

"Glabrous herb, 6 in. high. Leaves spathulate-lanceolate acute, the upper half of the margin dentate; blade 1.5 in. long, 0.5 in. wide, upper surface polished; petiole about 1 in. long. Scape simple, 1-3-flowered, polished; bracts thread-like, 0.6 in. long, or sometimes leafy. Calyx angular, 0.4 in. long, polished, teeth 0.2 in. long, acute, not spreading. Corolla white, grey-mauve, violet, or purple, with large orange or chocolate centre; tube 0.5 in. long, limb 1.25 in. wide, the lobes obcordate, 0.6 in. long, 0.5 in. wide; pubescent within the throat." "Field Notes."

[I have collected this plant in one locality in Sikkim where it showed the same remarkable range of colour. W. W. S.]

It varies also to orange:—

Doshong La. Alt. 12-13,000 ft. Flowers orange, more or less fragrant. On mud slides and in bogs in the alpine region. A beautiful plant. 29th June. F. K. W. No. 5869.

"Glabrous herb, 1.75 in. high. Leaves lanceolate; blade 0.75 in. long, 0.25 in. wide, upper surface polished; petiole 0.5 in. long. Scape simple, 1-flowered, 1.5 in. long, polished. Bracts minute 0.1 in. long. Calyx 0.4 in. long, angular, polished, teeth acute, 0.1 in. long, not diverging. Corolla orange, tube 0.6 in. long, puberulous on the outside; limb 0.75 in. wide, the lobes spreading, obcordate, 0.4 in. long, 0.4 in. wide; inside of throat and tube puberulous." "Field Notes."

Narrative and Observations on Distribution.

BY

F. KINGDON WARD.

In 1924, through the kindness of the Indian and Tibetan governments, I obtained permission for myself and one white companion to visit Tibet in order to collect plants. I laid my plans before the Government Grant Committee of the Royal Society and the Trustees of the Percy Sladen Memorial Fund, who thereupon financed me; Lord Cawdor volunteered to accompany me, and together we left Darjeeling on March 16.

Our objective was the country round the knee-bend of the Tsangpo, at the entrance to the great gorge, lat. $29^{\circ} 30'$ N. long. $95^{\circ} 0'$ E. Of the flora of this region, which lies almost midway between the Sikkim Himalaya and the mountains of Yunnan-Szechuan, practically nothing was known. In 1913, Majors Bailey and Morshead, travelling with very light equipment, had marched from Assam round the bend of the Tsangpo into Tibet, explored part of the gorge, and followed the

river westwards to Tsetang. The conditions under which this fine journey was accomplished, however, precluded the possibility of making collections ; and though Bailey did bring back a few fragmentary specimens and some seeds, it was rather on his diaries, in which reference is frequently made to Rhododendrons, Primulas, and other flowers, that I based my expectations. Thus on one occasion he writes : " The road was through pretty scenery, with clearings in the forest covered in flowers, among which we noticed blue poppies, purple iris, many varieties of Primula, and the poisonous aconite, *aconitum* " ; and it was in a village at this very spot that we ultimately made our base.

From Darjeeling we followed the main road to Lhasa, via the Chumbi valley, and Gyantse, having spent two delightful days with Major and Mrs. Bailey in Gangtok ; thus we were able to profit by Major Bailey's unique knowledge and experience of south-eastern Tibet. After leaving Gyantse we crossed the Karo La, and leaving the Lhasa road, skirted the southern shore of the Yamdrok Tso, and eventually reached Tsetang on the Tsangpo, about 50 miles S.E. of Lhasa. From here we followed the river eastwards for 200 miles, finally halting at the small village of Tumbatse (lat. $29^{\circ} 40'$ N. long. $94^{\circ} 45'$ E.). From here we made excursions southwards to the Himalayan range, visiting the Doshong La and Nam La ; northwards over the Salween divide on to the Tibetan plateau ; and through the gorge of the Tsangpo. In the winter of 1924-25 we returned to Tsetang by the Lhasa road, which follows the Gyamda valley, and turning due south along the 92nd meridian, reached India via eastern Bhutan.

In the course of the eleven months' journey, about 40 species of Primula were collected under 62 numbers.

We found in Tibet three climatic regions, each with its own distinct flora ; (i) the plateau, almost completely devoid of woody plants, semi-desert, but with a considerable sub-arctic and central Asian flora ; (ii) the region of dry winters and wet summers, including that portion of the Tsangpo valley which lies between the plateau and the gorge, and the mountains and valleys north of the Tsangpo and south of the Salween divide ; characterised by Coniferous forest, thick shrub growth, and a rich herbaceous alpine flora ; (iii) the region of perpetual precipitation, either winter snow and summer rain as in the alpine region, or both winter and summer rain, as in the gorge of the Tsangpo. The alpine belt is covered with a dense and varied growth of dwarf or scrub Rhododendron, passing into Conifer-Rhododendron forest below ; the rain-forest belt is covered with mixed forests, passing into sub-tropical forests below.

About two-thirds of the Primulas collected were found in region (ii), above, most of the remainder in region (iii).

The relationships of the Primula collection bring out clearly the unexpected result that the alpine flora of the Assam Himalaya is

more closely related to that of western China than it is to that of the Sikkim-Bhutan Himalaya; a conclusion amply confirmed in other genera such as *Rhododendron* and *Meconopsis*. At the same time there is, as might be expected, a strong Himalayan element in the flora; while the endemic element is confined chiefly to two sections, *Auriculata*, which belongs to Central Asia, and *Sikkimensis*; though it also runs through a number of other sections such as " *Nivalis*," " *Candelabra*," " *Petiolaris*," " *Soldanelloides*," " *Geranioides*," and " *Minutissima*," which have representatives both in Sikkim and China; in each of these sections we discovered one endemic species.

In the upper forests of Sikkim, below the Nathu La, in March, we found the banks blue with forms of *Primula petiolaris*, which grows in moist shady places, and is extremely variable. After crossing the Nathu La, we saw on sunny turf slopes in the Chumbi valley, *P. denticulata* in flower. Having crossed the Tang La, we reached the Tibetan plateau, and near Gyantse found in flower on April 1 the tiny *P. pygmaeorum*, which looks like a sessile flowered *P. tibetica*. It grows on grassy slopes and moss clad mounds, its bright rosy flowers nestling amongst the leaves. We did not meet with this plant again, though doubtless it extends both east and west, south of the Tsangpo.

Not till we reached the Tsangpo on April 21 did we see any more Primulas. A few miles below Tsetang, however, we left the plateau conditions behind, shrubs appeared, and in a ditch I found a " *Sikkimensis* " Primula in fruit—probably *P. Waltoni* or *P. prionotes*, one or other of which is found in irrigation channels at Gyantse, and around Lhasa.

After crossing the Tsangpo we found *P. tibetica* in flower for the first time on April 24, and saw it off and on throughout May and June, always in bogs, as far east as Tumbatse. It is a typical " dry-winter " plant, with a considerable east to west range on both sides of the Tsangpo, and a vertical range of some 3,000 feet. Round Tumbatse the bogs were inflamed with its bright rosy flowers, and here it attained 4 inches in stature. In Yunnan it is represented by the very similar *P. fasciculata*.

Another plant of wide distribution seen in flower for the first time the same day was *P. atrodentata*, a form of *P. denticulata*. This also was with us all the way to Tumbatse, growing by irrigation channels in half-shade, or on alpine lawns; it varies a good deal in stature, as might be expected of a plant with a vertical range of some 3,000 feet. It was extremely abundant in the drier meadows round Tumbatse at 11,000-12,000 feet, whence it extended into the alpine region. The best forms were found here.

At Tsela Dzong, where the Gyamda river joins the Tsangpo (lat. $29^{\circ} 30'$ N. long. $94^{\circ} 30'$ E.) we made our first serious halt, and from May 12 to June 4 explored the neighbourhood. We were in the " dry-winter wet-summer " region with *Rhododendron-Conifer* forest above,

but only bushes in the valley. The two commonest early *Primulas* are *P. Roylei* with cherry red flowers, and *P. atrodentata*. The former is found in the forests as low as 10,000 feet, and in the alpine region as high as 14,000 feet, waxing gross in the shade, remaining dwarfed at high altitudes. It is abundant in the mountains to the north-west of the Tsangpo loop, crossing over to the right bank at the Nam La ; in the alpine region it is particularly common on grassy flats where yak are tethered at night, but only scattered elsewhere. The plant continues to grow after flowering, forming a great cabbage, from the centre of which springs the glistening green umbel of seed-cups hoisted up on a long fleshy stalk. *P. Roylei* was previously known from Nepal, Sikkim, and Bhutan ; its distribution is thus carried eastwards and northwards. Sir George Watt mentions a yellow flowered form and a purple flowered form, the latter having a "strong metallic smell that causes headache," while the yellow forms have a "soft delicate odour." We saw no yellow flowered forms, nor did we notice the strong metallic odour in the purple flowered plants. Hooker says *P. Roylei* has rich claret coloured flowers, but the figure in the Botanical Magazine (tab. 6956) makes them purple. This figure is not particularly like our plant, while Royle's figure in his " Illustrations of the Botany of the Himalayan Mountains " bears no resemblance to either.

In the alpine region the only *Primula* which flowered as early as May, besides *P. atrodentata*, was *P. kongboensis*, a minute species of the "Denticulata" section, fairly common on the high hill tops, variable in colour from deep rose to almost white. In the region of perpetual moisture south of the Tsangpo, it is replaced by a species with violet or slate blue flowers (*P. doshongensis*). This, naturally, grows at a much lower elevation, namely 11,000-12,000 feet, as against 14,000-15,000 feet for the other.

June-July is the *Primula* season in this part of Tibet, for even in the dry winter region the snow lingers late, and ordinarily the rain does not come till mid-June.

Two "Candelabra" *Primulas*, flowering in June, have much more Chinese than Sikkimese affinity. *P. chungensis*, a dry winter species found on both sides of the Tsangpo, is a Chinese plant. *P. Morsheadiana*, a wet winter species found only south of the river, is allied to the Sino-Burmese *P. serratifolia*. But, as a matter of fact, it is rather misleading to call *P. serratifolia* either Chinese or Burmese. For purposes of distribution, it will be necessary to recognise a fourth area, contiguous to, but distinct from, the three areas—Chinese, Tibetan, and Himalayan—hitherto recognised. This new area, comprising the inner curve of the great mountainous arc which encloses the bends of the Tsangpo and Salween, and including therefore the headwaters of the Irrawaddy, may be called Indo-Malayan. It is the area referred

to above as that of perpetual precipitation. In the alpine belt, this precipitation, of course, takes the form of snow which lies for at least seven months, leaving only a five months' vegetative season. The *Primulas* of this area are *P. Morsheadiana*, *P. Valentiniana*, *P. Dickieana*, *P. petiolaris* and its allies, *P. Jonarduni*, and the unique *P. falcifolia*, from which it will be seen that it is not rich in alpine herbaceous plants. The distribution of the above shows the unity of this area, and is its justification. It is the political significance attached to such convenient names as Burma and China which makes them inappropriate, if not actually misleading, when dealing with geographical distribution.

We paid three visits to the Assam Himalaya on the Namcha Barwa range, on one occasion crossing over into Pemako on the south side of the Himalaya. In the middle of June we found at the Doshong La—a region of perpetual precipitation—*P. falcifolia* and *P. Morsheadiana*, much more abundant on the south side of the range than on the north, and both flowering either in the middle of June or in the middle of October; *P. Valentiniana*, confined to alpine turf slopes above 13,000 feet; *P. Dickieana*, in three colour varieties, confined to the south (wetter) slope, usually in marshes; *P. Jonarduni*, confined to gneiss rocks above 13,000 feet; and *P. chionota*, a yellow flowered "Petiolaris," also confined to the high alpine turf slopes.

P. falcifolia is endemic, and we found it nowhere but on the Doshong La, where it is extremely common, growing with *P. Morsheadiana*, another endemic species, on steep boggy grass slopes. The autumn plants differ slightly from the spring flowering; *P. Morsheadiana* in its paler flowers, *P. falcifolia* in not being scented.

P. Valentiniana is recorded from Hpimaw on the North-East Frontier of Burma, and from the Gompa La, on the Salween-Taron divide, these two localities being on the same range of mountains, about 150 miles apart. The Doshong La is about 300 miles west of the Gompa La, in an air line across the headwaters of the Irrawaddy.

P. Dickieana is recorded from Sikkim, where it is very local, from Imaw Bum, near Hpimaw, where it is fairly abundant, from the Gompa La where it is extremely abundant, and from the Doshong La where it is equally common. We found plants with violet flowers, others with yellow or white flowers, others again with grey flowers. Each colour variety tends to segregate, though yellow and white grow together; plants with violet flowers, which are borne on longer scapes than the others, keep entirely to themselves. Whole grass slopes and marshy meadows were sheeted with this species in bloom on June 29. Yet when we came to collect seed in October scarcely a capsule could we find. The vast majority had aborted.

P. chionota is a third endemic, which was fairly common, but only in the first flush of bloom at the end of June.

P. Jonarduni belongs to the "Dryadifolia" section, which is distinctly Chinese; it is recorded from Tibet, farther west, but there is no known "Dryadifolia" in Sikkim. *P. philoressia*, another species of the same section, very like *P. dryadifolia* itself, I discovered many years ago on the Mekong-Salween divide; it may be regarded as the dry-winter representative of *P. Jonarduni*, the former confined to the north bank, the latter to the south bank of the Tsangpo.

Our second visit to the Himalaya, in July, brought us to the Nam La, a pass only a few miles north-east of the Doshong La, but with an entirely different climate; it must in fact be classed with the dry-winter regions on the left bank of the river.

Four very interesting species were gathered here, all flowering in July. The Primulas, which centre round the Kansu *P. Maximowiczii*, have never before been recorded from the Himalaya, and the occurrence of both *P. Maximowiczii* itself, and *P. szechuanica*, over 300 miles west of their supposed home, came as a surprise. We found neither of them in abundance. *P. Maximowiczii* is a woodland plant, occurring on both sides of the river; *P. szechuanica*, an alpine or sub-alpine species, growing in the open amongst bushes on ancient moraines. Both are fragrant—the only respect in which they seem to differ from the Chinese types.

Section "Rotundifolia" is Himalayan and Trans-Himalayan, with no representatives in China. We found two species. *P. Baileyana* is endemic, and occurs abundantly in rocky places on both sides of the river at 13,000-14,000 feet. *P. Littledalei* is a fragrant mauve flowered plant of the highest crags. It appears to be somewhat rare, though widespread, having been recorded from north and east of Lhasa. We found it only at the Nam La, where it was not particularly common. It was originally described as having yellow flowers, but this is probably a mistake.

Perhaps the most interesting group of Primulas encountered were those of the "Sikkimensis" section, concentrated in the dry-winter area, but expanding outwards to the plateau on the one hand and to the area of constant precipitation on the other. In the dry-winter region they are the most abundant Primulas of all. There are at least four species, three of them endemic in Tibet. All are fragrant. All flower towards the end of June, lasting well into August. The finest is a new species, *P. Florindae*, abundant in running water under trees, growing in large colonies. It occurs from the upper end of the Tsangpo gorge, westwards on both sides of the river, for perhaps a hundred miles, and northwards almost to the southern foot of the Salween divide. Thus its range is restricted.

P. microdonta is more widespread. It has been recorded from Yunnan—where it must be very rare, but is quite common in Kongbo province, on the north bank of the Tsangpo. There are yellow, white, violet, claret, and other colour varieties, but the aggregate species tends to segregate into well marked microforms.

The pale yellow flowered plant of Tumbatse (var. *alpicola*), which grew in countless thousands in the moist meadows all up the valley and which was extraordinarily fragrant (K.W. 5746), we saw nowhere else. It flowers from mid-June onwards. At higher elevations and on the right bank of the Tsangpo it was replaced by coloured forms—violet, claret, and so on (K.W. 5818). Farther north a variety with taller scapes and three or four whorls of flowers, yellow or white, was met with (K.W. 6117). All of these were localised forms, but occurred in tens of thousands of plants; indeed, *P. microdonta* was probably the commonest Primula met with, usually growing by itself. In alpine regions on either side of the river *P. microdonta* is replaced by the dwarf yellow variety *P. micromeres*, or by *P. pudibunda*, found everywhere in the dry-winter alps, but not at the Doshong La.

Finally there is *P. Waltoni*, another Tibetan plant, found on one pass, where it was fairly abundant. It has ruby red flowers suffused with meal. *P. Waltoni* is a species of the plateau, growing along the banks of streams and irrigation channels at Gyantse.

The occurrence of these coloured species in Tibet is of particular interest. No purple flowered "Sikkimensis" is known from Sikkim, and in China they have so far segregated from the yellow flowered species as to refuse to cross with them. In Tibet, yellows and purples appear to be in a state of flux, and they probably cross freely. At any rate, yellows, whites and purples may be found growing together. The species, starting from a centre in south eastern Tibet, and working on internal lines of communication, seem to have radiated out west, south and east over the passes of the Himalaya, and developed distinct types; the only species which is common to Sikkim and China being *P. sikkimensis* itself, and that, curiously enough, does not occur in Tibet, the nearest approach to it being the yellow form of *P. microdonta*.

The "Nivalis" section brings out strongly the Chinese relationship already referred to. The section is very poorly represented in Sikkim, but richly in western China. Excluding *P. Maximowiczii* and *P. szechuanica*, but including the doubtful *P. falcifolia*, there are eight "Nivalis" species in Kongbo, half of which are Chinese species. Two species seen in fruit cannot be placed; one species is new, and there is the curious *P. falcifolia*, which has both Nivalid and non-Nivalid characters. The Chinese species are: a fine form of *P. sinopurpurea*, common on the alpine moorland; *P. pulchella*, of which a few plants were seen; *P. pulchelloides*, on dry scrub clad hills, widely

distributed north of the river ; and the alpine *P. rigida*, a rather local plant. These all flower in June. *P. ninguida* is a new microform of *P. nivalis*, found growing with *P. sino-purpurea* on Rhododendron moorland.*

The " *Geranioides* " section ranges from Sikkim to China, and is represented in Tibet by a new species *P. latisecta*, which is confined to the left bank of the Tsangpo, and is commoner in the north, especially round the Pasum Lake. (Lat. 30° 0' N. long. 94° 30' E.)

Evidently we did not go sufficiently far east to witness the expansion of the " *Muscaroid* " section, represented in the Himalaya by a few species and in China by a great many.

The Sikkim *P. bellidifolia* was abundant on every range in the dry-winter area, including the Nam La, flowering in late June and July. Two other species are the Bhutanese *P. micropetala*, of which we found two or three specimens only, and *P. atricapilla*, which was common.

The remaining species which call for notice are *P. Cawdoriana*, a new species of the section " *Soldanelloides*," found growing with *P. bellidifolia* and flowering in July ; and *P. pseudo-capitata*, which is a Chinese plant.

So much for the species found in Tibet ; and the list is remarkable enough. But not less remarkable are the absentees. We found no species of the " *Omphalogramma* " section, though the conditions appeared favourable, and the section is represented in Sikkim, China, and Burma ; no species of the " *Bella* " or " *Mollis* " or " *Farinosa* " sections, and only two " *Candelabras* " in a region admirably suited to them. Nor did we find *P. sikkimensis*, which is probably the only species of Primula common to Sikkim and China. For reasons already given I exclude here *P. Dickieana*, though it must be confessed that its east-west range is nearly equal to that of *P. sikkimensis*. Of the 40 species found, 12 or 30 per cent. are definitely Chinese, and 8 or 20 per cent. are Himalayan, Sikkim or Bhutan. No less than 16 or 40 per cent. appear to be peculiar to Tibet, while 2 species—*P. Valentiniana* and *P. Dickieana*, which are fairly widely distributed, may be classed as alpine Indo-Malayan.

Thus Tibet has more endemics than wide (to use the term coined by Dr. J. C. Willis), and the non-endemic flora is more Chinese than Himalayan. About 10 species or 25 per cent. are new.

* The blue and purple Nivalids (i.e. *P. sinopurpurea* and *P. ninguida*) are easily distinguished in fruit. The former is a smaller plant, with narrower, thicker, more fleshy leaves, the veins of which do not show through ; it also has a shorter and fatter capsule.

The following positions are given to facilitate exact reference (see Map, Geographical Journal, February 1925) :—

Place.	Lat. N.	Long. E.	Notes.
Doshong La -	29° 30'	95° 0'	E. Himalaya.
Atsa - - -	30° 40'	93° 0'	Plateau.
Gyantse - - -	29° 0'	89° 35'	Plateau.
Temo La - - -	10 miles south-west of Tumbatse		Rong chu basin.
Tumbatse - - -	29° 40'	95° 45'	Rong chu basin.
Tsela Dzong - -	29° 30'	94° 30'	Tsangpo Valley.
Kongbo Peri -	"	"	"
Pab Ri - -	"	"	"
Nyima La - -	6 miles south of Tumbatse		Rong chu basin.
Nam La - -	5 miles north of Doshong La		E. Himalaya.
Tongkyuk - -	30° 0'	94° 50'	Rong chu basin.
Druk-la Gompa -	30° 0'	94° 0'	Tsangpo-Salween divide.
Nambu La -	30° 0'	94° 30'	" "

A New *Omphalogramma* from Yunnan.

Omphalogramma Rockii, W.W.Sm. Sp. nov.

Species affinis *O. Engleri* (Knuth), Balf. fil. a quo scapis folia longe excedentibus, corollae lobis obtuse-angusti-ovatis leviter incisis sed haud retusis, corollae tubo multo graciliore recedit; ab *O. vincifloro*, Franch. primo intuitu corollae lobis facile distinguitur; ab affini *O. Viola-grandi*, Farrer et Purdom habitu majore, corollae lobis valde diversis recognoscitur.

Planta erarinosa glanduloso-hirsuta, foliis longe petiolatis, floribus coactaneis, sub anthesi squamis membranaceis vel nunc subfoliaceis basi cincta. Folia plerumque 12-20 cm. longa; lamina ad 10 cm. longa, ad 4 cm. lata, vulgo oblonga, apice rotundata, basi subrotundata, margine obscure sinuato-crenulata, in sicco textura membranacea, supra pilis longiusculis albidis bene conspersa, infra sparsius, utrinque glandulis globosis rubris crebre punctata, ad marginem pilis glandulosis.

[Notes, R.B.G. Edin., No. LXXII, Feb. 1926.]