



---

The Flora of Ladak, Western Tibet. I. Discussion of the Flora

Author(s): Ralph Randles Stewart

Source: *Bulletin of the Torrey Botanical Club*, Vol. 43, No. 11 (Nov., 1916), pp. 571-590

Published by: Torrey Botanical Society

Stable URL: <http://www.jstor.org/stable/2479609>

Accessed: 13-12-2016 05:08 UTC

---

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at <http://about.jstor.org/terms>



*Torrey Botanical Society* is collaborating with JSTOR to digitize, preserve and extend access to *Bulletin of the Torrey Botanical Club*

## The flora of Ladak, Western Tibet. I. Discussion of the flora

RALPH RANDES STEWART

(WITH TWO TEXT FIGURES)

### INTRODUCTION

In the books that deal with the "Trans-Himalaya" region there is the greatest confusion in the way the term "Western Tibet" is applied. The term may mean any place from the arid region, north of Sikkim, to the Karakoram Mountains, on the road to Turkestan. The result is that when the record "Western Tibet" appears in Hooker's *Flora of British India* (22)\* one knows very little about where the specimen really came from. Even when the name of the collector is given, the source of the specimen cannot always be determined, as several explorers travelled extensively. As a result, a number of the species mentioned in the check list in the second part of the present paper may not grow in Ladak, but they are listed for the sake of completeness.

The region with which this paper deals is properly called Ladak to distinguish it from the other parts of Little or Western Tibet. Its inhabitants are largely Tibetan Buddhists and its flora is closely related to that of Tibet proper, but it is under the political control of Great Britain, being a part of the dominions of the Maharajah of Kashmir. Hemsley and Pearson's list of the plants of Tibet (20) does not include those from this region.

In their *Flora Indica* (23) Hooker and Thomson limit Ladak to a narrow strip on each side of the Indus, but I shall follow Neve's *Tourist Guide* (1913 edition).† According to Neve:—"Ladak is a large tract of country including Rupshu, Zanskar, Nubra, as well as Middle Ladak, and the lofty plateaux south of the Karakoram. It contains the loftiest inhabited districts in the world. No part is below 9,000 ft. and a large portion of the population live at

---

\* The numbers refer to the Bibliography at the close of the second part of this paper.

† Neve, A. *Tourist's guide to Kashmir, Ladakh and Skardo.* 1913.

elevations of from 12,000 to 15,000 feet. While this is the height of the valleys and plateaux, the mountain ranges average from 17,000 to 21,000 feet and many peaks are 25,000 feet high."

In the check list of plants an effort has been made to list those reported from the region as given by Neve, using the "Great" or Snowy Range as the boundary on the Indian side, Baltistan on the west, the foot of the Karakoram on the north, Tibet on the east and also on the southeast.

One of the most characteristic features of Ladak is the Indus. The main caravan routes follow it or its branches and the villages are all placed so that they can get a little of its water for the fields. In fact, Ladak might be called the part of the drainage system of the Indus above 8,500 feet. The next lower part is called Skardo or Baltistan.

Contrary to the popular opinion, Tibet, including Ladak, is a very rugged country, rough, rocky and stony with countless mountain peaks and sandy desert valleys. The level places are either troughs between the mountains or the basins of extinct lakes. The further into the country one penetrates the more rounded are the hills and the gentler the slopes of the valleys, because of the smaller amount of erosion. There are many things that indicate that the Indus has been doing efficient work in clearing out the valleys near Kashmir, such as its deep gorges, the V-shaped valleys and the old marks of higher levels. Other great rivers are doing the same thing farther east.

Of the parts of Ladak visited, Rupshu is the least eroded. The whole country is above 15,000 feet and is extremely cold, barren and desolate. Springs are sometimes a day's journey apart and many valleys seem without any water. Many streams dry up before they reach a permanent river and in other places are shallow saline lakes, devoid of outlets. Despite its great altitude eighty flowering plants were found. There are practically no cryptogams. Both the flora and the topography resemble that of Tibet proper.

At the other extreme, Suru is supplied with much more water. The snow line is much lower and there are many streams and springs. The valleys in Suru are deep and the flora is more like that of Kashmir than that of Tibet. Dras is also more fertile than the rest of Ladak.

## GEOLOGY

Although the geology of Ladak is not very well known, the following interesting facts are gathered from Burrard and Hayden (8):—

“All the geologic series is reproduced in Tibet from almost the earliest till modern times. Tibet, counting everything behind the great Himalayan range, consists of more than 20,000 feet of sediments, almost entirely of marine origin and represented by such rocks as slate, sandstone, conglomerate and limestone. Along its southern border it is in contact with the Himalayan granite which throws out branches ramifying through and metamorphosing the sediments.

“During almost all geologic time all of Tibet and the northern slope of the Himalayas was under a sea which at one time stretched to China and at another to the Mediterranean. The region kept subsiding and subsiding and later was elevated. In Cambrian times it is believed that Tibet and North America were joined, as the fossils are similar while they differ from those of Europe. At the close of the Cambrian this sea (the Tethys of Suess) linked up with the Palaeozoic sea of Europe.

“Crystalline and metamorphic rocks, granite, gneiss and schist cover the greater part of northern Kashmir, including Baltistan and west to the mountains of Afghanistan. To the east they run through northern Ladak. In eastern Kashmir they constitute much of Zaskar.”

In view of the agreement among geologists that the elevation of the Himalayas has taken place in very recent time, and that Tibet, including Ladak, was under a sea which piled up tremendous sedimentary deposits until the Tertiary period, the flora can not be considered an old one. Nevertheless, the Russian botanist, Maximowicz (27), who worked on the plants of the untiring Tibetan explorer Prejevalsky, says that the flora is extremely ancient.

As the Workmans and other travellers have remarked, Ladak and Baltistan are lands of rock ruin. In the summer the heat in the daytime is so intense and it is so cold at night that the mountains are cracked and crumbling and there are huge talus slopes at their feet. Even in the winter Moorcroft reports that the heat may be intense for an hour or two in the sun, making a great daily variation in temperature.

## CLIMATE

Ladak is almost cloudless in the summer time and the glare from the bare rocks and the sand is so intense that travellers must wear smoked glasses and pith helmets and must take especial care to protect the skin. Sun temperatures are so high that it is a wonder that any plant can live out in the deserts. India is

noted for its heat but the Workmans found that the sun temperatures in India rarely go to 170° F. At altitudes of 14,000–19,000 feet, however, they obtained maximum temperatures of from 183° to 204° F., although it was from 47° to 60° in the shade. The result is that one frequently finds it uncomfortably cool in the shade of a great rock while the sand is blazing hot in the sun.

The plants, therefore, that are not in damp places are exposed to extremes of temperature. This is true even in the winter time, for although a little snow falls, it does not lie long in the valleys. The missionaries at Khalotse, however, told us that the Indus remains frozen over during a part of the winter at least.

The growing season in Ladak is a very short one, even in the lower parts, and a traveller who visits the country only in July and August can therefore find the great majority of the species. There are several causes for this. In the first place, there is no rainy season to give birth to an ephemeral desert flora such as we have in the American Southwest. In the second place, plants that are in fruit at one altitude can be found in flower at higher altitudes. Further, most of the wild flora, excluding the annual weeds in the villages, is perennial and the leaves can be found even if the flowers are missing.

At Leh, Moorcroft reported that frosts began early in September and continued until May. Barley sown May 10th was cut September 12th. At Spituk, nearly 1,000 feet lower, he says that it took barley only two months to mature. Strachey says that in western Tibet elevations below 14,000 feet appear to be exempt from night frost for the greater part of the summer quarter. At 15,500 feet it freezes every night in the year. At 18,000–19,000 feet it thaws only during the afternoons of July and August. While we were in Rupshu in August we suffered greatly at night from the cold. One night half an inch of ice formed and the thermometer registered 21° F.

The country is practically without rainfall. The average at Leh is about three inches a year. Usually what precipitation there is falls at night and only on the mountain ridges and passes. A number of times in July and August we noticed that a light blanket of snow fell on the mountain tops while there was no

precipitation in the valleys. This is the reason that up to a certain altitude the number of species tends to increase instead of decrease. Even passes like the Fotu and Namika that are not near perpetual snow have more plants near the summit than in the deserts that have to be crossed in the ascent.

### BOTANICAL EXPLORATIONS

Considering its remoteness, Ladak has been visited by a surprisingly large number of explorers who collected plants. This is due to the fact that it is on the only practicable highway from India to Central Asia, since Afghanistan is closed, and because it has been the base of a great deal of Tibetan exploration.

Despite its many visitors and the abundance of meager references the only attempt to bring together the work of the different visitors is that of the Flora of British India by Hooker (22) and here of necessity the plants are scattered through the seven volumes in their natural arrangement. Hooker never visited the Northwest Himalaya himself but we would be lost without his book. When we use Hooker's volume we are tempted to complain of the indefiniteness of many descriptions, the lack of keys to genera, and the "lumping of species"; but when we consider that he has done for British India what no one has done for the United States we are thankful indeed.

It is probable that the first Europeans to visit our region were the Jesuits, Desideri and Freyre, who passed through Ladak in 1724 on their way to Lhasa, but they have given us no botanical information. It was not until the expedition of Dr. Moorcroft, from 1819 to 1825, that we learn anything first-hand. In 1812 he had gained experience by penetrating into Tibet and exploring the region of the sacred Lake Manasarowar. In 1819 he started with Trebeck and Guthrie in an attempt to open up Central Asia to British trade. He entered Ladak from Lahoul, crossing over the Baralacha Pass and penetrating to Leh *via* Rupshu. He desired to press on to Turkestan, but although he waited about two years he failed to get permission from the authorities because of the jealousy of the Kashmir merchants. During his stay, however, he took time to explore Nubra, Zanskar, Dras and other parts of the country. He was not a botanist but he took a keen

interest in the agriculture of the people and the plants that might be useful elsewhere. Though his book (29) is nearly a hundred years old it is the best account of the crops and methods of cultivation. The few specimens he collected were sent to Wallich or Royle.

Vigne (38), who visited Kashmir, Astor, Skardu and Ladak in 1835, collected ninety species, but some were in such bad shape that Royle could not determine them.

Falconer, who was in charge of the Saharunpur Gardens, collected a little later (1839?) in Kashmir and Baltistan but he does not seem to have penetrated into Ladak any further than Dras.

The best collecting that has been done was probably by Thomas Thomson (36, 37), from 1847 to 1848. He was botanist to the Tibetan Boundary Commission appointed by Lord Hardinge. Captain Henry Strachey, another keen observer, was in charge of the survey. Western Tibet was explored from Spiti to the Karakorams and large collections were accumulated which were widely distributed. Most of the Ladak specimens in the herbarium of the New York Botanical Garden were collected at this time.

In 1848, Richard Strachey (35) with J. E. Winterbottom, visited Lake Manasarowar and explored the Tibetan course of the Sutlej. This is really outside of Ladak but the flora is much the same. The next year, with his brother Henry, Richard Strachey went in from Ladak and explored Hanle and the Tibetan province of Guge. We are indebted to these three men for a great deal of valuable botanical and geographical information.

From 1855 to 1857 the Schlagintweit brothers (32) visited the Himalayas, crossing Ladak and going into Tibet. They were not botanists but they collected plants carefully and their collections have been worked up by different specialists.

About 1862, while on a pleasure trip, William Hay made a collection of Rupshu plants to which Hooker had access. He does not seem to have published anything.

J. L. Stewart (33), about 1868, made a botanical tour through Rupshu and Ladak. Although he mentions some of his findings in his publications he did not publish a complete list.

In 1873 Henderson and Hume (21), members of the Forsyth Mission, published a list of four hundred and twelve plants col-

lected in Ladak and Yarkand. About two hundred and seventy-six of these are definitely listed from Ladak.

A great deal of our knowledge of the plants of Gilgit, Skardu, and the Karakoram is due to C. B. Clarke (12), although he does not seem to have done much, if any, work in Ladak proper.

J. F. Duthie crossed the Zoji in July, 1893, visited Dras, the Deosai Plains, and went back to Kashmir *via* Bandipur. In his reports (16) he does not list many of the plants he found.

A. Meebold entered Ladak from Kashmir *via* the Bhot Khol Pass in 1905 and explored parts of Suru, the Kangi region, and the road to Dah. He visited Leh and the Khardong, and has published interesting lists of plants (28).

A number of other men who collected in Ladak did not publish anything of their findings. Among these are Lance, Cayley, Stoliozka, and the Moravian missionaries, Heyde and Jaeschke. Hooker had access to most of these collections. Mention should also be made of the illustrated works of Royle (31), Jacquemont and Hoffmeister. The last two did not live to reach Europe and complete their work but Jacquemont's plants were published by Cambessedes and Decaisne (9), while Klotsch and Garcke (25) completed the work of Hoffmeister. Although none of these men visited Ladak they explored adjacent regions and their books are therefore very useful.

Recent lists of plants by Conway, Deasy, the Workmans and De Filippi of the Abruzzi expedition give us a good idea of the flora of the Baltistan and Karakoram region and are useful for comparison. The paper by Hemsley and Pearson on the Flora of Tibet (20), which covers the work of Thorold, Prejevalsky, Hedin and the other Tibetan explorers, is very valuable.

My own work was undertaken in 1912 and 1913. It covers Dras, Suru, Middle Ladak as far up the Indus as Upshi, and the region of Rupshu. The only districts that do not seem to have been collected in before are the Sapi, Rusi, and Yarungshan Passes in Suru and the obsolete road from Bosgo to Khalotse, *via* Tingmogung.

*Itinerary of my trips.*—I entered Ladak July 18, 1912, with three other men. We crossed the Zoji Pass (11,500 ft.) from Kashmir and followed the main caravan road to Leh (11,500 ft.),

arriving there July 30. August 2 we climbed to the Khardong Pass (17,500 ft.) but a snowstorm made it impossible to see what grew near the summit. This was the highest point reached in 1912.

Leaving Leh we returned to Kashmir by another route. From Bosgo we took the old and higher road *via* Timisgam and Tingmogung, rejoining the new road at Khalotse. August 14 we left the main path below Moolbeck and turned off toward Suru, crossing the Sapi La (16,000 ft.) on the 16th and visiting the Pakartse on the 19th. The 21st we crossed the Yarungshan La (15,500 ft.) and returned to Kashmir via the Wardwan Valley.

With another party I returned to Ladak in the same way (*via* the Zoji) in 1913 and arrived at Leh by the end of the month of July, staying a week in the vicinity. August 6th we started on up the Indus, passing the famous Himis Monastery and leaving the Indus at Upshi in order to visit Rupshu, reputed to be the highest inhabited part of the world. The inhabitants are nomads, depending for their livelihood on their herds of yaks, goats and sheep. From Gya we ascended the Takalung La (17,500 ft.) and descended to the plains that seem to be the favorite home of the wild ass, *Equus kyang*, and the Tibetan hare. August 9, we visited the salt lake called the Tsokar, one of the many Central Asian lakes without an outlet. August 12, we crossed the Lachalung La (16,600 ft.) and the Baralacha (16,000 ft.) the 15th, arriving in Kyelang, the main village of Lahoul, the next day. Thence *via* the Rotang and Kulu we went on to Simla.

Travelling on foot we covered about 400 miles in Ladak each summer. Not many novelties were found, though four or five things seem to be new. In order to make sure a trip to Calcutta or Kew would be necessary. With the exception of a few from Kargil (8,700 ft.) my specimens, which amount to about 475 species, were gathered at altitudes of from 9,000 to 17,500 feet.

#### FLORISTICS

Though the flora on the Indian side of the "Great range" of the Himalayas, which separates Kashmir from Ladak, is luxuriant and abundant, the opposite is true on the other side. In Kashmir, forests with *Betula utilis* at the upper limit are found up to about

13,000 feet but there is no forest in Ladak. Trees will grow when they are irrigated, or in a rare spot where they can find water naturally, but they form a very small part of the covering of the country.

Between Kashmir and Ladak there is, to be sure, a transition zone which is possibly widest in the Suru region, Himalayan alpine plants being found where there is water far into the heart of Tibet. Taking the flora as a whole, however, there could hardly be a more pronounced contrast than between these two regions. This is due not to altitude but entirely to water relations. The high mountains stop the rain-laden clouds and very little moisture gets across. Wherever there is enough water from melting snow, which can be led out by irrigation ditches to carefully prepared terraces, crops



FIG. 1. An oasis in the Rupshu region, altitude about 15,000 feet.

and trees flourish. Wheat or barley may be growing on one side of an irrigation ditch while desert plants are on the other. These ditches are prepared with great care and run along the hillsides for long distances. They are conspicuous objects because of the border of grass due to the extrat moisture.

There are, as Meebold also notes, three main elements in the flora of Ladak, alpine, desert and oasisitic. These three are very easily recognizable and separable. The alpine element is largely

confined to narrow belts below the melting snows and along the upper courses of the streams and does not spread out into the valleys. The main part of the country is desert with a flora that connects up with Turkestan more than it does with India. The flora of the oasis (FIG. 1) is cosmopolitan. A few things like *Lancea tibetica*, *Pedicularis longiflora*, and species of *Gentiana*, which grow out in the desert if there is water, are indigenous without doubt, but most of the plants are weeds that may be native but are probably introduced. When a country has been settled as long as parts of Central Asia it becomes difficult to tell what the indigenous flora is.

If one unfamiliar with Ladak were to read through a systematic list of the species growing there he would suppose that the flora as a whole was mesophytic. This is chiefly because of the large number of weeds growing in the villages. As a matter of fact, most of the country is desert, but the number of truly xerophytic species is not proportionately large.

#### FOTU LA AND NAMIKA LA\*

The following list of the plants collected on and near the barren Fotu and Namika Passes gives an idea of the type of plants that are found out in the open, away from the villages, at altitudes of from 10,000 to 13,000 feet. Even in this list there are a good many, such as the buttercups, the species of *Triglochin*, the gentians, the dandelion and the saxifrages, that grow only near springs in the desert.

<i>Funaria submicrostoma</i>	<i>Silene Moorcroftiana</i>
<i>Ephedra Gerardiana</i>	<i>Ranunculus Cymbalaria</i>
<i>Triglochin palustris</i>	“ <i>pulchellus</i>
“ <i>maritima</i>	<i>Corydalis flabellata</i>
<i>Pennisetum flaccidum</i>	<i>Lepidum latifolium</i>
<i>Agrostis alba</i>	<i>Sisymbrium Columnae</i>
<i>Bromus tectorum</i>	<i>Christolea crassifolia</i>
<i>Polygonum aviculare</i>	<i>Sempervivum acuminatum</i>
<i>Atriplex crassifolia</i>	<i>Saxifraga sibirica</i>
<i>Eurotia ceratioides</i>	<i>Potentilla anserina</i>
<i>Kochia prostrata</i>	“ <i>bifurca</i>

\* The Tibetan word “La” signifies Pass.

<i>Potentilla multifida</i>	<i>Cynanchum acutum</i>
<i>Rosa Webbiana</i>	<i>Lindelofia Benthami</i>
<i>Caragana pygmaea</i>	<i>Eritrichium strictum?</i>
<i>Astragalus Munroi</i>	<i>Nepeta floccosa</i>
“ <i>macropterus</i>	<i>Stachys tibetica</i>
“ <i>nivalis</i>	<i>Lancea tibetica</i>
<i>Oxytropis cachemirica</i>	<i>Pedicularis longiflora</i>
<i>Epilobium Royleanum</i>	<i>Rubia tibetica</i>
<i>Bupleurum falcatum nigrocarpa</i>	<i>Lonicera spinosa</i>
<i>Ligusticum Thomsoni</i>	<i>Aster tibeticus</i>
<i>Primula sibirica</i>	<i>Erigeron andryaloides</i>
<i>Androsace villosa</i>	<i>Leontopodium alpinum</i>
<i>Acantholimon lycopodioides</i>	<i>Chrysanthemum Richteria</i>
<i>Gentiana humilis</i>	<i>Cousinia Falconeri</i>
“ <i>serrata</i>	<i>Scorzonera divaricata</i>
<i>Pleurogyne Thomsoni</i>	<i>Taraxacum officinale</i>

## SURU, YARUNGSAN LA, SAPI LA, AND RUSI LA

Along the transition zone between Kashmir and Ladak almost any Kashmir plant that will live above 10,000 feet may be found, especially in Suru. Most of the plants are alpine mesophytes. Only 10 per cent. of these were also found in Rupshu, and they are forms like *Delphinium Brunonianum*, *Potentilla bifurca*, *Leontopodium*, *Taraxacum*, and *Aster heterochaeta*, which are widespread at high altitudes. Most of the plants in my list, that do not seem to have been reported before from Ladak, are from this transition region and are common Kashmir types. Examples are *Podophyllum Emodi*, *Lavatera Kashmiriana*, species of *Impatiens*, *Lotus corniculatus*, and *Astragalus frigidus*. The same may be said of the species from this region which were first collected by Meebold.

Coming from Kashmir, Meebold was impressed with the barren, Tibetan aspects of Suru, but going in the other direction later in the summer I was struck by the greater amount of green on the hillsides. While there are no forests and few trees, except willows, *Juniperus* and *Lonicera glauca*, there is much more herbaceous vegetation than in the rest of Ladak and everything indicates more moisture. This increased water supply is no doubt due to the presence of the Nun Kun peaks and glaciers. The greater

cloudiness, too, probably prevents the ground from drying out the way it does further into Ladak.

A list of plants from this region is given below. Definite stations will be cited in the second part of this paper.

<i>Bryum tibeticum</i>	<i>Aconitum Napellus multifidum</i>
<i>Cystopteris fragilis</i>	<i>Anemone rupicola</i>
<i>Juniperus macro-poda</i>	<i>Ranunculus pulchellus</i>
<i>Ephedra Gerardiana</i>	“ <i>hirtellus</i>
<i>Andropogon Ischaemum</i>	<i>Podophyllum Emodi</i>
<i>Panicum miliaceum</i>	<i>Corydalis Gortschakovii</i>
<i>Phleum alpinum</i>	<i>Thlaspi arvense</i>
<i>Alopecurus himalaicus</i>	<i>Draba glacialis</i>
<i>Agrostis alba</i>	“ <i>alpina</i>
<i>Trisetum subspicatum</i>	<i>Chorispora sabulosa</i>
<i>Poa annua</i>	<i>Sedum Rhodiola</i>
“ <i>nemoralis</i>	“ <i>asiaticum</i>
<i>Elymus dahuricus</i>	“ <i>Ewersii</i>
<i>Carex rigida</i>	“ <i>tibeticum Stracheyi</i>
<i>Juncus membranaceus</i>	<i>Sempervivum acuminatum</i>
<i>Salix daphnoides?</i>	<i>Saxifraga cernua</i>
<i>Polygonum affine</i>	“ <i>Hirculus indica</i>
“ <i>polystachyum</i>	“ <i>Jacquemontiana</i>
“ <i>tortuosum</i>	“ <i>flagellaris</i>
<i>Axyris amaranthoides</i>	“ <i>Stracheyi</i>
<i>Stellaria graminea</i>	<i>Ribes orientale</i>
<i>Arenaria Griffithii</i>	<i>Potentilla Sibbaldi</i>
“ <i>foliosa</i>	“ <i>fruticosa Inglisii</i>
<i>Silene vulgaris</i>	“ <i>bifurca</i>
“ <i>tenuis</i>	“ <i>argyrophylla</i>
<i>Lychnis apetala</i>	<i>Rosa Webbiana</i>
“ <i>nutans</i>	<i>Thermopsis inflata</i>
“ <i>himalayensis</i>	<i>Astragalus tibetanus</i>
<i>Dianthus anatolicus</i>	“ <i>melanostachys</i>
<i>Aquilegia vulgaris pyrenaica</i>	“ <i>himalayanus</i>
<i>Delphinium Brunonianum</i>	“ <i>coluteocarpus</i>
“ <i>cashmirianum</i>	“ <i>frigidus</i>
<i>Aconitum heterophyllum</i>	“ <i>rhizanthus</i>

<i>Astragalus subulatus</i>	<i>Lagotis glauca</i>
<i>Lotus corniculatus</i>	<i>Veronica deltiigera</i>
<i>Hedysarum microcalyx</i>	<i>Pedicularis tenuirostris</i>
<i>Cicer songaricum</i>	“ <i>bicornuta</i>
<i>Geranium collinum?</i>	<i>Galium verum</i>
<i>Impatiens brachycentra</i>	“ <i>boreale</i>
“ <i>Thomsoni</i>	<i>Lonicera glauca</i>
<i>Lavatera kashmiriana</i>	“ <i>asperifolia</i>
<i>Hypericum perforatum</i>	“ <i>microphylla</i>
<i>Epilobium latifolium</i>	<i>Campanula latifolia</i>
“ <i>angustifolium</i>	“ <i>aristata</i>
<i>Chaerophyllum acuminatum</i>	<i>Aster heterochaeta</i>
<i>Trachydium Roylei</i>	<i>Erigeron alpinus multicaulis</i>
<i>Pleurospermum Candollii</i>	“ <i>alpinus uniflorus</i>
<i>Bupleurum falcatum</i>	<i>Leontopodium alpinum</i>
<i>Acantholimon lycopodioides</i>	<i>Anaphalis nubigena</i>
<i>Primula Stuartii</i>	“ <i>virgata</i>
<i>Androsace villosa</i>	<i>Inula barbata</i>
<i>Gentiana Moorcroftiana</i>	“ <i>rhizocephaloides</i>
“ <i>aurea</i>	<i>Chrysanthemum Richteria</i>
“ <i>tenella</i>	<i>Tanacetum artemisioides</i>
“ <i>carinata</i>	<i>Allardia glabra</i>
“ <i>decumbens</i>	“ <i>nivea</i>
<i>Pleurogyne carinthiaca</i>	“ <i>tomentosa</i>
<i>Swertia cordata</i>	“ <i>Stoliczkai</i>
“ <i>patiolata</i>	<i>Artemisia amygdalina</i>
<i>Cuscuta capitata</i>	“ <i>salsoloides</i>
<i>Myosotis sylvatica</i>	<i>Senecio chrysanthemoides</i>
<i>Scutellaria prostrata</i>	“ <i>arnicoides frigida</i>
<i>Nepeta discolor</i>	<i>Cremanthodium Decaisnei</i>
“ <i>leucolaena</i>	<i>Arctium Lappa</i>
<i>Dracocephalum nutans</i>	<i>Saussurea Jacea</i>
<i>Phlomis bracteosa</i>	“ <i>albescens</i>
<i>Lamium album</i>	“ <i>sorocephala</i>
<i>Origanum vulgare</i>	<i>Jurinea ceratocarpa</i>
<i>Elsholtzia densa</i>	“ <i>ceratocarpa depressa</i>
<i>Verbascum Thapsus</i>	<i>Koelpinia linearis</i>
<i>Scrophularia scabiosaefolia</i>	<i>Tragopogon pratense?</i>

*Taraxacum officinale parvulum*    *Lactuca decipiens*  
*Lactuca Scariola?*

## BARALACHA LA

Farther east, where Rupshu adjoins Lahoul. the plant life is very scanty because of the great altitude and because conditions of rainfall are very different from those in Suru. Lahoul itself is the transition zone to the luxuriant flora of the outer Himalaya. On the Baralacha Pass (16,000 ft.) scarcely twenty species were noticed, as shown by the following list. On each side of the Pass there is a very cold alpine lake that seems too icy for plant life. As early as 1820 Moorcroft wrote quaintly of one of them:—"Not a weed deformed its pellucid and tranquil waters. There seemed to be no fish in it, nor was any bird or even a fly in its vicinity."

<i>Carex nivalis</i>	<i>Corydalis meifolia</i>
<i>Oxyria digyna</i>	<i>Draba lasiophylla</i>
<i>Polygonum cognatum</i>	<i>Sedum Rhodiola</i>
" <i>affine</i>	<i>Saxifraga sibirica</i>
" <i>molliaeforme</i>	<i>Potentilla fruticosa pumila?</i>
<i>Stellaria decumbens</i>	" <i>argyrophylla leucochroa</i>
<i>Silene Moorcroftiana</i>	<i>Nepeta glutinosa</i>
<i>Dianthus anatolicus</i>	<i>Allardia tomentosa</i>
<i>Ranunculus hirtellus</i>	<i>Werneria nana affinis</i>
<i>Meconopsis aculeata</i>	

## RUPSHU

As mentioned earlier, the most Tibetan part of Ladak visited was Rupshu. Plants must grow there to an elevation of fully 18,000 feet, for we found half a dozen species at 17,500 feet. All of the plants listed, with possibly two or three exceptions, grew above 15,000 feet. Species of *Oxytropis*, *Potentilla*, and *Nepeta*, *Sedum tibeticum* *Stracheyi*, *Aster heterochaeta*, *Elsholtzia pusilla*, *Delphinium Brunonianum* and *Caragana pygmaea* grew at the upper limit of plant life. On hillsides *Caragana* was the most conspicuous and abundant plant, spreading out on the ground in the way juniper does in the northeastern United States (FIG. 2). It furnishes the chief fuel in these lofty regions. The *Delphinium* is also a conspicuous plant with much the largest leaves and flowers of any plant near the top of the passes. The blades of its leaves may be

two inches in diameter. The wild rhubarb is the only Rupshu plant with good sized leaves. They are thick and very coriaceous.

The wind on the passes is so terrible that the plants that grow on the very top are prostrate and scarcely an inch high



FIG. 2. A shrubby pea, *Caragana pygmaea* DC., the only conspicuous plant in large sections of Western Tibet, above an altitude of 14,000 feet.

with very small leaves and flowers. Examples are *Oxytropis densa*, *Potentilla bifurca*, *P. sericea* and *Nepeta longibracteata*.

<i>Potamogeton pectinatus</i>	<i>Polygonum sibiricum</i>
<i>Triglochin maritima</i>	<i>Chenopodium album</i>
<i>Stipa barbata</i>	<i>Atriplex crassifolia</i>
<i>Deschampsia caespitosa</i>	“ <i>rosea</i>
<i>Poa pratensis</i>	<i>Eurotia ceratioides</i>
“ <i>nemoralis ligulata</i>	<i>Salsola collina</i>
<i>Festuca rubra</i>	<i>Stellaria graminea</i>
<i>Bromus crinitus</i>	<i>Arenaria muscifformis</i>
“ <i>barbatus</i>	“ <i>holosteoides</i>
“ <i>macrostachys</i>	<i>Lychnis macrorrhiza</i>
<i>Kobresia schoenoides</i>	“ <i>brachypetala</i>
<i>Carex Moorcroftii</i>	<i>Isopyrum grandiflorum</i>
<i>Urtica hyperborea</i>	<i>Aquilegia vulgaris viscosa</i>
<i>Rheum spiciforme</i>	<i>Delphinium Brunonianum</i>
<i>Polygonum tortuosum</i>	<i>Ranunculus pulchellus</i>

<i>Hypocoum leptocarpum</i>	<i>Gentiana aquatica</i>
<i>Corydalis crassifolia?</i>	<i>Marrubium lanatum</i>
“ <i>stricta</i>	<i>Nepeta longibracteata</i>
<i>Lepidium capitatum</i>	“ <i>nivalis</i>
<i>Arabis tibetica</i>	“ <i>tibetica</i>
<i>Alyssum canescens</i>	<i>Dracocephalum heterophyllum</i>
<i>Braya alpina</i>	<i>Thymus Serpyllum</i>
<i>Christolea crassifolia</i>	<i>Elsholtzia pusilla</i>
<i>Sedum tibeticum Stracheyi</i>	<i>Veronica ciliata?</i>
<i>Sempervivum acuminatum</i>	<i>Rubia tibetica</i>
<i>Saxifraga Hirculus indica</i>	<i>Galium pauciflorum</i>
<i>Potentilla tetrandra</i>	<i>Lonicera spinosa</i>
“ <i>fruticosa ochreatea</i>	<i>Aster heterochaeta</i>
“ <i>ambigua</i>	“ <i>tibeticus</i>
“ <i>bifurca</i>	<i>Leontopodium alpinum</i>
“ <i>multifida</i>	<i>Anaphalis nubigena</i>
“ <i>sericea</i>	<i>Tanacetum fruticosum</i>
<i>Caragana pygmea</i>	<i>Artemisia minor</i>
<i>Oxytropis densa</i>	<i>Senecio arnicoides frigida</i>
“ <i>lapponica</i>	<i>Werneria nana</i>
“ <i>microphylla</i>	<i>Saussurea bracteata</i>
“ <i>tatarica</i>	“ <i>glanduligera</i>
<i>Biebersteinia Emodii</i>	<i>Taraxacum officinale</i>
<i>Pleurospermum stellatum</i>	“ <i>officinale parvulum</i>
<i>Primula sibirica</i>	

NATIVE AND NATURALIZED SPECIES OF THE EASTERN UNITED STATES OCCURRING IN WESTERN TIBET

In comparing the flora of Ladak with a distant flora like that of the eastern United States there are many more similarities than one would suspect and it is possibly worth while to make a list of species that are common to both countries. Plant lists do not, of course, give a picture of a region, and the aspect of the two countries is absolutely different, but there are enough things similar to make an American feel somewhat at home.

At least 140 of the plants of Ladak, which amount to about 825 forms, occur here in America, too, but when one comes to examine them it appears that no less than 85 are weeds and not

native. As mentioned before it cannot be stated how many are introduced in Ladak. When one looks at the list of those that are native here it appears that nearly all are plants that like a great deal of water. An abundance of moisture is a great equalizer of environments and plants like Potamogetons, *Lemna* and Triglochins are very cosmopolitan. A smaller group consists of wide ranging temperate plants. There are therefore three groups of plants native to both countries: weeds, water-loving plants, and a few temperate cosmopolitan types.

NATIVE SPECIES

<i>Cystopteris fragilis</i>	<i>Polygonum Hydropiper?</i>
<i>Equisetum arvense</i>	<i>Chenopodium hybridum</i>
<i>Juniperus communis</i>	<i>Corispermum hyssopifolium</i>
<i>Potamogeton pectinatus</i>	<i>Salsola Kali</i>
" <i>perfoliatus</i>	<i>Sagina procumbens</i>
<i>Zannichellia palustris</i>	<i>Ranunculus Cymbalaria</i>
<i>Triglochin maritima</i>	" <i>aquatilis</i>
" <i>palustris</i>	<i>Barbarea vulgaris</i>
<i>Milium effusum</i>	<i>Cardamine pratensis</i>
<i>Deschampsia caespitosa</i>	<i>Braya humilis</i>
<i>Phragmites communis</i>	<i>Sedum Rhodiola</i>
<i>Koeleria cristata</i>	<i>Saxifraga oppositifolia</i>
<i>Catabrosa aquatica</i>	<i>Parnassia palustris</i>
<i>Poa alpina</i>	<i>Potentilla Sibbaldi</i>
" <i>pratensis</i>	" <i>Anserina</i>
" <i>nemoralis</i>	" <i>fruticosa</i>
<i>Festuca rubra</i>	<i>Astragalus alpinus</i>
<i>Scirpus pauciflorus</i>	<i>Epilobium angustifolium</i>
" <i>rufus</i>	<i>Hippuris vulgaris</i>
<i>Eleocharis palustris</i>	<i>Primula farinosa</i>
<i>Carex stenophylla</i>	<i>Glaux maritima</i>
" <i>rigida</i>	<i>Limosella aquatica</i>
" <i>Goodenovii</i>	<i>Veronica Anagallis-aquatica</i>
<i>Lemna minor</i>	<i>Utricularia minor</i>
<i>Oxyria digyna</i>	<i>Plantago major</i>
<i>Polygonum aviculare</i>	<i>Galium Aparine</i>
" <i>viviparum</i>	" <i>boreale</i>

## NATURALIZED SPECIES

<i>Panicum miliaceum</i>	<i>Cerastium vulgatum</i>
<i>Setaria viridis</i>	<i>Arenaria serpyllifolia</i>
<i>Heleochloa schoenoides</i>	<i>Dianthus deltoides</i>
<i>Alopecurus pratensis</i>	<i>Saponaria Vaccaria</i>
<i>Polypogon monspeliensis</i>	<i>Aquilegia vulgaris</i>
<i>Agrostis alba</i>	<i>Berberis vulgaris</i>
" <i>canina</i>	<i>Lepidium ruderaie</i>
<i>Aira caryophyllea</i>	<i>Sisymbrium Sophia</i>
<i>Avena fatua</i>	" <i>Thalianum</i>
<i>Eragrostis minor</i>	<i>Brassica juncea</i>
<i>Briza media</i>	" <i>nigra</i>
<i>Dactylis glomerata</i>	<i>Sedum Rhodiola</i>
<i>Poa annua</i>	<i>Ribes Grossularia</i>
<i>Festuca Myuros</i>	<i>Pyrus Malus</i>
<i>Bromus tectorum</i>	<i>Trifolium pratense</i>
" <i>japonicus</i>	<i>Medicago falcata</i>
<i>Lolium perenne</i>	" <i>sativa</i>
<i>Agropyron repens</i>	" <i>lupulina</i>
<i>Salix alba</i>	<i>Melilotus alba</i>
" <i>fragilis</i>	" <i>officinalis</i>
<i>Populus alba</i>	<i>Lotus corniculatus</i>
" <i>candicans</i>	<i>Geranium pratense</i>
" <i>nigra italica</i>	" <i>sibiricum</i>
<i>Urtica dioica</i>	<i>Erodium cicutarium</i>
<i>Parietaria debilis</i>	<i>Tribulus terrestris</i>
<i>Morus alba</i>	<i>Malva verticillata</i>
<i>Rumex Acetosa</i>	<i>Carum Carvi</i>
<i>Polygonum lapathifolium</i>	<i>Pimpinella Saxifraga</i>
" <i>Persicaria</i>	<i>Convolvulus arvensis</i>
" <i>Convolvulus</i>	<i>Cuscuta europaea</i>
<i>Chenopodium album</i>	<i>Lithospermum arvense</i>
" <i>glaucum</i>	<i>Lycopsis arvensis</i>
" <i>Botrys</i>	<i>Lamium amplexicaule</i>
<i>Atriplex rosea</i>	<i>Thymus Serpyllum</i>
<i>Stellaria glauca</i>	<i>Mentha longifolium</i>
" <i>graminea</i>	<i>Verbascum Thapsus</i>
" <i>media</i>	<i>Veronica Beccabunga</i>

<i>Veronica agrestis</i>	<i>Cnicus arvensis</i>
<i>Galium verum</i>	<i>Tragopogon pratense</i>
<i>Gifola germanica</i>	<i>Taraxacum officinale</i>
<i>Tussilago Farfara</i>	<i>Sonchus oleraceus</i>
<i>Arctium Lappa</i>	<i>Lactuca Scariola</i>
<i>Carduus nutans</i>	

GENERA BEST REPRESENTED IN WESTERN TIBET

When we come to look at the commonest genera in Ladak, we find that only two are not represented in the eastern United States. These are members of the Compositae, *Allardia* and *Saussurea*. In addition, we have no native species of *Dianthus* or *Nepeta*. It is interesting to note that the genera such as *Tanacetum*, *Artemisia*, *Astragalus* and *Oxytropis*, which are more numerous in Ladak than in the eastern United States, are genera which are common in the Russian parts of Central Asia.

<i>Stipa</i> *	<i>Chenopodium</i>	<i>Saxifraga</i>	<i>Lonicera</i>
<i>Poa</i>	<i>Stellaria</i>	<i>Potentilla</i>	<i>Galium</i>
<i>Bromus</i> *	<i>Arenaria</i>	<i>Astragalus</i> *	<i>Campanula</i>
<i>Festuca</i>	<i>Dianthus</i> *†	<i>Oxytropis</i> *	<i>Erigeron</i>
<i>Scirpus</i>	<i>Ranunculus</i>	<i>Epilobium</i>	<i>Inula</i> *
<i>Kobresia</i> *	<i>Thalictrum</i>	<i>Primula</i> *	<i>Tanacetum</i> *
<i>Carex</i>	<i>Corydalis</i> *	<i>Androsace</i> *	<i>Allardia</i> *†
<i>Juncus</i>	<i>Sisymbrium</i> *	<i>Gentiana</i> *	<i>Artemisia</i> *
<i>Allium</i> *	<i>Draba</i> *	<i>Nepeta</i> *†	<i>Senecio</i>
<i>Populus</i>	<i>Geranium</i> *	<i>Veronica</i>	<i>Saussurea</i> *†
<i>Salix</i>	<i>Sedum</i> *	<i>Pedicularis</i> *	<i>Lactuca</i>
<i>Polygonum</i>			

\* More species in western Tibet than in the eastern United States.

† No native species in the eastern United States.

## PLANT ASSOCIATIONS

From the foregoing we have seen that most of Ladak is covered by open desert associations with bare ground between the individual plants. Many hillsides have so little soil and the summer heat is so intense that there is scarcely any vegetation at all. Sometimes a plant that would otherwise be sure to be eaten off can find a refuge beneath a thorny bush of *Caragana*, but as a rule they stand alone or in tufts.

Occasionally we find a modification of the desert flora. Where there is a spring on the mountainside and the water cannot drain away readily we get a continuous sod and a typical association of *Pedicularis longiflora* and species of *Triglochin*, *Carex*, *Gentiana*, and *Taraxacum*. The ground is often boggy in such situations and the water may be alkaline.

Alpine meadows are rare except in the transition zone near Kashmir. The places along the streams that may have been meadows ages ago have been made to grow a few food plants. Usually the streams are so swift that they are bounded by steep banks and there is very little opportunity for plants to gain a foothold or for a sod to form.

The oases which surround the villages contain practically the only trees, and these, with the exception of the *Hippophaë*, which is frequently used for hedges, are practically all introduced. The commonest trees are willows, poplars, walnuts, mulberries, apples and apricots. Small groves of the native juniper, *Juniperus macro-poda*, are sometimes found. The commonest crops are barley, wheat and buckwheat. Our common garden vegetables do well and so do many of our common garden weeds.

Although there are no forests in Ladak, there are frequently thickets along streams and on little islands in the rivers. These have a typical association of the *Myricaria*, *Hippophaë*, *Rosa* and *Clematis orientalis*. These furnish shade for more delicate plants, such as species of *Veronica* and *Epilobium*.