakh (5100 m), Lahul (4800 m), Spiti.

TRIFOLIUM LINN.

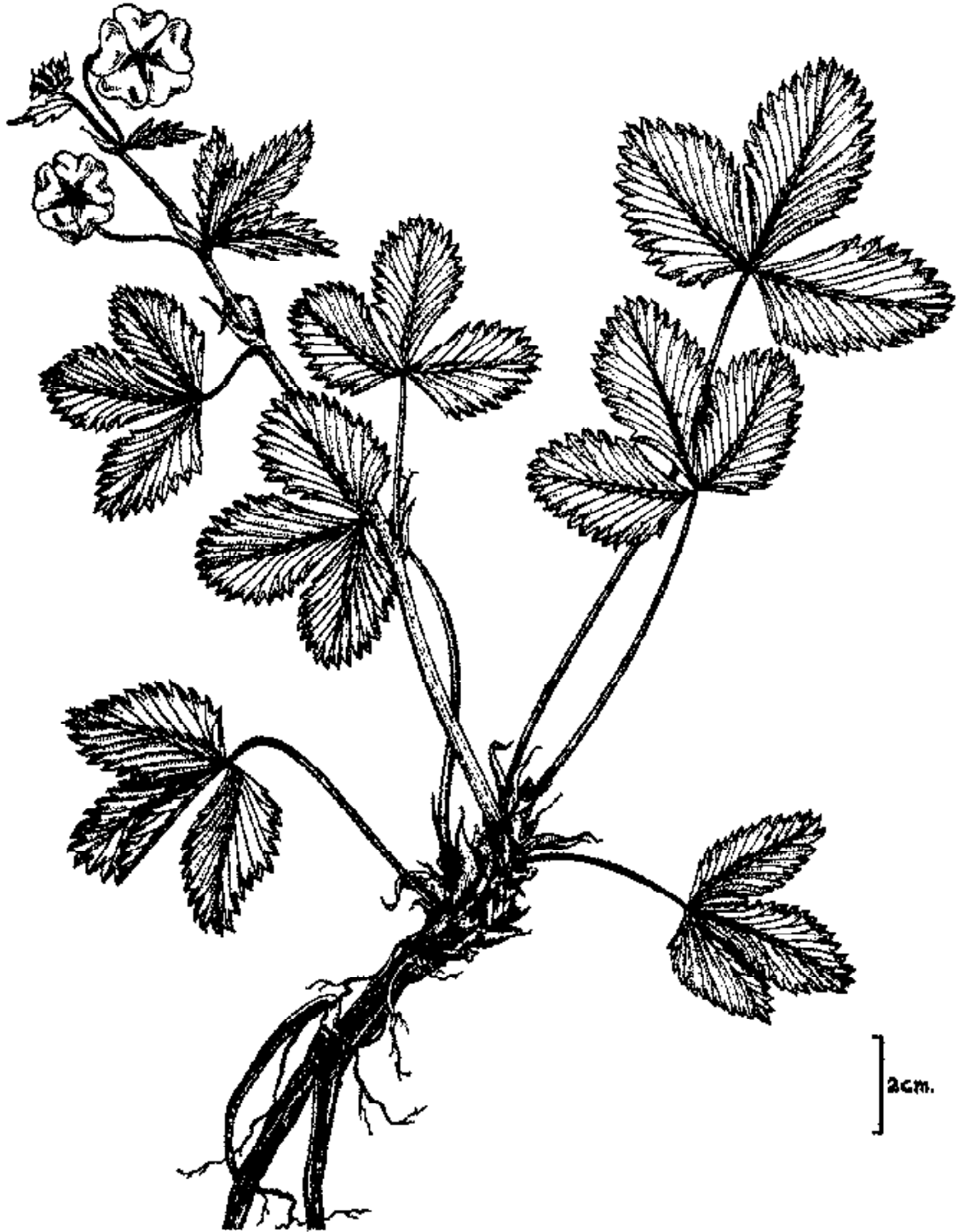
- T. repens** Linn.  
Throughout reaching alpine zone in some places.

TRIGONELLA LINN.

- T. emodi** Benth.  
Kashmir to Kumaon up to 3600 m.
- T. pubescens** Edgew. ex Baker  
Kashmir to Kumaon (3300 m).

ROSACEAE

The rose family is dominated by the genus, *Potentilla*, in the alpine zone. More than 20 species of this genus occur here. These possess showy yellow or red flowers. The most striking among them is the crimson-flowered, *P. atrosanguinea*. This is a conspicuous herb on many alpine slopes and the flowers are seen throughout the summer and autumn months. The trifoliate leaves on the plant are covered by soft, silky



*Potentilla atrosanguinea* Lodd.

hairs above and are silky white underneath. These leaves form a pleasing setting for the bright crimson flowers. Another herb almost similar in habit but with bright yellow flowers is *P. argyrophylla*. *P. nepalensis* has also red or purple-red flowers but here the leaves are 5-foliolate. A species with softly silky leaflets which are present in many alternating pairs of small and large ones is also met with in the area. This is *P. fulgens*. At high altitudes, a dwarf, densely tufted herb, *P. microphylla* occurs amidst mosses. In this species, the leaves are numerous and each leaf consists of crowded, minute leaflets. *P. multifida*, another species commonly seen in this area, has a wide distribution being found in the temperate and alpine regions of Europe, north Asia and north America, extending even to the arctic regions. In west Himalaya, this species often reaches an altitude of more than 4500 m. The highest recorded altitude for the species is 5400 m in Rupshu. The flowers are yellow with a bright orange spot at the base of petals. *P. ambigua* forms tufted clumps on rocks at high altitudes and bears large yellow flowers.

A genus, now treated as separate but, formerly included under *Potentilla*, *Sibbaldia* includes species which forms dense, silky, moss-like tufts on rocks in the alpine zone. The flowers are small, generally less than 1 cm in diameter. *S. purpurea* bears red flowers but the other species have yellow flowers.

A genus closely resembling *Potentilla* in habit but in which the style elongates considerably in fruit, often forming a hook at its tip, *Geum* has a representative in *G. elatum* in the alpine zone. The flowers are large and are of an attractive yellow colour.

The true roses, species of *Rosa*, occurring in or reaching the alpine zone in some localities are, *Rosa macrophylla*, *R. sericea*, *R. webbiana* and *R. lutea*. *R. webbiana* forms a bush and bears flowers of a light pink shade in abundance. The flowers are also fragrant.

Some species of the genera, *Cotoneaster*, *Fragaria*, *Prunus*, *Pyrus*, *Rubus* and *Spiraea* which are mostly of temperate distribution may reach the sub-alpine zone in some sectors.

#### KEY TO GENERA

1. Plants herbaceous
  2. Fruits follicles
    3. Carpels villous, 2-ovuled *Spiraea*
    3. Carpels glabrous when ripe, many ovuled *Aruncus*
  2. Fruits achenes
    4. Style not elongating after flowering
      5. Ripe carpels on fleshy receptacle *Fragaria*
      5. Ripe carpels on dry receptacles
        - 5a. Achenes 1-2 enclosed in membranous  
Calyx tube *Alchemilla*

- 5a. Achenes many on dry receptacle not enclosed in calyx tube
6. Stamens 10 or less *Sibbaldia*
6. Stamens many, more than 10 *Potentilla*
4. Style elongating after flowering *Geum*
1. Plants woody, trees or large rambling shrubs
7. Fruit, a cluster of achenes inside the fleshy calyx tube *Rosa*
7. Fruit, a pome, drupe or group of drupelets
8. Carpel 1, drupe globose, 1-seeded *Prunus*
8. Carpels more than 1
9. Drupelets many, 1-seeded, on dry receptacle *Rubus*
9. Drupe globose, fleshy with 2-5, bony, 1-seeded stones *Cotoneaster*

## LIST OF GENERA AND SPECIES

## ALCHEMILLA LINN.

- A. **psilotoma** Rothm. (*A. vulgaris* auct. non Linn.)  
Kashmir, alpine meadows.

## ARUNCUS (LINN.) SCHAEFF.

- A. **dioicus** (Walter) Fern. var. **triternatus** (Maxim) Hara (*Spiraea aruncus* auct. non Linn.)  
Garhwal (3800 m).

## COTONEASTER MEDIK.

- C. **acuminatus** Lindl.  
Garhwal, Kumaon (3600 m).
- \*C. **brandisii** Klotz  
Kangra (Laca Glacier, 3600 m).
- \*C. **cashmeriensis** Klotz  
Kashmir (3300 m).
- \*C. **duthieanus** (Schneid.) Klotz  
Garhwal (3800 m).
- \*C. **falconeri** Klotz  
Lahul (3600 m).
- \*C. **garhwalensis** Klotz  
Garhwal, Kumaon (4000 m).
- C. **microphyllus** Wall. ex Lindl.  
Kashmir to Kumaon (3600 m).
- \*C. **prostratus** Baker  
Kinnaur, Garhwal (3300 m).
- C. **rotundifolius** Wall. ex Lindl.  
Garhwal (3300 m).

## FRAGARIA LINN.

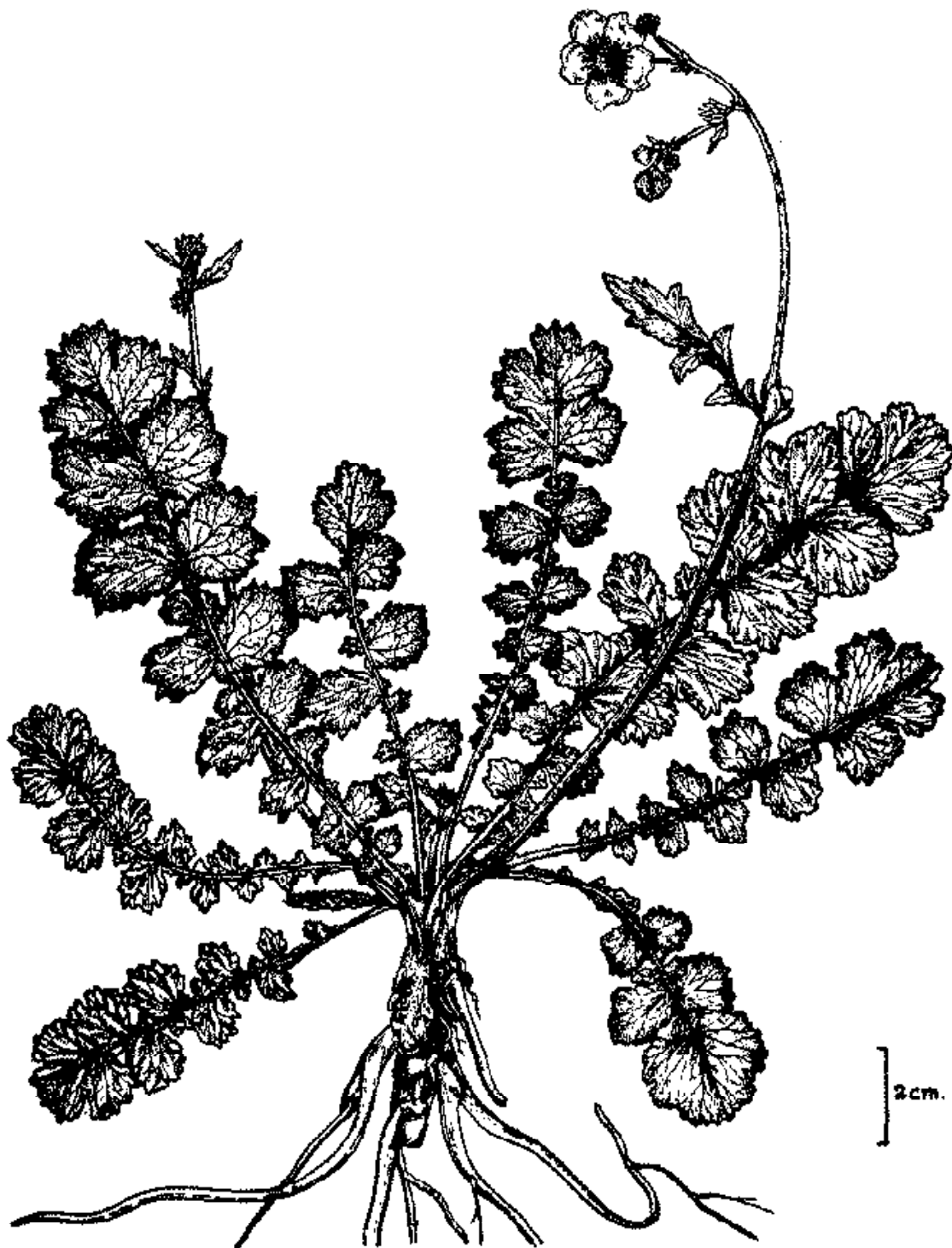
- F. daltoniana** Gay  
Kumaon (3600 m).  
**F. vesca** Linn.  
Kashmir to Kumaon (3300 m).

## GEUM LINN.

- G. elatum** (Royle) Hook. f.  
Kashmir to Kumaon (3900 m).

## POTENTILLA LINN.

- P. ambigua** Camb.  
Kashmir, Ladakh (4500 m) to Kumaon.  
**P. anserina** Linn.  
Rupshu (4500 m), Lahul, Spiti.  
**P. arbuscula** D. Don (*P. fruticosa* Hook. f. non Linn.)  
Kashmir to Kumaon (up to 4500 m).  
**P. arbuscula** D. Don var. *ochreatea* (Lindl. ex Lehm.) M.A. Rau, nov.  
comb. [*P. ochreatea* Lindl. ex Lehm. Revis. Potentill. 17, 1854;  
*P. fruticosa* Hook. f. non Linn. var. *ochreatea* (Lindl. ex Lehm.)  
Hook. f. in Fl. Brit. India 2: 347, 1878]  
Lahul (4500 m), Spiti, Kumaon.  
**P. arbuscula** var. *pusilla* (Hook. f.) Hand.-Mazz.  
Ladakh (4500 m), Lahul.  
**P. argyrophylla** Wall. ex Lehm.  
Throughout up to 4000 m.  
**P. atrosanguinea** Lodd.  
Kashmir to Kumaon (4500 m).  
**P. biflora** Willd. (*P. fruticosa* Hook. f. non Linn. var. *inglisii* Hook. f.)  
Kashmir, Lahul, Kumaon (5700 m).  
**P. bifurca** Linn.  
Lahul (4500 m), Kumaon.  
**\*P. collettiana** Aitch. & Hemsl.  
Kashmir (4200 m).  
**P. curviseta** Hook. f.  
Kashmir (3600 m).  
**P. desertorum** Bunge  
Lahul, Spiti (4300 m).  
**P. doubjouneana** Camb.  
Kashmir (4300 m).  
**P. eriocarpa** Wall. ex Lehm.  
Kulu to Kumaon (4500 m).  
**P. fulgens** Wall. ex Hook. (*P. sieversiana* Lehm.)  
Kinnaur to Kumaon.



*Geum elatum* (Royle) Hook. f.

- Potentilla gelida** C. A. Mey.  
Kashmir, Lahul (4800 m).
- P. ieschenaultiana** Ser.  
Kashmir (Deosai, 3900 m).
- P. leuconota** D. Don  
Ladakh (4300 m), Tehri-Garhwal, Kumaon.
- P. microphylla** D. Don  
Kashmir, Spiti, Garhwal, Kumaon (4000 m).
- P. monanthes** Lindl. ex Lehm.  
Kashmir, Lahul (4500 m) to Kumaon.
- P. multifida** Linn.  
Rupshu (5400 m), Lahul, Spiti, Kumaon.
- P. nepalensis** Hook.  
Chamba (3600 m).
- \***P. nivea** Linn. var. **himalaica** Kitamura (*P. nivea* Hook. f. non Linn.)  
Kashmir, Rupshu (5700 m).
- P. peduncularis** D. Don  
Garhwal (4000 m).
- P. polyphylla** Wall. ex Lehm. (*P. mooniana* Wight)  
Kumaon (3400 m).
- P. pteropoda** Royle  
Kashmir (4000 m).
- P. salesoviana** Stephan (*P. salessovii* Stephan)  
Kashmir, Lahul (4800 m), Spiti.
- P. saundersiana** Royle  
Rupshu (5400 m), Kumaon.
- \***P. saundersiana** var. **caespitosa** (Lehm.) Th. Wolf  
Garhwal (Niti P. 4000 m).
- P. thomsonii** Hand.-Mazz. (*P. sericea* Hook. f. non Linn.)  
Kashmir to Kumaon (up to 4800 m in Lahul).

## PRUNUS LINN.

- P. jacquemontii** Hook. f.  
Kashmir, Garhwal (3600 m).

## ROSA LINN.

- R. eglantheria** Linn.  
Kistwar (3300 m).
- R. macrophylla** Lindl.  
Kashmir to Kumaon up to 3600 m.
- R. sericea** Lindl.  
Tehri-Garhwal, Kumaon (3600 m).
- R. webbiana** Wall. ex Royle  
Kashmir to Kumaon up to 4200 m.

## RUBUS LINN.

- R. irritans** Focke (*R. purpureus* Hook. f. non Bunge)  
Kinnaur (3300 m).
- R. niveus** Thunb. (*R. lasiocarpus* Sm.)  
Kumaon (4500 m).
- R. pedunculatus** D. Don (*R. niveus* Wall. var. *pedunculatus* Hook. f.)  
Kumaon.
- R. saxatilis** Linn.  
Kashmir to Kumaon (3300 m).

## SIBBALDIA LINN.

- S. cuneata** Hornem. ex O. Ktze. (*Potentilla siboldi* Hook. f. non Hallier f.)  
Chamba, Lahul (4800 m), Spiti, Tehri-Garhwal, Kumaon.
- S. micropetala** (D. Don) Hand.-Mazz. (*Potentilla albifolia* Wall.)  
Kashmir to Kumaon (3600 m).
- S. perpusilla** (Hook. f.) Chatt. (*Potentilla perpusilla* Hook. f.)  
Kashmir to Kumaon (3600 m).
- S. purpurea** Royle (*Potentilla purpurea* Royle)  
Lahul, Tehri-Garhwal, Garhwal, Kumaon (4800 m).
- S. tetrandra** Bunge  
N. Kashmir, 4000 to 5000 m.

## SORBUS LINN.

- S. aucuparia** Linn.  
Kashmir, Lahul (4200 m) to Kumaon.
- S. foliolosa** (Wall.) Spach  
Kulu, Garhwal, Kumaon (3600 m).

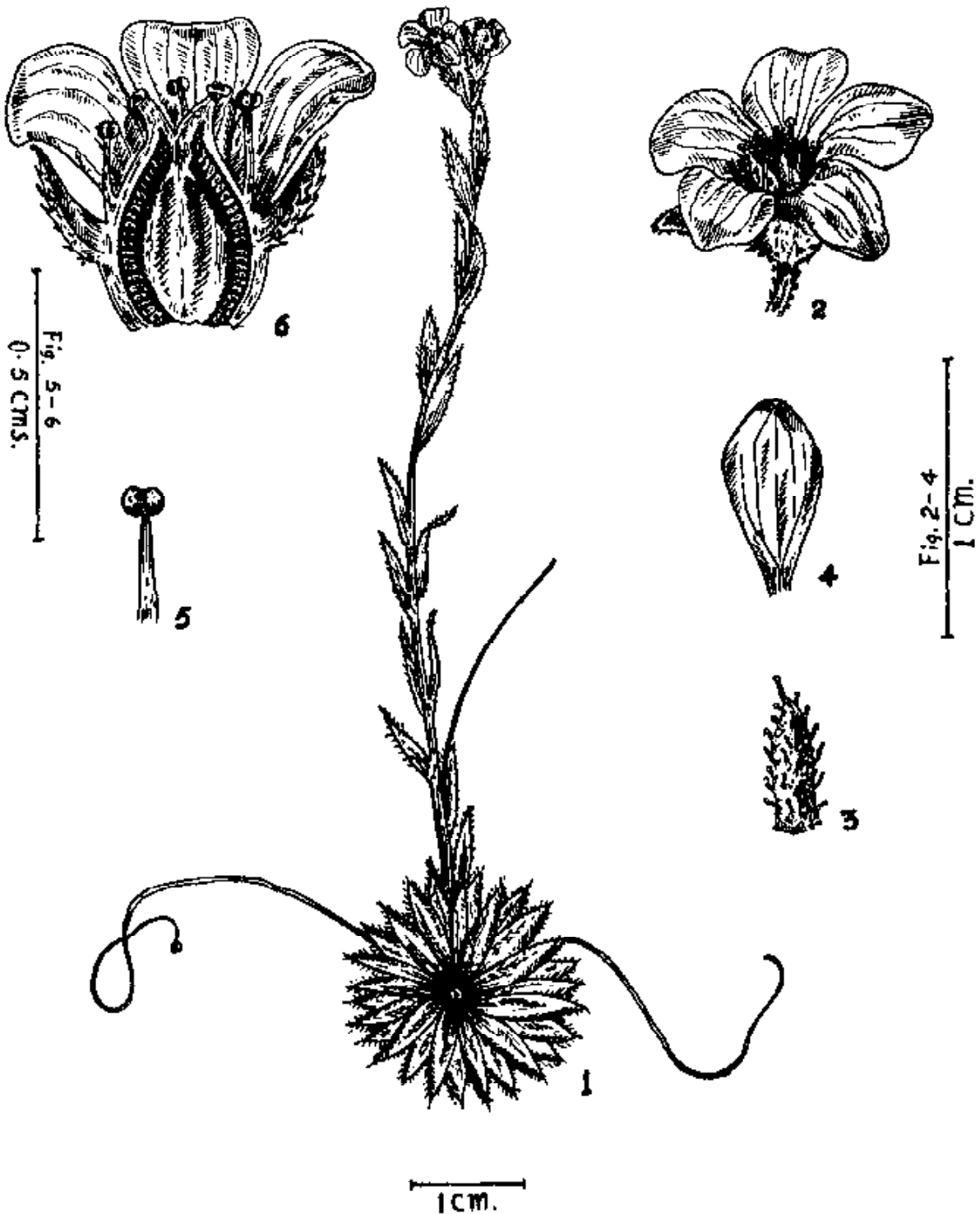
## SPIRAEA LINN.

- S. affinis** Parker  
Kashmir, Buzzil Pass (3900 m).
- S. arcuata** Hook. f.  
Garhwal to Kumaon.
- S. vestita** Wall. ex G. Don  
Kashmir to Kumaon (3600 m).

## SAXIFRAGACEAE

A family of many interesting and colourful herbs distributed mostly in the cold temperate regions of the world, the Saxifragaceae has more than 30 species in the alpine zone of west Himalaya. Most of these belong to the genus, *Saxifraga*. These are small herbs with yellow or white flowers. The radical leaves are often rosulate and a few species possess





*Saxifraga flagellaris* Willd. ex Sternb.

1. Habit. 2. A flower. 3. Sepal. 4. Petal. 5. Stamen. 6. Long. sec. of flower showing perigynous condition.

leafless, thread-like surculi which arise from amidst the basal rosette. These surculi terminate rooting buds. Of these species, *S. flagellaris* is of great interest. Eric Hulten in a recent monographic study of this species writes, "*S. flagellaris* is a very remarkable plant as it holds the position of being one of the most hardy plants in the world, able to grow under such extremely high arctic conditions as in northernmost Greenland and Ellesmoreland even in the mountains (up to 500 m in 82° northern latitude) and at extreme altitudes in the mountains further south (at least up to 5000 m in the Himalaya)". This species forms one large complex with several subspecies recognised on the basis of their geographical distribution. Hulten is of the opinion that this group apparently occurred before the Pleistocene glaciation. The subspecies found at present in the western Himalaya, viz., *stenophylla*, *crassiflagellata*, *hoffmeisteri*, *komarovii* and *mucronulata* are all considered to have been derived from the pre-glacial populations. Various factors, topographic, edaphic and climatic may have had a role in the development of closely related forms during and after the glacials which spread subsequently to newer areas. *S. brunoniana*, another alpine species, also possesses the curious surculi.

Some species of *Saxifraga* which occur on exposed rocky habitats present an extremely well developed cushion habit. Among such species, *S. pulvinaria* inhabits fairly large areas being found throughout the west Himalaya from Kashmir to Kumaon. This species with closely adpressed leaves and forming dense cushions on dry hill slopes is known from Kashmir at altitudes ranging between 3900 and 5000 m, and in Kinnaur and Kumaon in about the same altitude range. It has a distribution extending eastwards to Nepal. A large number of species belonging to the generic section, *Kabschia*, to which this species belongs, have been recently described from Nepal and eastern Himalaya. Harry Smith, who described them, states that the plants of this group must have flourished exceedingly during the upheaval of the Himalaya, and according to him, "what now remain are probably only the scattered survivors of their golden age".

*S. hirculus* is a widely distributed species occurring in the arctic, European Alps, Siberia, Carpathians, Central Asian mountains and in the Pamirs as also on the Rockies of North America. It is a polymorphic species and in the Himalaya, it has been recorded from Kashmir, Ladakh, Lahul and eastwards to Tehri-Garhwal in the altitude range, 4000 to 5000 m. The flowers are yellow, often with a sprinkling of orange on the base of the petals. One of the most widely distributed species of *Saxifraga* in west Himalaya, *S. diversifolia*, has numerous forms, of which the variety, *parnassifolia* is the one that is generally met with. All these are yellow-flowered.

The genus, *Chrysosplenium*, is characterised by the possession of

solitary, white flowers in which the petals are absent. These are small, succulent herbs usually found in moist localities, near waterfalls etc.

*Bergenia stracheyi* is a large herb seen growing amidst rocks and boulders at high altitudes. The leaves are large, undivided, oblong or obovate, shining and turning red during autumn. The pinkish flowers are produced in large corymbose scapes. This herb presents a striking appearance during autumn months with its coloured foliage. Excellent growth of the plant may be seen in the boulder strewn Satopanth basin in north Garhwal.

The genus, *Parnassia*, which is sometimes treated under a separate family, Parnassiaceae, is popularly known as the 'Grass of Parnassus' after Mt. Parnassus in Greece. These herbs are generally distributed in the temperate and arctic regions of the northern hemisphere. In west Himalaya, 5 species have been recorded of which 4 are known to reach alpine heights. The Parnassias are glabrous, perennial herbs. The radical leaves are long-petioled, entire and characteristically linear-veined. The solitary flowers are borne on long scapes. The petals are usually white in the alpine species and in some the margins of the petals are fimbriate. The 5 stamens alternate with 5 large staminodes. The fruit is a capsule of many non-albuminous seeds.

The Parnassias are extremely common at high altitudes in moist ground, particularly, on grassy slopes near stream banks. The present writer noticed a very striking association in Lahul where the cream-white flowered *Parnassia nubicola* was invariably found with a clump of the beautiful, purple-flowered, *Pedicularis punctata*.

#### KEY TO GENERA

- |   |                       |
|---|-----------------------|
| 1. Ovary 2-celled   |                       |
| 2. Herbs with rosulate and stem leaves; flowers white or yellow         | <i>Saxifraga</i>      |
| 2. Herbs with stout rootstock, leaves large; flowers white or lilac     | <i>Bergenia</i>       |
| 1. Ovary 1-celled   |                       |
| 3. Flowers without petals; stamens 4-8                                  | <i>Chrysosplenium</i> |
| 3. Flowers with 5 petals; stamens 5 with 5 alternating large staminodes | <i>Parnassia</i>      |

#### LIST OF GENERA AND SPECIES

##### BERGENIA MOENCH NOM. CONS.

- B. stracheyi** (Hook. f. & Thoms.) Engl. (*Saxifraga stracheyi* Hook. f. & Thoms.)  
Lahul, Spiti, Garhwal, Kumaon (4800 m).

## CHRYSOSPLENIUM LINN.

- C. carnosum** Hook. f. & Thoms.  
Tehri-Garhwal, Kumaon (4800 m).
- C. tenellum** Hook. f. & Thoms.  
Tehri-Garhwal (3600 m), Kumaon.
- C. trichospermum** Edgew. ex Hook. f. & Thoms.  
Kashmir (4200 m), Kumaon.

## PARNASSIA LINN.

- \***P. kumaonica** W. Nekrassova  
Tehri-Garhwal (4200 m), Kumaon.
- P. nubicola** Wall. ex Royle  
Kashmir to Kumaon (up to 4500 m).
- P. affinis** Hook. f. & Thoms. (*P. ovata* auct. non Ledeb.)  
Kashmir to Kumaon (3600 m).
- P. pusilla** Wall. ex Hook. f. & Thoms.  
Garhwal, Kumaon (4500 m).

## SAXIFRAGA LINN.

- \***S. androsacea** Linn.  
Kashmir (4200 m).
- S. aristulata** Hook. f. & Thoms.  
Kumaon (4500 m).
- S. brachypoda** D. Don  
Garhwal (3600 m).
- S. brachypoda** var. *fimbriata* (Wall.) Engl. & Irmsch. (*S. fimbriata* Wall.)  
Tehri-Garhwal, Garhwal, Kumaon (3600 m).
- S. brumoniana** Wall. ex Sternb.  
Lahul, Tehri-Garhwal (4500 m).
- S. cernua** Linn.  
Ladakh, Garhwal, Tehri-Garhwal (3300 m).
- S. diversifolia** Wall. ex DC. var. *parnassifolia* (D. Don) Engl. (*S. diversifolia* C.B. Clarke non Wall. ex DC.)  
Kashmir to Kumaon up to 4200 m.
- S. filicaulis** Wall. ex DC.  
Simla (Hattu), Kumaon (3600 m).
- S. flagellaris** Willd. ex Sternb. (s.l.)  
Kashmir to Kumaon.
- \***S. flagellaris** subsp. *crassiflagellata* Hulten  
Kashmir, Lahul (4500 m), Chamba, Tehri-Garhwal.
- \***S. flagellaris** subsp. *hoffmeisteri* (Klotzsch) Hulten  
Simla to Kumaon (4300 m).

- \***Saxifraga flagellaris** subsp. **komarovii** (Loz.-Lozin) Hulten  
Lahul (4800 m), Spiti.
- \***S. flagellaris** subsp. **mucronulata** (Royle) Engl. & Irmsch.  
Kashmir, Lahul, Kulu, Tehri-Garhwal, Kumaon (4500 m).
- S. flagellaris** subsp. **stenophylla** (Royle) Hulten  
Kashmir, Chamba, Lahul (4800 m), Tehri-Garhwal.
- S. hemisphaerica** Hook. f. & Thoms.  
Tehri-Garhwal (4500 m).
- S. hirculus** Linn.  
Kashmir, Ladakh (4500 m), Lahul, Spiti to Kumaon (5000 m).
- S. hispidula** D. Don  
Garhwal, Kumaon (4500 m).
- S. hookeri** Engl. & Irmsch. (*S. corymbosa* Hook. f. & Thoms. non Boiss.)  
Kashmir, Tehri-Garhwal (4500 m).
- S. jacquemontiana** Decne.  
Kashmir, Lahul, Tehri-Garhwal, Kumaon (4800 m).
- \***S. kumaonensis** Engl.  
Kumaon (3600 m).
- S. lychnitis** Hook. f. & Thoms.  
Kulu, Tehri-Garhwal (4500 m), Kumaon (4500 m).
- \***S. meeboldii** Engl. & Irmsch.  
Kashmir (4200 m).
- S. microphylla** Royle ex Hook. f. & Thoms.  
Tehri-Garhwal, Kumaon (4800 m).
- S. moorcroftiana** Wall. ex Sternb. (*S. diversifolia* C.B. Clarke p.p. non Wall. ex DC.)  
Kashmir (4300 m), Garhwal, Kumaon.
- S. odontophylla** Hook. f. & Thoms. (*S. asarifolia* Sternb.)  
Lahul, Kulu, Garhwal, Kumaon (4500 m).
- S. oppositifolia** Linn.  
Kashmir, Kumaon (Pindari Glacier, 3300 m).
- S. pallida** Wall. ex DC. (*S. micrantha* Edgew.)  
Kashmir to Kumaon (3600 m).
- \***S. pseudopallida** Engl. & Irmsch.  
Kashmir, Tehri-Garhwal (4500 m), Garhwal.
- \***S. pseudopallida** var. **bellidifolia** Engl. & Irmsch.  
Kulu (Rohtang Pass, 4000 m).
- S. pulvinaria** H. Sm. (*S. imbricata* Royle non Lamk. nec. Bertol.)  
Ladakh (5100 m), Rupshu (5400 m), Lahul, Tehri-Garhwal, Kumaon (5700 m).
- S. saginoides** Hook. f. & Thoms.  
Tehri-Garhwal (4800 m).
- S. sibirica** Linn.  
Kashmir to Kumaon up to 4800 m.

- \**Saxifraga stoliczkae* Duthie ex Engl. & Irmsch.  
Kumaon (4500 m).  
S. *strigosa* Wall. ex DC.  
Kumaon (4000 m).  
\*S. *subspathulata* Engl. & Irmsch. var. *kumaonensis* Engl. & Irmsch.  
Kumaon (3500 m).

## GROSSULARIACEAE

The currents or the gooseberries representing the genus, *Ribes*, formerly included under the Saxifragaceae, are characteristic plants of the temperate regions. They are mostly shrubs or small trees and some are prickly. The ripe berries are smooth, oblong or globose in shape and bright red or black in colour. The berries are pleasantly acid to taste. *Ribes emodense* is often found in the *Betula-Rhododendron campanulatum* forests at altitudes around 3600 m.

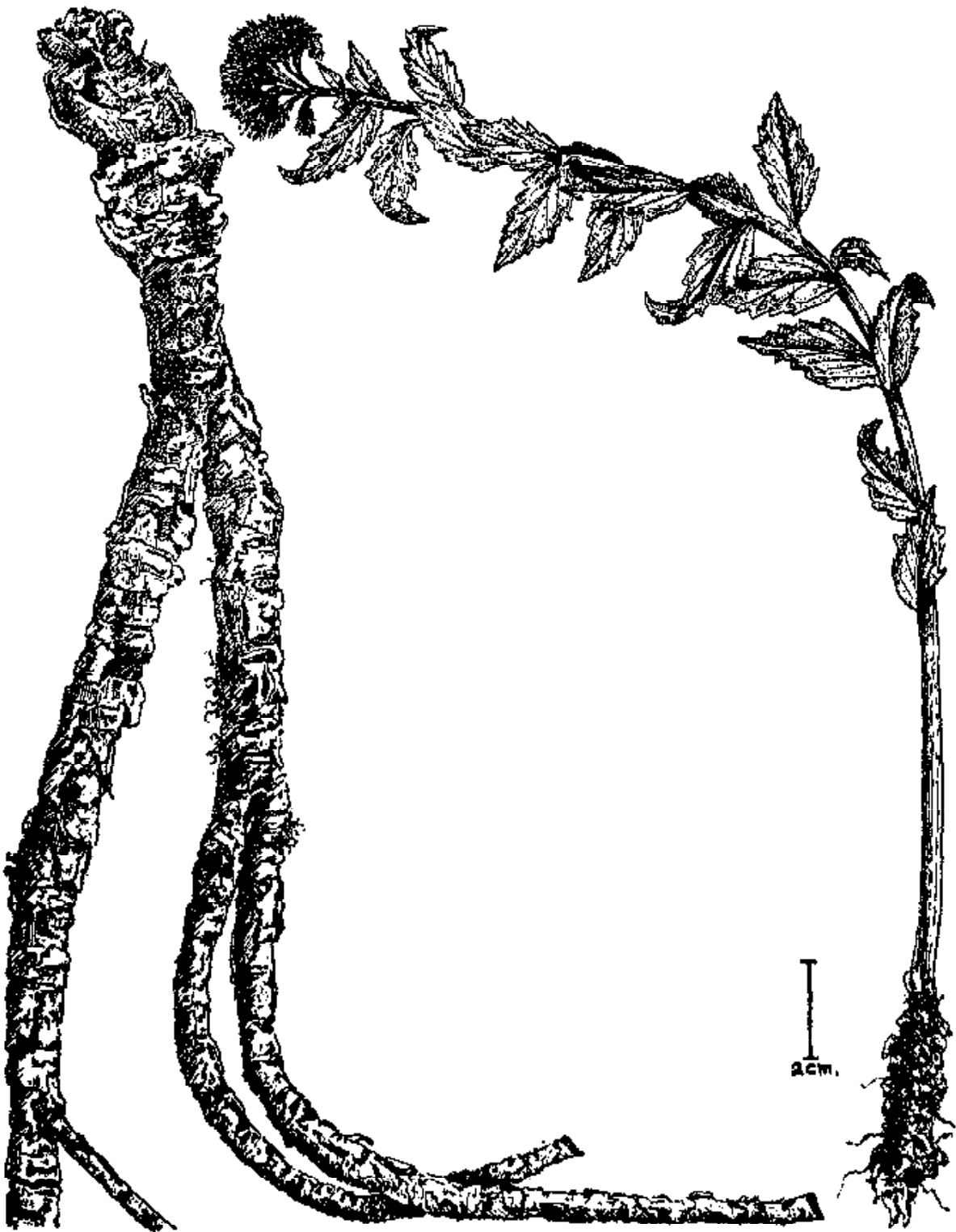
## LIST OF SPECIES

## RIBES LINN.

- R. *emodense* Rehder (*R. rubrum* C.B. Clarke non Linn.)  
Garhwal, Kumaon (3300 m).  
R. *glaciale* Wall.  
Kashmir, Kumaon (3600 m).  
R. *nigrum* Linn.  
Lahul (3600 m).  
R. *orientale* Desf.  
Lahul, Spiti (3700 m).  
R. *uva-crispa* Linn. var. *sativum* DC. (*R. grossularia* Linn.)  
Chamba, Tehri-Garhwal (3600 m).

## CRASSULACEAE

The herbs belonging to this family are well known succulents many of which are extremely popular as rock plants. These are known as stone-crops. There are several species in the alpine zone of west Himalaya. The genus, *Sedum*, to which most species belong includes many with showy flowers. Some of them reach very high altitudes, as for example, *Sedum quadrifidum* which has been found on wet ground at an altitude of 5700 m in Rupshu. The flowers of this species are recorded as of pale wine colour, somewhat darker in the throat. *S. crenulatum* is another species which was found on sunny precipitious slopes at Phungagal in the Panchchuli range at an altitude of 6000 m. These are among the highest altitudes known for the occurrence of species of the genus, *Sedum*. *S. roseum* is a tall herb, sometimes reaching 40 cm in height, which bears closely set,



*Sedum roseum* (Linn.) Scop.

Note the stout perennial rootstock which remains buried under snow for several months in the year.

sessile, succulent, toothed leaves and a terminal cluster of small yellowish flowers. This species is met with throughout the area and its distribution extends to the alpine zone of all northern continents including the arctic belt. *S. wallichianum* is an attractive herb of high altitudes where it forms dense rosettes on rock faces. These rosettes produce a profusion of yellow flowers. There are also some Sedums which bear purple flowers. Among them are *S. himalense* and *S. crenulatum*. The common, widely distributed, *S. linearifolium* has large, white flowers.

## KEY TO GENERA

- |   |                    |
|---|--------------------|
| 1. Flowers 4 to 5-merous; carpels 4-5 free                    | <i>Sedum</i>       |
| 1. Flowers 6 to 8-merous; carpels 6-8 free or adnate to calyx | <i>Sempervivum</i> |

## LIST OF GENERA AND SPECIES

## SEDUM LINN.

- \*S. **bouveri** R. Hamet  
Kumaon (3600) m.
- S. **crenulatum** Hook. f. & Thoms.  
Kumaon (6000 m).
- S. **elongatum** Wall. ex Hook. f. & Thoms.  
Tehri-Garhwal (3700 m).
- S. **ewersi** Ledeb.  
Kashmir to Kumaon (4800 m in Lahul).
- S. **fastigiatum** Hook. f. & Thoms.  
Garhwal (Niti).
- S. **heterodontum** Hook. f. & Thoms.  
Lahul (4800 m), Tehri-Garhwal, Kumaon.
- S. **himalense** D. Don  
Tehri-Garhwal (3900 m).
- S. **linearifolium** Royle  
Kashmir to Kumaon (4500 m).
- S. **linearifolium** var. **sinuatum** (Royle) R. Hamet (*S. trifidum* Wall.)  
Kashmir to Kumaon (3600 m).
- S. **oreades** (Decne.) R. Hamet [*Cotyledon oreades* (Decne.) C.B. Clarke and *Sedum jaeschkei* Kurz]  
Kashmir to Kumaon (4500 m).
- S. **quadrifidum** Pall.  
Rupshu (5700 m), Kashmir to Kumaon (4800 m).
- S. **roseum** (Linn.) Scop. (*S. rhodiola* DC.)  
Kashmir to Kumaon (4800 m in Tehri-Garhwal).
- \*S. **scabridum** Franch.  
Garhwal, Kumaon (3600 m).
- S. **tibeticum** Hook. f. & Thoms.  
Kashmir, Lahul (4800 m).



**Sedum trullipetalum** Hook. f. & Thoms.

Kashmir to Kumaon (3600 m).

**S. wallichianum** Hook. (*S. asiaticum* C.B. Clarke non DC.)

Kashmir to Kumaon up to 4800 m.

#### SEMPERVIVUM LINN.

?**S. acuminatum** Decne.

Kashmir, Lahul (3600 m).

**S. mucronatum** Edgew.

Kashmir to Kumaon (3600 m).

#### HIPPURIDACEAE

This small family has only a single member, *Hippuris vulgaris*. This is a perennial aquatic herb having a cosmopolitan distribution but found, particularly, in lakes, ponds, and slow streams, rich in bases, in the cold temperate regions. The herb has a creeping rhizome and whorled, linear leaves. The flowers are borne singly in the axils of leaves which are found above water. These flowers are in most cases bisexual but unisexual flowers may also be seen in some plants. The flower has a single stamen and a 1-celled, 1-ovuled, inferior ovary which develops into an achene.

#### HIPPURIS LINN.

**H. vulgaris** Linn.

Kashmir (3700 m), Lahul.

#### ONAGRACEAE

The evening primroses (*Oenothera* spp.) and the willow-herbs (*Epilobium* spp.) belong to this family. In the alpine zone of west Himalaya, only the members of the latter group are met with. These willow-herbs are characteristic mountain plants and are found in all the continents. They are particularly common in the high altitude ranges and one of their main centres of distribution in the world is in the Himalaya. Here they grow in sub-alpine meadows in forest undergrowth and alongside streams as well as on moist scree slopes of the alpine region. Some of the species possess attractive flowers and, in particular, the large bluish-purple flowered, *Epilobium latifolium* and *E. angustifolium*, deserve mention. These species belonging to the section, *chamaenerion*, of the genus, *Epilobium*, are characterised by the possession of alternate leaves and large zygomorphic flowers. These two species also enjoy a wide distribution in the world being found in the alpine and arctic regions of many lands of the northern hemisphere. In the western Himalaya, they are found throughout the range from the extreme west to the eastern

Kumaon heights. It is an enchanting sight to see large areas occupied by these herbs, as for example, in the glacial moraines beyond Kedarnath and in the famed Valley of Flowers. Referring to the growth of these herbs, Smythe writes, "the wide stonyriver bed, a mile above the camp, was coloured a brilliant magenta by a willow-herb (*Epilobium latifolium*) which flourishes on a diet of river borne grit". This was in the month of July and in another place in the Valley of Flowers, he found "acres of pure willow-herb" on the stream bed.

Whereas the above two species have large zygomorphic flowers, most other species of *Epilobium* have actinomorphic and much smaller flowers. Among these is the widespread, *E. hirsutum*, which has a distribution ranging from Europe to China and Japan as well as in east and south Africa. *E. cylindricum* and *E. royleanum* are among those species which have a distribution throughout the Himalaya extending to Yunnan in China. There are also some species with very limited distribution in the western Himalaya, as for example, *E. rhynchospermum*, which is known only from Kashmir and Laca in Kangra and *E. stracheyanum* recorded only from Kumaon.

## LIST OF SPECIES

## EPILOBIUM LINN.

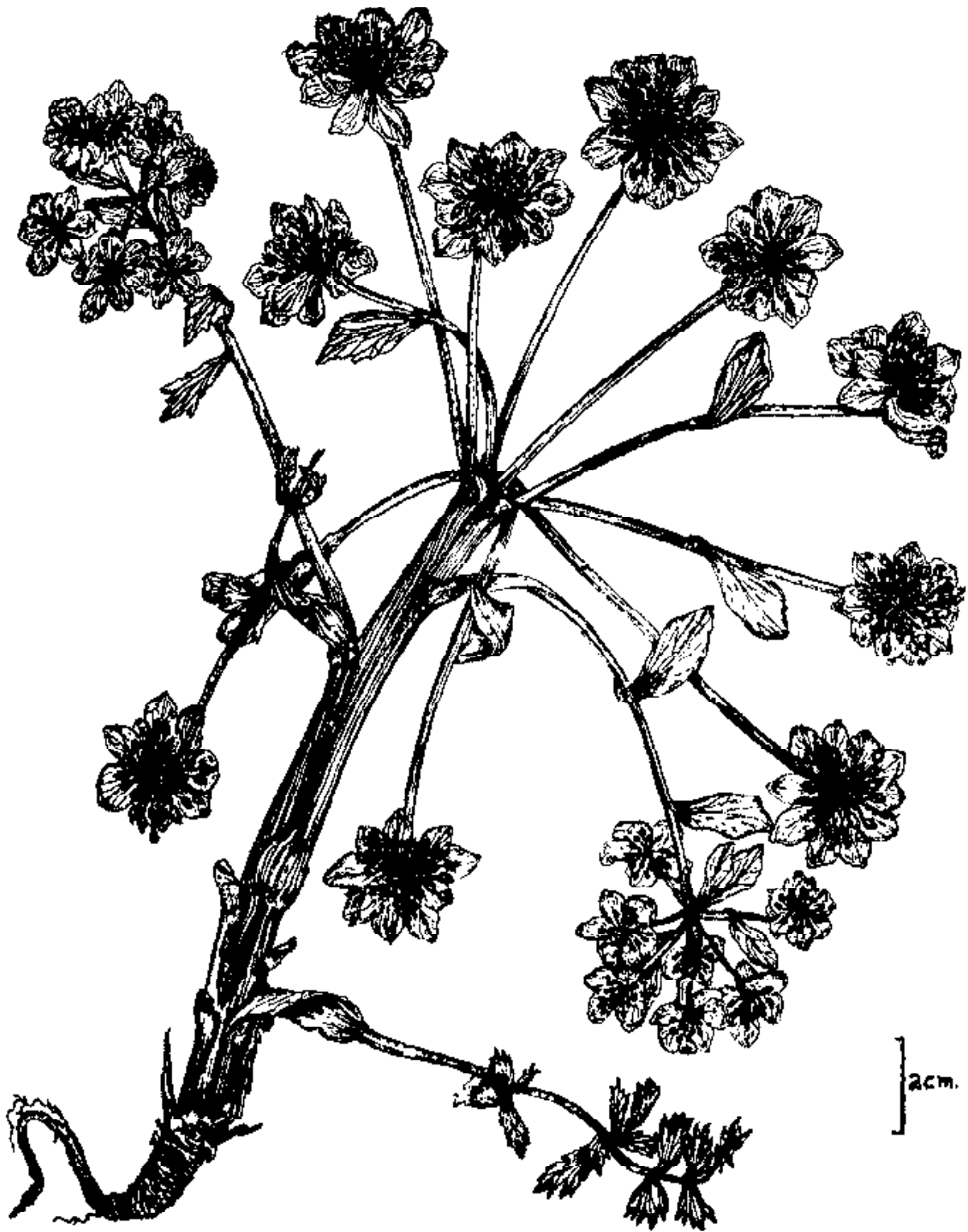
- E. **amurense** Hausskn. subsp. **laetum** (Wall. ex Hausskn.) Raven (*E. tetragonum*, C.B. Clarke p.p. non Linn.)  
Kumaon (3800 m).
- E. **angustifolium** Linn.  
Kashmir, Ladakh (4800 m) to Kumaon.
- E. **brevifolium** D. Don subsp. **brevifolium** (*E. tetragonum* C.B. Clarke p.p. non Linn.)  
Kumaon (4400 m).
- E. **cylindricum** D. Don [*E. roseum* Schreb. var. *cylindricum* (D. Don) C.B. Clarke]  
Kashmir, Lahul, Tehri-Garhwal (3900 m).
- \*E. **glaciale** Raven  
Kashmir (3500 m).
- E. **hirsutum** Linn.  
Garhwal (3500 m).
- E. **latifolium** Linn. subsp. **latifolium**  
Kashmir, Lahul (4500 m).
- \*E. **latifolium** subsp. **speciosum** (Decne.) Raven  
Zaskar (4500 m), Kashmir to Kumaon.
- \*E. **laxum** Royle  
Kashmir to Kumaon (4000 m).
- E. **lelophyllum** Hausskn. (*E. originifolium* C.B. Clarke p.p. non Lamk.)  
Ladakh, Spiti.

- \***Epilobium leiospermum** Hausskn.  
Kashmir, Chamba (3600 m), Lahul, Kumaon.
- \***E. minutiflorum** Hausskn.  
Ladakh, Kumaon (4500 m).
- E. palustre** Linn.  
Ladakh, Kumaon (4500 m).
- E. pseudoobscurum** Hausskn. (*E. roseum* Schreb. var. *anagallidifolium* C.B. Clarke p.p.)  
Lahul (4800 m).
- \***E. rhynchospermum** Hausskn.  
Kashmir (Kolohai 3600 m), Kangra (Laca).
- E. royleanum** Hausskn. (*E. roseum* Schreb. var. *indicum* C.B. Clarke and var. *dalhousieanum* C.B. Clarke)  
Kashmir to Kumaon (3800 m).
- \***E. sikkimense** Hausskn. var. *ludlowianum* Raven  
Tehri-Garhwal (3950 m).
- \***E. williamsii** Raven  
Kulu, Kumaon (3650 m).

UMBELLIFERAE (nom. altern. APIACEAE)

The Umbelliferae constitute one of the larger families of flowering plants. The plants are easily recognized by their umbellate inflorescences. Other distinguishing features of this family are the inferior, 2-celled ovary and the fruit of 2 indehiscent, dorsally or laterally compressed carpels which usually separate from each other (mericarps) leaving a central columella from which they split. Many plants belonging to this family are economically important. The well known spices, anise, asafoetida, caraway, coriander and cumin seeds, dill, as also the plants of food value like the celery, carrot, parsnips and others belong to this family. Some of them are strongly aromatic when crushed and a few are poisonous. The most spectacular of all Himalayan Umbelliferae are the species of *Pleurospermum*. More than ten species of this genus occur in the alpine zone of which *P. candollei* is the commonest, and perhaps, the most attractive of them all. Describing the beauty of this plant, Smythe writes, "even if you have little or no interest in flowers, it demands that you pause and pay tribute to its beauty and to the Divinity that raised it among the barren rocks". This species has been collected at altitudes above 4500 m in Lahul, Kangra, Tehri-Garhwal and Kumaon. The author saw beautiful specimens of this species, in late October, on the morainic slopes beyond Lake Hemkund in Garhwal. The large umbels are many-rayed and the bract and bracteoles are white-margined.

Another genus of the family, *Ferula*, one of whose species yields the asafoetida of commerce, is very widely distributed in Central Asia. In the west Himalaya, there is, however, only one species in the alpine zone.



*Pleurospermum candollei* (DC.) C.B. Clarke

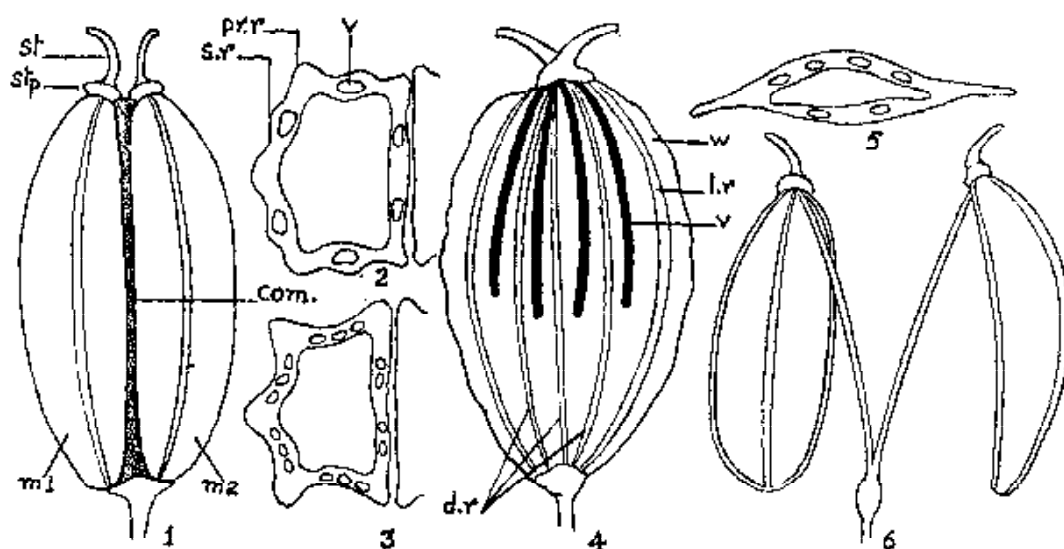
This species, *F. jaeschkeana*, is a large herb with prominent cauline sheaths and large compound leaves whose ultimate pinnae are closely crenate. The umbels are large and bear a profusion yellow flowers and large compressed, ovoid fruits, each more than a cm long. The genus, *Heracleum*, is represented by a few species in the alpine zone of which *H. brunonis* and *H. thomsonii* are common. The former is a strongly aromatic herb and is stated to cause nausea.

*Cortia depressa* is a herb generally restricted to the alpine zone. It is peculiar in having unequal, pubescent rays in its umbels. Other members of the family occurring in the alpine zone of west Himalaya are species of *Ligusticum*, *Selinum*, *Trachydium* and *Vicatia*.

While all the above Umbelliferae have dissected or pinnate leaves, the genus *Bupleurum* is unique in possessing entire, simple leaves. *B. longicaule* (var. *himalaica*), a rambling herb with dark purplish umbels is frequent in the sub-alpine valleys.

#### KEY TO GENERA

- |  |                      |
|--|----------------------|
| 1. Leaves entire; flowers yellow or greenish   | <i>Bupleurum</i>     |
| 1. Leaves not entire, variously dissected or compound; flowers white, yellow or purplish |                      |
| 2. Fruits laterally compressed   |                      |
| 3. Wall of fruit hairy or with hooked bristles or scales                                 |                      |
| 4. Fruit covered with hooked bristles  | <i>Sanicula</i>      |
| 4. Fruit without hooked bristles but densely hairy or scabrid                            |                      |
| 5. Rays of umbels 3-8. Herbs with greatly reduced upper leaves                           | <i>Pituranthos</i>   |
| 5. Rays of umbels 10-15. Tall herbs with large leaves, 2-3 pinnate                       | <i>Anthriscus</i>    |
| 3. Wall of fruit without bristles, scales or hairs                                       |                      |
| 6. Primary ridges of fruit spongy  | <i>Trachydium</i>    |
| 6. Primary ridges of fruit not spongy  |                      |
| 7. Fruits small, yellowish-brown, viscid   | <i>Carum</i>         |
| 7. Fruits not viscid   |                      |
| 8. The fruits ovoid, scarcely compressed   | <i>Vicatia</i>       |
| 8. The fruits oblong, compressed, narrowed upwards                                       |                      |
| 9. Furrows 1-vittate   | <i>Chaerophyllum</i> |
| 9. Furrows 2 to 3-vittate  | <i>Acronema</i>      |



Umbelliferae — Fruit

Figs. 1-6. Fig. 1. Fruit (Cremocarp) in lateral view with the two mericarps ( $m_1$  and  $m_2$ ) side by side; *com*, commissure, the region of coalescence of the two mericarps; *stp*, stylopodium; *st*, style. Figs. 2-3. Tr. secs. of mericarps with primary ridges (*pr. r.*) and secondary ridges (*s. r.*) with the oil canals or vittae (*v*) beneath the secondary ridges or in the furrows between primary ridges. Fig. 4. A strongly dorsally compressed fruit in its dorsal face with 5 primary ridges, 3 dorsal (*d. r.*) and 2 lateral (*l. r.*), the lateral ridges with wing-like expansion (*w*); between the primary ridges are seen the oil canals or vittae (*v*) and these are shown in dark thick lines. Fig. 5. Tr. sec. of a strongly dorsally compressed mericarp. Fig. 6. Splitting of the cremocarp into 2 mericarps which are held together by a slender wire-like structure (all figs. diagrammatic).

2. Fruits dorsally compressed
10. Flowers yellow. Tall herbs, nearly 2 m high
11. Epicarp spongy; vittae small, numerous *Prangos*
11. Epicarp not spongy; lateral ridges of fruit winged; vittae very large, solitary in each furrow *Ferula*
10. Flowers white or yellowish
12. Ovary hairy *Heracleum*
12. Ovary glabrous
13. Pericarp corky
14. Furrows 1 to 2-vittate *Angelica*
14. Furrows many vittate *Archangelica*
13. Pericarp not corky
15. Bracts and bracteoles white-margined *Pleurospermum*
15. Bracts and bracteoles not white-margined
16. Rays of umbels very unequal. Almost stemless herbs *Corita*
16. Rays of umbels uniform. Herbs with prominent stem
17. Dorsal furrows 2 to 3-vittate *Ligusticum*
17. Dorsal furrows 1-vittate *Selinum*

## LIST OF GENERA AND SPECIES

## ACRONEMA FALC. EX EDGEW.

- A. *tenera* Edgew. (*Pimpinella tenera* Benth.)  
Tehri-Garhwal (3900 m), Garhwal, Kumaon.

## ANGELICA LINN.

- A. *glauca* Edgew.  
Kashmir (3600 m), Kumaon.

## ANTHRISCUS PERS. EX HOFFM. NOM. CONS.

- A. *nemorosa* Spreng.  
Kashmir (3300 m).

## ARCHANGELICA HOFFM.

- A. *himalaica* Edgew. [*A. officinalis* Hoffm. var. *himalaica* (Edgew.)  
C. B. Clarke]  
Kashmir (3600 m).

## BUPLEURUM LINN.

- \***B. aitchisonii** (Boiss.) Wolff  
Kulu (Rohtang Pass, 4000 m).
- \***B. falcatum** Linn. var. **gracillimum** (Klotzsch) Wolff  
Lahul (4500 m), Spiti.
- B. longicaule** Wall. ex DC.  
Kashmir to Kumaon up to 4500 m.
- B. longicaule** var. **himalayense** (Klotzsch) C. B. Clarke  
Kashmir to Kumaon.
- B. longicaule** var. **dalhousiana** C. B. Clarke  
Kangra, Kulu.
- B. thomsonii** C. B. Clarke  
Kashmir (Deosai, alp. meadows).

## CARUM LINN.

- C. carvi** Linn.  
Kashmir to Kumaon up to 4300 m.

## CHAEROPHYLLUM LINN.

- C. reflexum** Lindl.  
Kashmir (3900 m), Lahul.
- C. villosum** Wall. ex DC.  
Kashmir to Kumaon up to 3900 m.

## CORTIA DC.

- C. depressa** (D. Don) Norman (*C. lindlei* DC.)  
Kumaon (4200 m).

## FERULA LINN.

- F. jaeschkeana** Vatke  
Kashmir, Lahul (3600 m).

## HERACLEUM LINN.

- H. brunonis** (DC.) C. B. Clarke  
Kulu, Tehri-Garhwal, Kumaon (3900 m).
- H. candicans** Wall.  
Kashmir (Deosai, up to 4000 m).
- H. thomsonii** C. B. Clarke  
Ladakh, Lahul, Spiti (3600 m).
- H. thomsonii** var. **glabrior** C. B. Clarke  
Kashmir, Lahul (3600 m).



## LIGUSTICUM LINN.

- \*L. **daucoides** Franch.  
Kumaon (4800 m).
- L. **thomsonii** C. B. Clarke  
Kashmir (3600 m).

## PITURANTHOS VIT.

- P. **thomsonii** C. B. Clarke  
Lahul (4500 m), Spiti.

## PLEUROSPERMUM HOFFM.

- P. **angelicoides** (DC.) C. B. Clarke [*Pterocyclus angelicoides* (Wall.) Klotzsch]  
Tehri-Garhwal, Garhwal, Kumaon (3800 m).
- P. **benthamii** C. B. Clarke  
Kumaon (4300 m).
- P. **brunonis** (DC.) C. B. Clarke  
Kashmir to Kumaon (4800 m in Lahul).
- P. **candollei** (DC.) C. B. Clarke  
Kashmir to Kumaon (5000 m).
- \*P. **corydalifolium** Aitch. & Hemsl. var. **indicum** Wolff  
Kashmir (3600 m).
- P. **densiflorum** (Lindl.) C. B. Clarke  
Kashmir, Lahul (4900 m), Tehri-Garhwal.
- P. **dentatum** (DC.) C. B. Clarke  
Garhwal, Kumaon (3900 m).
- P. **govanianum** (DC.) C. B. Clarke  
Kashmir to Garhwal (4500 m).
- P. **hookeri** C. B. Clarke  
Kumaon (4500 m).
- \*P. **pulchrum** Aitch. & Hemsl.  
Lahul (3600 m).
- \*P. **pulzkyi** Kanitz  
Ladakh (4800 m).
- P. **stellulatum** (D. Don) C. B. Clarke  
Kumaon (Milam).
- P. **stellatum** var. **lindleyana** C. B. Clarke  
Lahul, Tehri-Garhwal (4500 m).
- P. **stylosum** C. B. Clarke  
Kashmir, Lahul (3300 m).

## SANICULA LINN.

- S. **elata** Buch.-Ham. ex D. Don (*S. europaea* C. B. Clarke non Linn.)

## SELINUM LINN. NOM. CONS.

- S. candollei** DC. (*S. tenuifolium* Wall. non Salisb.)  
Kashmir to Kumaon (4800 m in Tehri-Garhwal).
- S. papyraceum** C. B. Clarke  
Ladakh, Lahul (4800 m).
- S. vaginatum** C. B. Clarke  
Kashmir to Kumaon (3900 m).

## TRACHYDIUM LINDL.

- \*T. garhwalicum** Wolff  
Tehri-Garhwal (4800 m).
- T. roylei** Lindl.  
Kashmir to Kumaon (4500 m).

## VICATIA DC.

- V. conifolia** DC.  
Kashmir to Kumaon (4000 m).
- V. millefolia** (Klotzsch) C. B. Clarke  
Tehri-Garhwal (3600 m).
- V. wolffiana** (Fedde ex Wolff) Norman  
Ladakh (4400 m).

## ARALIACEAE

This is a largely tropical or sub-tropical family but some members also occur in the temperate and sub-alpine zones of the Himalaya. The well known ginseng of commerce is obtained from a plant belonging to the family. The Araliaceae are mostly trees and shrubs, often with large pinnate, palm-like leaves. The plants bear large umbellate or paniculate inflorescences. The flowers are sometimes polygamous and possess a 5-carpelled ovary, which, in some species, is inferior. The only member to reach the alpine zone in west Himalaya is *Aralia cachemirica*. This is an unarmed shrub with pinnate leaves and large elongated umbellate panicles of yellowish or greenish-white flowers.

## ARALIA LINN.

- A. cachemirica** Decne.  
Kashmir to Kumaon (3300 m).

## ADOXACEAE

*Adoxa moschatellina* is the only member of this small family. It had been previously included in the Caprifoliaceae but is rather anomalous in that group and hence has been separated from it. The relationships of

the plant are obscure. It is widely distributed in Europe, North Asia and North America. It is known only from Kashmir in our area. *Adoxa* is a small, glabrous herb with a creeping rootstock and long-petioled, tri-pinnatisect, radical leaves. There is usually only one cauline leaf. The greenish-white flowers are arranged in a long-peduncled, few-flowered heads.

ADOXA LINN.

- A. *moschatellina* Linn.  
Kashmir (3500 m).

CAPRIFOLIACEAE

The honey-suckle family is represented by the genera, *Lonicera*, *Triosteum* and *Viburnum* in the high western Himalaya. *Triosteum* is a small herb whereas the other two genera are shrubby in habit. The *Viburnums* are mostly distributed in the temperate zone but a few species may reach the sub-alpine zone in some localities. Among these are, *V. cotinifolium*, *V. cordifolium* and *V. nervosum*. The flowers in all these plants are produced in corymbs, forming a flat topped inflorescence at the ends of branches. The ovary is inferior and the drupaceous fruits are red or black in colour, succulent and often compressed.

There are several species of *Lonicera* occurring in this zone and some of them are found at very high altitudes, where they exhibit a highly twisted or crooked branching system on account of exposure to cold and snow storms. The flowers are produced in stalked pairs, often their ovaries confluent, in the axils of leaves or they may form a paniced group in the sub-terminal region. The corolla is tubular, white or yellow in colour, often fragrant and the fruit is a berry developed from an inferior ovary. *Lonicera spinosa*, a bush less than a metre high, is found in dry ravines and river beds in the arid tracts of Ladakh, Lahul and Spiti. In this species, the flowers are purplish and strongly scented.

*Triosteum* is a rare genus and one of its species, *T. hirsutum*, is found in the sub-alpine zone of eastern Kumaon. It has been collected only on a few occasions on the slopes beyond Garbyang. The plant is peculiar in having the opposite pairs of leaves connate at the base. The funnel-shaped, greenish flowers are found in short terminal spikes or whorls.

KEY TO GENERA

- |  |                  |
|--|------------------|
| 1. Plants herbaceous; leaves sessile, connate                      | <i>Triosteum</i> |
| 1. Plants woody, shrubs or trees                                   |                  |
| 2. Flowers in large corymbose cymes; style short, stigma lobed     | <i>Viburnum</i>  |
| 2. Flowers in pairs in axils; style long, slender, stigma capitate | <i>Lonicera</i>  |

## LIST OF GENERA AND SPECIES

## LONICERA LINN.

- L. **angustifolia** Wall. ex DC.  
Throughout reaching 3600 m in some localities.
- L. **asperifolia** (Decne.) Hook. f. & Thoms.  
Kashmir, Kumaon (3900 m).
- L. **heterophylla** Decne.  
Kashmir, Lahul (3300 m).
- L. **hispidata** Pall. var. **bracteata** (Royle) Rehder ex Airy Shaw (*L. hispidata* C. B. Clarke non Pall.)  
Kashmir to Kumaon (3600 m).
- L. **hypoleuca** Decne.  
Lahul (3600 m), Spiti, Tehri-Garhwal, Garhwal.
- L. **microphyllus** Willd. ex Roem.  
Ladakh, Garhwal (3600 m).
- L. **myrtilus** Hook. f. & Thoms. var. **depressa** Rehder (*L. parvifolia* Hook. f. & Thoms. non Edgew.)  
Lahul, Chamba, Tehri-Garhwal, Kumaon (3700 m).
- L. **obovata** Royle ex Hook. f. & Thoms.  
Kashmir to Kumaon (3900 m).
- L. **purpurascens** (Decne.) Hook. f. & Thoms.  
Kashmir to Kumaon (3900 m).
- L. **quinquelocularis** Haridw.  
Kashmir to Kumaon reaching 3600 m in a few places.
- L. **rupicola** Hook. f. & Thoms.  
Kumaon (4000 m).
- L. **semenovii** Regel (*L. glauca* Hook. f. & Thoms. non Meerb.)  
Lahul, Spiti, Garhwal, Kumaon (4200 m).
- L. **spinosa** (Decne.) Jacq. ex Hook. f. & Thoms.  
Ladakh, Rupshu (4800 m), Lahul, Spiti, Garhwal, Kumaon (4500 m)
- L. **webbiana** Wall. ex DC. (*L. alpigena* Hook. f. & Thoms. non Linn.)  
Kashmir to Kumaon (3600 m).

## TRIOSTEUM LINN.

- T. **hirsutum** Wall.  
Kumaon (3300 m).

## VIBURNUM LINN.

- V. **cordifolium** Wall. ex DC.  
Kumaon (3600 m).
- V. **cotinifolium** D. Don  
Kumaon (3300 m).

*Viburnum nervosum* D. Don  
Tehri-Garhwal (3300 m).

#### RUBIACEAE

This is one of the largest families of flowering plants with more than 5000 species, most of which are, however, found in the tropical and sub-tropical regions. Only a small number of genera occur in the temperate zone and those reaching the alpine zone are fewer still. In the west Himalaya, only one of the madders, *Rubia tibetica*, and some species of *Galium* are seen in the sub-alpine and alpine zones. The stipules which are so characteristic of the members of this family are absent in both these genera. These are generally rambling, perennial or annual herbs with whorled, narrow leaves and small, white, yellowish-green or purplish flowers. The flowers are regular and the tubular corolla has usually 4 lobes. The stamens are also 4 and the ovary in all of them is inferior, 2-carpeled, 2-celled with a solitary ovule in each cell. The fruits are didymous and may often possess hooked hairs. The species of *Galium* are commonly seen in many localities in the high Himalaya and one of them, *G. acutum* has very small, narrow leaves and has the peculiar feature of drying black.

#### KEY TO GENERA

- |                          |                 |
|--------------------------|-----------------|
| 1. Corolla rotate        |                 |
| 2. Flowers pentamerous   | <i>Rubia</i>    |
| 2. Flowers tetramerous   | <i>Galium</i>   |
| 1. Corolla funnel-shaped | <i>Asperula</i> |

#### LIST OF GENERA AND SPECIES

##### ASPERULA LINN.

- A. brachyacantha** Boiss.  
Kashmir, Kinnaur.  
**A. cynanchica** Linn.  
Garhwal (3500 m).

##### GALIUM LINN.

- G. acutum** Edgew.  
Bashahr (3900 m), Tehri-Garhwal.  
**G. aparine** Linn.  
Ladakh, Lahul (4500 m), Tehri-Garhwal.  
**G. asperifolium** Wall.  
Throughout reaching alpine heights in some places.  
**G. exile** Hook. f.  
Kumaon (4200 m).

**Galium paradoxum** Maxim.

Kumaon (3900 m).

**G. serpylloides** Royle ex Hook. f.

Lahul (3600 m).

**G. tricornis** With.

Throughout reaching 3600 m in a few places.

**G. verum** Linn.

Lahul.

## RUBIA LINN.

**R. tibetica** Hook. f.

Ladakh, Spiti (4200 m).

## VALERIANACEAE

The Valerians are important for their strongly smelling rhizomes which find use in medicine. Some Valerians are also popular garden plants. These are mostly perennial herbs with basal or cauline, opposite leaves which may be pinnate or pinnatifid or entire. The calyx in the genus, *Valeriana*, characteristically, forms a feathery pappus in fruit. The corolla is small, funnel-shaped and is often zygomorphic. It may be white, yellow or purple. The fruit is an achene.

The genus, *Nardostachys*, is the well known spikenard whose fragrant rhizomes are much valued for their tonic and stimulating properties. *N. jatamansi*, locally known as 'jatamansi' or 'manshi', is reputed for its aromatic properties and is employed in the treatment of epilepsy, hysteria and other convulsive disorders. This plant is found in the alpine zone throughout the Himalaya.

## KEY TO GENERA

- |   |                     |
|---|---------------------|
| 1. Calyx in fruit with distinct lobes   | <i>Nardostachys</i> |
| 1. Calyx in fruit, feather, pappus-like | <i>Valeriana</i>    |

## LIST OF GENERA AND SPECIES

## NARDOSTACHYS DC.

**N. jatamansi** DC.

Tehri-Garhwal, Garhwal, Kumaon (4500 m).

## VALERIANA LINN.

**V. dioica** Linn.

Kashmir, Lahul (4800 m), Kumaon (4200 m).

**V. hardwickii** Wall.

Kashmir to Kumaon (4000 m).



*Nardostachys jatamansi* DC.

- Valeriana jaeschkei* C. B. Clarke  
Kashmir (4000 m), Lahul.
- V. *jatamansi* Jones (*V. wallichii* DC.)  
Kashmir to Kumaon (3900 m).
- V. *pyrolaefolia* Decne.  
Kashmir to Kumaon (3600 m).
- V. *roylei* Klotzsch  
Tehri-Garhwal (4200 m).

## DIPSACACEAE

The family includes the teasels (*Dipsacus* spp.), the Scabiosus (*Scabiosa* spp.), the whorl-flowers (*Morina* spp.) and a glandular small herb, *Triplostegia glandulifera*. The last named plant has a distribution extending from northwest Himalaya to Sikkim, Yunnan, east Tibet, Szechuan and Formosa. It is also found on mountains in central Celebes and in New Guinea. This is an erect perennial herb with opposite, decussate and dentate leaves. The leaves are arranged close together giving the appearance of a pseudo-rosette. The flowers are borne in terminal cymose panicles, the bracts being conspicuous on account of their glandular nature. These bracts persist and surround the 1-seeded fruit which is derived from an inferior, 1-celled ovary.

*Dipsacus inermis* is a tall herb, 1 to 3 m high and with rough, linear-ovate leaves all over. The lower leaves on the stem are pinnatifid and the upper ones are 3-lobed or may be simple and entire. The numerous white flowers are grouped in a globose head which terminates a long peduncle. The bracts subtending the head as also the bracteoles are all stiff and bristly. This plant has a wide distribution all along the Himalaya, particularly in the temperate zone.

*Scabiosa speciosa* is an attractive herb with branched stems about half a metre high. The mauve-coloured flowers are grouped in heads. The involucreal scales are oval and the calyx is made of 5 long bristles with the corolla exceeding it in length. The base of each flower is surrounded by a small, ribbed cup. The herb occurs on grassy slopes in the high temperate and sub-alpine zones and is commonly met with in Kashmir and Lahul.

The genus, *Morina*, popularly known as the whorl-flower, is represented by 3 species in western Himalaya. The leaves in all of them are linear or linear-oblong with a spinescent-toothed margin. The whorls of flowers are arranged in interrupted spikes and somewhat resemble the inflorescence of the Labiatae. The bracteoles amidst the floral whorls are also spinous. The plants are very attractive when in flowers on account of the profuse production of brightly coloured flowers. The corolla is elongate, funnel-shaped and curved with an oblique mouth. In Lahul, the yellow-flowered,



*M. coulteriana* is seen on dry slopes during the summer months. Elsewhere, the pink-flowered, *M. longifolia* is more common. This species forms one of the conspicuous elements of the thick herbaceous cover on the slopes in the Valley of Flowers and the Kedarnath Valley in Garhwal. Some of these Morinas are strongly scented. A few species of *Morina* also occur in Central Asia and there are pink and yellow-flowered ones among them. *M. lehmanniana* from Turkestan is a yellow-flowered species resembling in habit the Himalayan, *M. coulteriana*.

## KEY TO GENERA

- |  |                      |
|--|----------------------|
| 1. Flowers in 2 or 3-chotomous cymes. Small glandular, pubescent herbs               | <i>Triplostegia</i>  |
| 1. Flowers in paniced heads or in whorls on spikes. Tall leafy or spinescent herbs   |                      |
| 2. Calyx and corolla 2-lipped; flowers in whorls                                     | <i>Morina</i>        |
| 2. Calyx uniformly 4-lobed or bristly; corolla tubular, funnel-shaped or sub-labiate |                      |
| 3. Herbs bristly or prickly; calyx cup-shaped without bristles                       | <i>Dipsacus</i>      |
| 3. Herbs never bristly nor prickly; calyx cup with short teeth and long bristles     |                      |
| 4. Calyx bristles 20-24  | <i>Pterocephalus</i> |
| 4. Calyx bristles 5  | <i>Scabiosa</i>      |

## LIST OF GENERA AND SPECIES

## DIPSACUS LINN.

- D.** *mitis* D. Don (*D. inermis* Wall. p.p.)  
Kashmir (3600 m).

## MORINA LINN.

- M.** *coulteriana* Royle  
Kashmir to Garhwal (3600 m).  
**M.** *longifolia* Wall. ex DC.  
Kangra, Tehri-Garhwal, Garhwal, Kumaon (3600 m).

## PTEROCEPHALUS ADANS.

- P.** *hookeri* (C. B. Clarke) Airy Shaw & M. L. Greene (*Scabiosa hookeri* C. B. Clarke)  
Kumaon (4000 m).

## SCABIOSA LINN.

- S.** *speciosa* Royle  
Kashmir, Lahul (3300 m).

## TRIPLOSTEGIA WALL. EX DC.

T. *glandulifera* Wall. ex DC.

Tehri-Garhwal, Garhwal, Kumaon (3600 m).

## COMPOSITAE (nom. altern. ASTERACEAE)

The Aster family, Compositae or Asteraceae, is the largest of all the families of flowering plants. The plants belonging to the family possess certain very distinguishing features. The flowers are sessile and are grouped in compact heads on a flattened disc of the peduncle. The flowers may be of one kind or, as is often the case, may be organised into a marginal series of ray florets and a central group of disc flowers. The anthers of the 5 stamens are connate, with the filaments being free. The ovary is inferior, single-ovuled and develops into an indehiscent fruit, the achene or cypsela, which, in many, has a pappus associated with it. The pappus represents the calyx. The members of the Compositae are widely distributed being found throughout the altitudinal range with the upper limit reaching the snow line. They are mostly herbs and show a great variety of external form. The asters, dandelions (*Taraxacum* spp.), edelweisses (*Leontopodium* spp.), everlastings (*Anaphalis* spp.), ragworts (*Senecio* spp.), sawworts (*Saussurea* spp.), tansies (*Tanacetum* spp.), thistles (*Cirsium* spp.) and wormwoods (*Artemisia* spp.) belong to this family. The most curious of them all are, perhaps, the woolly members of the genus, *Saussurea*.

*Saussurea* is a genus of characteristic mountain plants. One of the main centres of distribution of its species is in the Himalaya, the others being in Siberia and the Central Asian mountains. More than 20 species have been recorded from the alpine zone of western Himalaya. *S. gossypiphora*, *S. simpsoniana*, *S. graminifolia* and a few others have a thick covering of wool around them. *S. obvallata* has its dark purple heads enclosed in large membranous incurved floral leaves. This is the well known 'brahma-kamal' used in worship at the temples of Badrinath and Kedarnath in north Garhwal. This plant is found near snow on alpine slopes and in slushy morainic ground. *S. lappa*, another species yields the 'kuth' of commerce.

Closely resembling the woolly *Saussurea* in general habit and wooliness is another herb, *Sorosaris glomerata*. It occurs in stony or rocky situations at altitudes above 3800 m. This herb is not common in the western Himalaya and has been collected only on a few occasions in Lahul and Kumaon.

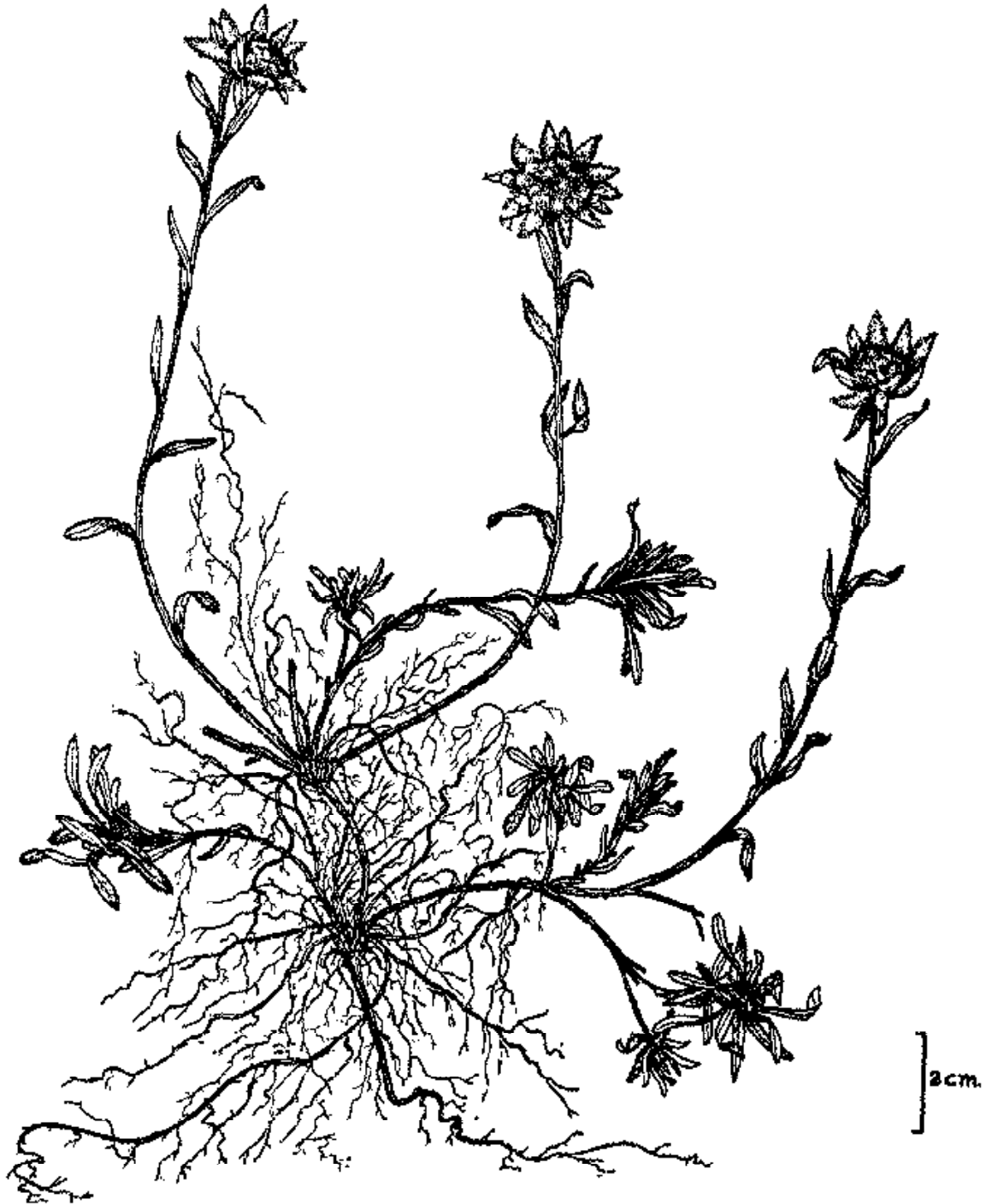
Among the species of the genus, *Inula*, the alpine *I. rhizocephaloides* has a very peculiar appearance. The plant forms woolly rosettes of leaves closely adpressed to the ground and the sessile, purplish heads of flowers are crowded amidst the rosette. This species is seen in Ladakh and other extremely cold northwestern regions.

*Senecio* is a large genus and several species are known from the alpine zone. Of these, *S. pedunculatus* is seen to reach an altitude of 5200 m in Lahul. All these ragworts possess attractive, yellow heads which consist of fertile ray florets and hermaphrodite disc flowers. The commonest *Senecio* in the area is *S. chrysanthemoides*. This is a large herb with lyrate-pinnatifid lower leaves and broadly auricled, toothed upper leaves. The heads are usually arranged in corymbs. A closely related genus of perennial herbs is *Ligularia* whose species possess large orbicular, cordate or palmate basal leaves and prominently sheathed, cauline leaves. *L. amplexicaulis* is a robust herb with cordate-reniform leaves and numerous drooping heads arranged racemously on a long axis. Another species, *L. arnicoides*, occurs in Lahul at altitudes above 4500 m.

The thistles are distinguished by their spinous habit. These are tall, stout herbs often with a white tomentum. The leaves are usually lobed or pinnatisect and spinous-toothed. The heads are solitary or may be present in groups. The flowers in the head are all tubular, white, blue or purple in colour and form globose or urn-shaped clusters. The receptacles and bracts are also stiff and bristly and very often are spinescent. Species of *Echinops*, *Cousinia*, *Carduus* and *Cirsium* are among the Himalayan thistles. *Cousinia thomsonii* is a tall, cottony herb with rigid, globose heads. The flowers are pale purple or pinkish in colour. The herb is very common in the drier regions throughout the western Himalaya and is particularly conspicuous in the Chandra Valley in Lahul. *Carduus nutans* is also a tall, stout thistle but here the stem is interruptedly winged. A somewhat stouter and more robust herb, generally restricted to Kashmir is *C. thomsonii*. It is found in Ladakh.

The genus, *Cirsium*, is characterised by the possession of a feathery pappus but, in other respects, resembles *Carduus*. There are several coarse herbs belonging to this genus and among them are, *C. involucratum*, *C. arvensis* and *C. wallichii*. The heads are mostly purplish in all of them.

The edelweisses, everlastings, tansies and wormwoods are very conspicuous herbs of the alpine zone. The Himalayan edelweiss, *Leontopodium himalayanum*, is a woolly herb growing in tufts on rocks and amidst other herbaceous members. The genus, *Anaphalis*, which includes the pearly everlastings, is abundantly represented at high altitudes often forming extensive patches on alpine slopes. There are many closely related species and intergrading forms among them occur. The tansies are aromatic herbs with yellow heads. *Artemisia*, likewise, is another genus of strongly scented herbs with small solitary or fascicled heads consisting of greenish or purplish flowers. Species of *Aster* and *Erigeron* are also well represented in the alpine zone of western Himalaya. *Tussilago farfara*, a woolly, scapigerous herb, popularly known as the colt's foot, which has a wide distribution in Europe and on the mountains of North Africa, is also found throughout the west Himalayan heights.



*Leontopodium himalayanum* DC.

## KEY TO GENERA

1. Heads of one kind of flowers only—either tubular or ligulate
  2. Flowers all tubular
    3. Leaves armed; thistle-like herbs
      4. Filaments of stamens glabrous *Cousinia*
      4. Filaments of stamens papillose-hairy
        5. Pappus hairs not feathery *Carduus*
        5. Pappus hairs feathery *Cnicus*
    3. Leaves unarmed
      6. Involucral bracts with hooked bristles *Arctium*
      6. Involucral bracts not as above
        7. Filaments of stamens, free, glabrous
          8. Pappus hairs 1-seriate *Saussurea*
          8. Pappus hairs many seriate *Jurinea*
        7. Filaments of stamens, free, papillose *Tricholepis*
  2. Flowers all ligulate
    9. Heads yellow
      10. Achenes beaked
        11. Heads clothed with black glandular hairs. Achenes blackish with a pale slender beak *Dubyaea*
        11. Heads without black glandular hairs. Achenes spinous or with muricate ribs
          12. Achenes incurved, ribbed, dorsal ribs with glochidiate spines *Koelpinia*
          12. Achenes long, straight, 5 to 10 ribbed
            13. Herbs hairy; achenes with narrow base and long slender beak *Taraxacum*
            13. Herbs glabrous; achenes with broad base, beak conspicuous or not *Tragopogon*
        10. Achenes not beaked
          14. Base of achenes broad *Scorzonera*
          14. Base and apex of achenes both contracted
            15. Herbs glabrous *Youngia*
            15. Herbs pubescent or woolly
              16. Heads numerous massed in the dilated top of a simple stem *Sorosaris*
              16. Heads on a sparingly branched flowering stem *Crepis*
        9. Heads lilac or purple *Cicerbita*

1. Heads of both ligulate and tubular (disc) flowers
  17. Pappus not of hairs, represented by flat bristles or absent
    18. Receptacle flat, naked
      19. Pappus of rigid, brownish or reddish, flattened bristles *Waldheimia*
      19. Pappus absent
        20. Heads distinctly rayed *Chrysanthemum*
        20. Heads disciform
          21. The heads in corymbs *Tanacetum*
          21. The heads in a raceme or panicle *Artemisia*
    18. Receptacle with palea *Achillea*
  17. Pappus of hairs
    22. Anther cells tailed
      23. Heads small, disciform
        24. Styles undivided
          25. Pappus hairs free at base *Anaphalis*
          25. Pappus hairs connate at base *Leontopodium*
        24. Styles divided *Gnaphalium*
      23. Heads large, rayed *Inula*
    22. Anther cells not tailed
      26. Rays yellow
        27. Herbs erect, branched; heads solitary or in racemes, corymbs, panicles
          28. Heads in scorpioid panicles *Solidago*
          28. Heads not as above
            29. Involucral bracts 2-seriate, broad; heads 3 cm or more in diam. *Doronicum*
            29. Involucral bracts usually 1-seriate, narrow; heads less than 3 cm in diam.
              30. Leaves variously divided or simple, without sheathing base *Senecio*
              30. Leaves broad, orbicular, reniform, cauline leaves with large sheaths *Ligularia*
        27. Herbs scapigerous, woolly
          31. Pappus soft, white, scanty *Tussilago*
          31. Pappus rough, white, copious *Cremanthodium*
    26. Rays white or lilac
      32. Ligules less than 1 cm long, very many in 2 to 3 series

33. Ligules minute; glandular herbs *Brachyactis*  
 33. Ligules as long or longer than  
 pappus; eglandular herbs *Erigeron*  
 32. Ligules longer than 1 cm; ray florets  
 generally in 1 series or sometimes absent  
 34. Disc flowers equally 5-lobed *Aster*  
 34. Disc flowers with lobes of unequal  
 length (4 short, 1 long) *Heteropappus*

## LIST OF GENERA AND SPECIES

## ACHILLEA LINN.

- A. millefolium** Linn.  
 Kashmir to Kumaon (3900 m).

## ANAPHALIS DC.

- A. contorta** Hook. f.  
 Kulu to Kumaon (4500 m).  
**A. cuneifolia** Hook. f.  
 Throughout up to 4000 m.  
**A. nepalensis** (Spreng. ) Hand.-Mazz. (*A. nubigena* DC.)  
 Kashmir to Kumaon up to 4800 m.  
**A. nepalensis** var. **polycephala** (DC.) Bonner  
 Kumaon (3600 m).  
**A. royleana** DC.  
 Chamba, Lahul (3900 m).  
**A. virgata** Thoms.  
 Lahul, Kinnaur (3900 m).

## ARCTIUM LINN.

- A. lappa** Linn.  
 Kashmir, Kinnaur (3400 m).

## ARTEMISIA LINN.

- A. biennis** Willd.  
 Lahul, Kumaon (4500 m).  
**A. desertorum** Spreng.  
 Ladakh (4200 m), Kinnaur  
**A. dracunculus** Linn.  
 Lahul (3300 m).  
**A. edgeworthii** Balak. (*A. stricta* Edgew. non Heyne ex DC.)  
 Ladakh, Kumaon (4500 m).  
**A. falconeri** C. B. Clarke ex Hook. f.  
 Ladakh (4500 m).  
**A. laciniata** Willd.  
 Lahul (3300 m).

- Artemisia macrocephala** Jacq. ex Bess.  
Ladakh (5200 m), Lahul (4500 m).
- A. maritima** Linn.  
Ladakh, Lahul, Spiti, Kumaon up to 4000 m.
- A. minor** Jacq.  
Ladakh (4800 m), Lahul.
- A. moorcroftiana** Wall. ex DC.  
Ladakh (3300 m).
- A. sacrorum** Ledeb.  
Lahul (4800 m), Spiti, Kumaon.
- A. salsoloides** Willd.  
Lahul (4500 m), Kumaon (4600 m).
- A. sieversiana** Willd.  
Kashmir, Lahul, Kumaon (3300 m).

## ASTER LINN.

- A. albescens** (DC.) Hand.-Mazz. (*Microglossa albescens* C. B. Clarke)  
Kashmir, Chamba, Tehri-Garhwal, Garhwal (3800 m).
- \***A. asteroides** (DC.) O. Ktze. subsp. **asteroides**  
Kashmir, Bashahr, Tehri-Garhwal (4200 m).
- A. diplostephoides** (DC.) C. B. Clarke  
Kashmir (4100 m), Bashahr, Tehri-Garhwal (4700 m), Kumaon.
- \***A. falconeri** (C. B. Clarke) Hutch. subsp. **falconeri**  
Kashmir (3900 m).
- \***A. falconeri** subsp. **nepalensis** Griens.  
Kumaon (3900 m).
- A. flaccidus** Bunge subsp. **flaccidus** (*A. tibeticus* Hook. f. p.p.)  
Zaskar, Ladakh (5200 m), Lahul, Kumaon (5200 m).
- A. flaccidus** subsp. **glandulosus** (Keissl.) Onno  
Ladakh (4700 m).
- A. indamellus** Griens. (*A. pseudamellus* Hook. f.)  
Lahul, Kumaon (3900 m).
- A. iaka** C. B. Clarke  
Kangra (Laca glacier), Kistwar (4500 m), Chamba.
- A. molliusculus** (DC.) C. B. Clarke  
Kashmir (3500 m), Lahul, Kumaon.
- A. stracheyi** Hook. f.  
Tehri-Garhwal (4800 m), Kumaon.
- A. thomsonii** C. B. Clarke  
Kashmir, Chamba, Garhwal (3900 m).

## BRACHYACTIS LEDEB

- B. menthodora** Benth.  
Kashmir, Garhwal, Kumaon (4200 m).



**Brachyactis robusta** Benth.

Kashmir to Kumaon up to 4000 m.

**B. roylei** (DC.) Wendelbo (*B. umbrosa* Benth.)

Kashmir, Lahul (3600 m).

## CARDUUS LINN.

**C. nutans** Linn.

Kashmir, Lahul, Tehri-Garhwal, Kumaon (3900 m).

**C. thomsonii**

Ladakh (3900 m).

## CHRYSANTHEMUM LINN.

**C. pyrethroides** (Kar. & Kir.) Fedtsch. (*C. richteria* Benth. ex C. B. Clarke)

Ladakh (5400 m), Lahul (4800 m).

**C. tibeticum** C. B. Clarke

Ladakh (3300 m).

## CICERBITA WALLR.

**C. cyanea** (D. Don) Beauv. (*Lactuca hastata* DC.)

Kashmir to Kumaon up to 3600 m.

**C. lessertiana** DC.

Kashmir to Kumaon (3900 m).

**C. macrorhiza** (Royle) Beauv. (*Lactuca macrorhiza* Hook. f.)

Kashmir to Kumaon up to 4800 m.

**C. rapunculoides** (DC.) Beauv. (*Lactuca rapunculoides* C. B. Clarke)

Kashmir, Lahul, Kumaon (3600 m).

**C. violaefolia** (Decne.) Beauv. (*Prenanthes violaefolia* Decne.)

Kashmir to Kumaon (3600 m).

## CIRSIUM MILL.

**C. arvense** (Linn.) Scop. (*Cnicus arvensis* Hoffm.)

Kashmir to Kumaon up to 3900 m.

**C. falconeri** (Hook. f.) Petrak (*Cnicus falconeri* Hook. f.)

Kashmir (3600 m).

**C. verutum** (D. Don) Spreng. (*Cnicus involucratus* DC.)

Kashmir to Kumaon up to 3600 m.

**C. wallichii** DC. (*Cnicus wallichii* DC.)

Kashmir, Tehri-Garhwal (3500 m).

## COUSINIA CASS.

**C. thomsonii** C. B. Clarke

Ladakh, Lahul (4500 m), Spiti, Kumaon.

## CREMANTHODIUM BENTH.

- C. decaisnei** C. B. Clarke  
Ladakh, Lahul (4800 m), Tehri-Garhwal (4500 m), Kumaon.
- C. nanum** (Decne.) W. W. Sm. (*Werneria nana* Benth.)  
Ladakh (5200 m), Garhwal, Kumaon (4800 m).

## CREPIS LINN.

- \***C. kashmirica** Babc.  
Kashmir (4500 m).
- C. multicaulis** Ledeb. (*C. stoliczkae* C. B. Clarke)  
Kashmir, Lahul (4800 m).
- \***C. naniforma** Babc.  
Kashmir (5000 m).

## DORONICUM LINN.

- D. falconeri** C. B. Clarke ex Hook. f.  
Kashmir, Kulu, Tehri-Garhwal (4500 m), Kumaon.
- D. roylei** DC.  
Kashmir, Kumaon (3600 m).

## DUBYAEA DC.

- D. hispida** (D. Don) DC. (*Lactuca dubyaea* C.B. Clarke)  
Garhwal, Kumaon up to 4000 m.

## ERIGERON LINN.

- E. alpinus** Linn.  
Kashmir to Kumaon up to 4800 m.
- E. alpinus** var. **multicaulis** Hook. f.  
Kashmir.
- E. alpinus** var. **patentisquama** C. B. Clarke  
Kashmir, Ladakh (4500 m), Kulu.
- E. alpinus** var. **uniflora** Hook. f.  
Lahul (4800 m), Spiti, Kumaon (4500 m).
- E. andryaloides** (DC.) C. B. Clarke  
Lahul (4800 m), Spiti.
- E. bellidioides** C. B. Clarke  
Lahul (3700 m).
- \***E. elisii** Hook. f.  
Kulu (Rohtang Pass).
- E. monticolus** DC.  
Kumaon (3600 m).
- E. multiradiatus** (DC.) Benth. & Hook. f.  
Kashmir to Kumaon up to 4000 m.

## GNAPHALIUM LINN.

- G. stewartii** C. B. Clarke ex Hook. f.  
Kashmir (3900 m).

## HETEROPAPPUS LESS.

- \***H. holohermaphroditus** Griens.  
Kashmir, Lahul (3600 m).  
\***H. semiprostratus** Griens.  
Ladakh (4100 m).

## INULA LINN.

- I. grandiflora** Willd.  
Kashmir to Kumaon up to 4000 m.  
**I. obtusifolia** Kerner  
Ladakh (4500 m), Kumaon.  
**I. rhizocephaloides** C. B. Clarke  
Ladakh (3300 m).  
**I. royleana** DC.  
Kashmir (4000 m).

## JURINEA CASS.

- J. ceratocarpa** (Decne.) C. B. Clarke  
Kashmir (3900 m).  
**J. macrocephala** (DC.) C. B. Clarke  
Kashmir to Kumaon up to 4000 m.

## KOELPINIA PALL.

- K. linearis** Pall.  
Kashmir (3600 m).

## LEONTOPODIUM R. BR. EX CASS.

- L. himalayanum** DC. (*L. alpinum* Hook. f. p.p. non Cass.)  
Kashmir to Kumaon up to 4800 m.  
**L. leontopodium** (DC.) Hand.-Mazz.  
Ladakh (5400 m), Lahul.  
**L. nanum** (Hook. f. & Thoms.) Hand.-Mazz. (*Antennaria nana* Hook.  
f. & Thoms.)  
Rupshu (4500 m).  
**L. stracheyi** C. B. Clarke ex Hemsl. (*L. alpinum* Hook. f. var. *stracheyi*  
Hook. f.)  
Kumaon (3900 m).



*Jurinea macrocephala* (DC.) C. B. Clarke

## LIGULARIA CASS. NOM. CONS.

- L. **amplexicaulis** DC. (*Senecio amplexicaulis* Wall.)  
Kashmir to Garhwal (3600 m).
- L. **arnicoides** DC. [*Senecio arnicoides* (Royle) C. B. Clarke]  
Kashmir, Lahul (4800 m), Kulu, Kumaon.
- L. **jacquemontiana** (Decne.) M.A. Rau, nov. comb. (*Senecillis jacquemontianus* Decne. in Jacq. Voy. Bot. 90, t. 98, 1844; *Senecio jacquemontianus* Benth. in Gen. Pl. 2:449, 1873).  
Kashmir (3900 m).
- L. **sibirica** Cass. (*Senecio ligularia* Hook. f.)  
Kashmir to Kumaon (3900 m).
- \*L. **sibirica** var. **racemosa** (DC.) Kitamura  
Kashmir to Kumaon (3400 m).

## SAUSSUREA DC. NOM. CONS.

- S. **bracteata** Decne. (*S. schultzii* Hook. f.)  
Ladakh (5400 m).
- S. **candolleana** C. B. Clarke (*S. clarkei* Hook. f.)  
Kashmir (4000 m).
- S. **deltoidea** C. B. Clarke  
Garhwal, Kumaon (4000 m).
- S. **falconeri** Hook. f.  
Kashmir, Kumaon (4200 m).
- S. **fastuosa** (Decne.) Sch.-Bip. (*S. denticulata* Wall. non Ledeb.)  
Garhwal, Kumaon (3300 m).
- S. **glanduligera** Sch.-Bip.  
Ladakh (4800 m).
- S. **gnaphalodes** (Royle) Sch.-Bip. (*S. sorocephala* Hook. f. & Thoms.  
ex C. B. Clarke)  
Lahul, Kinnaur, Kumaon (5100 m).
- S. **gossypiphora** D. Don  
Kashmir to Kumaon (4800 m).
- S. **graminifolia** Wall. ex Hook. f.  
Ladakh, Tehri-Garhwal to Kumaon (4800 m).
- S. **hookeri** C. B. Clarke  
Kumaon (4800 m).
- S. **hypoleuca** Spreng.  
Kashmir to Kumaon (3600 m).
- S. **jacea** C. B. Clarke  
Ladakh (4200 m), Lahul.
- S. **leontodontoides** (DC.) Lipsch. (*S. kunthiana* C. B. Clarke)  
Kashmir to Kumaon (4800 m).

- Saussurea lappa** (Decne.) Sch.-Bip.  
Kashmir (3600 m).
- S. obvallata** (DC.) Sch.-Bip.  
Kashmir to Kumaon (4800 m).
- S. piptathera** Edgew.  
Chamba, Kumaon (3600 m).
- S. pterocaulon** Decne. (*S. candolleana* Wall. ex Hook. f. non  
C. B. Clarke)  
Kashmir to Kumaon up to 3900 m.
- S. roylei** (DC.) Sch.-Bip.  
Zaskar (4500 m), Kangra, Garhwal.
- S. simpsoniana** (Field & Gardn.) Lipsch. (*S. sacra* Edgew.)  
Garhwal, Kumaon up to 4800 m.
- S. stoliczkae** C. B. Clarke  
Kashmir (4200 m), Kinnaur.
- S. taraxacifolia** Wall. ex DC.  
Rupshu (4800 m), Kulu to Kumaon.

## SCORZONERA LINN.

- S. divaricata** Turcz.  
Kashmir, Lahul (4500 m), Kinnaur.

## SENECIO LINN.

- S. alatus** Wall. ex DC.  
Kumaon (3600 m).
- S. candolleanus** Wall. ex DC.  
Kumaon (3900 m).
- S. chenopodifolius** DC.  
Kashmir to Garhwal up to 3600 m.
- S. chrysanthemoides** DC.  
Kashmir to Kumaon up to 4500 m.
- S. coronopifolius** Desf.  
Spiti (3600 m), Kumaon.
- S. duthiei** M. A. Rau, nom. nov. (*S. quinquelobus* Hook. f. &  
Thoms. ex C. B. Clarke, Comp. Ind. 209, 1876, nom. illegit.  
non *S. quinquelobus* DC. Prodr. 6: 404, 1838)  
Garhwal, Kumaon (3900 m).
- S. graciliflorus** DC.  
Kashmir to Kumaon up to 3600 m.
- S. kunthianus** Wall. ex DC.  
Kashmir to Kumaon (3900 m).
- S. pedunculatus** Edgew.  
Ladakh (5200 m), Lahul, Garhwal.

## SOLIDAGO LINN.

- S. virga-aurea** Linn.  
Kulu (Rohtang Pass).

## SOROSERIS STEBBINS

- \***S. daesyi** (S. Moore) Stebbins (*Crepis glomerata* Hook. f. p. p.) non Decne.  
Kashmir (5000 m).  
\***S. gillii** (S. Moore) Stebbins subsp. **occidentalis** Stebbins (*Crepis glomerata* Hook. f. p.p. non Decne.)  
Garhwal, Kumaon.  
**S. glomerata** (Decne.) Stebbins (*Crepis glomerata* Decne.)  
Garhwal, Kumaon (4200 m).

## TANACETUM LINN.

- T. gracile** Hook. f. & Thoms. ex Hook. f.  
Ladakh, Kumaon (4500 m).  
**T. longifolium** Wall. ex DC.  
Kashmir to Kumaon (4000 m).  
**T. nubigenum** Wall.  
Kumaon (3900 m).  
**T. robustum** Hook. f. & Thoms. ex C. B. Clarke  
Kinnaur, Tehri-Garhwal (3900 m).  
**T. tomentosum** DC. (*T. senecionis* Gay).  
Ladakh (4500 m), Lahul, Tehri-Garhwal, Kumaon (4000 m).  
**T. tenuifolium** Jacq.  
Kumaon (4000 m).  
**T. tibeticum** Hook. f. & Thoms. ex C. B. Clarke  
Lahul (4800 m).

## TARAXACUM WEBER NOM. CONS.

- \***T. forrestii** van Soest  
Kumaon (4500 m).  
\***T. kashmirensis** van Soest  
Kashmir (3600 m).  
**T. officinale** Weber  
Kashmir to Kumaon up to 5400 m.  
**T. wattii** Hook. f.  
Chamba (3900 m).

## TRAGOPOGON LINN.

- T. gracile** D. Don  
Throughout, reaching 3900 m in Spiti and Kinnaur.  
**T. pratensis** Linn.  
Kashmir to Kumaon up to 4000 m.

## TRICHOLEPIS DC.

- T. tibetica** Hook. f. & Thoms. ex C. B. Clarke  
Kashmir (3600 m).

## TUSSILAGO LINN.

- T. farfara** Linn.  
Kashmir to Kumaon (3300 m).

## WALDHEIMIA KAR. &amp; KIR.

- W. glabra** (Decne.) Regel (*Allardia glabra* Decne.) = *W. tridactylitis*  
Kar. & Kir.  
Kashmir to Kumaon up to 5400 m.
- W. nivea** (Hook. f. & Thoms.) Regel (*Allardia nivea* Hook. f. & Thoms.)  
Ladakh (5100 m).
- W. tomentosa** (Decne.) Regel (*Allardia tomentosa* Decne.)  
Kashmir to Kumaon up to 4800 m.
- W. vestita** (Hook. f. & Thoms.) Pamp. (*Allardia vestita* Hook. f. &  
Thoms.)  
Zaskar (4500 m).

## YOUNGIA CASS.

- Y. glauca** Edgew. (*Crepis glauca* Benth.)  
Ladakh, Lahul (4800 m), Kumaon.
- Y. gracilipes** (Hook. f.) Bab. & Stebbins (*Crepis gracillima* Hook. f.)  
Kumaon (3600 m).
- Y. tenuifolia** (Willd.) Bab. & Stebbins (*Crepis tenuifolia* Willd.)  
Kashmir (4500 m).

## CAMPANULACEAE

The Canterbury bells (*Campanula* spp.) are popular garden plants. Their wild relatives are many in the higher ranges of the Himalaya. These are herbs often possessing milky juice in them. Some are climbers. The leaves are usually alternate, simple and without stipules. The flowers are regular, bisexual and borne in axillary or terminal racemes. The corolla is bell-shaped or campanulate, white or blue in colour. The 5 stamens alternate with the corolla lobes. The ovary is inferior, usually 3-carpelled with a 3-lobed style. The fruit is a capsule often included in the persistent calyx tube.

The genus *Campanula* is represented by 5 species in the area of which *C. cashmeriana* is the most beautiful. It is a somewhat hairy herb and bears large, bright blue, bell-shaped flowers which are 2 to 3 cm long. The other species have much smaller flowers and of these, *C. colorata*, has a very wide distribution. *Codonopsis*, another genus of the family, includes twining herbs which bear conspicuous bluish or lurid, purple-veined, broadly campanulate flowers. *C. ovata* is a fairly widely distributed herb with large sky-blue flowers and conical, beaked capsules.





*Cyananthus lobatus* Wall. ex Benth.

A genus of exclusive Himalayan distribution, *Cyananthus* is represented by some of the prettiest herbs of alpine slopes and meadows. A conspicuous feature of these herbs is the shaggy calyx, usually blackish in colour and persisting in fruit. The corolla is of the prettiest shade of blue.

## KEY TO GENERA

- |  |                   |
|--|-------------------|
| 1. Calyx with shaggy black hairs; capsules quite included in calyx tube        | <i>Cyananthus</i> |
| 1. Calyx without shaggy black hairs; capsules included or projecting in a beak |                   |
| 2. Capsules with elongated beak  | <i>Codonopsis</i> |
| 2. Capsules with a blunt apex  | <i>Campanula</i>  |

## LIST OF GENERA AND SPECIES

## CAMPANULA LINN.

- C. **argyrotricha** Wall. ex DC.  
Kashmir to Kumaon (3900 m).
- C. **aristata** Wall. ex Roxb.  
Kashmir to Kumaon (4500 m).
- C. **cashmiriana** Royle  
Kashmir, Kumaon (3900 m).
- C. **colorata** Wall. ex Roxb.  
Kashmir to Kumaon up to 3900 m.
- C. **latifolia** Linn.  
Kashmir to Kumaon up to 3600 m.

## CODONOPSIS WALL.

- C. **ovata** Benth.  
Kashmir to Garhwal up to 3600 m (4500 m in Lahul).
- C. **rotundifolia** Benth.  
Kashmir to Kumaon (3600 m).

## CYANANTHUS WALL. EX BENTH.

- C. **integer** Wall. ex Benth.  
Tehri-Garhwal, Garhwal, Kumaon (3600 m).
- C. **lobatus** Wall. ex Benth.  
Kulu, Tehri-Garhwal (4000 m), Garhwal, Kumaon.
- C. **microphyllus** Edgew. (*C. linifolius* Wall.)  
Garhwal, Kumaon (3600 m).

## ERICACEAE

This is the well known *Rhododendron* family. The *Rhododendrons* attain their best development in the east Himalayan heights but in the alpine zone of western Himalaya, hardly a few species are met with. These are mostly shrubs or small trees, many of which exhibit a gnarled, wind swept and snow swept appearance. The leaves are simple, alternate, serrate or entire. The flowers are regular but may be somewhat irregular in some members. The corolla is tubular, brightly coloured and includes 10 stamens. The anthers open by apical pores. The ovary is 5-carpelled, developing into a 5-valved capsule. In the genus, *Gaultheria*, the calyx becomes succulent and encloses the ovary. The blue spherical fruits of *G. irichophylla*, a prostrate shrub in the alpine zone, are very conspicuous during the late summer weeks.

Among the *Rhododendrons*, *R. campanulatum* forms an associate of *Betula utilis* in the sub-alpine forests in all the sectors of western Himalaya. The aromatic species, *R. lepidotum* with purple flowers and *R. anthopogon*, with pale yellowish or cream-white flowers are prominent shrubs on many alpine slopes. The latter species is known to reach an altitude of more than 4500 m and is much valued as a firewood in these inhospitable regions.

A single species of the heather-like plants, *Cassiope fastigiata*, is seen in many localities in the alpine zone. It is a small, fastigiata shrub forming dense tufts and bears small, bell-shaped, white or pink flowers.

*Pyrola rotundifolia* is a glabrous perennial herb with orbicular or broadly ovate, petiolate, radical leaves. The white flowers are borne on a long racemose scape. The anthers open by 2 apical pores and the 5-celled ovary develops into a 5-angled, subglobose capsule which is crowned by the persistent simple style.

## KEY TO GENERA

- |  |                     |
|--|---------------------|
| 1. Plants herbaceous; corolla of free lobes  | <i>Pyrola</i>       |
| 1. Plants woody, shrubs or trees; corolla often campanulate, in any case, gamopetalous           |                     |
| 2. Capsules covered by fleshy calyx. Prostrate wiry shrub  | <i>Gaultheria</i>   |
| 2. Capsules not as above   |                     |
| 3. Leaves densely imbricate, adpressed to branches; fastigiata shrubs                            | <i>Cassiope</i>     |
| 3. Leaves large, alternate; small trees or shrubs  |                     |
| 4. Flowers in racemes; capsules loculicidally 5-valved   | <i>Lyonia</i>       |
| 4. Flowers in terminal fascicles or in sub-corymbose clusters; capsules septically 5 to 9-celled | <i>Rhododendron</i> |

## LIST OF GENERA AND SPECIES

## CASSIOPE D. DON

- C. fastigiata** D. Don  
Kashmir to Kumaon up to 4500 m.

## GAULTHERIA LINN.

- G. trichophylla** Royle  
Lahul to Kumaon (3900 m).

## LYONIA NUTT. NOM. CONS.

- L. villosa** (Hook. f. ex C. B. Clarke) Hand.-Mazz. (*Pieris villosa* Hook. f. ex C. B. Clarke)  
Garhwal (3300 m).

## PYROLA LINN.

- P. karakoramica** Kriisa  
Kashmir (3600 m), Chamba.  
**P. rotundifolia** Linn.  
Kashmir (3600 m).

## RHODODENDRON LINN.

- R. anthopogon** D. Don  
Kashmir to Kumaon up to 4800 m.  
**R. barbatum** Wall. ex G. Don  
Kumaon (3600 m).  
**R. campanulatum** D. Don  
Kashmir to Kumaon up to 4200 m.  
**R. lepidotum** Wall. ex G. Don  
Kashmir to Kumaon (up to 4500 m).  
**R. nivale** Hook. f.  
Tehri-Garhwal (4800 m).

## PLUMBAGINACEAE

A family of worldwide distribution whose members occur in a variety of unusual habitats, the Plumbaginaceae includes mostly herbs and shrubs. *Acantholimon* has many of its species occurring in the cold free deserts of north Himalaya, Tibet and Central Asia. *Statice* is a large genus whose species generally prefer saline habitats. In the alpine zone of western Himalaya, two members of the family are found, *Acantholimon lycopodioides* and *Statice macrorrhabdos*. The former is a prickly shrub with tufts of linear, spinescent leaves. The small, white or pink flowers are arranged in cymes on short scapes. The entire plant presents a densely tufted habit and is found in the drier regions of north Kashmir and in Tibet. *Statice macrorrhabdos* is an annual rosulate herb bearing tall scapes of flowers. This plant is found in Ladakh.

## KEY TO GENERA

- |  |                     |
|--|---------------------|
| 1. Shrubs, rigid with spinescent leaves        | <i>Acantholimon</i> |
| 1. Herbs, annual with radical, rosulate leaves | <i>Statice</i>      |

## LIST OF GENERA AND SPECIES

## ACANTHOLIMON BOISS.

- A. *lycopodioides* Boiss.  
Ladakh (5400 m).

## STATICE LINN.

- S. *macrorhabdos* Boiss.  
Ladakh (3500 m).

## PRIMULACEAE

The well known primrose family has several charming representatives in the western Himalaya. The primroses are favourite garden plants in many parts of the world and the Himalayan species are particularly sought by the plant collectors. In the alpine zone of west Himalaya, one of the most attractive species is *Primula macrophylla* which occurs in a wide variety of forms. Most of them have flowers of varying shades of purple. *P. stuartii* is very similar to the above species in habit but has yellow flowers. Some of these Primulas have a white meal beneath their leaves. Near melting snow appears, early in summer, one of the pink-flowered species, *P. rosea*. This species is exclusively west Himalayan in distribution. At the approach to the Rohtang Pass in Kulu Himalaya, one can see large patches of this beautiful herb during the month of June. An extensively distributed species occurring over a widerange of altitude is *P. denticulata*. This has been collected at a lower limit of 1500 m as well as at altitudes as high as 4500 m. In the alpine marshes and along streams is met with, the white-flowered, *P. munroi*. Perhaps, the most interesting of them is the minute, *P. minutissima* which forms small, moss-like rosettes in alpine river beds. In the Arwa-Saraswathi basin in the far interior of the Garhwal Himalaya, the author saw large patches of this herb at an altitude of more than 4000 m.

*Androsace* is another genus of the primrose family with many representatives in the alpine zone. Some of the species found at very high altitudes exhibit the cushion habit. On rocks exposed to biting cold winds, these soft cushions not only manage to survive but also produce charming flowers of a white or pale lilac colour with a small yellow eye. Among these cushion forming species are *A. chamaejasme*, *A. globifera*, *A. poissonii* and *A. villosa*. In late autumn, the small rosettes of these cushions turn yellowish or reddish. *Androsace* differs from *Primula* only by its proportionately short corolla tube.



*Primula stuartii* Wall.

*Cortusa* is a genus of scapigerous herbs which possess long-petioled, orbicular-cordate or lobed leaves. The purple flowers are borne on scapes and the funnel-shaped corolla of the flower includes the stamens which are found at the base. *Glaux maritima* is a very interesting plant of this family. It is a small creeping, succulent herb differing from all other members of the family in the absence of petals in its flowers. The calyx lobes are coloured white or pink. This plant enjoys a wide distribution in the north temperate and arctic regions. It has been collected in Rupshu in sandy plain, among sedges.

## KEY TO GENERA

- |                               |                  |
|-------------------------------|------------------|
| 1. Corolla present            |                  |
| 2. Anthers obtuse             |                  |
| 3. Corolla tube long          | <i>Primula</i>   |
| 3. Corolla tube short, rotate | <i>Androsace</i> |
| 2. Anthers acuminate          | <i>Cortusa</i>   |
| 1. Corolla absent             | <i>Glaux</i>     |

## LIST OF GENERA AND SPECIES

## ANDROSACE LINN.

- A. *aizoon* Duby  
Kashmir (3900 m).
- A. *chamaejasme* Host.  
Kashmir (4500 m).
- A. *globifera* Duby  
Kumaon (4500 m).
- A. *mucronifolia* Watt  
Kashmir (4000 m), Lahul.
- A. *muscoidea* Duby  
Kashmir, Rupshu (4600 m).
- \*A. *poissonii* Kunth  
Tehri-Garhwal, Garhwal (4000 m).
- A. *rotundifolia* Hardw.  
Kashmir to Kumaon (3900 m).
- A. *sarmentosa* Wall.  
Kashmir to Kumaon (3900 m).
- A. *sempervivoides* Jacq. ex Duby  
Kashmir, Kulu (4000 m).
- A. *septentrionalis* Linn.  
Kashmir (3600 m).
- A. *villosa* Linn.  
Kashmir to Kumaon (4800 m in Tehri-Garhwal).

## CORTUSA LINN.

- \*C. **himalaica** Losinsk  
Kashmir.
- C. **matthioli** Linn.  
Kashmir, Lahul, Kumaon (4000 m).

## GLAUX EHRH.

- G. **maritima** Linn.  
Rupshu (4700 m).

## PRIMULA LINN.

- P. **denticulata** Sm.  
Kashmir to Kumaon (4500 m).
- \*P. **duthicana** Balf. f. & W. W. Sm.  
Kashmir (4200 m).
- P. **edgeworthii** (Hook. f.) Pax (*P. petiolaris* Wall. var. *edgeworthii* Hook. f.)  
Garhwal, Kumaon (3600 m).
- P. **elliptica** Royle  
Kashmir (4500 m) to Kumaon.
- \*P. **glandulifera** Balf. f. & W. W. Sm.  
Kumaon (3900 m).
- P. **heydeii** Watt.  
Lahul (4800 m), Kumaon.
- P. **macrophylla** D. Don [*P. stuartii* wall var. *purpurea* (Royle) Hook. f.]  
Kashmir to Kumaon up to 4800 m.
- P. **moorcroftiana** Wall. ex Klatt (*P. stuartii* var. *moorcroftiana* Hook. f.)  
Kashmir, Ladakh (5200 m), Kulu, Kumaon (5000 m).
- P. **minutissima** Jacq. ex Duby  
Kashmir to Kumaon (4800 m).
- P. **manroi** Lindl. (*P. involucrata* Wall. ex Duby)  
Kashmir to Kumaon up to 4000 m.
- P. **obtusifolia** Royle  
Lahul (4200 m), Bashahr, Kumaon.
- P. **petiolaris** Wall.  
Throughout reaching 3600 m in some places.
- P. **primulina** (Spreng.) Hara (*P. pusilla* Wall. non Goldie nec. W. J. Hook.)  
Kashmir, Lahul (4800 m), Kumaon (5000 m).
- P. **rosea** Royle  
Kashmir, Chamba, Kulu, Tehri-Garhwal (4000 m).
- \*P. **reidii** Duthie  
Garhwal, Kumaon (3600 m).



- Primula reptans** Hook. f. ex Watt  
Kashmir, Lahul, Garhwal (4000 m).
- P. rotundifolia** Wall.  
Kashmir to Kumaon up to 4000 m.
- \***P. schlagintweitiana** Pax  
Lahul, Kumaon (5700 m).
- P. sibirica** Jacq.  
Lahul, Chamba (Pangi), Kumaon (4500 m).
- P. stuartii** Wall.  
Tehri-Garhwal (4000 m).
- \***P. traillii** Watt  
Kumaon (4800 m).

## OLEACEAE

This family includes such well known plants like, olive, lilac, ash, privet, Jasmine and others. These are mostly trees or shrubs and are characterised by the possession of simple or pinnate, opposite leaves and cymose clusters of usually scented flowers. The stamens are characteristically 2 in number and these are attached to the corolla tube. The 2-celled superior ovary generally develops into a capsular type of fruit.

In our area only one species of lilac (*Syringa emodi*) and two species of ash (*Fraxinus excelsior* and *F. floribunda*) reach the sub-alpine zone. The former is a small tree in fir forests and it bears cymose clusters of white or pale pink, scented flowers. The species of *Fraxinus* are conspicuous on account of their winged (samaroid) fruits.

## KEY TO GENERA

- |                                 |                 |
|---------------------------------|-----------------|
| 1. Fruits cylindric, not winged | <i>Syringa</i>  |
| 1. Fruits winged (samara)       | <i>Fraxinus</i> |

## LIST OF GENERA AND SPECIES

## FRAXINUS LINN.

- F. excelsior** Linn.  
Kashmir to Kumaon up to 3300 m.
- F. floribunda** Wall.  
Kashmir to Kumaon up to 3300 m.

## SYRINGA LINN.

- S. emodi** Wall. ex Royle  
Kashmir to Kumaon up to 3600 m.

## ASCLEPIADACEAE

The large milk-weed family is mostly tropical and sub-temperate in its distribution. Very few members of the family are found in the sub-alpine and alpine zones. The milk-weeds are mostly twining herbs and shrubs with a milky latex in them. The flowers are also very characteristic with a ring of hairs, scales or appendages (corona) on the petals and the pollen grouped in waxy masses (pollinia) inside the anthers. The ovary is 2-carpelled with the 2 carpels separating out in fruit which usually consists of 2 divaricating follicles with comose seeds within.

*Cynanchum* is a genus of erect or twining herbs and shrubs. The flowers have a rotate corolla and each cell of the anther has a single mass of pollen. The species of the genus are known to occur in the sub-alpine zone of western Himalaya and one of them, *C. heydei*, is known only from Ladakh.

## LIST OF SPECIES

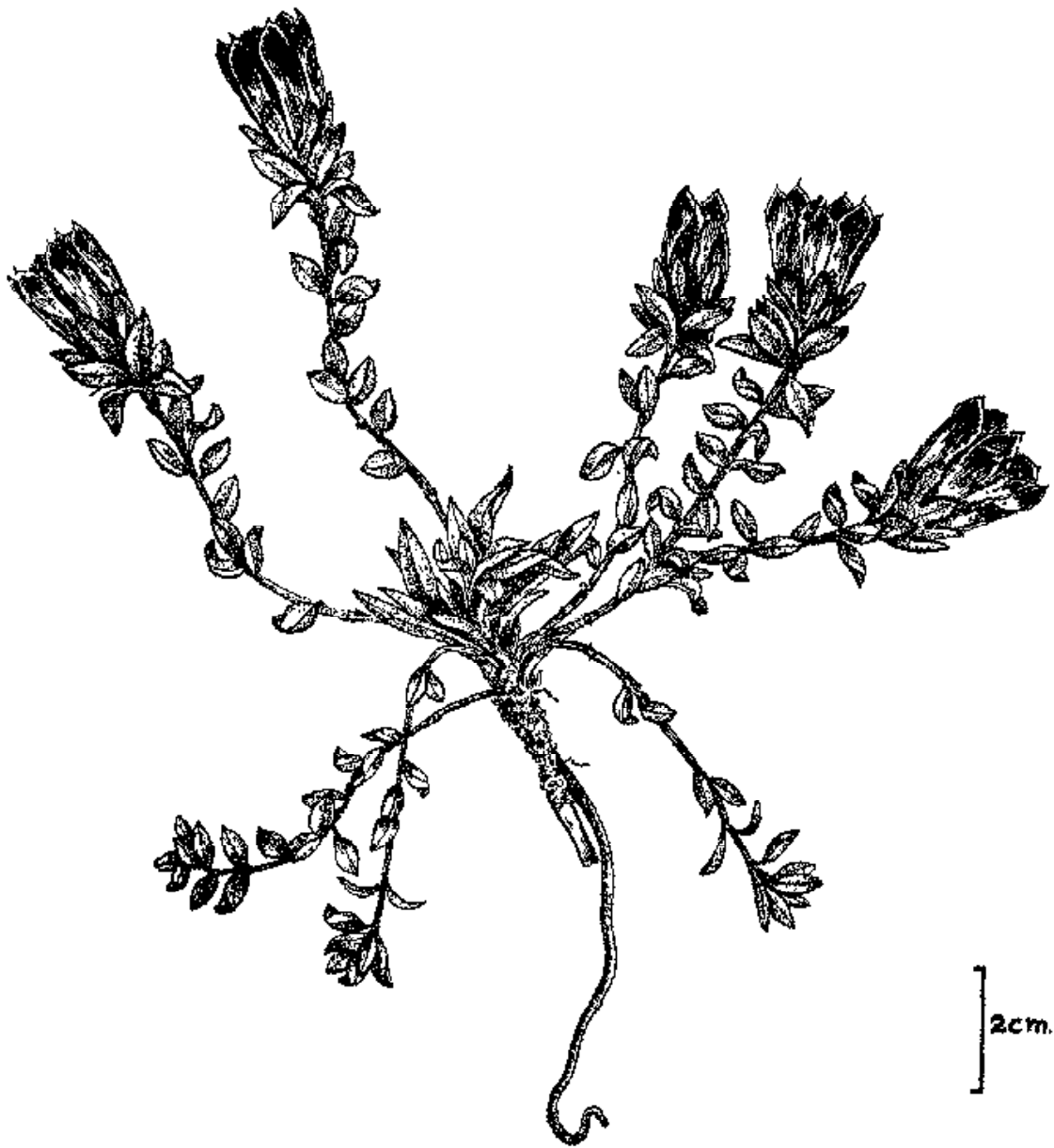
## CYNANCHUM LINN.

- C. *auriculatum* Royle ex Wight  
Kashmir to Kumaon up to 3600 m.
- C. *heydei* Hook. f.  
Ladakh (3000 m).

## GENTIANACEAE

The Gentians are among the most attractive of all the flowering plants occurring in alpine pastures. Most of these bear flowers of various shades of blue. The calyx and corolla are tubular, the former persisting in fruit. The corolla shows characteristic folding between the lobes. *Gentiana kurroo*, *G. stipitata* and *G. venusta* are particularly beautiful. *G. kurroo* has large sky-blue flowers and is reputed to possess medicinal properties. *G. stipitata* is a late flowering species, its pale bluish, purple-backed flowers forming a conspicuous feature of the alpine meadows in late autumn. This herb is abundant in the inner valleys of Garhwal. *G. venusta* is a small, almost stemless herb possessing large flowers, nearly 2-3 cm long. *G. detonsa* is another attractive herb with long funnel-shaped, blue flowers. The solitary flowers of this species are supported on long peduncles sometimes nearly 20 cm long. The other species of *Gentiana* occurring in the Himalaya have much smaller flowers, but on account of the crowding of numerous stems, large patches of these blue-flowered species afford an enchanting spectacle during summer months.

A closely related genus is *Gentianella*. This differs from *Gentiana* in possessing a fringe at the top of the corolla tube. *G. pedunculata* (appearing in Indian Flora under the name of *Gentiana tenella*) is a small blue-flowered herb which is very common in the alpine meadows and is known to reach an altitude of 5200 m in Kumaon.



*Gentiana stipitata* Edgew.

*Swertia* is another genus of the family which is also well represented in the alpine zone. In this genus, the corolla has one or two nectary pits near the base or in the middle of each of its lobes. Most of the species have opposite leaves but one of them with alternate leaves, *S. alternifolia* is a very beautiful herb with large lurid green flowers. *S. cuneata* bears brilliant blue flowers in late autumn. In the genus *Halenia* the pits of the corolla are prolonged into spurs. *Jaeschkea* and *Lomatogonium* are the other genera of the family met with in the area.

## KEY TO GENERA

- |   |                     |
|---|---------------------|
| 1. Corolla without pits at base of petals   |                     |
| 2. Tube of corolla prominent, bell or funnel-shaped, often with folds between lobes |                     |
| 3. Stamens attached to tube of corolla  |                     |
| 4. Corolla without fringe at top of tube  | <i>Gentiana</i>     |
| 4. Corolla with a fringe at top of tube   | <i>Gentianella</i>  |
| 3. Stamens attached between lobes of corolla  | <i>Jaeschkea</i>    |
| 2. Tube of corolla very short, rotate   | <i>Lomatogonium</i> |
| 1. Corolla with basal pits or spurs   |                     |
| 5. Pits of corolla shallow  | <i>Swertia</i>      |
| 5. Pits of corolla prolonged into spurs   | <i>Halenia</i>      |

## KEY TO GENERA AND SPECIES

## GENTIANA LINN.

- \***G. algida** Pall. var. **nubigena** Kuznetsov  
Lahul (4800 m), Kumaon.
- G. aquatica** Linn.  
Kashmir (4000 m).
- G. argentea** Royle ex D. Don  
Kashmir, Kulu (4000 m).
- G. aurea** Linn. [= *Gentianella aurea* (Linn.) H. Sm.]  
Lahul (4000 m).
- G. borealis** Bunge [= *Gentianella borealis* (Bunge) H. Sm.]  
Kashmir, Lahul (4000 m).
- G. cachemirica** Decne.  
Kashmir (4000 m).
- G. capitata** Buch.-Ham. ex D. Don  
Kumaon (3600 m).
- G. carinata** Griseb.  
Kashmir, Lahul, Kulu, Tehri-Garhwal (5000 m), Kumaon.
- G. coronata** Royle  
Tehri-Garhwal.

- \***Gentiana crassuloides** Burr. & Fr.  
Tehri-Garhwal (4200 m), Kumaon.
- G. dahurica** Fisch.  
Lahul (3600 m).
- G. detonsa** Rottb.  
Kashmir, Lahul, Kumaon (4500 m).
- G. detonsa** var. **stracheyi** C. B. Clarke  
Kashmir, Kulu, Spiti, Kumaon (4300 m).
- G. infelix** C. B. Clarke  
Kumaon, 5000 m.
- \***G. kumaonensis** Biswas  
Kumaon (3300 m).
- G. kurroo** Royle  
Kashmir (3300 m).
- \***G. leucomelaena** Maxim. (*G. prostrata* C. B. Clarke non Haencke)  
Rupshu, Lahul (4500 m), Spiti.
- G. marginata** Griseb.  
Kashmir, Lahul (4000 m).
- G. ornata** Wall. ex Griseb.  
Tehri-Garhwal (4500 m).
- G. recurvata** C. B. Clarke  
Kumaon.
- G. stipitata** Edgew. (*G. cachemirica* C. B. Clarke non Decne.)  
Bashahr, Garhwal (4000 m).
- \***G. tetrasepala** Biswas  
Kumaon (4000 m).
- G. thianschanica** Rupr. (*G. decumbens* Linn. f.)  
Zanskar, Spiti, Bashahr (3600 m).
- G. tubiflora** Wall. ex Griseb.  
Kulu-Tehri-Garhwal (4500 m), Garhwal.
- G. venusta** Wall. ex Griseb.  
Kashmir to Kumaon (4000 m).

## GENTIANELLA MOENCH

- G. maddenii** (C. B. Clarke) Airy Shaw (*Gentiana moorcroftiana* Wall. ex Griseb. var. *maddenii* C. B. Clarke)  
Ladakh (3700 m).
- G. moorcroftiana** (Wall. ex Griseb.) Airy Shaw (*Gentiana moorcroftiana* Wall. ex Griseb.)  
Kashmir to Kumaon (4500 m).
- G. pedunculata** (Royle) H. Sm. (*Gentiana tenella* C. B. Clarke non Fries)  
Kashmir to Kumaon (5100 m).

## HALENIA BORCKH. NOM. CONS.

- H. elliptica** D. Don  
Kulu, Kumaon up to (3300 m).

## JAESCHKEA KURZ

- J. latisepala** C. B. Clarke  
Chamba (3900 m).  
**J. oligosperma** (Griseb.) Knobl. (*J. gentianoides* Kurz)  
Lahul, Chamba, Spiti (4300 m), Kulu.

## LOMATOGONIUM A. BR.

- L. carinthiacum** (Wulff) Reichb. (*Pleurogyne carinthiaca* Griseb.)  
Lahul, Bashahr, Garhwal (4000 m).  
**L. coeruleum** (Royle) H. Sm. (*Swertia coerulea* Royle)  
Simla (Chor, 3600 m).  
**L. spathulata** (A. Kerner) Fernald (*Pleurogyne spathulata* A. Kerner)  
Lahul (4000 m).  
**L. thomsonii** (C. B. Clarke) Fernald (*Pleurogyne thomsonii* C. B. Clarke)  
Spiti (4500 m).

## SWERTIA LINN.

- S. alternifolia** Royle  
Lahul, Kulu, Garhwal (3600 m).  
**S. ciliata** (G. Don) B. L. Burtt [*S. purpurascens* (D. Don) C. B. Clarke]  
Kashmir to Kumaon up to 3600 m.  
**S. cordata** (G. Don) C. B. Clarke  
Kashmir to Kumaon up to 3600 m.  
**S. cuneata** D. Don  
Kangra, Tehri-Garhwal, Garhwal (4500 m), Kumaon.  
**S. petiolata** D. Don  
Kashmir (4500 m), Lahul, Bashahr, Kumaon.  
**S. speciosa** D. Don  
Kashmir, Kangra, Kumaon (3900 m).  
**S. thomsonii** C. B. Clarke  
Kashmir (3600 m).

## POLEMONIACEAE

Some of the most popular garden plants like the phloxes, gillias and Jacob's ladders (*Polemonium* spp.) belong to this family. These are mostly annual or perennial herbs with spirally arranged or opposite, exstipulate

leaves. The flowers are regular and are borne in cymes. The corolla is variously coloured and has a basal tube with the 5 free lobes above. The 5 stamens alternate with the petals and are inserted on the corolla tube. The ovary is superior, 3-celled and develops into a capsular fruit.

In the high temperate and alpine zones of the western Himalaya, only a single species, *Polemonium coeruleum* is frequently seen on grassy slopes or near rock ledges. This is a tall, perennial herb, bearing very pretty bluish flowers. It is a polymorphic species having a wide distribution in the temperate and alpine zones in Asia, Europe and America.

#### POLEMONIUM LINN.

##### **P. coeruleum** Linn.

Kashmir, Tehri-Garhwal, Garhwal, up to 3600 m.

#### BORAGINACEAE

Among the many blue or purple-flowered herbs occurring in the alpine zone, the Boraginaceous herbs occupy a very prominent position. The intense blue colour possessed by the various species of the genera, *Cynoglossum*, *Eritrichium*, *Lindelofia*, *Myosotis* and others are not likely to be missed by the travellers in the area. Though the individual flowers are small, the large number of flowers that are produced on the plant along with their bright colour make these herbs very conspicuous and attractive. The Chandra Valley in Lahul, in particular, abounds in these Boraginaceous herbs. These are mostly hairy perennials with alternate, entire leaves. The flowers are generally borne in dichotomous or scorpioid cymes and the corolla is typically rotate or funnel-shaped, often with scales or hairs at the top of the tube. The ovary is superior, 2-carpelled with the 4 locules separating out in the fruit as nutlets.

On the dry slopes in Lahul and other more western localities, a profusely hairy herb with small blue flowers is often met with which is locally known as 'Rattan jot'. This is *Arnebia benthamii* (*Macrotomia benthamii*). The roots of this plant have a purple coloration. Another profusely hispid herb with yellow flowers is *Onosma hispida*. The forget-me-nots (*Myosotis* spp.) are widely distributed and three species occur in the alpine zone of west Himalaya. The Lindelofias are attractive herbs bearing bright blue flowers in abundance. *Lindelofia longiflora* is the best among them.

A very interesting but extremely rare plant which is mostly Tibetan in distribution but also found in Ladakh is *Microula tibetica*. The plant is an almost stemless herb, very scabrid and with a rosette of spatulate, radical leaves. The dense cymes of small white flowers are found amidst the leaves.

## KEY TO GENERA

1. Receptacle prolonged in the form of a conical or elongated column amidst carpels and at base of style (carpophore)
  2. Apex of nutlets not projecting above the scar (point of attachment) which is continued to apex
    3. Stamens included in corolla tube
      4. Nutlets glochidiate, margins not winged *Cynoglossum*
      4. Nutlets glochidiate but margins conspicuously winged *Mattiastrum*
    3. Stamens exerted
      5. Anthers linear, sagittate; stamens just exceeding corolla tube *Lindelofia*
      5. Anthers ovate; stamens far exerted *Solenanthus*
  2. Apex of nutlets produced above the scar which may be central or basal on the nutlet
    6. Styler base elevated, gibbous or more or less rotund
      7. Fruiting calyx much compressed  
Scabrous rambling herb *Asperugo*
      7. Fruiting calyx not compressed. A stemless, scabrous herb with rosulate spatulate leaves (rare in Ladakh) *Microula*
    6. Styler base pyramidal, hollow
      8. Nutlets prominently glochidiate
        9. Scar central *Hackelia*
        9. Scar basal *Lappula*
      8. Nutlets not prominently glochidiate
        10. Scar central *Anoplocaryum*
        10. Scar basal
          11. Inner face of nutlet keeled
            12. Carpophore columnar, apex blunt *Oreogenia*
            12. Carpophore short, apex conical narrow, long *Eritrichium*
          11. Inner face of nutlet keeled toward apex but grooved at base *Microcaryum*
  1. Receptacle flat; scars of nutlets basal
    13. Corolla lobes minute *Onosma*
    13. Corolla lobes distinct



14. Nutlets ovoid-oblong  
 15. Corolla tube as long or longer than  
 calyx, lobes erect or sub-erect;  
 anthers exsert from tube *Mertensia*
15. Corolla tube very short, lobes  
 spreading, twisted; anthers in-  
 cluded in corolla tube *Myosotis*
14. Nutlets trigonous *Trigonotis*

## LIST OF GENERA AND SPECIES

## ANOPOLOCARYUM LEDEB.

- \*A. **brandisii** Brand  
 Chamba, Lahul, Bashahr, Kumaon (4000 m).

## ARNEBIA FORSK.

- A. **benthamii** (Wall. ex G. Don) I.M. Johnston (*Macrotomia benthamii* DC.)  
 Kashmir to Kumaon up to 3900 m.
- A. **euchroma** (Royle) I.M. Johnston (*Macrotomia perennis* Boiss.)  
 Kashmir, Lahul (4800 m), Spiti, Kumaon.
- A. **guttata** Bunge (*A. tibetana* Kurz)  
 Ladakh (4300 m), Chamba, Lahul.

## ASPERUGO LINN.

- A. **procumbens** Linn.  
 Kashmir, Kumaon (up to 3600 m).

## CYNOGLOSSUM LINN.

- C. **nervosum** Benth. ex C. B. Clarke  
 Chamba, Kulu (up to 3600 m).
- C. **wallichii** G. Don  
 Kashmir, Ladakh (3700 m).

## ERITRICHIMUM SCHRAD.

- E. **nanum** Schrad. subsp. **villosum** (Ledeb.) Brand var. **euvillosum**  
 Brand (*E. basifixum* C. B. Clarke)
- E. **pustulosum** C. B. Clarke  
 Kumaon (5300 m).
- E. **rupestre** (Pall.) Bunge var. **pectinatum** (Pall.) Brand (*E. strictum*  
 Decne.)  
 Ladakh, Lahul (4800 m).
- E. **rupestre** var. **pectinatum** subvar. **spathulatum** (Benth.) Brand (*E.*  
*spathulatum* C. B. Clarke)  
 Kumaon, 4800 m.

## HACKELIA OPIZ.

- \*H. **roylei** (Wall. ex DC.) I. M. Johnston  
Kumaon.
- \*H. **stewartii** I. M. Johnston  
Kashmir (3300 m).
- H. **uncinata** (Benth.) C.E.C. Fischer (*Paracaryum glochidiatum* Benth.)  
Kashmir to Kumaon (3600 m).

## LAPPULA v. WOLF

- L. **barbata** (M. Bieb.) Gurke (*Echinospermum barbatum* Lehm.)  
Lahul, Kumaon (4000 m).

## LINDELOFIA LEHM.

- L. **anchusoides** (Lindl.) Lehm.  
Kashmir, Zanskar (3500 m), Ladakh (4000 m).
- L. **stylosa** (Kar. & Kir.) Brand (*L. benthamii* Hook. f.)  
Kashmir (4000 m).
- \*L. **lahulensis** Brand  
Lahul (4200 m).
- L. **longiflora** (Benth.) Baill. (*L. spectabilis* Lehm.)  
Kashmir to Kumaon up to 3600 m.

## MATTIASTRUM BRAND

- M. **himalayense** (Klotzsch) Brand [*Paracaryum himalayensis* (Klotzsch)  
C. B. Clarke]  
Ladakh (4600 m).
- M. **tibeticum** (C. B. Clarke) Brand (*Paracaryum tibeticum* C. B. Clarke)  
Ladakh (4000 m).

## MERTENSIA ROTH NOM. CONS.

- M. **echioides** (Benth.) C. B. Clarke  
Kashmir, Lahul (3600 m).
- M. **primuloides** (Decne.) C. B. Clarke  
Kashmir (3700 m).
- M. **racemosa** (Royle) C. B. Clarke  
Kulu, Kumaon (4000 m).

## MICROCARYUM I. M. JOHNSTON

- \*M. **diffusum** Brand  
Garhwal, Kumaon (5000 m).
- \*M. **duthieanum** Brand  
Tehri-Garhwal (5000 m).

- Microcaryum pygmaeum** (C. B. Clarke) I. M. Johnston (*Eritrichium pygmaeum* C. B. Clarke)  
Tehri-Garhwal.

## MICROULA BENTH.

- M. tibetica** Maxim. (*M. benthamii* C. B. Clarke)  
Ladakh, Kumaon (4800 m).

## MYOSOTIS LINN.

- M. arvensis** Hoffm.  
Kashmir (3600 m).  
**M. caespitosa** Schultz  
Kashmir, Kumaon (3300 m).  
**M. silvatica** Hoffm.  
Kashmir to Kumaon (3900 m).

## ONOSMA LINN.

- O. bracteatum** Wall.  
Kashmir to Kumaon (4500 m).  
**O. emodi** Wall.  
Tehri-Garhwal, Garhwal (4000 m), Kumaon.  
**O. hispida** Wall. ex D. Don (*O. echioides* C. B. Clarke non Linn.)  
Kashmir, Lahul, Bashahr (3600 m).

## OREGENIA I. M. JOHNSTON

- O. munroi** (C. B. Clarke) I. M. Johnston (*Eritrichium munroi* C. B. Clarke)  
Kinnaur, Tehri-Garhwal (5000 m), Kumaon.

## SOLENANTHUS LEDEB.

- S. circinnatus** Ledeb.  
Zanskar, Chamba.

## TRIGONOTIS STEV.

- T. rotundifolia** (DC.) C. B. Clarke  
Kumaon (3300 m).

## CONVOLVULACEAE

The genus of parasitic twiners, *Cuscuta*, commonly known as the dodder, is the only one of this family to occur in the subalpine zone of our area. The parasite twines around and its suckers penetrate the host. The twining stem may be white or yellowish in colour and the small flowers are crowded in short axillary spikes or heads. The bell-shaped corolla has small scales at its base. The fruit is a fragile capsule, often breaking irregularly or sometimes exhibiting a circumcissile dehiscence.

## CUSCUTA LINN.

- C. capitata** Roxb.  
Kashmir to Bashahr up to 3600 m.
- C. europea** Linn var. **indica** Engelm.  
Kashmir to Kumaon up to 3600 m.

## SOLANACEAE

This economically important family which includes such well known plants like the tobacco, tomato, brinjal, capsicum, henbane, belladonna and some garden favourites like the petunias and cestrums is, however, poorly represented at high altitudes. Only the henbane (*Hyoscyamus niger*) and belladonna (*Atropa acuminata*) reach the sub-alpine zone but a third species, *Physochlaina praealta* is found in the alpine zone up to an altitude of 4500 m. The last named plant is particularly common in Kashmir and Lahul where it is seen on dry slopes. This nearly glabrous herb has long-petioled leaves and bears its lurid-yellow flowers in terminal corymbs. The plant is reputed to possess important medicinal properties.

## KEY TO GENERA

- |  |                     |
|--|---------------------|
| 1. Fruit, a berry  | <i>Atropa</i>       |
| 1. Fruit, a capsule  |                     |
| 2. Flowers sub-sessile, funnel-shaped, limb broad, oblique; corolla purple-veined, lurid-green | <i>Hyoscyamus</i>   |
| 2. Flowers pedicelled, funnel-shaped, limb narrow; corolla yellowish                           | <i>Physochlaina</i> |

## LIST OF GENERA AND SPECIES

## ATROPA LINN.

- A. acuminata** Royle  
Kashmir (3300 m).

## HYOSCYAMUS LINN.

- H. niger** Linn.  
Kashmir to Garhwal up to 3300 m.

## PHYSOCHLAINA G. DON

- P. praealta** (Walp.) Hook. f.  
Kashmir, Lahul (4000 m).

## SCROPHULARIACEAE

This is one of the most widely distributed and best represented families of the alpine zone in west Himalaya. The alpine meadows, screes,

ledges and moraines abound in numerous herbs of the family among which are species of *Euphrasia*, *Pedicularis*, *Picrorhiza* and *Veronica*. *Pedicularis* is a large genus with more than 600 species distributed in the cold temperate regions of the northern hemisphere. It attains its best development in eastern Himalaya and in southwestern China. A recent monographic study recorded 36 species from the western Himalaya. In spite of its large size, the genus is remarkably well knit in the taxonomic relations of its species, the corolla exhibiting considerable diversity in its form, yet maintaining close relationship through intergrading forms.

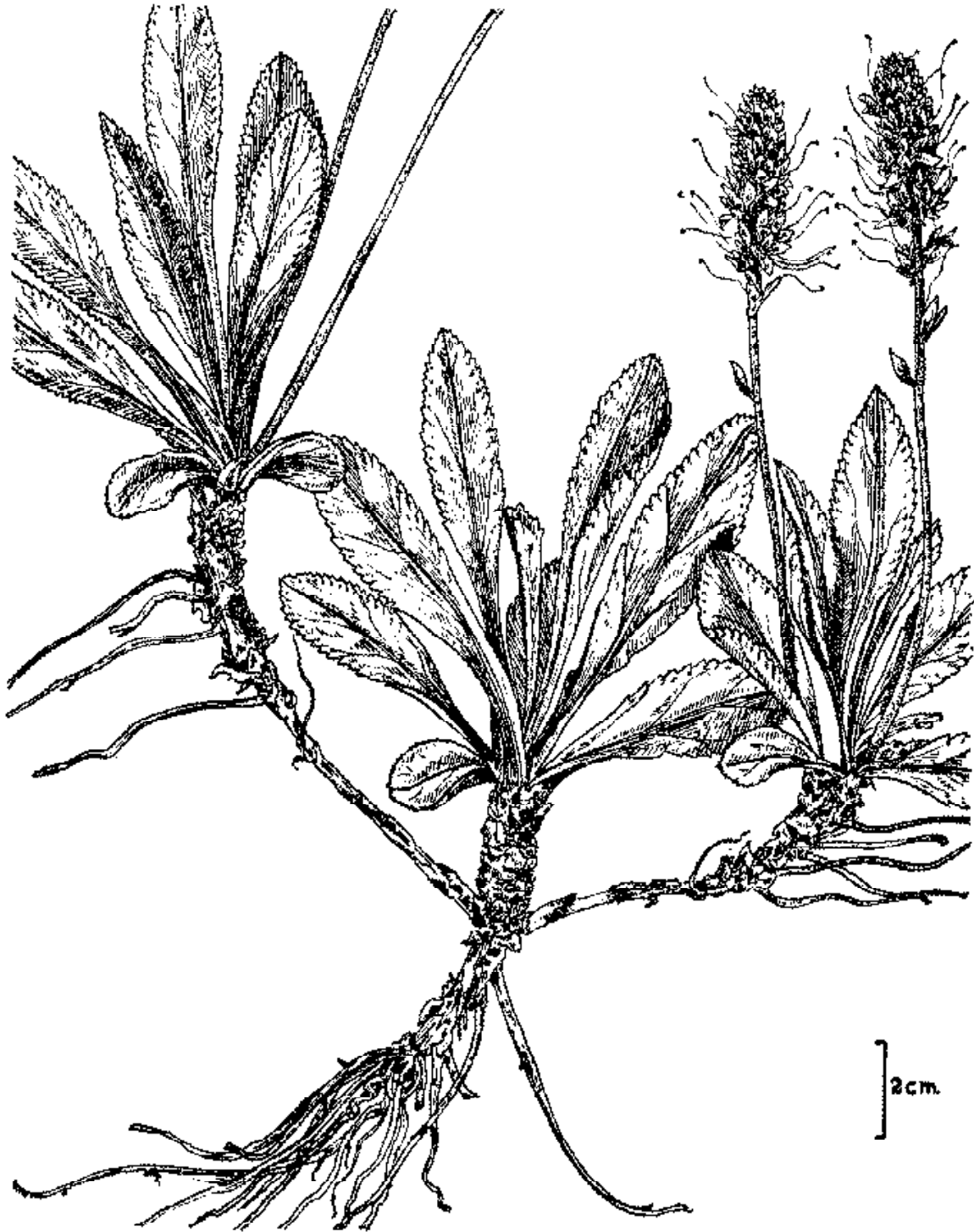
*Pedicularis oederi* with yellow fragrant flowers was collected by Koelz in Rupshu at an altitude of 5800m. A pale, rose-coloured species, *P. heydei*, has been recorded from Ladakh at an altitude of 5200 m. *P. svenhedinii* with white flowers and a purple hood also occurs at this altitude in Ladakh. *P. ophiocephala*, *P. roylei* and *P. nodosa* are known from altitudes above 5000 m. *P. punctata* is a common herb along water margins and is very conspicuous during summer months on account of the great profusion of its bright purple flowers. *P. pyramidata* which is found in Lahul and further west, in meadows and openings in birch forest, has been described as "one of the most stately and beautiful species of the genus".

The species of *Pedicularis* are generally considered to be hemiparasites but specific information in this regard is lacking for the west Himalayan species.

The plant popularly known as 'eyebright' and which enjoyed a big reputation in Europe as a tonic and a cure for eye diseases, *Euphrasia officinalis*, was included by Hooker in his Flora of British India as Himalayan in distribution. It is now known that the plants occurring in the west Himalaya are different from the typical European species. Nearly 20 species have now been described from the area though some of these are based on just single collection. The Euphrasias are particularly common in Kashmir, Ladakh, Lahul and Chamba and very few species extend eastward to Garhwal and Kumaon. The most widely distributed species are *Euphrasia himalayica* and *E. schlahintweitii*.

*Picrorhiza kurroa* is a well known plant of the region which is particularly valued for its medicinal properties. 'Karui', as it is locally known, is a panacea for a wide variety of ailments and is widely used by the hill people. This has long been considered to be a monotypic genus exclusively Himalayan in distribution but Pennell, who has monographed the Himalayan Scrophulariaceae, is of the opinion that the plants occurring in the eastern region in Sikkim form a separate species on account of their longer corolla and shorter stamens. *P. kurroa* is a rhizomatous herb which bears a profusion of flowers, lilac in colour and with protruding anthers.

A plant with a peculiar dimorphism of its leaves, *Hemiphragma*



*Picrorhiza kurroa* Royle ex Benth.

*heterophyllum* is the only species of the genus, *Hemiphragma*. It occurs throughout the Himalayan range extending into the mountains of Yunnan. The leaves are of two kinds, one with broad lamina and the other, very narrow and needle-like. The plant bears attractive, red, spherical fruits. The relationships of the plant are obscure. Another interesting plant of the family is *Lancea tibetica* which has deep purple flowers. It occurs in and around boggy places at high altitudes.

The genus, *Scrophularia*, is also represented by a few species in the sub-alpine zone. The plants are conspicuous on account of their green, velvety flowers.

An aquatic member of the family, *Limosella aquatica* occurs in Kashmir and Lahul. It is a widely distributed species being found all over the northern temperate regions.

#### KEY TO GENERA

- |  |                     |
|--|---------------------|
| 1. Stamens 5. Densely hairy herbs with stout yellow-flowered cylindrical spikes                    | <i>Verbascum</i>    |
| 1. Stamens 4 or 2  |                     |
| 2. Flowers with tubular or rotate corolla, lobes 5, equal or sub-equal, not distinctly 2-lipped    |                     |
| 3. Corolla greenish or brown; flowers in thyrsoid cymes or panicles. Tall, erect or rambling herbs | <i>Scrophularia</i> |
| 3. Corolla white, pink or purple; flowers solitary or in axillary racemes                          |                     |
| 4. Stamens 4   |                     |
| 5. Leaves dimorphic  | <i>Hemiphragma</i>  |
| 5. Leaves uniform. Aquatic or marsh herbs  | <i>Limosella</i>    |
| 4. Stamens 2   | <i>Veronica</i>     |
| 2. Flowers with a distinct 2-lipped corolla  |                     |
| 6. Herbs rosulate; flowers almost sessile amidst leaves  | <i>Lancea</i>       |
| 6. Herbs not rosulate; flowers in spikes or racemes  |                     |
| 7. Flowers dimorphic   | <i>Picrorhiza</i>   |
| 7. Flowers uniform   |                     |
| 8. Corolla white or lilac, purple-veined; flowers in spikes  | <i>Euphrasia</i>    |
| 8. Corolla yellow or purple or sometimes pink; flowers in racemes                                  | <i>Pedicularis</i>  |

## LIST OF GENERA AND SPECIES

## EUPHRASIA LINN.

- \*E. **himalayica** Wettst.  
Bashahr to Kumaon (4000 m).
- \*E. **jaeschkei** Wettst.  
Kashmir, Chamba, Lahul (3300 m).
- \*E. **kashmirana** Pugsley  
Ladakh (4000 m).
- \*E. **paucifolia** Wettst.  
Kashmir, Spiti (4000 m).
- \*E. **platyphylla** Pennell  
Kashmir (3400 m), Lahul.
- \*E. **schlagintweitii** Wettst.  
Kashmir, Garhwal (3300 m).

## HEMIPHRYGMA WALL.

- H. **heterophyllum** Wall.  
Garhwal (3600 m).

## LANCEA HOOK. F. &amp; THOMS.

- L. **tibetica** Hook. f. & Thoms.  
Rupshu, Kumaon (5700 m).

## LIMOSELLA LINN.

- L. **aquatica** Linn.  
Ladakh, Lahul, Spiti (4000 m).

## PEDICULARIS LINN.

- \*P. **albida** Pennell  
Ladakh, Spiti (3700 m).
- P. **bicornuta** Klotzsch ex Klotzsch & Garcke  
Lahul, Tehri-Garhwal (4000 m).
- P. **brevifolia** D. Don  
Kashmir to Kumaon up to 4500 m.
- \*P. **brunoniana** Wall. ex Pennell  
Bashahr, Kumaon (4000 m).
- \*P. **brunoniana** subsp. **ctenodonta** Pennell  
Chamba (4900 m).
- \*P. **heydei** Prain  
Ladakh (5300 m), Bashahr.
- P. **hoffmeisteri** Klotzsch  
Chamba, Bashahr, Garhwal, Kumaon up to 3700 m.



- Pedicularis hookeriana** Wall. ex Benth.  
Tehri-Garhwal, Kumaon (4000 m).
- \***P. kashmirana** Pennell  
Kashmir (3500 m).
- P. longiflora** Rudolph var. **tubiformis** (Klotzsch) Pennell (*P. tubiflora*:  
Fisch.)  
Rupshu (4200 m), Spiti, Kumaon.
- P. macrantha** Klotzsch  
Garhwal, Kumaon up to 4500 m.
- P. mollis** Wall. ex Benth.  
Bashahr to Kumaon (4000 m).
- \***P. nodosa** Pennell  
Kumaon (5000 m).
- P. oederi** Vahl (*P. versicolor* Wahlb.)  
Rupshu (5700 m), Lahul, Tehri-Garhwal.
- \***P. oederi** var. **heteroglossa** Prain  
Tehri-Garhwal, Kumaon (4300 m)
- \***P. ophiocephala** Maxim.  
Kumaon (4800 m).
- P. pectinata** Wall. ex Benth.  
Lahul (4500 m), Kumaon.
- \***P. pectinata** Wall. subsp. **bipinnatifida** Pennell  
Kashmir, Lahul (4000 m).
- P. porrecta** Wall. ex Benth.  
Chamba to Kumaon up to 4300 m.
- P. punctata** Decne.  
Kashmir to Kumaon up to 4500 m.
- \***P. purpurea** Pennell  
Kashmir, Lahul (4600 m).
- \***P. pycnantha** Boiss. subsp. **cuspidata** Pennell  
Lahul, Bashahr (4000 m).
- P. pyramidata** Royle ex Benth.  
Kashmir, Lahul (3600 m).
- P. rhinanthoides** Schr. ex Fisch. & Mey.  
Zaskar, Lahul (3600 m).
- \***P. rhinanthoides** subsp. **speciosa** Pennell  
Ladakh (4500 m), Rupshu, Spiti.
- \***P. rhinanthoides** subsp. **labellata** (Jacq.) Prain  
Kashmir, Lahul (4500 m), Spiti.
- P. roylei** Maxim.  
Kashmir to Kumaon up to 4500 m.
- \***P. stewartii** Pennell  
Chamba (3600 m).

**\*Pedicularis svenhedinii** Pauls.

Ladakh (5400 m), Chamba, Bashahr.

**P. tenuirostris** Benth.

Kashmir, Chamba, Bashahr, Tehri-Garhwal.

**P. trichoglossa** Hook. f.

Kumaon (4500 m).

## PICRORHIZA ROYLE EX BENTH.

**P. kurrooa** Royle ex Benth.

Kashmir to Kumaon up to 4300 m.

## SCROPHULARIA LINN.

**S. calycina** Benth.

Kashmir, Kulu (4000 m) to Kumaon.

**S. decomposita** Royle ex Benth.

Kashmir, Chamba, Kulu, Kumaon.

**S. dentata** Royle ex Benth.

Zaskar, Rupshu, Lahul (4800 m), Spiti.

**S. edgeworthii** Benth.

Garhwal, Kumaon (3400 m).

**S. himalayensis** Royle ex Benth.

Chamba to Kumaon up to 4000 m.

**\*S. koelzii** Pennell

Ladakh, Lahul, Spiti, Chamba, Bashahr up to 5000 m

**S. scabiasaefolia** Benth.

Kashmir, Ladakh, Lahul (3600 m).

## VERBASCUM LINN.

**V. thapsus** Linn.

Lahul, Chamba, Kumaon up to 4000 m.

## VERONICA LINN.

**V. beccabunga** Linn.

Kashmir, Ladakh, Bashahr (3500 m).

**V. biloba** Linn.

Kashmir to Kumaon up to 4500 m.

**V. cachemirica** Gaud.

Kashmir (3300 m).

**V. capitata** Royle ex Benth.

Bashahr to Kumaon (4400 m).

**\*V. cephaloides** Pennell

Kumaon (5700 m).

**\*V. hirta** Pennell

Kashmir, Chamba, Kulu (4000 m).

- \**Veronica koelzii* Pennell  
Ladakh (4500 m), Rupshu.
- V. *lanosa* Royle ex Benth.  
Kashmir, Lahul, Bashahr, Garhwal up to 3700 m.
- \*V. *lasiocarpa* Pennell  
Kashmir (4000 m), Chamba, Lahul, Kumaon.
- V. *macrostemon* Bunge ex Ledeb.  
Ladakh (4800 m).
- \*V. *nana* pennell  
Rupshu (4500 m).
- V. *perpusilla* Boiss.  
Kashmir, Lahul (3600 m).
- \*V. *secunda* Pennell  
Bashahr (3600 m).
- \*V. *serpyllifolia* Linn. subsp. *humifusa* (Dicks.) Vahl  
Kashmir, Chamba, Kumaon up to 4000 m.
- \*V. *umbelliformis* Pennell  
Kumaon (4100 m).
- \*V. *uncinata* Pennell  
Ladakh (4300 m).

#### SELAGINACEAE

A small family of herbs and undershrubs, often included under the Scrophulariaceae, it has a predominantly African distribution but one of its genera, *Lagotis*, is a characteristic mountain plant of North and Central Asia. In the alpine zone of west Himalaya, 3 species are recognized which are all rhizomatous, fleshy herbs bearing a close-set spike of white or violet-blue flowers. The calyx is spathaceous and the corolla tube, 2-lipped and curved. There are only 2 stamens and the ovary is 2-carpelled with a single ovule in each cell. *Lagotis cashmeriana* is a very prominent herb on the grassy slopes along the Rohtang Pass during the early summer months. *L. globosa* has been described as possessing fragrant flowers.

#### LIST OF SPECIES

##### LAGOTIS GAERTN.

- L. *cashmeriana* (Royle) Rupr.  
Kashmir, Chamba (Sach Pass), Kulu (Rohtang Pass, 4000 m).
- L. *globosa* (Kurz) Hook. f.  
Kashmir, Ladakh (4500 m).
- L. *kunnawarensis* (Royle) Rupr.  
Bashahr (4000 m).



*Lagotis cashmeriana* (Royle) Rupr.

1. Habit.      2. A flower with lips.      3. A stamen.      4. Fruit.

## OROBANCHACEAE

The members of this family are parasitic herbs, attached to the roots of their hosts through suckers. The genus, *Orobanche*, is represented in the high temperate and sub-alpine regions of west Himalaya by a few species of which *O. epithymum* is the one most frequently seen. This parasite generally attacks *Thymus serpyllum* though it may occasionally parasitize some species of *Artemisia*. The parasite has an erect stem that is brownish or purplish in colour with the leaves reduced to scales. The flowers are crowded in the axils of the scales and are purplish in colour. The corolla is tubular, somewhat curved with an oblique or 2-lipped mouth. There are 4 stamens and a superior 1-loculed ovary with numerous ovules.

## KEY TO GENERA

- |                                 |                    |
|---------------------------------|--------------------|
| 1. Upper lip of corolla 2-lobed | <i>Orobanche</i>   |
| 1. Upper lip of corolla entire  | <i>Boschniakia</i> |

## LIST OF GENERA AND SPECIES

## BOSCHNIAKIA C.A. MEY.

- B. himalaica** Hook. f. & Thoms.  
Gathwal (3300 m).

## OROBANCHE LINN.

- O. cernua** Loeffl.  
Kashmir to Kumaon up to 3300 m.
- O. epithymum** DC.  
Kashmir to Kumaon (3600 m).
- O. hansii** Kerner  
Lahul (3600 m).
- O. kashmirica** C. B. Clarke ex Hook. f.  
Kashmir (3300 m).
- O. solmsii** C. B. Clarke ex Hook. f. & Thoms.  
Kashmir, Kistwar, Kumaon (up to 3300 m).

## LENTIBULARIACEAE

The bladderworts (*Utricularia* spp.) and the butterworts (*Pinguicula* spp.) form an interesting group of plants. These plants are generally restricted to aquatic or moist habitats and exhibit peculiar adaptation in relation to their insectivorous habit. In *Pinguicula*, there is a rosette of basal leaves. These leaves are covered with glands which secrete a sticky fluid to which small insects adhere. *Pinguicula alpina* met with in the alpine meadows and marshes in Kumaon and Gathwal bears an erect, leafless scape with a solitary white or yellowish flower. The corolla is spurred and 2-lipped.

The genus, *Utricularia*, is of worldwide distribution and has a large number of species most of which are, however, found in aquatic situations at lower altitudes. In the west Himalaya only one species, *U. minor*, has been recorded from the alpine zone. The bladderworts possess minute floating bladders which function as traps for small insects.

## KEY TO GENERA

- |   |                    |
|---|--------------------|
| 1. Leaves all radical, forming a rosette; flower<br>solitary, white, yellow-spotted | <i>Pinguicula</i>  |
| 1. Leaves on stem; flowers 2-8 on scape, yellow                                     | <i>Utricularia</i> |

## LIST OF GENERA AND SPECIES

## PINGUICULA LINN.

- P. alpina** Linn.  
Garhwal, Kumaon (3800m).

## UTRICULARIA LINN.

- U. minor** Linn.  
Ladakh (3300 m).

## LABIATAE (nom.altern. LAMIACEAE)

The mint family has several members in the alpine zone. The plants are mostly herbs with 4-angled stems and opposite, simple leaves. The flowers are borne in cymes which are often condensed in whorls, these whorls occurring in spikes or heads. The calyx and corolla are usually 2-lipped with the 4 stamens in 2 pairs or sometimes reduced to only 2. The fruit is a group of 4 nutlets with the style arising from their midst (gynobasic).

*Nepeta* is a widely distributed genus and at high altitudes more than 20 species are seen in the area. *N. spicata* is an erect herb, up to a metre high in some places. It bears pale blue flowers in closely set spikes. *N. longibracteata*, *N. floccosa*, *N. salviaefolia*, *N. nivalis* and *N. tibetica* have all been recorded from altitudes above 5000 m in Lahul and Ladakh. *N. tibetica* has pale lavender flowers with an elongated yellow mark, margined with purple dots in the upper throat. This species was collected by Koelz near a watered slope in Ladakh at an altitude of 5400 m. *N. longibracteata*, is a small, very pretty herb with silky hairs and beautiful light blue flowers. *N. govaniiana* has yellow flowers.

Some of the most attractive members of the family are the tall, stately *Phlomis* species. These are hairy herbs with large whorls of blue-purple flowers. The mints (*Mentha* spp.), thyme (*Thymus serpyllum*) and the wild marjoram (*Origanum vulgare*) also occur in the alpine zone of west Himalaya.

## KEY TO GENERA

- |  |                      |
|--|----------------------|
| 1. Stamens 2   | <i>Salvia</i>        |
| 1. Stamens 4   |                      |
| 2. Corolla lobes flat, equal or obscurely 2-lipped   |                      |
| 3. Flowers uniform   | <i>Mentha</i>        |
| 3. Flowers dimorphic   |                      |
| 4. Bracts large; whorls corymbose  | <i>Origanum</i>      |
| 4. Bracts small; whorls capitate   | <i>Thymus</i>        |
| 2. Corolla distinctly 2-lipped   |                      |
| 5. Calyx tubular, 5-toothed  |                      |
| 6. Corolla minute, flowers in dense, cylindrical, terminal spikes  |                      |
| 7. Spikes densely woolly; flowers imbedded in wool; bracts linear or bristly                                 | <i>Marrubium</i>     |
| 7. Spikes villous; bracts rounded, ovate or broad, often imbricating all round the spike                     | <i>Elsholtzia</i>    |
| 6. Corolla conspicuous; flowers in simple spikes, terminal or axillary or spikes panicled or whorls capitate |                      |
| 8. Calyx 15-ribbed   | <i>Nepeta</i>        |
| 8. Calyx 5-10 nerved   |                      |
| 9. Anthers hairy. Woolly dwarf herbs   | <i>Lamium</i>        |
| 9. Anthers not hairy. Erect, branched or simple-stemmed, glabrous or pubescent, tall herbs                   |                      |
| 10. Whorls 1-2-fid, all axillary; corolla pink   | <i>Stachys</i>       |
| 10. Whorls many-fid, axillary; corolla bluepurple  | <i>Phlomis</i>       |
| 5. Calyx 2-lipped  |                      |
| 11. Corolla tube straight  |                      |
| 12. Calyx 13-nerved; flowers purple  | <i>Clinopodium</i>   |
| 12. Calyx 15-nerved; flowers white, blue or purple   | <i>Dracocephalum</i> |
| 11. Corolla tube sharply recurved; flowers yellow, tipped with rose  | <i>Scutellaria</i>   |

## LIST OF GENERA AND SPECIES

## CLINOPODIUM LINN.

- C. *umbrosum* (M. Bieb.) Koch (*Calamintha umbrosa* Benth.)  
Kashmir to Kumaon up to 3600 m.

- Clinopodium vulgare** Linn. (*Calamintha clinopodium* Benth.)  
Kashmir to Kumaon up to 3600 m.

## DRACOCEPHALUM LINN. NOM. CONS.

- D. heterophyllum** Benth.  
Rupshu (5100 m), Lahul (4500 m).  
**D. nutans** Linn.  
Kashmir (4000 m).  
**D. speciosum** Benth.  
Kulu, Tehri-Garhwal (4000 m).  
**D. stamineum** Kar. & Kir.  
Kashmir (3300 m).

## ELSHOLTZIA WILLD.

- E. densa** Benth.  
Kashmir to Kumaon (3900 m).  
**E. eriostachya** Benth. (also var. *pusilla* Hook. f.)  
Tehri-Garhwal (4300 m), Kumaon.  
**E. strobilifera** Benth.  
Kashmir to Kumaon up to 4200 m.

## LAMIUM LINN.

- L. rhomboideum** Benth.  
Kashmir, Kinnaur, Kumaon (3900 m).

## MARRUBIUM LINN.

- M. lanatum** Benth.  
Garhwal (4800 m).

## MENTHA LINN.

- M. longifolia** (Linn.) Huds. (*M. sylvestris* Linn. <sup>Δ</sup>)  
Kashmir, Spiti (3700 m), Garhwal.

## NEPETA LINN.

- N. clarkei** Hook. f.  
Kashmir (3300 m).  
**N. coerulescens** Maxim.  
Rupshu (4500 m).  
**N. connata** Royle ex Benth.  
Kashmir (4000 m).  
**N. discolor** Royle ex Benth.  
Kashmir, Lahul (4500 m).  
**\*N. duthlei** Prain & Mukherjee <sup>Δ</sup>, Spiti, Garhwal.  
Tehri-Garhwal, Kumaon (3600 m).



- Nepeta eriostachya** Benth.  
Spiti, Kulu (4000 m), Garhwal.
- N. floccosa** Benth.  
Rupshu (4800 m), Lahul, Spiti.
- N. glutinosa** Benth.  
Kashmir, Lahul (3900 m).
- N. govaniana** Benth.  
Kashmir to Kumaon (up to 3300 m).
- N. laevigata** (D. Don) Hand.-Mazz. (*N. spicata* Benth.)  
Kashmir to Kumaon up to 3600 m.
- N. leucolaena** Benth. ex Hook. f.  
Zanskar, Ladakh (3800 m).
- N. linearis** Royle ex Benth.  
Kashmir, Lahul (3600 m), Bashahr.
- N. longibracteata** Benth.  
Ladakh (5300 m), Lahul (4800 m).
- N. nivalis** Benth.  
Lahul, Kumaon (4500 m).
- N. raphanorrhiza** Benth.  
Kashmir to Chamba up to 3600 m.
- N. st. viviaefolia** Royle ex Benth.  
Ladakh (4800 m), Kashmir.
- N. supina** Stev. (= *N. kokanica* Regel)  
Kashmir to Garhwal (4500 m).
- N. tibetica** Benth.  
Ladakh (4400 m), Spiti.

## ORIGANUM LINN.

- O. vulgare** Linn.  
Kashmir to Kumaon (up to 3600 m).

## PHLOMIS LINN.

- P. bracteosa** Royle ex Benth.  
Kashmir to Kumaon up to 3600 m.
- P. setigera** Falc. ex Benth.  
Kashmir to Kumaon up to 3600 m.

## SALVIA LINN.

- S. campanulata** Wall. ex Benth.  
Kumaon (3900 m).
- S. hians** Royle ex Hook.  
Kashmir, Chamba (4000 m).

## SCUTELLARIA LINN.

- S. **heydel** Hook. f.  
Zaskar (4500 m).  
S. **prostrata** Jacq. ex Benth.  
Kashmir to Kumaon up to 4000 m.

## STACHYS LINN.

- S. **tibetica** Vatke  
Kashmir (4000 m).

## THYMUS LINN.

- T. **serpyllum** Linn. subsp. **quinquecostatus** (Celak) Kitamura (*T. serpyllum* Hook. f. non Linn.)  
Kashmir to Kumaon up to 4000 m.

## PLANTAGINACEAE

In the Indian Pharmacopoeia, 'Ispaghula' consisting of the dried seeds of *Plantago ovata* and other species of the genus, *Plantago*, have been listed as a beneficial drug in the treatment of chronic dysenteries, diarrhoeas and other ailments of the gastro-intestinal tract. The Plantagos, popularly known as the plantains, are widely distributed in the plains and hills of our country and some species occur also in the alpine zone. Among these are *Plantago major*, *P. tibetica* and *P. brachyphylla*. These are scapigerous herbs with radical leaves forming a rosette, closely pressed to the ground, from whose midst arises a long slender spike of closely set flowers. The flowers are small, tetramerous, the 4 stamens inserted on the salver-shaped corolla tube. The ovary is superior with few ovules and develops into a 1 to 4-celled capsule.

## LIST OF SPECIES

## PLANTAGO LINN.

- P. **brachyphylla** Edgew.  
Kashmir to Kumaon up to 3900 m.  
P. **major** Linn.  
Throughout up to 3600 m.  
P. **tibetica** Hook. f. & Thoms.  
Kashmir (3300 m).

## CHENOPODIACEAE

This family includes a remarkable assemblage of herbs and shrubs, most of which exhibit a marked preference for soils rich in salts (*Halo-*

phytes). As a consequence, several peculiar adaptations are seen in the vegetative parts of these plants. The roots are usually deep seated and the leaves and stems often become fleshy. In some, the leaves are not developed at all. The geographical distribution of the members of this family is also interesting and one of the chief centres of distribution is the cold desert region of Central Asia, where certain genera like, *Haloxylon*, *Salsola* and others attain their best development. In the cold, arid regions of northwest Himalaya, some of these plants are met with, particularly, in and around the salt marshes and lakes.

#### KEY TO GENERA

- |  |                       |
|--|-----------------------|
| 1. Flowers all 2-sexual                                      |                       |
| 2. Leaves, flat not terete, variously lobed or cut or entire | <i>Chenopodium</i>    |
| 2. Leaves fleshy, terete                                     |                       |
| 3. The leaves not ending in pungent tip                      |                       |
| 4. Stem jointed  | <i>Haloxylon</i>      |
| 4. Stem not jointed  | <i>Suaeda</i>         |
| 3. The leaves ending in pungent tip                          | <i>Salsola</i>        |
| 1. Flowers 1-sexual or polygamous                            |                       |
| 5. Leaves narrow, entire                                     | <i>Kochia</i>         |
| 5. Leaves not as above                                       |                       |
| 6. Flowers dimorphic   |                       |
| 7. Fruiting bracts without hairs                             | <i>Atriplex</i>       |
| 7. Fruiting bracts with long silky, brown hairs              | <i>Eurotia</i>        |
| 6. Flowers all alike   |                       |
| 8. Female flowers with perianth                              | <i>Axyris</i>         |
| 8. Female flowers without perianth                           | <i>Microgynoecium</i> |

#### LIST OF GENERA AND SPECIES

##### ATRIPLEX LINN.

- A. *crassifolia* C. A. Mey.  
Ladakh (4800 m), Lahul, Spiti.

##### AXYRIS LINN.

- A. *amaranthoides* Linn.  
Lahul, Kumaon (4000 m).

##### CHENOPODIUM LINN.

- C. *album* Linn.  
Kashmir to Kumaon up to 3600 m.  
C. *botrys* Linn.  
Lahul, Garhwal (3300 m).

- Chenopodium foliosum** (Moench) Asch. (*C. blitum* Hook. f.)  
Kashmir, Lahul (4800 m), Kumaon.
- C. glaucum** Linn.  
Ladakh, Lahul (4500 m).
- C. hybridum** Linn.  
Ladakh (3600 m).

## EUROTIA ADANS.

- E. ceratoides** C. A. Mey.  
Zanskar (5100 m), Ladakh, Rupshu (5700 m), Spiti, Lahul, Garhwal.

## HALOXYLON BUNGE

- H. thomsonii** Bunge  
Ladakh (3300 m).

## KOCHIA ROTH.

- K. odontophora** Schrenk  
Ladakh, Lahul (4500 m).
- K. prostrata** (Linn.) Schrad  
Kashmir (3300 m).

## MICROGYNEOCIUM HOOK. F.

- M. tibeticum** Hook. f.  
Kumaon (4300 m).

## SALSOLA LINN.

- S. collina** C. A. Mey.  
Ladakh (3300 m).

## SUAEDA FORSK. EX SCOP. NOM. CONS.

- S. corniculata** (C. A. Mey.) Hook. f.  
Ladakh (4500 m).
- S. microsperma** Ledeb.  
Rupshu (4500 m), Lahul (4500 m).

## POLYGONACEAE

The buck-wheat (*Fagopyrum*), rhubarbs (*Rheum* spp.), sorrels (*Rumex* spp.) and the knotgrasses (*Polygonum* spp.) belong to this family whose members are all characterised by the possession of sheathing stipules or 'ochrea' around the stem above the base of the leaf-stalk. The flowers are borne in spikes or panicles and the floral parts are generally in threes. In some members, there may be only one whorl of perianth or 5 lobes and 5 to 8 stamens (*Polygonum*). Many of the Polygonaceae are wind pollinated and the fruits are often winged and distributed by wind.

*Polygonum* is a large genus with many species in the high temperate and alpine zones. Some of the shrubby members are conspicuous by their large panicles of pink or white flowers (e.g. *Polygonum vacciniifolium*). Smythe writing about *P. affine*, another conspicuous member on rocks in the alpine zone, says "it colours the hillsides in millions upon millions of rose blooms and the glow of it may be seen a mile away, lighting the slopes". In *P. viviparum*, which has been found at altitudes as high as 5400 m, many of the flowers are replaced by bulbils in the lower part of the inflorescence. *P. polystachyum* is another tall herb which is frequently seen in heavily grazed ground.

The Himalayan rhubarbs are all large herbs and are seen on rock ledges or in high alpine grasslands. They are conspicuous on account of their large leaves, some of which turn reddish in late autumn. The leafy stems of these are edible.

*Oxyria digyna* is another herb of the family which is characteristic component of the flora of the alpine and arctic regions of the northern hemisphere. In this plant, the flowers are dimerous with the outer stamens branched. The leaves are prominently cordate-based and obtuse.

#### KEY TO GENERA

- |   |                  |
|---|------------------|
| 1. Flowers unisexual  | <i>Rumex</i>     |
| 1. Flowers bisexual   |                  |
| 2. Nuts without wings   | <i>Polygonum</i> |
| 2. Nuts with wings  |                  |
| 3. Herbs with mostly orbicular-cordate radical leaves; sepals 4, 2 outer reflexed, 2 inner larger; nut 2-winged | <i>Oxyria</i>    |
| 3. Herbs with large leaves; sepals 5, uniform; nuts usually 3-winged  | <i>Rheum</i>     |

#### LIST OF GENERA AND SPECIES

##### OXYRIA HILL

- O. digyna** Hill  
Kashmir to Kumaon up to 4200 m.

##### POLYGONUM LINN.

- P. affine** D. Don  
Kashmir to Kumaon (4500 m).  
**P. alpinum** All.  
Kashmir to Kulu (3600 m).  
**P. amplexicaule** D. Don  
Kashmir, Chamba, Kulu (4000 m).

**Polygonum aviculare** Linn.

Kashmir to Kumaon (3600 m).

- P. cognatum** Meissn.  
Zaskar, Lahul (4800 m), Spiti, Garhwal.
- P. delicatulum** Meissn.  
Kashmir to Kumaon up to 3900 m.
- P. filicaule** Wall. ex Meissn.  
Kashmir to Kumaon (4500 m).
- P. glaciale** Hook. f.  
Kashmir to Kumaon (4000 m).
- P. islandicum** (Linn.) Hook. f.  
Ladakh (4400 m), Lahul, Kumaon.
- P. macrophyllum** D. Don (*P. sphaerostachyum* Meissn.)  
Tehri-Garhwal, Garhwal (3900 m).
- P. molliaeforme** Boiss.  
Lahul (4500 m).
- P. nummularifolium** Meissn.  
Kashmir to Kumaon (4500 m).
- P. paronychioides** C. A. Mey.  
Zaskar, Lahul, Kinnaur (3900 m).
- P. perpusillum** Hook. f.  
Kulu (4000 m), Garhwal, Kumaon (4000 m).
- P. persicaria** Linn.  
Kashmir (3600 m).
- P. plebejum** R. Br.  
Throughout (4000 m in Spiti).
- P. polycnemoides** Jaub. & Spach  
Ladakh (4800 m).
- P. polystachyum** Meissn.  
Tehri-Garhwal (3600 m).
- P. rumicifolium** Royle ex Bab.  
Kashmir to Kumaon (4500 m).
- P. sibiricum** Laxm.  
Kulu (4000 m), Kangra.
- P. tortuosum** D. Don  
Rupshu (5100 m), Lahul, Tehri-Garhwal, Kumaon (4500 m).
- P. tubulosum** Boiss.  
Kashmir, Milam (3600 m), Niti.
- P. vaccinifolium** Wall. ex Meissn.  
Kashmir to Kumaon up to 4300 m.
- P. viviparum** Linn.  
Kashmir, Ladakh (4900 m), Rupshu, Kulu Garhwal, Kumaon (5700 m).

## RHEUM LINN.

- R. emodi** Wall. ex Meissn.  
Kashmir to Kumaon up to 3600 m.
- R. spiciforme** Royle  
Kumaon (4800 m).
- R. tibeticum** Maxim. ex Hook. f.  
Zaskar, Kashmir (3600 m).
- R. webbianum** Royle  
Kashmir to Kumaon (4000 m).

## RUMEX LINN.

- R. acetosa** Linn.  
Kashmir to Kumaon (3600 m).

## ELAEAGNACEAE

A family of shrubs and small trees, the Elaeagnaceae is distinguished by the presence of abundant scales on the aerial parts of its members. *Hippophae rhamnoides* is a small thorny tree found usually along stream banks. At high altitudes it forms a stunted shrub and is often not more than 15 cm high. This is a dioecious plant whose rigid branches and leaves are covered by shining scales. The male flowers are minute and the fruits when ripe are orange coloured, globose in shape, about 0.5 cm in diameter and very acidic to taste.

## HIPPOPHAE LINN.

- H. rhamnoides** Linn. subsp. *turkestanica* Roussi  
Lahul (4500 m), Spiti, Kumaon.
- H. tibetana** Schlect.  
Garhwal, Kumaon (4200 m).

## LORANTHACEAE

The mistletoes and loranthi are well known parasitic plants, which, though possessing green leaves, attach themselves to their hosts by suckers or haustoria. An extreme reduction of the plant body is seen in the genus, *Arceuthobium*, where the leaves are reduced to scales and the unisexual flowers are adressed to them. *Arceuthobium minutissimum* is, perhaps, the smallest dicotyledonous plant known and this stemless, minute plant is found on the bark of the blue pine (*Pinus wallichiana*). This parasite causes extensive damage to the pine and the disease is locally known as 'armi' in Kashmir. Another species of the genus, *A. oxycedri*, is widespread in Europe and is generally parasitic on *Juniperus oxycedrus*. This species has been recorded from Lahul in the west Himalaya.

## ARCEUTHOBIMUM M. BIBB. NOM. CONS.

- A. **minutissimum** Hook. f.  
Kashmir, Kumaon (3300 m).
- \*A. **oxycedri** M. Bieb.  
Lahul (3600 m).

## EUPHORBIACEAE

This large family of flowering plants is mostly tropical in its distribution and only a very small number of species may be seen in the colder parts of the world. The family includes many well known, economically important plants among which are the rubber yielding ones (*Manihot*, *Hevea*), the castor plant (*Ricinus*) and tung oil plant (*Aleurites*). One of the largest genera of the family is *Euphorbia* whose species are popularly known as the spurges. These plants have unisexual flowers and the highly reduced flowers of *Euphorbia* are usually grouped in a peculiar inflorescence, the cyathium, in which the central female flower, represented only by the ovary, is surrounded by groups of male flowers again represented by just individual stamens. A few species of this genus occur in the alpine zone of west Himalaya. *Euphorbia tibetica* is known from altitudes as high as 4500 m in Ladakh and Rupshu and a recently described species, *E. sharmae*, was found in Garhwal at about the same altitude.

## LIST OF SPECIES

## EUPHORBIA LINN.

- E. **hispida** Boiss.  
Lahul (4800 m).
- E. **kanaorica** Boiss.  
Kumaon (4500 m).
- \*E. **sharmae** U. C. Bhatt.  
Garhwal (4500 m).
- E. **stracheyi** Boiss.  
Kulu, Tehri-Garhwal, Kumaon (4500 m).
- E. **thomsoniana** Boiss.  
Ladakh (3600 m).
- E. **tibetica** Boiss.  
Ladakh (4500 m), Rupshu, Kumaon.
- E. **wallichii** Hook. f.  
Kashmir, Kumaon (3300 m).

## URTICACEAE

The nettles are well known for their stinging hairs and in keeping with their extensive distribution in the colder regions, a few of them also reach



the alpine zone in western Himalaya. *Urtica hyperborea* is a low tufted herb with stinging hairs and is found in the inner ranges bordering Tibet. The flowers are very small, unisexual and arranged in crowded cymes, often paniculate.

#### KEY TO GENERA

- |  |                   |
|--|-------------------|
| 1. Herbs erect, with stinging hairs              | <i>Urtica</i>     |
| 1. Herbs diffuse, flaccid without stinging hairs | <i>Parietaria</i> |

#### LIST OF GENERA AND SPECIES

##### PARIETARIA LINN.

- P. debilis** Forst.  
Throughout up to 3600 m.

##### URTICA LINN.

- U. hyperborea** Jacq. ex Wedd.  
Ladakh (4000 m), Kumaon.
- U. parviflora** Roxb.  
Kashmir to Kumaon up to 3600 m.

##### BETULACEAE

The birches (*Betula* spp.), hazel nuts (*Corylus* spp.), horn-beams (*Carpinus* spp.) and alders (*Alnus* spp.) are prominent trees of the temperate forests. In the west Himalaya the Himalayan birch (*Betula utilis*) reaches the highest limit known for trees but at such high altitudes, it generally exhibits a gnarled and wind swept appearance. This birch which is often associated with *Rhododendron campanulatum* in the sub-alpine and alpine zones of the area is locally known as 'bhojapattra'. It has found use in the ancient past for its bark peels which were used for writing purposes. The plant has also figured in indigenous medicine. It bears male and female flowers in hanging clusters (catkins). The male flower has 2 stamens enclosed in a perianth but the female flower is naked. The ovary is inferior, 1-ovuled and develops into a winged nut.

##### BETULA LINN.

- B. Jacquemontii** Spach.  
Kashmir, Lahul (3600 m).
- B. utilis** D. Don  
Tehri-Garhwal, Garhwal, Kumaon (4000 m).

##### FAGACEAE

The oaks (*Quercus* spp.), beech (*Fagus sylvatica*) and chestnut (*Castanea sativa*) belong to this family. All these are well known trees forming

extensive forests in many countries, particularly, those in the northern temperate regions. In the Himalaya, there are several oaks forming associations with conifers, birches, maples, Rhododendrons and other tree species but only one of these reaches an altitude as high as 3600 m. This is the 'kharsu' oak, *Quercus semecarpifolia*. The oaks are cupuliferous plants where the characteristic fruits, the 1-seeded nuts (acorns) are surrounded by a cup-like structure, the cupule.

#### QUERCUS LINN.

##### **Q. semecarpifolia** Sm.

Throughout up to 3600 m.

#### SALICACEAE

The willows (*Salix* spp.) and poplars (*Populus* spp.) are also catkin-bearing plants which have a wide distribution in the temperate and tropical regions of the world. These are extremely valuable for their wood and several species have been introduced in many countries. The male and female flowers are borne in usually erect catkins and the seeds are characteristically plumose. The poplars are differentiated, in their flowers, from the willows by the presence of a cuplike disc and numerous outer scales on the buds. The willows are lacking in such a cup-like disc and the buds have only one outer scale. In the Himalaya, the willows occurring in the alpine zone show a very much stunted habit and some of them form large spreading mats on the ground. In a few of them, there is a woolly covering on the branches and around the catkins. In this respect, these Himalayan species resemble the arctic species of Europe which show the dwarf or creeping habit and the extreme woolliness of their branches and catkins.

#### KEY TO GENERA

- |   |                |
|---|----------------|
| 1. Flowers with cup-like disc; stamens many         | <i>Populus</i> |
| 1. Flowers without cup-like disc; stamens 5 or less | <i>Salix</i>   |

#### LIST OF GENERA AND SPECIES

##### POPULUS LINN.

- P. balsamifera** Linn.  
Kinnaur (3600 m).

##### SALIX LINN.

- S. daphnoides** Vill. (= *S. sericocarpa* Anderss.)  
Spiti (4000 m).



*Salix lindleyana* Wall, ex Anderss.

- Salix denticulata** Anderss.  
Bashahr (3600 m).
- S. divergens** Anderss. (*S. coesia* Vill.)  
Zanskar, Ladakh (4500 m), Spiti (3900 m).
- S. flabellaris** Anderss.  
Kashmir to Kumaon (4500 m in Tehri-Garhwal).
- S. fruticulosa** Anderss.  
Kumaon (Pindari, 3600 m).
- S. karelinii** Turcz ex Stschëzl (*S. hastata* auct. non Linn.)  
Kashmir to Garhwal (4000 m).
- S. lindleyana** Wall. ex Anderss.  
Kashmir, Garhwal (4200 m).
- S. oxycarpa** Anderss.  
Ladakh (4000 m), Spiti.
- S. pycnostachya** Anderss.  
Ladakh, Lahul (3600 m).
- S. sclerophylla** Anderss.  
Kumaon (4500 m).
- S. wallichiana** Anderss.  
Kashmir, Garhwal, Kumaon (4000 m).

## ORCHIDACEAE

This is one of the largest families of flowering plants. Several thousand species of orchids are distributed in a wide variety of environment all over the world. The epiphytic orchids of the tropical and sub-tropical forests have attracted worldwide attention on account of their beautiful flowers. The distribution of orchids in the Himalayan region is of great interest. The rich orchid belt of the eastern Himalaya, particularly, of the Sikkim and Darjeeling regions is too well known to need any comment here. In the western Himalaya, except in the lower temperate and sub-tropical belt of eastern Kumaon, epiphytic orchids are hardly of any significance further west, though terrestrial orchids are common in the forest undergrowth of the temperate zone. The number of species dwindles with increasing altitude and hardly a dozen species are known to reach alpine heights in western Himalaya. Among these are species of the genera, *Orchis*, *Goodyera* and *Herminium*. *Orchis latifolia*, one of the 'salep' yielding species which enjoyed a big reputation in Europe at one time is, perhaps, the one to reach the highest altitude recorded for any orchid in west Himalaya. It is known to occur at altitudes above 4500 m in Lahul and Ladakh. It is abundant on the grassy slopes in many localities, as for example, in the Chandra Valley in Lahul and in the Valley of Flowers in Garhwal. This is a tall herb, often up to a metre high, and bearing a dense-flowered cylindrical spike. The flowers are purplish and the lip is spotted with deep purple. The bulbs are collected for the local drug trade.

## KEY TO GENERA

- |  |                     |
|--|---------------------|
| 1. Anthers 2; lip inflated, sac-like               | <i>Cypripedium</i>  |
| 1. Anther 1  |                     |
| 2. Lip not spurred                                 |                     |
| 3. Herbs with coralloid roots                      | <i>Corallorhiza</i> |
| 3. Herbs without coralloid roots                   |                     |
| 4. Lip flat, ovate, not concave or saccate at base | <i>Malaxis</i>      |
| 4. Lip concave or shortly saccate at base          |                     |
| 5. Roots fibrous, densely tufted                   | <i>Goodyera</i>     |
| 5. Roots tuberous                                  | <i>Herminium</i>    |
| 2. Lip spurred. Herbs with sheathing leaves        | <i>Orchis</i>       |

## LIST OF GENERA AND SPECIES

## CORALLORHIZA CHATEL

- C. trifida** Chatel  
Kashmir, Kumaon (3300 m).

## CYPRIPIEDIUM LINN.

- C. elegans** Reichb. f.  
Garhwal (3600 m).  
**C. himalaicum** Rolfe ex Hemsl. (*C. macranthum* Hook. f. p.p.)  
Garhwal, Kumaon (3800 m).

## GOODYERA R. BR.

- G. fusca** Hook. f.  
Garhwal (3900 m).

## HERMINIUM GUETT.

- H. dutbiei** Hook. f.  
Garhwal, Kumaon (3600 m).  
**H. fallax** Hook. f.  
Garhwal, Kumaon (3600 m).  
**H. monorchis** (Linn.) R. Br.  
Kashmir to Kumaon (3600 m).

## MALAXIS SOLAND EX SW.

- M. muscifera** (Lindl.) O. Ktze. (*Microstylis muscifera* Ridley)  
Kashmir to Kumaon up to 3600 m.

## ORCHIS LINN.

- O. chusua** D. Don  
Kumaon (3600 m).
- \***O. habenarioides** King & Pantl.  
Chamba, Tehri-Garhwal (3900 m).
- O. latifolia** Linn.  
Ladakh (4200 m), Lahul to Kumaon.
- O. spathulata** Reichb. f. ex Hook. f.  
Tehri-Garhwal (3900 m), Kumaon.
- O. stracheyi** Hook. f.  
Garhwal (3800 m).

## TRIDACEAE

The irises are lovely herbs and are universally popular. Among the Himalayan irises, *Iris kumaonensis* is the most widely distributed species. It reaches the sub-alpine zone in a few localities. This is a perennial, dwarfish herb with linear leaves. The perianth tube is 4 to 5 cm long and the lobes of the inner whorl are crested with yellow-tipped hairs. The herb forms often gregarious patches on the grassy slopes and flowers during the summer months. It is particularly common in the Lahul, Kangra and Kulu Valleys.

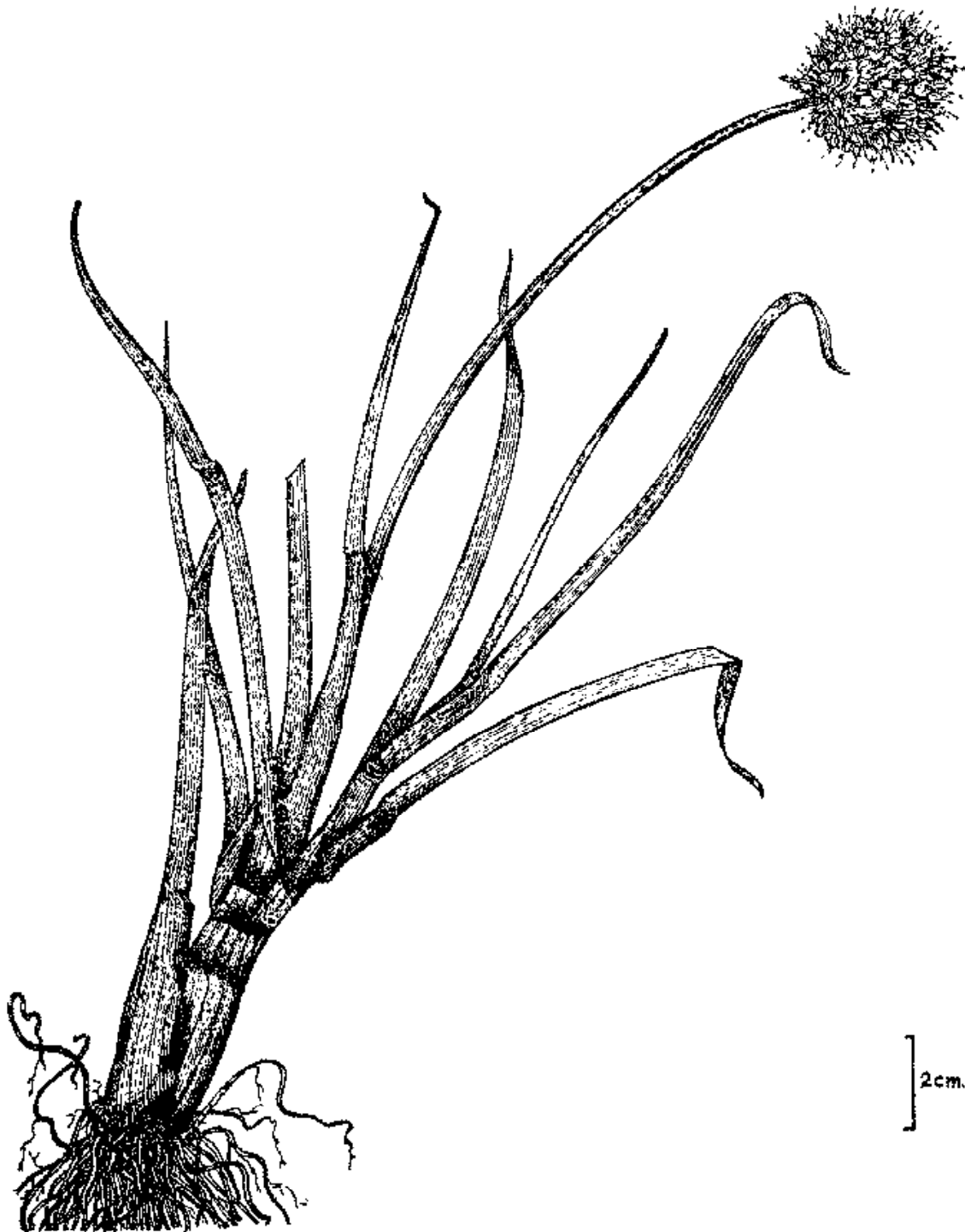
## IRIS LINN.

- I. hookeriana** Foster  
N. Kashmir, alpine meadows.
- I. kumaonensis** Wall. ex G. Don  
Kashmir to Kumaon up to 3600 m.

## LILIACEAE

The lily family includes many attractive herbs. Among them are the true lilies, Fritillarias, Alliums and others. In the alpine zone there are several species of *Allium* of which *A. carolinianum* reaches an altitude of more than 5000 m in some places. This is an attractive, stout herb with a large bulb, often 10 cm in diameter and a globose head of pinkish flowers, *A. victorialis* is also a large herb with a prominent bulb. It bears yellow flowers.

Only a single species of *Lilium*, *L. polyphyllum*, is found at high altitudes. This is a tall herb, about a metre high, and possesses large, purple-streaked flowers of a yellowish shade. The flowers are pendulous on the flowering axis. Among the fritillaries, *Nomocharis oxypetala*, with solitary nodding yellowish flowers, is a common herb on the grassy slopes, particularly, in the Valley of Flowers in Garhwal and on the hills opposite Badrinath.



*Allium carolinianum* DC.

*Trillium govatanum*, with dark purple, solitary flowers and *Smilacina purpurea*, with a raceme of purple flowers are herbs frequently seen in the undergrowth of birch forests. These are particularly abundant in the Jumnotri region of Tehri-Garhwal. *Clintonia alpina* is another herb found in similar habitat.

## KEY TO GENERA

- |   |                    |
|---|--------------------|
| 1. Flowers axillary, solitary or in few-flowered peduncles. Tall leafy herbs with creeping rootstock  |                    |
| 2. Perianth tubular, peduncles curved, drooping   | <i>Polygonatum</i> |
| 2. Perianth rotate; flowers on long filiform pedicels   | <i>Streptopus</i>  |
| 1. Flowers terminal, in racemes, corymbs, umbels or heads or solitary   |                    |
| 3. Inflorescence a globose or hemispheric head or umbel, at first, enclosed in membranous spathes   | <i>Allium</i>      |
| 3. Inflorescence not as above   |                    |
| 4. Flowers in racemes or corymbs  |                    |
| 5. Herbs more than a metre high; racemes on stout scapes or at end of leafy stem  |                    |
| 6. Leaves radical; scape and raceme very stout; flowers white, about 2 cm in diam., segments oblong   | <i>Eremurus</i>    |
| 6. Leaves on erect stem; raceme raised on the naked top of stem; flowers large, about 5 cm in diam., segments long, yellowish with purple streaks | <i>Lilium</i>      |
| 5. Herbs less than a metre high; racemes on slender terminal axes   |                    |
| 7. Leaves on simple stem; flowers purple  | <i>Smilacina</i>   |
| 7. Leaves radical or sub-radical; flowers on long naked slender scapes  |                    |
| 8. The leaves grass-like; flowers small, short-pedicelled in close racemes  | <i>Aletris</i>     |
| 8. The leaves large, obovate or elliptic; flowers small in terminal corymbs or short racemes, pedicels elongating in fruit                        | <i>Clintonia</i>   |



4. Flowers solitary or few
9. Leaves basal or in a whorl at top of stem; stem not leafy throughout
10. Herbs bulbous; leaves linear, basal
11. Flowers white with yellow lines; leaves wiry, convolute *Lloydia*
11. Flowers yellow; leaf solitary linear, from base of stem *Gagea*
10. Herbs with creeping rootstock; leaves 3 in a whorl at top of stem; flower solitary in the midst of leaves, dark purple *Trillium*
9. Leaves throughout on simple, erect stem. Bulbous herbs
12. Flower yellow, nodding *Nomocharis*
12. Flower greenish-yellow or pale purple, purple-tessellate *Fritillaria*

## LIST OF GENERA AND SPECIES

## ALETRIS LINN.

- A. **pauciflora** (Klotzsch) Hand.-Mazz. (*A. nepalensis* Hook. f.)  
Throughout up to 4500 m.

## ALLIUM LINN.

- A. **carolinianum** DC. (*A. blandum* Wall.)  
Lahul, Garhwal (4800 m), Kumaon.
- A. **fedschenkoanum** Regel  
Kashmir (3600 m).
- A. **govanianum** Wall. ex Baker  
Kumaon (3600 m).
- A. **jacquemontii** Regel  
Kumaon (4800 m).
- A. **loratum** Baker  
Kistwar (3600 m).
- A. **przewalskianum** Regel  
Ladakh (4000 m).
- A. **semenovii** Regel  
Kashmir to Garhwal up to 4000 m.
- A. **stracheyi** Baker  
Kashmir to Kumaon (3900 m).
- A. **thomsonii** Baker  
Kashmir (3600 m).
- A. **victoralis** Linn.  
Kashmir to Kumaon up to 3900 m.
- A. **wallichii** Kunth  
Kumaon (3600 m).

## CLINTONIA RAFIN.

- C. udensis** Trautv. var. **alpina** (Kunth ex Baker) Hara (*C. alpina* Kunth ex Baker)  
Garhwal, Kumaon up to 3600 m.

## EREMURUS BIEB.

- E. himalaicus** Baker  
Kashmir, Lahul (3600 m).

## FRITILLARIA LINN.

- F. roylei** Hook.  
Kashmir to Kumaon up to 3600 m.  
**F. stracheyi** Hook. f.  
Kumaon (3600 m).

## GAGEA SALISB.

- G. lutea** Schultz. f.  
Kashmir to Kumaon up to 3600 m.

## LILIUM LINN.

- L. polyphyllum** D. Don  
Kashmir to Kumaon up to 3600 m.

## NOMOCHARIS FRANCH.

- N. oxypetala** (Royle) Balf. f. ex W. E. Evans (*Fritillaria oxypetala* Royle)  
Garhwal, Kumaon up to 4000 m.

## LLOYDIA SALISB. EX REICHB. NOM. CONS.

- L. alpina** Salisb. (*L. serotina* Reichb.)  
Kashmir to Kumaon up to 5000 m.

## POLYGONATUM MILL.

- P. hookeri** Baker  
Garhwal (3600 m).  
**P. verticillatum** All.  
Kashmir to Kumaon (4000 m).

## SMILACINA DESF. NOM. CONS.

- S. purpurea** Wall. (*S. pallida* Royle)  
Garhwal, Kumaon up to 3600 m.

## STREPTOPUS RICH.

- S. simplex** D. Don  
Kumaon (3600 m).

## TRILLIUM LINN.

- T. govaniatum** Wall.  
Kashmir to Kumaon up to 3600 m.

## JUNCACEAE

The rushes, as these plants are popularly known, are tufted rhizomatous herbs, grass-like or sedge-like in general appearance and characteristically distributed in the cold temperate and arctic regions, particularly, in marshy and semi-aquatic situations. The leaves are narrow and the small flowers are arranged in cymose clusters. The individual flower has a perianth of 6 lobes in 2 whorls, 6 stamens and a superior ovary of 3 carpels.

## KEY TO GENERA

- |                                |               |
|--------------------------------|---------------|
| 1. Ovary 3-celled; ovules many | <i>Juncus</i> |
| 1. Ovary 1-celled; ovules 3    | <i>Luzula</i> |

## LIST OF GENERA AND SPECIES

## JUNCUS LINN.

- J. bracteatus** Buchen.  
Garhwal (3600 m).
- J. bufonius** Linn.  
Kashmir to Kumaon up to 3600 m.
- J. concinnus** D. Don  
Kashmir to Kumaon up to 3800 m.
- J. grisebachii** Buchen.  
Kumaon (3300 m).
- J. himalensis** Klotzsch & Garcke  
Kashmir to Kumaon up to 3600 m.
- J. lampocarpus** Ehrh.  
Kashmir to Kumaon up to 4000 m.
- J. leucanthus** Royle ex D. Don  
Kumaon (3300 m).
- J. leucomelas** Royle ex D. Don  
Kashmir to Kumaon up to 4000 m.
- J. membranaceus** Royle ex D. Don  
Kashmir to Kumaon up to 3600 m.
- J. sphacelatus** Decne.  
Kashmir to Kumaon up to 4000 m.

**Juncus triglumis** Linn.

Kashmir to Kumaon up to 4000 m.

## LUZULA DC. NOM. CONS.

**L. campestris** (Linn.) DC.

Kashmir to Kumaon up to 4000 m.

**L. spicata** DC.

Kashmir to Kumaon up to 4000 m.

## JUNCAGINACEAE

This is a small family of mostly marshy or semi-aquatic herbs which have predominant distribution in the southern hemisphere. The genus, *Triglochin* of the family, however, has a worldwide distribution. The genus includes tufted herbs which are commonly known as arrow grass. These are usually found growing in fresh water or salt marshes. *T. maritimum* and *T. palustre* are the two species frequently seen in Great Britain and other European countries and the same two species occur also in western Himalaya. They show the tufted habit, very narrow, linear leaves and a long, leafless, flower-bearing scape. The flowers have the usual trimerous arrangement. A conspicuous feature of the flower is the projection of the inner whorl of the perianth beyond the stamens. The ripe carpels which have recurved tips surround a central beak.

## TRIGLOCHIN LINN.

**T. maritimum** Linn.

Ladakh, Lahul, Garhwal (4500 m).

**T. palustre** Linn.

Lahul, Garhwal (4500 m).

## POTAMOGETONACEAE

The pondweeds (*Potamogeton*) are common aquatic herbs which have a creeping rhizome. The flowers are hermaphrodite and are borne on cylindrical spikes. There are 4 perianth lobes, 4 stamens and 4 carpels which develop into single seeded drupelets.

## POTAMOGETON LINN.

**P. pectinatus** Linn.

Throughout up to 5000 m.

**P. natans** Linn.

Garhwal (4500 m).

## ZANNICHELLIACEAE

This is another family of aquatic herbs and includes only one cosmopolitan species, *Zannichellia palustris*. Here the flowers are unisexual, both

kinds being found on the same plant. The male flowers arise from the axils of the bracteoles at the base of the female flower. Each male flower has 1 or 2 stamens. The female flower has 4 carpels which are surrounded by a cup-like perianth.

ZANNICHELLIA LINN.

**Z. palustris** Linn.

Throughout up to 4500 m.

CYPERACEAE

The sedges (Cyperaceae) and grasses (Gramineae) form a distinct group of plants in which the naked flowers are found in the axils of chaffy bracts borne on the axis of the spikelets. The leaves are mostly linear and are so distinctive that the term 'grass-like' has a very familiar meaning to everyone. The sedges are differentiated from the grasses by their closed sheath, the absence of a bract above the flower and the seed coat not adhering to the wall of the fruit. The sedges have a cosmopolitan distribution but are particularly common in and around marshes and in semi-aquatic habitats. Some of the cotton-grasses (*Eriophorum* spp.) reach very high altitudes, as for example, *Eriophorum microstachyum* which has been seen in Tehri-Garhwal at 4800 m. The most abundant of all sedges in the alpine zone are the species of *Carex*. *Carex melanantha* var. *moorcroftii*, *C. nivalis* and *C. atro-fusca* have been recorded from altitudes above 4800 m. These carices are all perennial herbs with unisexual flowers. The female flowers are enclosed in a beaked trigonous or flattened sac (Perigynium) which forms the utricle. *Kobresia* is another genus which has also unisexual flowers but here the female flowers are only enclosed in an incomplete envelope. Some of the species of *Kobresia* like, *K. duthiei*, *K. royleana* and *K. schoenoides* reach very high altitudes in western Himalaya.

KEY TO GENERA

- |  |                      |
|--|----------------------|
| 1. Nuts not enclosed in envelope                   |                      |
| 2. Leaves absent                                   | <i>Eleocharis</i>    |
| 2. Leaves present                                  |                      |
| 3. Spikelets many-flowered, many perfect flowers   |                      |
| 4. Hypogynous bristles not divided or absent       | <i>Scirpus</i>       |
| 4. Hypogynous bristles divided, comose in fruit    | <i>Eriophorum</i>    |
| 3. Spikelets few-flowered, only one perfect flower | <i>Microschoenus</i> |
| 1. Nuts enclosed in a sac (utricle)                |                      |
| 5. Utricle split on one side                       | <i>Kobresia</i>      |
| 5. Utricle entire                                  | <i>Carex</i>         |

## LIST OF GENERA AND SPECIES

## CAREX LINN.

- C. alpina** Sw. subsp. **infusata** Nees var. **erostrata** (Boott) Kukenth. and var. **gracilentata** (Boott) Kukenth.  
Kashmir, Lahul, Kumaon (4500 m).
- C. atrofusca** Schkuhr var. **angustifructus** Kukenth. (*C. ustulata* C. B. Clarke non Wahlb.)  
Ladakh, Rupshu, Kashmir, Kumaon (5000 m).
- \***C. borii** Nelves  
Lahul (4800 m).
- C. cruenta** Nees (*C. ferruginea* C. B. Clarke non Scop.)  
Kashmir to Kumaon up to 4500 m.
- C. curta** Good var. **maxima** (Kukenth.) R. R. Stew.  
Kashmir (3600 m).
- C. duthiei** C. B. Clarke  
Kashmir, Garhwal (4200 m).
- C. haematostoma** Nees  
Kashmir (4000 m), Kumaon.
- C. kashmirensis** C. B. Clarke  
Kashmir (4500 m).
- C. lehmannii** Drejer  
Kashmir (4000 m), Kumaon.
- C. maritima** Gunner (*C. incurva* Lightf.)  
Rupshu (5000 m), Kumaon.
- C. melanantha** C. A. Mey.  
Rupshu, Kashmir up to 5000 m.
- C. microglochin** Wahlb.  
Ladakh, Kinnaur up to 5000 m.
- C. moorcroftii** Falc. ex Boott  
Rupshu, Zaskar (5000 m).
- C. munroi** Boott ex C. B. Clarke  
Kinnaur (3400 m).
- C. nivalis** Boott  
Kashmir (5000 m) to Kumaon (4500 m).
- C. notha** Kunth  
Kinnaur, Tehri-Garhwal, Garhwal (3300 m).
- C. nubigena** D. Don  
Throughout up to 3600 m.
- C. obscura** Nees var. **brachycarpa** C. B. Clarke  
Kashmir (4000 m).
- C. orbicularis** Boott (*C. erostrata* Boott ex C. B. Clarke; *C. rigida* C. B. Clarke non Gooden. and *C. vulgaris* C. B. Clarke non Fries)  
Ladakh, Rupshu, Kumaon up to 4500 m.

- Carex pamirensis** C. B. Clarke ex B. Fedtsch. (*C. rostrata* C. B. Clarke non Stokes)  
Kashmir, Lahul, Kumaon up to 4000 m.
- C. parva** Nees  
Kashmir (4500 m) to Kumaon.
- C. philocrena** V. Krecz (*C. flava* C. B. Clarke non Linn.)  
Kashmir (3300 m).
- C. plectobasis** V. Krecz (*C. hirtella* Dreger)  
Zanskar, Ladakh, Kashmir, Kistwar, Tehri-Garhwal, Garhwal up to 4500 m.
- C. pseudofoetida** Kukenth. ex Ostenf.  
Zanskar, Ladakh, Rupshu (up to 5000 m).
- C. setosa** Boott  
Kashmir (3900 m), Tehri-Garhwal.
- C. stenophylla** Wahlb. and var. *longipedicellata* (Boeck.) Kukenth  
Ladakh, Rupshu (up to 5000 m).
- C. stracheyi** Boott ex C. B. Clarke  
Garhwal (3600 m), Kumaon.
- C. supina** Wahlb.  
Kumaon (4500 m).
- C. tristis** M. Bieb.  
Ladakh, Kashmir (up to 5400 m).
- C. vulpinaris** Nees ex Wight  
Kashmir to Garhwal up to 4000 m.

ELEOCHARIS R. BR.

- E. palustris** R. Br.  
Throughout up to 3600 m.
- E. quinqueflora** (Hartm.) O. Schwarz  
Zanskar, Rupshu (4000 m).
- E. uniglumis** (Link) Schult.  
Kashmir, Ladakh (3600 m).

ERIOPHORUM LINN.

- E. microstachyum** Boeck.  
Tehri-Garhwal (3600 m).
- E. scheuchzeri** Hoppe  
Kashmir (Kolohai, 4000 m).

KOBRESIA WILLD

- K. capillifolia** C. B. Clarke  
Kashmir to Garhwal up to 3600 m.
- K. duthiei** C. B. Clarke  
Garhwal, Kumaon (4800 m).

**Kobresia laxa** Nees

Kashmir to Kumaon up to 3600 m.

**K. macrantha** Boeck.

Ladakh (3600 m).

**K. nepalensis** (Nees) Kukenth. (*Carex linearis* Boott)

Kashmir to Kumaon up to 3600 m.

**K. nitens** C. B. Clarke and var. **vaginosa** (C. B. Clarke) Kukenth.

Kashmir, Ladakh, Rupshu (4800 m), Garhwal, Kumaon.

**K. pygmaea** C. B. Clarke

Ladakh, Lahul, Kinnaur (4500 m).

**K. pamiroalaica** Ivan. (*K. schoenoides* auct. non Steud.)

Zaskar, Ladakh, Kashmir, Lahul, Garhwal up to 4500 m.

**K. royleana** Boeck.

Kashmir, Ladakh, Kumaon (4500 m).

**K. trinervis** (Nees) Boeck. var. **foliosa** (C. B. Clarke) Kukenth. (*K. foliosa*

C. B. Clarke)

Garhwal (3900 m).

## MICROSCHOENUS C. B. CLARKE

**M. duthiei** C. B. Clarke

Tehri-Garhwal (4500 m).

## SCIRPUS LINN.

**S. lacustris** Linn.

Kashmir, Ladakh (4000 m).

**S. planifolius** Grimm (*S. caricis* Retz.)

Kashmir to Kumaon (4500 m).

**S. pumilus** Vahl

Kashmir (3600 m).

**S. rufus** (Huds.) Schrad.

Rupshu (4500 m).

**S. setaceus** Linn.

Kashmir to Kumaon up to 3900 m.

## GRAMINEAE (nom. altern. POACEAE)

Gramineae or the Poaceae constitute one of the largest families of flowering plants. They are also among the most valuable from the economic point of view, providing cereals, sugar, forage, etc. The grasses have attained such a high degree of adaptability that their representatives are found in every conceivable type of habitat. Extensive grasslands are met with in many parts of the world. The grasses are herbaceous annuals or perennials ranging in size and form from the minute, delicate annuals to



the giant bamboos. The grasses are distinguished by their linear leaves with sheathing bases, the inflorescence of spikelets, the individual spikelet being enclosed by the glumes and the seed coat adhering to the pericarp in fruit (Caryopsis).

In the alpine zones, the grasses often form pure associations and are also prominent components of the vegetation of most meadows and slopes. Some of the grasses reach very high altitudes and are found even on slopes and ridges exposed to the rigours of cold winds and snow storms. Among the grasses met with at such high altitudes, almost to the upper limit of all vegetation, are *Trisetum spicatum* (up to 5400 m), *Colpodium* spp., *Poa koelzii* (above 5000 m), *Stipa basiplumosa* (at 5100 m) and *Festuca valesiaca*, a dwarf grass at 5000 to 6000 m. In the alpine marshes and swamps are seen, *Alopecurus aequalis*, *Deschampsia caespitosa* and others. Among the important fodder grasses of the alpine pastures are species of *Agrostis*, *Alopecurus*, *Dactylis*, *Poa* and others. In the arid regions and on dry rocky slopes may be seen, *Stipa Jacquemontii*, *Leucopoa albida*, *Orinus thoroldii*, *Bromus oxyodon* and others. Some of the elegant and beautiful grasses of the alpine zone are *Hierochloa laxa*, *Poa calliopsis* (with purple, gold-tipped lemmas), *P. pseudamoena* and *Calamagrostis emodensis*.

#### KEY TO GENERA

1. Spikelets of 2 or more florets
  2. Inflorescence a simple spike or raceme
    3. Spikelets subtended by bristles *Pennisetum*
    3. Spikelets not subtended by bristles
      4. Awn terminal, straight or recurved, not twisted or kneed at base
        5. Spikelets normally solitary at each node of spike-axis; perennials (the annual, *Triticum* is also cultivated in the area) *Agropyron*
        5. Spikelets more than one, often fascicled at each node *Elymus*
      4. Awn from between 2 lobes of lemma, twisted and kneed at base *Duthiea*
  2. Inflorescence a panicle
    6. Glumes as long or longer than lowest floret, often enclosing all florets
      7. Ligules membranous
        8. Styles 3 *Pseudodanthonia*
        8. Styles 2 or 1
          9. Ovary hairy; awns twisted at base *Helictotrichon*
          9. Ovary glabrous; awns not twisted at base



*Hierochloa laxa* R. Br. ex Hook. f.

- 10. Awns dorsal
  - 11. Awns as long as the glume, column not twisted *Deschampsia*
  - 11. Awns longer than glume, column twisted or not *Trisetum*
- 10. Awns absent or lemmas with a bristle
  - 12. Leaves sword-shaped (ensiform) *Hierochloa*
  - 12. Leaves linear, not ensiform; panicles shining *Koeleria*
- 7. Ligule, a hairy rim *Danthonia*
- 6. Glumes shorter than lowest floret, upper distinctly exerted
  - 13. Ovary with a hairy appendage at apex *Bromus*
  - 13. Ovary without hairy appendage
    - 14. Plants dioecious *Leucopoa*
    - 14. Plants bisexual
      - 15. Lemmas keeled on back
        - 16. Awns absent
          - 17. Lemmas inflated, cordate-based *Briza*
          - 17. Lemmas not as above
            - 18. Lemmas 1-3 nerved *Orinus*
            - 18. Lemmas 5-7 nerved *Poa*
        - 16. Awns present *Dactylis*
      - 15. Lemmas rounded on back
        - 19. Apex of lemma obtuse
          - 20. Panicles large, open; aquatic or semi-aquatic grasses *Catabrosa*
          - 20. Panicles continuous; tufted herbs
            - 21. Spikelets 1-2 flowered *Colpodium*
            - 21. Spikelets more than 2-flowered *Puccinellia*
        - 19. Apex of lemma acute or awned
          - 22. Herbs annual *Eremopoa*
          - 22. Herbs perennial *Festuca*
- 1. Spikelets of 1 floret
  - 23. The spikelets in spicate panicles
    - 24. Panicles dense, not spreading
      - 25. Lemma without awn *Phleum*
      - 25. Lemma awned *Alopecurus*
    - 24. Panicles spreading
      - 26. Lemmas rigid at maturity

27. Spikelets awnless	<i>Milium</i>
27. Spikelets awned	
28. Lemma produced into stout bristles	<i>Trikeriaia</i>
28. Lemma not produced into bristles	
29. Awn kneed, twisted	<i>Stipa</i>
29. Awn not twisted, even- tually deciduous	<i>Oryzopsis</i>
26. Lemmas membranous at maturity	
30. Rachilla long produced, penici- llate	<i>Deyeuxia</i>
30. Rachilla not penicillate	
31. Callus hairs prominent	<i>Calamogrostis</i>
31. Callus hairs short or absent	<i>Agrostis</i>
23. The spikelets sessile or shortly pedicelled, 3 at each node of the simple spike-axis	<i>Hordeum</i>

## LIST OF GENERA AND SPECIES

AGROPYRON J. GAERTN.

- \***A. canaliculatum** Nevski  
Ladakh (5100 m), Lahul, Spiti.
- A. caninum** (Linn.) P. Beauv.  
Kashmir (3300 m).
- A. cognatum** Hack.  
Kashmir.
- A. cognatum** var. **shingoense** Melderis  
Ladakh.
- A. dentatum** Hook. f. and vars. **elatum** Hook. f.; **scabrum** Nevsk  
Kashmir (3600 m).
- \***A. dentatum** var. **kashmiricum** Melderis  
Kashmir.
- \***A. himalayanum** (Nevski) Melderis  
Kashmir, Tehri-Garhwal (4000 m).
- \***A. intermedium** (Host.) P. Beauv.  
Zaskar, Ladakh.
- A. jacquemontii** Hook. f.  
Ladakh, Rupshu (4000 m).
- A. repens** (Linn.) P. Beauv.  
Kashmir, Ladakh, Spiti (3900 m).
- \***A. schrenkianum** (Fisch. & Mey.) Drobov  
Lahul (4500 m).
- \***A. schuganicum** Nevski  
Lahul (4500 m).

**Agropyron striatum** Nees ex Steud.

Kashmir, Lahul (3600 m).

**A. thomsonii** Hook. f.

Tehri-Garhwal (3300 m).

## AGROSTIS LINN.

**A. canina** Linn.

Kashmir, Ladakh (3500 m).

**A. gigantea** Roth

Kashmir, Kistwar-(3500 m).

**A. munroana** Aitch. & Hemsl. (*Calamogrostis munroana* Boiss.)

Kashmir to Kumaon up to 3600 m.

**A. pilosula** Trin. and var. *royleana* (Trin.) Bor (*Calamogrostis pilosula* Hook. f. var. *alpestris* Hook. f.)

Kashmir to Kumaon.

**A. stolonifera** Linn. (*A. alba* Hook. f. non Linn.)

Lahul (3500 m).

## ALOPECURUS LINN.

**A. aequalis** Sobol (*A. aristulatus* Michx.)

Kashmir (4000 m).

**A. arundinaceus** Poir.

Kashmir to Garhwal up to 3600 m.

**A. himalaicus** Hook. f.

Kashmir (4000 m).

## BRACHYPODIUM P. BEAUV.

**B. sylvaticum** (Huds.) P. Beauv.

Kashmir to Kumaon up to 3600 m.

## BRIZA LINN.

**B. media** Linn.

Kashmir to Garhwal up to 3900 m.

## BROMUS LINN.

**B. arvensis** Linn.

Ladakh, Rupshu (4000 m).

**B. gracillimus** Bunge (*B. crinitus* Boiss. & Hoh.)

Rupshu, Lahul (4000 m).

**B. inermis** Leyss.

Kashmir to Kumaon (3900 m).

**B. japonicus** Thunb.

Lahul (3300 m).

- Bromus oxyodon** Schrenk  
Kashmir, Lahul (3600 m).
- B. ramosus** Huds. (*B. asper* Murray)  
Kashmir to Kumaon up to 3300 m.
- B. stenostachyus** Boiss. [*B. inermis* var. *confinis* (Nees ex Steud.) Stapf]  
Lahul (3300 m).
- B. tectorum** Linn.  
Kashmir to Kumaon up to 3300 m.

## CALAMOGROSTIS ADANS.

- C. emodensis** Griseb.  
Kashmir to Kumaon up to 3600 m.
- \***C. garhwalensis** C. E. Hubb. & Bor  
Kashmir, Lahul, Garhwal.
- C. pseudophragmites** (Hall. f.) Koel. (*C. littorea* DC.)  
Ladakh, Rupshu (4500 m).
- C. turkestanica** Hack. (*C. littorea* var. *tartarica* Hook. f.)  
Zaskar, Ladakh, Rupshu up to 4500 m.

## CATABROSA P. BEAUV.

- C. aquatica** (Linn.) P. Beauv.  
Ladakh, Rupshu.
- C. sikkimensis** Stapf  
Ladakh (5000 m).

## COLPODIUM TRIN.

- C. himalaicum** (Hook. f.) Bor (*Phippisia himalaica* Hook. f.)  
Kashmir (4800 m).
- C. nutans** Griseb. [*Catabrosa nutans* (Griseb.) Stapf]  
Kashmir to Garhwal (4000 m).

## DACTYLIS LINN.

- D. glomerata** Linn.  
Kashmir to Kumaon up to 3600 m.

## DANTHONIA DC.

- D. cachymeriana** Jaub. Spach. (*D. exilis* Hook. f.)  
Kashmir, Lahul (3500 m).
- D. schneideri** Pilgert var. **glabrata** Conert (*D. cachymeriana* Hook. f. non Jaub. & Spach.)  
Lahul, Bashahr, Garhwal (4000 m).
- D. schneideri** var. **minor** (Hook. f.) Conert (*D. cachymeriana* Hook. f. var. *minor* Hook. f.)  
Kashmir, Rupshu (5000 m), Kumaon.

## DESCHAMPSIA P. BEAUV.

- D. caespitosa** (Linn.) P. Beauv.  
Kashmir to Kumaon up to 5000 m.

## DEYEUZIA CLARION EX P. BEAUV.

- D. arundinacea** (Linn.) P. Beauv. (*D. sylvatica* Kunth)  
Kashmir, Kumaon (3300 m).  
**D. holciformis** (Jaub. & Spach.) Bor (*D. compacta* Munro ex Hook. f.)  
Ladakh, Rupshu, Lahul, Kumaon (4500 m).  
**D. pulchella** (Griseb.) Hook. f.  
Lahul, Garhwal, Kumaon (4500 m).  
**D. scabrescens** (Griseb.) Munro ex Duthie  
Kashmir, Ladakh (4000 m).

## DUTHIEA HACK.

- D. bromoides** Hack.  
Kashmir (Apharwat, 4000 m), Kistwar, Lahul.

## ELYMUS LINN.

- E. dahuricus** Turcz.  
Kashmir, Ladakh, Lahul up to 4500 m.  
**E. dasystachya** Trin.  
Zanskar, Lahul (4500 m).  
**E. nutans** Griseb. (*E. sibiricus* Linn. var. *minor* Hack.)  
Kashmir, Lahul (4800 m), Spiti.

## EREMOPOA ROSHEV

- E. persica** (Trin.) Roshev (*Poa persica* Trin.)  
Zanskar, Lahul (4500 m).  
**E. soongarica** (Schrenk) Roshev  
N. Kashmir (Deosai, 4000 m).

## FESTUCA LINN.

- F. kashmiriana** Stapf  
Kashmir to Kumaon up to 4200 m.  
**F. lucida** Stapf  
Ladakh (5000 m), Lahul, Garhwal.  
**F. nitidula** Stapf  
Kumaon (4500 m).  
**F. rubra** Linn.  
Lahul (4000 m).

**\*Festuca rubra** var. *villosa* Mert. & Koch

Ladakh, Rupshu (4800 m).

**F. valesiaca** Schleich. ex Gaud. var. *tibetica* Stapf

Kashmir, Ladakh, Lahul, (4800 m).

## HELICTOTRICHON BESS. EX ROEM. &amp; SCHULT.

**H. pratense** (Linn.) Pilger (*Avena pratensis* Linn.)

Kashmir to Garhwal up to 4500 m.

**H. virescens** (Nees ex Steud.) Henr. (*Avena aspera* Muuro var. *roylei*

Hook. f.)

Kashmir, Kumaon (3600 m).

## HIEROCHLOA (J. G. GMEL.) R. BR. NOM. CONS.

**H. laxa** R. Br. ex Hook. f.

Kashmir (4500 m), Lahul, Garhwal, Kumaon.

## HORDEUM LINN.

**H. turkestanicum** Nevski

Ladakh, Rupshu (4500 m).

**H. vulgare** Linn.

Ladakh, Rupshu (4000 m), Lahul, Cult.

## KOELERIA PERS.

**K. argentea** Griseb.

Ladakh, Kistwar up to 3900 m.

**K. argentea** var. *nepalensis* Domin

Lahul.

**K. gracilis** Pers. (*K. cristata* auct. non Pers.)

Kashmir, Ladakh (4500 m) to Kumaon.

## LEUCOPOA GRISEB.

**L. albida** (Turcz.) V. Krecz. & Bobr. (*Festuca sibirica* Hack.)

Ladakh, Lahul (4500 m).

## LOLIUM LINN.

**L. perenne** Linn.

Kashmir.

## MILIUM LINN.

**M. effusum** Linn.

Kashmir (3300 m).

## ORINUS HITCHCOCK

**\*O. thoroldii** (Stapf) Bor

Ladakh (4700 m), Kashmir.



## ORYZOPSIS MICHX.

- O. gracilis** (Mez) Pilger  
Ladakh (3600 m), Zaskar.
- O. brachyclada** Pilger  
Ladakh (3600 m).
- O. fasciculata** Hack.  
Kashmir.
- O. lateralis** (Regel) Stapf apud Hook. f.  
Lahul (4500 m).
- O. molinoides** (Boiss.) Hack.  
Ladakh.
- O. munroi** Stapf ex Hook. f.  
Kashmir, Ladakh (3900 m).

## PENNISSETUM RICH.

- P. flaccidum** Griseb.  
Throughout up to 4000 m.
- P. lanatum** Klotzsch  
Kashmir (3300 m).

## PHLEUM LINN.

- P. alpinum** Linn.  
Throughout up to 4800 m.

## POA LINN.

- P. alpina** Linn.  
Kashmir to Kumaon up to 4800 m.
- P. angustifolia** Linn. (*P. partensis* Linn. var. *angustifolia* Wahlb.)  
Kashmir to Kumaon up to 4500 m.
- P. annua** Linn.  
Kashmir, Ladakh, Lahul to Kumaon (3600 m).
- \*P. arartica** Trautv.  
Ladakh, Kashmir, Lahul up to 4500 m.
- \*P. bactriana** Roshev  
Ladakh, Lahul.
- P. bulbosa** Linn.  
Kashmir, Lahul (3900 m).
- \*P. calliopsis** Litw. ex Kom.  
Kashmir, Lahul (4000 m).
- P. falconeri** Hook. f.  
Kulu, Garhwal (3900 m).
- \*P. glabriflora** Roshev  
Ladakh, Lahul.

- \***Poa jainsarensis** Bor  
Kumaon (4000 m).
- \***P. koelzii** Bor  
Kashmir, Ladakh, Rupshu (5000 m), Lahul.
- \***P. lahulensis** Bor  
Ladakh, Rupshu, Lahul (3600 m).
- P. nemoralis** Linn.  
Kashmir to Kumaon (4500 m).
- P. nepalensis** Wall. ex Duthie  
Kulu to Kumaon.
- P. pagophila** Bor  
Kashmir up to 5100 m.
- P. polycolea** Stapf  
Garhwal (3600 m).
- P. pratensis** Linn.  
Throughout up to 4500 m.
- \***P. pseudamoena** Bor  
Kumaon.
- \***P. rhadina** Bor  
Tehri-Garhwal (4500 m).
- P. sikkimensis** Bor  
Ladakh.
- P. stapfiana** Bor (*P. tremula* Stapf non Lamk.)  
Kashmir to Garhwal up to 5000 m.
- P. stapfiana** var. *micranthera* (Stapf) Bor  
Kashmir (3900 m).
- P. sterilis** M. Bieb.  
Kashmir (4500 m).
- \***P. stewartiana** Bor  
Kashmir (3300 m).
- \***P. supina** Schrad.  
Kashmir (3600 m).
- P. tibetica** Munro ex Stapf  
Rupshu (5700 m), Lahul.

## PSEUDODANTHONIA BOR &amp; C. E. HUBB.

- P. himalaica** (Hook. f.) Bor & C. E. Hubb. (*Danthonia himalaica* Hook. f.)  
Kinnaur (4000 m).

## PUCCINELLIA PARL. NOM. CONS.

- \***P. distans** (Linn.) Parl.  
Ladakh.

**\*Puccinellia himalaica** Tzvel.

Ladakh, Rupshu (5000 m).

**P. kashmeriana** Bor

Kashmir, Lahul (5000 m).

**\*P. stapfiana** R. R. Stew.

Ladakh, Rupshu (4600 m).

**P. tenuiflora** (Griseb.) Scribn. & Merr.

Rupshu.

**P. thomsonii** (Stapf) R.R. Stew. (*Glyceria thomsonii* Stapf)

Ladakh, Rupshu.

## STIPA LINN.

**S. basiplumosa** Munro ex Hook. f.

Ladakh, Rupshu (5000 m).

**\*S. breviflora** Griseb.

Ladakh.

**S. capillata** Linn.

Ladakh, Kashmir (3300 m).

**\*S. caucasica** Schmal.

Ladakh.

**S. concinna** Hook. f.

Kashmir (4000 m), Kulu (Rohtang Pass).

**\*S. consanguinea** Trin. & Rupt.

Ladakh, Spiti.

**S. duthiei** Hook. f.

Kashmir (3600 m), Tehri-Garhwal.

**\*S. himalaica** Roshev

Ladakh (3900 m).

**S. jacquemontii** Jaub. & Spach.

Kashmir (4500 m).

**S. mongholica** Turcz. ex Trin.

Ladakh, Rupshu, Lahul (4500 m).

**S. orientalis** Trin.

Ladakh, Lahul, Garhwal (4500 m).

**S. purpurea** Griseb.

Rupshu (5000 m).

**\*S. regeliana** Hack.

Kashmir (Apharwat, 4000 m).

**\*S. roylei** (Nees) Mez

Kashmir to Kumaon.

**S. splendens** Trin.

Ladakh (3600 m).

## TRIKERAIA BOR

**T. hookeri** (Stapf) Bor (*Stipa hookeri* Stapf)

Rupshu (4200 m).

## TRisetum PERS.

- T. aeneum** (Hook. f.) R. R. Stew. (*Avena aenea* Hook. f.)  
Kashmir to Kumaon up to 3600 m.
- T. clarkei** (Hook. f.) R. R. Stew. (*Avena clarkei* Hook. f.)  
Kashmir to Chamba (3300 m).
- T. spicatum** (Linn.) Richt. (*Avena subspicata* Clairv.)  
Ladakh, Zaskar, Kinnaur up to 6000 m.

## TRITICUM LINN.

- T. aestivum** Linn.  
Throughout. Cult. up to 4000 m.



## REFERENCES

- ARBER, E. A. N. *Plant Life in Alpine Switzerland*. London. 1910.
- BLATTER, E. *Beautiful flowers of Kashmir*. Vols. 1-2. London. 1927-29.
- BOR, N. L. *Grasses of India, Pakistan, Burma and Ceylon*. London. 1960.
- BURKILL, I. H. *Chapters on the History of Botany in India*. Calcutta. 1965.
- CAIN, S. A. *Foundations of Plant Geography*. New York. 1944.
- CHAMPION, H. G. A preliminary survey of the forest types of India. *Indian For. Rec. (N.S.) Silv.* 1. 1936.
- COVENTRY, B. O. *Wild Flowers of Kashmir*, Series 1-3. London. 1923-30.
- DANG, HARI A natural sanctuary in the Himalaya: Nanda Devi and the Rishiganga Basin. *J. Bombay nat. Hist. Soc.* 58: 707-714. 1961.
- DAVIS, ANNE Across the Inner Line. *Him. J.* 22:84-94. 1959.
- DUDGEON, W. AND KENOYER, L. A. The Ecology of Tehri-Garhwal: A Contribution to the Ecology of Western Himalaya. *J. Indian bot. Soc.* 4: 233-285. 1925.
- DUTHIE, J. F. Plants found in Kumaon, Garhwal and the adjacent parts of Tibet by Capt. (now Genl.) Richard Strachey and Mr. Winterbottom. In *E. T. Atkinson's Gazetteer of North Western Provinces*, vol. 10, chapter 8: 403-670. 1882.
- *Catalogue of the Plants of Kumaon and of the adjacent portions of Garhwal and Tibet based on the collections made by Strachey and Winterbottom during the years 1846-1849*. London. 1906.
- *The Orchids of North Western Himalaya*. Calcutta. 1906.
- GIBSON, J. T. M. The Harki Doon. *Him. J.* 18:93-102. 1954.
- GOOD, R. *The Geography of the Flowering Plants*. London. 1953.
- GRIERSON, A. J. C. A revision of the Asters of the Himalayan Area. *Notes R. Bot. Gdn, Edinb.* 26:67-163. 1964.
- HARA, H. (ed.) *The Flora of Eastern Himalaya—Results of the Botanical Expedition of Eastern Himalaya organized by the University of Tokyo, 1960 and 1963*. Tokyo. 1966.
- HARDY, M. E. *A Junior Plant Geography*. Oxford. 1913.
- HERRLIGKOFFER, K. M. *Nanga Parbat*. London. 1954.
- HOOKER, J. D. *The Flora of British India*, Vols. 1-7. London. 1872-97.
- *A Sketch of the Flora of British India*. Oxford. 1906.
- HULTEN, E. The *Saxifraga flagellaris* Complex. *Svensk. bot. Tidskr.* 58:81-104. 1964.

- JACKSON, B. D. *A Glossary of Botanic Terms*. London. 1953.
- JAIN, S. K. AND BHARADWAJA, R. C. On a botanical trip to the Parbatti Valley. *Indian For.* 75: 302-363. 1949.
- KASHYAP, SHIVRAM The Vegetation of Western Himalayas and Western Tibet in relation to their climate. *J. Indian bot. Soc.* 4:327-334. 1925.
- Some aspects of the Alpine Vegetation of the Himalaya and Tibet. *Proc. 17th Indian Sc. Congr.* Bangalore. 1932.
- KIHARA, H. (ed.) *Fauna and Flora of Nepal Himalaya*. Vol. 1. Kyoto. 1955.
- KITAMURA, S. *Plants of West Pakistan and Afghanistan*. Kyoto. 1964.
- KRISHNAN, M. S. *Geology of India and Burma*. Madras. 1960.
- MASON, K. Rainfall and rainy days in the Himalaya, west of Nepal. *Him. J.* 8:86-95. 1936.
- MCNEILL, J. Taxonomic studies in the Alsinoideae: I. Generic and Infra-Generic Groups. *Notes R. Bot. Gdn. Edinb.* 24:79-155. 1962.
- MODDIE, A. D. A high walk in the Central Himalaya. *Him. J.* 22: 146-152. 1959-60.
- MUKHERJI, B. *The Indian Pharmaceutical Codex*. New Delhi. 1953.
- MURRAY, W. H. *The Scottish Himalayan Expedition*. London. 1951.
- NAIR, N. C. On a botanical tour to Lahul and Spiti (Punjab Himalaya). *Bull. bot. Surv. India* 6:219-235. 1964.
- NAKAO, S. *Living Himalayan Flowers*. Tokyo. 1964.
- OSMASTON, A. E. Notes on the Forest Communities of the Garhwal Himalaya. *J. Ecol.* 10:129-167. 1922.
- *A Forest Flora for Kumaon*. Allahabad. 1927.
- PENNELL, F. W. *The Scrophulariaceae of the Western Himalayas*. Philadelphia. 1943.
- POLUNIN, N. *Introduction to Plant Geography*. London. 1960.
- POLUNIN, O. An Expedition to Nepal. *J. R. Hort. Soc.* 75:302-315. 1950.
- Plant hunting in the Nepal Himalayas. *Geogr. Mag.* 23:132-147. 1950.
- PURI, G. S. *Indian Forest Ecology*. Vols. 1-2. New Delhi. 1960.
- RAO, T. A. Report on a Botanical Tour to Milam Glacier. *Bull. bot. Surv. India* 1:97-120. 1959.
- A Botanical Tour to Pindari Glaciers and Kumaon Hill Stations. *Ibid.* 2:61-94. 1960.

- RAO, T. A. A Botanical Tour in Kashmir State. *Rec. bot. Surv. India* 18(2) : 1-67. 1961.
- Further contributions to the flora of Jammu and Kashmir. *Bull. bot. Surv. India* 2:387-423. 1960.
- Observations on the vegetation of Eastern Kumaon bordering the Nepal Frontier. *Ibid.* 6:47-57. 1964.
- RAU, M. A. On a collection of plants from Lahul. *Ibid.* 2:45-56. 1960.
- Flowering Plants and Ferns of North Garhwal, Uttar Pradesh, India. *Ibid.* 3:215-251. 1961.
- *Illustrations of West Himalayan Flowering Plants.* Calcutta. 1963.
- The vegetation around Jumnotri in Tehri-Garhwal, U. P. *Bull. bot. Surv. India* 5:277-280. 1963.
- A visit to the Valley of Flowers and Lake Hemkund in north Garhwal, U.P. *Ibid.* 6:169-171. 1964.
- RAVEN, P. H. The genus *Epilobium* in the Himalayan region. *Bull. Brit. Mus. (Nat. Hist.)* 2:323-382. 1962.
- ROYLE, J. F. *Illustrations of the Botany and other branches of the Natural History of the Himalayan Mountains and of the Flora of Cashmere.* London. 1839-40.
- SCHIMPER, A. F. W. *Plant Geography on a physiological basis.* Oxford. 1903.
- SCHMID, E. Contributions to the knowledge of flora and vegetation in the Central Himalayas. *J. Indian bot. Soc.* 17:269-278. 1938.
- SCHWEINFURTH, U. *Die Horizontale und Vertikale Verbreitung der Vegetation in Himalaya.* Bonn. 1957.
- SINGH, D. P. Kuth cultivation in Lahaul and its future. *Indian For.* 76:526-527. 1950.
- SINGH, GURDIAL Three months in Upper Garhwal and adjacent Tibet. *Him. J.* 19:3-17. 1955-56.
- SMYTHE, F. S. *Kamet conquered.* London. 1932.
- *The Valley of Flowers.* London. 1938.
- SOEST, J. L. VAN New species of *Taraxacum* from the Himalayan region. *Bull. Bot. Mus. (Nat. Hist.)* 2:261-273. 1961.
- STEARNS, W. T. *Allium and Milula in the Central and Eastern Himalaya.* *Bull. Brit. Mus. (Nat. Hist.)* 2:161-191. 1960.
- STEWART, R. R. The Flora of Ladakh. *Bull. Torrey bot. Cl.* 43:571-588; 625-650. 1916.



- STEWART, R. R. The Flora of the Deosai Plains. *Pakistan J. For.* 11: 225-295. 1961.
- TROLL, C. Die Klimatische und Vegetations-geographische Gliederung des Himalaya-systems. *Khumbu Himal.* Bd. 1:355-448. 1967.
- TURRILL, W. B. *Pioneer Plant Geography.* The Hague. 1953.
- WADIA, D. N. *Geology of India.* London. 1957.
- WEIR, T. *The Ultimate Mountains.* London. 1953.
- WYNTER-BLYTH, M. A. A Naturalist in the North-West Himalaya. *J. Bombay nat. Hist. Soc.* 50: 344-354; 559-572. 1951.
- ZIMMERMANN, A. *Pflanzen an der obersten Grenze der Vegetation 'Berge de Welt'.* Munchen, 1953.

## A D D E N D A

## RANUNCULACEAE

- Isopyrum anemonoides* Kar. & Kir.  
Kashmir, Himachal Pradesh (Chamba, 3600 m).

## CRUCIFERAE

- Hedinia tibetica* (T. Thoms.) Ostenf. (*Capsella thomsonii* Hook. f.)  
Kashmir (Ladak).
- Lignariella obscurus* (Dunn) Jafri [*Aphragmus obscurus* (Dunn) O.E. Schulz ex Krasch.]  
Kashmir.

## ROSACEAE

- Acomastylis elata* (Wall.) F. Bolle (*Geum elatum* Wall. ex Hook. f.)  
Kashmir (3000-4000 m).

## UMBELLIFERAE

- Eriocyclus caespitosus* (Edgew.) Wolff  
Kinnaur, Tehri-Garhwal, Garhwal (Niti, 3600 m).
- E. nuda* Lindl.  
Kinnaur (3300 m).
- Seseli sibiricum* (Linn.) Boiss.  
Kashmir, Himachal Pradesh (Pangi), Kumaon (4000 m).
- S. trilobum* (Edgew.) C. B. Clarke  
Tehri-Garhwal, Garhwal (Niti, 3600 m).

## COMPOSITAE

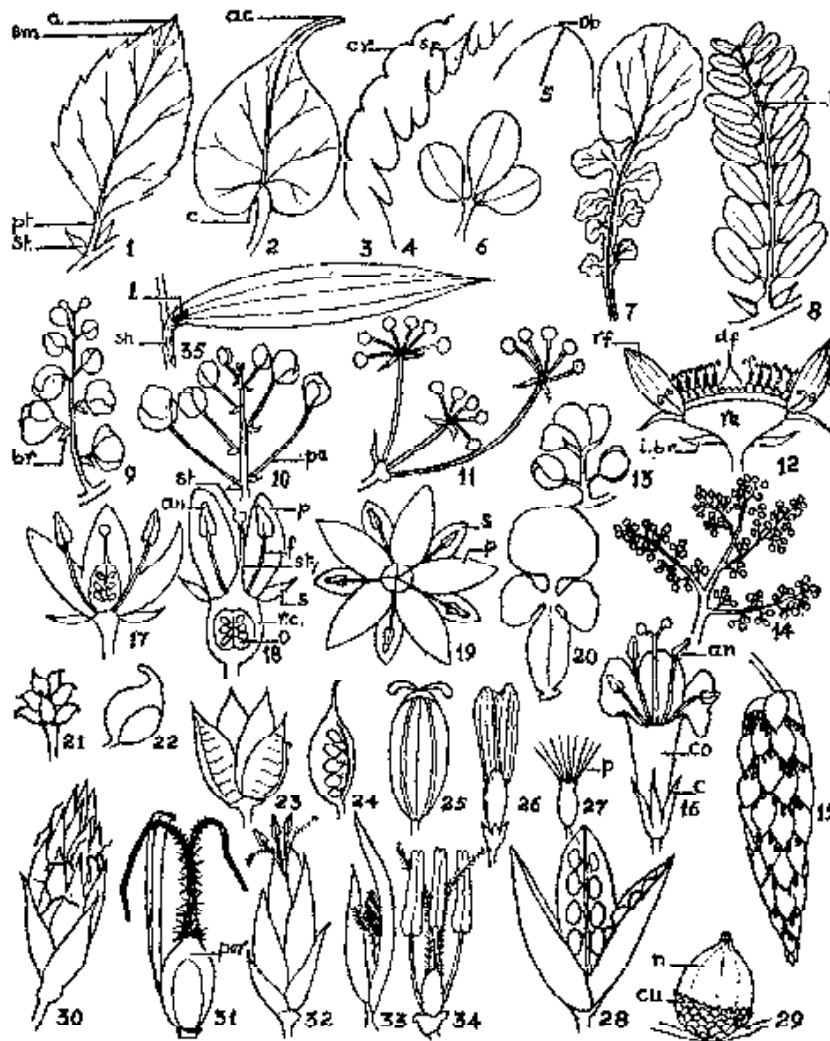
- Psychrogeton andryaloides* (DC.) Novopokr. [*Erigeron andryaloides* (DC.) C.B. Clarke]  
Lahul, Kinnaur.
- P. andryaloides* var. *denudatus* (Botsch.) Griens.  
Lahul (Baralacha La, 4800 m), Zaskar (4100 m).

## BORAGINACEAE

- Actinocarya acaulis* (W. W. Sm.) I. M. Johnston  
Ladakh, Rupshu (4500 m).
- A. tibetica* Benth.  
Ladakh (4500 m).
- Lappula heteracantha* (Ledeb.) Gurcke  
Kashmir (Zoji Pass 3300 m), Ladakh Road.
- L. patula* (Lehm.) Asch. & Gurcke  
Ladakh (Tsako La 5000 m).
- L. semiglabra* (Ledeb.) Gurcke  
Kashmir up to 3600 m.
- Lasiocaryum munroi* (C. B. Clarke) I. M. Johnston  
Ladakh (6000 m), Rupshu.
- L. densiflorum* (Duthie) I. M. Johnston (*Microcaryum duthieanum* Brand)  
Kashmir.
- Pseudomertensia echloides* (Benth.) Riedl [*Mertensia echloides* (Benth.) C. B. Clarke]  
Kashmir.
- P. mollis* var. *primuloides* (Decne.) Kazmi (*Mertensia primuloides* C. B. Clarke)  
Kashmir.
- P. lahulensis* (Brand) Kazmi (*Lindelofia lahulensis* Brand.)  
Lahul.

## GLOSSARY

- Achene**, a small dry, indehiscent 1-seeded fruit, usually derived from a single, free carpel.
- Acorn**, the characteristic fruit of an oak, containing a single large seed and enclosed basally in a cup-like structure.
- Actinomorphic**, radially symmetrical, with more than one plane of symmetry.
- Acuminate**, the apex of a leaf narrowed and gradually tapering to a point.
- Acute**, apex ending in a point but not drawn out.
- Adnate**, fused with another organ.
- Albuminous**, with reserve food material in the endosperm of seeds.
- Angiosperm**, plant having the seeds enclosed in an ovary.
- Anther**, the part of a stamen containing pollen grains.
- Auricled**, with ear-like projections at the base of leaves, petals etc.
- Awn**, a stiff, bristle-like extension from the tip or back of a floral envelope in grasses or from fruits.
- Berry**, a fleshy fruit, usually many-seeded.
- Bract**, a reduced leaf-like structure enclosing or subtending a flower.
- Bracteole**, a small bract or bractlet.
- Callus**, a swollen area in general; the base of a flowering glume below the point of insertion in a grass spikelet.
- Calyx**, the collective term for the sepals of a flower.
- Campanulate**, bell-shaped.
- Capitate**, head-like or in a dense cluster.
- Capsule**, a dry, indehiscent fruit derived from a many-carpelled and many-ovuled ovary.
- Carpel**, the constituent part of the ovary.
- Carpophore**, an extension of the receptacle between the carpels.
- Caryopsis**, the characteristic fruit of the Gramineae in which the ovary wall and the seed coat are united.
- Catkin**, a spike-like inflorescence of usually unisexual flowers.
- Cauline**, belonging to the stem or axis.
- Circumscissile**, dehiscing by a ring-like splitting, the top coming off like a lid.
- Comose**, with a tuft of hairs.
- Connate**, joined, generally applied to the fusion of organs of the same kind.
- Connective**, the part of the stamen holding together the two anthers.
- Convolute**, rolled inwards from one edge to the other.
- Coralloid**, coral-like.
- Cordate**, heart-shaped, the base of a leaf with a prominent sinus.
- Coriaceous**, leathery.
- Corona**, a ring or crown of scales, hairs or other appendages.
- Corymb**, an inflorescence in which the flowers of different ages come up to about the same level at the top due to correspondingly varying lengths of their pedicels.



Figs. 1-8 & 35. Leaves: 1. An ovate leaf with *pt*, petiole; *st*, stipule; *sm*, serrate margin; *a*, acute apex. 2. A leaf with *c*, cordate base; *ac*, acuminate apex. 3. Leaf margin *cr*, crenate. 4. Leaf with *sp*, spinescent margin. 5. Leaf with *ob*, obtuse apex. 6. A trifoliate leaf. 7. A pinnatisect leaf. 8. A pinnate leaf with *r*, rachis. 35. A leaf of grass with *sh*, sheath; *l*, ligule and parallel venation.

Figs. 9-15, 30 & 32. Inflorescences: 9. A raceme, *br*, bract. 10. A corymb, *pe*, pedicel. 11. An umbel (compound). 12. A head or capitulum (compositae), *i.br.* involucre bract; *re*, receptacle; *rf*, ray floret; *df*, disc flowers. 14. A panicle. 15. A catkin. 30. The spikelet of Cyperaceae. 32. A grass spikelet.

Figs 16-20, 33 & 34. Flowers: 16. A flower with *c*, calyx; *co*, corolla; *an*, anther. 17. Long. sec. of a flower with superior ovary. 18. Long. sec. of a flower with inferior ovary, *o*, ovary; *rc*, receptacular cup; *s*, sepal; *p*, petal; *f*, filament; *an*, anther; *sty*, style; *st*, stigma. 19. Diagram of an actinomorphic (radially symmetrical) flower. 20. Diagram of a zygomorphic (bilaterally symmetrical) corolla. 33 & 34.

Figs. 21-29 & 31. Fruits: 21. A cluster of achenes. 22. An achene. 23 & 24. Follicies. 25. The fruit of Umbelliferae (cremocarp). 26. A winged fruit (samara). 27. A cypsela (Compositae) with *p*, pappus. 28. A capsule. 29. An acorn with *n*, nut and *cu*, cupule. 31. The utricle of a *Carex* with *per*, perigynium.

- Crenate**, with rounded teeth along the margin.
- Cruciform**, placed cross-wise.
- Cuneate**, narrowed at the base, wedge-shaped.
- Cupule**, a cup-like structure derived from the coalescence of bractlets and enclosing the basal part of fruit (acorn).
- Cyathium**, the characteristic inflorescence of *Euphorbia* in which the staminate flowers, each represented by a single stamen, surround a single, central female flower and the entire group of these unisexual flowers is enclosed in a cup-like involucre.
- Cyme**, an inflorescence in which the central or terminal is the oldest.
- Cypsela**, an indehiscent 1-seeded fruit of the nature of an achene but derived from an inferior ovary.
- Decussate**, in opposite pairs (of leaves) but pairs at successive nodes placed at right angles to each other.
- Dentate**, marginal teeth projecting at right angles to the margin.
- Diadelphous**, stamens arranged in two groups, as in the Papilionoideae, where one bundle consists of 9 stamens and the tenth stamen is free.
- Dichotomous**, forking with two equal arms at each point of forking.
- Dicotyledons**, flowering plants having 2 cotyledons in their seeds.
- Didymous**, in pairs or twinned.
- Didynamous**, in two pairs, the pairs not being of the same length (e.g. 2 long and 2 short stamens of Labiatae).
- Dimerous**, parts of the flower in two or multiples of two.
- Dioecious**, the two sexes being found on different individuals.
- Dorsal**, the side away from the axis or the outer face of an organ.
- Drupe**, a fruit in which a fleshy outer coat surrounds a hard inner coat which encloses one or more seeds (stones).
- Drupelet**, diminutive drupe; a collection of drupelets is seen in a fruit like that of Raspberry.
- Ebracteate**, without bracts.
- Ensiform**, sword-shaped.
- Entire**, without teeth or divisions of any kind.
- Epicarp**, the outer coat of a fruit where the fruit wall (*pericarp*) consists of more than one layer or zone.
- Epigynous**, above the level of the ovary as in the case of an inferior ovary where the other floral parts are found on the rim of the calyx cup which is adnate with the ovary wall.
- Epiphyte**, a plant perched on another for support but not parasitic.
- Ericoid**, habit of a plant growing in peaty soils (heathers).
- Fascicle**, a close cluster or bundle of leaves or flowers.
- Fastigate**, with leaves or branches closely pressed to the main axis.
- Filliform**, very slender, thread-like.
- Follicles**, dehiscent, many-seeded fruits derived from a single carpel.
- Furrow**, deeply grooved or the striate part.

- Gamopetalous**, with fused petals.
- Gibbous**, swollen on one plane, surface or side.
- Glabrous**, smooth, without any hairs.
- Glochidiate**, possessed of bristles or hairs with barbed tips.
- Glume**, one of the basal chaffy structures of a grass spikelet.
- Gynobasic**, provided with an elongated or enlarged protuberance from the receptacle to which the carpels are attached and the stylar base adhering to the receptacular protuberance.
- Gynoecium**, the pistil or the female part of the flower.
- Halophyte**, a plant growing in an area rich in salts or salt marshes.
- Haustoria**, the suckers of a parasite.
- Hermaphrodite**, both sexes present in the same flower.
- Hypocotyl**, the portion of axis of a seedling below the level of insertion of the cotyledons.
- Imbricate**, closely overlapping one another.
- Indehiscent**, not splitting open in the usual way.
- Inferior ovary**, an ovary which is adnate to the floral cup (receptacular) and the sepals, petals, stamens attached to the rim of the cup above the level of the ovary.
- Inflorescence**, the arrangement of flowers on the flowering axes.
- Keeled**, with a ridge (the two anterior petals of a flower of the Papilionoideae are fused along their anterior margin and form a keel or boat-shaped structure).
- Labiate**, with lips, *i.e.*, in two dissimilar sets of structures like the petals (Labiatae) where the two upper petals form one lip and the lower three the other (bilabiate).
- Lamina**, the flat expanded portion of a leaf, the blade.
- Latex**, the milky juice found in plants.
- Lemma**, the lower bract enclosing the floral parts in grasses.
- Ligulate**, having a flat strap-shaped corolla as in the case of ray florets of the Compositae.
- Lip**, one of the two portions of a bilabiate corolla; the specialised petal of the orchids (*labellum*).
- Locule**, the chamber in an ovary or an anther.
- Loculicidal**, dehiscing along the middle of each chamber of a fruit derived from an ovary of more than one fused carpels.
- Lurid**, dull yellowish or brownish.
- Lyrate**, lobed along the margin of a linear leaf with the terminal lobe largest.
- Mericarp**, a portion of the fruit obtained by the splitting of the entire fruit and each one of these portions has all the appearance of an individual fruit (Umbelliferae).
- Monocotyledons**, flowering plants with one cotyledon in their seeds.
- Monoecious**, the male and female flowers occurring on the same individual.
- Muricate**, surface with small, hard projections.

- Nectary**, a nectar-secreting gland.
- Nut**, a hard, indehiscent fruit with one seed.
- Nutlet**, a diminutive nut; the indehiscent 1-seeded portions of the fruit in Boraginaceae, Labiatae and others.
- Obcordate**, heart-shaped with the attachment at the narrow end.
- Obovate**, egg-shaped with the broader end apical and the attachment at the narrow end.
- Obtuse**, rounded or with a blunt apex.
- Ovate**, shaped like an egg in longitudinal section with the attachment at the broader end.
- Ovary**, the part of the female structure (*pistil*) containing the ovules in an angiospermous flower.
- Ovule**, the structure containing the egg which develops into a seed after fertilization.
- Palea**, the upper bract which along with the lower bract (lemma) encloses the stamens and ovary in a grass floret.
- Palmate**, lobed or with leaflets arranged like the fingers on a palm.
- Panicle**, a branched inflorescence of racemes, spikes or cymes.
- Papillose**, with small rounded projections.
- Pappus**, the modified calyx in the Compositae which may consist of a tuft of hairs or scales or simple projections.
- Pedicel**, the stalk of an individual flower in an inflorescence.
- Peduncle**, the stalk of an inflorescence or that of an solitary flower.
- Penicillate**, brush-like.
- Perennial**, lasting for several growing seasons or years.
- Pericarp**, the wall of a fruit which is derived from the wall of the ovary.
- Perigynium**, a flask-shaped structure which encloses the ovary in *Carex*.
- Petal**, the individual member of the corolla of a flower.
- Pinnae**, the leaflets of a pinnately compound leaf.
- Pinnately compound**, the leaflets distributed on either side of a common axis.
- Pinnatifid**, divided in a pinnate fashion but the segments not separate from one another.
- Pinnatisect**, deeply divided as far as the axis.
- Placenta**, the ovule-bearing part of the carpel in an ovary.
- Plumose**, bearing hairy structures as in a feather.
- Pollinia**, collection of pollen in a waxy mass.
- Polygamous**, bisexual and unisexual flowers on the same plant.
- Polymorphic**, occurring in several forms.
- Pome**, the fruit of apples, pears etc., where the floral cup enclosing the ovary forms the main part of the fleshy mass around the chambers of the inferior ovary.
- Posterior**, the side towards the axis.
- Pubescent**, hairy.

**Pungent**, sharp-pointed.

**Raceme**, an inflorescence in which the flowers are distributed on an elongated axis with the progressively younger flowers found towards the apex of the axis (indeterminate).

**Rachilla**, an axis of the second order in an inflorescence or a pinnately compound leaf.

**Rachis**, the primary axis of an inflorescence or a pinnately compound leaf.

**Radical leaves**, leaves arising from the base, *i.e.*, from the crown of the root.

**Ray**, the marginal part of an inflorescence (the head) in the Compositae; the individual part of an umbel.

**Receptacle**, the part of the axis on which the floral parts are borne; the apical part of the inflorescence axis which supports the flowers as in the case of the Compositae.

**Reniform**, bean-shaped.

**Rhizome**, the horizontally growing underground stem; the rootstock.

**Rootstock**, the rhizome.

**Rosette**, leaves arranged in a radiate fashion.

**Rosulate**, in rosettes.

**Rotate**, wheel-shaped; corolla with short tube and spreading lobes.

**Rotund**, rounded in outline.

**Sagittate**, arrow-shaped; a triangular leaf with two acute lobes at the base.

**Salver-shaped**, with a narrow tubular part which suddenly expands into a saucer-shaped upper portion, *e.g.*, the corolla of a *Primula*.

**Samara**, an indehiscent fruit with wing-like expansion.

**Scabrid**, with a rough surface.

**Scap**, an elongated flower-bearing axis arising from the base and usually leafless.

**Scapigerous**, bearing scapes.

**Scar**, the mark left on the seed at the place of attachment when it is detached.

**Schizocarp**, a dehiscent fruit which splits into 1-seeded portions.

**Scorpioid**, an inflorescence which has the general appearance of a coiled structure before the flowers open (Boraginaceae).

**Scree**, generally applied to a mountain which has small, loose stones which slide down when one walks on them.

**Sepal**, the individual members of the outer floral envelope, the calyx, in a flower.

**Septicidal**, dehiscing along the lines of fusion of the carpels in a multi-ovuled ovary of more than one carpel.

**Septum**, partition.

**Serrate**, with teeth pointing upwards along the margin of a leaf.

**Setulose**, minutely bristled.



- Silique**, the characteristic fruit of the Cruciferae in which a false partition separates the two seed-bearing chambers and at the time of dehiscence, the two valves fall apart leaving the central frame with the seeds (*replum*).
- Sinuate**, with a wavy margin.
- Spathe**, a large foliaceous bract, generally coloured and enclosing an inflorescence of the nature of a spadix (a spike with a fleshy axis).
- Spike**, an inflorescence of the general nature of a raceme but with sessile flowers.
- Spikelet**, the characteristic unit of inflorescence of the sedges and grasses; a diminutive spike.
- Spinulate**, with minute spines or prickles.
- Stamen**, the male structure in a flower consisting of the stalk, the filament and the pollen-bearing part, the anther.
- Staminode**, a sterile stamen.
- Stipule**, an appendage generally occurring in pairs at the base the petiole where it is attached to the main axis; in the Polygonaceae, the stipules are fused to form a sheath around the node (*ochrea*).
- Stolon**, a prostrate stem-producing roots at the nodes and giving rise to new stems or plants.
- Style**, the slender part of the pistil between the ovary and the stigma.
- Superior ovary**, an ovary which is free from its surrounding parts and where the other floral parts are inserted around its base (*hypogynous*).
- Surculi**, suckers; structures for vegetative propagation.
- Syngenesious**, anthers cohering by their margins (Compositae).
- Tendril**, a twining or coiled structure seen in stems, leaves, leaflets of climbing plants.
- Tepals**, floral envelopes which cannot be clearly differentiated as petals and sepals.
- Terete**, cylindric, circular in transverse section.
- Ternate**, in threes.
- Tessellate**, chequered.
- Tetramerous**, parts of the flowers in fours or multiples of four.
- Tomentum**, woolly hairs.
- Torulose**, cylindrical with swollen portions at intervals.
- Trimerous**, parts of the flower in threes.
- Umbel**, an inflorescence in which the pedicels are of equal length and arise from a common point.
- Utricle**, a fruit with an inflated pericarp and enclosing a single seed.
- Venation**, the mode of branching of the veins or of disposition of the veins in a leaf.
- Villous**, with long weak hairs.
- Viscid**, sticky.
- Vittae**, the aromatic oil containing tubes seen in the wall of the fruits of Umbelliferae.
- Zygomorphic**, symmetrical in one plane only; bilaterally symmetrical.

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