CONTRIBUTIONS TO THE FLORA OF BHUTAN:

THE MONOCOTYLEDONS

A collection of papers submitted to
the University of Edinburgh
for the degree of
Doctor of Philosophy (by Research Publication)

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Abstract

The published work submitted for consideration for the degree of Ph.D. (by Research Publication) consists of two parts of the *Flora of Bhutan*, describing the monocotyledons (some 942 species) with the exception of Orchidaceae. Together with these are ten precursor papers relating to these parts of the *Flora*: the papers include descriptions of new species, nomenclatural discussion (including typifications) and phytogeographic information. The critical review gives the historical background for the whole *Flora* project, together with the methods used in my own contribution and some of my more interesting findings. An enumeration of new taxa described, and new combinations made, is given in an appendix.

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CRITICAL REVIEW

Introduction

This 'critical review' is supposed to describe the aims, objectives, methodology, results and conclusions of the published work submitted. Since the project is fundamentally descriptive in nature, it will not adopt this format, which is suited to a more experimental methodology. It is also inappropriate in that my own work forms part of a much larger project, and the purpose of this review is primarily to put my contribution to the whole work into context.

I have written two parts of the *Flora of Bhutan* (with some contributions from others, separately attributed in the volumes), covering the monocotyledons excluding Orchidaceae. In submitting this work to be considered for a doctorate, I am acutely aware that this represents only a contribution towards a much greater whole. In achieving this contribution I am hugely in the debt of others, especially to David Long and the late Andrew Grierson, who jointly initiated the project, and undertook the substantial groundwork required for such a major floristic work. Nevertheless, my contribution stands as part of a team effort, and has validity as a section of work in its own right. It includes one very large family, the Gramineae, the second largest in the *Flora* with 125 genera and 388 species (Noltie, 1999a, b; 2000a, b), and *Carex*, the third largest genus in the *Flora*, with 73 species (Noltie, 1993a, 1994a).

In putting my contribution into context, it is necessary to explain something of Floras in general, and the particular history of this one - which is unusual in many respects. Explaining the cultural, scientific and political background to this *Flora* may be a useful contribution to understanding the difficulties that can attend Western attempts to document the biodiversity of a developing country.

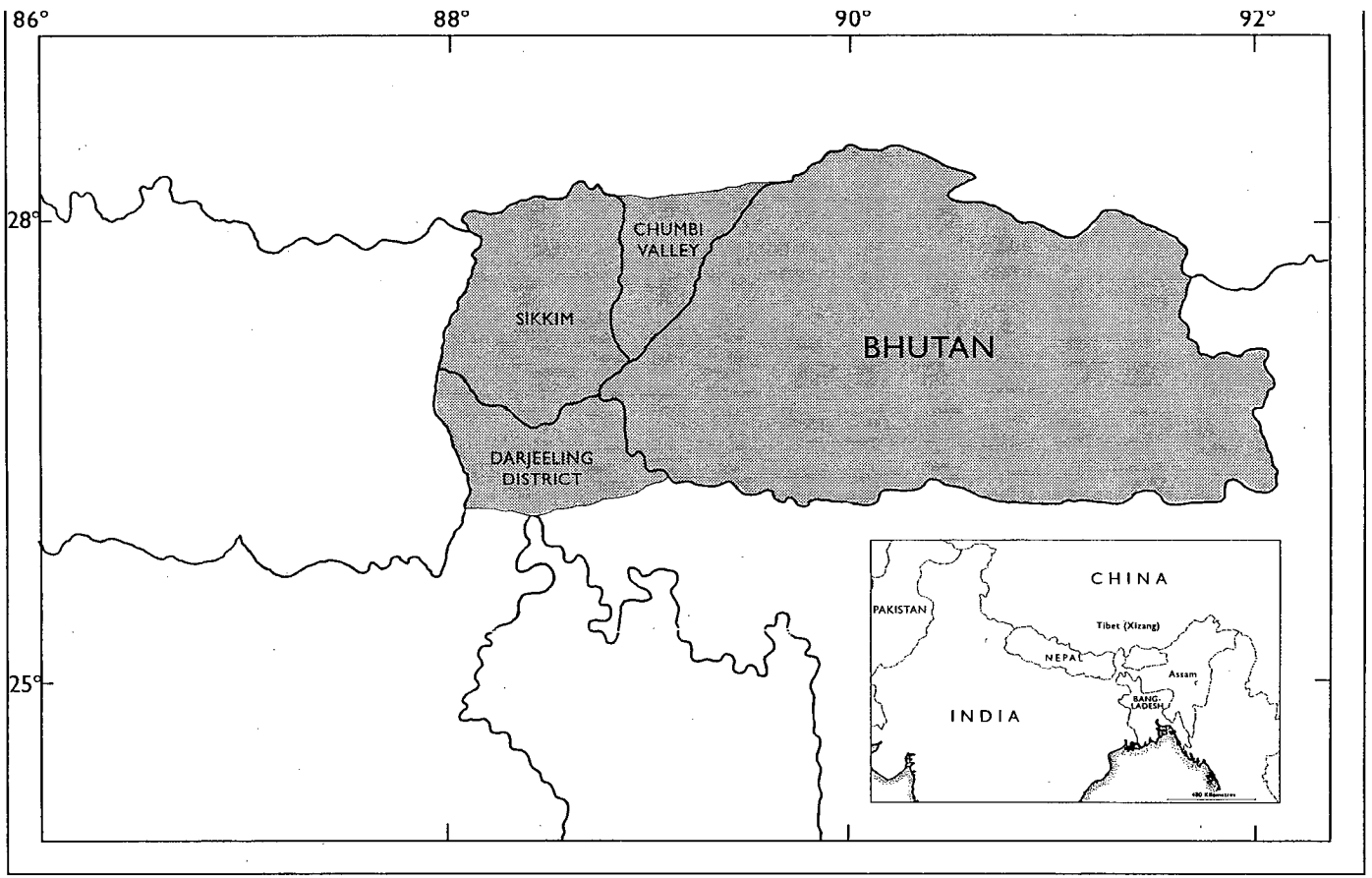


FIG. 1 AREA COVERED BY THE FLORA

What is a Flora?

A Flora is, at its simplest, an inventory of plant species occurring in a defined geographical area; within this basic definition there exists wide scope in terms of the information contained, style, etc. The *Flora of Bhutan* was designed to be used in the field, without the backup of a large herbarium or library. The arrangement of families follows the Englerian system. Introduced and cultivated plants are included, in addition to native ones. The descriptions are short, and minimal synonymy is given (chiefly that relating to the *Flora of British India*, still the standard floristic text for the region). Keys are given to genera within families and to species within genera. Local names and uses are included wherever possible. Distribution within the country is given, along with ecological details (altitudinal ranges and habitats). Representatives of all the families are illustrated by means of line drawings. Not included in the *Flora* are citations of specimens or types, the places of publication of names, or distributions of species outwith the area. None of these were thought to be of much use in Bhutan, in the absence of a herbarium or library, though in retrospect, and especially given the amount of research into nomenclature and distribution, some of these are perhaps regrettable omissions.

The existing floristic literature relating to Bhutan is extremely sparse; a few nineteenth century records (those of William Griffith) are included in the *Flora of British India* (1872--97), and there are some more recent floristic lists (e.g. Hara, 1971; Subramanyam, 1973). Such a lack of primary information for an area of major phytogeographic significance has been a severe lacuna in world floristic literature, and, at the local level, in applied fields such as conservation, ethnobotany and the sustainable use of plant resources (for example in traditional medicine). In filling this gap, an authoritative floristic treatment of the plants of Bhutan will enable broader views to be taken of the distribution and ecology of S Asian taxa. It is vital, therefore, to stress the fundamental importance, and pressing need for such a *Flora*. In more recent

times, such cataloguing of biodiversity has become a legal requirement, as one of the conditions arising from signing the Convention on Biological Diversity, which the Royal Government of Bhutan (RGOB) did on 11th June, 1992.

A common criticism of Floras is that they are artificial in the sense that they describe the plants of arbitrary, or at least 'non-natural' areas. This is undoubtedly true, but does not make them unimportant or without value. The question of artificiality of boundaries is true in the case of Bhutan: although it is naturally defined in terms of its northern and southern boundaries (the summits of the high Himalaya and the northern edge of the Bengal plain respectively), the eastern and western boundaries are more or less arbitrary. The inclusion of Sikkim and Darjeeling (originally on the grounds that their plants were better known, being more extensively collected) makes the area covered by the *Flora* more representative of the E Himalayan floristic province than if it had been restricted to the political country of Bhutan (FIG. 1). In my own work I have been very conscious of the dangers of looking too narrowly and have paid especial attention to China in determining species limits, and also in the fields of literature and nomenclature. Having been based at the Royal Botanic Garden Edinburgh (RBGE), with its unique Chinese collections of herbarium specimens and literature, has been a significant advantage. This would not have been possible if, for example, the work had been carried out at Calcutta or other apparently suitable bases.

Brief outline of Bhutan

It seems appropriate to describe here, very briefly, something of the physical and geographical background to Bhutan since this accounts, in a large degree, for its botanical interest. This is not the place to go into detail, as this is provided in the summaries in the first volume of the *Flora* (Grierson & Long, 1983); valuable information is also supplied in the recent *Atlas of Bhutan* (LUPP, 1997).

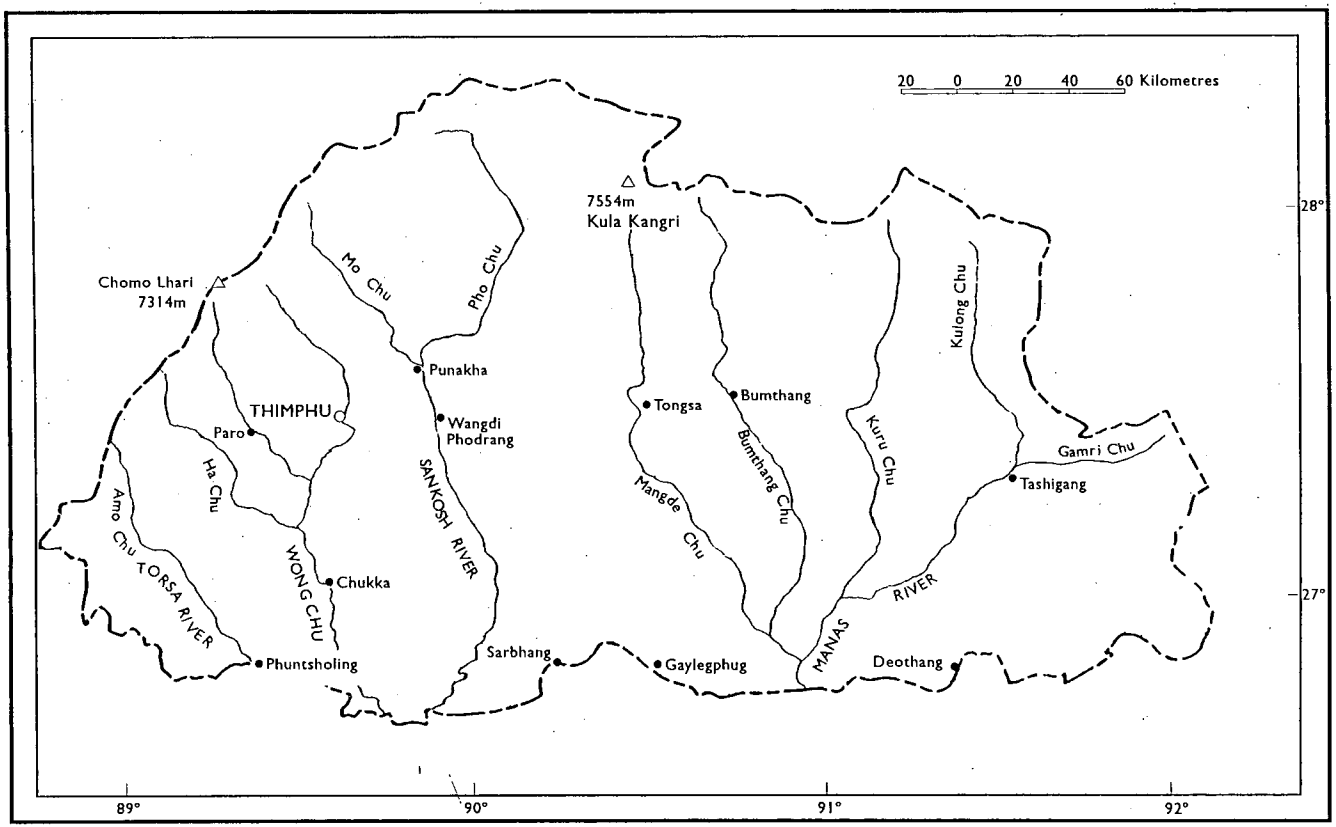
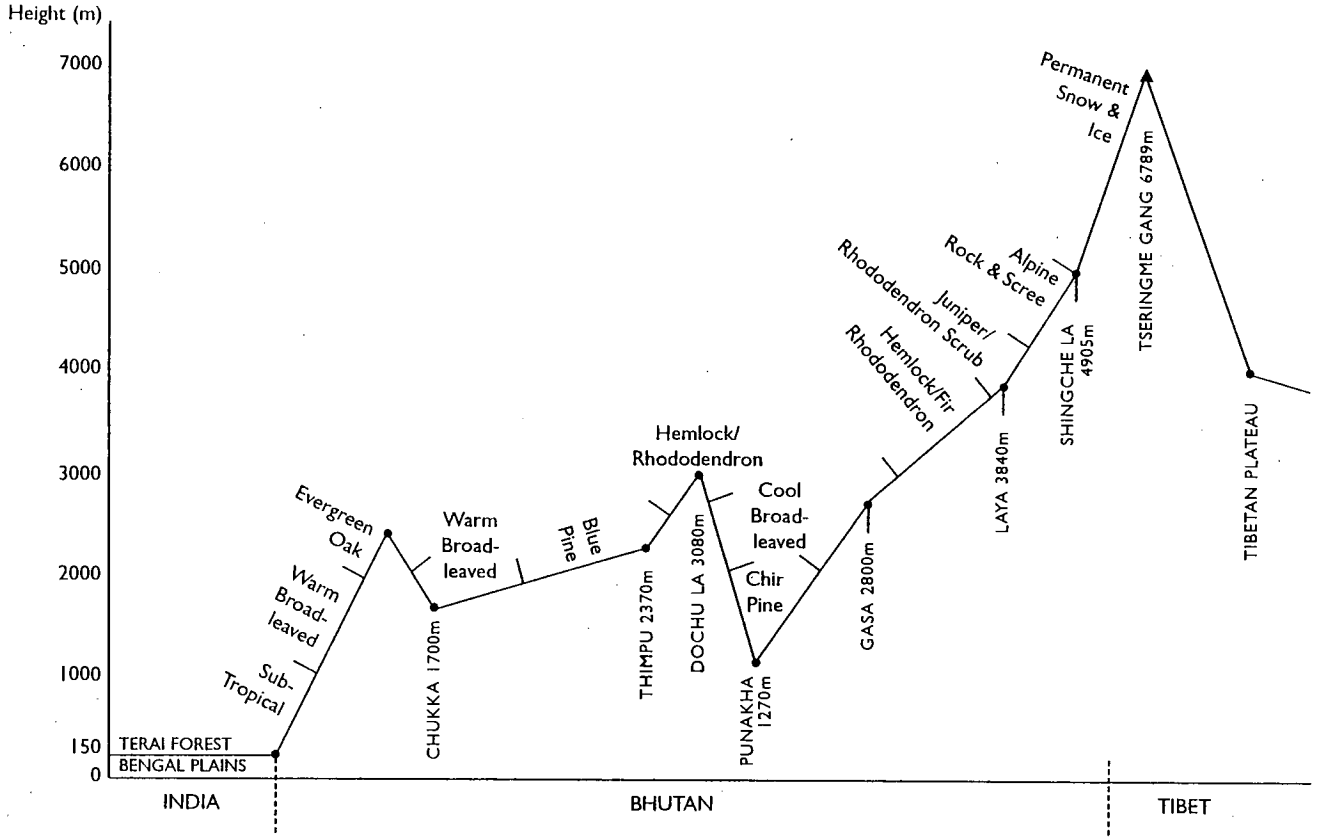


FIG. 2 MAP OF BHUTAN

Bhutan (FIG. 2) is a small kingdom of 40, 077 sq. km, situated in the East Himalaya. It lies between the longitudes of 88°45' and 92°10' E, and the latitudes of 26°40' and 28°21' N. Politically it is sandwiched between China (Tibet) to the north and north west, and India (the States of West Bengal and Arunachal Pradesh) to the south west, south and east. The land rises very steeply from south to north, in a distance of under 175km, the Bengal plain being at about 200m, and the large Himalayan peaks reaching over 7500m. A series of river valleys and ridges run north to south throughout the country. These valleys vary greatly in depth, the deeper ones enabling subtropical vegetation to enter far into the interior of the country e.g. north of Punakha. Some, such as the Manas, are very dry and desert-like in their middle courses.

The dominant climatic feature of the E Himalaya is the summer monsoon, which brings very large amounts of precipitation between April and October. Useful figures are given in Eguchi (1987). The climate is more variable than one might expect, given the size of the country, due mainly to the extremely varied topography. Rainfall is greatest in the southern foothills which receive the brunt of the moisture-laden winds coming from the Bay of Bengal, so that the annual precipitation at Phuntsholing on the Indian border is 4222mm (wettest month July, with 1000mm). The deep N-S valleys are much drier, so, for example, Thimphu only about 70km (as the crow flies) to the north receives 597mm of rain per year (wettest month August, with 150mm). The eastern valleys are drier still, for example, the annual rainfall at Mongar on the Kuru Chu is 518mm. Temperature also varies greatly - from the subtropical climate of the southern belt (with small seasonal fluctuations) - to temperate in the central zone - and extreme alpine in the north (the latter two with much greater seasonal fluctuations). To take two examples: at Phuntsholing in the south, the mean temperature in January is about 18°C and 25°C for June; at Paro, in the central zone, the mean January temperature is about 6°C and for June about 19°C.

FIG. 3 VEGETATION ZONES OF WESTERN BHUTAN



Vegetation is clearly zoned with altitude, as noted first by Griffith. Grierson and Long (1983) classified the vegetation into 11 zones (see Table 1 and FIG. 3)

Subtropical forest (200--1000(--1200)m)
Warm broad-leaved forest (1000--2000(--2300)m)
Chir Pine forest (900--1800(--2000)m)
Cool broad-leaved forest (2000-2900m)
Evergreen oak forest (1800--)2000--2600m)
Blue pine forest (2100--3000(--3100)m)
Spruce forest (2500--)2700--3100(--2200)m)
Hemlock forest (2800--3100(--3300)m)
Fir forest (3100--)3300--3800m)
Juniper/Rhododendron scrub (3700--4200m)
Dry alpine scrub (4000--4600m)

Table 1. VEGETATION ZONES OF BHUTAN (after Grierson & Long, 1983).

Flora of Bhutan: the history of the project

Because of the history of plant collecting and the development of taxonomy from principles laid down in eighteenth century Europe, with its rules of priority and dependence on literature and type specimens, the West has a tremendous responsibility for undertaking taxonomic work and making the results available to developing countries. It was for such reasons, and the idea of repatriation of data (to use a more recent term), that led to the establishment of the Flora of Bhutan project in 1975.

It should be said at the outset that the project has had a rather chequered history, but that now, after 25 years, the end is firmly within sight. Difficulties have concerned finance, politics and the highly unusual attitudes which pertain in Bhutan - a complex mixture of culture, religion and politics.

By the early 1970s Indian foresters advising the Royal Government of Bhutan (RGOB), especially one by the name of S. Doley, realised the need for a Flora describing the plants of Bhutan. The RGOB approached the British government to establish an aid programme with the aim of documenting Bhutanese specimens in British collections - the initial designation being a 'Floral Inventory'. The then Ministry of Overseas Development (later Overseas Development Administration - ODA) took this on, and RBGE, with its rich Sino-Himalayan collections, was assigned to the task.

The project was thus, from the start, seen in terms of foreign aid. The initial agreement was that RBGE would pay the salary of one senior taxonomist (Andrew Grierson, Principal Scientific Officer) and ODA would pay a contract taxonomist at Higher Scientific Officer level. This they did until 1991 (David Long 1975--1987; Henry Noltie 1988--1991). ODA also bore the cost of printing the volumes (including 500 to be supplied, free of charge, to Bhutan), the costs outside Bhutan of any field trips, and of herbarium visits to London. The contribution of RGOB was restricted to the comparatively minor expenses of field trips within the country. It was also established from the start that a set of any specimens collected on field trips would be left in Bhutan.

The support of ODA was crucial, but it was soon seen as a rather unusual project for their support. At a meeting in 1979, for example, ODA stated that if the project were starting then, it would be considered to be of 'low developmental value...and most unlikely that we would take it up'. Nevertheless, they continued to support the project until 1991 and it was only stopped at the request of the Bhutanese, in the person of Dasho Paljor Dorji, an active player in the conservation movement in Bhutan, and cousin of the King. It is somewhat ironic that this man is the great grandson of Raja Ugyen Dorji who helped to allow R.E. Cooper's visits in 1914/5, and the grandson of Topgye Dorji who was so helpful to Ludlow and Sherriff (see History below). Such alterations in attitude are indicative of some of the political, dynastic and cultural changes at work in

Bhutan in the troubled period of the 1980s and 1990s, but that is a subject for a historian.

Between 1984 and about 1996 there was little contact between RGOB and RBGE, so it was very hard to discover why the Bhutanese (or certain individuals in positions of authority) were dissatisfied; all we heard were secondhand rumours (through various contacts such as John Wood who was working in the country, and certain privileged visitors such as John Goelet and Simon Bowes Lyon who were friends of the Queen Mother of Bhutan). This was a difficult period for Bhutan, a wave of xenophobia struck the country and traditional attitudes over ownership of heritage, both cultural and natural, undoubtedly became even more rigid. During this time 100,000 Nepalese settlers left the country, and laws about the compulsory wearing of National dress were introduced. It seems that there was a feeling that research on matters such as Bhutan's plant life could wait until there were Bhutanese nationals able to undertake it. It also seems that there was a problem over the description of new species (a minor concomitant of Flora writing). It was felt (inaccurately) that too many had been named after western botanists, moreover, that describing new species seemed to be equated with some sort of 'patenting'.

The few contacts during this period were mainly over a projected field-trip for David Long and myself in 1988, which was never permitted. Another concerned the collecting of specimens in Bhutan. A Royal proclamation had forbidden the collection of plant specimens by non-nationals. In August, 1986, in response to our enquiries, we were assured that as an existing project this would not apply to us; but we were not to be allowed back into Bhutan for a further 12 years.

Other contacts during what could be called the 'dark ages' were as follows. In July 1991, I had an unofficial meeting with Mingma Sherpa, WWF representative to Bhutan, in the Druk Sherig Guesthouse, Thimphu. Mingma had tried to get the Bhutanese authorities to continue the project, but without

success. The reasons he had been told for Edinburgh's lack of favour was that RBGE had 'not stuck to the original agreement' and had not left duplicate specimens; he had also heard a bizarre tale that plant specimens had been confiscated from some tourists who claimed they were collecting for Edinburgh. Whoever told him the former had only to go to the Taba herbarium to see that the question of duplicates was not true; moreover there were still people in the Forest Department who knew this, but who were evidently not prepared to stick their necks out and point this out to higher officials in what is effectively a feudal system. Dasho Leki Dorji, Deputy Minister responsible for the Ministry of Agriculture visited RBGE in February 1992 in a private capacity, during a visit to Scotland to study whisky distilleries. There was some follow up correspondence after this, trying to explain and clarify RBGE's work. In November 1994 I had a clandestine meeting with Dasho Jigme Thinley, then Bhutanese Ambassador to the United Nations in Geneva, in a flat in the shadow of Westminster Cathedral belonging to a close relative of our own Royal Family! Thinley was under several misapprehensions, arising from lack of communication and the rumour-ridden nature of Bhutanese society. For example he had heard that the Grierson and Long expeditions had been done 'with no reference to Bhutan', clearly an impossibility. He was, however, sympathetic to the project and undoubtedly helped its cause when he returned to Bhutan several years later. The lifting of the unwritten embargo really followed from a visit to Edinburgh by the then Deputy Minister responsible for the Ministry of Agriculture, Dasho Khandu Wangchuk in September, 1997. A coda to this unfortunate period occurred at a party in Bhutan, in October 1999, when Dasho Paljor Dorji remarked, in an aside to David Long, that he had stopped the project because there were not enough 'controls', presumably referring to the timescale. Whatever the other reasons, and they were no doubt complex, this last one is undoubtedly part of the truth.

It is worth considering why this might be the case. The writing of a Flora of an almost completely unknown, and floristically

rich country is no light undertaking, and much has to be learned by trial and error. Estimation of timescale (and therefore cost) is particularly difficult. Further problems arose as Bhutan was, at that point, a country with no botanical infrastructure, with the exception of a Forest Department whose primary concern was with trees and their sustainable use. There were also difficulties in communication over a large geographical and cultural distance, not helped by the fact that Bhutan (even now) has no direct diplomatic relations with the UK.

There were, no doubt, differing expectations from two completely different cultures. What seemed like a simple request for a 'Floral Inventory' eventually led to the production of what we believe to be a much more useful product. A list of Bhutanese specimens collected by early collectors in British herbaria could have been provided with a relatively small amount of effort, but it would have been of no use in Bhutan with neither a herbarium of comparative specimens, nor a botanical library. The names on many of the specimens would moreover have been inaccurate or out-of-date. There is also the question of intellectual satisfaction on the part of the scientists who would undertake the work, and the benefits resulting from taking a more global view. In 'politically correct' times, it could be said that we in Edinburgh took what could be caricatured as a paternalistic attitude in saying what was best for Bhutan.

There were problems in deciding what would best serve Bhutan's needs, and the project changed radically during an early period of evolution which involved RBGE, ODA and to a rather limited extent the Forest Department of RGOB. Difficulties arose from basic lack of knowledge (e.g. how many taxa there were in Bhutan, details of historical collections and geography) and the low number of herbarium specimens from Bhutan (estimated in 1983 at 26,600, of which 70% were in British collections). It was for this latter reason that it was decided to include Sikkim and Darjeeling, which floristically belong with Bhutan, but have been explored more

thoroughly. The justification for this broadening of geographical scope has been constantly borne out in my own work, as species after species known only from Sikkim has been discovered in Bhutan. By 1979, after discussions between Grierson and Long and the Forest Department in Bhutan, a short format *Flora* was agreed upon. There is no doubt whatever that this was the right decision, but it had major implications on the time taken for the project, and thereby (in hindsight) fueled critical Bhutanese attitudes. In Bhutan, aid projects are seen in terms of short visits by foreign consultants, followed by hastily produced reports. The concept of long-term scientific research is still extremely poorly understood there. As an example of the inaccuracy of time budgeting my own group may be cited. In 1988, at the start of my ODA contract, it was estimated that the monocots would take 3 or 4 years to complete. In fact, excluding the orchids, it has taken 12 years to cover 942 species. The whole *Flora* will finally include 235 Families, 1657 Genera and 5603 species, and the two volumes originally envisaged, will have expanded to nine.

Another major time-consuming activity was the necessary background research on historical and geographical subjects. On the latter topic, particular problems arise in Bhutan from language and transliteration and the resultant changes in spelling of place names, which have still not been stabilised. There is also a major problem with maps - new ones based on satellite photographs may look attractive, but they are of very limited use if effort has not been spent in adding place names. The best map for place names is still one printed in India in 1972, which we have followed to a great extent. Political units within Bhutan have also changed within the lifetime of the *Flora*. Partly for this reason, and to make units of roughly equal size, botanical recording districts were devised based on natural features of watersheds and a division into N, C and S zones very approximately relating to Alpine, Temperate and Subtropical zones. The differences between these units and political districts (especially where the names are the same) seem not to have been appreciated in Bhutan (R. Pradhan,

pers. comm.). Historical research led to the important paper on Griffith and Cooper by Long (1979) and geographical research to a gazetteer of plant collecting localities in Bhutan and Sikkim/Darjeeling, the work of many individuals, but finalised and put onto the World Wide Web by M.F. Watson in 1997.

The finalised aims of the project as stated in a memorandum of August 1988, were:

> **1. To make available to the Royal Government of Bhutan information about its flora, since no comprehensive *Flora* of the country has ever been written.**
>
> **2. To disseminate information to field botanists, foresters, horticulturists and taxonomists both in India and elsewhere.**

This memorandum was, unfortunately, never agreed with the Bhutanese; but this was not for want of trying on the part of ODA and RBGE. As described above, RGOB requested work on the *Flora* to stop in 1991, obliging the ODA to cease its funding.

The position in 1991 was that RBGE had invested so heavily in the project that it decided that it could not afford to stop it, and that, even without access to new collections, the *Flora* could be successfully completed on the basis of existing ones. From 1991 until 1998, the project was supported entirely by RBGE, with some additional sponsorship from external sources, most notably the Headley Trust (one of the Sainsbury family charities). Whereas for the first 12 years of the project, it was run entirely by two full-time staff, after 1987 additional RBGE staff were used to write accounts in an effort to speed up progress; of these Rose Clement made the largest contribution. In addition three botanists were employed on contracts of varying lengths, paid for by sponsorship money, to write particular families. The project has also been very fortunate in the contributions from two outstandingly gifted

'amateur' botanists J.R.I. Wood and N.R. Pearce on an entirely voluntary basis. A small number of families were contributed by staff of the Royal Botanic Gardens, Kew and there were also a few other external contributors. Two students made small contributions to the large families Rubiaceae and Gramineae. The contributing authors are listed in Appendix 4, the total number involved with the project amounting to 24.

A major change came about in 1998 with the involvement of DANIDA, the overseas aid division of the Royal Danish Government, who generously agreed to pay for the completion of the project. Denmark gives large amounts of aid to Bhutan, particularly in the environmental sector. Their advisors (notably N. Kjølsen) realised that the completion of the *Flora* was a vital necessity, and persuaded the Bhutanese to 'restart' it as a 'Flora Completion Project'. The result was the signing of a contract with Danida in September 1998, and the allocation of DKK 1,353,000 (c. £100,000) to the project over a period of 5 years. The money will cover editorial and printing costs of outstanding parts, preparation of plates and two field trips to Bhutan to study orchids and grasses. There are several other components to the project; a consultancy on building a new National Herbarium (undertaken by David Long in October, 1999); the training of Bhutanese nationals (one M.Sc. in taxonomy and a training course at Kew in herbarium techniques). Money has also been assigned to enable the data from the card index of Bhutanese specimens (see below) to be put onto a database.

Funding

The substantial financial contribution of RBGE and ODA to the project can be inferred from the above history. The project also obtained money from private sponsors after the withdrawal of ODA: the Headley Trust (£46, 200, used for contracts to M.F. Watson, R.R. Mill, L.S. Springate); the Spoelberch-Artois Foundation (£8, 000 for general work); DANIDA (c. £100,000 for the Flora Completion Project).

Obtaining external funding was severely limited by non-cooperation from Bhutan. The reaction of WWF was particularly disappointing in this context. As an organisation working extensively in Bhutan, and bringing to it large sums of foreign currency, they were in a better position than any to impress upon RGOB the urgency and necessity of completing the *Flora*. Although they tried, their efforts came to nothing, apparently always being blocked at a level above the Ministry of Agriculture (i.e. above the people who understood the value of the *Flora*). In 1991 WWF offered us 9000 Swiss francs, a derisory sum compared with what was required to complete the work, but even this was conditional on receiving a letter of endorsement from RGOB, which we were unable to obtain.

Storage of data

The project was initiated before the widespread use of computers in data storage. With hindsight it is easy to say that this is regrettable. Records of specimens studied are therefore stored in the traditional way, on index cards, with basic information of nomenclature, locality, altitude, collector's number and herbarium location. A start was made to input this information into RBGE's PANDORA database and J.A. Nyberg was employed for 7 months to enter names and snonymy from parts of the *Flora* published up to 1993. Work on developing this will form part of the DANIDA project using Bhutanese nationals. Eventually there will be a database of Bhutanese plants, based in the new National Herbarium, which can be kept updated, and available for use by botanists,

conservationists, foresters and the numerous ecotourists who visit Bhutan for its wildlife.

Illustrations

The illustrations are an important part of the *Flora*, and are aimed to facilitate field identification in a country lacking an extensive herbarium. Written descriptions have severe limitations and the value of diagnostic line drawings cannot be overstated. In all some 18 artists have been used; their names are given in Appendix 4. These have included members of RBGE staff, free-lance artists and some authors who have illustrated their own taxonomic accounts.

For reasons of cost , little use has been made of colour illustrations. Volume 2/1 has a colour frontispiece of the recently described endemic *Rhododendron kesangiae*; there are reproductions of 12 watercolour plant portraits in 3/1; 8 pages of colour photographs of grass habitats and portraits in 3/2 and there will be a substantial number of colour photographs of orchids in 3/3. It is hoped at some point in the future to produce a colour field guide to the plants of Bhutan, using the extensive collection of 35mm transparencies built up over the course of the project.

Funding for illustrations has come from the same sources as that for the taxonomic research, with additional contributions from the Spoelberch-Artois Foundation (£12,000), the Gordon Fraser Charitable Trust (£4000), and the Friends of the RBGE (£400).

Biogeography

The botanical significance of Bhutan lies both in its geographical position and the state of preservation of its vegetation. According to the most recent figures, based on satellite images taken in 1989, the forest cover in Bhutan is an astonishing 72.5% (Anon, 1998, p. 17). This arises in part from cultural reasons, a genuine respect for nature being part

of the Buddhist religion, whose influence is all-pervasive in every aspect of Bhutanese life. There are, however, other contributory factors, such as the steepness of the terrain, the inaccessibility of much of the country, and the very low population, currently estimated at 600, 000.

The area covered by the *Flora* forms a significant part of the East Himalayan Floristic Province, part of the Eastern Asiatic region of the Holarctic Kingdom (Takhtajan, 1986). Being at the extreme western edge of this region, it is exposed to influences from other floristic regions, in particular the Central Asiatic Subregion of the Irano-Turanian Region from the north, and the Indian and Indochinese regions of the Indomalesian Subkingdom from the south and south-east. At the start of the project Grierson and Long (1983) listed six major floristic elements as follows: SE Asian-Malaysian; Himalayan-Chinese-Japanese (various subcategories); Deccan; Tibetan; Euro-Siberian; Arctic-alpine.

Detailed work on the phytogeography of Bhutan remains to be undertaken, but in the case of *Carex* (Noltie, 1993a) and Gramineae (Noltie, 2000a), I have attempted to arrange the species according to the above categories (with certain necessary additions/modifications). Such work is rather inexact, since the distribution of many species is neither well known, nor stable. For example, the analysis of *Carex* is already out of date: since it was written I have found six species in China previously thought to be restricted to the E Himalaya. As a preliminary example, however, the floristic elements represented in Gramineae are shown in FIG. 4 (details given in Appendix 3).

It should be noted that 'Widespread Tropical' is additional to Grierson & Long's categories, and is no doubt partly artificial. Although this analysis is only of species considered to be native, it is no doubt complicated by the presence of taxa which may be unrecognized, long-established introductions. With the exception of these widespread tropical species, this analysis confirms the expected range of influences on Bhutan's

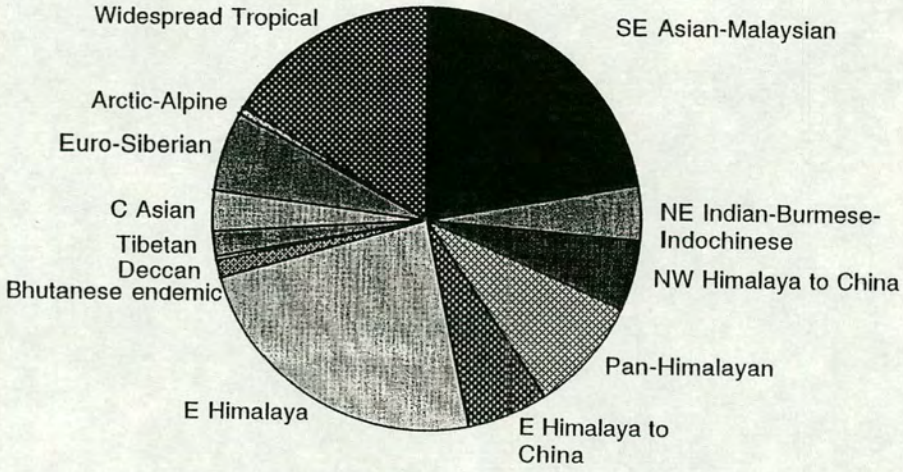


FIG. 4 FLORISTIC ELEMENTS IN GRAMINEAE

flora, with the two most important being the Sino-Himalayan and the (tropical) SE Asian. Hooker and Thomson (1855) long ago pointed out the importance of the 'Malayan Archipelago' and 'China and Japan' elements of the Himalayan flora, the latter particularly in the E Himalaya. The Peninsular Indian element is very small, no doubt a reflection of tectonic history. It would be of particular interest to compare in detail the floras of Bhutan and the geologically more ancient Khasia Hills directly to the south, but on the other side of the Brahmaputra River. In view of their differing geological and glacial histories, their floras are rather different, and there is an element in the Khasian flora of species that have not managed to cross the Brahmaputra. Others, however, have - in Gramineae for example *Calamagrostis elatior* and *Cymbopogon khasianus* appear to be restricted to Bhutan and Khasia.

According to Mill (1995, p. 79), quoting others, c. 39% of vascular plant species in the E Himalayan province are said to be endemic. I have found the level to be rather lower; in the case of Gramineae (25%) and *Carex* (18%). If one looks at narrow, political endemism, the proportion in Bhutan is very considerably lower: Gramineae 1.2%, *Carex* 1.4%. Of groups studied up to the present (i.e. excluding Orchidaceae), the total number of species endemic to Bhutan is c. 82, and of these 39 have been described during the course of the project (some of those in critical groups will, no doubt, eventually prove to be more widespread).

The E Himalayan province is floristically rich, with an estimated 9000 vascular plant species, (Mill, 1995, p. 79). The *Flora* covers 5603 species, and so can be seen to provide fundamental information about a significant proportion of the plants of a very important region.

Introduced and cultivated plants

The inclusion of non-native species in the *Flora* came about at least partly from Grierson's interest in cultivated plants, but was undoubtedly a wise decision. Introduced plants are a fascinating part of any flora, for many reasons, for instance in the speed with which some may spread, either deliberately or accidentally. To cite one example, montbretia (*Crocosmia* x *crocosmiiflora*), a taxon that, so far as is known, had a single (horticultural) origin in France in 1880, has even reached the gardens of Bhutan. Introduced species are often ignored by collectors and omitted from Floras. They are often very hard to identify since in many cases their country of origin cannot be guessed. This neglect has arisen partly from such difficulties of identification, and also from notions of 'purity' of native floras. This latter is, however, somewhat suspect: after all man is as much a 'natural' vector of propagules as any other animal. Another reason for taking introductions seriously is that in several documented cases new species have arisen when an introduced species has hybridised with a native relative. Although there is a tendency within the country to regard all plant life as unique to Bhutan, this is especially untrue in the case of most of its crop plants. Crops provide many examples of ancient and distant dispersal; where would Bhutan be without maize, wheat, barley, chillis, aubergine, etc? The only major crops (or at least their progenitors) that might be native are, in fact, rice and *Colocasia esculenta*. Introductions are particularly important in Gramineae (forming some 20% of the total grass flora), and I took pains to obtain information about cereals and pasture grasses from agriculturists in Bhutan. An interesting species which I added to the cultivated flora was an aroid cultivated on a small scale, which turned out to belong to the S American genus *Xanthosoma*, not previously recorded from the Himalaya. The case of *Allium hookeri* demonstrates the difficulty of telling the native/introduced status of a plant. Stearn (1960) described its distribution as 'one of the puzzles of plant-geography', being known to him from herbarium specimens from the E Himalaya, Khasia, SE Tibet, Yunnan and Sichuan, but

originally described from Ceylon. In fact it turns out to be frequently cultivated in our area, but this was not recorded on any of the specimen labels in the herbarium, and so it had been assumed to be native. I have seen it grown in gardens, and its leaves are sold like chives in markets, for example in Thimphu and Zhongdian (Yunnan). Its strange distribution is probably due to man, and its original home remains a mystery. Watt (1889) long ago pointed out that 'the greatest possible confusion exists in India regarding the cultivated forms ... of *Allium* ... in addition to the preceding forms, many others are regularly known to the natives of India, and even cultivated and sold in our bazars'.

History of exploration

The area covered by the *Flora* consists of the kingdom of Bhutan itself, the Indian state of Sikkim, Darjeeling District of the Indian state of W Bengal, and the Chumbi valley of Tibet (FIG. 1). These have rather different histories of botanical exploration. Whereas Sikkim and Darjeeling came under the influence of British India from the mid-nineteenth century, Bhutan maintained its independence and allowed very few visitors of any description to enter the country until the 1970s.

Bhutan

The history of botanical exploration in Bhutan is summarised by Grierson & Long (1983) and Desmond (1992). The following is an expanded version of an article published in the Bhutanese journal *Tsenden* (Noltie, 1995), in turn based on a talk which I gave in Edinburgh to the Bhutan Society (27 v 1995).

Several diplomatic missions sent by Warren Hastings (Governor-General of India) to try to establish trading links with Tibet passed through Bhutan. Hastings was interested in natural products and was anxious to obtain seeds and information about plants such as walnuts, madder [*Rubia manjith*] and ginseng [*Panax pseudoginseng*] (Markham,

1876, pp. 6 & 8). The first of these missions was led by a Scotsman, George Bogle (1748--81), and spent several months in Bhutan in 1774 and 1775 on the way to and on the way back from visiting the third Panchen Lama at Tashi Lhunpo. Bogle records approximate English names of some of the trees and plants, and information on crops seen; he also introduced the potato to Bhutan. Bogle employed a Bhutanese to collect seeds to send to Hastings, and records the sending of 'a slip of sweet brier' (sic) [*Rosa* sp.] to Hastings (Markham, 1876, p. 52).

The fourth of such missions sent by Hastings was led by Samuel Turner in 1783, and accompanied by a medic, Robert Saunders, who published what could best be described as a short natural history travelogue about the visit. This, however, is the first account of Bhutan in a scientific publication, and includes information about crops, useful plants, vegetation, geology, minerals and medicine. Saunders obviously did not collect specimens and did the best he could in giving common names or names of similar plants that he knew from Europe (Saunders, 1789).

William Griffith was a botanist of genius and Bhutan may consider itself fortunate that he was the first to study its flora seriously, during a four and a half month visit from January to May of 1838. He was the medic and naturalist attached to Major R.B. Pemberton's diplomatic mission. Long (1979) worked out his itinerary: Griffith entered the country in the south east (Dewangiri) went north to Tashi Yangtsi then west to Thimphu and finally south leaving by Buxa. He thus saw a vast range of habitats, and made extensive notes, including pioneering ecological transects. Griffith died in 1845, at the age of only 35, and his voluminous notes were edited by M'Clelland posthumously. His specimens were badly treated, being added to the East India Company's herbarium along with vast amounts of material representing the labours of other Indian botanists. Griffith made 1191 collections in Bhutan; the field notes for these were published by M'Clelland (Griffith, 1848) as was Griffith's *Journal*, which included much detailed

information about plants and less than generous notes on culture and people (Griffith, 1847). Polished abstracts of this journal were actually published during Griffith's lifetime - both in India, and in England (Griffith, 1840). Griffith's specimens were rescued with the other botanical collections from the basement of India House by J.D. Hooker in 1858 (Desmond, 1992, p. 192) and taken to Kew whence duplicates were distributed. The top set of the surviving specimens, with the field labels, is extant at Kew. Duplicates were sent to other herbaria, with a complicated system of numbers, which annoyingly do not allow reference back to the original collecting numbers. This collection is the foundation stone of Bhutanese botany, and the records were included by Hooker in his *Flora of British India*. Several of Griffith's plants have never been refound in Bhutan, for example *Erioscirpus microstachys* and *Carex crassipes*. In many cases work for the present project is the first time that these collections have been critically studied, and novelties have been found among them. For example my own recently described *Carex burttii* was first collected by Griffith.

The only other collectors to visit Bhutan in the nineteenth century were ones sent from the Calcutta Botanic Garden to the Chumbi Valley and Sikkim, some of whom strayed into western Bhutan. Very little is known about them, and most of the place names they used (transliterations from Tibetan) are impossible to trace. The one person we are certain of is Dungboo who was the first to discover the striking white *Meconopsis superba* at its only known locality (which he recorded as Ho-Ko-Chu) in the Ha valley in 1884 .

J. Claude White (1853--1918) was Political Officer in Sikkim and seems to have made five visits to Bhutan between 1905 and 1908. These mainly related to diplomatic matters, such as presenting the insignia of the Knight Commander of the Indian Empire to the Tongsa Penlop, Ugyen Wangchuk, and in 1907 attending his installation as first hereditary King at Punakha. White's exact itineraries are not easy to put together from his published memoirs (White, 1909) and the accounts he wrote of

these trips; the latter contain some errors of dates. White collected in excess of 250 specimens, which are mainly at Calcutta, with some duplicates at Kew. It was White who rediscovered the spectacular slipper orchid *Paphiopedilum fairrieanum* in the Amo Chu valley, and *Primula whitei* is named after him.

The link between Edinburgh and Bhutan could be said to have started in 1914, when Roland Edgar Cooper (1890--1962) first visited the country, spending five months collecting seeds of horticulturally interesting plants for the British nursery firm of Bees. He had already collected for Bees in Sikkim in 1913. That Cooper was allowed into Bhutan is rather remarkable, but was made possibly through the first King's Agent, Raja Ugyen Dorji. Cooper's itineraries were worked out by David Long (Long, 1979) and there is more information about him in Brenda McLean's book about A.K. Bulley, the owner of Bees (McLean, 1997). Cooper visited Bhutan again, for another five months, in 1915, on both occasions he amassed substantial collections of herbarium specimens (2675 in 1914 and 1283 in 1915). Unfortunately, most of these were trapped in the hostile environment of Calcutta, being eaten by insects for some 15 years. They were eventually retrieved when Cooper went to Edinburgh to work as a horticulturist. Cooper's journeys were very extensive, covering the main E-W route, but with extensive forays to the NW and to the remote northern passes of the Monla Karchung La and the Kang La. He also visited the fascinating and still very unknown areas of the Black Mountain (Dunshinggang) and the Yuto La ridge. On the latter he found the extraordinary *Lobelia nubigena*, endemic to Bhutan and resembling somewhat in habit the giant lobelias of E Africa. Cooper made several notable introductions to horticulture (the main interest of his commercial sponsor!), such as *Viburnum grandiflorum* and *Berberis cooperi*. His own favourite genus was *Primula*, but these proved short-lived in cultivation. Of monocots it was Cooper who discovered the endemic *Allium rhabdotum*, only collected later by Ludlow and Sherriff in 1949 and myself in 1991. Cooper also discovered two interesting monocots of wet habitats: what was

later to be described from Kweichow (China) by T. Koyama as *Schoenoplectus fuscorubens* and a *Sagittaria* in Bumthang and Punakha (where it can no longer be found). The latter was misidentified in the herbarium, and only found to be identical with a species recently described by Li Heng from Yunnan (*S. tengtsungensis*) during the present work.

Between May and August 1938, Basil J. Gould (1883--1956), Political Officer in Sikkim, journeyed through Bhutan to visit the second King, Jigme Wangchuk, in Bumthang. Gould had been asked to collect plants for Kew, and was enthusiastically helped by the King's Chief Agent, Raja Sonam Topgye Dorji (son of the Agent who had helped Cooper). A useful collection of about 1400 specimens was made, which included several new species including the asclepiads *Ceropegia dorjei* and *C. ugeni*. Gould also made a brief trip to Ha in 1939, collecting a few specimens. Unfortunately plants are mentioned only very cursorily in his posthumously published memoirs (Gould, 1957).

Frank Ludlow (1885--1972) and George Sherriff (1898--1967), were probably the greatest collectors to have worked in Bhutan. Through their friendship with Topgye Dorji and his family, and through them with the second King, they had greater freedom to travel in the country than any foreigners before or since. Ludlow and Sherriff, along with a varying entourage, visited the country six times between 1933 and 1949. Their story is told, in dry and indigestible form by Fletcher (1975), but a fuller story, that will do their efforts greater justice, is still to be written. Their initial interest (apart from birds) was in plants that would do well in British gardens, especially what they called the 'aristocratic' genera *Meconopsis*, *Primula* and *Rhododendron*.

The first expedition of 1933 traversed the major E-W route, but with excursions to the NE to rediscover some of Cooper's finds at the Kang La. It was on this trip that they discovered the riches of the Me La in the extreme NE - a site they were to revisit on two subsequent expeditions. It was also on this

expedition that they rediscovered Dungboo's *Meconopsis superba*. In 1934 Ludlow and Sherriff returned to E Bhutan (and SE Tibet). On this trip they climbed an unknown shrub (to be described as *Luculia grandifolia*) against a cliff at Chungkhar to reach two strange primulas; the larger, with long, tubular, mauve flowers, was described as *Primula sherriffae* and the smaller as *P. ludlowii*, now sunk under the latter. 1936 found them again in E Bhutan and Tibet, and their 1937 expedition took Sherriff on his own to Central Bhutan and the Black Mountain. Sherriff refound *Lobelia nubigena* on this occasion. The 1938 expedition was accompanied by Dr (later Sir) George Taylor, and was mainly to Tibet, though the indefatigable pair made significant collections on their way back through E Bhutan. Taylor stressed the need to collect as wide a spectrum of taxa as possible, not neglecting groups of little horticultural merit such as grasses and sedges. This advice was to bear rich fruits on the last expedition in 1949, accompanied by Sherriff's wife Betty and Dr John Hicks. The 1949 expedition was a stupendous achievement of organisation and led to major results: the party divided into three groups to cover the whole of alpine Bhutan - Ludlow covered the NW from Paro to Tongsa via Laya and the Gafoo La; Sherriff explored Central Bhutan working north from Tongsa and Bumthang, reaching the Monla Karchung La. Betty Sherriff and Hicks returned to the ever-productive Me La. The combined journeys extended through the whole growing season, ending up with autumn seed-collecting. Numerous interesting discoveries were made such as *Lilium sherriffiae*, which I rediscovered in 1991. A *Fritillaria* on high screes near Lingshi was thought to be new and described as *F. bhutanica*, but as part of the present work (Noltie, 1992) was found to have been described earlier from Yunnan as *F. delavayi*. As with those of Griffith and Cooper, new species continue to be found among the Ludlow and Sherriff collections, in the case of monocots *Iris dolichosiphon* (Noltie, 1990) and *Lloydia delicatula* (Noltie, 1993b). Such discoveries come from plants which were misnamed in the herbarium, or arise from studying plants in a wider geographical context. The Ludlow and Sherriff expeditions

stopped due to political instability arising from the Chinese invasion of Tibet.

After 1949 occurred a gap, to be followed by what could be called the era of the professional, institution-based botanist. This corresponded with the cautious 'opening up' of Bhutan from its centuries of self-imposed isolation under the leadership of the third King, Jigme Dorje Wangchuk, in the early 1960s. For this Bhutan leaned heavily on India for support and technical help in everything from road building and national security to botany. Thus the Botanical Survey of India was invited to make a start on a botanical inventory of Bhutan. The Survey made numerous visits in the period 1963-5, the botanists included G. Sen Gupta, D.B. Deb, S. Rao, N.P. Balakrishnan and J.K. Maheshwari. This work was of particular importance as it concentrated in the south of the country, a very neglected area, and one that is currently inaccessible due to political unrest. The BSI collected many specimens (which are deposited at Calcutta (CAL) and Shillong (ASSAM)), and eventually published an annotated list of their Bhutanese records (Subramanyam, 1973). Ramesh Bedi, an officer from the Ministry of Health in Delhi made a visit to Bhutan, collecting medicinal plants in 1971.

From the 1960s onwards the Japanese have played an important role in the botanical exploration of the Himalaya. This interest arose at least partly from the desire to investigate floristic links between Japan and the E Himalaya. Especially important has been the University of Tokyo, initially under the leadership of Professor Hiroshi Hara (1911--86). Hara's expeditions (and those of his successors) have mainly been to Nepal, and to a lesser extent to Darjeeling and Sikkim, but they visited Bhutan in 1967. Their results were published in the three volumes of the *Flora of the East Himalaya* (Hara, 1967, 1971; Ohashi, 1975). A unique contribution was made by another Japanese, Keiji Nishioka who published what was, until recently, the only popular, colour-illustrated book on Bhutanese plants and ethnobotany. This was written in conjunction with S. Nakao, who collected in Bhutan in 1958

and 1981. Nishioka worked in the field of agricultural development based at Bondey Farm, Paro from 1964 until his untimely death in 1991. He was possibly unique as a foreigner in being awarded the title of Dasho by the King. Another important Japanese contribution was the ecological work undertaken by groups from Chiba University in the 1980s.

The history of the *Flora of Bhutan* project is explained above. Part of the initial project was to undertake a series of expeditions in conjunction with the Forest Department of the RGOB, mainly to cover underexplored areas and plant groups. Prior to the political difficulties of 1985 onwards, four expeditions took place: Grierson and Long in 1975, 1979 and 1982; Sinclair and Long 1984. After this occurred the hiatus in communication described above, but during this period two Edinburgh botanists were able to visit Bhutan as the private guests of John Wood (see below). Rose A. King (later Clement) (1952--1996) visited in 1989 and myself in 1991. Links were re-established in the late 1990s and I was privileged to make the first official visit of the new era in 1998, collecting grasses in the company of Rebecca Pradhan, Tandin Wangdi and Sherub.

The tradition of the talented British 'amateur' botanist has not disappeared and two individuals have made notable contributions to the discovery of the Bhutanese flora. Simon Bowes Lyon has visited the country on many occasions arising from his friendship with the Bhutanese royal family. He collected specimens in 1966, 1967, 1969, 1971 and 1994, which are mainly at BM. Particularly interested in rhododendrons and the first to recognise *R. bhutanense* as distinct, Bowes Lyon also suggested naming an endemic rhododendron (first noticed by K. Rushforth in 1987) as *Rhododendron kesangiae*, after the Queen Mother of Bhutan (H.M. Ashi Kesang, widow of the third King, and daughter of Topgye Dorji). John R.I. Wood has made the most important individual contribution to our knowledge of the flora after Griffith, being an outstandingly gifted and observant botanist with wide experience. He worked in the Department of

Education from 1987 to 1992 and collected some 1800 specimens, many of which came to RBGE. Wood specialised in difficult groups, especially the families Acanthaceae, Umbelliferae and Gramineae.

Many other British botanists have visited Bhutan as ecological tourists, some have unfortunately been unable to stop themselves collecting without permission - a habit that has no doubt added to problems between Bhutan and the UK (and by association, Edinburgh, see above).

From the 1970s onwards, several foreign consultants and aid workers have visited the country and collected plants, either as part of their job or as a hobby. For example various agriculturists working on fodder development, including Daniel J. Miller and Graham A. Dunbar. Chris Parker, a consultant on weeds, visited in 1991 and 1992, collected specimens, and published a book on the weeds of Bhutan (Parker, 1992). Among those who collected as a hobby may be mentioned the Hon. Deborah Keith, Caroline Sargent, Ian Broad and Michael Bigger.

Bhutanese started taking an interest in the flora of their country from the 1970s. The first were R. Nawang and Sonam Tshering. Tshering assisted Grierson and Long on their field trips and was trained in herbarium techniques for twelve weeks at Edinburgh ii/iv 1981. Of much greater importance is the contribution of Rebecca Pradhan. Wife of an officer in the Forest Department, she single-handedly held the torch for botany in Bhutan at a very difficult time, and played a vital role in re-establishing links between RGOB and RBGE. She also completely reorganised and curated the small Forest Department herbarium at Taba and has undertaken a large amount of fieldwork and collecting. Rebecca has recently (1999) published a popular, colour-illustrated, account of Bhutanese rhododendrons. Other recent contacts have been Tandin Wangdi, who obtained an M.Sc. in plant taxonomy at Edinburgh (1996-7); Sonam Wangchuk of the Nature Conservation section, who worked in the herbarium at RBGE

in 1996 and D.B. Gurung, a lecturer in the Natural Resources Training Institute at Lobesa, who wrote a thesis on the orchids of Bhutan at RBGE as part of an M.Sc. in Resource Management (Gurung, 1997). Agriculturists encouraged to collect grasses by myself on the 1998 field trip were Kinzang Wangdi and Tsering Gyaltsen, who it is hoped will continue this work.

Sikkim and Darjeeling

Many more collectors have worked in Sikkim and Darjeeling than in Bhutan, and there is not space to discuss them here in detail; summaries are given in Grierson & Long (1983). Mention must at least be made of those who have contributed most to the collection of monocots. First among these is Joseph Hooker who explored Sikkim in 1848--9 and laid the foundation of all subsequent work in the region. The other great nineteenth century collectors of grasses and sedges were C.B. Clarke (briefly Superintendent of the Calcutta Botanic Garden, then an inspector of schools in Bengal) and the forester J.S. Gamble. In the early twentieth century W.W. Smith, during his period as Keeper of the Herbarium at Calcutta (1907--11), made several trips to Sikkim, alone or with G.H. Cave; these resulted in several papers on its alpine vegetation. R.E. Cooper (see above) was Smith's nephew by marriage (and ward). A link with Edinburgh was made when Smith returned to Edinburgh as Deputy Regius Keeper of the RBGE in 1911. The native Lepcha collectors Ribu and Rohmoo started to work for the Calcutta Botanic Garden in the same period, and collected important specimens in Sikkim. N.L. Bor made extensive collections of grasses during World War II in Sikkim and the Chumbi valley. Two recent Edinburgh expeditions have visited Sikkim, the first in 1992 to the west, and the second in 1996 to the north, both following in the footsteps of Hooker. I took part in both of these and was able to make substantial monocot collections (see below).

My own work

A brief outline of the *Flora of Bhutan* format was given above. Something must now be said about the actual methods used to write the work. Flora writing is a curious fusion of art and science. Being primarily descriptive, and forming part of the alpha stage of the taxonomic process, it is not scientific in the sense of testing hypotheses by experimental methods. Though it could be said that a species description is a hypothesis, which can be tested (as to its limits and accuracy) by field observation. In later stages of the taxonomic process the species hypothesis, and subjects such as its evolutionary history, can be investigated in the laboratory, the most recent techniques using analyses of parts of the genome at a molecular level. Flora writing is also part of the enabling science for the disciplines of plant geography, evolution and ecology. It combines many different skills and uses information from many fields. Among these are bibliography, history, geography, ecology, botanical nomenclature, observation and the recording of morphological data. Ancillary characteristics required at the present time are fund-raising abilities and diplomatic skills!

In my own contribution, as the *Flora* format was already established, I followed this with only minor modifications. I have used more illustrations than in the dicot volumes, since many of the species covered are rather hard to identify: utricles of all species of *Carex*, and inflorescences and spikelets of all Gramineae are illustrated. Longer species descriptions were often found to be necessary (see below). I used the system of Dahlgren, Clifford & Yeo (1985), which dismembers the very heterogeneous Liliaceae of earlier authors. For the Grass volume, because of the importance of the family and the fact that the volume is devoted solely to it, I wrote a substantial introduction describing ecology and uses in some detail. In general I have given more frequent notes, pointing out taxonomic problems, than in other parts of the *Flora*.

The starting point for writing accounts for this *Flora* is to examine the literature relating to Bhutan and adjacent areas, and to search herbaria, in order to assemble a preliminary list of recorded taxa. For reasons given above, herbaria used were largely restricted to the UK - the Natural History Museum (BM), the Royal Botanic Gardens Kew (K) and the Royal Botanic Garden Edinburgh (E). I was fortunate to be able to visit the Calcutta Botanic Garden (CAL) in 1991, where I checked all the Bhutanese (and many Sikkimese) monocots except for grasses, and did the same at the sadly neglected herbarium of the Lloyd Botanic Garden, Darjeeling in 1992.

The basic aim in writing a floristic account is to recognise species, to determine their correct name, and make descriptions of them. The next step is to construct keys to enable their identification. Finally material is chosen for illustration and the artists carefully supervised.

The methods used for species delimitation have been entirely traditional, using nothing other than the eye, aided with a binocular dissecting microscope; pattern recognition, correlation and information processing has been done entirely with a human brain. Difficulties encountered have varied from group to group - some biological in origin, others related to limitations of the collections available. Specimens from our area are often old or inadequate, and it is not uncommon for taxa to be represented by single specimens. Biological difficulties occur in groups where clear disjunctions in the pattern of variation are hard to detect (e.g. *Arisaema*, *Polygonatum*, *Poa*). The reasons for such variation are difficult to ascertain without biosystematic or molecular studies. Hybridisation, a well-known factor leading to such 'fuzzy edges', undoubtedly occurs. It was suspected from herbarium specimens, on morphological grounds, in *Polygonatum*, *Juncus*, *Bothriochloa*, *Calamagrostis*, *Cymbopogon*, *Eleusine* and *Setaria*. On recent field trips it has also been observed in *Maianthemum* and *Raphidophora*, which suggests that more intensive field study will show hybridisation to be more frequent than suspected from the

herbarium. It is interesting that I did not find any suggestion of hybridisation in *Carex*, a genus in which the phenomenon is common elsewhere in the world.

The solutions to such problems of species delimitation varies, and in writing a Flora account in a reasonable time, many have to be left unresolved. I have striven always to mention such problems in the form of notes after species entries, rather than 'sweep them under the carpet' as is so often done.

Problems also arise when it comes to applying the 'correct' name to a species - that is in applying the labyrinthine rules of the latest version of the *International Code of Botanical Nomenclature* (Greuter *et al.*, 1994). There are particular difficulties in dealing with Himalayan plants and one must have a detailed knowledge of the complex literature relating to the Indian subcontinent dating back to the time of William Roxburgh (and occasionally beyond). There are also substantial problems over the typification of many species. To take one example, let us consider plants described from what is commonly called the 'Wallich Herbarium'. In fact this collection, now housed at Kew, is the top set of specimens that formed the herbarium of the Honourable East India Company. It contains many collections other than those of Wallich, but was sorted by him (with the help of others) between 1823 and 1832, and duplicates extensively distributed. A lithographed catalogue was published, containing many new names, but these were *nomina nuda*. If subsequent authors took these names up and validated them, then the type is the specimen on which the author actually worked (be it De Candolle in Geneva, or Hooker in his own herbarium). This specimen may, or may not, be the same as the plant under the same number in the 'Wallich Herbarium'. Problems frequently occur in critical groups (such as Gramineae, or *Smilax* - see Noltie, 1994b) where mixed may collections occur under a single number; moreover mistakes were sometimes made in sorting and distributing duplicates. This is one example of why it is often necessary to borrow types from a wide range of international herbaria in the course of such work. Other very

common problems arise from species described in the *Flora of British India* where numerous syntypes (in modern parlance) are cited, which often turn out to represent different taxa (e.g. in the case of *Poa khasiana* - see Noltie, 2000b). When names in common use turn out not to be the earliest, a regrettable name change is necessary. In one case, however, I was able to persuade the nomenclatural arbiters to conserve a species name: *Carex filicina* (Noltie, 1997). Where problems of this nature become apparent, time has often been taken to resolve them, and the results published as taxonomic notes in the series 'Notes Relating to the Flora of Bhutan' in the *Notes from the Royal Botanic Garden Edinburgh*, now re-titled the *Edinburgh Journal of Botany*. Novel species have been described in the same place - a list of those discovered during the present work is given in Appendix 2. Such time-consuming technicalities and niceties would, of course, have been quite unthought of by the initiators of the idea of a Bhutanese 'Floral Inventory'.

The measurements and descriptions throughout the *Flora* have been made from scratch, from specimens collected within the *Flora* area. In the past much trouble has resulted from the copying of descriptions from older works. This has been a particular problem in the Indian subcontinent, where there is a respect amounting to reverence for the *Flora of British India*. This is, without doubt, one of the greatest Floras ever written, but it is more than 100 years old, and, in order to complete it, Hooker took a necessarily pragmatic approach; moreover it was written before the evolution of our very precise type concept. An example of another sort of problem occurs in the Gramineae: Hooker had a different, and initially confusing, terminology for the parts of the spikelet from that presently used. Another danger of copying descriptions and amalgamating measurements, often without specifying the material used, is that it can obscure genuine local variation (which may be significant as a starting point for speciation).

The original aim of the *Flora* was that the species descriptions should be very short, but in the case of the monocots, it has

often been necessary to be rather less than concise. This is because of the complex structure of many of the species treated, and the fact that many have not been very fully or accurately described before. For example Bor's work on Gramineae represents a stupendous achievement, but it is clear that the descriptions in his most detailed treatment (describing the grasses of neighbouring Assam - Bor, 1940) were based on very small samples. In his *magnum opus* (Bor, 1973), due to its wide geographical coverage and the large number of taxa treated, there are no species descriptions, and the measurements in the keys are often misleading (again, obviously based on small samples).

As already stated I have tried to avoid looking at the plants of Bhutan in a narrow sense, and have always checked Chinese specimens and literature (though until the completion of the *Flora of China*, this is hindered by language difficulties). Such investigations have led to the recognition or discovery in Bhutan of many species described from, and previously only known from China (e.g. *Lloydia yunnanensis* - see Noltie 1993b; *Sagittaria tengtsungensis; Juncus perpusillus* - see Noltie, 1994c and *Arenga micrantha* - see Noltie, 2000c). The same applies, but in reverse, to species described first from Sikkim or Bhutan and discovered during recent field trips to Yunnan (e.g. *Carex radicalis*, *Kobresia pseuduncinoides*, *Iris dolichosiphon* - see Noltie, 1990). Bearing phytogeography in mind, I have also always checked Indian and SE Asian material, particularly of warm temperate and subtropical species from lower altitudes. This led to the recognition of *Neyraudia curvipes* from Bhutan, a species only previously known from Mount Kinabalu in Borneo.

Fieldwork for monocots

Because my involvement with the project coincided with the period in which RBGE was not allowed into Bhutan, my fieldwork in the country has been limited to two visits (the first unofficial). It has, however, been my great privilege to participate in a number of field trips to surrounding areas during the period of my research. On these group or solo expeditions, my main rôle was to collect monocots. This experience has added greatly to the authority of the accounts written, both in general terms of taking a broader approach, and in particular from being able to study living plants. Field work has been of particular importance in the case of under-collected groups such as Gramineae and Cyperaceae. It has also been extremely valuable in the case of plants which require specialist collecting (e.g. *Musa*, Palmae). In the course of these expeditions I discovered six species (*Agrostis ushae*, *Juncus hydrophilus*, *J. spumosus*, *J. tobdenii*, *Poa longii*, *Trachycarpus latisectus*) and two subspecies (*Carex laeta* subsp. *gelongii*, *Stipa jacquemontii* subsp. *chuzomica*) new to science, and saw ten taxa in the field that I had 'discovered' and described from older, wrongly named, herbarium collections. The most spectacular of the discoveries was perhaps the Windamere palm, *Trachycarpus latisectus*, grown as two specimen trees outside the Windamere (sic) Hotel, Darjeeling, and since discovered in the wild near Kalimpong (Spanner *et al.*, 1997). It was also possible to obtain previously unrecorded information on the distribution of sexes between individuals in *Kobresia esenbeckii* and its allies (Noltie, 1993c). These species had been described as dioecious, but it was found, by careful uprooting, that a single individual could produce male and female inflorescences in different parts of a single plant, and thus the apparent dioecy was an artefact of casual collecting. The female of the dioecious palm *Arenga micrantha* (previously known only from male specimens from Tibet) was described for the first time (Noltie, 2000c). Numerous extensions of species ranges were made, and many new records for the countries visited:

some of this information is included in the 'Notes Relating' papers, and some in the *Flora* itself.

The field trips in which I participated or undertook were as follows:

Kew, Edinburgh, Kanchenjunga Expedition (KEKE) to E Nepal (August to October, 1989) - 277 monocots collected.

Solo visit to Bhutan (July to August, 1991) - 177 specimens collected.

Edinburgh Expedition to Sikkim & Darjeeling (ESIK) (July to August, 1992) - 502 monocots collected (see Watson, 1993).

Kunming, Edinburgh Göteborg Expedition (KEG) to NW Yunnan (May to June, 1993) - 428 monocots collected (see Noltie, 1994e).

Scientific Exploration Society Expedition to Namdapha, Arunachal Pradesh (January, 1994) - 124 specimens [not released by Indian authorities].

Forestry Commission, Edinburgh Expedition to Deqen Prefecture, NW Yunnan (September, 1995) - 114 monocots collected.

Edinburgh Expedition to Northern Sikkim (EENS) (July, 1996) - 218 monocots collected (see Noltie, 1996).

Solo visit to Chittagong, Bangladesh (October, 1997) - 59 specimens collected

Solo visit to Bhutan (August to October, 1998) - 366 specimens collected (including 154 species of Gramineae).

Practical uses of the Flora: examples from the monocots

Some examples of practical uses of the *Flora* may be given from the monocots. Species of potential or actual commercial value have been discovered: for example species with horticultural possibilities include many of the cobra lilies (*Arisaema* spp.) and the beautiful *Iris dolichosiphon,* though any market for these is likely to be specialist. A new banana, *Musa griersonii* (Noltie, 1994d), could conceivably have interest as a wild relative of a commercially important genus. Most interesting of my own discoveries is, perhaps, *Cymbopogon bhutanicus* (Noltie, 1999b). This species is currently commercially exploited in Eastern Bhutan - essential oils are extracted by steam distillation and exported to India for use in the manufacture of perfumes. The species had previously been identified (probably by Indian taxonomists) as *C. distans*, but it turned out not to be that. The situation was found to be more complex - the species exists in two forms, which are distinguishable (with some difficulty) in the field, but not in the herbarium; one produces a commercially valuable oil rich in citral, the other higher yielding, but rich in the unpleasantly scented piperitone, and so not commercially useful. My account of the canes of Bhutan (*Calamus*, *Plectocomia* and *Daemonorops* - Noltie 1994a) was found to be useful during an EU funded project on these commercially important palms (S. Barrow, pers. comm.), and will be the basis of a field guide to the Canes and Bamboos of Bhutan to be written by scientists based at Kew.

The use of the *Flora* in providing primary data for conservation was mentioned earlier, and will become even more important when the *Flora* is complete. Tandin Wangdi, in an M.Sc. thesis, has already compiled a preliminary Red Databook of scarce and endemic Bhutanese plants based on information in the Flora of Bhutan card index (Wangdi, 1997).

The Future

With our aim of the primary documentation of Bhutan's phanerogamic flora firmly in sight, the future lies to a large extent with the Bhutanese themselves. For the last several years, there seems to have been a genuinely new atmosphere in the country. Helped by foreign aid from DANIDA, the building of a new, purpose-built, National Herbarium has been started. This will replace a hopelessly inadequate wooden building, with a leaky roof, situated at Taba, north of Thimphu. The new building is sited within a recently established Royal Botanic Garden at Serbithang just south of Thimphu. In the field of training Bhutanese nationals, one student has already received an M.Sc. in plant taxonomy from the University of Edinburgh (1997) and two more are scheduled to register in 2000 and 2001.

There will no doubt continue to be problems, for example arising from internal politics and rivalries. The herbarium has been taken away from the Forest Services Division and placed under a new National Biodiversity Programme, which perhaps unfortunately covers Agro-biodiversity (i.e. local races of crops) in addition to wild biodiversity. It is not clear how the NBP will interact with potential users of the Herbarium from other government departments, such as the Nature Conservation Section of the Forest Department. There is also a problem in Bhutan of a lack of personnel suitable for training - due to its small population. For example in the past Sonam Tshering, having received training in herbarium management at Edinburgh was assigned to other duties on returning to Bhutan. Low priority has been given in the past to subjects such as Botany, but this is not really surprising given the point reached in the country's recent and rapid development. It is also not uncommon for individuals to be sent abroad for training as a 'perk', and therefore based on an individuals 'connections' rather than on any inherent interest or aptitude. There are signs that this is changing, not least from the realisation that the 'Environment' is a growth industry worldwide. The production of a recent and extremely

professional *Biodiversity Action Plan for Bhutan* (Anon., 1998) is indicative of such changes and gives cause for hope.

The *Flora* project has identified many problems that can be addressed in future. Of taxonomic problems further work is needed, for example, on the genus *Polygonatum*, on *Arisaema griffithii* and its allies, and on *Carex* section *Vigneastra* Tuckerman (syn. *Indicae* Clarke). Among Gramineae further work is required in the genera *Agrostis*, *Calamagrostis* and *Cymbopogon*, and on the polymorphic species *Tripogon filiformis*, *Brachypodium sylvaticum* and *Arundinella nepalensis*. In terms of collecting there is a need for specialist collecting of neglected groups such as Gramineae throughout the country. The genus *Musa* requires further investigation, as indicated by the discovery of an undescribed species in 1998 growing beside a major route used by numerous botanists in the past. Efforts should be made to re-collect a mysterious yellow *Iris* known only from a single Ludlow and Sherriff collection; likewise an undescribed species of *Allium* of which I was sent a photograph by a Japanese amateur botanist. A strange, non-flowering bulbous monocot was found by me in 1998 south of Wangdi Phodrang and whose genus I cannot even guess at; it evidently seldom flowers, but careful watching by a local botanist will bring a fascinating result in due course. Of areas in which large-scale collecting is still required effort must be put, as a matter of urgency, to the subtropical south of the country, though this is currently inaccessible due to terrorist activity from Assamese rebels.

It is to be hoped that as more work is undertaken by Bhutanese nationals, the link with RBGE will be maintained. This will always be necessary since, apart from anything else, many type and otherwise important specimens will continue to be preserved here.

Conclusions

As stated at the start of this Review, my work has been primarily descriptive and many of the conclusions arising from it will be made by users of the *Flora* in fields such as phytogeography, conservation and ecology. However, it is possible to state briefly some conclusions that have arisen from the work. Firstly the initial expectations of a rich and phytogeographically interesting flora have been amply confirmed. Much new information has been discovered as a result - including new taxa and extensions of the known distributions of many species. Many nomenclatural and taxonomic problems have been resolved, though more have been identified. The former will be useful far beyond the boundaries of Bhutan, for example to taxonomists working in China, India and Nepal. As an example of this my work on Bhutanese Juncaceae and Iridaceae has enabled me to contribute substantially to the accounts of those families for the *Flora of China* (Wu & Raven, in press).

The work, less positively, has confirmed the extraordinarily fraught nature of such international projects which aim to document biodiversity. Lessons must be learned from this for future Flora projects, such as the Flora of Nepal. Finally, I would make a plea for the support of this type of alpha taxonomic research which, though labour intensive, is fundamentally more important than the currently more fashionable sort of project based on the analysis of databases, which are frequently based on dubious data.

Acknowledgements

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Appendix 1

Publications submitted for Ph.D.

Books:

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Papers:

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Appendix 2

New taxa described during the preparation of Volume 3, parts 1 and 2.

Agrostis ushae Noltie
Arundinella dagana Noltie
Carex burttii Noltie
Carex griersonii Noltie
Carex laeta Boott
subsp. *gelongii* Noltie
Carex nigra (L.) Reich.
subsp. *drukyulensis* Noltie
Carex schlagintweitiana Boeck.
subsp. *deformis* Noltie
Carex speciosa Kunth
subsp. *dilatata* Noltie
Carex speciosa Kunth
subsp. *pinetorum* Noltie
Cymbopogon bhutanicus Noltie
Deschampsia cespitosa (L.) P. Beauv.
subsp. *sikkimensis* Noltie
Eriocaulon bhutanicum Noltie
Iris dolichosiphon Noltie
Juncus bryophilus Noltie
Juncus glaucoturgidus Noltie
Juncus hydrophilus Noltie
Juncus spumosus Noltie
Juncus tobdenii Noltie
Kobresia pseuduncinoides Noltie
Kobresia woodii Noltie
Lloydia delicatula Noltie
Musa griersonii Noltie
Poa chumbiensis Noltie
Poa cooperi Noltie
Poa dzongicola Noltie
Poa lachenensis Noltie
Poa longii Noltie
Poa pseudotibetica Noltie

Poa rajbhandarii Noltie
Poa rohmooiana Noltie
Smilax elegans Wall. ex Kunth
subsp. *subrecta* Noltie
Smilax rigida A. DC.
var. *rigida* Noltie
Stipa bhutanica Noltie
Stipa jacquemontii Jaub. & Spach
subsp. *chuzomica* Noltie
Stipa milleri Noltie
Stipa rohmooiana Noltie
Trachycarpus latisectus Spanner, Noltie & Gibbons

New combinations

Actinoscirpus grossus (L.f.) Goetghebeur & D.A. Simpson
var. *kysoor* (Roxb.) Noltie
Agrostis petelotii (Hitchc.) Noltie
Carex fusiformis Nees
subsp. *finitima* (Boott) Noltie
Cymbopogon munroi (C.B. Clarke) Noltie
Juncus duthiei (C.B. Clarke) Noltie
Kobresia esenbeckii (Kunth) Noltie
Maianthemum oleraceum (Baker) La Frankie
var. *acuminatum* (Wang & Tang) Noltie
Urochloa supervacua (C.B. Clarke) Noltie
Urochloa villosa (Lam.) T.Q. Nguyen
var. *barbata* (Bor) Noltie
Themeda triandra Forssk.
var. *laxa* (Anders.) Noltie

Appendix 3

Floristic elements in the native species of Gramineae.

	Gramineae (no. species)
SE Asian-Malaysian	72
NE Indian, Burmese, Indo-Chinese	14
Himalayan-Chinese-Japanese	
NW Himalaya to China	17
Pan-Himalayan	29
E Himalaya to China	19
E Himalaya	77
Bhutanese endemic	4
Deccan	?1
Tibetan	7
C Asian	9
Euro-Siberian	20
Arctic-alpine	2
Widespread Tropical	53

Appendix 4

Contributors to the *Flora of Bhutan*

E.M.M. Aitken (Bignoniaceae, Gentianaceae, Pedaliaceae, Primulaceae p.p.)
S. Andrews (Aquifoliaceae)
D.L. Boufford (Onagraceae)
A.C. Broome (Gramineae, p.p.)
R.A. Clement (née King) (Alangiaceae, Campanulaceae, Caprifoliaceae, Combretaceae, Cornaceae, Dipsacaceae, Elaeagnaceae, Flacourtiaceae, Labiatae, Melastomataceae, Morinaceae, Nyssaceae, Rhizophoraceae, Valerianaceae)
C. Grey-Wilson (Balsaminaceae)
A.J.C. Grierson (numerous)
O.M. Hilliard (Gesneriaceae)
P.C. Hoch (Onagraceae)
D.G. Long (numerous)
R.R. Mill (Boraginaceae, Convolvulaceae, Scrophulariaceae, Solanaceae)
A.G. Miller (Elaeocarpaceae)
P.W. Myer (Caprifoliaceae: Lonicera)
H.J. Noltie (numerous)
N.R. Pearce (Orchidaceae)
S.J. Rae (Bromeliaceae, Buddlejaceae, Clethraceae, Diapensiaceae, Monotropaceae, Orobanchaceae, Pyrolaceae, Taccaceae, Thymelaeaceae and joint author of many small families)
R.M. Smith (Costaceae, Zingiberaceae)
L.S. Springate (Compositae, Phrymaceae, Plantaginaceae, Rubiaceae p.p.)
C.M.A. Stapleton (Gramineae: Bambuseae)
W.T. Stearn (Alliaceae, Amaryllidaceae)
K. Tan (Polygalaceae)
M.F. Watson (Apocynaceae, Asclepiadaceae, Oleaceae, Umbelliferae)
J.R.I. Wood (Acanthaceae, Rubiaceae p.p.)
J. Wright (Rubiaceae p.p., Carlemanniaceae p.p.)

Artists (number of plates drawn)

M. Bates (118)
M. Benstead (12)
P. Burbidge (2)
E. Catherine (1)
Y.-J. Chen (4)
J. Chisholm (2)
C. Grey-Wilson (3)
C. Oliver (1)
L. Olley (45)
S.J. Rae (7)
G.A. Rodrigues (59)
H.A. Salzen (4)
D. Simon (3)
C.M.A. Stapleton (8)
R.M. Smith (1)
S. Stuart-Smith (142)
K. Tan (2)
M. Tebbs (30)

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NOTES RELATING TO THE FLORA OF BHUTAN: XIX
Kobresia (Cyperaceae)

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The following new taxa, combinations and synonymy in the genus *Kobresia* from E Himalaya and SW China are proposed: *K. pseuduncinoides* Noltie *sp. nov.*; *K. woodii* Noltie *sp. nov.*; *K. esenbeckii* (Kunth) Noltie *comb. nov.* of which *K. seticulmis* Boeckeler, *K. hookeri* Boeckeler, *K. angusta* C.B. Clarke and the illegitimate *K. trinervis* Boeckeler become synonyms; *K. esenbeckii* var. *fissiglumis* (C.B. Clarke) Noltie *comb. nov.*; *K. prattii* C.B. Clarke and *K. harrysmithii* Kük. are reduced to synonymy of *K. vidua* (Boott ex C.B. Clarke) Kük.; *K. williamsii* is reduced to synonymy of *K. gammiei*; *K. curvata* is reduced to synonymy of *K. fragilis*; *K. stiebritziana* is reported new to Bhutan and Sikkim and *K. curticeps* and *K. gammiei* new to Bhutan. Notes on *K. nepalensis*, *K. vaginosa*, *K. vidua*, *K. gammiei* and *K. cercostachys* are given. Observations on apparent dioecy and distribution of sex within the species *K. esenbeckii*, *K. vidua*, *K. vaginosa* and *K. curticeps* are reported.

INTRODUCTION

The genus *Kobresia* has recently been revised for the *Flora of Bhutan*. The Sino-Himalayan region is the major centre of diversity for this genus; the area covered by the *Flora* (Bhutan, Sikkim and Darjeeling) contains 22 species out of a worldwide total of c.50 and represents something of a meeting point within the region of eastern and western elements with, for example, *K. laxa* representing the western and *K. stiebritziana* the Chinese elements. The genus has recently been revised for Nepal (Rajbhandari & Ohba, 1991) but these authors took a rather conservative view. Although Kobresias are relatively humble in appearance, they are of considerable economic significance forming a major component of high pastures (over 4000m) grazed in summer by yak and sheep. The following notes were originally based purely on herbarium studies, but have been greatly expanded from recent fieldwork in E Nepal, Bhutan and Sikkim.

NOTES & OBSERVATIONS

A. Observations on apparent dioecy

Before discussing one of the commonest and most variable species of Himalayan *Kobresia* (*K. esenbeckii*), a note is necessary on sexual expression in the group. Useful information was obtained on this subject on a recent trip to the alpine zone of W Sikkim.

The subject of variability in distribution of sexes in apparently dioecious species in the tribe Cariceae has been studied more extensively in *Carex* than *Kobresia*. For example, Martens (1939) reported the occasional production of androgynous spikes in the normally strictly dioecious *Carex picta*. In *Kobresia* the phenomenon has been little studied and existing descriptions in Flora accounts are often ambiguous.

In sect. *Hemicarex* (sensu Kükenthal), which has single- flowered spikelets arranged in a simple spike that may be female only, male only or bisexual (androgynous or gynaecandrous), many taxa have been described as being dioecious implying that male

and female spikelets are borne on separate plants. This, however, has been deduced largely from herbarium specimens and in the field a more complex situation is found to pertain in at least three species (*K. vaginosa*, *K. vidua* and *K. esenbeckii*).

It should be noted that these plants are difficult to collect as they form very dense, brittle mats or tussocks often of large extent, and it is only too easy to break mere fragments from the edge. If care is taken, however, it is possible to dissect out larger pieces in which it is possible to prove physical connections between different inflorescence-bearing shoots.

The following dispositions of spike types within such dissected pieces were found:

	m+m	f+f	m+f	m+f+m/f	m+f+f/m	f+m/f	m+f+f/m/f	m/f+m/f
K. esenbeckii (incl. *K. angusta*)	x	x	x	x				x
K. vaginosa	x	x			x		x	
K. vidua	x	x	x			x		

f/m = gynaecandrous spike; m/f = androgynous spike; f/m/f = mixed spike; m = entirely male spike; f = entirely female spike; + = physical connection proved between spikes

Note: pieces bearing spikes of only a single sex cannot definitely be stated to represent a dioecious condition since they could have been part of a larger individual bearing the opposite sex in another part of the clump. Voucher specimens demonstrating these conditions have been preserved at E.

What can be concluded from the table above is that individuals are commonly and unambiguously found which bear both male and female inflorescences on the same individual, which if broken off during collecting would give rise to an apparently dioecious condition on the herbarium sheet. These species often exhibit, therefore, a type of monoecism, though on occasions, perhaps true dioecism may occur. Variability certainly occurs and this type of variation in distribution of sexes cannot be taken to be of taxonomic significance as has been done in the past.

This type of monoecism is analogous to that in many *Carex* species - although in *Carex* the male and female 'spikes' are normally part of a single infloresence rather than, as here, separated on different shoots.

The sort of variation recorded above in *K. vaginosa* and *K. vidua*, i.e. normally unisexual inflorescences sometimes producing spikelets of the opposite sex in various positions, is well-known in certain *Carex* spikes (e.g. Holm, 1921).

Experiments are clearly needed to see if expression of sex changes, for example, from year to year or by altering nutrition.

In sect. *Eucobresia* (sensu Kükenthal) with highly branched inflorescences the distribution of sexes is more complex and more variable. The Himalayan *K. laxa* has been studied in detail in this respect (e.g. Timmonen, 1985) as it is almost certainly a primitive inflorescence-type within the tribe Cariceae and provides useful evidence on the evolution of the group and light on the vexed question of the separation of *Schoenoxiphium* and *Kobresia* (Kern, 1958). Variability in distribution of male and female spikelets in *K. laxa* was noticed early and led to confusion. Bentham, for example, placed different forms of what was (to others) obviously the same species in different genera.

Clarke (1883) realised this and noted 'I always supposed this species (as are many others) somewhat dimorphic, the male flowers predominating in one form, the female in another'. Kern (1958) says that according to Clarke sometimes wholly male or wholly female plants occur. I cannot trace the origin of this statement; but even if quoted correctly I suspect it not to be true and that a similar situation pertains as with the 'apparent dioecy' in sect. *Hemicarex*, with problems arising from incomplete herbarium specimens. In the field in Sikkim the same phenomenon was found to occur in *K. curticeps* (a rarely collected species now reported from as far east as the Dochu La in W Bhutan), which normally has single-flowered, androgynous lateral spikes with male spikelets above and female below (though occasionally with a few basal, androgynous spikelets). At Dzongri (W Sikkim) several entirely female inflorescences were found and one individual was proved, by uprooting, to bear both an androgynous and an entirely female inflorescence. If such flowering stems had been broken off separately, then the appearance in the herbarium would have suggested dioecy.

B. The correct name for *Kobresia trinervis* Boeckeler and its allies

Carex trinervis Nees (1834) non Degland (1807) is an illegitimate homonym based on a Royle specimen of a *Kobresia* from Nepal (isotype: *Royle* 138 in part, LIV). This consists (in addition to two specimens of *Carex parva*) of a single, distinctive, plant bearing 2 male-only spikes, with strong basal leaf-sheaths and glumes with wide, hyaline margins. Kunth (1837) provided this with a new name – *Carex esenbeckii* (based on the same type).

Boeckeler (1875) with some caution transferred the (illegitimate) *trinervis* to *Kobresia*, thus forming the illegitimate combination *K. trinervis* Boeckeler, giving *Carex esenbeckii* as a synonym. In the same paper he described two new species of *Kobresia* – *K. seticulmis* and *K. hookeri*, based on duplicates of specimens collected in Sikkim by J.D. Hooker, without commenting on their relationship to *K. trinervis*.

Since the holotype of *K. hookeri*, which should be at Berlin, is presumed to have been destroyed, it is necessary to lectotypify the name. Two relevant sheets are present at Kew, both bearing the same data – 'Sikkim [Lachen, 20.6.1849], 12,000ft, J.D. Hooker. C. esenbeckii Kunth?' – one from Hooker's own herbarium and the other a duplicate from Boott's. Most authors have placed great weight on the distribution of the sex of the spikelets within the spike in this group of species, which we have seen to be unreliable. The specimen from Boott's herbarium actually demonstrates this unreliability, showing a gradation of states from spikes almost entirely male to predominantly female; and it is this sheet that I propose as the lectotype. There can be no doubt that this plant is the same as the male-only type of *Carex esenbeckii*; Hooker presumably queried it as belonging to this species because most of the spikes are androgynous. Harry Smith correctly equated the two species when he determined the Hooker sheet as *K. trinervis* Boeckeler in 1937. It should be noted that C.B. Clarke annotated both sheets with the name *K. hookeri* Boeckeler, thus demonstrating his concept of the species (see below).

The same question of typification applies to *K. seticulmis*, with two sheets at Kew (both from Hooker's own herbarium) bearing the relevant data – 'Sikkim [Lachen,

25.6.1849], 13,000ft. J.D. Hooker. Elyna 2'. There are no significant differences between the sheets so the sheet traditionally regarded as the type is therefore designated the lectotype - this bears a drawing of a spike and a female spikelet by C.B. Clarke. The specimens have androgynous, but primarily female spikes, but the spikelets are more mature than in the type of *K. hookeri*, so that the stoutly-beaked nuts are emergent from the prophylls; other minor differences include the weaker sheaths and narrower, longer leaves. Realising the lack of real differences between these taxa, Clarke (1883) originally united them under the name *Hemicarex hookeri*, citing (by implication - from the altitudes given) the Hooker syntypes of both species and one of his own specimens (*Clarke* 25648, Singaleleh, 11,500ft). He later (1894) changed his mind, retaining them as distinct species under *Kobresia* – in this same work he further confused the issue by saying that Boeckeler's description of *seticulmis* was partly based on specimens of *K. filicina* C.B. Clarke. The glumes and nuts of this predominantly W. Himalayan species, however, are distinctive and Hooker did not collect the species in Sikkim, so it is difficult to give any credence to Clarke's comment.

Kükenthal (1909) correctly subsumed *K. hookeri* Boeckeler under *K. trinervis* (Nees) Boeckeler, but created confusion by assuming that Clarke had misinterpreted Boeckeler's *hookeri* and creating a spurious taxon *K. hookeri* sensu Clarke 1883 (which should in any case have had a new name); from Clarke's annotations and the specimens he cited (see above), however, there is no reason to think that he misinterpreted Boeckeler's name.

Koyama (1978) treated *K. hookeri* and *K. seticulmis* as synonymous under the latter name, aptly stating 'my observations revealed continuous variation from the one to the other without any discontinuity at all, and hence it is impossible to mark any taxonomic boundary'. He is wrong, however, in saying that 'the relatively larger phase ('*K. hookeri*') occurs at lower altitudes up to c.4000m, while *K. seticulmis* as originally defined has been collected mostly at higher altitudes above c.4000m'.

Recent fieldwork in W Sikkim shows the pattern of variation to be complex and not easily interpreted. Weak forms (of which *K. angusta* is only the extreme) occur on rocks and cliff ledges especially in shade, but these include both androgynous and unisexual forms. The stouter, broad-leaved form with unisexual spikes sometimes occurred at the same site but in obviously deeper soils and once in a base-rich habitat but in one locality (ESIK 527) was found growing on the same rock as a starved, androgynous form. Thus while microecological differences sometimes seem to be relevant, other factors must be involved and more work is clearly needed.

It should be noted that at extreme altitudes (4550–4850m) on nutrient-poor (presumably acid) glacial debris, a minute, apparently truly dioecious form occurred (height under 2cm, male and female spikes both under 8mm and reduced to c.6 spikelets), but this also seems to belong to the same species, being analogous to depauperate forms of *Carex haematostoma* and *K. stiebritziana* with which it was associated.

In conclusion, these taxa can all be united under the name *K. esenbeckii* having a wide distribution from NW Himalaya to SW China (SE Tibet and Yunnan).

Kobresia esenbeckii (Kunth) Noltie, **comb. nov.**

Syn.: *Carex esenbeckii* Kunth, Enum. Plantarum 2: 522 (1837). Type: *Royle* 138p.p. (iso. LIV).

C. trinervis Nees in R. Wight, Contrib. Bot. India: 120 (1834), *nom. illegit.* (Art. 64.1), non Degland in Loiseleur, Fl. Gallica 2:731 (1807).

Kobresia trinervis Boeckeler in Linnaea 39:4 (1875), *nom. illegit.* (Art. 63.1)

K. seticulmis Boeckeler in Linnaea 39: 3 (1875). Type: 'Sikkim [Lachen, 25.6.1849], 1300ft, *J.D. Hooker*. Elyna 2' (lecto. K, chosen here).

K. hookeri Boeckeler in Linnaea 39: 4 (1875). Type: 'Sikkim [Lachen, 20.6.1849], 12,000ft, *J.D. Hooker*. C. esenbeckii Kunth?' (lecto. K ex Boott herb., chosen here).

K. hookeri var. *dioica* C.B. Clarke in Hooker, Fl. Br. India 6:695 (1894).

K. angusta C.B. Clarke in Hooker, Fl. Br. India 6:695 (1894).

K. fissiglumis also belongs to this group but is worth retaining at varietal rank on account of having prophylls open to the base and blunt female glumes with hyaline margins.

K. esenbeckii var. **fissiglumis** (C.B. Clarke) Noltie, **comb. nov.**

Syn.: *K. fissiglumis* C.B. Clarke in Hooker, Fl. Br. India 6:696 (1894).

C. *Kobresia curvata* and *K. fragilis*

Boott based his *Carex curvata* on a mixed collection of Hooker from two localities in Sikkim – Tungu and Lachen. Two forms are present on the type sheets, though it is impossible to be completely certain which comes from which locality.

Form 1: lower lateral spikes branched; glumes pale. By elimination this was probably collected at Tungu. This is the form illustrated by Boott and therefore the one to which the name should strictly refer. The bottom right-hand specimen on the sheet from Boott's own herbarium comes closest to one of his illustrations and is here chosen as the lectotype.

Form 2: all lateral spikes simple; glumes chestnut. A packet of dissections labelled by Boott indicates that these are the specimens from Lachen; of these one specimen has a notably erect habit (see below).

Unfortunately *C. curvata* was an illegitimate homonym and the name was not validated until 1908 – in the genus *Kobresia* (where it correctly belongs). In the meantime (1903) *Kobresia fragilis* had been described by Clarke from Sichuan, based on a single specimen (*Soulié* 731, K). In addition to several detached culms, the type consists of a single large plant with very erect flowering culms, the smallest and youngest of which exactly matches the erect specimen of 'C. curvata' from ?Lachen. The larger inflorescenes are characterised by bearing some androgynous spikelets, which have been stated to be diagnostic (Kükenthal, 1909; Koyama, 1978). In view of the variation in sexual

expression in other *Kobresia* species described above I am not inclined to view this character as being worthwhile in itself in supporting specific status. The other main diagnostic character used to separate *K. fragilis* from *K. curvata* has been erect versus curved stems; fieldwork, however, suggests that curvature is a response to grazing and trampling. Forms with the habit of *K. fragilis* have been seen from Bhutan (*Wood* 6493, E), Tibet (*Ludlow, Sherriff & Taylor* 4517, E) and Nepal (*KEKE* 528, E; *Polunin, Sykes & Williams* 4793, E, BM) and forms matching the lectotype of *K. curvata* with branched lateral spikes from Sikkim (*ESIK* 227, E; *Bor's Collector* 45, K). However there are many intermediates from Bhutan and Nepal and I see no option but to regard them all as forms of a single species, for which *K. fragilis* is unfortunately the correct name.

K. fragilis C.B. Clarke in J. Linn. Soc. Bot. 36:267–268 (1903). Type: *Soulié* 731 (holo. K).

Carex curvata Boott, Ill. Genus Carex 1:2, t. 5 (1858) *nom. illegit.* (Art. 64.1), non Knaf in Flora 30:184 (1847).

Kobresia curvata C.B. Clarke in Kew Bulletin, Add. Ser. 8:68 (1908). Type: Sikkim, *J.D. Hooker* (lecto. K ex Boott herb. – bottom right-hand specimen, chosen here; see notes above).

D. *Kobresia nepalensis* and allies

K. vaginosa was described from Hooker specimens from north-central Sikkim (Momay). Kükenthal, however, also included NW Himalayan specimens in his concept of the taxon and reduced it to a variety of *K. nepalensis*. Koyama (1978) identified material from Nepal as being the same as the NW Himalayan element and raised it to a subspecies. This taxon is a large, robust plant with stiffly erect leaves, large prophylls and cream glumes and is quite different from the Sikkim plant to which the name must be restricted. *K. vaginosa* was found in some quantity in W Sikkim, where it could be dominant on dry slopes; it is very distinct and appears to be endemic to Sikkim. It is characterized by its usually unisexual spikes (see above) and its prophyll similar in size to *K. nepalensis*, from which it differs in its laxer, very slender spikes and blunt, hyaline glumes.

The other variety formerly included by Kükenthal under *K. nepalensis* (var. *elachista* (C. B. Clarke) Kük.) was seen in W Sikkim and proved to be only a starved form from trampled pasture and not worthy of formal recognition. In the field it superficially looks very different from *K. nepalensis* and more like *K. pygmaea* or *K. prainii*.

K. stiebritziana Hand.-Mazz. was described from NW Yunnan on the basis of rather depauperate specimens (*H.-M.* 4734, iso. E). It is superficially similar to *K. nepalensis*, from which it differs in its darker, non-aristate female glumes, shorter beak to the nut and especially in its prophyll which is open to the base. This species has now been found in Bhutan and Sikkim; in W Sikkim it was found to be very common, often growing with *K. nepalensis*.

E. *Kobresia vidua* and allies

Kobresia vidua was described as a dioecious species, the type specimen consisting of some rather depauperate female spikes collected by Hooker in Sikkim. The prophyll is

closed having an apical orifice exactly like the utricle of a *Carex* – in which genus it was originally placed. It was not re-collected (or at least identified as such) until 1952 – this time in W Nepal (*PSW* 134, BM, E) and again only entirely female inflorescences were collected. A search in herbaria, however, discovered a husband for this persistent spinster in the form of two specimens from E Bhutan (*LSH* 20694 a & b, BM). These were labelled as male and female of a single species, but had remained unidentified until Koyama mistakenly determined them as *K.* aff. *duthiei* C.B. Clarke. These specimens differ from the type in having been collected at anthesis, before the culms had elongated. Recent fieldwork has confirmed that this elongation is a marked feature of this and other species of *Kobresia*, *K. vidua* being commonly found in W Sikkim. At the same time, observations on distribution of sexes were made (for results see above) with the result that although the species might sometimes be truly dioecious, it can also be monoecious with male and female spikes produced on the same plant. Moreover, the spikes are not always strictly unisexual and androgynous spikes were found.

Examination of the types of two Chinese species, in the light of these new collections prove them to be synonymous with *K. vidua*.

K. prattii C.B. Clarke was described from a male plant from W Sichuan/Tibet (type *Pratt* 744, K) and is identical with male *K. vidua*. In this case, however the wrong 'wife' (*Pratt* 741) was initially (in ms on sheet) assigned to it by Clarke. Clarke later (1903) realised his mistake and re-determined this as *K. cercostachys* (Franchet) C.B. Clarke. Kükenthal (1909) repeated Clarke's original mistake and assigned *Pratt* 741 to *K. prattii*. This specimen, however, differs fundamentally from both *K. prattii* and *K. cercostachys* (both of which have strictly unisexual spikelets) in having androgynous spikelets. It is possibly referrable to *K. setschwanensis* Hand.-Mazz., or one of its allies, but this group requires further study.

An isosyntype of *K. harrysmithii* Kük. from N. Sichuan with both male and female spikes (*Smith* 3729, K) can also be clearly referred to *K. vidua*.

K. vidua therefore provides another example of the links between the flora of the E Himalaya and SW China.

The following synonymy can therefore be presented:

K. vidua (Boott ex C.B. Clarke) Kük., Pflanzenreich., 38. IV. 20:40 (1909).

Syn: *Carex vidua* Boott ex C.B. Clarke in Hooker, Fl. Brit. India, 6:713 (1894). Type: see text and specimen citations.

K. prattii C.B. Clarke in J. Linn. Soc. Bot., 36:268 (1903). Type: see text and specimen citations.

K. (Cobresia) harrysmithii Kük. in Medd. Goteborg Bot. Trad., 5:37 (1930). Type: see text and specimen citations.

Specimens seen

NEPAL: Maharigaon, 14,500ft, 13 vii 1952, *Polunin, Sykes & Williams* 134, female (BM, E). SIKKIM: Lachen, 13,000ft, 15 vii 1849, *Hooker* s.n., female (K: holotype). Above Thangshing, 4350m, 20 vii 1992, *ESIK* 562 (E). Thangshing to Lam Pokhri, 4150m, 19 vii 1992, *ESIK* 524 (E).

FIG. 1. A–G, *Kobresia pseuduncinoides* Noltie. A, habit (x ½); B, T.S. leaf (x 14); C, glume of spikelet; D, undissected spikelet; E, prophyll; F, immature gynoecium; G, male flowers dissected out of prophyll (dissections all x 4). H–L, *K. woodii* Noltie. H, habit (x ½); I, T.S. leaf (x 24); J, glume of female spikelet; K, female spikelet; L, nut (dissections all x 6).

CHUMBI: Lingmathang, 11,000ft, 2 vi 1945, *Bor & Ram* 20792, male (K). Chumbithang, 13,000ft, 2 vi 1945, *Bor & Ram* 19662, male (K).
BHUTAN: Shingbe, Me La, 13,000ft, 3 vi 1949, *Ludlow, Sherriff & Hicks* 20694 a & b, male and female (BM). N side of Shingche La, 4530m, 23 ix 1984, *Sinclair & Long* 5266, female (E).
CHINA (Sichuan): Szechuan austr., in mont. altiss. supra Nerali vers. bor. occid., solo schistoso, 4200m, 22 v 1914, *Schneider* 1404 (E). Montis Tschahungnyotscha ... ad septentr. oppidi Yenyuen, 4150–4300m, 27 v 1914, *Handel-Mazzetti* 2651 (E). Dongergo, 4800–5000m, 21 vii 1922, *H. Smith* 3729 (K: isosyntype of *K. harrysmithii*). W Szechuen and Tibetan Frontier, chiefly near Tachienlu, 9–13,500ft, *Pratt* 744 (K, BM: holotype & isotype of *K. prattii*).

F. *Kobresia gammiei*

K. gammiei was distinguished as a new species from Sikkim by C.B. Clarke but unfortunately published posthumously and with an inadequate description. This description omits any reference to its stoloniferous rhizomes - one of its most distinctive characteristics and one that is rare in the genus. Koyama in 1973 described *K. williamsii* as a new species from Nepal characterized by stoloniferous rhizomes. Inspection of the holotype of *K. williamsii* at BM and the only syntype of *K. gammiei* remaining at CAL (Sikkim, *Gammie* s.n., 1892) show them to be conspecific – as suspected from the descriptions. An expanded description and drawing of *K. gammiei* was provided by Ghildyal (1986), but it should be noted that this is incorrect in showing an open prophyll and must have been based on examination of a damaged spikelet. Recent fieldwork has shown *K. gammiei* to be not uncommon in W Sikkim and to occur as far east as the Bumthang district in Central Bhutan. It should be noted that the species was also collected by Hara *et al.* in W Sikkim but misidentified as *K. sikkimensis* Kük. (Hara, 1966).

G. New Species

Kobresia pseuduncinoides Noltie, **species nova** a *K. uncinoide* (Boott) C.B. Clarke spiculis androgynis, basibus vaginarum foliorum atroisabellinis nitidis, circum caespites collum perdurans formantibus, foliis latioribus (magis quam 4.7mm, nec minus 4mm lata), crassioribus differt. **Fig. 1.**

Densely tufted perennial. *Bases of leaf sheaths* dark yellowish-brown, shining, persistent, not fibrillose. *Leaves* sub-basal, about equalling stems, 4.7–9mm wide, flat, very acute, thick-textured, cross-veinlets prominent when dry. *Culm* 24–38cm, erect, stout (2.5–2.7mm wide), acutely trigonous, angles minutely scabrid. *Inflorescence* a dense, spike-like panicle, 5.5–6.5 x 1.5–1.8cm, with 8 or more appressed lateral partial inflorescences; inflorescence bract with large (0.7–1.6cm), oblong, glume-like base with brown-hyaline sides and broad green midrib produced as filiform tip not exceeding inflorescence. *Partial inflorescences* with upper spikelets single-flowered, male, lower 5–10 spikelets androgynous with 1 female and 2–4 male flowers within a prophyll; 'glumes' of spikelets 6.2–6.5 (excl. arista) x 2.3–3.5mm, oblong-elliptic, acute to aristate, sides brown, midrib green, 1-veined, narrow, margins narrowly hyaline near apex. *Prophyll* 5.6–7 x 1–1.3mm, oblong, truncate, open to base, hyaline, flushed brown, margins minutely scabrid. *Style* 2.5–4mm; stigmas 3, 3–4.5mm. Mature nut not seen.

Male glumes 7–7.5 x 2–2.6mm, lanceolate, acute, brown. *Stamens* 3 per flower, anthers 3.2–4.9mm, linear, apex minutely apiculate.

Type: Bhutan, Upper Kulong Chu district, Shingbe, Me La, 12,500ft, 11 vi 1949, *Ludlow, Sherriff & Hicks* 20725 (holo. BM).

Habitats recorded: Grassy slopes (in open or among dwarf rhododendrons); grassy moraine 'flats'; near small streams; open marshes, 3810–4420m.

Distribution: Nepal, Bhutan, SE Tibet.
Other specimens seen:

NEPAL: Jangla Bhanjang, 13,000ft, 29 vi 1952, *Polunin, Sykes & Williams* 2334 (BM, E). Maharigaon (Khola), c.14,000ft, 16 vii 1952, *Polunin, Sykes & Williams* 1563 (BM). Near Dogadi Khola, 14,000ft, 24 vi 1954, *Stainton, Sykes & Williams* 3236 (BM, E).
SE TIBET: Tsari Sama, Langong, 14,500ft, 14 vi 1938, *Ludlow, Sherriff & Taylor* 5548 (BM).

Note: this species has been confused with *K. uncinoides*, to which it bears an uncanny but superficial resemblance. It differs, however, fundamentally in its androgynous spikelets, leaf sheaths and leaf blades. Harry Smith on a note on *LST* 5548 pointed out that it was probably an undescribed species, but said it was too young for identification. It is curious that this species has not been distinguished earlier as there are several good collections and it is very spectacular in appearance. It has been collected only in its flowering stage, when it is presumably conspicuous on account of its large number of anthers. Fruiting material is still required.

Kobresia woodii Noltie, **species nova** a *K. cercostachyde* (Franchet) C.B. Clarke spicis unisexualibus, glumis femineis latioribus (c.6.5mm, non c.2mm) obtusis (haud acutis usque aristatis), prophyllis longioribus (7–9mm non minus quam 6.5mm) et ad basem apertis, rostro nucis longiore (c.1.5mm, non c.0.5 mm) differt. **Fig. 1.**

Densely tufted perennial. *Upper parts of leaf sheaths* straw-coloured, lower parts chocolate brown with darker margins, slightly shining, persistent, not fibrillose. *Leaves* slightly exceeding scapes, c.1.5mm diameter, semi-circular to V-shaped in section, scarcely keeled. *Culm* 24–28cm, c.1mm diameter, ± terete. *Inflorescences* unisexual, male and female borne on same plant, spike-like, unbranched. *Female inflorescence* 6 x 0.6cm, linear, lower spikelets slightly distant. *Female glumes* 6.5 x 4mm, oblong-ovate, blunt, brown, margins narrowly hyaline, midrib wide, green, 1-veined; lowest glume (inflorescence bract) shortly aristate. *Prophyll* 7–9 x 1mm, linear oblong, keels minutely scabrid, margins free to base, overlapping, apex brown. *Nut* linear: stipe c.1mm, body c.2.5 x 0.7mm, beak c.1.5mm; style c 2.5mm; stigmas 3, c.3mm. *Male glumes* c.8 x 2.5mm, oblong-oblanceolate, rounded.

Type: Bhutan, Thimphu district, below Phajoding Monastery, 3300m, 21 vi 1987, *J.R.I. Wood* 5534a (holo. E).

Habitat: Grassland, possibly seasonally burnt, in upper forest limits.

Known only from the type collection which was mixed with *K. capillifolia* (Decne.) C.B. Clarke (an abnormal form with atypical, aristate glumes).

Named after J.R.I. Wood who discovered this species and who has made such a significant contribution to our knowledge of the Bhutanese flora.

K. cercostachys has a simple androgynous spike (though as with other members of sect. *Hemicarex* forms with unisexual spikes might well be expected to occur), with single-flowered spikelets; female glumes (c.6 x 2mm) are narrow, acute and aristate; prophyll closed (originally described as a *Carex*); beak of nut very short (c.1mm). This species has been much confused and is probably known only from the type collection (*Delavay* 3403, iso. E). Clarke (1903) included within his concept of *K. cercostachys* a discordant element with androgynous spikelets (*Pratt* 741 – see above) which is perhaps referable to *K. setschwanensis* Hand.-Mazz. (also close to *K. cuneata* Kük.). This incorrect application of the name has unfortunately been followed by some subsequent workers (in identifications on herbarium specimens); though more collections are needed from China to resolve the taxonomy of the forms with androgynous spikelets.

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The author is indebted to Dr R.R. Mill for translating the diagnoses into Latin; the curators of the herbaria of the Royal Botanic Gardens, Kew, the Natural History Museum, London, Liverpool Museum, Central National Herbarium, Howrah, Calcutta; and to Mary Bates for preparing the illustration.

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NOTES RELATING TO THE FLORA OF BHUTAN: XX
Lloydia (Liliaceae)

H. J. NOLTIE

Lloydia himalensis is confirmed as being synonymous with *L. serotina*; *L. yunnanensis* is reported for the first time from the E Himalaya; *L. delicatula* Noltie *sp. nov.* is described; *L. mairei* and *L. serotina* var. *parva* are discussed.

INTRODUCTION

Until recently our knowledge of this attractive genus of alpine bulbs in the E Himalaya was extremely poor. This was due, at least in part, to the fact that they make poor herbarium specimens. Old specimens frequently lack colour notes, and as both white and yellow tepals fade to a dull brown it can be impossible to distinguish between them after several decades. Even flower posture is difficult to deduce from herbarium specimens in the absence of notes. The most important limitation of dried specimens concerns the nectary, which may be difficult or impossible to observe, and descriptions of presence or absence based only on herbarium material are probably not reliable. Hooker (1892) evidently despaired and included all Himalayan forms (including a perfectly good species he had himself described earlier) in the single species *L. serotina*; by the time he wrote this account, he had evidently forgotten his experience in Sikkim of almost 50 years earlier. Hara (1966) was the first to draw attention to the diversity occurring in the E Himalaya, based on his field experience in Sikkim and E Nepal, though without coming to very firm taxonomic conclusions. It was not until 1974 that he described the highly distinctive E Himalayan, yellow-flowered plants as *L. flavonutans* (having previously identified them as the Chinese *L. delavayi* Franchet). The author was fortunate to be able to study two of the taxa discussed below in W Sikkim on the Edinburgh Expedition to Sikkim and Darjeeling (ESIK) during the summer of 1992.

A. Large white-flowered species (*L. serotina, L. himalensis* and *L. yunnanensis*)

L. himalensis Royle was described and illustrated by Royle (1840) from the NW Himalaya, and distinguished from *L. serotina* (then known as *L. alpina*) on small and insignificant characters; it has, therefore, generally and correctly been included under the latter. The type of *L. himalensis* should be in Royle's herbarium at LIV and was seen by Dasgupta & Deb (1986). Recent enquires, however, have failed to locate it (A. Gunn, pers. comm.). However, the published illustration is of high quality and in Hooker's herbarium at Kew there is what is almost certainly a syntype labelled '*Lloydia himalensis* Royle Ill. t. 93. NW India. Hb. Royle'. All specimens on this sheet (except one which is *L. longiscapa* Hook. f.) clearly belong to *L. serotina*. In recent years, however, the name *L. himalensis* has been reinstated to cover a rather distinct E Himalayan plant with long tepals and a very long style. Hara (1966) did so informally and was followed (at

least the E Himalayan plants cited) by Dasgupta & Deb (1986), who also noticed the trifid stigma of this taxon. This usage, however, is quite contrary to the description, illustration and specimens of *L. himalensis* and the identity of this taxon must be elucidated.

This proves to be another case where the answer is found by looking east to China, the plant concerned being *L. yunnanensis* Franchet (Fig. 1). This species was described from the Tsang Shan mountains near Tali in Yunnan. The original description is rather inadequate and places great weight on the trifid stigma but does not mention the tepal characters or lengths of anthers and style which are useful and more reliable in distinguishing it from *L. serotina*. Herbarium studies have shown this taxon to occur as far west as E Nepal, apparently favouring acid rocks (granite in China) and occuring from 3000–4200m. The degree of production and revolution of the stigma lobes is in fact variable.

	L. yunnanensis	**L. serotina var. serotina**
tepal length	(1.5–)1.8–2.2cm	0.9–1.8cm
tepal apex	contracted below apex, sometimes apiculate	rounded
outer tepal shape	oblong	narrowly elliptic
outer tepal width	2.5–4mm	4.2–8mm
inner tepal shape	narrowly oblanceolate	narrowly elliptic to narrowly obovate
inner tepal width	4.5–6.5mm	4–6.2mm
nectary visible when dry	–	+
flanges present at base of inner tepals	sometimes	never
style	8.2–11.5mm (3x length of ovary)	2.8–4mm (about equalling ovary)
stigma lobes	often developed & recurved	never developed
anther length	1.8–2.2mm	1–1.7mm

Specimens of *L. yunnanensis* seen:

E NEPAL: Arun Valley, Chhovang Khola, W of Num, 12,500ft, 21 vi 1956, *Stainton* 735 (BM). Kangrang La, 12,500ft, 17 vi 1969, *Williams* 710 (BM).
SIKKIM: Changu, 12,000ft, 2 vii 1913, *Cooper* 131 (E). Namdee, 10,000ft, v 1885, *Pantling ex herb. Clarke* 46327 (K). Phalut, 11,000ft, 13 vi 1891, *Gammie* 60 (CAL). Bikbari, 4000–4200m, 12/13 vii 1992, *ESIK* 300 & 312 (E). Dzongri Pass to Dzongri, 4100m, 16 vii 1992. *ESIK* 406 (E). Onglakthang, 4200m, 24 vii 1992, *ESIK* - field record.
BHUTAN: Tare La, above Ha, 11–14,500ft, 17 vii 1938, *Gould* 1199 (K). Ritang, Tang Chu, 12,500ft, 9 vi 1937, *Ludlow & Sherriff* 3232 (BM). Me La, Cho La Valley, 12,000ft, 2 vii 1949, *Ludlow, Sherriff & Hicks* 20465 (BM).
BURMA: Hpimaw Pass and Ridge, 11-12,000ft, 30 vi 1919, *Farrer* 1075 (E). Chawchi Pass, 13,000ft, 14 vii 1919, *Farrer* 1724 (E). Seinghku Wang, 28°8'N 97°24'E, 11–12,000ft, 27 vi 1926, *Kingdon Ward* 6997 (K, E).
CHINA (YUNNAN): Fu Ch'uan Mt, McLaren 'D' 225 (E, BM). E flank of the Tali Range, 10–11,000ft, vii 1910, *Forrest* 7154 (E). [Do-kar-la], 13,000ft, 30 vi 1913, *Kingdon Ward* 616 & 423 (E). Tehching (Atuntze), Miyetzim, 3500m, 19 vi 1937, *Yu* 8653 (BM). Mt Tsang Shan, au dessus de Tali, 3000m, 16 vi 1884; 3000–3500m, 10 vi 1885, *Delavay* 93 (P: syntypes of *P. yunnanensis*). Tsang shan, au dessus de Tali, 4 vi 1883, *Delavay* 274 (P: syntypes of *P. yunnanensis*).

Handel-Mazzetti (1936) reported *L. mairei* Léveillé from Sikkim on the basis of a Hooker specimen of which I have been unable to locate a duplicate at Kew. Handel-Mazzetti distinguished this species from *L. serotina* in having tepals lacking a nectary; Hara (1966) reported *L. serotina*-like plants similarly lacking a nectary from Sikkim, but doubted if they should be separated from *L. serotina*.

It seems likely that Handel-Mazzetti's record of *L. mairei* should be referred to *L. yunnanensis*, under which species it has, in fact, been sunk by recent Chinese authors (Chen, 1980). Examination of the type of *L. mairei* at E, however, suggests that it is a distinct species and in some ways intermediate between *L. yunnanensis* and *L. serotina*, having the tepal shape, apparent absence of nectaries when dry and long style of the former, but small tepal size, shorter anthers and unlobed stigma of the latter; it sometimes produces two flowers per scape and differs from any material seen from E Himalaya.

B. Dwarf alpine forms

Hooker (1892) was the first to note 'a very minute tufted state' of *L. serotina* in Sikkim. Examination of his herbarium specimens reveal them to be a mixture of two miniscule taxa which have commonly been confused in the E Himalaya ever since.

L. serotina var. **parva**

The first taxon is merely a dwarf variety of *L. serotina* (L.) Rchb. which can be referred to var. *parva* (Marq. & Shaw) Hara; a syntype of this variety has been studied (Rong-chu (Tumbatse), SE Tibet, *Kingdon Ward* 5798, E). There has been some confusion as to whether or not nectaries are present on the tepals of this variety. Hara (1971), when raising *parva* from the rank of forma to variety, states that it does not have a transverse fold (i.e. nectary) above the base of the inside of the tepals. This absence would distinguish it from *L. serotina* var. *serotina*, which always has such a fold. However, after examining small specimens of *L. serotina* it seems the absence of nectaries is at least sometimes more apparent than real. The closeness of the nectary to the tepal base makes it often very difficult to observe (virtually impossible in the dry state and scarcely easier in boiled-up material). Nectaries are definitely present in the syntype cited above. Krause evidently thought of treating this taxon at specific rank at some stage since a Chinese specimen (Litang River divide, 14–15,000ft, *Kingdon Ward* 4078, E) bears the manuscript name 'L. wardii Krause n. sp.' in his hand – but this seems never to have been published.

Given the unreliability of the nectary character, the main difference between var. *parva* and var. *serotina* seems to be one of stature, with the total height of the former (including bulb) never exceeding 7 cm and usually under 4 cm. All its floral part are correspondingly smaller.

Specimens of var. *parva* seen:

INDIA (KUMAON): Rilkot via Martoli to Milum, 11,100–11,600ft, vi 1855, *Schlagintweit* 9875 (BM).

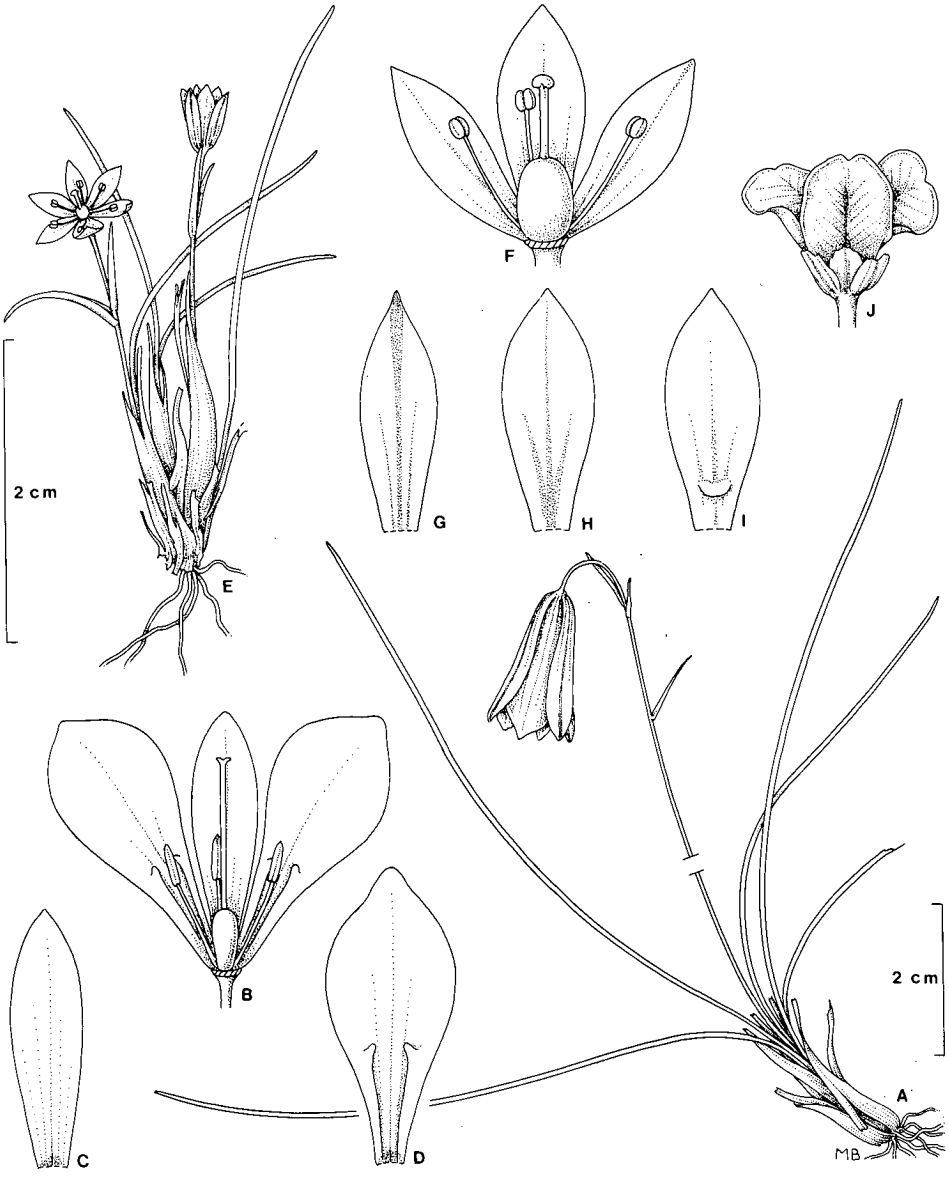

FIG. 1. A–D, *Lloydia yunnanensis* Franchet. A, habit (x 1); B, half-flower (x 2); C, outer tepal from inside (x 2); D, inner tepal from inside (x 2). E–J, *Lloydia delicatula* Noltie. E, habit (x 2); F, half-flower (x 6); G, outer tepal from outside (x 6); H, inner tepal from outside (x 6); I, inner tepal from inside (x 6); J, capsule (x 6).

NEPAL: Namdo, N of Mustang, 15,500ft, 7 viii 1954, *Stainton, Sykes & Williams* 2263 (E, BM)
INDIA (SIKKIM): Behind Tangu Bungalow, 14,800ft, 5 vii 1903, *Younghusband* T53 (K, CAL). Muguthang, Lhonak, 14,500ft, 5 vii 1989, *D.C. Lang* s.n. (E). Lachen, 13-14,000ft, 17 vii 1849/Lama Gingna, 14,000ft, 24 vii 1849, *Hooker s.n.* (K; p.p. mixed with *L. delicatula*).
BHUTAN: Lingshi, 15,000ft, 21 vii 1914, *Cooper* 1642 (E).
CHINA (TIBET): Hills S of Lhasa, 14,500ft, 11 vii 1943, *Ludlow & Sherriff* 9757 (E, BM). Reting, 60 miles N of Lhasa, 14,000ft & 15,500 ft, 12 vii 1944 & 24 vii 1942, *Ludlow & Sherriff* 9975 & 8867 (E, BM). Reting, 60 miles N of Lhasa, 12,500 ft, 1939, *Taring* s.n. (BM). Rong chu (Tumbatse), 14,000ft, 18 vi 1924, *Kingdon Ward* 5798 (K, BM, E: isotypes of var. *parva*)
CHINA (YUNNAN): Litang River divide, 14–15,000ft, 14 vi 1921, *Kingdon Ward* 4078 (E). Bei-ma Shan (2818' N, 9910' E), NW Yunnan, 16–16,500 ft, vii 1921, *Forrest* 19608 (E, K).

Habitat: despite being a slightly more robust plant than *L. delicatula* (see below), it can apparently occur at higher altitudes (to c.5000m).

An interesting specimen at Kew of the Tibetan drug 'Tsa-a-wa', consisting of fragments of leaves and fruiting capsules and collected near Yerpa Monastery (14,000ft, *Kennedy* 15), is almost certainly *L. serotina* var. *parva*.

L. delicatula

The second dwarf element, with which var. *parva* has been confused, represents a hitherto undescribed taxon which is apparently widespread in the E Himalaya. It has no doubt been under-collected due to its diminutive stature and was found to be relatively common in W Sikkim and is described below as *L. delicatula*. The two dwarf taxa can be distinguished as follows:

	L. delicatula	**L. serotina var. parva**
flower posture	erect	probably pendent
tepal length	3.6–5.7mm	5–7mm
tepal shape	narrowly elliptic to narrowly rhombic	oblanceolate
tepal apex	narrow, subacute	broad, rounded
tepal midrib	reaching apex	stopping short of apex
nectary	conspicuous, c.¼ way up tepals	minute, basal or absent

Lloydia delicatula Noltie, **species nova** a *L. serotina* var. *parva* omnibus partibus minoribus, floribus erectis, costa tepalorum lata purpurea apicem subacutum attingenti, nectario prominenti in zona flavescenti circa quartam partem e base tepali sito differt. **Fig. 1.**

Minute bulbous perennial, growing in dense clumps. *Bulbs* narrowly ovoid, *c.* 4–5mm diameter; tunics pale fawn, papery. *Lower part of stem* and leaf sheathed with collar (0.5–2.5cm) of papery remains of old leaf-bases. Green part of stem (i.e. part projecting beyond sheath) 0.2–2cm, very slender, bearing usually 3 leaf-like bracts on upper part, the lower 2 usually subopposite; bracts linear-lanceolate with narrow scarious borders, lowest 0.4–1cm. *Leaf* usually 1 per bulb, lower part enclosed by tunic-sheath, free part filiform, 0.7–2.5cm x 0.4–0.5mm, apex rounded, darkened. *Flower* single, erect. *Tepals* 6, oblong, narrowly elliptic or narrowly rhombic, widest *c.* ⅔ from base, narrowed to base and to subacute apex, 3.6–5.7(–6.5) x 1.1–1.8mm, white, sometimes suffused purplish (especially in older flowers) with prominent purplish midrib which reaches

apex and 1 or more purplish veins on either side of midrib, running upwards from nectary; nectary conspicuous (in boiled up and fresh material), thickened, roundish or laterally elongated, yellowish, c.¼ from base of tepals. *Anthers* flattened, circular in outline at maturity (0.4–0.5(–0.8)mm), locules dehiscing laterally, convex (longer and more oblong before dehiscence); filaments glabrous, 2.1–2.9mm. *Ovary* 1.5–2.3 x 0.8–1.4mm, narrowly ellipsoid to oblong-ovoid, top truncate, or narrowed into style; style 1.1–2.2mm; stigma slightly expanded, ± capitate. *Capsule* dehiscing from top into 3 spathulate lobes with waved margins, c. 2.8 x 1.9mm, surrounded by persistent tepal-bases.

Distribution: This species appears to be restricted to the E Himalaya, occurring from C Nepal to NE Bhutan.

Habitat: in mossy turf on boulders and exposed ridges; scree and rock ledges; occasionally meadows, c.3600–4600m. Fl. June–July.

Type: Bhutan, Me La (S side), 14,500ft, 9 vi 1949, *Ludlow, Sherriff & Hicks* 20347 (holo. BM).

Other specimens seen:

C NEPAL: Gusain Kunda, 23 vi 1935, *F.M. Bailey's Coll.* 114 (BM). Rambrong, Lamjung Himal, 13,500 ft, 3 vii 1954, *Stainton, Sykes & Williams* 6076 (BM).
E NEPAL: Inukhu Khola, Naulekh Mathi, 15,000ft, 30 vi 1964, *Mc Cosh* 326 (BM). Chumbu [Khumbu], Thummu Khola, 14,000ft, 29 vi 1964, *Bowes-Lyon* 2170 (BM). Tatbhaiya, 13,500ft, 20 vi 1969, *Williams* 810 (BM). Rato pokhari, 13,500ft, 24 vii 1971, *Shrestha & Joshi* 326 (BM). Khimti Khola, 13,500ft, 10 vii 1964, *Stainton* 2131 (BM). Thame-Taranga, 13,500ft, *Banerjee & Shakya* 5776 (K). Maulekh, 14,000ft, 19 vi 1981, *Stainton* 8358 (E). Arun Valley, Chhoyang Khola W of Num, 13,000ft, 21 vi 1956, *Stainton* 734 (E, BM). Simbua Khola, above Yalung, 4170m, 6 vi 1991, *McBeath* 2501 (E).
INDIA (SIKKIM): Changu, 12,000ft, 2 vii 1913, *Cooper* 132 (E). Lachen, 13–14,000ft, 17 vii 1849/Lama Giñgna, 14,000ft, 24 vii 1849, *Hooker s.n.* (K; p.p. mixed with *L. serotina* var. *parva*). Kapoor below Kinchinjunga, vi 1887, *King's Coll* s.n. (CAL). Near Nathui La, 14,000ft, 14 vii 1910, *W.W. Smith* 3468 (CAL). Above Changu, 13,000ft, *W.W. Smith* 3175 (CAL). Chaunrikhiang, 4450m, 15 vii 1992, *ESIK* 385 (E). E of Bikbari, 4300m, 13 vii 1992, *ESIK* 342 (E). Above Thangshing, 4350m, 20 vii 1992, *ESIK* field record. Samiti, 4350m, 21 vii 1992, *ESIK* field record.

Wright Smith evidently noticed the distinctness of this plant, but unfortunately did not produce a valid description, merely giving the name 'var. *sikkimensis minima*' on herbarium sheets at CAL and in his account of the alpine vegetation of Sikkim (Smith, 1913). Hara determined many of the BM specimens cited above as *L. serotina* var. *parva*. Dasgupta & Deb (1986) included several of the above specimens under *L. serotina* along with other dwarf forms stating that such small plants showed 'no qualitative difference'.

Much further work requires to be done on Himalayan and Chinese *Lloydia*, especially on the anatomy of the bulb and nectary, which might have a bearing on generic and sectional limits. Until then, I agree with Hara (1974) in retaining *Lloydia* in a broad sense (see Greuter 1970). In any case the new species would have to be placed closest to *L. serotina* (i.e. in sect. *Eulloydia* subsect. *Nectarobothrium* sensu Engler & Prantl).

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NOTES RELATING TO THE FLORA OF BHUTAN: XXI
Carex (Cyperaceae)

H. J. NOLTIE

The following new species and subspecies are described: *Carex burttii* Noltie, *C. griersonii* Noltie, *C. nigra* (L.) Reich. subsp. *drukyulensis* Noltie, *C. schlagintweitiana* Boeck. subsp. *deformis* Noltie, *C. speciosa* Kunth subsp. *dilatata* Noltie, *C. speciosa* subsp. *pinetorum* Noltie, *C. laeta* Boott subsp. *gelongii* Noltie. The new combination *C. fusiformis* Nees subsp. *finitima* (Boott) Noltie is made. *C. sikkimensis* C.B. Clarke is reduced to the synonymy of *C. fucata* Boott ex C.B. Clarke, and *C. praelonga* C.B. Clarke to that of *C. teres* Boott. Notes are provided on *C. notha* Kunth, *C. inclinis* C.B. Clarke, *C. inanis* C.B. Clarke and *C. alopecuroides* D. Don ex Tilloch & Taylor. *C. fastigiata* Franch. and *C. radicalis* Boott are reported new to Bhutan and *C. montis-everestii* Kük. new to Sikkim. Lectotypes are designated for *C. fucata*, *C. sikkimensis*, *C. teres*, *C. praelonga*, *C. setigera* γ *humilis*, *C. inanis*, *C. fusiformis*, *C. finitima*, *C. alopecuroides*, *C. chlorostachys* D. Don ex Tilloch & Taylor and *C. alopecuroides* var. *chlorostachya* C.B. Clarke. A phytogeographical checklist is provided for species occurring in the *Flora of Bhutan* area.

INTRODUCTION

Carex L. is (next to *Pedicularis*) the second largest genus occurring in the area covered by the *Flora of Bhutan*. In the account 73 species and 9 infraspecific taxa are treated, although further collecting and research will undoubtedly raise this number somewhat. Sedges occur in virtually the full range of available habitats from seasonally burnt terai grassland (*C. oligostachya*) through broad-leaved and coniferous forest zones to extreme alpine situations - the highest reliable record being for *C. moorcroftii* at 5430m, although several species perhaps occur up to 5790m.

The following precursor notes relating to the *Flora* account mainly concern nomenclature and typification. Surprisingly few new taxa have been discovered during the course of the work. The sedges of Sikkim have been well-studied since the time of Hooker and Clarke, but much of Bhutan still remains practically unexplored caricologically. One significant recent addition has been *C. radicalis*, previously known only from the type specimens from Lachen (Sikkim) and now reported for W Bhutan (*Wood* 5650, *Noltie* 9).

Many problems of nomenclature and typification have been encountered, especially relating to the early (widely distributed) collections of Hooker and Royle. The great sedge expert Francis Boott described many of the E Himalayan taxa based on Hooker's Sikkim specimens in his *Illustrations* (1858–1867). Boott retained these type (and figured) specimens in his own herbarium, but at least the majority of them were eventually (1894) incorporated into the main Kew herbarium by C.B. Clarke, the other great authority on Himalayan *Carex*. Boott also saw, and annotated, the specimens retained in Hooker's own herbarium and the earlier NW Himalayan collections of Royle now in Liverpool. These latter had previously been 'arranged and described' by Nees von Esenbeck, who described (Nees, 1834) many new *Carex* species based on these

collections. Nees retained duplicates for his own herbarium (subsequently destroyed at Berlin) and it is not certain whether the Liverpool specimens can truly be considered to be holotypes (Harrison, 1978). For this reason it has been thought wiser to designate some as lectotypes (see below).

The rank of subspecies has been used below to describe several new taxa which differ in relatively small characters but which seem to be consistent and correlated with ecology or geography.

The following notes are arranged in the order of Kükenthal (1909) – although very out of date this work is still the only monograph of *Carex* and it still provides a useful and easily available framework. No other satisfactory infra-generic classification of the genus exists for the Sino-Himalayan region, whereas those for adjoining regions, such as the former USSR (Krechetovich, 1964), Malesia (Kern & Nooteboom, 1979) and Flora Iranica (Kukkonen, in prep.) differ widely; no revision is yet available for the Chinese species. Kükenthal's names for the various subgeneric ranks are given merely for convenience even where not nomenclaturally correct. Many problems relating to Bhutanese sedges remain (such as specific limits in certain critical groups, especially the Indocarices) and the following notes are only those required most urgently for the treatment to be published in the Flora.

NOTES

SUBGENUS INDOCAREX: SECTION INDICAE: SUBSECTION HISPIDULAE

Carex burttii Noltie, **sp. nov.**

Carex vesiculosa sensu C.B. Clarke (in Hooker f., Fl. British India, 6: 717, 1894), p.p. (Bhutan plants), non Boott.

C. vesiculosa Boott f. *pallida* Kük. in Engler, Das Pflanzenreich 38 (IV.20): 283 (1909).

C. continua sensu Ohwi in Hara, Fl. E. Himalaya, 2: 146 (1971), non C.B. Clarke.

Typo *C. vesiculosae* Boott (e Khasia) paniculis partialibus linearibus et spicorum fasciculis aequaliter dispositis arctissime affinis, sed culmis multo tenuoribus vaginis aphyllis ovatis rubescenti-purpureis ad bases paulo tumidas crebre adpressis, culmis basem versus exfoliatis (haud foliatis), foliis angustioribus, 2–3.5mm (non 2.8–6.5mm) latis, spicis minoribus, utriculis castanescentibus nitidescentibusque, haud costatis, rostro minus quam ⅓ longitudinis corporis (non ⅓ longitudinis corporis usque idem aequans, glumis femineis distincte (non minute) mucronatis, eis masculis mucronatis (non acutis), usque ad 3.5mm longis (non c.4.5mm) differt; axes inflorescentiarum partialium filiformes flexuose ascendentes. Tempos florendi vernali (Apr.– Mai), non aestati/autumni (Jul.–Nov.) etiam a *C. vesiculosa* recedit. **Fig. 1A–F.**

Rhizomes short, stems tufted; bladeless sheaths ovate, purplish-red, closely appressed to swollen culm-base; lower leaf-sheaths long, so lower part of culms naked, bases reddish-purple, not persistent, margins fibrillose. *Leaves* 2–3.5mm wide, exceeding inflorescence, margins hispid, surface hispid when young, evenly disposed along culm.

Culms 44–86cm. *Inflorescence* 18–36cm, almost equalling leafy part of culm, slender; partial panicles single at lower 2–4 nodes, c.3 at terminal node; bracts exceeding inflorescence; bracteoles with conspicuous, long, filiform points. *Partial panicles* linear, axes filiform, flexuous, secondary branches scarcely developed so lower spikes appearing clustered – these and upper single spikes widely and evenly spaced. *Spikes* androgynous, small, primarily male; male section 3.5–4.4mm, female 1.5–1.7mm, utricles suberect at maturity. *Utricles* 2.4–2.9 x 0.8–0.9mm, ellipsoid-trigonous, tapered into short beak, not curved, whitish-green becoming suffused chestnut and shining, not ribbed, hispid on upper part; beak c.0.6mm, hispid, deeply bifid. *Stigmas* 3. *Female glumes* 1.5–2.5 x c.1.6mm, ovate, becoming reddish-brown and shining, margins paler, subacute, mucronate, scabrid point 0.4–0.9mm. *Male glumes* 2.4–3.5 x 1–2mm, lanceolate to oblong-elliptic, reddish brown with green midrib, blunt with short mucronate point.

Type: Sikkim. Between Ramtek Gompa and Murtam (opposite Gangtok), c.6000ft, 30 iv 1913, *Lacaita* 16572 (holo. BM, iso. E)

Distribution: Sikkim, Bhutan, SE Tibet. Wet cliffs; on rocks; among bamboo. Altitude c.1070–2290m.

Other specimens seen

SIKKIM: Tumlong, 3500ft, 29 iv 1876, *C.B. Clarke* 27688 (BM, CAL, K – isotypes of *C. vesiculosa* f. *pallida* Kük.); N bank of Rate Chu N of Gangtok, 1670m, 31 vii 1992, *ESIK* 954 (E); Kabi, 9 v 1967, *R.S. Rao* 142 (CAL).

BHUTAN: Unlocalized specimens, *Griffith (Kew Distribution No.)* 2676 (BM, K), 2677 (BM), 2678 (= HEIC No 6088) (BM, CAL, K). Tashiling-Neylong-Charikhachor, 2200m, 20 iv 1967, *Kanai et al.* 8271 (BM). Tashiling-Tongsa Bridge-Tongsa, 1700–2100m, 16 iv 1967, *Kanai et al.* 5361 (BM).

CHINA (SE TIBET): Nyam Jang Chu, between Le and Pangchen, 7500ft, 2 ix 1938, *Ludlow, Sherriff & Taylor* 6500 (E).

Named after B.L. Burtt, on the occasion of his eightieth birthday, in recognition of his outstanding contributions to taxonomic botany and his generosity in sharing his enormous knowledge and experience with younger colleagues.

Considering the distinctive appearance of this elegant sedge, there has been a surprising amount of confusion over its status. Some of the Griffith collections (e.g. the one seen by Boott) are immature and so remained unidentified. Clarke identified others as *C. vesiculosa* and included them under this species in Clarke (1894) – he later changed his mind and queried the identification on the specimens. The Clarke specimens from Sikkim were identified by himself and Kükenthal (1909 – where it was described as f. *pallida*) as *C. vesiculosa*. The excellent Lacaita specimens were likewise identified as *C. vesiculosa*. Of the more recent specimens, the Bhutanese ones were identified by Ohwi (1971) as '?*C. continua* C.B. Clarke' and the Tibetan one as '*Scleria* sp. aff. *lithosperma*' by Nelmes (on label)! It is interesting to note that fruiting takes place at the end of the dry season (April–May); most Indocarices, including *C. vesiculosa*, flower during or towards the end of the wet season.

It should be noted that *C. vesiculosa* is not a well-understood species ('hardly separable from *C. condensata*' as Clarke (1894) observed) and the name has possibly

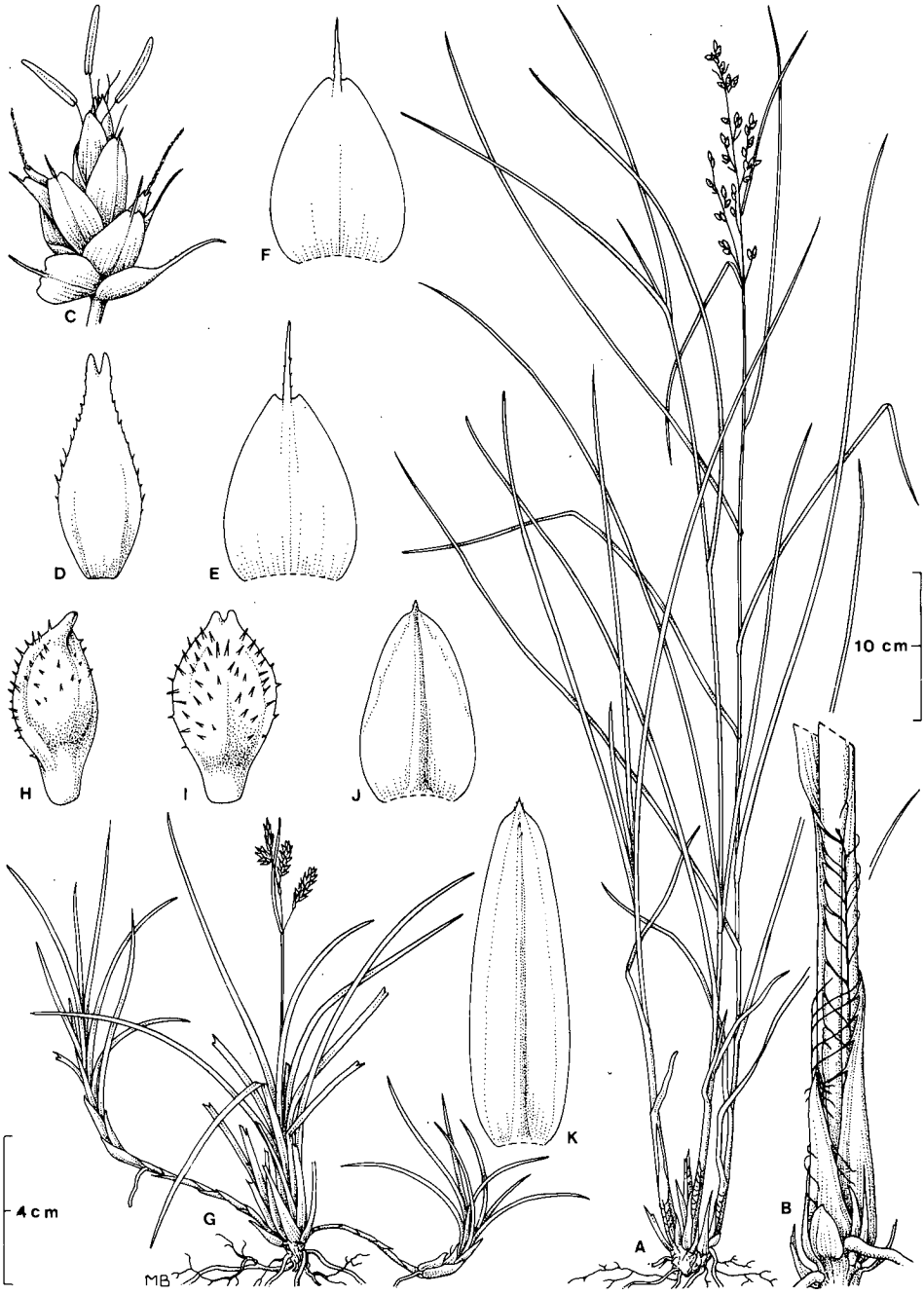

FIG. 1. *Carex burttii* Noltie. A, habit; B, culm base showing fibrillose margins of leaf sheaths (x 1); C, single (androgynous) spike (x 5); D, utricle (x 12); E, female glume (x 12); F, male glume (x 12). *C. griersonii* Noltie. G, habit; H, I, utricle (x 12); J, female glume (x 12); K, male glume (x 12).

been misapplied to Malesian specimens (e.g. Kern & Nooteboom, 1979). It can usually be distinguished from *C. condensata* by its fibrillose leaf sheaths and material matching the type (Chirrha Pungee [= Cherrapunji], Khasia, *Gomez s.n.* ex herb. Boott, K), however, has been seen from Khasia, Bhutan and E Nepal. Much further work requires to be done to resolve the seemingly intractable *C. vesiculosa/cruciata/condensata* group over the whole of SE Asia.

SUBGENUS EUCAREX: SECTION ACUTAE: SUBSECTION VULGARES

Carex nigra

Members of subsections *Vulgares* and *Caespitosae* (sensu Kükenthal) are apparently rare in the Sino-Himalayan region and in SE Asia in general and are very poorly represented in herbaria. None had previously been reported for the E Himalaya so the occurrence of the present taxon in Bhutan was somewhat surprising. It cannot be accommodated in the Australian/E Asian *C. gaudichaudiana* Kunth and comes extremely close to the widespread European and N American *C. nigra*. The exact distribution of *C. nigra* s.l. in Asia is uncertain though it was not recorded (under *C. goodenoughii*) for India or China by Kükenthal (1909). *C. nigra* is recorded for Turkey (Nilsson, 1985); *C. juncella* Th. Fr. and *C. wiluica* Meinsh., which should almost certainly be included in *C. nigra* (Chater, 1980), are both recorded for Russia (Krechetovich, 1964), the former only for the European part and the latter occurring in arctic parts as far east as Kamtschatka. In the same work *C. dacica* Heuff. is recorded for the Caucasus and this is probably also best treated as a subspecies of *C. nigra*. This, therefore, seems to be as far east as the species extends in south-central Asia and it is not included in the list of species for the *Flora Iranica* area (Kukkonen, 1987). Records for NW Himalaya/W Tibet (under *C. vulgaris*; Clarke, 1894) must be regarded as doubtful as I have seen no specimens. Further work is needed to clarify the relationship between *C. nigra* and the related species *C. forrestii* Kük. and *C. prolongata* Kük. from SW China; and also the Japanese *C. gaudichaudiana* var. *thunbergii* (Steud.) Kük., which Clarke (1903) included under *C. goodenovii*.

It seems clear that the occurrence of *C. nigra* in Bhutan represents a dramatic disjunction and therefore worth recognizing at subspecific level, despite the fact that this species is notoriously polymorphic and the morphological distinctions of the present taxon relatively slight.

Carex nigra (L.) Reich. subsp. **drukyulensis** Noltie, **subsp. nov.**

A *C. nigra* subsp. *nigra* spicis femineis longioribus (infima 2–4.5cm longa), utriculis validiore 5–9-nervatis, spica mascula majore (2.2–4.5cm longa), magis distanti (pedunculo plus quam 1cm longo) recedit.

Rhizomes ?short; stems ?tufted. *Basal bladeless sheaths* few, short, acute, reddish-brown, non-fibrillose. *Culm* 23–33cm, trigonous, angles hispid; leaves sub-basal. *Leaves* shorter than to equalling culm, 1.6–2.6mm wide. *Bracts* leaf-like, lowest shorter than inflorescence, not sheathing. *Female spikes* 3, erect, overlapping, ± sessile, narrowly cylindric; sometimes with long-peduncled sub-basal spike; upper sometimes with

some apical male flowers. *Female glumes* 1.9–2.6 x 0.7–1mm, narrowly oblong-lanceolate, blunt, dark purplish brown, midrib green, margins very narrowly hyaline. *Utricles* 2–2.4 x 1–1.2mm, elliptic, slightly contracted below apex and above base, biconvex, grey-green, minutely papillose, nerves 5–9 per face, beakless, base of style persisting projecting slightly from entire orifice. *Stigmas* 2. *Male spike* single, 2.2–4.2cm, terminal, peduncle 1.5–3.5cm. *Male glumes* 3.5–4 x 0.9–1mm, narrowly oblanceolate, blunt, slightly paler than female ones.

Type: Bhutan, Bumthang district, Byakar, 2750m, 9 vi 1979, *Grierson & Long* 1764 (holo. E, iso. K).

Other specimens seen:

BHUTAN: Bumthang district, Chunkar, 9500ft, 12 iv 1949, *Ludlow, Sherriff & Hicks* 20100 (BM); 6km N of Thimphu Dzong, 2450m, 9 vi 1975, *Grierson & Long* 119 (E).

The plant grows in damp flushes and moist meadows between c. 2450 and 2900m. The subspecific epithet is derived from the Bhutanese name for Bhutan, to which it appears to be endemic.

SUBSECTIONS FORSICULAE AND PRAELONGAE

Carex fucata, C. sikkimensis and **C. notha**

There has been much confusion over these three taxa in the E Himalaya. This has arisen for various reasons:

1. too much weight has been placed on the sex of the terminal spike in distinguishing species and assigning them to sections or subsections. For example, Clarke (1894) placed *C. sikkimensis* in sect. *Remotae* (terminal spikes gynaecandrous) and *C. notha* and *C. fucata* in sect. *Vulgares* (terminal spikes male). Kükenthal (1909) treated *C. sikkimensis* as a variety of *C. fucata* in subsect. *Forsiculae* and placed *C. notha* in subsect. *Praelongae*, these subsections being separated on very tenuous grounds, such as the degree of pendulousness of the female spikes.
2. the type sheets of *C. fucata* contain a mixture of 2 gatherings.

Field studies by the author, in 1992, at the presumed type locality of *C. sikkimensis* (Sikkim: near Dzongri) have confirmed the variability in distribution of sexes in the terminal spike actually demonstrable (but previously un-noticed) in the type collections. Variability in posture of female spikes is evident even from the old herbarium collections.

To clarify the situation it is firstly necessary to lectotypify the name *C. fucata* Boott ex C.B. Clarke. There are three relevant sheets at Kew: one from Boott's herbarium and two from Hooker's – all contain a mixture of two gatherings from Lachen, Sikkim, made by J.D. Hooker, at two different altitudes and on two dates. One element is extremely immature and has relatively paler (brownish-black) glumes, the mature element having black glumes, but both almost certainly belong to the same taxon. The original field labels are attached to one of the Hooker sheets. Boott was obviously unsure of the

identity of the plants as the sheet from his own herbarium is labelled *C. notha* Kunth, but one of the duplicates from Hooker's herbarium bears a note in his hand naming it *C. fucata* Boott, stating that it differs from *C. notha* in the entire orifice of the beak. The close relationship of the two taxa is particularly evident in immature specimens. Boott did not publish the name *C. fucata*, which was taken up by C.B. Clarke (1894: 710); it is therefore necessary to lectotypify by specimens which agree with Clarke's protologue, i.e. ones with a terminal male spike and black glumes.

As mentioned above, Clarke failed to notice that whereas some of the type specimens of *C. fucata* have entirely male terminal spikes, others have terminal spikes at least partly female. In the same work Clarke described *C. sikkimensis*, based on his own collections from Dzongri, Sikkim. He distinguished *C. sikkimensis* from *C. notha* chiefly by its larger size and gynaecandrous terminal spike, but did not compare it with *C. fucata* with which it is quite clearly conspecific, as was realized by Kükenthal who treated it as a variety of *C. fucata*. The type specimens are merely robust examples at a more mature stage of fruiting than the types of *C. fucata* and are not even worth varietal rank.

C. fucata is apparently restricted to the E Himalaya occurring from E Nepal through Sikkim to E Bhutan.

It should be noted that most of the Nepalese specimens determined as *C. fucata* by Koyama (1978) are actually *C. notha* which he does not list for Nepal.

Carex fucata Boott ex C.B. Clarke in Hooker f., Fl. Br. India 6: 710 (1894). Lectotype (selected here) 'Lachen, 11–12,000ft, 2 vii 1849, *J.D. Hooker* s.n.' – three left hand specimens on sheet ex herb. Hooker, bearing his field tickets (K).

C. sikkimensis C.B. Clarke in Hooker f., Fl. Br. India 6: 708 (1894). Lectotype (selected here) 'Jongri, 12,000ft, 15 x 1875, *Clarke* 25788B (BM); Isolectotype: same number, ex herb. Gamble (K).

C. fucata var. ß *sikkimensis* (C.B. Clarke) Kük. in Engler, Das Pflanzenreich 38 (IV.20): 344 (1909).

As indicated above *C. fucata* is close to *C. notha* and they can be separated as follows:

1. Glumes black; midribs of female glumes usually not excurrent; utricles ± lanceolate in outline gradually tapering into beak; orifice of beak not notched; lowest bract overtopping inflorescence; terminal spike male or sometimes with female spikes in various positions _____ **C. fucata**

\+ Glumes dark purplish-brown; midribs of female glumes usually minutely excurrent; utricles elliptic, abruptly contracted into beak; orifice notched; lowest bract usually not overtopping inflorescence; terminal spike almost invariably male-only _____ **C. notha**

C. notha is a Himalayan taxon, occurring from Himachal Pradesh as far east as Bhutan. Closely related species occur in Yunnan, SW China, notably *C. melinacra* Franch. (treated as a subspecies of the Japanese *C. forficula* Franch. & Sav. by Kükenthal). The inflorescence of this species is very similar to that of *C. notha* but the plant differs vegetatively in having reddish-brown, strongly fibrillose leaf sheaths. *C. luctuosa*

Franch. was said by Kükenthal (1909: 344) to be synonymous with *C. fucata*, which he therefore recorded for China. The type of *C. luctuosa* (from Sichuan), however, is so immature that it can only be referred to *C. notha* agg.

Carex teres and **C. praelonga**

There has been much confusion over this pair of species in E Himalaya with specialists such as C.B. Clarke and E. Nelmes often changing their minds over the assignment of individual specimens to one or other of the species. As with many sedge problems, the root of the trouble lies in the fact that the specimens on which the earlier name (*C. teres*) is based are immature. After examining the types and material available at BM, E and K it has been found impossible to draw a line between them and they are better regarded as conspecific. This was confirmed by collections made in Darjeeling (during the 1992 ESIK expedition) very close to the type locality and agrees with the conclusion reached by Kern & Nooteboom (1979) on the variability of the species in Sumatra and Java.

C. teres was described by Boott (1858) from material collected by Hooker at Senchul, Darjeeling District. The sheet from Boott's own herbarium and used for the illustration (marked 'figd.') is here chosen as the lectotype. The utricles are immature and the nut has not begun to expand, hence the utricle is narrow and tapers gradually into the beak. The utricles are darkish and conspicuously marked with purplish glands, and distinctly 5-nerved. The specimen does, however, bear some slightly more mature utricles in which the body is more elliptic. Boott also figured these wider utricles, but Clarke (1894) and later Kükenthal (1909) assumed that these belonged to another species, the intractably confused *C. prescottiana* Boott, apparently wanting to believe that the mature utricles of *C. teres* always remained narrow and tapered gradually into the beak.

C. praelonga was described by Clarke (1894) from specimens (with ripe fruit) he collected at Dikeeling, Sikkim. In the same work he describes *C. teres* as 'from the root to the glumes extraordinarily like *C. praelonga* but rather stouter; the fruiting spikes and utricles are totally unlike'. In these specimens the utricles are fully mature, olive-yellow with only small reddish glands, smooth (nerves scarcely visible), with the body widely ellipsoid and distinctly shouldered into the beak, and the nut filling the body.

In fact, specimens have been seen with intermediate utricle-characters, including the recent collection from Senchul (*ESIK* 56), and the two species must be united under the name *C. teres*.

The probable reason for Clarke's confusion is that some specimens, which he collected at Tonglo (*Clarke* 35636, K) and Sandukphoo (*Clarke* 35667, K), are rather atypical, but which he took to be the mature form of *C. teres*. In these, the mature utricles are large, lanceolate in outline, gradually tapered into the beak, and tending to reflex. Some of the specimens, however, bear a mixture of these and typical utricles and they seem to represent some sort of monstrous form; further collections are required to verify this.

Examination of herbaria revealed many previously unidentified or misidentified specimens, showing that the Sino-Himalayan distribution of *C. teres* extends from Nepal, through Sikkim/Darjeeling, Bhutan, SE Tibet, Khasia, N Burma to W Yunnan; it also occurs in Sumatra and Java. Further work is required to clarify the relationships

between *C. teres* and the related species *C. cremostachys* Franch. and *C. fargesii* Franch. from SW China.

Other specimens seen:

NEPAL: *Stainton, Sykes & Williams* 4939 (E, BM); *Stainton* 190 (E, BM) - both determined as 'probably *C. fucata*' by T. Koyama but not included in Koyama (1978); *EMAK* 892 (E).
SE TIBET: *Ludlow, Sherriff & Elliot* 13727 (E).
BHUTAN: *Ludlow, Sherriff & Hicks* 20566 (E, K).
NE UPPER BURMA: *Forrest* 25037, 26826 (E, K); *Kingdon Ward* 3185 (E).
W YUNNAN: *Sino-British Exped. Cangshan 1981* 825 (E).

Carex teres Boott, Ill. Genus Carex 1: 62, t. 167 (1858).
Lectotype (selected here) 'Sinchall (sic), Sikkim Himalaya, 8–9,000ft, Dr Hooker [s.n.] – specimen ex herb. Boott marked 'figd.' (K).

C. praelonga C.B. Clarke in Hooker f., Fl. Br. India 6: 707 (1894).
Lectotype (selected here) 'Dikeeling, Sikkim, 7000ft, 11 v 1876, *Clarke* 27879A (K); isolecto *Clarke* 27879C (BM).

SECTION TRACHYCHLAENAE

C. setigera, *C. schlagintweitiana* and *C. inanis* represent a difficult complex on which further research is required, having been variously treated by different authors. Problems have arisen from stunted and immature specimens, specimens in which the spikes are infected with a fungus (when the glumes become translucent), confusion over Royle collecting numbers, and which specimens of a given number Nees actually saw. It appears that Clarke's treatment (1894) is better than that of Kükenthal (1909), though in light of re-examination of the Royle types slight modification to Clarke's synonymy is required (see below).

Carex schlagintweitiana
Although I have been unable to locate any type material of *C. schlagintweitiana* Boeckeler (*Schlagintweit* 5056), it seems safe to follow Clarke's concept (1894) since he had seen the type and equated it with that part of Boott's *C. setigera* ß *minor* figured as t. 6. fig. 1 in Boott (1858). Kükenthal also treated this taxon as a variety of *C. setigera*. Koyama (1978) stated that he had seen the type of *C. schlagintweitiana*, though without citing its herbarium location (the holotype should have been at Berlin, and was almost certainly destroyed, and I can find no isotype material at K or BM); he almost certainly wrongly sunk it under *C. inanis*. More recently Kukkonen (1987) has maintained *C. schlagintweitiana* as a species. The typical form of this species is restricted to the NW Himalaya and proves to be synonymous with *C. setigera* γ *humilis* Nees (lectotype (selected here) *Royle* 121, LIV). Eastern plants differ and are here described as a new subspecies.

Carex schlagintweitiana Boeckeler subsp. **deformis** Noltie, **subsp. nov.**
A subsp. *schlagintweitiana* apice utriculi haud (vel minute) rostrato, ubi immaturo recurvato, orificio utriculi integro (non acute bidentato), et distributione orientale-himalayensi differt.
Rhizomes slender, spreading, clothed with purplish-red fibrous scales. *Bases of leaf sheaths* pale reddish-fawn, fibrillose. *Leaves* 1.3–2.5mm wide, exceeding culms, weakly erect, sub-basal. *Culms* 15–30cm, very slender. *Inflorescence* of 2–4 delicate, erect spikes near top of culm, upper overlapping; peduncles erect, slender, lowest 0.4–1.5cm; terminal spike male, 1.4–2.1cm; lower 2–3 spikes female (upper sometimes with a few terminal male flowers) 1–1.8 x c.0.3cm, utricles dense, suberect; bracts with narrow leaf-like blades – lowest exceeding inflorescence, bases sheathing. *Utricles* 1.4–1.7 x c.0.7mm, narrowly obovoid, densely hairy, becoming marked reddish-brown, gradually narrowed to apex, apex deflexed when immature; beakless or extremely shortly beaked (under 0.2mm), aperture entire. *Stigmas* 3. *Female glumes* 2.3–3.3 (total length) x 0.6–1.2mm, lanceolate, acuminate into short (under 0.5mm) awn, reddish-brown, margins hyaline, midrib green, keeled. *Male glumes* c.3.5 x 0.6mm, linear-lanceolate, finely acuminate.
Type: Bhutan, Thimphu district, Hills above Taluka Monastery, 3700m, 19 vi 1988, *J.R.I. Wood* 6414 (holo. E).
Distribution: E Nepal, Bhutan, Chumbi, Yunnan. Screes and rocky hillsides; moss around base of trees in open *Abies* forest, c.3050–3960m.

Other specimens seen

NEPAL: Near Namche, 11–12,000ft, 2 v 1954, *Stonor* 57 (K).
TIBET (CHUMBI): Pipitang, 12,000ft, 14 v 1945, *Bor & Ram* 19201 (K). Yatung, 10,000ft, 15 v 1945, *Bor & Ram* 19242 (K).
TIBET/YUNNAN: Dokar La, Mekong-Salween Divide, 13,000ft, 29 vi 1913, *Kingdon Ward* 605 (E).

On account of the deflexed apices, the utricles look deformed when immature, hence the subspecific epithet.

C. tsangensis Franch. (*Delavay* 2615) from Yunnan is placed under synonymy of *C. schlagintweitiana* by Kükenthal (1909). Although I have not seen the type, it seems not to refer to the present plant as the utricle is described as 'abrupte et breviter rostrati, rostro bidentulo'.

Carex inclinis
Also in this critical group must be placed *C. inclinis* C.B. Clarke. This name was coined by Boott as a variety of *C. setigera* but not published. Clarke (1894) took it up, but was at a loss as to know its relationships, placing it under 'species of Sect. '*Indicae*' not easily placed in any one of the preceding four subsections'. Kükenthal (1909) inexplicably placed it in sect. *Frigidae* subsect. *Decorae*, but it cannot belong there, having spikes inserted singly at the inflorescence nodes.

Carex inanis

The name *C. inanis* has been wrongly attributed to Kunth. Kunth (1837: 522) included this name at the end of his account of *Carex* under '*species obscura*' and refers back to Nees (1834: 120). Nees provided a description of a plant but gave it no name, thus: 'C. .... - Royle. herb. n. 122 (ex parte)'. Kunth merely quoted Nees' description (and had evidently not seen the specimens) under the 'name' 'C. (inanis) Nees'. In this work no other epithet is included in parenthesis, and he did not intend to coin a binomial for the species, merely to indicate its nameless state. The name cannot therefore be attributed to Kunth. C.B. Clarke appears to be the first author to validate the name which should therefore be cited as follows:

Carex inanis C.B. Clarke in Hooker f., Fl. British India 7: 743 (1894).
Lectotype (selected here): Sikkim, Lachen, July 9 [18]49, *J. D. Hooker* s.n. (K).
Of Royle's specimens at Liverpool, part of no. 122 is *C. tenuis* Nees (= *C. hirtella* Drejer) and the remainder of 122 consists of two sheets mixed with *Royle* 131. According to Boott's annotation, Nees did not see *Royle* 131 and it cannot be said which part of the confused *Royle* 122 was actually seen by Nees. One specimen of *Royle* 122 at Liverpool certainly belongs to Clarke's concept of *C. inanis* and agrees with Nees' description in most respects. It differs, however, in that it has 3–4 spikes rather than a single one as described by Nees. Whether or not Nees only had a damaged and incomplete duplicate will never be known. In view of this confusion and the fact that the specimen lacks basal parts it is better to typify Clarke's name on material mentioned in the protologue and annotated in his hand. No specimens are cited but the distribution is given as 'Kashmir *C.B. Clarke*, to Sikkim *J.D.H.*' I select the sheet cited above since Clarke evidently regarded the Kashmir plants as being slightly atypical giving them an unpublished ms. name on the sheets. The E Himalayan plants are less variable than those occurring further west and have short, densely cylindric female spikes clustered near the apex of the culm. It should be noted that Clarke was incorrect in citing *C. setigera* var. *humilis* Nees as a synonym – the type of this variety is *C. schlagintweitiana* (see above).

Carex griersonii Noltie, **sp. nov.**

A *C. inanis* habitu concinniore spicis femineis magis compactis, glumis atrioribus et praecipue stolonibus gracilibus extendentibus (vice rhizomatium contractorum casepitites densas formantium) differt. **Fig 1 G–K.**

Stolons slender (c.1mm diam.), covered in brown scales. *Bases of leaf sheaths* dark brown, becoming slightly fibrous. *Leaves* usually shorter than stems, 1.7–3mm wide, rather stiff, basal. *Culm* 2.5–19(–22)cm, trigonous. *Inflorescence* of 1 terminal male spike (occasionally with short basal branch) and 2–3 female spikes (upper occasionally with some terminal male flowers), upper spikes crowded, sometimes also with basal, long-peduncled female spike; male spike 0.5–1.1cm, sessile; female spikes 0.5–1.4 x 0.3–0.5cm, cylindric, erect on short peduncles (lowest 0.4–1cm), utricles spreading, dense; inflorescence bract equalling to slightly exceeding inflorescence, base shortly sheathing. *Utricles* 1.7–2.3 x 0.8–1mm, curved, trigonous, faces rhombic to oblanceolate, densely hispid, pale tawny-coloured, becoming flushed darker, beak short (0.2–

0.3mm), orifice entire. *Stigmas* 3. *Female glumes* 1.9–2.8 x 0.9–1.1mm, lanceolate, acute, shortly mucronate, midrib green, sides fuscous purple, margins hyaline. *Male glumes* 3–4 x 1mm, oblong-elliptic, acute, shortly mucronate.
Type. BHUTAN: Ha district, Ha, hill opposite bazaar, 2600m, 7 vi 1988, *J.R.I. Wood* 6380 (holo. E, iso. K).
Distribution: Kashmir to W Bhutan. Damp soil and silt by streams; grazed terraces, c.2290–3350m.

Other specimens seen:

KASHMIR: Near Gulmarg, 8–9000ft, 8 vi 1892, *Duthie* 11383 (BM).
UTTAR PRADESH: Palang Gadh, Byans, Kumaon, 11,000ft, 20 vii 1886, *Duthie* 6099 (K).
NEPAL: Jumla, 7500ft, 5 v 1952, *Polunin, Sykes & Williams* 910 (BM, E). Between Kalapani and Larjung, 8300ft, 3 vi 1971, *Barclay & Synge* 2453 (K). Tarakot, 2800m, 2 vii & 29 v 1973 *Einarsson, Skärby & Wetterhall* 1466 & 250 (BM).

This species also resembles some members of Kükenthal's section *Pachystylae* (such as *C. grioletii* Roemer), none of which, however, occur in the Himalaya. *C. griersonii* is named after the late A.J.C. Grierson, initiator and senior author of the *Flora of Bhutan*.

KEY TO HIMALAYAN MEMBERS OF SECT. *TRACHYCHLAENAE*

1. All spikes androgynous or terminal one(s) sometimes male-only ____ 2
+ Terminal spike(s) male, others entirely female ____ 3

2. Female glumes acute or minutely mucronate; utricles minutely hairy or sometimes glabrous ____ **C. inclinis**
+ Female glumes long-aristate (awn over 1.2 mm); utricles densely hairy _ **C. setigera**

3. Rhizomes short, plants forming dense clumps, basal sheaths never fibrillose, persisting as dense collars of dark, reddish-brown fibres ____ **C. inanis**
+ Rhizomes spreading, stoloniferous, basal sheaths often fibrillose, not (or scarcely) persisting as fibres ____ 4

4. Utricle beak sharply bidentate ____ **C. schlagintweitiana** subsp. **schlagintweitiana**
+ Utricle beak with ± entire orifice ____ 5

5. Female glumes reddish-brown, awned; stolons stout; basal sheaths fibrillose, reddish ____ **C. schlagintweitiana** subsp. **deformis**
+ Female glumes fuscous-purple, shortly mucronate; stolons slender; basal sheaths not fibrillose, dark brown ____ **C. griersonii**

SECTION DIGITATAE SUBSECTION RADICALES

Carex speciosa

C. speciosa Kunth is a widely distributed SE Asian species whose 'polymorphism ... is badly in need of special study' (Kern & Nooteboom, 1979). It was originally described by Nees who gave it the illegitimate homonym *C. concolor*, Kunth merely provided a new name. Some Sikkim specimens exactly match the types from Nepal (*Wallich* 3391, isotypes E); however, two other forms occur in E Himalaya which are highly distinctive

and merit description at subspecific level; they differ from the type in an even greater degree than the S Indian var. *courtallensis* (Nees) Kük.

Carex speciosa Kunth subsp. **dilatata** Noltie, **subsp. nov.**
A subsp. *speciosa* (var. *courtallensis* inclusa) foliis ensiformibus latioribus (1–1.6cm latis), non minus quam 0.8cm, plerumque minus quam 0.5cm latis quam caulibus brevioribus (haud eos aequantibus vel superantibus), caulibus altioribus (39–)50–87cm, non 20–42cm), spicis (2–)5–7 (non 2–4), utriculis minoribus (3.8–4.5mm, non 4.2–6mm) glumas paulo tantum excedentibus, costis in quaque superfacie minus quam 10, inaequalites incrassatis (non plus quam 15 in quaque superfacie arcte dispositis aequaliter incrassatisque), glumis femineis longioribus (3–)3.2–4.4mm longis (non 2.2–3.2mm) magis acuminatis distingitur.
Type: NE INDIA (Nagaland): Kohima, 6500ft, 21 x 1885, *C.B. Clarke* 41058 (holo. K, iso. BM)
Distribution: Nepal, Sikkim, NE India, Yunnan. Dense evergreen, broad-leaved forest, c.1220–2200m (in China reputedly to 2850m).

Both Clarke and Nelmes noticed the distinctiveness of this spectacular taxon in manuscript notes on herbarium sheets, Clarke providing the varietal name '*dilatata*' but not publishing it. In its leaf width it resembles *C. speciosa* subsp. *latifolia* T. Koyama, described from Thailand, but that subspecies differs in having larger (5.5–6.2mm) utricles and winged culms.

Other specimens seen:

E NEPAL: Khabili, 4–6000ft, 10 xii [1848], *J.D. Hooker*, s.n. (K); Iwa Valley, *Hooker* s.n. (ex herb. Boott, K).
DARJEELING DISTRICT: Rumman [=Ramman], 6000ft, xi 1881, *Gamble* 10043 (K).
BHUTAN: Lomitsawa, 2200m, 13 viii 1989, *J.R.I. Wood* 2080 (E).
NE INDIA: (Nagaland) Khomi, 6000ft, 19 vii 1942, *Bor* 16031 (K). Takiya, Naga Hills, 6000ft, 6 xi 1935, *Bor* 6790 (K). (Arunachal Pradesh): Bomde La, 7000ft, 15 vii 1938, *Kingdon Ward* 13936 (E).
SW CHINA (Yunnan): Mienning, Poshang, 2850m, 11 x 1938, *T.T. Yü* 18018 (E). Kengma, Chuichayko, 2500m, 10 viii 1938, *T.T. Yü* 17307 (E).

Carex speciosa Kunth subsp. **pinetorum** Noltie, **subsp. nov.**
A subsp. *speciosa* habitu graciliore, utriculis minoribus 2.2–4mm longis superfaciebus omnibus utriculi breviter pilosis (vice superfacie adaxialis tantum pilosi), et costis paucioribus perobscuris recedit.
Type. Bhutan: Thimphu district, ridge W of the Thimphu Valley, 2500m, 1 vii 1987, *J.R.I. Wood* 5548 (holo. E).

Apparently restricted to W Bhutan, where it occurs in dry, relatively open habitats in the *Pinus wallichiana* zone. In its altitudinal range, habit and especially in its utricles it is somewhat intermediate between *C. speciosa* and *C. radicalis*.
Other specimens seen:

BHUTAN: hill above Thimphu Hospital, 2670m, 19 vii 1991, *Noltie* 7 (E). Above Lobnakha, 2830m, 22 vii 1991, *Noltie* 19 & 20 (E). Near Motithang Hotel, Thimphu, 2630m, 7 viii 1991, *Noltie* 120 (E).

It should be noted that leaf width on its own is not a good character: var. *angustifolia* Boott described from Khasia and S India has narrow leaves but the inflorescence and utricles are typical of subsp. *speciosa* of which it appears merely to be a starved form.

SUBSECTION EU-DIGITATAE

Carex laeta Boott subsp. **gelongii** Noltie, **subsp. nov.**
A *C. laeta* subsp. *laeta* habitu graciliore et partibus omnibus minoribus, utriculis glaberrimis minoribus 1.7–2.5mm (non 2.8–3.4mm) ambitu ellipticis (non oblanceolatis) distincte rostratis, rostro 0.3–0.7mm longo differt.
Type: Bhutan, Thimphu district, below Darkey Pang Tso, 3920m, 3 viii 1991, *Noltie* 98 (holo. E, iso. K).

Other specimens seen:

BHUTAN: Upper Bumthang Chu district, above Lambrang, 4050m, 11 viii 1991, *Noltie* 145 (E).
TIBET (Chumbi): Yatung, in bed of the Amo Chu, 10,500ft, 5 vi 1945, *Bor & Ram* 20043 (K)

Apparently endemic to Bhutan and Chumbi, where it occurs at high altitudes in flushes associated with species such as *Blysmus compressus*, *Carex atrofusca*, *C. microglochin*, *C. parva*, *Kobresia duthiei*, *Juncus triglumis*, *J. sikkimensis*, *J. allioides* and *J. thomsonii*.

Named after the Dzongkha word for a monk (*gelong*) in honour of the Bhutanese monastic body and in particular of the anonymous gelong who acted as guide on a trek to the type locality and who found the rare endemic *Allium rhabdotum* for me – even although his interest in the plant was more gastronomic than botanical.

Although this taxon is completely distinct from the type of *C. laeta* (of which typical specimens have been seen from Bhutan), specimens from E Nepal are intermediate, having the utricle size and hairiness of subsp. *laeta* but the shape of subsp. *gelongii*. It therefore seems wiser to recognize the plant at subspecific rank. Ecological factors could be significant, with subsp. *gelongii* occurring where there is moving ground-water and subsp. *laeta* in drier habitats.

Taxa in this group seem to be very variable in utricle characters, with variation seen in the degree of beak development even within a single specimen. Further field studies are needed, for example to ascertain the status of *C. laeta* var. *major* Boott. It should be noted that *C. laeta* (described from Sikkim) is endemic to the E Himalaya. Of the specimens determined as *C. laeta* by Koyama (1978) from W and C Nepal, some are *C. cardiolepis* Nees, whereas others probably belong to *C. pisanensis* Koyama, which he later wrongly treated as a synonym of *C. laeta*. It should also be noted that *C. setosa* Boott, placed by Kükenthal under sect. *Frigidae* subsect. *Ferrugineae* is closely related.

SECTION FRIGIDAE SUBSECTION FERRUGINEAE/FULIGINOSAE

Carex montis-everestii Kük.
A little known species, until recently known only from the immature type collected on Mount Everest. A.O. Chater correctly determined a group of more mature specimens

from S Tibet as belonging to this taxon and an augmented description can now be provided based on less stunted, more mature specimens; its geographical range is also extended.

Augmented description (measurements from original description in brackets):

Rhizomatous; culms surrounded at base by dense tufts of many-leaved vegetative shoots. *Bases of leaf sheaths* reddish-brown, persistent, not becoming fibrous. *Leaves* about half length of culm, very slender, (1–)1.4mm wide, erect, basal. *Culms* (1.5–)12–14cm, subterete. *Inflorescence* of 2–3 spikes; terminal male or gynaecandrous, narrowly ellipsoid, borne on suberect peduncle (0.5–)2cm; lower spikes female, broadly cylindric, (0.7–)1.2–1.3 x 0.8–1cm, borne on pendent, filiform peduncles c.1.5cm; lowest bract with filiform blade shorter than inflorescence, sheath obliquely open with dark, hyaline margins. *Utricles* (2–)4.5 x 1mm, completely glabrous, elliptic, compressed when dry, beakless, shining, chartaceous, pale below, reddish chestnut above, orifice minutely notched. *Stigmas* 3. *Female glumes* to 5.5 x 2mm, oblanceolate, acute, dark reddish-brown, shining. *Male glumes* to 6 x 1.2mm.

Specimens seen (all):

C NEPAL: Sangda La, 17,300ft, 12 viii 1977, *Miehe Feldbuch 5* 468 (BM). c.4 miles SW of Saldanggaon, 18,500ft, 26 vi 1952, *Polunin, Sykes & Williams* 22 (E) – mixed gathering with *C. supina*.
SIKKIM: Llonok [= Llonakh], 15,000ft, 5 viii 1909, *Smith & Cave* 2155 (E).
TIBET: Shisha Pangma, N slope, 5000–5530m, 9 & 13 ix 1984, *Miehe* 1495, 1527, 1607, 1760 (BM). Shisha Pangma Base Camp, 5020m, 8 vi 1984, *Miehe* 1486, 1653 (BM). Up from Nielma, 4400–5300m, 2 & 4 ix 1984, *Miehe* 1382, 1450 (BM). Mt. Everest, N slope Rongluk Lateral, 5200–5440m, 18 ix 1984, *Miehe* 1788, 1810 (BM). Central Tibet, chiefly from Gooring Valley, 30°12'N, 90°25'E, c.16,500ft, vii & viii 1895, *Littledale* s.n. (K). Camp I [Mt Everest], 18,200ft, 2 vii 1933, *Wager* 66 (holo. K).

Other specimens of this taxon from N Sikkim were seen in CAL but have unfortunately not been released on loan.

C. montis-everestii is superficially rather similar to *C. atrofusca* Schkuhr from which it differs in bearing many-leaved vegetative shoots at the base of the culm (rather than few-leaved vegetative shoots borne on stolons, distant from the culm) and its extremely narrow leaves; female spikes squatter, with more widely spreading utricles, female glumes shining, acute (rather than acuminate); utricle beakless.

This group is in great need of revision in the Sino-Himalayan region, requiring further collections and field-study. Relationships between the very variable *C. atrofusca* and species such as *C. nivalis* need to be resolved, as pointed out long ago by Boott (1858: 13). *C. atrofusca* var. *angustifructus* Kük. was described partly from Sikkim material. Nelmes (1940) raised this to specific rank, but recent field observations in Sikkim (*ESIK* 570) showed it to be merely a form of *C. atrofusca* and certainly not worthy of more than varietal recognition. In its elongate spikes, however, this variety resembles the W Himalayan *C. nivalis* Boott. Both *C. nivalis* and *C. cruenta* Nees are recorded for Sikkim by Kükenthal (1909) but all specimens seen so determined refer to forms of *C. atrofusca*. Other (probably undescribed) taxa, however, appear to occur in Bhutan.

SECTION HYMENOCHLAENAE SUBSECTION DEBILES

Carex finitima and C. fusiformis

C. fusiformis Nees (1834) was described from material collected at Mussoorie (NW Himalaya) (*Royle* 88, lecto LIV, isolecto K; both selected here). Up until now the name has been more or less restricted to this gathering and to a handful of other specimens from Kumaon and Sikkim. Examination of the type shows it to be a slightly atypical form (chiefly in its large utricles) of the widely distributed plant commonly identified as *C. finitima* Boott, which occurs from NW Himalaya to SW China. This latter taxon is also reported from Taiwan, Sumatra and New Guinea (Kern & Nooteboom, 1979) - I have seen no specimens from these areas, but it is almost certain that they too should be referred to *C. fusiformis*.

To understand how this confusion arose it is necessary to investigate the taxonomic history of *C. finitima*, described by Boott (1858) from Sikkim and distinguished from *C. fusiformis* by its greater number of narrower, denser-flowered spikes; glumes muticous as opposed to aristate; utricles smaller and glabrous; leaves subrigid. However, Boott's plate (1858, t. 112) and the sheet from which this was drawn (and which can therefore be taken as the type sheet) are found to include material of two rather different taxa – the left hand specimen can be referred to *C. fusiformis*, but the right hand one is distinct. Boott's description refers at least in the important vegetative characters (leaf width, colouring at base of stem, length of lowest bract sheath) to the latter. It is to this element which the name *C. finitima* must be applied, the right hand specimen being chosen here as the lectotype.

The two plants on the type sheet (and duplicates at K ex herb. Hooker – see Introduction) seem to have been collected at different localities, though the locality on the type sheet is merely given as 'Sikkim Himalaya. J.D. Hooker. 12000 ft'. However, on a duplicate sheet (also from Boott's herbarium and bearing both taxa) two localities are given, viz '1. Lachen. Ind. Orient. Woods. June 11 1849. Dr Hooker' [narrow-leaved] and '2. Tonglo Top. Dr Hooker'[broad leaved]. Unfortunately the sheet from Hooker's own herbarium bears only one field label (Lachen), but two taxa – the Tonglo field label has evidently been lost at some stage.

Although the type of *C. finitima* differs greatly from *C. fusiformis* examination of a wider range of material suggests that the former is better treated as a subspecies of the latter. It appears to be rare and is perhaps an ecological form; specimens exactly matching the type have been seen from E Nepal and somewhat intermediate ones from Kulu and Manali (NW Himalaya).

Carex fusiformis Nees subsp. **finitima** (Boott) Noltie, **stat. et comb. nov.**

C. finitima Boott, Ill. Gen. Carex 1: 44–5; t. 112 (1858). Lectotype (selected here): right hand specimen on sheet ex herb. Boott marked 'specimens figured by Miss Rees': Sikkim Himalaya (probably Tonglo Top [Darjeeling District]: see above), 12,000ft, *J. D. Hooker* s.n. (K).

The differences between subsp. *fusiformis* and subsp. *finitima* are as follows:

1. Leaves and bracts long and narrow (occasionally broad), gradually tapering to apex; longest leaves 24–42cm x (1.8–)2.5–7(–12.7)mm, rather weak, often with patches of puckering; lowest bract sheath 2–3(–4.5)cm; extreme bases of leaf sheaths chestnut to reddish-brown; male glumes tapering to acute apex; beak of utricle over 2mm _____ subsp. **fusiformis**

\+ Leaves and bracts short and broad, rather abruptly contracted below apex; longest leaves 11–22cm x [4–]5.5–7.2mm, rather stiff, never with puckering; lowest bract sheath 3–7.5cm; extreme bases of leaf sheaths intense reddish-purple; male glumes with broad, obtuse apices; beak of utricle under 2mm _____ subsp. **finitima**

C. fusiformis subsp. *fusiformis* – representative specimens

INDIA: NW Himalaya, *Watt* 5365 (E). Mussoorie, *Royle* 88 (lecto. LIV, isolecto. K).
NEPAL: Foot of Deorali Danda, Simbua Khola, 2920m, 22 ix 1989, *KEKE* 879 (E, K).
SIKKIM/DARJEELING: Lachen, 11,000ft, 11 vi 1849, *Hooker* s.n., (BM, K); Sundukphoo, 10,000ft, 6 vi 1884, *Clarke* 35059 (K).
BHUTAN: Drugye Dzong, 10,000ft, 12 v 1949, *Ludlow, Sherriff & Hicks* 16210 (BM).
CHINA (Sichuan): Tien-chuan-hsien, 2400m, 27 v 1936, *Chu* 2655 (E).
CHINA (Yunnan): Dali Xian, Diancang Shan Range, 2900–3300m, 18 vii 1984, *Sino-American Bot. Exped.* 1098 (E).

C. fusiformis subsp. *finitima* – specimens seen (all)

INDIA (Himachal Pradesh): Marsh above Manali, 16 vi 1888, *Drummond* 24158, (E, K); Kulu, 1888, *Drummond* 24157 (E, K).
E NEPAL: Sankhuwa Sabha District, Kosi Zone, Gai Kharka, Kasua Khola (16 km N of Num), 3172m, 16 vi 1974, *Emery* 75 (K).
SIKKIM: [probably Tonglo Top], *Hooker* s.n. (K, BM).

Carex fastigiata

A comment is required on the Hooker specimens from Lachen referred to by Boott (1858) as '*C. fusiformis* var. ß' but only given the ms. name 'var. *polystachya*' on one of the sheets. These unfortunately are immature but are exceptional plants with wide (0.8–1.3cm) leaves, long spikes and female glumes c.5mm. They are uncommonly like a Nepal specimen (*Stainton, Sykes & Williams* 6062, BM, E) identified by Koyama (1978) as *C. fastigiata* Franchet, a species described from China. The Nepal plant agrees with *C. fastigiata* vegetatively and in having gynaecandrous terminal spikes whereas the Sikkim plants have male terminal spikes. However, this character is likely to be variable and too much weight should probably not be placed on the distribution of sex in a single specimen. Clarke comments 'terminal [spike] not rarely female in the middle' for *C. finitima*. If these collections represent the same taxon (merely varying in sex of terminal spike), they both differ from *C. fastigiata* in length of spikes and size of glumes and might well represent an undescribed taxon, but further collections are needed.

It should be noted that *C. fastigiata* exactly matching Yunnan specimens is reported (*Noltie* 138, E) for Bumthang in central Bhutan – a new record for the country. Interestingly it occurred in a valley in which another Chinese species *(Iris bulleyana)* occurred; floristic links with SW China are much more likely in central Bhutan than in central Nepal.

SECTION TUMIDAE

Carex alopecuroides

Much confusion has surrounded the nomenclature and identity of the species *C. chlorostachys* and *C. alopecuroides* traditionally ascribed to D. Don (1825), but in fact (see Mabberley, 1980) the names were published earlier (1823) by Tilloch and Taylor. The former was, in any case an illegitimate homonym, for which Sprengel (1826) published the new name *C. doniana*, as well as publishing an unnecessary new name *(C. emodorum)* for the latter.

Tilloch and Taylor's and Don's descriptions of the two species are inadequate, being based on immature specimens, and there has always been confusion over the correct application of the names. A further confusion was initiated by Boott (1860: 88 and t. 257) when he included *C. chlorostachys* in *C. japonica* Thunb., illustrating a Sikkim specimen under the latter name (source of plant not mentioned in text, but noted on the specimen at K). Boott retained *C. alopecuroides* as a (closely related) species. Boeckeler (1877: 283) took things a stage further giving *C. chlorostachys*, *C. doniana* and *C. alopecuroides* as synonyms of *C. japonica*, commenting that *C. alopecuroides* was a 'forma', though not recognizing it formally. Clarke (1894) followed Boott in referring Indian material to *C. japonica* (but evidently with reservations as he wrote 'Indian *C. japonica* is *C. chlorostachys* Don'!) of which he made *alopecuroides* a variety. Later (1903: 271) Clarke resolved the situation by abandoning the name *C. japonica* for Chinese and Indian plants and making the new var. *chlorostachya* (sic) of *C. alopecuroides* - adding 'I have taken Boott's Carex t. 257 as the 'type' of this variety, i.e. it is the most strongly marked form, and it was drawn from Boott's specimen of "C. doniana, Spreng."'- this figured specimen (labelled by Clarke as 'Carex alopecuroides D. Don var. chlorostachya C.B. Cl.' may thus be taken as the lectotype of the variety. Unfortunately, Kükenthal (1909) reverted to the older treatment and retained both *chlorostachys* and *alopecuroides* as distinct varieties of *C. japonica*. Koyama (1966) added to the confusion by raising var. *chlorostachys* to subspecific rank under *C. japonica*. Kern & Nooteboom (1979) correctly re-instated Clarke's 1903 treatment, stating the diagnostic characters of *C. japonica*, though they assigned at least the majority of the Malesian material to the wrong variety (see below).

Fortunately it is possible to resolve this confusion since specimens have been found at K which can serve as lectotypes for both of Don's names. Both were incorporated into Boott's herbarium from Don's own herbarium and are labelled '*C. alopecuroides*. Nipal' and '*C. chlorostachys*. Nipal'. Both are immature, but are obviously very similar to one another, differing chiefly in leaf-width (c.4.5mm versus 5.5–7mm). There is also a specimen at E from Don's herbarium ex herb. Menzies labelled 'Nepal Dr Wallich. Mr D. Don' and named in pencil (unknown writing) 'C. alopecuroides Don C. Emodorum Sp.' This has leaves 5mm wide and can be considered an isolectotype. As Clarke (1903) wrote, 'most of D. Don's own *C. chlorostachya* (sic) appears to be nearer *C. alopecuroides*, D. Don, between which and my variety b *chlorostachya* I see no good line.'

Material matching this description of var. *chlorostachya* has been seen from throughout the range of the species, but appears to be rarer than intermediates – suggesting that it is probably just an extreme growth form or ecotype. Field-work is obviously necessary to establish this, so it seems safer to retain them as varieties for the time being. It should be noted that most of the Malesian (Sumatra, New Guinea, Philippines) specimens seen belong to var. *alopecuroides* and not to var. *chlorostachya* as stated by Kern & Nooteboom (1979).

For full synonymy see Clarke (1903); the following is only to names referred to above.

C. alopecuroides [var. **alopecuroides**] D. Don ex Tilloch & Taylor in Phil. Mag. 62: 455 (1823) and Trans. Linn Soc. 14: 332 (1825). Lectotype (selected here): 'Nipal' ex herb Don & Boott (K); Isolectotype 'Nepal Dr Wallich. Mr D. Don' ex herb. Don and Menzies (E).

C. emodorum Sprengel, Syst. Veg. 3: 818 (1826) *nom. superfl.*

C. japonica Thunb. var. *alopecuroides* (D. Don) C.B. Clarke in Hooker f., Fl. Brit. India 6: 737 (1894).

var. **chlorostachya** C.B. Clarke in J. Linn. Soc. Bot. 36: 271 (1903). Lectotype (selected here): Rungeet, East Indies, iv 1850, *J.D. Hooker* s.n. ex herb. Boott, figured as t. 257 in Boott (1860) (K).

C. chlorostachys D. Don ex Tilloch & Taylor in Phil. Mag. 62: 455 (1823) and D. Don in Trans. Linn. Soc. 14: 330 (1825) non Steven in Mem. Soc. Imp. Nat. Moscou 4: 68 (1813). Lectotype (selected here): 'Nipal' ex herb Don & Boott (K).

C. doniana Sprengel, Syst. Veg. 3: 825 (1826).

C. japonica Thunberg var. *chlorostachys* Kük. in Engler, Das Pflanzenreich 38 (IV.20): 620 (1909).

C. japonica Thunb. subsp. *chlorostachys* (Kük.) T. Koyama in Hara, Fl. East Himalaya 382 (1966).

KEY TO VARIETIES:

1. Leaves 2.6–5.5(–7)mm wide; spikes 5–6mm wide at maturity; utricles 2.5–3.5 mm long, spreading to recurved, narrowly ovoid, slightly inflated, shortly tapered into short (under 1mm) beak; apex of beak weak, hyaline, shallow teeth often recurved _____ var. **alopecuroides**

\+ Leaves (5.5–)6–11mm wide; spikes fatter, 7–8mm wide at maturity; utricles 4–4.5 mm long, sub-erect to spreading, narrowly lanceolate, not inflated, gradually tapered into long (c.1.5mm) beak; apex of beak stout, erect, bidentate var. **chlorostachya**

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APPENDIX

Large genera are interesting to analyse phytogeographically since they represent an epitome of the floristic elements of the flora as a whole. Since external distributions are not given in the *Flora of Bhutan* it has been thought worthwhile to provide a list of species arranged according to their distribution type, which will also serve as an enumeration of the Bhutanese taxa:

1. Widespread N Hemisphere (Eurasia):
C. diandra Schrank, *C. echinata* Murray, *C. viridula* Michaux.

1a. Widespread (Eurasia) arctic-alpines:
C. atrata L., *C. atrofusca* Schkuhr, *C. microglochin* Wahlenb.

2. Central Asian:
C. orbicularis Boott.

3. Tibetan:
C. moorcroftii Falconer ex Boott, *C. montis-everestii* Kük., *C. praeclara* Nelmes.

4. Sino-Himalaya (occurring from NW Himalaya to SW China):
C. gracilenta Boott ex Boeck., *C. lehmannii* Drejer, *C. parva* Nees, *C. remota* L. subsp. *rochebrunii* (Franch. & Sav.) Kük., *C. setosa* Boott, *C. thomsonii* Boott.

4a. E Sino-Himalayan (occurring from E Nepal to SW China):
C. fastigiata Franch., *C. remota* subsp. *rochebrunii* (Franch. & Sav.) Kük., *C. speciosa* Kunth subsp. *dilatata* Noltie.

5. Himalayan (occurring from NW Himalaya to Bhutan):
C. condensata Nees, *C. desponsa* Boott, *C. duthiei* C.B. Clarke, *C. foliosa* D. Don ex Tilloch & Taylor, *C. fusiformis* Nees subsp. *finitima* (Boott) Noltie, *C. griersonii* Noltie, *C. haematostoma* Nees, *C. inanis* C.B. Clarke, *C. notha* Kunth, *C. obscura* Nees, *C. pseudofoetida* Kük., *C. psycrophila* Nees, *C. remota* L. subsp. *stewartii* Kukkonen, *C. setigera* D. Don.

5a. E Himalaya endemic (E Nepal, Bhutan, ± Khasia):
C. atrata L. var. *glacialis* Boott, *C. burttii* Noltie, *C. composita* Boott, *C. continua* C.B. Clarke, *C. crassipes* Boeck., *C. daltonii* Boott, *C. decora* Boott, *C. fragilis* Boott, *C. fucata* Boott ex C.B. Clarke, *C. anomoea* Hand.-Mazz., *C. inclinis* C.B. Clarke, *C. insignis* Boott, *C. laeta* Boott, *C. laeta* Boott subsp. *gelongii* Noltie, *C. munda* Boott, *C. nigra* (L.) Reichard subsp. *drukyulensis* Noltie, *C. obscuriceps* Kük., *C. polycephala* Boott, *C. pulchra* Boott, *C. radicalis* Boott, *C. rubro-brunnea* C.B. Clarke, *C. schlagintweitiana* Boeck. subsp. *deformis* Noltie, *C. speciosa* subsp. *pinetorum* Noltie, *C. vesiculosa* Boott.

6. SE Asian (Peninsular India, Malesia, China, ± Japan):
C. alopecuroides D. Don ex Tilloch & Taylor, *C. baccans* Nees, *C. breviculmis* R. Br. subsp. royleana (Nees) Kük., *C. cruciata* Wahlenb., *C. filicina* Nees,

C. fusiformis Nees, *C. hebecarpa* C.A. Meyer, *C. indica* L., *C. jackiana* Boott, *C. lenta* D. Don, *C. longicruris* Nees, *C. longipes* D. Don ex Tilloch & Taylor, *C. myosurus* Nees, *C. nubigena* D. Don ex Tilloch & Taylor, *C. oedorrhampha* Nelmes, *C. oligostachya* Nees, *C. olivacea* Boott, *C. phacota* Sprengel, *C. pruinosa* Boott, *C. rara* Boott, *C. speciosa* Kunth, *C. stramentita* Boott ex Boeck., *C. teres* Boott.

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NOTES RELATING TO THE FLORA OF BHUTAN: XXII
Asparagaceae: *Asparagus filicinus* and Convallariaceae: *Maianthemum oleraceum*

H. J. NOLTIE

The variability of *Asparagus filicinus* Buch.-Ham. ex D. Don in the Sino-Hiamalayan region is discussed; the typical variety of this species has been generally misinterpreted. Three varieties are here treated and lectotypified: var. *filicinus*, var. *giraldii* C.H. Wright and var. *lycopodineus* Baker. The new combination *Maianthemum oleraceum* (Baker) Hook. f. & Thoms. ex Hook. f. var. *acuminatum* (Wang & Tang) Noltie is made.

Asparagus filicinus

A. filicinus Buch.-Ham. ex D. Don is a well-known and widespread Sino-Himalayan taxon. It is very variable and numerous varieties have been described at various times by Baker, J. D. Hooker, Wright and Wang & Tang. Variation is found particularly in the width and length of the cladodes and most authors have placed great weight on this character which appears not to be of taxonomic significance; it is suggested that pedicel length, number of cladodes per whorl in the ultimate branchlets and flower position are more useful diagnostic characters.

On looking at a large quantity of herbarium material at K, BM and E it is concluded that Baker was correct in treating *A. filicinus* as a single species with varieties, since although there are nodes of variation which would appear at first sight to be worthy of specific rank, there are many intermediates; subspecific rank might perhaps be appropriate for the taxa but since the plants are not well-known in the field, nor the ecology or control of the variation understood, it seems wisest to take a conservative approach for the sake of taxonomic stability. Unfortunately it emerges that Baker and subsequent authors have misunderstood Don's name and some resulting changes in the varietal names are necessary.

TYPIFICATION OF *A. FILICINUS*

A. filicinus was based on a Buchanan-Hamilton specimen from Nepal and published by Don (1825). Unusually for species described in this work an unambiguous type exists in BM labelled 'Asparagus filicina B Semba 2d June 1802' in Hamilton's writing and 'Napaul Dr Buchanan' in what is probably Don's writing. The specimen has the following diagnostic characters: cladodes inserted mainly in whorls of 5, falcate, to 10 x c. 0.7cm; pedicels very short (lower part c. 0.8mm, upper part c. 1.5mm), flowers c. 2.3mm long. The short pedicels are specifically mentioned in the protologue 'pedicellatis [sic] folio brevioribus'. Unfortunately, Baker (1875) seems to have ignored this and seems not to have seen the type and, therefore, misunderstood the species. He took the typical variety of the species to be the more widespread and common form with long pedicels, and described two short-pedicelled forms as var. *brevipes* and var. *brevifolius*. Hooker described a further variety with short pedicels (var. *microclada*) which is merely an immature state with cladodes that are not fully developed. Baker's concept has been

followed by subsequent authors including Hooker (1892) and Wang & Tang (1937, 1978).

The following synonymy can be made:

A. filicinus Buch.-Ham. ex D. Don, Prodromus Fl. Nep. 49 (1825).

Syn.: *A. filicinus* var. *brevipes* Baker in J. Linn. Soc. Bot. 14: 605 (1875). Lectotype (selected here): Khasia, 3–4,000ft, *Hooker f. & Thomson* s.n. (K).

A. filicinus var. *brevifolius* Baker in J. Linn. Soc. Bot. 14: 605 (1875). Lectotype (selected here): Khasia, Syong, 5–6,000ft, 4 vii 1850, *Hooker f. & Thomson* s.n. (K).

A. filicinus var. *microclada* Hook. f., Fl. Brit. India 6: 315 (1892). Lectotype (selected here): Assam, 1829, *Masters* s.n. (K).

Distribution: Nepal; Sikkim; Bhutan; NE India (Arunachal Pradesh, Nagaland, Meghalaya); Burma; China (Yunnan: *Henry* 12181, 12181A & B, 9865. Few specimens seen – apparently rare).

This variety is, in number of cladodes per whorl, cladode width and flower position, somewhat intermediate between the two following varieties (var. *giraldii* and var. *lycopodineus*).

LONG-PEDICELLED FORM

From the above it can be seen that a name is required for the long-pedicelled form at varietal rank. The earliest available name seems to be var. *giraldii* C.H. Wright, described from China.

A. filicinus var. **giraldii** C.H. Wright in Gardeners' Chronicle 44: 122 (1908). Lectotype (selected here): China, in monte Tui-kio-tsan, Shensi sett[entrionale], floruit in Horto bot.florentino, Majo 1898, *Giraldi* 5 (on same sheet as *Giraldi* 3, 4) (K).

[*A. filicinus* [var. *filicinus*] sensu Baker etc., non D. Don]

A. filicinus var. *megaphylla* Wang & Tang in Bull. Fan Mem. Inst. 7: 290 (1937) (merely a form with very large cladodes)

Distribution: Pakistan; Kashmir; India (Himachal Pradesh, Uttar Pradesh); Nepal; Bhutan; China (Yunnan, Sichuan, Kansu, Tibet, Hubei, Shensi).

A. FILICINUS VAR. *LYCOPODINEUS*

The epithet *lycopodineus* was coined by Wallich but first validly published at varietal rank by Baker (1875) citing specimens from NE India. Its characteristics are having flowers restricted to the base of the ultimate branches, short pedicels, and cladodes inserted in threes. Forms with very broad cladodes occur (especially in China) and were described by Wang & Tang (1937) as var. *sessilis* under *A. lycopodineus* (thereby, but without clearly so stating, raising the latter to specific rank). However, there are too many intermediate specimens to follow their treatment, although they are clearly correct in their later account (Wang & Tang, 1978) in distinguishing long- from short-pedicelled

forms. The latter (for the reasons given above) they called *A. filicinus* [s.s.] and the latter *A. lycopodineus* (under which they included var. *brevipes* and their var. *sessilis*).

Asparagus filicinus var. **lycopodineus** Baker in J. Linn. Soc. Bot. 14: 605 (1875). Lectotype (selected here): Arunachal Pradesh, Mishmee, *Griffith* HEIC 5854 K).

A. lycopodineus (Baker) Wang & Tang in Bull. Fan Mem. Inst. Biol. 7:291 (1937) and Fl. Reip. Pop. Sinicae 15(2):105 (1978)

A. lycopodineus var. *sessilis* Wang & Tang in Bull. Fan. Mem. Inst. Biol. 7:291 (1937)

Distribution: Sikkim, Bhutan, NE India (Nagaland, Arunachal Pradesh); Burma; China (Sichuan, Kweichow, Yunnan).

It should be noted that Handel-Mazzetti (1936) included both short and long pedicelled forms in his concept of var. *lycopodineus*, relying solely on cladode width to distinguish the variety.

KEY TO TAXA

1. Pedicels longer than cladodes, evenly spaced along ultimate branchlets; cladodes in whorls of 4 to 7 _____ **A. filicinus** var. **giraldii**
+ Pedicels shorter than cladodes, restricted to base of ultimate branchlets _____ 2

2. Cladodes wide (over 1.2mm), strictly in whorls of 3; stems erect; flowers large (c. 4mm long) _____ **A. filicinus** var. **lycopodineus**
+ Cladodes narrow (commonly under 1mm), almost always in whorls of 4 or 5; stems often flexuous; flowers smaller (under 3.5mm long) **A. filicinus** var. **filicinus**

Maianthemum oleraceum

When La Frankie (1986) transferred all the species of *Smilacina* Desf. to the genus *Maianthemum* G.H. Weber, he did not deal with any infra-specific taxa. Hara, just before his death, had nearly completed a revision of the Asiatic species of *Smilacina*, which was published posthumously (Hara, 1987). Hara did treat infraspecific taxa, but had not seen La Frankie's paper, and therefore several infraspecific combinations remain to be made.

As in other genera of Himalayan Convallariaceae (especially *Ophiopogon* and *Polygonatum*), *Maianthemum* species are extremely variable defying easy taxonomic treatment, with clearly marked forms being linked by intermediates and discrete taxonomic entities almost impossible to define. The ESIK expedition to W Sikkim in 1992 provided an opportunity to study the variability of two species of *Maianthemum* in the field. It was found that *M. purpureum* (Wall.) La Frankie occurred over a wide altitudinal range, and merely decreased in size with altitude. The dwarf, high altitude, form was originally described as *Tovaria oligophylla* Baker and reduced to a forma of *S. purpurea* by Hara; but this sort of clinal variation seems not to be worth recognizing taxonomically. In contrast, the pattern of variation in *M. oleraceum* (Baker) La Frankie was found to be different. In fir forest up to 3400m, the typical form with dense panicles of white or mauve-flushed flowers and a straight inflorescence axis occurred. Above this altitude,

the typical form was replaced by a strikingly beautiful one with flowers varying from dark claret-coloured to almost black (a particularly dark form, hopefully introduced into cultivation, being given the informal name in the field of 'McBeath's Glory') this also differed in having more open inflorescences arranged on a zig-zag axis.

Examination of herbaria reveals that these striking field-differences are less distinct after drying. Specimens with poor notes on flower colour, and ones collected in fruit, cannot be identified with certainty. Intermediate specimens, with pale flowers but open panicles, also seem to occur. Further work is clearly needed to investigate the control of such variation, but in the meantime it is worth recognizing the dark-flowered form, originally described as *S. oleracea* var. *acuminata* Wang and Tang. Hara reduced this to a forma, but as the distinction seems to be related to altitude, varietal status seems more appropriate, and thus the new combination is needed:

Maianthemum oleraceum (Baker) Hook. f. & Thoms. ex Hook. f. Fl. Brit. India 6: 323 (1892) var. **acuminatum** (Wang and Tang) Noltie, **comb. nov.**

Smilacina oleracea var. *acuminata* Wang & Tang in Bull Fan Mem. Inst. 7: 288 (1937). Type: Chumbi, Yatung, *H.E. Hobson* s.n. (holo. K).

Specimens of this variety have been seen only from E Nepal, Bhutan and Chumbi, whereas var. *oleraceum* extends further east into N Burma, NW Yunnan, Sichuan and Kweichou.

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NOTES RELATING TO THE FLORA OF BHUTAN: XXIV
Juncaceae

H. J. NOLTIE*

The following new taxa, combinations and synonymy in the genus *Juncus* from E Himalaya and SW China are proposed: *J. bryophilus* Noltie *sp. nov.*; *J. spumosus* Noltie *sp. nov.*; *J. glaucoturgidus* Noltie *sp. nov.*; *J. hydrophilus* Noltie *sp. nov.*; *J. longiflorus* (A. Camus) Noltie *comb. & stat. nov.*; *J. duthiei* (C.B. Clarke) Noltie *comb. nov.* of which the following are synonyms: *J. rohtangensis* Aswal & Goel, *J. sikkimensis* Hook.f. var. *monocephalus* Hook.f. and *J. harae* Miyam. & H. Ohba; *J. bhutanensis* Satake is reduced to synonymy of *J. leucomelas* Royle ex D. Don, *J. pseudocastaneus* (Lingelsh.) Sam. to that of *J. sikkimensis*; *J. tratangensis* Satake to that of *J. ochraceus* Buchenau, *J. unifolius* A.M. Lu & Z.Y. Zhang to that of *J. minimus* Buchenau; *J. phaeocarpus* A.M. Lu & Z.Y. Zhang to that of *J. grisebachii* Buchenau; *J. longibracteatus* A.M. Lu & Z.Y. Zhang to that of *J. kingii* Rendle; *J. luteocarpus* Satake, the illegitimate *J. albescens* Satake and *J. yoskisukei* Goel to that of *J. concinnus* D. Don and *J. bracteatus* Buchenau to that of *J. benghalensis* Kunth.

J. perpusillus Sam. is reported new to Sikkim and Nepal; *J. amplifolius* A. Camus new to Bhutan, Sikkim and Nepal; *J. trichophyllus* W.W. Sm. new to Nepal and Bhutan; *J. nepalicus* Miyam. & H. Ohba new to Sikkim. *J. uniflorus* W.W. Sm. is lectotypified. Notes on *J. spectabilis* Rendle and *J. biglumoides* Hara are given.

INTRODUCTION

The E Himalaya and SW China are rich in species of *Juncus*, with 37 occurring in the area covered by the *Flora of Bhutan*. These species have been relatively little studied since the monograph of Buchenau (1906), though Camus (1910) added significantly to our knowledge of the Chinese species, as did Samuelsson, who accurately determined many herbarium sheets and wrote the very useful account in Handel-Mazzetti (Samuelsson, 1936). There is a comprehensive treatment (in Chinese) in the *Flora of Tibet* (Lu & Zhang, 1987), but the genus has not yet been revised for the *Flora Reipublicae Popularis Sinicae*. The unattributed listing of Nepalese species (in Hara et al., 1978) does not pretend to be critical. The accounts for the E Himalaya by Satake (1966, 1971, 1975) are useful, but he, along with other recent authors, has unfortunately tended to describe new species without adequately investigating the literature and herbaria. Types of most of the species recently described from the area have been examined and many found to have been described previously.

Great difficulties are encountered in identifying herbarium specimens of Himalayan *Juncus*, especially those belonging to subgenus *Alpini* (sensu Buchenau). There are various reasons for this: many old sheets contain mixed gatherings (with up to four species on a single sheet!); the reliability of the much-used character of presence/absence of upper stem leaf is unclear, and is certainly variable in some species. Field trips to Nepal, Sikkim and Bhutan have been illuminating, though many problems still remain and will probably only yield to biosystematic

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methods. For instance, it is almost certain that hybridization (known to be common in the genus) occurs among these alpine species, with many species cohabiting (e.g. in a flush at Dzongri, Sikkim eight species were found growing in close proximity). Some species are difficult to identify in the field (where it is difficult to cut leaf sections) and it is essential to look at whole populations. It is not always possible to be certain of the identity of individual specimens due perhaps to hybridization or the existence of atypical forms (e.g. single-headed forms of normally multiple-headed species, stunted forms at high altitude, forms of species such as *J. concinnus* with highly compound inflorescences). Work is needed to explain this variation.

The following precursor notes necessary for the account in the *Flora of Bhutan* are arranged approximately in the order of Buchenau's monograph which, although very out-of-date (1906), is the most recent generic monograph and does not include the species described by Camus (1910). Much work is required to produce a usable infrageneric treatment, Buchenau's being largely informal with no names given to sections, and several of the taxa discussed below suggest that two of his subgenera are not clearly distinct.

SUBGENUS ALPINI

(A) Species with a single terminal 'capitulum' of white flowers and usually tubular septate leaves (corresponding to sections 46, 49 and 50 of Buchenau).

J. leucomelas Royle ex D. Don in Trans. Linn. Soc. Lond. 18: 319–20 (1840).

Syn.: *J. bhutanensis* Satake in J. Jap. Bot. 43: 382–4 (1968). Holotype: Barshong to Nala, 3100–3500m, 25 v 1967, *Kanai et al.* 6201 (TI!).

Examination of the holotype of *J. bhutanensis* shows it to be synonymous with the well-known, though apparently rare, Sino-Himalayan *J. leucomelas* Royle ex D. Don, typical in its leafless stem and leaf sheaths lacking apical auricles. It is atypical of mature *J. leucomelas* in having short filaments (about equalling the anthers), but as in all Junci the relative lengths of anther to filament depends on the age of the flower. In *J. leucomelas*, the characteristically long (over 2mm) anthers are completely exserted from the tepals at maturity — but this specimen is immature and the filaments have not yet lengthened. The characters given in the description distinguishing it from *J. thomsonii* Buchenau and *J. leucomelas*, viz. flowers pedicellate, long lowermost bract and broad tepals, are of no relevance, being as expected for *J. leucomelas*. Satake later (1971) identified fruiting specimens from Darjeeling District as belonging to *J. bhutanensis* and augmented his description; however, these belong to *J. benghalensis* Kunth. *Juncus benghalensis* and *J. leucomelas* are very similar, though the blunt, often brown leaf-sheath auricles are diagnostic of the former. The stem leaf is always absent in *J. leucomelas* but may be present or absent in *J. benghalensis.*

Juncus perpusillus Sam. in Hand.-Mazz., Symb. Sin. 7: 1237–8 (1936). Holotype: China, Sikang, Taofu (Dawo) District, Haitzeshan, ad rupes calcareas, 4400–4600m, 31 viii 1934, *H. Smith* 11684 (UPS!).

A dwarf alpine rush found at Chaunrikiang, Sikkim was discovered to belong to the little-known Chinese taxon *J. perpusillus* Sam. This species was based on a single gathering from Sichuan

(Sikang) China, representing a particularly reduced form with a 1–2-flowered inflorescence; it was also collected late in the season when the white tepals had (as in all the alpine species) become suffused with dark purplish pigmentation. The description and distribution can thus be expanded as follows.

Rhizomes very short, stout, covered with dark brown scales, plant densely tufted. *Flowering stems* 1.5–8cm, setaceous. *Leaves* bitubular, filiform, stem leaf sheaths with conspicuous, often reddish-brown auricles, upper stem leaf present or absent, basal stem leaf with dark, purplish-brown sheath. *Capitula* (1–)2–4-flowered. *Bracts* chestnut, lowermost often with leaf-like point exceeding inflorescence. *Tepals* 3–4.5 × 1mm, oblong, blunt, initially white, becoming suffused dark purplish. *Filaments* exceeding tepals at maturity, anthers 1.5–2mm. *Stigma lobes* c.0.5mm, spreading. *Capsule* 2.5–3 × 1.5–2mm, oblong-ellipsoid, abruptly contracted into beak, 1–1.5mm.

Very close to *J. benghalensis*, especially in its bitubular leaves, the usually long, leaf-like lowest bract and the conspicuous leaf-sheath auricles, but differing in its very dwarf stature (inflorescence sometimes reduced to 1 or 2 flowers) and its short, branched rhizomes giving rise to dense clumps, rather than having stems borne singly and spreading by very slender stoloniferous rhizomes.

Other specimens seen:

SIKKIM. Above Chuanrikiang, near foot of E Rathong Glacier, 4550m, 14 vii 1992, *ESIK* 375 (E).

NEPAL. Gosainkund Lake, 4250m, 14 viii 1974, *De Haas* 2252 (BM). Rocks N of Gosainkund Governmental House, 4500m, 12 viii 1974, *De Haas* 2222 (BM). Lau, 4600m, 25 vii 1974, *Yon* 243 (BM).

J. trichophyllus W.W. Sm. in Rec. Bot. Surv. India 6: 103 (1914).

A very distinctive species, bearing curious viviparous bulbils in the axils of the bract-like stem leaves. Until recently known only from the type collections from Sikkim, recently found in E Nepal and Bhutan. Related to *J. cephalostigma* Sam., with which it was possibly hybridizing at Dzongri.

Specimens seen:

NEPAL. Ridge near Kauma, S of Shipton La, 3540m, 26 ix 1991, *EMAK* 294 (E). Tributary on N side of Barun Khola opposite Shipton La, 4200m, 10 x 1991, *EMAK* 653 (E).

SIKKIM. Changu, 13,000ft, 16 vii 1910, *Smith* 3502 (K, isosyntype). Locality unknown, 1889, *King's Coll.* s.n. (K, isosyntype). Between Jamlinghang and Bikbari, 3800m, 11 vii 1992, *ESIK* 234 (E). Dzongri, 4000m, 16 vii 1992, *ESIK* 431 (E). Phedang and Laxmi Pokhri, *ESIK* — field records.

BHUTAN. Ridge above Phajoding, 4060m, 30 vii 1991, *Noltie* 66 (E). Above Ragyo, N of Paro, 3890–3960m, 3 viii 1991, *Noltie* 95A (E). Below Ju La, 4080m, 11 viii 1991, *Noltie* — field record.

J. spectabilis Rendle in J. Bot. Lond. 44: 46 (1906). Holotype: Tibet, Gyantse, *Walton* 69 (BM!; iso. K!).

Bhutanese specimens identified as *J. spectabilis* in the herbarium were found to belong to *J. allioides* Franch., in which the (normally present) upper stem leaf was lacking. The type of *J. spectabilis* was examined and found to be worth retaining as a species, despite a determination by Egorova on one of the specimens stating it to be *J. thomsonii* Buchenau. *J. spectabilis* has the appearance of a large *J. thomsonii* and agrees in its leaf morphology (pluritubular, with up to three

thin longitudinal septa and many weak transverse septa). The flowers, however, are much larger (tepals 5.8–6.5mm; anthers 2.2–2.5mm) and in this it resembles *J. allioides.*

Another Tibet specimen (Rongshar Valley, 13,000ft, *Hingston* 35, K) has characters intermediate between *J. thomsonii* and *J. allioides* (no upper stem leaf and anthers under 2mm as in the former; leaves unitubular with strong transverse septa and long tepals over 5.5mm as in the latter). These two specimens again raise the question as to whether hybridization might be occurring.

Juncus glaucoturgidus Noltie, **sp. nov.**

A *J. allioide* Franchet foliis caulibusque multo crassioribus, foliis turgidis erectis glaucis septis paucis distantibus debilibus in sicco externe haud manifestis, folii caulinis inferioris auriculis minutis, bracteis latioribus differt. **Fig. 1A–E.**

Rhizome system condensed, stems densely tufted. *Flower stems* 10–25cm; upper part of stem bearing a leaf-like bract (sheath 3.5–5cm, tubular, apex with membranous, subacute auricles to 2.2mm, blade bristle-like to 6.5 mm); lower part sheathed with numerous scale leaves. *Scale leaves* dull, straw-coloured, darker at centre, paler at margins, minutely apiculate. *Stem leaf* single, sub-basal, shorter than stem (5.5–12.5cm), 2–3.5mm diameter, suberect, glaucous, cylindric, hollow, constricted below the blunt apex, with few, distant, weak, transverse septa, not visible externally even when dry, sheath short, with minute auricles (under 1mm). *Non-flowering shoots* with a single leaf usually equalling stems and similar to stem leaf. *Inflorescence* a terminal c.12-flowered capitulum to 2cm diameter; bracts forming an 'involucre', subequal, longest 15–22 × 7–8mm oblong-ovate, acute, dark reddish-brown, paler at margins. *Flowers* shortly (to 3mm) pedicelled; tepals cream, outer 6–6.5 × 1.4–1.7mm, oblong-lanceolate, subacute, keeled, inner not keeled, otherwise similar or slightly longer. *Filaments* slightly shorter than tepals; anthers 2–3.4mm, narrowly oblong, pale yellow, exserted. *Ovary* 2.5–3 × 1.2–1.9mm, ellipsoid, abruptly contracted into style (2–2.7mm); stigma lobes 1–1.5mm, stout, cream, erect. *Capsule* 4–4.5 × 2.5mm, ellipsoid, golden brown, beak 1–1.5mm.

Type: Sikkim, Samiti Lake (Bungmoteng Chho), 4300m, 21 vii 1992, *ESIK* 572 (holo. E, iso. K).

Other specimens seen:

NEPAL. Kyangin Kharka area, 12–14,000ft, 18 vii 1967, *Malla* 9197 (BM).

BHUTAN. Kantanang, Tsampa, 13,000ft, 3 vi 1949, *Ludlow & Sherriff* 19042 (BM).

A very distinctive species due to its swollen, erect, glaucous leaves and large capitula with very wide bracts. In Sikkim it grew above the tree-line on an open, sandy, probably calcareous slope, with vegetation noticeably differing from its surroundings. Associated species — Dwarf shrubs: *Cotoneaster microphyllus, Cassiope fastigiata, Juniperus indica, Bistorta macrophylla, Ephedra gerardiana, Rhododendron lepidotum, Potentilla arbuscula.* Herbs: *Kobresia nepalensis, K. stiebritziana, Carex haematostoma, Fritillaria cirrhosa, Aletris pauciflora, Polygonatum hookeri, Lilium nanum* var. *nanum, Ponerorchis chusua, Corydalis ecristata, Chesnya* sp., *Androsace lehmannii, Acanthocalyx* sp.

FIG. 1. *Juncus glaucoturgidus* Noltie (*ESIK* 572). A, habit; B flower (× 3); C, ovary (× 3); D, stigma (× 12); E, capsule (× 5). *J. bryophilus* Noltie (*Sinclair & Long* 5217b). F, habit (*ESIK* 698); G, flower (× 8); H, ovary (× 8); I, stigma (× 16); J, capsule (× 8); K, seeds (× 12).

(B) Species with brown flowers and tubular, septate leaves included under Buchenau's section 52 (i.e. *Juncus sikkimensis* and allies).

J. sikkimensis Hook.f., Fl. Brit. India 6: 399 (1892).

Syn.: *J. pseudocastaneus* (Lingelsh.) Sam. in Hand.-Mazz., Symb. Sin. 7: 1230 (1936).

J. pseudocastaneus was described as being distinct from *J. sikkimensis* in having visibly septate leaves, long stolons, persistent bases of old leaves and yellow-brown (rather than red-brown) leaf sheaths. On studying the types of *J. sikkimensis* and a large number of specimens from C Nepal to Sichuan it is found that none of these characters are consistently correlated, and *J. pseudocastaneus* must be regarded as a synonym of *J. sikkimensis*.

Juncus longiflorus (A. Camus) Noltie, **comb. & stat. nov.**

Basionym: *J. sikkimensis* Hook.f. var. *longiflorus* A. Camus in Notulae Systematicae 1: 283 (1910). Lectotype (chosen here): Lieux humides ou peu ombragés du Tsang-chan, alt. 4000m, 27 juin 1887, *Delavay* 2806 (P!).

J. sikkimensis var. *longiflorus* A. Camus described from Yunnan is clearly distinct from *J. sikkimensis* and should be raised to specific rank. It has much larger flowers, is always single-headed, has longer leaves (± equalling stems), and more slender, very densely tufted stems, with conspicuous fibrous remains of shining yellowish-brown leaf sheaths at the base. S.Y. Hu realised this and annotated the specimens at P accordingly but did not publish either the lectotypification or the new combination. It appears to be restricted to Yunnan, but is omitted from *Index Flora Yunnanensis* (Wu, 1984).

J. sikkimensis Hook.f. var. *monocephalus* Hook.f.

There has been much confusion over the Himalayan taxon described as *J. sikkimensis* Hook.f. var. *monocephalus* Hook.f. and referred to by Samuelsson (1936) in a note under *J. pseudocastaneus*, of which he took it to be a slender, few-flowered geographical race. Part of this confusion has come about due to the great variability in the plant's stature. From herbarium studies of a large range of specimens it became obvious that the taxon was worth recognizing at specific rank, and recent fieldwork has confirmed this. It has, in fact, been described three times at specific rank, the earliest being as the type of a genus in Cyperaceae! For further details of this confusion see Simpson & Noltie (1995).

The following new combination and synonymy is therefore necessary, and since the type represents a rather extreme, depauperate form, an amended description is provided.

Juncus duthiei (C.B. Clarke) Noltie, **comb. nov.**

Basionym: *Microschoenus duthiei* C.B. Clarke in Hooker, Fl. Brit. India 6: 675 (1894). Holotype: Uttar Pradesh, Rhudughera, Tihri Garhwal, 15–16,000ft, 20 vii 1882, *Duthie* 132 (K, iso. CAL).

Syn.: *J. rohtangensis* Goel & Aswal in Indian J. For. 10: 262 (1987). Holotype: Himachal Pradesh, Lahaul-Spiti District, Rohtang Pass, 4000m, 27 vii 1979, *Aswal* 10554A (CDRI n.v.); iso. *Aswal* 10554E (CAL!).

J. harae Miyam. & H. Ohba in J. Jap. Bot 68: 27 (1993). Holotype: E Nepal, Koshi Zone, Sankhuwa Sabha District, Sano Pokhari — Khongma, 3850m, 12 viii 1990, *Minaki et al.* 9020853 (TI!).

J. sikkimensis Hook.f. var. *monocephalus* Hook.f., Fl. Brit. India 6: 399 (1892) (as *monocephala*). Type: Sikkim, Lachen, 12,000ft, 20 vi 1849, *Hooker* Juncus 19 (K!).

Rhizomes short, slender, c.1.5mm diameter. *Flower stems* 2–25cm. *Scale leaves* pale brown, not shining, the upper apiculate, becoming fibrous on decay. *Stem leaf* usually 1, sub-basal; blade 1.5–7.5cm (tip reaching half-way up stem or more), 0.3–1.4mm wide, unitubular and septate (visible in well-developed specimens), slightly contracted below blunt apex, sheath with brownish membranous margins carried upwards as free auricles. *Auricles* 0.1–1.1mm long, blunt, oblong, transparent or sometimes brown, apparently sometimes decaying and so not visible. *Inflorescence* a single head of (1–)2–3 shortly pedicellate flowers (if flower single then sessile), which usually appear to be lateral. *Lowest bract* 0.5–3.5cm, leaf-like, exceeding to much longer than flowers, usually erect (sometimes spreading), with brown sheathing base. *Upper bract(s)* ovate to lanceolate. *Tepals* reddish-brown to blackish, sometimes with paler tips and greenish midribs, narrowly lanceolate, the inner narrower than the outer and with narrow membranous margins, all gradually tapered to acute apex, rather irregular in length even in a single specimen; (3–)5.0–7.7mm long. *Stamens* shorter than tepals; anthers linear, becoming twisted, cream 1.2–3.5(–4.0)mm, longer than filaments (0.4–1.2mm). *Ovary* ellipsoid- to oblong-trigonous, 1.3–2.2mm long; style stout, 1.5–4.0mm; stigma lobes very fine, ± erect, sometimes twisted, long, red (2–)5.0–9.0mm. Capsule (1.4–)2.5–3.5(+?)mm, narrowly ellipsoid-trigonous, contracted into short exserted beak 0.6–1mm. Seeds 0.6–0.7mm, with short tails at both ends, total length 0.7–0.8mm. Inflorescence occasionally reduced and proliferating.

Distribution and habitats: Himachal Pradesh, Uttar Pradesh, Nepal, Sikkim, Chumbi, Bhutan, SE Tibet. An alpine species occurring above the tree-line on open grassy slopes, streamsides, damp turf, rock ledges, wet sand and on rocks, 3000–4877m. June–July (fl.).

Other specimens seen:

KUMAON. Barji Kang Pass, 14,000ft, viii 1848, *Strachey* 7 (K).

C NEPAL. Lari, 4650m, 6 vii 1974, *Yon* 107 (BM). Muktinath, 3962m, 26 vi 1954, *Stainton, Sykes & Williams* 1451 (BM, E). Above Sauwala Khola, 3962m, *Stainton, Sykes & Williams* 3582 (BM, E). Langtang Valley, 4572m, vi 1949, *Polunin* 626 (BM). Dhudkund, 6 ml E of Timure, 4724m, 5 vii 1949, *Polunin* 810 (BM). 5 ml E of Timure, 4115m, 3 vii 1949, *Polunin* 801 (BM). Shiar Khola, W of Chumje, 3810m, 29 vi 1953, *Gardner* 1016 (BM). NE of Gosainkund, 4600m, 15 viii 1974, *De Haas* 2275 (BM). Tharepati, N of Kathmandu, 3200m, *Grey-Wilson & Phillips* 163 (K).

E NEPAL. Makalu Base Camp, 4728m, 8 vii 1974, *Emery* CH 25 (K). Bhalukhop, 4110m, 24 vii 1971, *Shrestha & Joshi* 292 (BM). By Hongu Khola, 4267m, 2 vii 1964, *McCosh* 353 (BM). Shipton La, 4030m, 27 ix 1991, *EMAK* 356b (E). Upper Barun Khola above Mera, 4460m, 4 x 1992, *EMAK* 532 (E). Base of Upper Barun Glacier above Makalu Base Camp, 4720m, 7 x 1991, *EMAK* 561 (E). Near Lapsang, Simbua Khola, 4270m, 19 ix 1989, *KEKE* 760 (E). Between Tamo La and Sinion La, 4000m, 15 ix 1989, *KEKE* 678 (E).

SIKKIM. Behind Tangu Bungalow, 4572m, 5 vii 1903, *Younghusband* T61 (K). Choktsu nr Jongri, 1887, *King's Coll.* s.n. (K). Dzongri, 4100m, 2 vii 1983, *AGSES* 268 (K). Above Changu, 3658m, 8 vii 1910, *Smith* 3202 (K, CAL, syntype of *J. uniflorus* — which is also on sheet). Chakung Chu, 3962m, 26 vii 1910, *Smith* 3854 (K, CAL, syntype of *J. uniflorus*). Tosa, 4267m, 2 viii 1910, *Smith* 4046 (CAL). Nathui La, 4267m, 14 vii 1910, *Smith* 3465 (CAL).

CHUMBI. NW Chumbi below Tang Kar La, 4267m, vi 1891, *Waddell* s.n. (K). N Chumbi (Upper Khangbu), 3962m, vi 1891, *Waddell* 73 (K). Dotha, 3962m, 20 vi 1945, *Bor & Ram* 20510 (K).

BHUTAN. Pajoding, above Thimphu, 3750m, 19 vii 1979, *Grierson & Long* 2785 (E). Above Phajoding, 3840m, 30 vii 1991, *Noltie* 62 (E). Below Darkey Pang Tso, N of Paro, 4020m, 4 viii 1991, *Noltie* 107 (E). Kemphu [Kamephu], 4267m, 14 vi 1938, *Gould* 463 (K). Above Laya, 4315–4480m, 21 ix 1984, *Sinclair & Long* 5203, 5229, 5217a (E). Koina [Kohina], 3000m, 28 vii 1983, *Sargent* 66 (E). Chesha [Kesha] La, 4267m, 27 vi 1949, *Ludlow, Sherriff & Hicks* 16647 (BM).

SE TIBET. Above Nyima La, 4877m, 4 vii 1938, *Ludlow, Sherriff & Taylor* 5128 (BM).

First collected in Sikkim, at Lachen by J.D. Hooker (Juncus 19, K and p.p. Juncus 13, K, mixed sheet with three other species). Fairly frequently recollected since that time in Nepal, Sikkim, Chumbi, Bhutan and SE Tibet, often correctly identified as *J. sikkimensis* var. *monocephalus* but very frequently misidentified as e.g. *J. sphacelatus*, *J. uniflorus*, etc.

Very variable in stature and in some respects intermediate between *J. sikkimensis* and *J. uniflorus*. Large specimens differ from *J. sikkimensis* in their more slender habit, the always single inflorescence with 3 or fewer flowers and above all in their long red (not yellow-green) stigmas. Dwarfed specimens differ from *J. uniflorus* in their flower(s) appearing lateral (due to lower bract usually being erect and conspicuously exceeding the inflorescence), usually more than one flower, but if only one then sessile (vs flower shortly pedicellate), leaves wider, erect, unitubular (vs filiform, often recurved, bitubular in section).

J. harae was recently described from E Nepal; examination of the type shows it to be a viviparous form of *J. duthiei*. Similar specimens were seen growing in Sikkim (*ESIK* 180, E) mixed with typical, non-viviparous, forms. It is not uncommon for the flowers of certain *Juncus* species (e.g. *J. wallichianus* Laharpe) to proliferate, though as stated by Miyamoto & Ohba (1993) the phenomenon has not been observed before in an 'alpine species'.

J. biglumoides Hara was based on fruiting material from C Nepal (Rambrong, Lamjung Himal, 12,000ft, 29 vi 1954, *Stainton, Sykes & Williams* 6029, holo. BM!). It resembles dwarf forms of *J. duthiei* but differs in flowering earlier, having smaller anthers (under 1.5mm), a creeping, linear rhizome and rather stout stems. Stigmas are unfortunately not present in the type specimen. The species is apparently a very local endemic; the other specimen (*Strachey* 7) tentatively referred to the taxon by Hara is here referred to *J. duthiei*.

J. uniflorus W.W. Sm. in Rec. Bot. Surv. India 6: 104 (1914). Lectotype (chosen here): Sikkim, Se-moo-do-ne about 2500ft below Zelep La, [3658m], 22 vi 1882, *King's Coll.* s.n. (K!).

J. uniflorus was first described informally (Smith, 1913) as 'sp. nov. vel forma minima *J. sikkimensis* Hook. f. var. *monocephalae*' and was stated 'to be connected to the variety *monocephala* by a series of intermediates'. All the syntypes have been examined with the exception of *Gammie* 202 (which could not be found at CAL) and all bear the name *J. uniflorus* in the hand of Wright Smith. Unfortunately the syntypes are found to contain two taxa. The identity of one of the elements with reduced forms of *J. duthiei* is clearly shown by the specimens on *Smith* 3465 at CAL which show a transition from very small single-flowered forms to typical *J. duthiei*.

Lectotypification is therefore needed, preferably to preserve the usage of the name *uniflorus* for the very dwarf, single, pedicellate-flowered, filiform-leaved plant which has been most commonly called *J. uniflorus* by subsequent workers (e.g. Samuelsson).

Unfortunately Wright Smith's initial description, and the later validating one (Smith, 1914), is confused and refers to both species (e.g. the descriptions of tepal colour and fruits refer to

the *J. duthiei* element). However, his statement (Smith, 1913) that it is the smaller plant that 'will have to be regarded as specifically distinct' and his annotations on the specimens are helpful since only two of the syntypes bear the annotation 'sp. nov. vel forma minima *J. sikkimensis* Hook. f. var. *monocephalae*', namely *King's Coll.* s.n. (K) and *Smith* 3202 (CAL). It thus appears that the taxon on these sheets represents the species he regarded as distinct and that he later broadened his concept too widely to include the other specimens. It cannot be coincidental that these sheets are the only ones of the syntypes which bear what I propose should be called *J. uniflorus* (though 3202 also bears *J. duthiei*). The other syntypes seen (*Smith* 3465, 3854, 4046) bear only *J. duthiei*. It therefore seems best to choose the King specimen as a lectotype.

J. uniflorus differs from reduced forms of *J. duthiei* in its paler (reddish-brown) tepals, pedicellate flowers, weak lower bract, recurved at flowering and filiform, recurved, bitubular leaves. It is almost invariably single-flowered but one specimen (*Bowes Lyon* 15098) has several two-flowered inflorescences.

Other specimens seen:

E NEPAL. S of Topke La, Arun-Tamur watershed, 3962m, 7 vii 1956, *Stainton* 872 (BM).

SIKKIM. Above Changu, 3658m, 8 vii 1910, *Smith* 3202 (K with *J. duthiei*). Sheradthang, 3658–3962m, 18 vii 1913, *Cooper* 307 (BM, E). Hills N of Changu, 4115m, 29 vi 1913, *Cooper* 73 (BM, E).

BHUTAN. Pajoding, above Thimphu, 3750m, 19 vii 1979, *Grierson & Long* 2783 (E). Above Phajoding, 3840m, 30 vii 1991, *Noltie* 63 (E). Penge La, Bumtang, 4110m, 26 vi 1969, *Bowes Lyon* 15098 (BM). Shingbe, Me La, 3658m, 3 vi 1949, *Ludlow, Sherriff & Hicks* 20693 (BM, E). Above Talukah Gompa, 4200m, 28 viii 1988, *Wood* 6615a (E).

SE TIBET. Lusha Chu, 3810m, 10 vi 1938, *Ludlow, Sherriff & Taylor* 4766 (BM, E).

It seems that *J. uniflorus* is of more restricted distribution and probably rarer than *J. duthiei*, occurring from E Nepal to SE Tibet. Interestingly — considering its minute stature — it has not been recorded from such high altitudes as *J. duthiei*.

Juncus bryophilus Noltie, **sp. nov.**

A *Junco unifloro* W.W. Smith lobis stigmaticis cremeis (haud roseis) brevioribus (minus quam 1.5mm, non 1.8–3.2mm), antheris minutis (0.7–0.9mm, non 1.2–1.5mm) quam filamentis minoribus, et bractea suberecta foliacea (flos ut videtur lateralis) differt. A *J. duthiei* (C.B. Clarke) Noltie formis nanis foliis bitubulosis, lobis stigmaticis brevibus cremeis, antheris minoribus quam filamentis brevioribus recedit. **Fig. 1F–K.**

Rhizomes short, stems loosely tufted. *Flower stem* filiform, 0.4–3cm, swollen at base and clothed with dark-brown, ribbed, scale leaves. *Stem leaf* single, sub-basal, filiform (c.0.3mm diam.), about equalling flower stem, bitubular. *Auricles* of sheath minute, membranous, blunt. *Inflorescence* a single, apparently lateral flower, lowest bract to 1.5cm, suberect, leaf-like. *Tepals* chestnut, linear-lanceolate, acute, subequal 2.5–3.9mm long. *Stamens* 6, shorter than tepals; anthers 0.7–0.9mm, shorter than the filaments 1–2.3mm. *Stigma lobes* short, 0.7–1.5mm, cream. *Capsule* ellipsoid-trigonous, tapered into short style 0.5–0.7mm. *Seeds* pale brown, ellipsoid, with very short membranous points at both ends, c.0.7mm long.

Type: Bhutan, Upper Mo Chu District, ridge above Laya, on wet rock ledge, 4450m, 21 ix 1984, *Sinclair & Long* 5217b (holo. E).

Other specimen seen:

SIKKIM. Dzongri, 4000m, 25 vii 1992, *ESIK* 698 (E).

Closest to *J. uniflorus* and dwarfed specimens of *J. duthiei*, but differing from both of these in its short style and short, cream (not pink) stigma lobes and anthers shorter than the filaments.

Known only from two collections, but this is probably merely a reflection of its minute stature. The specific epithet refers to the plant's habitat — growing among moss on wet boulders and rock ledges, and also honours the botanical affections of David Long, one of its discoverers.

(C) Grassy-leaved, white-flowered species of which Buchenau knew only *J. clarkei*, which comprised his section 54.

Juncus hydrophilus Noltie, **sp. nov.**

A *J. clarkei* Buchenau habitu et inflorescentia tenuiore, foliis caulinis superioribus inflorescentiam haud excedentibus, foliis plerumque minus quam 2.5mm latis (haud plerumque magis quam 3mm), inflorescentia ut videtur terminali (non laterali), bractea infima inflorescentiam breviore (haud eam multo excedenti), lamina setiformi (non foliacea), basi vaginali anguste membranacea hyalina (non rubrofusca), filamentis tepala excedentibus antheris sic omnino exsertis (non ea brevioribus antheris inclusis vel paene exsertis), fructibus in mensibus Julio sero-Augusto praecox (haud Augusto sero-Octobri). **Fig. 2I–O.**

Rhizomes stoloniferous; stolons short, slender (under 1mm diam.), dark brown, clothed with scales and fibrous remains of old scales. *Flowering stems* loosely tufted, 32–40cm, basal scale leaf single, 0.7–4cm. *Stem leaves* 3–4, evenly spaced, longest 14–17 × 0.2–0.33cm, leaf sheaths 2.5–4cm, reddish-brown, lacking auricles. *Non-flowering shoots* 3-leaved, blades shorter than stems, grass-like, tapering gradually to acute apex, margins extremely narrowly hyaline, midrib prominent on lower surface. *Inflorescence* usually of a single anthela with 3(–5) capitate partial inflorescences, appearing terminal; capitula 4–9-flowered, c.1.5cm diameter at flowering. *Lowest bract* shorter than inflorescence, blade bristle-like, sheathing base narrowly membranous. *Outer tepals* 3.5–5 × 0.8–1.4mm, narrowly lanceolate, acute, keeled, cream; inner tepals 4–5.3 × 0.9–1mm, similar in shape, cream. *Filaments* exceeding tepals; anthers exserted, 1.4–2.5mm, pale yellow, narrowly oblong. *Ovary* 5–6.5 (incl. style) × 1–1.5mm, straw-coloured, very narrowly ovoid, gradually tapered into beak-like style. *Stigma lobes* 0.5–1mm ± spreading. Capsule c.6 × 1.8mm, very narrowly ovoid, straw-coloured, shining.

Type: Sikkim, Prek Chhu Bridge below Bakhim, 2300m, 27 vii 1992, *ESIK* 771 (holo. E, iso. K).

Other specimens seen:

BHUTAN. Dotena, 2730m, 20 vii 1991, *Noltie* 13 (E). Above Gortsam, Bumthang, 3510m, 10 viii 1991, *Noltie* 137 (E).

NEPAL. NW of Saltie, along trail to Pangsing Bhanjyang, 2760m, 25 viii 1974, *De Haas* 2547 (BM).

Apparently endemic to the E Himalaya (E Nepal to C Bhutan), where it grows in the evergreen oak–blue pine forest zone on extremely wet cliffs with running water, fruiting during the monsoon.

J. clarkei grows in similar forest but on mossy boulders lacking running water (apparently in stony pastures in Yunnan) and fruiting later (at the end of the monsoon or beginning of the dry season).

(D) *Juncus amplifolius* and allies

An interesting group not known to Buchenau, with brown flowers and flat, coriaceous leaves. *J. minimus* Buchenau placed in section 51 should be included here. Camus (1910) was correct in suggesting that *J. amplifolius* came between Buchenau's subgenera *Alpini* and *Graminifoli*, demonstrating the need for a better infrageneric classification.

J. amplifolius A. Camus in Notulae Systematicae 1(10): 281 (1910).
This species was described from Yunnan but herbarium studies show that its distribution extends as far west as E Nepal.

Specimens seen:

E NEPAL. Chhovang Khola W of Num, Arun Valley, 12,500ft, 21 vi 1956, *Stainton* 727 (BM, E). Khongma La, 18km N of Num, 3965m, 10 vii 1974, *Emery* CH 48 (K).

SIKKIM. Mon Lapcha to Phedang, 3800m, 26 vii 1992, *ESIK* 750 (E).

BHUTAN. Tongsa District: Yuto La, 10,700ft, 3 vi 1966, *Bowes Lyon* 3304 (BM).

BURMA. Tama Bum, N Triangle, 10,000ft, 20 vi 1953, *Kingdon Ward* 21017 (BM). Naung Chaung Valley, 11,000ft, 20 vi 1914, *Kingdon Ward* 1703 (E). Hpimaw Pass, 11,000ft, 7 vi 1929, *Parkinson* 10056 (K).

CHINA — YUNNAN. Dali, Cangshan *CLD* 1316 (E), 1339 (E); *Forrest* 4909 (E); *Kingdon Ward* 865 (E), 625 (E); *Sino-British Exped. Cangshan* 619 (E), 826 (E), 879 (E); *Sino-American Bot. Exped.* 854 (E).

TIBET. Trulung, Po Tsangpo, Pome, 8000ft, 28 v 1947, *Ludlow, Sherriff & Elliot* 13050 (E). Lisum, Nunkhu Phu Chu, nr Tongkyuk, Pome, 11,000ft, 26 v 1947, *Ludlow, Sherriff & Elliot* 13769 (E). Doshong La, Kongbo, 13,000ft, 17 viii 1947, *Ludlow, Sherriff & Elliot* 14384 (E).

J. nepalicus Miyam. & H. Ohba in J. Jap. Bot. 68: 28 (1993). Holotype: Nepal, around Cha Ding Kharka, Sankhuwa Sabha District, 3970m, 9 viii 1990, *Minaki et al.* 90 (TI!).

This species is closely related to *J. amplifolius*, having a similar contracted, woody, rhizomatous rootstock and broad coriaceous leaves, but differs in having inflorescences with 1–2 (vs 2–3) heads, smaller, more acute tepals (the inner 3.3–4 vs (4–)5.1–6mm); smaller anthers (c.1.3 vs 2–2.5mm), shorter stigma lobes (2–2.5 vs 3–5mm) and smaller, shorter-beaked capsules. It turns out to have been found earlier by Hooker in Sikkim.

Other specimens seen:

SIKKIM. Lachen, 10,000ft, 6 vi 1849, *Hooker* s.n. (K); Lachen, 12,000ft [another field label on same sheet reads Kankola, 15,000ft, but probably does not refer to this species], *Hooker* s.n. (K — sheet bearing mixture of *J. nepalicus*, *J. himalensis*, *J. sikkimensis* and *J. duthiei*).

Juncus spumosus Noltie, **sp. nov.**
In characteribus vegetativis *J. amplifolio* A. Camus similis, sed inflorescentia decomposita, inflorescentiis partialibus ('capitulis') pluribus (6–21, non 2–3) minoribus, tepalis brevioribus (interioribus 3–3.5mm, non (4–)5.1–6mm), pallidioribus (albescentibus roseo-tinctis, non atro-

FIG. 2. *Juncus spumosus* Noltie (*Noltie* 122). A, habit; B, inflorescence (× ⅔); C, partial inflorescence (× 4); D, bract (× 6); E, flower (× 6); F, ovary (× 6); G, fruit (× 6); H, immature seed (× 12). *J. hydrophilus* Noltie (*ESIK* 771). I, habit; J, inflorescence (× 1); K, partial inflorescence (× 3); L, bract (× 6); M, flower (× 6); N, ovary (× 6); O, fruit (× 9).

fuscis) et praecipue antheris exsertis minoribus (0.7–1mm, non 2–2.5mm) et lobis stigmaticis multo minoribus (0.6–0.8mm, non 3–5mm) differt. **Fig. 2A–H.**

Rhizome system very condensed, woody, bearing fibrous remains of old shoots. *Flower stems* 11–56cm; reduced scale leaves present at base. *Stem leaves* 2–4, evenly spaced, 3–8 × 0.2–0.4cm, leaf sheaths 2–7cm, reddish, lacking auricles. *Leaves of non-flowering shoots* to 9cm, widest just above base and tapering gradually to blunt apex, margins narrowly hyaline, minutely papillose, upper surface smooth, lower ridged. *Inflorescence* usually of 2 superposed anthelae with 6–21 capitate partial inflorescences; capitula 2–6-flowered, to 7mm diameter at flowering. *Lowest bract* leaf-like, about equalling inflorescence; bracts of capitula shorter than capitula, reddish, ovate. *Outer tepals* 2.4–2.8 × c.0.7mm, narrowly lanceolate, acute, keeled, whitish-membranous, flushed pinkish brown near centre and apex, midrib tinged greenish; inner tepals 3–3.5 × c.1mm, similar in shape, whitish. *Filaments* 3–3.4mm, exceeding tepals, anthers exserted, 0.7–1mm, pale yellow, oblong. *Ovary* c.3.7 × 2mm, brown, narrowly ovoid, tapered into beak-like style c.1.2mm. *Stigma lobes* 0.6–0.8mm ± spreading. Capsule 5.5 × 2.5mm, narrowly ovoid, dark reddish-brown, shining, beak 0.5mm; immature seeds 0.4mm, tails c.0.9mm — total length c.2.2mm.

Type: Bhutan, Tongsa District, W side of Yuto La, 3350m, 8 viii 1991, *Noltie* 122 (holo. E, iso. K).

This extremely attractive and distinctive species was seen in great quantity on landslips in *Abies densa* forest on both sides of the Yuto La in Central Bhutan. The epithet refers to the frothy appearance of the pale inflorescence. Vegetatively it is indistinguishable from *J. amplifolius*, but the inflorescence and flowers are very different.

SUBGENUS GRAMINIFOLI

J. ochraceus Buchenau in Abhand. Naturwiss. Vereine Bremen 3: 292 (1872).

Syn.: *J. tratangensis* Satake in Hara, Fl. E. Himal. 2: 164 (1971). Holotype: Bhutan [Tongsa District], Tongsa to Uto La Road, 2000–2500m, 17 iv 1967, *Kanai & Yamazaki* 5952 (TI!).

Placed in this subgenus, though with some doubt ('an rectius ad *J. alpinos* transferendus?') in Buchenau's section 58, is the extremely curious *J. ochraceus* Buchenau. This was first described from Sikkim and Assam, but later discovered in Yunnan (Tsangchan, *Delavay* 2603, P!) as reported by Camus (1910). It has recently been refound in Yunnan (*CLD* 90, E), though it is not recorded in Wu (1984).

J. ochraceus is characterized by having a large proportion of the partial inflorescences transformed into sterile, spirally arranged aggregates of golden-coloured 'bracts'. Most of these bracts are empty but some subtend curious reduced shoots (?sterile flowers). The aggregates of bracts resemble superficially a Cyperaceous spikelet (e.g. *Fimbristylis* spp.) and merit further anatomical and developmental investigation. In most specimens some fertile, typically Juncaceous flowers occur, especially towards the base of the inflorescence; the relative proportion of sterile to non-sterile flowers, however, varies and is presumably subject to environmental modification. Buchenau (1885) suggests, by analogy with *Luzula flavescens*, that infection with a smut might be a reason for the transformation. Specimens with a higher proportion of fertile

flowers were described from Bhutan as *J. tratangensis* but observations in E Nepal show that they merely form an extreme type and are not worth taxonomic recognition.

MISCELLANEOUS NOTES

In the course of this work the types of several recently described Sino-Himalayan species have been studied and the following new synonymy can be made.

J. unifolius A.M. Lu and Z.Y. Zhang in Acta Phytotax. Sin. 8: 125 (1979). Holotype: Tibet, Za-Yul, 4250m, 13 viii 1973, *Chang & Cheng* 1525 (PE!) = **J. minimus** Buchenau (the type consists of a mixture of a *Luzula*, possibly *L. oligantha* Sam., in addition to the *Juncus*).

J. phaeocarpus A.M. Lu & Z.Y. Zhang in Acta Phytotax. Sin. 8: 126 (1979). Holotype: Tibet, Ne La Mu, Chang Mu, 3550m, 11 v 1966, *Chang & Ling* 3285 (PE!) = **J. grisebachii** Buchenau.

J. longibracteatus A.M. Lu & Z.Y. Zhang in Acta Phytotax. Sin. 8: 126 (1979). Holotype: Tibet, Gyi-Lung, 4152m, *Qing-Zang Exped. Veg. Group* Q131-1 (PE!) = **J. kingii** Rendle.

J. luteocarpus Satake in J. Jap. Bot. 43: 384 (1968). Holotype: Bhutan, Chendebi to Rukubi, 2300–2600m, 21 iv 1967, *Kanai et al.* 8478 (TI!) = **J. concinnus** D. Don.

J. albescens Satake in Fl. E. Himalaya, Second Report, ed. H. Hara, p. 161 (1971) non (Lange) Fernald. Holotype: Bhutan, Laya to Laum Thang, 3650–3900m, 18 v 1967, *Kanai et al.* 11847 TI!) = **J. concinnus** D. Don.

J. yoskisukei Goel in J. Econ. Tax. Bot. 7: 208 (1985) (*nom. nov.* for *J. albescens* Satake) = **J. concinnus** D. Don.

J. bracteatus Buchenau in Bot. Jahrbuch. 6: 220 (1885). Type: Sikkim, 12,000ft, Hooker [Juncus 9] (holo. presumed destroyed at B; isotype BM!) = **J. benghalensis** Kunth.

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NOTES RELATING TO THE FLORA OF BHUTAN: XXVI
Smilacaceae: *Smilax*

H. J. NOLTIE*

The following new taxa, combinations and synonymy in the genus *Smilax* from E Himalaya and SW China are proposed: *S. myrtillus* var. *rigida* Noltie, *var. nov.*, *S. elegans* Wall. ex Kunth subsp. *subrecta* Noltie, *subsp. nov.* of which *S. longebracteolata* Hook.f., and *S. elegans* var. *major* A.DC. are synonyms; *S. elegans* subsp. *glaucophylla* (Klotzsch) Noltie, *comb. & stat. nov.*, *S. elegans* subsp. *osmastonii* (Wang & Tang) Noltie, *comb. & stat. nov.*, *S. elegans* subsp. *microphylla* (C.H. Wright) Noltie, *comb. & stat. nov.* of which *S. microphylla* var. *angustifolia* Warb., *S. castaneiflora* H. Lév., *S. labordei* H. Lév. and *S. gracillima* H. Lév. & Vaniot are synonyms. Notes are provided on Warburg's varieties *angustifolia*, *nigrescens* and *elongata* of *S. microphylla*. *S. bockii* Warb. is reduced to synonymy of *Heterosmilax japonica* Kunth. *S. glaucophylla* Klotzsch, *S. osmastonii* Wang & Tang, *S. microphylla* C.H. Wright and *S. minutiflora* A.DC. are lectotypified; *S. elegans* Wall. ex Kunth and *S. wallichii* Kunth are neotypified.

INTRODUCTION

There has been much confusion over the identification and nomenclature of a group of species belonging to *Smilax* section *Vaginatae* (sensu T. Koyama 1957) occurring in the Himalaya and variously called *S. elegans*, *S. parvifolia*, *S. glaucophylla* and *S. menispermoidea*, and the related Chinese species *S. microphylla*. This confusion has become evident during preparation of the account of the genus for the *Flora of Bhutan*, since the area covered by the *Flora* represents a meeting point of eastern and western elements. Much work remains to be done on the taxonomy of related Chinese plants, but a treatment is suggested for this difficult group, retaining *S. menispermoidea* as a distinct species, but including the remainder under *S. elegans*, recognizing the nodes of variation (which are geographically correlated) at subspecific level.

Notes on other Himalayan members of this section are given, together with a key to their identification.

In addition to nomenclatural difficulties and problems arising from misidentifications and misapplication of names, a genuine difficulty is found in delimiting species in this group due to the complex pattern of variation observed in herbarium specimens. The plants are phenotypically extremely plastic in terms of shape, size and texture of leaves and spininess of stems, with quite strikingly different forms of plants which apparently belong to the same species occurring sympatrically. Nevertheless, it seems counter-productive not to recognize at least some of this variation taxonomically, some of which is geographically correlated and which might be further elucidated using biosystematic or molecular approaches.

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SECTION VAGINATAE

NOMENCLATURAL DISCUSSION

(i) *Smilax elegans* s.l.

As with many nomenclatural problems relating to Himalayan plants, the root of the trouble lies in Wallichian specimens and their names which were not validly published (*nomina nuda*) in the Wallich Catalogue. The relevant sheets in the Wallich Herbarium (K-W) are numbered 5117A, 5117B, 5117 (additional) and 5118. Sheets with the same numbers in other herbaria (including the main herbarium at K) do not necessarily bear exactly the same species (or mixture of species!).

5117 — all sheets bear the Wallich Catalogue name '*S. elegans*'.

5117A (from Sheopore, Nepal) consists of a mixture of what are correctly called *S. elegans* Wall. ex Kunth and *S. menispermoidea* A.DC.

5117B (from Dehra Dun) consists entirely of *S. glaucophylla* Klotzsch.

An extra sheet numbered 5117 from Chusapang (?Nepal) consists of *S. elegans*.

5118 — bears the Wallich Catalogue name '*S. parvifolia*'; the specimens are from Assam (Chora Poonji, Mont. Sylhet) and represent a taxon (also occurring in SW China) the nomenclature of which is discussed below.

Kunth (1850) was the earliest author to validate one of these names when he published *S. elegans* based on a duplicate (no longer extant at Berlin) of 5117A. Whilst stating that his sheet was a mixed gathering, his description and application of the name to the small-leaved, male plant is quite unambiguous. A suitable neotype is the sheet (ex herb. Bentham) with the number 5117 in the main Kew herbarium which bears only this species without the complication of a second species (it is annotated with the name *S. parvifolia* in J.D. Hooker's writing). Kunth stated that the other species present on his sheet was either '*S. maculata*' (= *S. aspera* L.) or a female specimen of *S. elegans*. It is most likely, however, to have been the species later described as *S. menispermoidea* A.DC, which as we have seen above is present on sheet 5117A in K-W.

De Candolle (1878) accepted Kunth's *S. elegans*, but in a wide sense, also including *S.* '*parvifolia*' *Wallich* 5118 and *S. glaucophylla*. In the same work he described a var. *major* of *S. elegans* and the related species *S. menispermoidea* and *S. minutiflora*.

Hooker (1892) appears to have ignored Kunth's description of *S. elegans* and applied the name to the second element of *Wallich* 5117A (probably because one of the sheets with that number in his own herbarium, now in K, bears only this species), treating *S. menispermoidea* as a synonym for his '*elegans*'.

Hooker published (illegitimately by including earlier synonyms and in any case the name existed already for a fossil species) the name *S. parvifolia* based on *Wallich* 5118, but also included the small-leaved element from 5117A (i.e. true *S. elegans*) and 5117B (i.e. *S. glaucophylla*) in his concept.

Kunth does not seem to have seen a duplicate of 5118 and merely lists the name *S. parvifolia* as a species not seen by him.

S. elegans

S. elegans s.str. is characterized by its very zigzag lateral branchlets (see illustration in Wang & Tang (1978) as *S. glaucophylla*); leaves small, herbaceous at flowering, strongly glaucous underneath (at least when fresh or properly dried); very slender peduncles and unexpanded 'receptacles' with minute bracteoles. It has a distinct and discrete E Himalayan distribution from C Nepal to N Assam, with outliers seen from Manipur and N Burma.

S. glaucophylla

S. glaucophylla was described by Klotzsch in 1862; no locality is given in the description, but in the lists of species and itineraries given in the introduction to the book the only mention of a *Smilax* (p. 4) is from the Upper Forest Region in the valleys of Kunegar and Mundragiri, between Alacananda and Kedarnath, i.e. in Uttar Pradesh. This is almost certain to be the type locality. Unfortunately Klotzsch's types (formerly at Berlin) are lost. However, his lithograph (plate 91) is of such good quality (especially in its faithful rendering of the fine leaf venation) that it may be designated as a lectotype, unless isotype material is discovered in another herbarium at some future date. Most authors since Klotzsch (e.g. J.D. Hooker — see above) have treated *S. glaucophylla* as being conspecific with '*elegans/parvifolia*' (although the nomenclature has varied). Although specimens occasionally occur which are not easy to place, it seems to be a distinct morphological and geographical entity (W Himalayan, from Pakistan (Swat) to C Nepal) and warrants being retained at subspecific rank under *S. elegans*.

Koyama (1963) was the first to recognize the affinity of Indian plants of this group with the Chinese *S. microphylla*. He overlooked Kunth's validation of *S. elegans* and took *S. glaucophylla* to be the earliest name in the group of which he made *microphylla* a variety. Unfortunately he misunderstood Warburg's var. *elongata* of *S. microphylla* and treated this as synonymous with *S. glaucophylla* (erroneously giving *S. parvifolia* Wall. ex Hook.f. and *S. elegans* Wall. ex A.DC. as synonyms). Koyama later changed his mind and reverted to using the name *S. microphylla* var./subsp. *elongata* for E Himalayan and Chinese plants discussed below under *S.* '*parvifolia*'.

S. osmastonii

This species was first described in 1925 by Osmaston as *S. erecta*, an illegitimate homonym, replaced by *S. osmastonii* by Wang & Tang in 1937. It was said to differ from '*S. parvifolia* Wall.' (by which Osmaston meant *S. glaucophylla*) in its erect (vs. climbing) habit, papillose underside to the leaves and green vs. pinkish-brown flowers (an insignificant character which is dependent, at least partly, on age of flower). Osmaston cited specimens from Garhwal and Khasia without designating a type, but clearly referred chiefly to the Garhwal plant, and it is two specimens (probably duplicates since neither are annotated with the name *S. erecta*) bearing the number *Osmaston* 1076 that are in a type cover at K. It is this number to which Wang & Tang exclusively refer.

There is something of a mystery here since, despite the protologue, one of the leaves on one of these specimens bears a tendril, which suggests that the plant has the potential to climb. It therefore seems advisable to lectotypify on the other specimen which completely lacks tendrils. The specimens are extremely close to *S. glaucophylla*, differing only in the papillosity of the leaf. I have seen no other papillose material from the W Himalaya, but the Khasian specimens

form a coherent group and completely lack tendrils. Further collections are clearly needed from the W Himalaya, but in the meantime the taxon is best treated as a further subspecies of *S. elegans*, occurring mainly in Khasia, with an unexplained disjunction in Garhwal.

S. 'parvifolia' (*Wallich* 5118)

A problem exists over finding a suitable name and rank for *Wallich* 5118 and similar specimens occurring from Khasia (Assam) to Yunnan, for which, as we have seen, the name *S. parvifolia* cannot be used. The Chinese specimens tend to have slightly shorter peduncles than the Indian, but are otherwise identical, thus emphasizing the links between the E Himalayan flora and that of SW China.

Handel-Mazzetti (1936) was the first to apply the name *S. microphylla* C.H. Wright var. *elongata* Warb. to such specimens and was followed by Koyama (1960). Unfortunately neither seems to have seen type material of this variety, and the name turns out to have been misapplied. The holotypes of Warburg's taxa were at Berlin and most are presumed to have been destroyed, but fortunately a duplicate set of isotypes survives at Oslo. Koyama later (1975) raised *elongata* to subspecific rank and has used this name widely in determining herbarium specimens.

Wright described *S. microphylla* in 1895 from Hupeh Province (Central China), citing six specimens collected by A. Henry from Ichang. Among these are both spiny, small-leaved forms and one (*Henry* 3996) almost spineless, with larger leaves, which demonstrates the close relationship with '*S. parvifolia*'; the A duplicate of this number (which does not match the protologue very well) has an annotation 'lectotype' but this lectotypification does not seem to have been published. It is necessary to lectotypify *S. microphylla* on one of the small-leaved spiny forms and, after seeing the syntypes at K and A, I recommend selecting *Henry* 3980 as best matching the description (none of the Gray duplicates of the syntypes are annotated by Wright). However, given the variability of characters such as spininess and leaf size/shape, it seems wisest to follow Koyama's original idea of regarding *S. microphylla* as conspecific with Himalayan plants, but recognizing it at subspecific rank as *S. elegans* subsp. *microphylla*.

S. darrisii H. Lév., described from Kweichow (Guizhou), is spineless and has very small, rather oblong leaves rather similar to those of *S. elegans* subsp. *elegans*. It is known only from the original collections of Esquirol and Cavalerie, although a collection from Mount Omei in Sichuan (*L.Y. Tai* T162, A) perhaps belongs to the same taxon. Wang & Tang (1978) retain it as a species, but others (e.g. McKean, 1986) have treated it as synonymous with *S. microphylla*. Until more collections are seen it seems unwise to pronounce on its status, although it will probably be worth recognizing at subspecific rank under *S. elegans*.

A name is still required for the larger-leaved, spineless form, which I describe below as subsp. *subrecta*. The reasons why *elongata* cannot be used are given below.

It should be noted that this taxon appears to be currently known in China (judging from determinations on herbarium sheets and the drawing in Wang & Tang, 1978) as *S. mairei* H. Lév. A specimen of this taxon (*Tsai* 62896) at Kew bears the determination by Wang & Tang (dated 1938) *S. microphylla* var. *mairei* (Lévl.) Wang & Tang, although this combination does not seem to have been published. The name (at whatever rank), however, has been misapplied and refers to a non-climbing species with subapical leaf abscission.

Discussion of Warburg's varieties of *S. microphylla*

Warburg (1900) described (somewhat inadequately) a series of varieties of *S. microphylla* based on sometimes inadequate material collected in Sichuan by Bock & von Rosthorn:

var. *angustifolia* does not differ enough from small-leaved, spiny *S. microphylla* to warrant any recognition.

var. *nigrescens* is probably synonymous with *S. scobinicaulis* C.H. Wright, as treated by Wang & Tang (1978), differing from *S. elegans/microphylla* in its petiole having a very short, weak wing and in the abscission point occurring part way along the upper part of the petiole (rather than at its swollen apex at the junction with the blade), the unexpanded 'receptacle' and few-flowered inflorescence.

var. *elongata* is problematic; the axillary (?inflorescence) buds have not developed and are inhabited by insect larvae, the leaves are rather strange looking — perhaps under influence from the galled buds. It can never be identified with certainty but Wang & Tang (1934) were correct in pointing out the prophyllate nature of its inflorescences. This means that it must belong to sect. *Macranthae* and they (who apparently collected material from the type locality) were probably correct in saying it is close to *S. lanceifolia* Roxb. At first they considered it a distinct species (*S. austrosinensis*) but later (1978) they reduced it to a variety under *S. lanceifolia*; in leaf shape it is identical to *S. cocculoides* Warb. var. *lanceolata* Norton (type *Henry* 12577 from Yunnan), which was also treated as a variety of *S. lanceifolia* by Wang & Tang (1978). Whatever the final conclusion on the status of this taxon it is clear that it cannot be used at any rank for plants related to *S. microphylla*.

Of Warburg's other types studied it should be pointed out that *S. bockii* is in fact *Heterosmilax japonica* Kunth. Of the two syntypes cited in the protologue, one (*Bock & von Rosthorn* 2375) survives at Berlin and the other at Oslo (*Bock & von Rosthorn* 2408).

S. longebracteolata

This taxon, first described as *S. elegans* var. *major* by de Candolle and raised to specific rank by Hooker, is known only from the type collections (from Khasia). Koyama (1963) regarded it as an abnormal form of '*S. glaucophylla*' (under which he included *S. elegans* and *S. 'parvifolia'*). In view of the great plasticity of these taxa I would place it under *S. elegans* subsp. *subrecta*, from which it differs only in the degree of development of its bracteoles and peduncle.

(ii) *S. menispermoidea*

This is the most widely distributed member of the group, occurring from Garhwal in the W Himalaya to Kansu in NW China. Despite the nomenclatural confusion with *S. elegans* discussed above, it is a relatively distinct species and uniform except in NW China where shrubby forms with smaller, more coriaceous leaves were described by Rehder as *S. rubriflora*. I have not seen any of the syntypes cited in the protologue, but have seen duplicates at Kew bearing the type number (i.e. Hooker's *Smilax* 7).

(iii) *S. minutiflora*

This is a clearly defined, usually shrubby species with characteristic leaves: herbaceous, underside bearing curious scurfy scales with raised edges (sometimes rubbed off) and with the cuticle forming raised lines on the veins beneath. Other characteristic features are the broad, cream, persistent petiole wings which taper upwards, the abscission from below the apex of the petiole; and the contrast between the lanceolate young leaves and ovate mature leaves which are not always developed.

It appears to be more widely distributed than hitherto realized, occurring from NE Nepal to Assam and N Burma, Yunnan and Sichuan. Further work is needed, however, on specimens from Sichuan, which are evidently closely related and possibly synonymous (including the very narrow-leaved *S. tsingchengshanensis* Wang).

(iv) *S. rigida*

The well-known name of this distinctive, ericaceous-like, dwarf shrub was shown by Mabberley (1982) to be a later homonym and some nomenclatural re-adjustment is therefore needed for the Himalayan plants. As is usual in this group the Indian plants were described before the Chinese, and, if looked at in a narrow geographical sense, delimitation of taxa seems to be clearer than it actually is. Kunth's *S. rigida* is spiny, with sessile, ovate-cordate, coriaceous leaves, and occurs mainly in E Nepal, Sikkim and Bhutan with outliers seen from Assam, N Burma and W Yunnan. De Candolle described the closely related *S. myrtillus* from Assam, which is spineless, and has rhombic-ovate (usually larger), more herbaceous leaves with a subcuneate base. However, when material from Yunnan is examined the correlation between leaf shape and spininess is by no means clear-cut, and Koyama was clearly correct in reducing the two to varietal rank (under *S. rigida*). Koyama later (1971) raised them to subspecific rank. Such striking variation, for which there must be some interesting genetic or ecological basis, despite the occurrence of intermediates, merits taxonomic recognition, but as the distributional difference is not clear-cut subspecific rank is probably not appropriate. Clearly it would be interesting to know if the two are ecologically separated where sympatric, but the sparse notes on most specimens are not an adequate basis on which to form an opinion.

The unfortunate discovery that *S. rigida* is illegitimate means that the species must be known as *S. myrtillus*, which necessitates making a new variety for the earlier described species, which becomes *S. myrtillus* var. *rigida*.

(v) *S. vaginata*

The type species of this section, *S. vaginata* Decne., is a very distinctive shrubby species with subapical leaf abscission and oblong-ovate, truncate leaf blades with rounded apices. It has a similar distribution to subsp. *glaucophylla*, i.e. restricted to the W Himalaya (Afghanistan to Uttar Pradesh) though related to the Japanese *S. stans* Maxim. and to the Chinese *S. pekingensis* A.DC, with which it has sometimes been united (e.g. Koyama, 1960).

NOMENCLATURAL SUMMARY AND SPECIMENS SEEN

(i) **S. elegans** Wall. ex Kunth subsp. **elegans** in Enum. Pl. 5: 163 (1850) — excl. female plant; A.DC., Monogr. Phan. 1: 107 (1878) — excl. *S. glaucophylla* Klotzsch; non sensu Hook.f., Fl. Brit. India 6: 305 (1892). Neotype (chosen here): Napalia, 1832, *Wallich* 5117, specimen ex herb. Bentham (K).

Syn.: *S. parvifolia* Wall. ex Hook.f., Fl. Brit. India 6: 304 (1892) nom. illegit. — p.p. excl. *S. glaucophylla* Klotzsch and Khasia plants.

S. glaucophylla sensu Wang & Tang in Fl. Reip. Pop. Sin. 15: 207 (1978), non Klotzsch.

Specimens seen (all):

?NEPAL. Chusapang, 18 xii 1821, *Wallich* 5117 (additional) (K-W).

C NEPAL. Sheopore, 1821, *Wallich* 5117A (E, K, K-W, BM. Note: some sheets mixed with *S. menispermoidea*). Godavari-Phulchauki, Kathmandu, 1600–2500m, 26 vi 1967, *Kanai et al.* 1019, 2692 (E, BM). Khading, 8000ft, 1928, *Dhwoj* 226 (E). Phulchoke S of Kathmandu, 7500ft, 12 v 1966, *Schilling* 794 (K). Phulchoke S of Kathmandu, 28 v 1972, *Ohashi & Ohba* 724010 (BM). Below Helumbu, Sindhu Palchok District, 2400m, 28 ix 1966, *Nicolson* 2665 (BM). S of Tharke Gyang, 2550m, 7 ix 1974, *De Haas* 2698 (BM). SE of Malemchigaoh, 2100m, 17 ix 1974, *De Haas* 2799 (BM). Gatlang, Ganesh Himal, 8000ft, 26 iv 1962, *Stainton* 3630 (BM). Ngyak, 8000ft, 9 vii 1953, *Gardner* 1188 (BM). Chipling to Latsu, 2350m, 21 viii 1969, *Kanai & Malla* 673584 (BM). Melumchee, 8000ft, 30 x 1931, *Sharma* E271 (BM). Nr Bongakhani, 6700ft, 4 v 1954, *Stainton, Sykes & Williams* 2691 (BM). Okhaldhungagaon, 9000ft, 2 vi 1954, *Stainton, Sykes & Williams* 397 (BM). Burungdi Khola, 6500ft, 20 v 1954, *Stainton, Sykes & Williams* 5331 (BM). Nr Lumsum, 7000ft, 7 ix 1954, *Stainton, Sykes & Williams* 4267 (BM). Lete, N of Dana, 8000ft, 26 v 1954, *Stainton, Sykes & Williams* 680 (BM). Khangjung, 7–8000ft, 5 vi 1949, *Polunin* 137 (BM). Between Bharkhu and Syabru, Rasuwa District, 1960m, 22 iv 1992, *Long & McDermott* 21928 (E).

E NEPAL. E Napalia, 1828, *Wallich* s.n. (BM). Tambur [= Tamar] River, 5–8000ft, 22 xi [1848], *Hooker* s.n. (K). Birwa–Yektin, 28 xi 1963, *Kanai et al.* 6300843, 6301136 (E, BM). Baroya Khimty–Thakma Khola, 16 xi 1963, *Kanai et al.* 6301143 (E, BM). Above Shidua, 2570m, 28 viii 1989, *KEKE* 39 (K, E). Amjilassa to Kyapra, Ghunsa Khola, 2600m, 6 ix 1989, *KEKE* 301 (K, E). Sinduwa, Dhankuta, 2100m, 24 x 1963, *Hara et al.* 6301139 (BM). Bhandukay to Yamphodin, 16 xi 1963, *Hara et al.* 6307405 (BM).

BHUTAN. Thimphu–Chima Khothi, 2150–2250m, 1 vi 1967, *Kanai et al.* 404 (BM). Bootan [almost certainly nr Panga, *Griffith* 1028], *Griffith* K.D. 2641, HEIC 5435 (K, BM). Ritang to Ratsoo, 1850–2000m, 23 iv 1967, *Kanai et al.* s.n. (BM). Dengchung, Khoma Chu, 7000ft, 2 v 1949, *Ludlow, Sheriff & Hicks* 18805 (BM). Below Lobnakha, 2530m, 22 vii 1991, *Noltie* 17 (E).

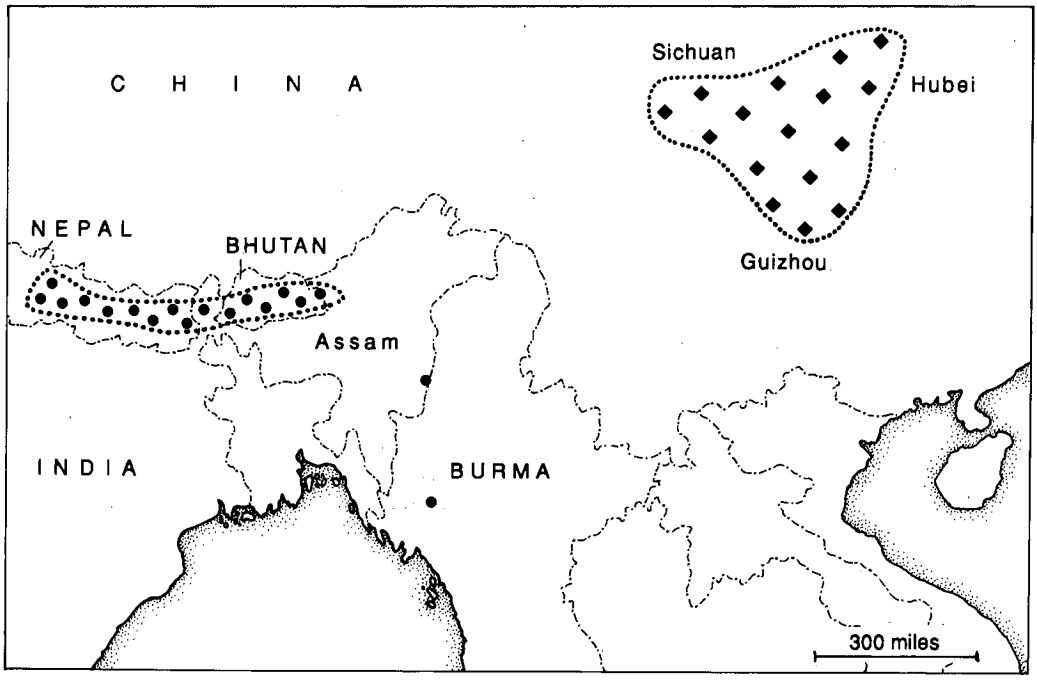
ASSAM. Shergaon, Balipara Frontier Tract, 6000ft, 5 v 1935, *Kingdon Ward* 11386 (BM).

MANIPUR. Above Pushing, Khaiyang, 6–7000ft, 19 v 1948, *Kingdon Ward* 17497 (A).

N BURMA. Mindat Ridge, 7500ft, 21 v 1956, *Kingdon Ward* 22252 (BM, E).

Distribution: E Himalaya, from C Nepal to N Assam, Manipur and N Burma; also S Tibet teste Wang & Tang (1978). Habitat: oak and pine/rhododendron forest; alt. 1520–2740m. **Map 1.**

NB. Many collections of Hara *et al.* of this subspecies from Nepal, Sikkim and Bhutan were named (by Koyama and others) as *S. menispermoidea*, *S. glaucophylla* or *S. microphylla* subsp. *elongata*.



MAP 1. •, *Smilax elegans* subsp. *elegans*; ♦, *S. elegans* subsp. *microphylla*.

S. elegans subsp. **glaucophylla** (Klotzsch) Noltie, **comb. & stat. nov.**

Syn.: *S. glaucophylla* Klotzsch, Bot. Reise Pr. Waldemar, p. 45; t. 91 (1862). Lectotype (chosen here): Klotzsch, t. 91.

Specimens seen (all):

PAKISTAN. Kaghan to Balakot, Hazara District, 12 v 1983, *Omer et al.* 728 (BM). Murry, NE of Islamabad, 2000m, 12 viii 1989, *Bosshard et al.* 812.11 (K). Murree Mt, 13 v 1851, *Fleming* 142 (K). Jhikka Gaki to Upper Topa, 6800ft, 28 v 1918, *Sprague* 106 (K). Malkamli, Kagan Hazara, 2 vii 1899, *Duthie* s.n. (K). Natlua, NWFP, vi 1907, *Deane* s.n. (K).

KASHMIR. Below Chikar, Azad Kashmir, 6000ft, 2 x 1960, *Nasir* 1041 (E). Kishtwar, 4500ft, 18 ix 1876, *Clarke* 31393 (BM, K). Mundi, 4800ft, 4 vii 1876, *Clarke* 28293 (K). Nr Thana, 3 v 1847, *Winterbottom* 28 (K).

HIMACHAL PRADESH. Kotharna, Kangra District, 6500ft, 5 v 1901, *Hart* 539 (E). Chumba, NWH, 3200ft, 27 v 1878, *Watt* 606 (E). Salori Bridge, Bhandal, Chamba State, 4000ft, 9 v 1896, *Lace* 1349 (E). Simla, 4, 6 & 16 v 1831, *Dalhousie* s.n. (E). Simla, *Gamble* 4290A, 4926A, *Bourne* 3667, *Collett* 531 (K); 1887, *Drummond* KD 20915 (E, K). Taklech, 5000ft, 15 v 1890, *Lace* 136 (E, K). Dalhousie, 6000ft, 28 v 1917, *Stewart* 2046 (K). Kulel, Chamba, 4000ft, 26 viii 1896, *Gammie* 18439 (K).

PUNJAB. Punjab, *Drummond* KD 26082, 26084, (E, K); 26081, 26080 (K). Kulu, 4000ft, 2 vi 1952, ?SCHILPE 3205 (BM). Abbottabad, i 1902, *Drummond* 49 (K).

UTTAR PRADESH. Nynee Tal, iv 1844, vi 1845, *Thomson* 660 (E, BM). Khar Bazar, West Almora Div., Kumaon, 5 vi 1933, *Ram* 2321 (E). Mussoorie, 6000ft, v & vi 1919, *Anderson* s.n. (E). Nr Mussourie, vii 1870, *King* s.n. (E). Mussooree, *Jacquemont* 537 (K). Nr Woodstock Rocks, Naini Tal,

6800ft, 6 vi 1885, *Reid* s.n. (E). Between Pinra & Ramgarh, iv 1887, *Reid* s.n. (E). Saharunpur, *Jameson* s.n. (E). Barkot to Mandrassi, N of Massuri, x 1855, *Schlagintweit* s.n. (BM). Samkhet, Kumaon, 5500ft, *Strachey & Winterbottom* 1 (BM, K). Kamoon, *Graham* s.n. (BM). NW Himalayas, *Watt* 8874 (E). Paori, 4–6000ft, 1844, *Edgeworth* 91 (K). Chyta, Karli Himalaya, 5–7000ft, 1844, *Edgeworth* 87 (K). Deota, Tehri Garhwal, 7500ft, v 1898, *Gamble* 26732, 26694, 26863; v 1892, *Gamble* 23566 (K). Lambatach, Tehri, 7–8000ft, 13 v 1895, *Duthie* 15585 (K). Mandal, Chamoli, 4500ft, 30 ix 1970, *Naithani* 41980 (K). Kathyan, Jaunsar, 7–8000ft, 14 v 1893, *Duthie* 12943; v & vi 1891, *Gamble* 22943, 22830 (K). Kathi, United Provinces, 7–8000ft, 2 v 1939, *Legge* 12 (K).

W NEPAL. Gum nr Rara Daha, 8000ft, 14 viii 1952, *Polunin, Sykes & Williams* 5220 (BM). Shimi, 1300m, 23 vi 1974, *Dobremez* 2705 (BM). Nahapani, 1700m, 18 iv 1973, *Dobremez* 1861 (BM).

C NEPAL. Tarakhola W of Beni, 6000ft, 8 v 1954, *Stainton, Sykes & Williams* 492 (BM).

[ASSAM. Khasia, 4–6000ft, *Hooker & Thomson* s.n. (E). A distributed duplicate and almost certainly wrongly labelled.]

[A specimen at BM collected by A.P. Young bears a printed label 'Southern Maratha Country & N. Canara: Bombay Presidency'. As there are no collection details its origin must be viewed with suspicion — it exactly matches W Himalayan material.]

Distribution: W Himalaya, from N Pakistan to C Nepal. Habitat: open 'banj' forests (Osmaston, 1927); alt. 975–2440m. **Map 2.**

S. elegans subsp. **osmastonii** (Wang & Tang) Noltie, **comb. & stat. nov.**
Lectotype (chosen here): Garhwal, U.P., 2 ix 1919, *Osmaston* 1076 (comm. Beeson) — sheet with specimen lacking tendrils (K).

Syn.: *S. osmastonii* Wang & Tang in Bull. Fan Memorial Inst. 7: 298 (1937).
S. erecta Osmaston in Kew Bull. 1925: 284 (1925); non Merrill (1918).

Other specimens seen (all):

?SIKKIM: Sikkim temp., 5–7000ft, *Hooker* s.n. (K, E — distributed specimens with printed labels and no field labels so could possibly be mislabelled Assam specimens).

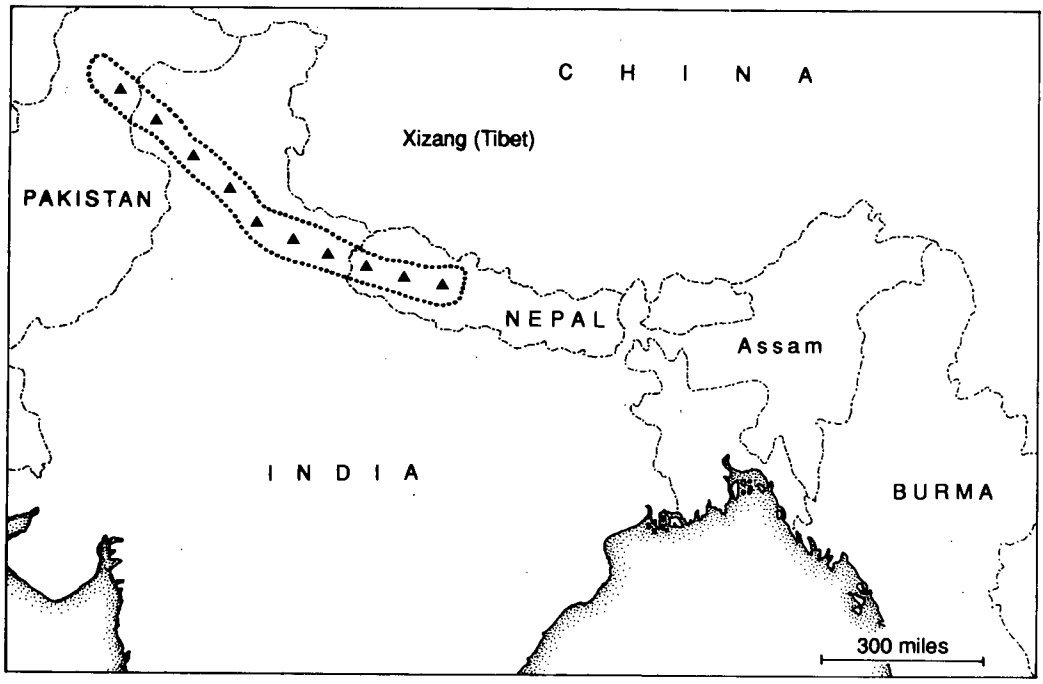
ASSAM/MANIPUR. Mishmee (towards summit), 1836, *Griffith* HEIC 5434 (K). Khasya, *Griffith* HEIC 5436 (K). Surareen, Khasia, 5000ft, 15 v 1886, *Clarke* 43891 (K). Pynursla, Khasia Hills, 5000ft, 26 xi 1946, *Kingdon Ward* 16041 (BM). Delei Valley, 6–7000ft, 3 v 1928, *Kingdon Ward* 8222 (K). Khaiyang [Manipur], 7–8000ft, 7 v 1948, *Kingdon Ward* 17418 (BM).

BURMA. Adung Valley, Upper Burma, 6000ft, 6 iii 1931, *Kingdon Ward* 9280 (BM).

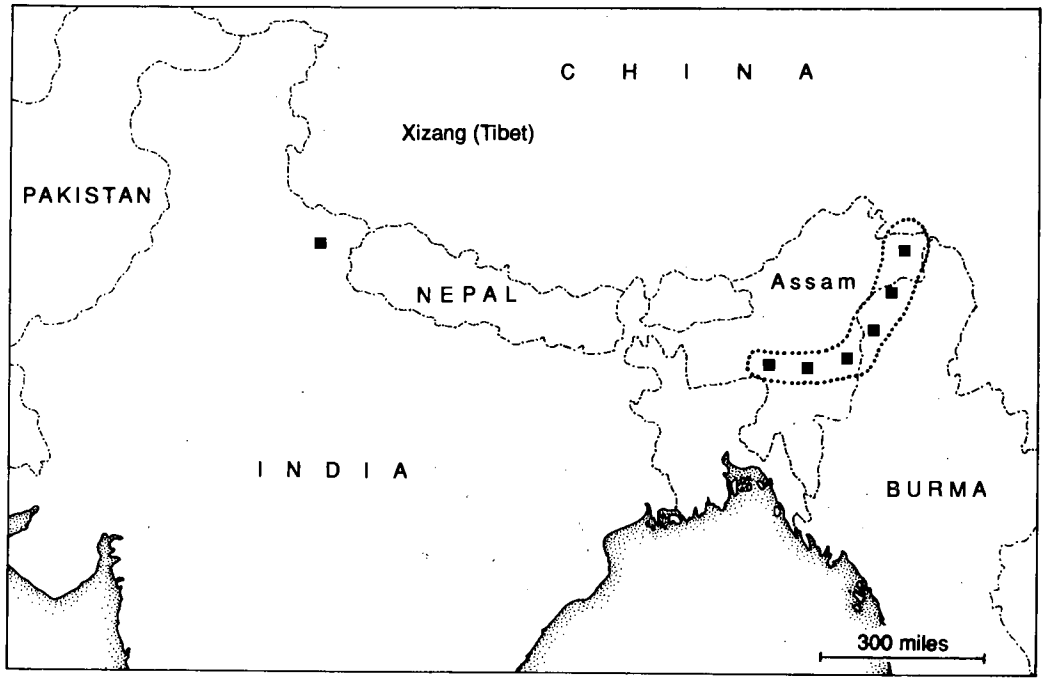
Distribution: Uttar Pradesh (Garhwal); NE India. Habitat in Garhwal: shady oak–cypress forest (according to protologue); alt. 1520–2440m. **Map 3.**

S. elegans Wall. ex Kunth subsp. **subrecta** Noltie, **subsp. nov.**
Holotype: India, Meghalaya, Shillong, 5200ft, 13 vi 1886, *Clarke* 44099A (K) — male plant.
Paratype: India, Meghalaya, Soyung, 5000ft, 16 ix 1886, *Clarke* 45405B (BM) — female plant.

Syn.: *S. longebracteolata* Hook.f., Fl. Brit. India 7: 305 (1892). Holotype: Khasia, Myrung, 4–6000ft, 17 x 1850, *Hooker* s.n. (K).
S. parvifolia Wall. Cat. no. 5118, nom. nud. (1831–32).
S. parvifolia Wall. ex Hook.f. p.p., Fl. Brit. India 7: 304 (1892), nom. illegit., non A.Br. in O. Heer, Die Tertiare Flora der Schweiz 1: 83 (1855) — a fossil species.
S. elegans var. *major* A.DC., Monogr. Phan. 1: 107 (1878). Type: Khasia, 0–3000ft, *Hooker* Smilax 12 (K).



MAP 2. ▲, *Smilax elegans* subsp. *glaucophylla*.



MAP 3. ■, *Smilax elegans* subsp. *osmastonii*.

S. elegans sensu A.DC. p.p., non Wall. ex Kunth.
S. glaucophylla p.p., sensu Koyama (1963) non Klotzsch.
S. microphylla subsp. *elongata* sensu Koyama, non Warb. (as var.).
S. mairei sensu Wang & Tang 1978, non H.Lév.

A subsp. *eleganti* ramulis lateralibus florentibus ± rectis (haud forte fractiflexis), foliis plerumque maioribus coriaceribus inferne vix glaucis, pedunculo crassiore apici ('receptaculo') conspicue tumido, bracteolis maioribus, inflorescentia mascula pluriflora.

Differs from subsp. *elegans* in its lateral flowering branchlets being more or less straight as opposed to strongly zigzag. Leaves usually larger and more coriaceous, scarcely glaucous beneath. Peduncle stouter, the apex ('receptacle') conspicuously swollen, bracteoles larger, male inflorescence with more flowers.

Other specimens seen:

BHUTAN. Bagha La, Kurmed [Mongar District], 6000ft, 26 viii 1915, *Cooper* 4598 (BM, E). Trashiyangse Dzong, 5500ft, 28 iv 1949, *Ludlow, Sherriff & Hicks* 20206 (BM).

KHASIA. Chora Poonji, Mont. Sylhet, v 1829, *Wallich* 5118 (K-W, K, BM). Shillong, 4000ft, 6 viii 1885, *Clarke* 38516 (K, BM). Shillong, 5200ft, 13 vi 1886, *Clarke* 44099 (K). Kollong Rock, 5000ft, 4 vi 1868, *Clarke* 7336 (K). Myrung, 5000ft, 12 ix 1886, *Clarke* 44758 (K). Soyung, 5000ft, 16 ix 1886, *Clarke* 45405 (BM). Nyrmai, 4500ft, 25 v 1886, *Clarke* 43996 (K, BM). Nyrmai, 5000ft, 30 x 1872, *Clarke* 19279 (K). Maophlang, 6000ft, 16 vi 1885, *Clarke* 38310 (BM). Mofling, 4–6000ft, 2 vii 1850, *Hooker & Thomson* s.n. (K). Kolapani, 4–6000ft, *Simons* 36 ex herb. Hook.f. (K). Nungkree. 13 x 1850, *Hooker & Thomson* s.n. (K). Assam, *Griffith* 1338 (BM). Churra, 4–6000ft, 17 vi 1850, *Hooker & Thomson* 1031 (K). ?Boja Panee, 4–6000ft, *Hooker & Thomson* s.n. (K). Theku bama, Naga Hills, 7000ft, 18 vi 1935, *Bor* 4458 (K).

ARUNACHAL PRADESH. Dirang Dzong, 5–6000ft, 23 v 1935, *Kingdon Ward* 11503 (BM). Dirang Dzong, 5–6000ft, 25 vi 1938, *Kingdon Ward* 13805 (BM).

MANIPUR. Ukhrul, 5000ft, 9 vi 1948, *Kingdon Ward* 17642 (BM). Khaiyang, 6–7000ft, 19 v 1948, *Kingdon Ward* 17497 (BM).

BURMA. Mount Victoria, 9000ft, 10 iv 1956, *Kingdon Ward* 21995 (BM). Mount Victoria, 8500ft, 16 iv 1926, *Unwin* 3046 (E).

YUNNAN. Shweli-Salween divide, 10,000ft, vi 1924, *Forrest* 24322 (E, K). W of Tengyueh, 5000ft, v 1912, *Forrest* 7666, 7820 (E, K). Flanks of Mingkwong Valley, 6–7000ft, v 1912, *Forrest* 7820 (E). Anning Xian, Kunming, 1850-2000m, 29 vii 1984, *Sino-american Bot. Exped.* 1439, 1444, 1450 (E). Yangbi Xian, W side of Diancang Shan, 2700m, 25 vi 1984, *Sino-american Bot. Exped.* 516 (E). Chuxiong Xian nr Longtang, 1820m, 25 vii 1984, *Sino-american Bot. Exped.* 1264, 1265 (E). Atuntze, Mt Kaakerpu, 2500m, 1 x 1937, *TT Yü* 10505 (E, BM). Atuntze, Mt Miyetzimu, 3400m, 20 x 1937, *TT Yü* 10580 (BM). Mengze, 5500ft, *Henry* 9330, 9330A (E, K). Vicinity of Yunnansen, *Maire* 1310, 1373, 1375, 2533 (E); 216, 1309, 1793 (E, K); 1306 (E, BM, K). NW Yunnan, *Monbeig* 257 (E). Chengkang, Snow Range, 2750 and 2850m, 26 and 28 vii 1938, *TT Yü* 17012, 17064 (E). Shunning, Yeuaih, 1800m, 13 v 1938, *TT Yü* 15856 (E). Shunning, Wenkuankuai, 2100m, 17 vi 1938, *TT Yü* 16332 (E). Menghua, Wepoushan, 2200m, 29 xii 1938, *TT Yü* 18284 (E). Pe ka, Kiao Kia, v 1909, *Ducloux* 1147 (E). Pe Yen Tsin, 28 iii 1916, *Ten* 64 (E). Tie so, Pe Yen Tsin, 10 vi 1916, *Ten* 180 (E). Bet. Poloti & Yung peh, 2400m, 30 vi 1914, *Schneider* 1672 (E, K). Nr Lichiang towards Taku, 3200m, x 1914, *Schneider* 3194 (K). Vallons du Tebong chan, Yunnansen, 11 vi 1905, *Ducloux* 442 (E). Marlipo: Panchiachu, 1500–1700m, 31 x 1947, *KM Feng* 12646 (A). Yunan, *HT Tsai* 62896 (K). Yunan-sen District, *Cavalerie* 7510 (K). Mengtsz, 6–7000ft, 9 vi 1895, *Hancock* 308 (K). Environs de Yunan-sen, *Ducloux* 3540 (K). Yunan-sen, vii 1897, *Ducloux & Bodinier* 212 (K). Sung Kuei, Lichiang Range, *McLaren's Coll* C222 (E, K, BM). Nr Tjintjischan, Loping, 1600m, 12 vi 1917, *Handel-Mazzetti* 10189 (K).

SICHUAN. Tienchuan Hsien: Tienchuanchow, 2500–3000ft, 9 ix 1928, *Fang* 3488 (E). Above Gaoyao, nr Ningyuen, 1650m, 14 iv 1914, *Handel-Mazzetti* 1328 (K).

TIBET. Tsekou, Thibet, 17 ix 1909, *Monbeig* s.n. (BM). Tsekou, Thibet Oriental, *Soulié* 1387 (K).

GUIZHOU. SW Kweitschou: ad viam Tschenning-Huang tsauba ... ad vic. Falang, 900m, 20 vi 1917, *Handel-Mazzetti* 10379 (A).

Distribution: NE India, SW China (Khasia, Bhutan, N Burma, Yunnan, E Tibet). Habitat: oak–pine forest; alt. 1220–3400m. **Map 4.**

S. elegans subsp. **microphylla** (C.H. Wright) Noltie, **comb. & stat. nov.**

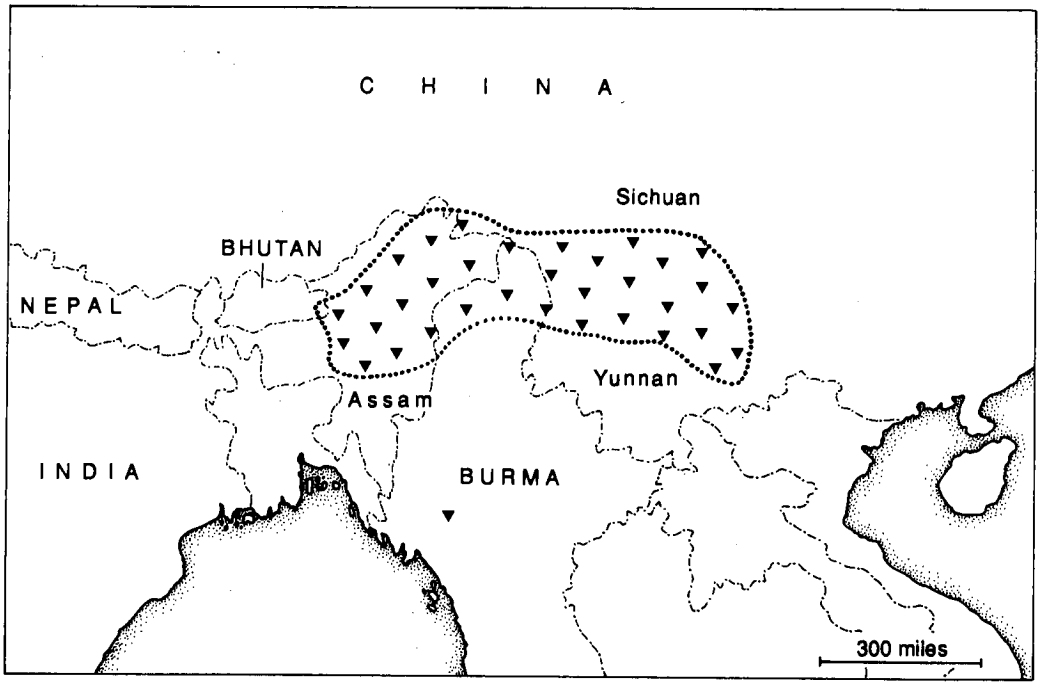
Syn.: *S. microphylla* C.H. Wright in Kew Bull. 1895: 117 (1895). Lectotype (chosen here): China, Hupeh, Ichang, *Henry* 3980 (K).

S. microphylla var. *angustifolia* Warb. in Bot. Jahrbuch. 29: 259 (1900). Isotype: Sichuan, Nanch'uan: Fupei-tsui, 8 x 1891, *Bock & von Rosthorn* 1160 (O!).

S. castaneiflora H. Lév. in Bull. Acad. Géog. Bot. 25: 39 (1915). Holotype and isotype: China, Yunnan, Tong-tchouan, 2700m, vi 1912, *Maire* s.n. (E).

S. gracillima H. Lév. & Vaniot in Mem. Acad. Pont. Nuovi Lincei 23: 355 (1905). Type: Guizhou, Tsin-gai, 15 vii 1903, *Cavalerie* 1156 (E, K).

S. labordei H. Lév. in Mem. Acad. Pont. Nuovi Lincei 23: 355 (1905). Type: Guizhou, environs de Kouy-yang, 2 vi 1898, 9 xii 1897, *Laborde & Bodinier* 2318 (E).



MAP 4. ▼, *Smilax elegans* subsp. *subrecta*.

Other specimens seen (all):

HUBEI. Patung Hsien, 3–5000ft, vi 1907, *Wilson* 3247 (A, E, K). Ichang, *Henry* 1521 (G, K — syntype of *S. microphylla*). Ichang, *Henry* 3089 (K). Ichang, *Henry* 3089A (G, K — syntype of *S. microphylla*). Ichang, *Henry* 3996 (G, K, BM — syntype of *S. microphylla*). Ichang, *Henry* 4410 (K). Nangyang Ho, 1400ft, 14 viii 1922, *WY Chun* 3866 (A, W). Hupeh, vi 1900, *Wilson* 1194 (K).

SICHUAN. Mupin, 3–4000ft, xi 1908, *Wilson* 1256 (A, E, K, BM). W Sechuan, vi 1907, *Wilson* 3247 (BM). Chengtu, 15 xii 1938, *Fang* 13200 (A). Chengtu, 4 vi 1938, *Fang* 12424 (A, W, BM). Chengtu, 1 vii 1938, *Fang* 12434 (W, BM). Chengtu, 6 xii 1943, *CY Wang* 7557 & 7357 (E). Ling-ai-ssu, Mt Omei, 3 vii 1939, *Sun & Chang* 652 (A). O-Pien Hsien, ix 1937, *Yu-Shih Liu* 2174 (A). Ching Feng Sze, nr Ya-an, 1000m, 31 vii 1939, *CY Chiao* 1296 (A). Lu-shan-hsien, 1150m, 16 x 1936, *KL Chu* 4002 (E, W, BM). Kiang-yu Hsien, Mt Kwan-yin, 1200m, *Wang* 22167, 6 viii 1920, (E). Nanch'uan: Wangt'ienling, 9 x 1891, *Bock & von Rosthorn* 1171 (O).

GUIZHOU (KWEICHOW). Jiangkou Xian, Baishuidong, 500m, 3 ix 1986, *Sino-american Guizhou Bot. Exped.* 756 (A). Jiangkou Xian, Shaoxiding, 500–650m, 2 ix 1986, *Sino-american Guizhou Bot. Exped.* 715 (A). Trinlau, 1910, *Cavalerie* 3818 (E, K).

Specimens intermediate with subsp. *subrecta*:

YUNNAN. Yung-pei-ting, 8000ft, 20 v 1921, *Kingdon Ward* 3903 (E — small-leaved but spineless).

HUBEI. W Hupeh, vi 1900, *Wilson* 1194A (K — large leaves like subsp. *subrecta*, but spiny).

Distribution: SW China (Hubei, Sichuan, Yunnan, Guizhou). Habitat unknown; alt. 430–2700m. **Map 1.**

(ii) **S. menispermoidea** A.DC., Monogr. Phan. 1:108 (1878).
Syn.: *S. elegans* sensu Hook.f., Fl. Brit. India 6: 305 (1892).

Specimens seen from Garhwal, Nepal, Sikkim, Bhutan, Assam, N Burma, Laos, Yunnan, Sichuan, SE Tibet; Kansu; [Shaanxi, Hubei, Guizhou teste Wang & Tang 1978]; [Viet-Nam teste Koyama 1983].

Records from Punjab (Koyama, 1963) almost certainly refer to *S. elegans* subsp. *glaucophylla*.

Distribution: Sino-Himalaya. Habitat: *Abies–Rhododendron* forest, 2100–3700m.

(iii) **S. minutiflora** A.DC., Monogr. Phan. 1: 109 (1878). Lectotype (chosen here): Assam, Mishmee (summit), 1836, *Griffith* HEIC 5433 (K!).

Other specimens seen:

E NEPAL. Memeng to Chyangthapu, 8000ft, 11 vi 1969, *Williams* 553 (BM). Above Yamphudin, 2380m, 26 ix 1989, *KEKE* 973 (K, E). NE of Guphar Pokhari, 2870m, 30 viii 1989, *KEKE* 107 (K, E).

SIKKIM. Chola, 8000ft, xi 1849, *Hooker* s.n. (K). Prek Chhu below Bakhim, 2400–2800m, 8 vii 1992, *ESIK* field record.

DARJEELING DISTRICT. Sandakphu–Garibans, 2600–3000m, 7 vi 1960, *Hara et al.* 1726 (BM). Sinchul, 8–10,000ft, *Hooker Smilax* 4 (K, BM — printed labels on duplicates give locality as 'Sikkim temp.'). Senchal, 2400m, 6 iv 1960, *Hara et al.* 1724 (BM). Senchal, 8500ft, x 1879, *Gamble* 7269 (K). Senchal, v 1878, *Lister* s.n. (K). Sonada, 7000ft, 19 vi 1876, *Clarke* 28089 (BM, K). Sonada, 6500ft, 14 vi 1877, *King* 4760 (K). Tonglo, 9000ft, 1913, *Ribu & Rhomoo* 6295 (E). Tonglo, 10,000ft, vii 1882, *Gamble* 10388 (K). Khursiong, 7000ft, 28 ix 1884, *Clarke* 36011 (K). Ging, 5000ft, vi 1874, *Gamble* 1131A (K). Darjeeling, 9000ft, 3 ix 1875, *Clarke* 27383 (K). Above Nursery, Rungbool, 7000ft, viii 1875, *Gamble* 1130A (K). Bet. Ghoom and Tiger Hill, 2460m, 5 vii 1992, *ESIK* 38 (E).

BHUTAN. Bootan, *Griffith* K.D. 2640 (K, BM). Thimphu–Dochu La, 2250–3050m, 30 v 1967, *Kanai et al.* 759 (BM, E). Chabley Khola above Sham Khara, 1800m, 3 vi 1979, *Grierson & Long* 1589 (E). Jumudag to Tala, 2060m, 22 ii 1982, *Grierson & Long* 3139 (E).

ASSAM. Patkari (summit), *Griffith* s.n. (K).

N BURMA. Sumpra Bum, 3500ft, 10 ii 1953, *Kingdon Ward* 20539 (BM). Uring Bum, 7500ft, 3 xi 1953, *Kingdon Ward* 21548 (BM). 27°35'N, 97°40'E, 3–4000ft, 5 xii 1937, *Kingdon Ward* 13542 (BM). Janrawng Bum, Sumprabum, 7–9000ft, 7 i 1962, *Keenan et al.* 3147A and 3156 (E). Kachin Hills, *Toppin* s.n. (K).

YUNNAN. Mengzi, 5500ft, *Henry* 9415A (E).

SICHUAN. Kuan-hsien: Mt Tsing-cheng, 25 ix 1938, *Fang* 13116 (BM, W).

Distribution: E Himalaya, SW China. Habitat: oak forest; alt. 1070–3050m.

(iv) **S. myrtillus** A.DC. var. **rigida** Noltie, **var. nov.**

Syn.: *S. rigida* Wall. ex Kunth, Enum. Pl. 5: 164 (1850), nom. illegit, non Solander in Russell, Nat. Hist. Aleppo (Ed. 2) 2: 271 (1794). Type: Nepal, 1821, *Wallich* 5120 (iso. E!).

A var. *myrtillo* caulibus spinosis et foliis coriaceis ovatis cordatis (haud subherbaceis rhomboideo-ovatis subcuneatis) differt.

Distribution: Primarily E Himalaya (C Nepal, Sikkim, Assam, Bhutan); specimens also seen from N Burma and W Yunnan. Habitat: oak–rhododendron forest; alt. 2130–2900m.

KEY TO HIMALAYAN SPECIES OF SECT. *VAGINATAE* AND SUBSPECIES OF *S. ELEGANS*

It is difficult to write a dichotomous key to this group due to extreme plasticity, especially of leaf characters. Leaf shape and size is especially variable and there are often differences between vegetative and flowering shoots. Leaf texture is also very variable, with leaves of normally herbaceous species sometimes becoming coriaceous (due to habitat or perhaps climatic or seasonal effects). Flower colour seems to be of no value, with all species varying from greenish to brown or purple.

1. Shrubs completely lacking tendrils ____ 2
\+ Climbers with tendrils developing from apex of petiole sheaths ____ 6

2. Leaves subsessile or sessile ____ 3
\+ Leaves distinctly petiolate ____ 4

3. Stems spiny; leaves sessile, ovate-cordate, coriaceous ____ **S. myrtillus** var. **rigida**
\+ Stems spineless; leaves subcuneate at base, usually herbaceous ____ **S. myrtillus** var. **myrtillus**

4. Leaf abscission from swollen apex of petiole; lower leaf surface papillose ____ **S. elegans** subsp. **osmastonii**
\+ Apex of petiole not swollen, leaf abscission above apex of petiole sheath, but below base of leaf blade; leaves not papillose beneath ____ 5

5. Leaf blade truncate, oblong-ovate, apex ± blunt _____ **S. vaginata**
\+ Leaf blades not truncate, blades of upper leaves narrowly lanceolate, apex abruptly acuminate _____ **S. minutiflora**
6. Stems spiny; peduncle shorter than subtending petiole ___ **S. elegans** subsp. **microphylla**
\+ Stems spineless; peduncle shorter to longer than petiole _____ 7
7. Petiole wings narrowly triangular, gradually narrowing from base to apex; leaves ovate _____ **S. menispermoidea**
\+ Petiole wings oblong; leaves lanceolate _____ 8
8. Leaves glaucous beneath; branchlets strongly zigzag; receptacle not swollen _____ **S. elegans** subsp. **elegans**
\+ Leaves not glaucous beneath; branchlets ± straight; receptacle swollen _____ 9
9. Leaves drying pale greyish-green, finely reticulate above; bracteoles minute; peduncle slender usually greatly exceeding petiole _____ **S. elegans** subsp. **glaucophylla**
\+ Leaves drying olive-brown (sometimes darker), coarsely reticulate above; bracteoles conspicuous; peduncle conspicuously flattened, shorter than to equalling petiole (occasionally longer) _____ **S. elegans** subsp. **subrecta**

SECTION MACRANTHAE

S. wallichii

There has also been confusion over the correct name for an E Himalayan *Smilax* belonging to section *Macranthae* Kunth emend. Koyama, which occurs from C Nepal to Sikkim. It is characterized by its large, coriaceous, acuminate, narrowly ovate leaves; narrow petiole wing; large, many-flowered umbels borne singly on long, stout, bracteate peduncles; elongate receptacles; and conspicuously large flowers. Specimens have been determined as belonging to at least 8 different taxa! I propose to use the name *S. wallichii* Kunth for this taxon, which is close to *S. orthoptera* A.DC. and perhaps to *S. blumei* A.DC.

S. wallichii was based by Kunth on a duplicate (no longer extant at Berlin) from the Wallich herbarium numbered 5124B; he evidently realized that more than one taxon was distributed under that number as he adds 'ex parte'. In fact none of the 12 specimens numbered 5124 (and all belonging to either *S. prolifera* Roxb. or *S. ovalifolia* Roxb.) in K-W fits his description. In distributing this number even more errors must have occurred than usual, since there are specimens at K and E labelled 5124D, which do not agree with any specimens in K-W (according to de Candolle, specimens in herb. Delessert numbered 5124D were '*S. ovalifolia*' = *S. prolifera*). Kunth's plant appears to have been male and it was de Candolle who suggested that a specimen in Hooker's herbarium (now in the general herbarium at Kew) labelled *Wallich* 5124D was probably the female of *S. wallichii*. As he had seen Kunth's type, it seems reasonable to accept his opinion. Although as in all cases of this sort there must always remain some uncertainty I would thus recommend adopting this specimen as a neotype, allowing the name to be used for a distinctive and widespread E Himalayan species.

S. wallichii Kunth, Enum. Pl. 5: 246 (1850).

Neotype (chosen here): Napal, [Wallich] 5124D (K — specimen ex herb. Hooker, annotated by A.DC. 'Smilax wallichii Kunth? (femina)').

Other specimens seen:

NEPAL. Nepal, *Wallich* 5124D (K, E), (non K-W). Nepal, 1821, *Wallich* s.n. (K). Between Ghanpokhara and Lamjung, 6000ft, 2 v 1954, *Stainton, Sykes & Williams* 5150 (BM). Hills round Nepal Valley, 4–8000ft, 17 ii 1954, *Proud* 225 (BM). Nagarjong, Nepal Valley. 5000ft, 2 iii 1967, *Stainton* 5666 (BM). NW slope of Nagarjung, Bagmati Zone, 1500m, 2 iii 1967, *Nicolson* 2942 (BM). Phulchoke, S of Kathmandu, 6000ft, 20 ii 1966, *Schilling* 739 (K). Godavari, 5500ft, 18 iii 1975, *Stainton* 7314 (E). Narainhetty, 7 ii 1803, *Buchanan Hamilton* s.n. (BM). Phulchoki, N side, 6000ft, 15 ii 1967, *Pradhan et al.* 6744 (BM). Sooryavinayak, 5000ft, 15 vi 1957, *Fell* 50 (BM).

DARJEELING DISTRICT. Sikkim Trop., 1–5000ft, *Hooker* s.n. (K, BM). Rangirun, 6000ft, 9 iv 1903, *Lace* 2671 (E). Kursiong, 4000ft, 29 ii 1876, *Clarke* 27052 (K, BM). Ambiokh, 2000ft, iii 1875, *Gamble* 1140A (K). Mamring, 4000ft, 20 ii 1912, *Ribu & Rhomoo* s.n. (E).

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NOTES RELATING TO THE FLORA OF BHUTAN: XXVIII
Eriocaulaceae (*Eriocaulon*), Musaceae (*Musa*), Cyperaceae (*Actinoscirpus*)

H. J. NOLTIE*

The following new taxa and combinations of plants from India and Bhutan are made: *Eriocaulon bhutanicum* Noltie *sp. nov.*; *Musa griersonii* Noltie *sp. nov.*; *Actinoscirpus grossus* (L.f.) Goetghebeur & D.A. Simpson var. *kysoor* (Roxb.) Noltie, *comb. nov.*

ERIOCAULACEAE

Eriocaulaceae (represented by only one genus, *Eriocaulon*) is a small, but under-collected, family in the *Flora of Bhutan* area. The *Flora* account covers six species with two additional doubtful ones. This is rather fewer than expected when compared with adjacent regions, although the majority of the 50+ Indian species (Fyson, 1923) occur in subtropical areas, and the number recorded for Nepal (13; Hara et al., 1978) includes some doubtfully distinct, recently described, taxa. Regardless of number of taxa, *Eriocaulon* species appear from field experience to be genuinely much commoner in Nepal, where they occur as frequent rice-field weeds. Parker (1991, 1992) made a detailed study of the weeds of Bhutan and found *Eriocaulon* to be very rare, so the difference appears to be genuine.

Nevertheless, when revising the group one of John Wood's collections was found to represent an undescribed species.

Eriocaulon bhutanicum Noltie, **sp. nov.**
Type: Bhutan, Thimphu District, above Serbitang, 2600m, 18 ix 1988, *J.R.I. Wood* 6689 (holo. E).

Ab *E. rockiana* Hand.-Mazz. petalis florum femineorum angustissimis (0.1mm latis, non 0.2mm), albis (non griseis), apicibus glandulosis, et seminibus tenuiter transverse elongato-reticulatis et papillis parvis obtectis (haud longitudinaliter sulcatis epapillosis) differt. **Fig. 1.**

Differs from *E. rockianum* Hand.-Mazz. as follows: female petals very narrow (0.1 not 0.2mm), white (not grey), gland-tipped (vs. not gland-tipped); seeds with fine, transversely elongate reticulation and covered in small white papillae (not longitudinally grooved and epapillose).

Tufted, ?annual rosette herb. *Leaves* gradually tapered to acute apex, less than ⅓ length of scape, c.0.8mm wide at base. *Scape* filiform, weak, 2–6cm, 3–5-grooved. *Capitulum* hemispherical, 1.5–3mm diam., black and white (from white hairs on dark floral parts); receptacle slightly convex, glabrous. *Involucral bracts* erect, broadly oblong to obovate, blunt, 1.3–1.5 × 0.8–1.2mm,

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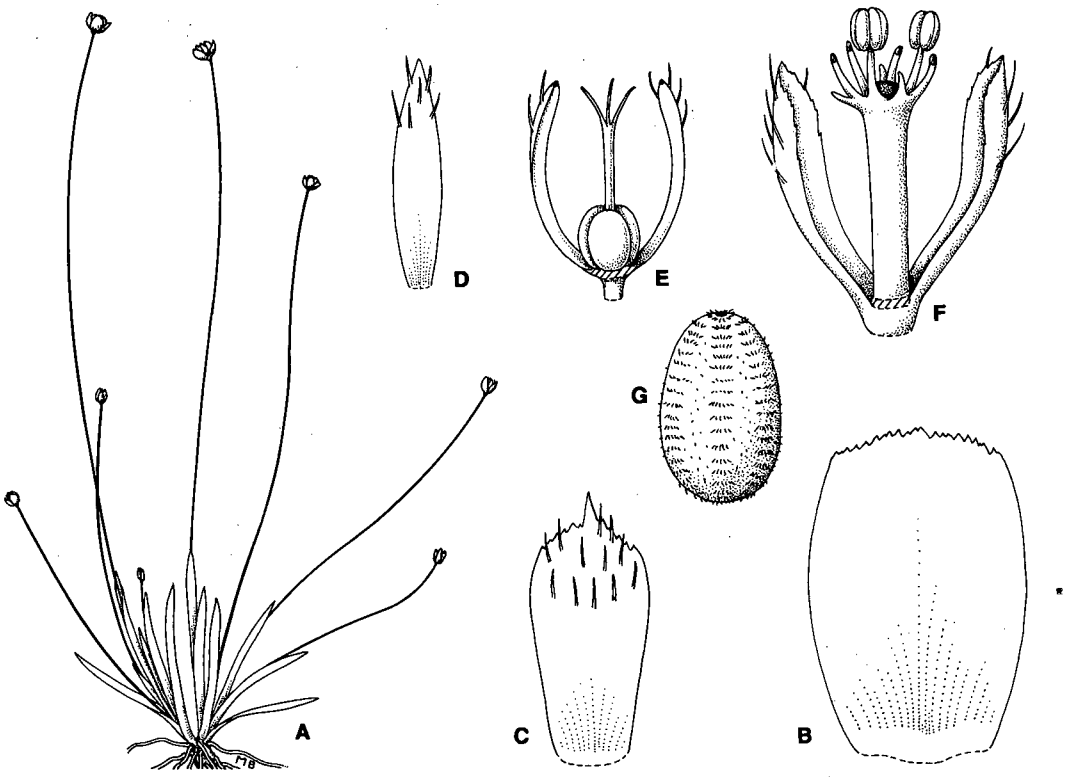

FIG. 1. *Eriocaulon bhutanicum* Noltie. A, habit (× 1.5); B, involucral bract; C, floral bract; D, female sepal; E, female flower, 1 petal removed; F, male flower, 1 sepal removed (B–F, × 27); G, seed (× 54). Drawn by Mary Bates.

glabrous, blackish-hyaline. *Floral bracts* finely acuminate, c.1.2 × 0.4mm, black above with short white hairs. *Female flowers* sessile; sepals 3, oblong-elliptic, acute, c.1 × 0.3mm, grey, white-hairy; petals linear, black-gland-tipped, c.0.8 × 0.1mm, membranous, white, hairy; ovary sessile; style c.1mm, divided ⅓ to halfway. *Male flowers* c.1.3mm long; calyx 3-lobed for ⅔, lobes c.0.8 × 0.2mm, grey, hairy; petals minute, subequal; anthers 1–2(–3?), black. *Seeds* oblong in outline, c.0.4 × 0.3mm, pale brown, marked with fine, transversely elongate reticulation and densely covered with rows of minute white papillae.

Habitat: in open swamp with scattered, grazed *Arundinaria*.

There are few collections of *Eriocaulon* from natural (or at least semi-natural) habitats at high altitude in the Himalaya and China. An exception is the widespread *E. alpestre*, which has been collected from Kumaon, Nepal, Sikkim, SE Tibet, Khasia, Yunnan and Sichuan and grows up to an altitude of 3960m. This and two Chinese species superficially resemble *E. bhutanicum*, having slender scapes and very small, black capitula. They can be distinguished from it as follows:

E. alpestre Hook.f. & Thoms. ex Körn. has distinctive female petals which are white, swollen, gland-tipped and glabrous and differentiated into a claw and blade; female calyx spathe-like, scarcely 3-lobed, glabrous.

E. rockianum Hand.-Mazz. (Yunnan) has broader, grey female petals which are not gland-tipped, and the seeds are epapillate and grooved.

E. leianthum W.L. Ma (Yunnan: 3100m) has female petals similar in shape (and likewise gland-tipped) to those of *E. alpestre* but they are hairy; floral bracts broad (× 0.9mm), blunt, glabrous; female sepals glabrous.

MUSACEAE

The native bananas of Sikkim/Darjeeling and Bhutan have been severely neglected taxonomically since the late nineteenth century, when George King made pioneering descriptions of four native taxa from the former area. These descriptions have never been completely published, although they were taken up in various ways by Baker (1893), Schumann (1900) and Cowan & Cowan (1929). A copy made by Hooker of King's manuscript fortunately survives at Kew and this might be worth publishing at a later stage of studies of the bananas of the whole NE Indian region: this would be a worthwhile future project, given their neglect and importance as wild relatives of a very important group of crop plants. Additional species are highly likely to occur in the area covered by the *Flora of Bhutan*, particularly in the lower, forested parts of Bhutan, where, for example, no member of Section *Rhodochlamys* has yet been recorded. The forthcoming account for the *Flora* is far from satisfactory, but one of the species for which there are good recent photographs resembles no known species and is worth describing at this stage, despite the lack of notes on certain critical characters such as growth habit and seeds. It is named in honour of the late Andrew Grierson, who discovered the plant with David Long.

Musa griersonii Noltie, **sp. nov.**
Holotype: Bhutan, Sarbhang District, above Jhogi Dhanra, 11km above Sarbhang on Chirang road, 740m, 8 iii 1982, *Grierson & Long* 3566 (E).

A *M. balbisiana* Colla alis petioli horizontaliter patentibus (non involutis), foliis infra haud ceraceis, bracteis florum masculorum extus fuscopurpureis (non glaucis rubropurpureis), intus pallide roseis (non kermesinis), apice reflexo (non recto) differt; a grege *M. acuminati* Colla margine vaginae folii distaliter valde scarioso recedit. **Fig. 2.**

Differs from *M. balbisiana* Colla as follows: petiole wings spreading horizontally (not inrolled), leaves not waxy beneath, male bracts brownish-purple (not glaucous reddish-purple) outside, and pale pink (not crimson) inside, tip reflexed (not straight). Differs from the *M. acuminata* Colla complex in not having a pronounced scarious margin on the upper part of the leaf sheath.

Pseudostem 3m, stout, marked with purplish-brown below, waxy, glaucous green above with upper margins of leaf sheaths ± smoothly appressed, with a narrow black line at the edge not or only minutely and irregularly scarious. *Leaf blades* scarcely spreading, oblong, base rounded, 2–2.5m; midrib blackish-purple beneath. *Petiole* to 50cm, lower part glaucous, dark purple on abaxial side, margins developed into outward-curving, green wings. *Inflorescence* pendent, axis

FIG. 2. *Musa griersonii* Noltie. *Left*, upper part of stem, leaves and inflorescence; *right*, close-up of inflorescence. Photographs by D.G. Long.

glabrous. *Bracts* of male flowers recurving at tip, deciduous, dark brownish-purple outside, inside pinkish with cream margins. *Male bud* elongate, acute, twice as long as broad, almost totally convolute. *Female flowers* borne in 7 or more hands, each of 22 or more flowers borne in 2 rows on small callosities; compound tepal pinkish-cream, c.3.5cm, teeth c.4mm, free tepal c.2.5cm, staminodes 5, shorter than free tepal. *Immature fruits* forwardly directed, very shortly pedicellate, sharply angled. *Male flowers*: compound tepal c.4.5 × 1cm, orange-yellow, teeth to 4mm; free tepal c.2cm; stamens shorter than compound tepal.

Easily spotted at some distance by the very distinctive blackish-purple midribs, and confirmed by the winged petioles.

Habit and mature fruit/seeds not known.

Known with certainty only from the type; more collections required.

This taxon might, perhaps, be the same as King's inadequately described 'var. *dubia*' (*M. sapientum* L. var. *dubia* (King ex Schumann) Cowan & Cowan); Lepcha name 'luxom'. King distinguished this from his 'var. *pruinosa*' (i.e. *M. balbisiana* Colla) as follows: less tall (stem 3.6–4.5m) and robust; leaves glaucous only when young; bracts deciduous; fruit thinner, brown; seeds smaller (6.3 × 8.4mm). Leaf blade elliptic, 1.65 × 0.5m; petiole 0.6m. Sikkim/Darjeeling from 457–1676m (common between 610 and 914m).

CYPERACEAE

Actinoscirpus grossus

When Goetghebeur & Simpson (1991) made the combination *Actinoscirpus grossus* for a widespread SE Asian sedge of wandering generic habits, they commented that the species showed 'a wide range of morphological variation and closer study may reveal the presence of infraspecific taxa . . .'. It appears that one Indian form of the plant is a case in point, and worthy of retaining at varietal rank. The plant was originally described as *Scirpus kysoor* by Roxburgh. Nees (1834) seemed to regard it as distinct from *Scirpus grossus*, but was evidently not certain enough to make the combination under *Hymenochaete* to which he transferred *S. grossus*. For discussion of the complicated generic history see Goetghebeur & Simpson (1991). Clarke (1893) reduced the taxon to a variety of *Scirpus grossus*.

The taxa can be separated on a number of vegetative and floral characters, as clearly established by Roxburgh.

var. **kysoor**: stem angles hispid; glumes commonly narrowed towards apex, strongly mucronate; hypogynous bristles 'plumose' with twisted, multicellular, spreading, glandular hairs.

var. **grossus**: stem angles smooth; glumes wide just below rounded apex, minutely apiculate; hypogynous bristles with sharp, backward-pointing, unicellular hairs.

In Indian material, the stem and glume characters appear to be diagnostic by themselves, which is convenient since the nature of the hairs on the bristles is difficult to see without a good microscope. A further important character is shown on the Roxburgh drawing, in that var. *kysoor* bears tubers on its roots (?stolons) and a footnote to his listing of the name in *Hortus Bengalensis* (Roxburgh, 1814) states it to have esculent roots, a character not given for var. *grossus* in the same work. Several more recent specimens bear annotations mentioning edible tubers in var. *kysoor*, which suggest that the plant might at some point have been deliberately cultivated or spread about.

TYPIFICATION

In the absence of specimens, species published in Roxburgh's *Flora Indica* are normally typified by the Roxburgh Icones at Kew, in this case No. 2017 labelled *Scirpus kysoor* Roxb. This illustration is not particularly good; although it shows a root tuber, the shape of the glume is closer to var. *grossus*, and the stem angles and hypogynous bristles are not at high enough magnification to show. I therefore propose as an epitype (Art. 9.7 of forthcoming Code) *Buchanan-Hamilton* 173 to back up the lectotype. This material is immature and does not show the diagnostic bristle character. However, it does show both glume and stem angle characters, and these, together with the annotation of the Hindi name on which Roxburgh based his specific epithet, are justification for this designation.

Actinoscirpus grossus (L.f.) Goetghebeur & D.A. Simpson var. **kysoor** (Roxb.) Noltie, **comb. nov.**

Lectotype (chosen here): Roxburgh Icones No. 2017 (K).

Epitype (chosen here): *Buchanan-Hamilton* 173 (E; dupl. in K-W). The epitype has the following supporting documentation:

Field ticket: Scirpus kesor. Nathpur 10th Sept. 1810.

Entry in Buchanan-Hamilton's manuscript catalogue (E): 'Scirpus kysoor Hort. Beng: 6 [Roxb: Fl: Ind: i, 235 in later writing] Kesor Hindice. Habitat in stagnis et arvis inundatis Mithila'.

Syn.: *Scirpus kysoor* Roxb. *nom. nud.*, Hort. Bengalensis 6 (1814).
S. kysoor Roxb., Fl. Indica 1: 235–6 (1820).
S. grossus var. *kysoor* (Roxb.) C.B. Clarke in Fl. Brit. India 6: 660 (1893).

Distribution: India (mainly North, Central and East), Pakistan, Nepal, Bangladesh and Burma.

Specimens seen from India (W Bengal, Assam, ?Arunachal Pradesh, Maharashtra, Bihar, Orissa); Bangladesh (Chittagong); Nepal; Pakistan (Sind); Burma (Lower Burma).

Var. *grossus* is more widespread, occurring in China, Japan, Malesia and Australia. A very few specimens from these regions have scabrid stem angles, but none have plumose bristles.

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NOTES RELATING TO THE FLORA OF BHUTAN: XXXVIII. *GRAMINEAE* I, TRIBE STIPEAE

H. J. NOLTIE*

Three new species and one new subspecies of *Stipa* are described from the E Himalaya: *S. jacquemontii* subsp. *chuzomica* and *S. bhutanica* which appear to be endemic to Bhutan; *S. milleri* from Nepal, India (Sikkim) and Bhutan and *S. rohmooiana* from India (Sikkim).

Keywords. E Himalaya, new taxa, *Stipa*.

INTRODUCTION

The family *Gramineae* has been rather poorly collected in the *Flora of Bhutan* area, but even given this general neglect, the genus *Stipa* L. is represented by notably few specimens in British herbaria. It is not possible to be certain whether or not this is due to genuine rarity. As the majority of the species are high alpines (occurring over 3300m), it seems likely that at least those species are genuinely rare and rather isolated geographically. However it should be noted that the previously rarely collected *S. roylei* (Nees) Mez, which occurs at intermediate altitudes (above 2300m) was found, on a recent field trip, to be common thoughout the country in suitable habitats.

Revision of the genus for the *Flora* has found it to be represented by 11 taxa, of which no fewer than four appear to be undescribed. The genus is thus relatively small in our area, compared with other parts of Asia: for example Freitag (1985) treats 42 species in the area between the Mediterranean and the Himalaya as far east as Nepal; if one adopts Freitag's generic concepts, then Tzvelev (1984) treats 71 species for the former USSR, Wu (1987) 28 for Tibet and Kuo (1987) 44 for China. The genus is controversial in terms of delimitation, and Russian and Chinese authors have tended to use segregate genera. It is also problematic at the species level, not least as so many of the species are known from very few specimens. A comprehensive revision of all Asian species, including China, is badly needed.

Having studied the specimens in the herbaria of BM, K and E and available literature, the following taxa appear to be undescribed. Nevertheless it is with some trepidation that I describe them, given our poor knowledge of the Chinese species. Accounts of *Stipeae* are published for Tibet (Wu, 1987) and for the whole of China (Kuo, 1987) in Chinese, but unfortunately the numerous illustrations in the latter are too small and poorly reproduced to be of much help. The broad generic concept of Freitag (1985) is followed, though I find it hard to place some of these species into his sections.

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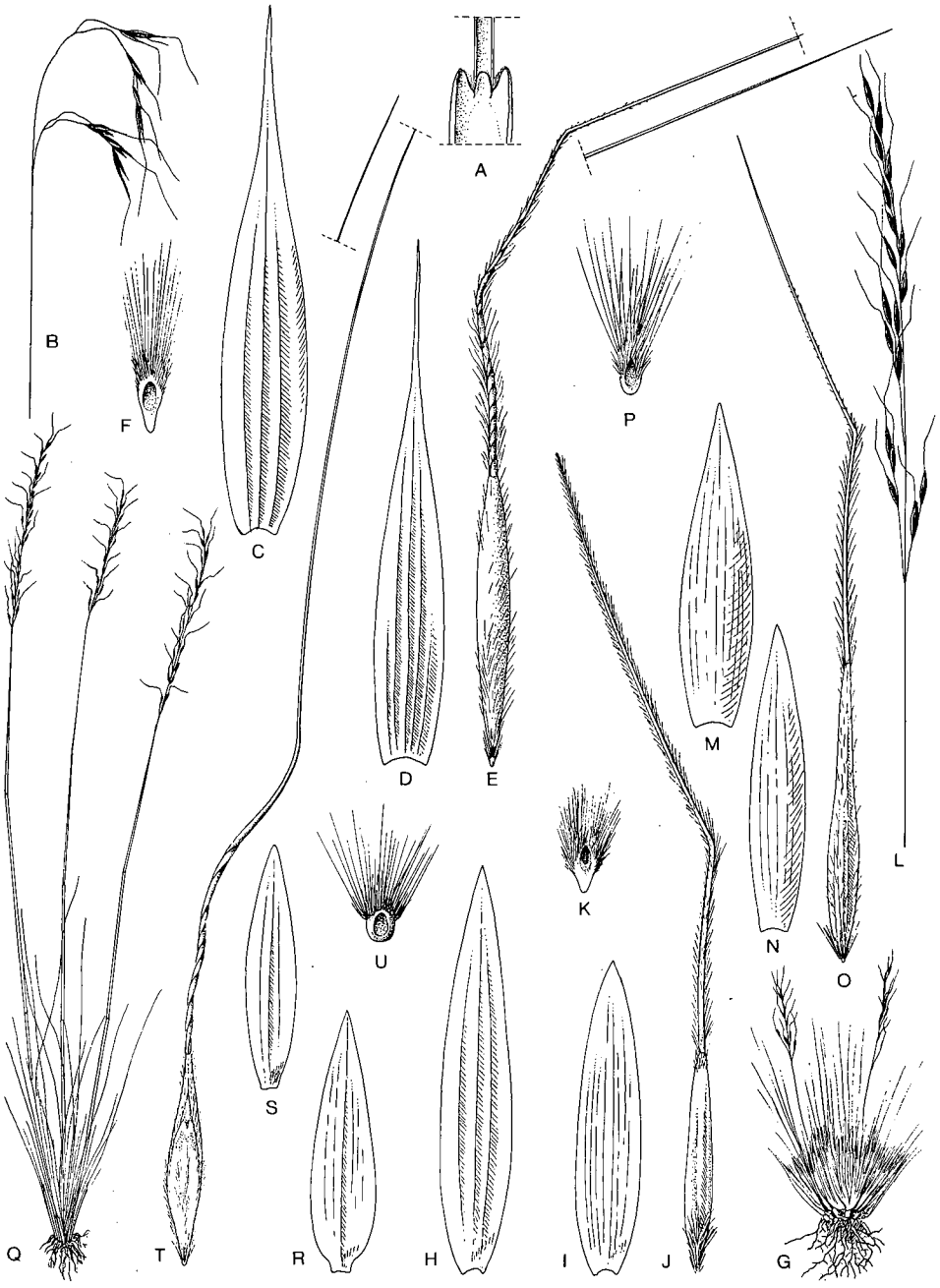
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S. rohmooiana Noltie, **sp. nov. Fig. 1A–F**

Affinis *S. alienae* Keng, sed characteribus sequentibus differt: tota planta (culmi, folia, inflorescentiaque) minor, foliorum culmi vaginarum margines sursum in auriculas prominentes triangulares utroque latere ligulae productae; inflorescentia spiculis paucioribus (6–7 non c.20), glumae atropurpureae (non stramineae vel flavobrunneae), ea inferior veinis paucioribus (3–4, nec 7–9), pili in dorso lemmatis breviora (c.0.5mm nec 1.5mm). Affinis *S. purpureae* Griseb. in inflorescentiae forma et colore sed characteribus sequentibus differt: anthecium brevius (c.7.5mm, non plus quam 8mm); callus brevior (c.1.2mm, non plus quam 1.5mm); arista brevior (usque ad 24mm, non plus quam 50mm), infra articulationem inferiorem solum pilosa, pilis brevioribus, 0.8–1.2mm longis, seta minute scabrida. Similis etiam *S. regelianae* Hack. a qua differt statura humiliore, inflorescentia laxiore, glumis longioribus, arista lemmatis longiore, seta aristae minute scabrida.

Type: India, Sikkim, Chugya, 15,000ft, 12 ix 1912, *Rohmoo* 277 (holo. E, iso. K).

Densely tufted, branching intravaginal. *Culms* 3.5–12cm, pubescent below inflorescence, nodes concealed. *Culm leaves* 2; sheaths glabrous, that of upper leaf more than half-length to almost equalling culm, margins extended upwards into auricles, auricles c.1.2mm, triangular, rounded, hairy; ligule c.0.8mm, triangular, ciliate; blades 1–2cm, filiform, inrolled, minutely rough on veins on upper surface, lower surface smooth. *Basal leaves* similar, blades 3–6cm, glabrous. *Inflorescence* 4–8cm, of 5–7 spikelets, lax, branches borne singly, flexuous, pubescent, the lower two to 1.8cm, bearing 2 spikelets, upper spikelets borne singly, pedicels to 1.5cm, filiform, flexuous, pubescent. *Spikelets* c.13.5mm. *Glumes* papery, dark purple, subequal, margins and apex widely hyaline; the lower 13–13.5 × c.2mm, oblong-lanceolate, finely acuminate, 3–4-veined; the upper similar, 12.8–13.2 × c.1.7mm, 4–6-veined. *Anthecium* c.7.5mm; callus c.1.2mm, acute, curved in lateral profile, scar lanceolate, hairs to 1mm. *Lemma* c.6.3 × 0.8mm, cream, linear, back hairy all over, hairs c.0.5mm, margins tightly enclosing palea; awn 22.2–24mm, bigeniculate at 5.5–6 and at 8.5–9.5mm, column twisted, hairy, hairs 0.8–1.2mm, decreasing to 0.2–0.5mm below second articulation, seta very minutely scabrid. *Palea* c.6 × 0.5mm, very slightly shorter than lemma, with a few, sparse hairs on back. *Lodicules* 3, similar, linear-lanceolate, acute, c.1mm. *Anthers* 3–3.2mm, cells not bearded.

Other specimen seen. Sikkim, Chaerlung, 16,000ft, 12 ix 1912, *Rohmoo* 385 (E).

FIG. 1. *Stipa rohmooiana* Noltie (*Rohmoo* 277): A, sheath apex of culm leaf (×6); B, inflorescence (×½); C, lower glume (×6); D, upper glume (×6); E, anthecium (×6); F, callus scar (×16). *S. milleri* Noltie (*EENS* 349): G, habit (×⅓); H, lower glume (×6); I, upper glume (×6); J, anthecium (×6); K, callus scar (×16). *S. bhutanica* (*NPSW* 349): L, inflorescence (×⅔); M, lower glume (×6); N, upper glume (×6); O, anthecium (×6); P, callus scar (×16). *S. jacquemontii* subsp. *chuzomica* Noltie (*NPSW* 333): Q, habit (×¼); R, lower glume (×6); S, upper glume (×6); T, anthecium from front showing short palea (×6); U, callus scar (×16).

These sheets were studied by Bor, who initially identified them as *S. purpurea*, then later as *S. regeliana*. From the callus shape this species is probably best placed in sect. *Pseudoptilagrostis* Tzvelev. However, it is also similar in some ways to *S. regeliana* which Freitag (1985) placed in sect. *Achnatheropsis* Tzvelev. From the protologue (Keng, 1941) and the illustrations in Wu (1987) and Kuo (1987) it is clearly very close to *S. aliena* Keng, described from Kansu, of which no authenticated specimens have been seen.

The name commemorates the Lepcha collector Rohmoo. Lepcha collectors based at the Government Quinine Factory at Mungpoo near Darjeeling were first used by Sir George King as a means of obtaining seeds and specimens for the Calcutta herbarium. Along with Ribu, Rohmoo was one of the collectors employed by William Wright Smith and G.H. Cave to explore the mountains of Sikkim around 1910. Lepchas are the indigenous people of Sikkim, who made excellent and observant plant collectors and were also used by Ludlow and Sherriff.

S. milleri Noltie, **sp. nov. Fig. 1G–K.**

Affinis statibus parvis *S. mongholicae* Turcz. ex Trin. (=*S. concinnae* Hook.f.) in characteribus vegetativis et aristis lemmatis usque ad apicem plumosis, sed in characteribus sequentibus differt: panicula linearis; glumae inequalis, longiores (inferior c.10mm, non minus quam 6mm); callus acutus. In forma calli et aspectu generali spicularum similis etiam *S. roborowskyi* Roshev., sed ab illa differt glumis brevioribus (inferior non plus quam 14mm longa) et arista breviore, unigeniculata (haud bigeniculata et plus quam 30mm).

Type: India, Sikkim, Goichang, Lasha Chhu valley, 27°55′52″N, 88°36′17″E, 4555m, 19 vii 1996, *EENS* 349 (holo. E, iso. BSHC).

Densely tufted, branches intravaginal. *Culms* short (3–7cm), nodes basal, concealed. *Culm leaves* 1–2, sheaths glabrous, margins widely hyaline, not auriculate at apex, ligule 2.5–2.7mm, broadly triangular, apex rounded; leaf blades to 3.5cm, filiform, inrolled, shortly hairy on veins above, minutely scabrid on veins beneath. *Basal leaves* similar, blades 3–7cm. *Inflorescence* 3.7–6cm, not or only slightly exserted from upper leaf sheath, linear, ± simple, spikelets borne singly or in pairs on infl. axis, pedicels 0.7–1.2cm, erect. *Spikelets* 9.4–10.2mm, purplish. *Glumes* unequal, green flushed purple, margins and apex hyaline, 4-veined; the lower 9.5–10.2 × 1.5–1.6mm, narrowly lanceolate, acuminate; the upper 7.5–7.6 × 1–1.2mm, oblong-lanceolate, apex minutely toothed. *Anthecium* 4.7–5mm; callus 0.5–0.7mm, acute, curved in lateral profile, scar lanceolate, hairs c.0.5mm. *Lemma* 4.4–4.6 × 0.8mm, greenish, oblong, back appressed-hairy in lower third, hairs to 0.3mm, apical lobes 0.2mm, margins completely enclosing palea; awn c.13mm, weakly uni-geniculate at c.5mm, plumose throughout, hairs 1–1.1mm at base, 0.7–0.8mm at apex. *Palea* c.4 × 0.5mm, linear-lanceolate, glabrous. *Lodicules*: anterior pair lanceolate, c.1.2mm; the posterior linear, c.1.4mm. *Anthers* c.0.9mm, not bearded.

Other specimens seen. NEPAL. Above Bibre, 16,000ft, 29 x 1984, *D.J. Miller* 215 (K).

BHUTAN. Upper Mo Chu district, above Jangothang, c.14,000ft, 11 x 1987, *D.J. Miller* 303 (K).

The sectional placement of this very distinct species is problematic, but from the shape of the callus it is perhaps best placed in sect. *Pseudoptilagrostis* Tzvelev.

A species of high altitude turf, grazed by yak (*Bos gruniens*). Named after Daniel J. Miller, a rangeland and livestock specialist who was the first to make a detailed study of the alpine grasses of Bhutan and made important collections there.

S. bhutanica Noltie, **sp. nov. Fig. 1L–P.**

S. regelianae Hack. similis sed a speciminibus emodis illius speciei characteribus sequentibus differt: glumae minorer (non plus quam 8mm); anthecium longius (non minus quam 5.5mm); callus brevior, rotundus (haud acutus, plus quam 0.7mm); antherae breviores (non plus quam 3mm). *S. subsessilifloram* (Rupr.) Roshev. etiam simulans a qua differt pilis in columna aristae brevioribus.

Type: Bhutan, Ha district, W side of Chelai La, 27°22′N, 89°20′E, 3600m, 29 ix 1998, *Noltie, Pradhan, Sherub and Wangdi* 349 (holo. E., iso. THIM).

Densely tufted, branches intravaginal. *Culms* 8–32.5cm, nodes concealed. *Culm leaves* 2–3, distant; sheaths 6.8–11cm, glabrous, margins hyaline, not produced into auricles above, ligule 2.8–3.3mm, triangular, acute or blunt; leaf blades 3–8.3cm, filiform (0.3–0.5mm wide), inrolled, minutely scabrid on veins beneath. *Basal leaves* similar, blades 5–15cm. *Inflorescence* 5–11cm, usually shortly exserted from upper leaf sheath, linear, spikelets 7–18, branches short, erect, the lowest unequally paired, the longer to 1.8cm bearing 2–3 spikelets, pedicels 0.4–0.9cm, filiform, erect, scabrid. *Spikelets* 7.1–8.1mm, purplish. *Glumes* flushed dark purple, papery, subequal, 3-veined, margins narrowly hyaline; the lower 7.1–8.1 × 1.6–1.9mm, lanceolate, apex hyaline, very acute; the upper 6.9–8 × 1.3–1.4mm, more oblong, less acute than lower. *Anthecium* 6.5–7.5mm; callus c.0.5mm, rounded, scar circular, hairs 0.7–1mm. *Lemma* 6–7 × 0.7–0.8mm, herbaceous, green streaked purple, linear, back shortly hairy at extreme base, hairs 0.4–0.6mm, with longer (c.0.6mm) hairs near and overtopping apex, apical lobes not developed, margins completely concealing palea; awn 13–16.3mm, unigeniculate at 6–7mm, column hairy, hairs 0.7–0.9mm, seta minutely scabrid. *Palea* conspicuously shorter than lemma, 4.2–5 × 0.5–0.6mm, linear, subacute, sparsely hairy. *Lodicules*: anterior pair oblong, blunt, c.1.4mm, the posterior linear, acute, c.1.4mm. *Anthers* 1.6–1.7mm, cells not bearded.

Other specimens seen. BHUTAN. Ha/Thimphu district, Chelela, 13,000ft, 4 ix 1986, *Miller* 185 (K); summit of Chelai-la, 12,800ft, vii 1983, *Keith* 173 (E, K). Thimphu district, mountain E of Thimphu, 3500m, 24 vii 1988, *Wood* 6504 (E). Bumthang district, Kidifuh, *Anon*, s.n. (K). Unlocalized specimens collected by Griffith in Bhutan in 1838, from which all the florets have been shed, almost certainly belong to this species: *Kew Distrib. No.* 2694, *HEIC No.* 6586 (K).

Grows in alpine turf among dwarf rhododendron scrub, 3500–3960m.

The sectional placement of this species is problematic, but from the callus shape it is probably best placed in sect. *Lasiagrostis* (Link) Hack.

S. jacquemontii Jaub. & Spach subsp. **chuzomica** Noltie, **subsp. nov. Fig. 1Q–U.**
A *subsp. jacquemontii* ligula foliorum culmi caespites laterales pilorum carenti, lemmatibus coriaceis atrobrunneis (haud membranaceis pallidis), antheris brevioribus (non plus quam 3mm) haud barbatis differt.
Type: Bhutan, Thimphu district, Paro valley just above Confluence, 27°19′N, 89°32′E, 2160m, 28 ix 1998, *Noltie, Pradhan, Sherub & Wangdi* 333 (holo. E, iso. THIM).

Densely tufted, branches extravaginal. *Culms* to 40cm, wiry, slightly angled at the prominent nodes. *Culm leaves* 3, widely spaced; sheaths glabrous, apical auricles minute, ligule c.0.2mm, truncate, lacking lateral hair tufts; blades 7.5–13cm, filiform, inrolled, c.0.7mm wide, minutely hispid above. *Basal leaves* similar, blades to 14cm. *Inflorescence* 8–13cm, long exserted from upper leaf, very stiff and narrow, spikelets numerous, branches slender, very short, erect, whorled, again branched, longest branch of lowest whorl 1.3–1.5cm, bearing 3–7 spikelets. *Spikelets* c.6mm; pedicels 0.4–1cm. *Glumes* subequal, whitish-hyaline, 3-veined; the lower c.5.8 × 1.7mm, oblong-lanceolate, apex apiculate; the upper c.5.6 × 1.2mm. *Anthecium* c.4.6mm; callus 0.3mm, rounded, scar lanceolate, hairs c.0.7mm. *Lemma* c.4.1 × 0.7mm, dark brown, coriaceous, linear-lanceolate, with short (0.6mm), hyaline apical lobes, back covered in white, bristly hairs, hairs to 0.5mm, overtopping apex, margins not concealing palea; awn to 27.7mm, bigeniculate at 4.2 and 7.7mm, minutely scabrid throughout, seta c.20mm. *Palea* c.2.6mm, conspicuously shorter than lemma, oblong, truncate, back bristly. *Lodicules* dissimilar, anterior pair oblong, c.0.7mm, the posterior linear, c.0.4mm. *Anthers* c.2.5mm, not bearded.

Known only from the type, this subspecies belongs to sect. *Lasiogrostis* (Link) Hackel in Freitag's scheme. Although differing from subsp. *jacquemontii* in only small characters, it seems worth describing in view of the large disjunction in distribution. Subsp. *jacquemontii* is a plant of the NW Himalaya (from E Afghanistan to W Nepal).

The epithet refers to the area where the plant was found growing on dry slopes among *Ceratostigma/Cotoneaster* scrub. Chuzom is the Dzongkha word for a river confluence, in this case the junction of the Paro and Thimphu rivers. This is an interesting rain-shadow area, but differs in its vegetation from the dry valleys of central and eastern Bhutan (those of the Sankosh, Kuru Chu and Manas Rivers) which are all much deeper and hotter. It is interesting that it was growing with *S. brandisii* Mez, the only other member of the genus to grow at low altitudes in Bhutan. *S. brandisii* is unknown elsewhere in Bhutan, though it has a wide distribution from the NW Himalaya to SW China. Another associated plant was the attractive shrub *Ceratostigma griffithii* C.B. Clarke, which has its centre of distribution in the same area.

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NOTES RELATING TO THE FLORA OF BHUTAN: XXXIX. *GRAMINEAE* II

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The following descriptions of new taxa, new combinations, lectotypifications, and nomenclatural notes are required for the forthcoming volume of the *Flora of Bhutan* (volume 3, part 2, *Gramineae*). New species: *Agrostis ushae* Noltie from India (Sikkim), *Arundinella dagana* Noltie and *Cymbopogon bhutanicus* Noltie from Bhutan. New subspecies: *Deschampsia cespitosa* subsp. *sikkimensis* Noltie from India (Sikkim) and China (Tibet). New combinations: *Agrostis petelotii* (Hitchc.) Noltie, *Urochloa supervacua* (C.B. Clarke) Noltie, *Cymbopogon munroi* (C.B. Clarke) Noltie, *Urochloa villosa* var. *barbata* (Bor) Noltie, *Themeda triandra* var. *laxa* (Andersson) Noltie. The following species are reported here for the first time from the following countries. Bhutan: *Neyraudia curvipes* Ohwi, *Tripogon purpurascens* Duthie, *Elymus duthiei* (Melderis) G. Singh, *Urochloa panicoides* P. Beauv., *Spodiopogon lacei* Hole, *Microstegium falconeri* (Hook.f.) Clayton. China (Yunnan): *Agrostis zenkeri* Trin. Bangladesh: *Panicum laxum* Sw.

Keywords. Bangladesh, Bhutan, China, *Gramineae*, India, lectotypifications, new combinations, new records, new taxa, Sikkim, Tibet.

INTRODUCTION

This paper includes nomenclatural notes and descriptions of new taxa for the forthcoming volume on the grasses of Bhutan (*Flora of Bhutan*, volume 3, part 2). It covers all tribes except for *Stipeae*, on which notes have already been published (Noltie, 1999), and *Bambuseae*, which have been treated by Stapleton (1994a, 1994b, 1994c, 1999). In addition, several new records are given where they represent interesting disjunctions. The order of treatment within the paper follows Clayton & Renvoize (1986), whose generic treatment has largely been followed in the *Flora* account. The new taxa will be illustrated in the *Flora*.

The grasses of Bhutan have not previously been studied systematically, though those of adjacent Sikkim are relatively well known, at least as regards historical collections. A great deal of work remains to be done, particularly on critical genera such as *Calamagrostis*. Despite this, much interesting taxonomic and distributional information has resulted from the study. Some of this is published here, and much else will be evident in the *Flora* account. Particular tribute must be given to John Wood, Daniel Miller, Rebecca Pradhan, Andrew Grierson and David Long for their fieldwork over the last twenty years: without their collections the account could simply not have been written, as earlier collectors had made very few grass collections. The total number of genera of *Gramineae* for the Flora area (i.e. Darjeeling

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District of West Bengal, Sikkim, the Chumbi Valley (Tibet), the narrow strip of Terai close to the southern border of Bhutan and the Kingdom of Bhutan itself) is 126, of which 9 are represented only by introduced species. The total number of species is approximately 392, of which 65 are introduced/cultivated. Much collecting is still required, particularly in the south of Bhutan and further additions are to be expected; for example, none of the large, Andropogonoid Terai species have so far been collected in Bhutan, but are known (R. Pradhan, pers. comm.) to be present in areas such as the Royal Manas National Park. Because of the critical nature of many species, further specialist collecting trips will be required. This was amply demonstrated on a grass collecting trip that I was privileged to undertake to Bhutan in August–September 1998, which allowed the acquistion of much additional taxonomic, distributional and ecological data.

I. TRIBE *AVENEAE*

Deschampsia

Deschampsia cespitosa (L.) P. Beauv. subsp. **sikkimensis** Noltie, **subsp. nov.**
Syn.: *D. cespitosa* var. *colorata* sensu Hook.f., Fl. Brit. India 7: 273 (1897), non Grisebach.
Inflorescentiis densissimis subsp. *koelerioidi* (Regel) Tzvelev similis sed characteribus sequentibus differt: folia angustiora; inflorescentia ambitu pyramidalis (haud cylindrica), spiculis in glomerulis densis sphaericis aggregatis, ramulis primariis evolutis vel haud evolutis; glumae majores, inferior 3.6–4.5mm (non 3–3.6mm), superior 4–4.8mm (non 3.6–4.2mm).
Type: India, Sikkim, Upper Lasha Chhu valley, below Yulhe Khang glacier, 4545m, 20 vii 1996, *Edinburgh Expedition to Northern Sikkim (EENS)* 359 (holo. E; iso. BSHC).

Compact, densely tufted perennial. *Culms* 8.5–24cm, erect, bearing a single leaf in lower third. *Culm leaf*: blade 0.9–3 × c.0.2cm, short, becoming inrolled, glabrous or minutely rough on veins above; sheath long, covering half or more of culm, glabrous, ligule c.4mm, lacerate. *Leaves* of vegetative shoots: blades 3.6–19 × c.0.1cm, inrolled, glabrous; sheaths papery, pale brown. *Inflorescence* golden, tinged purplish, 3–7cm, spikelets in dense, rounded clusters 1–1.5 × 1–1.3cm at ends of short (0.3–1.2cm) branches, or branches not developed when inflorescence densely pyramidal-ovoid. *Spikelets* 4.2–5mm, 2- or 3-flowered. *Glumes* dark purplish, with golden-hyaline margins and apex, sometimes green in centre, oblong-lanceolate, acuminate, papery, sometimes minutely toothed near apex, the lower 3.6–4.5 × c.1mm, the upper 4–4.8 × c.1.5mm. *Lower floret*: callus hairs 1–2mm; lemma purplish below, hyaline above, 3.3–3.6mm, oblong, truncate-erose; awn inserted about or below middle, straight, shorter than lemma (1–3.2mm); palea 3–3.5mm; anthers dark purple or cream, 1.3–1.9mm. *Lowest rachilla internode* 0.8–1.1mm, hairs 0.5–1mm.

Other specimens seen. INDIA. Sikkim: Momay, Sept. [1849], *J.D. Hooker*, s.n. (K); Samding, 16,000ft, 11 ix 1849, *J.D. Hooker*, s.n. (K – mixed sheet with specimens approaching subsp. *cespitosa* probably collected at Tungu); Naku La, 17,290ft, 23 viii 1972, *Pradhan, Norbu & Naku* 163 (E); Chholhamoo, 17,820ft, 18 viii 1972, *Pradhan, Norbu & Naku* 146 (E).

CHINA. S Tibet [N of Kumaon]: Balch Pass, 16,500ft, *Strachey & Winterbottom* s.n. (K).

There are no habitat notes on any of the old specimens, but the type specimen was collected in shallow runnels at the edge of a fast-flowing river.

D. cespitosa is a very widespread and polymorphic species; it is difficult to deal with the variation taxonomically, which has resulted in various different treatments. For example, the taxon to which this plant is closest has been recognized at specific rank by Cope (1982) and subspecific rank by Tsvelev (1984), who recognized 17 subspecies of *D. cespitosa* in the former USSR. More or less typical *D. cespitosa*, a tall plant with a very lax panicle, is not uncommon in Bhutan and Sikkim between 3050 and 4880 metres.

The new subspecies was first recognized by Hooker (1897) at varietal rank under a name that applies to a form described from the Rhodope Mountains (Bulgaria). It approaches *D. cespitosa* subsp. *koelerioides* which occurs in C Asia and NW Himalaya (N Pakistan, Kashmir, Baltistan), i.e. further north and west than subsp. *sikkimensis*. The spikelets of both the C Asian and Sikkim taxon differ from those of *D. cespitosa* in only slight ways and are characterized by their dense inflorescences. Given the disjunct distribution and the slight differences between other recognized subspecies, however, it seems worth describing the Sikkim plant at subspecific rank.

Agrostis, Calamagrostis *and related genera*

There are really no clear-cut characters or character combinations to distinguish *Agrostis* from *Calamagrostis*. The genera *Deyeuxia*, *Aniselytron* and *Anisachne* that are very close to *Calamagrostis* have also been recognized from our area in the past. There is no consensus over which of these genera should be recognized in floristic treatments of adjacent regions. The characters traditionally used to separate these genera include texture of glumes, induration of lemma, relative lengths of glumes and lemma, size of spikelets, presence/length of callus hairs and development of a rachilla rudiment, but all of these are variable and occur in various combinations. Without wishing to get deeply involved in the subject for the *Flora* account, I have chosen to follow the pragmatic approach of Clayton & Renvoize (1986). They separate *Agrostis* from *Calamagrostis* on fairly subjective characters as follows:

1a. Lemma hyaline to cartilaginous, callus beardless or rarely with hairs up to half its length; inflorescence typically open, of small spikelets ——— **Agrostis**

1b. Lemma firmly membranous to coriaceous (indurated), rarely hyaline and then with a callus beard as long as itself; inflorescence typically denser, of larger spikelets ——— **Calamagrostis**

Of the related genera, they sink *Deyeuxia* and *Aniselytron* under *Calamagrostis* with

which I agree, but their placement of *Anisachne* requires further discussion (see below).

Agrostis zenkeri *and allies*

There has been much confusion over the generic placement, synonymy and origin of the type of *A. zenkeri* Trin., a species characterized by small spikelets and the presence of a penicillate rachilla extension and callus hairs. Much ink has already been spilled but, regrettably, it is necessary to add to it. *A. zenkeri* was described by Trinius, based on a single specimen said to come from the Nilgiri Mountains in S India, and therefore assumed (see Bor, 1954b) to have been collected by B. Schmid. All subsequent collections, however, have been from NE India (and more recently China). Either there was a mistake in labelling or, if it does occur in the Nilgiris, it must be extremely rare, as it has not been re-collected there. By the time Trinius wrote his paper (1841), he had seen grass specimens from the NW Himalaya (collected by Hügel and Royle), but it is not certain that he had seen specimens of any taxa from Khasia or the E Himalaya, hence the mystery of how a label switch could have occurred. Regardless of this I disagree with Korthof and Veldkamp (1985) who claim that the type of *A. zenkeri* is like no other 'American, Asian, Australian, European or Indian species known to us' and I see no reason whatsoever to disagree with most of the conclusions of Bor (1954b).

Hooker (1897) treated *A. zenkeri* as a 'doubtful species' and described the new *Deyeuxia abnormis* (based on a manuscript name of Munro) citing specimens from Sikkim (*Hooker, Agrostis* 11) and Khasia (*Hooker & Thomson, Agrostis* 12 and '*Griffith*, &c [*Clarke*]'). There are 12 syntype sheets at Kew annotated with the name in Hooker's hand, but unfortunately these bear two similar taxa: of these five bear what I propose to call *A. petelotii*, six bear *A. zenkeri*, and one bears both. The protologue includes both elements, but Hooker describes one character that enables the name to be applied unambiguously to one of the elements: 'gl. III [lemma] rather shorter than I [lower glume]'.

Korthof & Veldkamp (1985) lectotypified the name *D. abnormis* choosing *Hooker & Thomson, Agrostis* 12, having seen duplicates at L. They did not see any of the Kew material, and cited 'Lectotype ... K, holo, *n.v.*; L'. As the two L specimens are of the same taxon (the one I propose to call *A. petelotii*) they saw no reason to doubt that there would be a 'hololectotype' representing the same taxon at Kew. However, as we have seen above, two taxa are represented among the syntypes. In any case Bor (1954b) had effectively lectotypified the species earlier on a sheet of *Agrostis* 12 from Surureem, Khasia bearing the Hooker & Thomson field number 1232. This sheet must, however, be rejected (Art. 9.13) as the lectotype as it does not agree with the important part of the protologue quoted above.

It must be realised that '*Agrostis* 12' is not a unique collecting number, rather an aggregate 'species number' and Hooker applied it to several sheets of what he believed to be the same species collected in Khasia. There are three of these, annotated by

Hooker, at Kew (with duplicates in other herbaria, e.g. BM, L). There is therefore no 'holo[lecto]type' at K and of the three sheets there, two bear a species that disagrees with the important element of the protologue quoted above and one bears a mixture of two taxa. It is thus necessary to select an element from this material that agrees with the protologue. While it is possible to retain part of *Agrostis* 12 (following Bor, and Korthof & Veldkamp) as a lectotype it is necessary to be more specific. That Bor was aware of a conflict in his application is shown by an annotation on his own copy of the *Flora of British India* at Kew – against 'III rather shorter than I' he has written 'no, longer'.

I therefore propose to lectotypify on the right hand specimen of the mixed sheet of *Agrostis* 12 (Nonkreem, Khasia) which shows Hooker's important diagnostic character of the short lemma. This will also cause the least nomenclatural disturbance as *D. abnormis* thereby becomes a synonym of *A. zenkeri*, as it has commonly (if for the wrong reason) been taken.

This leaves the need for a name for the second element of *D. abnormis*. In 1921 Mez described *Agrostis pleiophylla* based on two Clarke sheets from Khasia and Darjeeling; their numbers were not cited in the protologue but fortunately they are extant at B (*Clarke* 44736B from Khasia and *Clarke* 26852 from Darjeeling). Surprisingly there are no duplicates of either of these numbers at K. In the protologue Mez makes no mention of a rachilla extension and it was therefore surprising that Bor took the species to be synonymous with *A. zenkeri*. Korthof and Veldkamp (1985) assumed the types to be destroyed, cited non-existent syntypes at Kew and sunk *A. pleiophylla* under *D. abnormis*. The two syntype sheets in B in fact bear three different taxa: *A. micrantha*, *A. petelotii* and an unidentifiable species. A hairy rachilla extension is present only on the weakest of the Khasian specimens and unfortunately Bor seems not to have noticed that this was different from the other two. For purposes of typification this specimen must be discounted, as not agreeing with the most important parts of the protologue. The only part of the description that refers to this specimen is the character of a branched culm, but the important description of the spikelets (and Mez's drawings on the sheets) applies equally to the other two. I propose lectotypifying (see below) on the left-hand Khasia specimen, in which case *A. pleiophylla* can be sunk under *A. micrantha* Steud. The Darjeeling specimen remains a puzzle, but as it is incomplete, with no basal parts, it is best ignored.

Keng described the new genus and species *Anisachne gracilis* in 1958, commenting on its closeness to *Agrostis zenkeri*. The holotype has not been seen, but two Yunnan specimens determined by Y.C. Tong at E, one of which is a paratype, and from the clear illustration accompanying the protologue, there is no doubt about its identity with the second element of Hooker's *D. abnormis*. The monotypic genus *Anisachne* is still recognized in Chinese literature (Kuo, 1987), but Clayton & Renvoize (1986) sunk it under *Calamagrostis*. It is now clear that it should actually be sunk under *Agrostis*. There is, however an earlier description of the species: as *Aulacolepis petelotii* Hitchcock, 1934, from Vietnam. The type of this has been studied and

matches the second element of *D. abnormis*, differing only in having slightly more robust culms and wider leaves than the Bhutanese and Khasian specimens. A new combination, however, is required in *Agrostis*.

Bor described *Agrostis nagensis* based on a single specimen from Nagaland. With more specimens now available from Bhutan it can be seen to be merely an extreme form of *A. zenkeri* with rather large spikelets.

The following synonymy and typification can be made:

Agrostis zenkeri Trin., in Mem. Acad. Sc. St Petersburg, ser. VI (2): 363 (1841). Type: India, 'Nilagiri, *Zenker*' (holo. LE *n.v.* [Hb. Trinius 1669.01, IDC microfiche BT-16/1]; photo at K!).

Syn.: *Calamagrostis zenkeri* (Trin.) Davidse, Fl. Ceylon 8: 107 (1994), name only.

Deyeuxia abnormis Hook.f., Fl. Brit. India 7: 268 (1897), p.p. Type: India, Khasia, Nonkreem, 10 x 1850, *Hooker & Thomson, Agrostis* 12 (right-hand specimen, with branched culm) (lecto. selected here, K).

Agrostis nagensis Bor, in Kew Bull. 9: 497 (1954). Type: India, Nagaland, Japvo, 8000ft, 28 ix 1935, *Bor* 6449 (holo. K).

Deyeuxia nagensis (Bor) Veldkamp, in J. Econ. Tax. Bot. 13: 74 (1989).

Specimens seen. INDIA. Sikkim: *Kurz* s.n. (K); *Hooker, Agrostis* 11 (K). Meghalaya (Khasia): *Griffith HEIC (KD)* 6663 (K); *Assam Deputation* s.n. (K); *Hooker & Thomson, Agrostis* 12 (in small part) (K); *Clarke* 15413, 16055A, 19627, 43575A (K), 45769A (E); *Bor* 17927 (part), 17928 (K). Nagaland: *Bor* 6449 (K).?Tamil Nadu (Nilgiris): *'Zenker'* [*Schmid*] s.n. (LE, n.v.).

BHUTAN. *Wood* 5800, 5860, 6692 (E); *Pradhan & Wangdi* EG 109 (E); *Noltie, Pradhan, Sherub & Wangdi (NPSW)* 15, 215, 238, 286, 352 (E).

CHINA. Yunnan: *Forestry Commission, Edinburgh Expedition to Deqen (FED)* 165 (E), *Maire* 2978 (E).

Note: the origin of the type as from the Nilgiris must remain unconfirmed. The Yunnan records are the first for China.

Agrostis petelotii (Hitchc.) Noltie, **comb. nov.**

Basionym: *Aulacolepis petelotii* Hitchc., in J. Washington Acad. Sc. 24: 291 (1934). Type: Vietnam, environs de Chapu, c.1900m, viii 1933, *Pételot* 4743 (holo. US; iso. P, *n.v.*).

Syn.: *Deyeuxia abnormis* Hook.f. p.p. (*Hooker & Thomson, Agrostis* 12, p.p., Khasia).

Anisachne gracilis Keng, in J. Washington Acad. Sc. 48: 117 (1958). Type: China, Kweichow, Pichieh Hsien, 1400m, 1 vi 1934, *Hou Hsueh-yuh* 2143 (holo. N, *n.v.*).

Specimens seen. INDIA. Arunachal Pradesh: *Kingdon-Ward* 13905, 14001 (E, BM); 13880, 14172A, 14174 (BM). Meghalaya (Khasia): *Hooker & Thomson, Agrostis* 12 (in large part) (K, E, L. BM); *Clarke* 15413C, 38339, 38350, 38526 (K), 44382 (K, BM); 44736B (B); *Koelz* 23090, 23175 (K); *Rup Chand* 7929, 7946 (K); *Bor* 17805 (K). Manipur: *Kingdon-Ward* 17882 (K).

BHUTAN. *Ludlow & Sherriff* 3512 (BM); *Grierson & Long* 2628 (E); *Miller* 166, 273 (K); *Wood* 5668, 5795, 5841, 6727 (E); *NPSW* 12, 17, 47, 86, 159, 180, 221, 232A, 237 (E).
CHINA. Yunnan: *Rock* 10693 (E); *Maire* 1296/1913 (E).
VIETNAM. *Pételot* 4743 (US).

The two species appear to be sympatric, occurring in NE India, Bhutan, Vietnam and Yunnan; they are very similar, but can be separated as follows:

1a. Lower glume usually exceeding lemma, (2.1–)2.5–3.5mm, finely acuminate, tip often curved, glumes conspicuously unequal, the lower (2–)2.1–3mm. Longest callus hairs (1.3–)1.8–2.5mm, more than half lemma. Plants weakly tufted; culms large, often scrambling; basal leaves not conspicuous at flowering; sheaths of culm leaves very scabrid. Inflorescence very lax (secondary and tertiary branches well developed), ±cylindric, pedicels filiform, flexuose ——— **A. zenkeri**

1b. Glumes usually shorter than lemma (floret exserted), the lower glume 1.6–2(–2.3)mm, subacute, glumes equal. Longest callus hairs 0.5–1mm, less than half lemma. Plants densely tufted; culms relatively short; basal leaves numerous, filiform; sheaths of culm leaves smooth. Inflorescence less effuse (secondary and tertiary branches scarcely developed), ±triangular in outline, pedicels not flexuose ——— **A. petelotii**

Note: the longest callus hairs are attached at the base of the lemma margins and should not be confused with the hairy rachilla extension (which in immature florets is appressed to the palea and hidden by the lemma margins).

Calamagrostis debilis *and* C. treutleri

Korthof and Veldkamp (1985) also treated two other species of problematic generic placement which occur in our area:

The Sikkimese *Calamagrostis debilis* Hook.f. they transferred to *Deyeuxia*. *C. debilis* is known only from Hooker's type from Sikkim. It was transferred by Bor (1960), without comment, to *Agrostis*, thereby making an illegitimate combination (there was already an *Agrostis debilis* Poir., 1810), for which Bennet & Raizada coined the new name *A. neodebilis*. Even if one recognizes *Deyeuxia* the transfer there is unwarranted, as the lemma is membranous and there is no rachilla extension. The question is whether it is better placed in *Agrostis* or *Calamagrostis*. While intermediate between the two genera, on the basis of spikelet size (c.4mm), and long callus hairs, it seems best retained in *Calamagrostis*.

The widespread SE Asian *Calamagrostis treutleri* (Kuntze) U. Shukla they place in *Aniselytron*. As stated above I have chosen to follow Clayton & Renvoize (1986) who admit that whilst the SE Asian species of *Aniselytron* look distinct, the genus cannot be maintained when Australian species of *Calamagrostis* (including *Deyeuxia*) are considered.

Agrostis brachiata

This very distinctive species has long been a puzzle, known only from the type specimens; more can now be said about it. Bor (1960) was the first to point out its similarity to a then unpublished Chinese taxon, eventually validly published (Keng, 1984) as *A. megathyrsa* Keng ex P.C. Keng. Recent collections show the two taxa to be identical. The origin of *A. brachiata* given in Hooker (1897) and Bor (1960) is mistaken: the *Wallich Catalogue* gives the source of *Wallich* 3769C as 'Montes Monghir, 1820'. This locality is in Bihar Province, south of the Ganges, which seemed suspicious for a plant that appeared to be temperate. The specimen in K-W, however, bears the field ticket 'Sheopore, 4 ix 1821', and was thus collected by Wallich himself in Nepal. On a recent expedition to Bhutan the plant was found in oak forest at 2700m in the Thimphu valley. Thus the species can be confirmed as a Sino-Himalayan species.

The following synonymy and distribution can therefore be given:

A. brachiata Munro ex Hook.f., Fl. Brit. India 7: 256 (1897) Type: Nepal [mis-cited as Bihar, see above], *Wallich* 3769C [mis-cited as 3769B] (holo. K; iso. K-W, E).
Syn.: *A. megathyrsa* Keng ex P.C. Keng, in Bull. Bot. Res. 4(3): 197 (1984). Type: China, Sichuan, Nan-chuan Xien, Jin-fo-shan, 6 ix 1943, *Y.L. Keng & P.C. Keng* 3876 (holo. N, *n.v.*).

Specimens seen. NEPAL. *Wallich* 3769C (K, K-W, E).
BHUTAN. *NPSW* 32 (E, THIM).
CHINA. Sichuan: *Keng & Keng f.* 3893 (collected at same time as type) (K). Yunnan: *Maire* 6863, 7090 (BM); Hubei: *1980 Sino-Amer. Exped.* 1321 (E).

Its very effuse panicle led Wallich to identify it as a *Sporobolus*. Its spikelets, however, are almost indistinguishable from those of *Agrostis micrantha* Steud. It is distinguished from the latter only by its large, scrambling habit and massive, lax inflorescence and the tendency for the glumes to be deciduous.

Agrostis ushae Noltie, **sp. nov.**
Forma inflorescentiae *A. inaequali* Griseb. similis, sed characteribus sequentibus differt: planta magis robusta, folia basalia latiora; lemmata majora (c.1.9mm, non usque ad 1.5mm), aristata; antherae longiores (0.8–0.9mm, non 0.4–0.5mm). *A. hugonianae* Rendle etiam similis, quae a specie nova spiculis majoribus (3–3.9mm longis), glumis subaequalibus, lemmate longiore (c.2.6mm) et in varietate typica haud aristato recedit. Ab *A. hugoniana* var. *aristata* Keng ex Y.C. Yang inflorescentia densiore et arista infra dimidio inserta differt.
Type: India, Sikkim, Upper Lasha Chhu valley, below Yulhe Khang glacier, 4545m, 20 vii 1996, *EENS* 360 (holo. E; iso. BSHC).

Tufted perennial. *Culms* 5–10cm, bearing 2 leaves on lower quarter. *Culm leaves*: blades 15–30 × 1.8–2mm, narrowly lanceolate, acute, flat, minutely hispid above,

beneath and on margins; sheath of upper leaf covering most of culm, glabrous, ligule c.2mm, rounded-ciliate, minutely hispid on back. *Basal leaves* to 9.5cm, to 2.6mm wide. *Inflorescence* 3–5 × 0.5–1cm, purple, narrowly cylindric, dense, branched to 3 orders; branches slender, hispid, stiffly appressed, whorled, lowest whorl of 3–4 branches, the longest 2.1–3cm; pedicels 1.5–2mm, slender, hispid. *Spikelets* 2.5–3mm; glumes unequal, papery, 1-veined, purple, green around midrib, 1-veined; the lower 2.5–3 × 1.1–1.2mm, widely lanceolate, acuminate, keel hispid; the upper 2.2–2.5 × c.1mm, oblong-lanceolate, subacute. *Floret*: lemma c.1.9 × 1.3mm, oblong-ovate, hyaline, glabrous, apex blunt, minutely ciliate, 5-veined, awned; awn arising below halfway, 2.9–3.3mm, weakly geniculate, purple above; palea minute, c.0.2mm or absent; callus with a few minute hairs (0.1–0.2mm); anthers purple, 0.8–0.9mm.

This distinctive species is known only from the type specimen; a high alpine, it grew in runnels at the edge of a river. It is named after Usha Ganguli Lachungpa, of the Wildlife Section of the Sikkim Forest Department, who has added so much to our knowledge, and worked so hard for the conservation, of the wildlife of northern Sikkim.

Close to *A. hugoniana*, from China (Kansu and Shensi), from which it differs as described above. No material has been seen of *A. hugoniana* var. *aristata*, described from Yunnan and Sichuan, but it differs from the description and illustration (Yang, 1984) as given above. This variety might turn out to be synonymous with the new species, but specific rank seems more appropriate given the small differences between species in *Agrostis*.

Agrostis micrantha

In the light of a large number of recent collections, it is impossible to maintain *A. myriantha* Hook.f. and *A. himalayana* Bor as distinct from the earlier *A. micrantha* Steud. This is the commonest member of the genus at moderate elevations in the E Himalaya. On a recent field trip to Bhutan, it was found to be extremely plastic and subject to environmental modification. In habit it can vary from neat, tufted plants with culms under 20cm, to large sprawling plants with leafy culms to almost one metre. In damp conditions there is a tendency for the culm bases to become decumbent and root from the lower nodes, and in some cases, when the vegetative shoots do the same, it can superficially resemble *A. stolonifera* L. (from which it can be told by its smaller spikelets and anthers). The inflorescence shape is also variable: the branches usually ascend after anthesis to form a rather narrow, dense inflorescence, but in some forms it is laxer, with the branches remaining spreading. Elements within the variable species admittedly look rather distinct in terms of leaf width, production of vegetative shoots and spikelet size.

The form with wide leaves and lush vegetative growth was described by Hooker (1897) as *A. myriantha*, who stated it to be very close to *A. micrantha*. Hooker included smaller specimens from Sikkim and larger ones from Khasia in the pro-

tologue, calling the former 'var. *sikkimensis*' and the latter 'var. *khasiana*'. One of the varietal names is thus superfluous and as the description includes both elements, either could be selected as the type variety. In the protologue the only specimen number mentioned is *Hooker, Agrostis* 7. Of the syntype sheets bearing this number at Kew three come from Sikkim and one from E Nepal. As it is this variety that Hooker lists first, and as Stapf attached a 'Type' label to one of the Sikkim sheets, there seems no reason not to designate this formally as the lectotype of the species as it is a good specimen and agrees with the protologue. This makes var. *sikkimensis* superfluous. It should be noted that none of these specimens bear the name *A. myriantha* in Hooker's hand. It is also necessary to lectotypify var. *khasiana*. Of the sheets in the type cover at Kew none are annotated with the name by Hooker. Some are annotated with the name *A. wightii* Nees, which Hooker (1897) cited as a partial synonym of *A. micrantha*, and can therefore be discounted. The remaining three sheets are labelled *Hooker & Thomson, Agrostis* 8 and bear no field labels. While it is odd that this number is not mentioned in the protologue it seems reasonable to designate one of these as the lectotype as they agree with the protologue of var. *khasiana*, and I choose the one with the most mature inflorescences.

A. himalayana was described by Bor (1953a) based largely on its small spikelets, and more equal glumes, but is connected to *A. myriantha* by intermediates. The spikelet size of some of the syntypes of the latter collected by Hooker in Sikkim in fact come within the range given for *A. himalayana*. Examination of several isotypes (*Wallich* 3776, E) of *A. micrantha* show it to be similarly variable in spikelet size (1.5–2.25mm); the specimens lack basal parts and vegetative shoots but seem to me well able to accommodate the other species. Similar variability is seen in *A. nervosa* Nees ex Trin. and *A. pilosula* Trin.

The following synonymy and typification can therefore be made:

Agrostis micrantha Steud, Syn. Pl. Glum. 1: 170 (1854). Type: Nepal, *Wallich* 3776 (iso. E, K-W).

Syn.: *A. myriantha* Hook.f., Fl. Brit. India 7: 257 (1897). Type: India, Sikkim, Lachen, 9–10,000ft, 2 viii 1849, *Hooker & Thomson, Agrostis* 7 (lecto. selected here, K).

A. myriantha var. *sikkimensis* Hook. f., Fl. Brit. India 7: 257 (1897), *nom. superfl.*

A. myriantha var. *khasiana* Hook. f., Fl. Brit. India 7: 257 (1897). Type: India, Khasia, *Hooker & Thomson, Agrostis* 8 (part: sheet with two mature inflorescences) (lecto. selected here, K).

A platyphylla Mez in Fedde Repert. 17: 302 (1921). Type: India, Khasia, *Hook. & Thomson, Agrostis* 8 (part) (holo. B, *n.v.*; photo K!).

A. himalayana Bor in Kew Bull. 8: 269 (1953). Type: India, Arunachal Pradesh, Nyukmadung, 7000ft, 28 v 1935, *Kingdon-Ward* 11538 (holo. BM; iso. E).

A. pleiophylla Mez in Fedde Repert. 17: 301 (1921). Type: India, Khasia, Soynung, 5000ft, 12 ix 1886, *Clarke* 44736B (left-hand specimen) (lecto. selected here, B).

II. TRIBE *ARUNDINEAE*

Danthonia

There has been much confusion over the identity and nomenclature of a widespread Sino-Himalayan species of *Danthonia* since the account in *Flora of British India*. In this account Hooker (1897) misapplied the name *D. cachemyriana* Jaub. & Spach, which should be restricted to a NW Himalayan species. Bor (1952) realised Hooker's mistake and attempted to resolve the situation, but unfortunately made matters worse. He claimed to make a *nomen novum*, *D. jacquemontii*, for Hooker's plant, but actually described a new species by citing a different type. This name, however, was invalid as there was no Latin description. In any case it would have been superfluous as he cited *D. cumminsii* Hook.f. 1897 as a synonym of a variety he described of the new species (see below). Between the publications of Hooker and Bor, Pilger had described *D. schneideri* from China. H.J. Conert, on annotations in herbaria, realised in the 1960s that Chinese and Himalayan material belonged to the same species for which he used the name *D. schneideri*, but he seems not to have published on the subject. Conert actually annotated the holotype of *D. cumminsii* as '*D. schneideri* var.' The use of the name *D. schneideri* for Himalayan plants was adopted by Cope (1982) in the *Flora of Pakistan*. Hara *et al.* (1978), however, had correctly noted that *D. cumminsii* was an earlier name for *D. schneideri* and that the name *D. jacquemontii* Bor was superfluous.

A further complication arises from the fact that both Hooker and Bor described varieties within their taxa. Hooker described a var. *minor* of his '*D. cachemyriana*' and Bor described a var. *minor* of his invalid *D. jacquemontii*. The latter was based on one of the elements of Hooker's variety, but because the species name was not valid, Bor's varietal name was also invalid. Hooker annotated three sheets with the name var. *minor*, two of his own collections from Sikkim and one from the NW Himalaya (*Strachey & Winterbottom* 2, K). The variety was mainly based on small stature and the protologue does not give measurements for the more important character of glume size. One of the specimens on the Strachey and Winterbottom sheet, however, has long glumes, so it seems wisest to select one of the Sikkim sheets as the lectotype. Bor cited the one with the field label as the 'type' of his invalid variety and there is no reason not to designate this formally as the lectotype of Hooker's var. *minor*.

After studying the large number of specimens available at K and E, it seems impossible to maintain varieties based on spikelet size as was done by Bor (1960). Despite large differences in appearance between some of the specimens in terms of spikelet size and number of spikelets per inflorescence (from 3–60), the variation is continuous and there seems to be no correlation between spikelet size and habitat. Forms with small spikelets occur at both low and high altitudes, and apparently in mixed populations. There is also variability in characters such as presence or absence of hairs on the glumes and the length of the lateral lemma lobes/awns. Much further work is required to work out the basis of this variability and a satisfactory taxonomic

treatment. In the meanwhile, there seems no choice but to agree with Hara *et al.* (1978) and to regard it as a single very variable species. The following more detailed synonymy and typification can therefore be made:

D. cumminsii Hook.f., Fl. Brit. India 7: 282 (1897). Type: [Sikkim], 'Gnatong, Bhootan', pre-1893, *Cummins*, s.n. (holo. K).
Syn.: *D. cachemyriana* sensu Hook.f., Fl. Brit. India 7: 282 (1897), non Jaub. & Spach.

D. cachemyriana var. *minor* Hook.f., Fl. Brit. India 7: 282 (1897). Type: Sikkim, Yeumting, 12,000ft, 2 ix 1849, *Hooker, Danthonia* 2 (lecto. selected here K).

D. schneideri Pilg., in Fedde Repert. 17: 131 (1921). Type: Yunnan, in pratis alpinis ... prope Lichiang, 4200m, 2 ix 1914, *Schneider* 2342 (holo.?B, *n.v.*; iso. K).

D. schneideri Pilg. var. *minor* (Hook.f.) Conert, *ined.*

D. jacquemontii Bor, *nom. invalid.*, Kew Bull. 7: 80 (1952). Based on *Jacquemont* 2068 (K).

D. jacquemontii var. *minor* [Hook.f.] Bor, in Kew Bull. 7: 81 (1952), *nom. inval.* (species name not valid). Based on Hooker's type, but locality mis-cited as 'Geumtong'.

The species occurs throughout the Sino-Himalaya from Pakistan to Yunnan over a surprisingly wide range of altitudes (2520–4267m).

Generic limits in the *Arundineae* are controversial and Clayton & Renvoize (1986) implied that Himalayan taxa traditionally included in *Danthonia* should be placed in the genus *Rytidosperma* Steud., but did not make the relevant combinations; nor have they been made since. *Rytidosperma* is separated from *Danthonia* chiefly on having the lemma hairs arranged in tufts in two rows. In our specimens, however, the hairs are generally distributed over the upper part, or over the whole back, of the lemma, so it seems wisest to retain the traditional generic placement. This was the provisional conclusion reached by Linder & Verboom (1996) in a cladistic analysis of generic limits in the *Rytidosperma* complex: 'the position of the Himalayan species ... are not clear ... the analysis of all species aligns them to the *Rytidosperma* s.l. clade rather than to *Danthonia* ... however, despite these results we do not feel satisfied that we have seen enough good quality, convincing material to make the formal transfer of these species'. Clearly further work is required.

III. TRIBE *ERAGROSTIDEAE*

Neyraudia

Until now *N. arundinacea* (L.) Henr. var. *zollingeri* (Büse) Henr. (syn. *N. reynaudiana* (Kunth) Keng ex Hitchc.) has been the only member of the genus known from Bhutan, where it is very common. Determinations of specimens as *N. arundinacea* var. *arundinacea* have all been shown to be mistaken and that variety appears to be restricted in the subcontinent to the north-west. On a recent collecting trip to Bhutan,

however, a very different species of *Neyraudia* was collected near Deothang in the south-east of the country (*NPSW* 187; E, THIM). This specimen is immature but matches an earlier, very damaged specimen (virtually devoid of florets apart from some diseased remnants), collected at nearly the same locality (*Grierson & Long* 2239, E). These specimens are referable to *N. curvipes* Ohwi, a little known species described from Mount Kinabalu in Borneo. The only way in which the Bornean specimen differs from the Bhutanese ones is in the character referred to in the epithet – the basal rachilla internode is curved. However this seems a trivial character and as the recent specimen is immature it is possible that this character might develop at a later stage. This therefore represents a new, and dramatically disjunct, record for the E Himalaya. It is possible that the species occurs on mountains in Indo-China and has not been collected. These large grasses are awkward to collect, and therefore often ignored by collectors.

Key to Bhutanese taxa

1a. Glumes subequal, lanceolate, finely acuminate; spikelets 5–7-flowered; lower lemma sterile (often adhering to lower glume), epaleate, glabrous ——— **N. arundinacea** var. **zollingeri**

1b. Glumes very unequal, oblong-elliptic, blunt; spikelets 2- or 3-flowered; lower lemma fertile, paleate, margins hairy towards base ——— **N. curvipes**

Tripogon

A thorough modern revision of the Chinese and Indian species of this difficult genus is required. Three species occur in our area, one of which is reported here for the E Himalaya for the first time. Until recently, when reported for Xinjiang, NW China (Chen, 1990) and Arabia (Cope, 1985), *T. purpurascens* Duthie was known only from the NW Himalaya. It has recently been discovered in Bhutan by John Wood, representing a disjunction similar to that of *Elymus duthiei* (Melderis) G. Singh and *Stipa jacquemontii* Jaub. & Spach both also found nearby in the Thimphu valley.

T. filiformis Nees ex Steud. is a very variable species in Bhutan, and occurs over a wide range of altitudes; it is possible that more than one taxon is present. Further work, however, is required on this species, and on Sino-Himalayan specimens referred to *T. bromoides* Roem. & Schult.

The original description of *T. trifidus* Munro ex Stapf is very inadequate: Stapf quotes the Munro ms. name and cites specimens from Sikkim, the Khasia Mountains and Tonkin, but gives no description and diagnoses a new species (*T. lisboae* Stapf) against it. R.K. Brummitt (pers. comm.) takes this diagnosis to be sufficient to validate the name. A description of the plant is given in Hooker (1897), who comments on the difference between the Khasia and Sikkim specimens, but concludes that they are conspecific, with which I agree. There is some doubt, however, as to

whether the specimens on the sheet really come from Sikkim. Hooker's field label reads 'Lachoong, rocks, 15–16000ft, Aug 15th '49', the altitude has been queried and later scored out by Hooker himself, and replaced with '5–6000ft'. It seems possible that this is the wrong field label which might well have belonged to another plant genuinely collected at the higher altitude because other collections from Lachung and its environs, by Hooker, Gammie and Pradhan, are all *T. filiformis*.

Whether or not *T. trifidus* occurs in Sikkim, it is necessary to lectotypify the name, and I choose here the only specimen in the type cover at Kew that bears Munro's ms. name unqueried and in his own hand. This sheet bears three plants, which all agree with the description in Hooker (1897), though it is not annotated by Stapf.

T. trifidus Munro ex Stapf, in Kew Bull. 1892: 85 (1892).
Type: India, Meghalaya, Khasia, *Griffith, HEIC (KD)* 6634 (lecto. selected here, K).

IV. TRIBE *PANICEAE*

Urochloa

There has been much discussion about the generic delimitation (and typification) of *Urochloa* and *Brachiaria*. Veldkamp (1996) and Webster (1987) have recommended restricting *Brachiaria* to *B. eruciformis* (Sm.) Griseb. and a few allied species and transferring the remainder of the large genus (c.100 species) to *Urochloa*. The difference between the genera is, in any case, small. According to Clayton & Renvoize (1986) they differ as follows:

1a. Spikelets adaxial, plump; upper lemma usually not mucronate ___ **Brachiaria**
1b. Spikelets abaxial, plano-convex; upper lemma mucronate _____ **Urochloa**

It should be noted that the spikelet orientation character only applies if the spikelets are borne singly and the definition of a 'mucro' is rather subjective; furthermore problematic intermediates exist. Clayton & Renvoize (1986) commented under *Urochloa* that 'it is a moot point whether generic rank is justified'. Most of the species in our area have been traditionally placed in *Brachiaria*, and *U. panicoides* P. Beauv. has only recently been found in Bhutan (*NPSW* 291; E, THIM). Given the small differences and the presence of intermediates it seems not unlikely that all *Brachiaria* might eventually be sunk under the earlier *Urochloa*. I therefore propose to follow this usage. This requires only one new varietal and one new specific combination for Bhutanese taxa. The latter is necessary because the species concerned has been overlooked and never transferred from *Panicum*.

Urochloa supervacua (C.B. Clarke) Noltie, **comb. nov.**
Basionym: *Panicum supervacuum* C.B. Clarke, in J. Linn. Soc. Bot. 24: 408 (1888).
Type: India, West Bengal, Balasun, 400ft, 28 v 1884, *Clarke* 35103 (lecto. selected here, K; isolecto. [35103A] BM).

Similar to *U. ramosa* (L.) T.Q. Nguyen, but differing as follows: leaves narrower (5–7mm vs. (6–)11–15mm), hairy; spikelets with two sterile florets.

This interesting species was described by Clarke, who cited three syntypes (*Clarke* 35103, 33585, 36932). No. 33585 has not been found, but a sheet at K bears two specimens and two labels with the first and last numbers. A duplicate of 35103 at BM gives the locality, altitude and date lacking on the K label. This matches the left-hand specimen on the Kew sheet, which appears to be associated with the label bearing Clarke's drawing reproduced with the protologue. As it also agrees with the description, it is this specimen that should be designated as the lectotype. The species was overlooked by Hooker (1897) and inexplicably sunk under *Brachiaria ramosa* (L.) Stapf by Bor (1960). It is distinct not only in the exceptional number of florets but also in the narrower, hairy leaves and the shape of the glume and lemma apices (±mucronate, tending towards *Urochloa* in the traditional sense).

Stapf (1919) treated the species as an aberrant form of *B. ramosa* and cited a specimen collected on the Cape Verde Islands. This specimen has since been re-identified as the related *B. lata* (Schumach.) Hubbard and demonstrates that an extra floret can occasionally develop in other species (as it can in other Panicoid genera). No doubt production of an extra floret results from a relatively simple mutation. However, given that our plant has a facies different from that of *U. ramosa*, a distinct distribution and appears to be relatively common, it seems desirable to reinstate Clarke's species. *U. supervacua* appears to be a weedy, subtropical species restricted to the lower Himalaya (to 1700m).

Specimens seen. INDIA. Uttar Pradesh: Nakind, above Dehra Dun, ix 1899, *Duthie* 23068 (K); Moradabad, viii 1843, *Thomson* 297 (K); Saharunpur, *Jameson* s.n. (E) (with *U. subquadripara*). West Bengal: Balasun, Sikkim Terai, 500ft, 13 x 1884, *Clarke* 36932A (K); Silgori, 1 vi 1875, *Clarke* 26495 (BM, K); Dinajpur, ix 1874, *Bignold* (ex herb. *Clarke* 23472) (K, E).

NEPAL. Kanchaupar Dist., Royal Sukla Phanta Wildlife Reserve, Singhpur H.Q., 600ft, 2 x 1975, *Schaaf* 107 (K).

BHUTAN. Punakha district: near Punakha Dzong, 1100m, 3 x 1987, *Wood* 5911 (E); Punakha, 4500ft, 20 v 1914, *Cooper* 2402 (E, BM); Wangdi Phodrang, 1200m, 20 ix 1998, *NPSW* 290 (E, THIM). Mongar district: Lingmethang, 950m, 2 vii 1979, *Grierson & Long* 2417 (E) (with *U. ramosa*); Yayung, 900m, 8 vi 1992, *Parker* 7207 (E). Tashigang district: between Kanglung and Tashigang, 1700m, 13 ix 1995, *Pradhan & Wangdi* EG42 (E); below Tashigang, 700m, 2 v 1988, *Wood* 6269 (E); Gamri Chu, 1300m, 9 ix 1998, *NPSW* 139 (E, THIM); Tashigang, 1300m, 9 ix 1998, *NPSW* 134 (E, THIM).

Urochloa villosa (Lam.) T.Q. Nguyen var. **barbata** (Bor) Noltie, **comb. nov.**
Basionym: *Brachiaria villosa* var. *barbata* Bor, Grasses of Burma, Ceylon, India and Pakistan, p. 286 (1960). Type: Nepal, Arun Valley N of Num, 4500ft, *Stainton* 1374 (holo. K; iso. E, BM).

This variety is characterized by having a tuft of long apical hairs on the upper glume. Although the hairiness of the upper glume of var. *villosa* is rather variable, it seems worth maintaining Bor's variety as it is easily recognized, and appears to be rather

uncommon. An analogous variety (var. *pilicoronata* (Ohwi) Jansen) occurs in the closely related Philippine species *Brachiaria fusiformis* Reeder.

Specimens seen. INDIA. Punjab: *Drummond* 21155 (E, K); *Gamble* 6448A (K). West Bengal: Darjeeling: *Sharma* 115 (K); *ESIK* 1163 (E).
NEPAL. *Wallich* 8735A (E, K); *Stainton* 1374 (K).
BHUTAN. *Wood* 5762, 5984A; *Pradhan & Wangdi* EG 129 (E).

Panicum laxum

A strange species of *Panicum*, with extremely small spikelets (c.1.3mm) was recently found in Bangladesh. It turns out to be *P. laxum* Sw., a tropical S American species. How it came there is a mystery, and the species seems never to have been reported as an introduction in Asia.

Specimen seen. BANGLADESH. Cox's Bazar District: Doapalong Range, Upper Rezu Reserve Forest, open areas by path in partly cleared lowland broad-leaved forest with *Eugenia* and *Dipterocarpus*, 30m, 25 x 1997, *Noltie et al.* 33 (= *Rahman* 2183) (E).

V. TRIBE *ARUNDINELLEAE*

Arundinella dagana Noltie, **sp. nov.**
Species nova inter *A. bengalensem* (Spreng.) Druce et *A. birmanicam* Hook. f. intermedia. *A. bengalensi* forma inflorescentiae et habitu perenni similis sed spiculis majoribus (plus quam 3.5mm longis, non plerumque minus quam 3.2mm), arista lemmatis superioris majore (2.1–2.5mm, non minus quam 1.5mm), gluma inferiore lemma inferius subaequali vel excedenti (haud 0.5–0.9mm breviore) differt. *A. birmanicae* facie tota et in structura spiculae simulans sed habitu perenni et aristis brevioribus recedit.
Type: Bhutan, Sankosh district, Daga Dzong, 1600m, viii 1989, *J.R.I. Wood* 7042 (holo. E; iso. THIM, US).

Perennial; rhizomes short, loosely tufted. *Culms* to 35cm, erect, bearing 5–7 leaves; leaf blades 13–20 × 0.6–1.2cm, lanceolate, finely acuminate, base rounded, slightly clasping, densely hairy above and beneath, hairs spreading, those at base of blade long (to 5mm); sheaths densely hairy; ligule c.0.5mm. *Inflorescence* 17–19cm, narrowly cylindric, branches stiffly appressed, the longest to 5cm. *Spikelets* 3.5–4mm. *Glumes* thickly herbaceous; the lower 3–3.5 × c.1.1mm, equal or exceeding lower lemma, narrowly lanceolate, acuminate, 3-veined, keel hispid, lateral veins with long bristles; the upper 3.2–3.8 × c.1.4mm, similar to lower, but wider and 5-veined. *Lower floret*: lemma 2.5–3 × 0.6–0.8mm, oblong-lanceolate, acute, thinly herbaceous; palea 1.7–1.9 × c.0.4mm, narrowly lanceoalte, hyaline; anthers (immature) c.0.3mm. *Upper floret*: lemma 2–2.3mm, narrowly lanceolate, hyaline, awn geniculate, column 0.8–1mm, brown, twisted, seta 1.3–1.5mm, hyaline; palea 1.8–2mm, narrowly lanceolate, hyaline; anthers 0.7–0.9mm.

The type specimen is extremely hairy and has very broad leaves, which give it a similar appearance to *A. birmanica*, from which it differs as described above. The new species, however, is closer to the widespread and variable *A. bengalensis* (which has forms with very hairy vegetative parts), but differs in the important spikelet characters described above. While having qualms about basing a new species on a single specimen, there seems little choice here and it is to be hoped that further collections will be made. The part of Bhutan in which it was collected is almost totally unexplored botanically, and John Wood is the only western botanist ever to have made collections there.

The plant grew on grassy banks around fields at 1600m.

VI. TRIBE *ANDROPOGONEAE*

New records

Spodiopogon lacei Hole has, until now, been known only from Burma, Thailand and NE India (Manipur). This species is extremely distinctive in having pseudopetiolate, deeply sagittate leaf bases. It was discovered by John Wood in chir pine (*Pinus roxburghii*) forest below Mongar in 1987 and refound there in 1999 (*Wood* 5998, E; *NPSW* 101, 203, E, THIM).

Microstegium falconeri (Hook.f.) Clayton has, until now, been known only from old collections from around Mussoorie and Nainital in the NW Himalaya (India: Uttar Pradesh). It is a small, delicate annual, no doubt easily overlooked and said to grow on walls (presumably naturally on rocks and cliffs) at 1830–2135m. It is superficially very similar to *Arthraxon microphyllus* (Trin.) Hochst., from which it differs in having well-developed, awned, pedicelled spikelets. Hooker based the genus *Ischnochloa* on this species, defined by its non-disarticulating raceme axes, but Clayton (1981) considered this character not to be significant and reduced the genus to *Microstegium*. It was discovered in Bhutan, near Shemgang (Tongsa district) by Ian Broad in 1985 (*Broad*, s.n., E). The specimen, however was initially identified as *Arthraxon sikkimensis* Bor (=*A. microphyllus*). This is the first record of the species for the E Himalaya, but whether or not this is a true disjunction is uncertain – it must be easily overlooked in the field, and should be looked for in Nepal.

Cymbopogon

This difficult genus is in need of revision, despite the worldwide monograph of Soenarko (1977), and that of the Indian species by Bor (1953b, 1954a). The genus is of enormous commercial importance in SE Asia, as aromatic oils are extracted from various species. In E Bhutan (the Kuru Chu and Manas valleys) oil is extracted (by steam distillation) from a species collected from the wild, and forms the basis of an important local industry. On a recent field trip the author was fortunate to meet two people who provided useful information on the industry and the plants:

Neten Drukpa of the Ministry or Agriculture's Renewable Natural Resources Research Centre at Lingmethang and Patma Dorji, a commercial oil extractor at Pahadrang, near Yadi. They told me that two 'species' of 'lemon grass' grow intermingled in the chir pine zone, which they distinguish by leaf texture. One produces a lower yield of oil, which is high in citral, and therefore commercially valuable: this they call '*C. flexuosus*'. The other type is higher yielding, but the oil is rich in piperitone and low in citral and therefore unsaleable: this they call '*C. distans*'. The identifications of the plants were presumably made in India, where the oil is sold.

On the visit in September, there did appear to be two forms – one narrower leaved, later flowering and tasting of menthol/lemon, the other with broader leaves, earlier flowering and lacking the menthol taste. The two cannot be told apart on spikelet characters in the herbarium, however, and no doubt merely represent chemical races of a single species. A similar situation is found in *C. martinii* (Roxb.) J.F. Wats. where two forms distinguishable in the field, but indistinguishable in the herbarium, produce two different types of oil (Bor, 1960).

However, neither of the locally used names is correct. The name *C. distans* has no doubt been applied as the species is relatively narrow-leaved. *C. distans*, however, is a NW Himalayan species of much lower stature and with larger spikelets. The name *C. flexuosus* has no doubt been applied as it is that species which is used for extraction of 'lemon grass oil' in India. However, *C. flexuosus* has a much broader, denser inflorescence, with smaller, wrinkled spikelets, and is mainly Peninsular, being represented in our area by the scarcely aromatic var. *sikkimensis* Bor. The oil-producing Bhutanese plant is closest to *C. pendulus*, but seems different enough to warrant description as a new species.

Cymbopogon bhutanicus Noltie, **sp. nov.**

A *C. pendulo* (Nees ex Steud.) J.F. Wats. foliis angustioribus (3.7–9.8mm, non 7–14mm); spiculis sessilibus angustioribus (1–1.2(–1.3)mm latis non 1.2–1.4(–1.6)mm), alis etiam angustioribus (0.1–0.2mm non 1.7–2mm); pilis in pedicellis internodiisque brevioribus (1.5–2.5mm, non 3–4mm), spatheolis angustioribus, ligula longiore (3.5–6mm, non 1.7–2mm) rotundato usque subacuto (haud truncato), junctura vaginae cum pagina abaxiali folii pilosa differt. A *C. distanti* (Nees ex Steud.) J.F. Wats. culmis elatioribus (non usque ad 90cm), foliis latioribus (non 2–3mm); inflorescentia longiore (non usque ad 30cm); spiculis sessilibus brevioribus (non 6–7(–8.5)mm), latioribus differt.

Type: Bhutan, Mongar district, between Mongar and the Kuru Chu, 1200m, 6 ix 1998, *NPSW* 99 (holo. E; iso. THIM).

Tufted perennial. *Culms* 150–250cm, sometimes waxy below; leaves glaucous, blades to 8.2mm wide, sheaths appressed-hairy on underside at junction with sheath; ligule rather pointed, longer than wide, 3.5–7mm. *Leaves* of vegetative shoots 50–80cm, narrow, 3.7–8.7(–9.8)mm wide, becoming inrolled on drying, strongly lemon-scented. *Inflorescence* a decompound panicle, 60–116cm, rather narrow, primary

branches erect, widely spaced, the lowest 31–58cm, 3–4cm wide. *Spatheoles* 17–30mm, linear. *Racemes* 12–20mm, the shorter subsessile, with 1 homogamous basal pair, 1–5 spikelet pairs and 1 terminal triad; the pedicelled raceme with 3–6 spikelet pairs and one terminal triad; raceme internodes 2.3–3.5mm, marginal hairs white, the longest 1.5–2.5mm, apical cup unequally 3-lobed. *Sessile spikelet* 5–6.4mm; lower glume 4.6–5.8 × 1–1.3mm, oblong-acuminate, coriaceous, yellowish, covered in minute glands, back flat, with shallow, central groove in lower half, with 2 or 3 intercarinal veins in upper half, keels very narrowly winged above, wings 0.1–0.2mm wide, apex minutely bifid; upper glume 4.4–5.5mm, oblong-lanceolate, keeled, keel narrowly winged near apex, sometimes minutely mucronate, margins ciliate; lower lemma 3.4–5.1mm, lanceolate, hyaline, margins ciliate; upper lemma, base oblong, 1.3–2mm, apical teeth 0.7–1.9mm, awn geniculate, column 5.1–8mm, seta 6.3–10mm; anthers 1.7–2.6mm. *Pedicel* 2.1–3.7mm; pedicelled spikelet 3.9–5.8mm.

Specimens seen. BHUTAN. Mongar district: Lingtsi [Lhuntse], Kurted, 4500ft, 5 viii 1915, *Cooper* 4359 (E); below Mongar, 1300m, 24 x 1990, *Wood* 7363 (E); below Mongar, 700m, 9 xi 1991, *Wood* 7506 (E); Lingmethang, 750m, 15 ix 1995, *Pradhan & Wangdi* EG86 (E); between Mongar and the Kuru Chu, 1350m, 15 ix 1998, *NPSW* 202 (E). Tashigang district: 1km NE of Tashigang, 1330m, 18 vi 1979, *Grierson & Long* 2067 (E, K); Kiri, 1400m, 14 ix 1995, *Pradhan & Wangdi* EG50 (E); below Yadi, 820–1500m, 8 ix 1998, *NPSW* 115, 125, 126, 127, 129 (E); 2km S of Tashigang, 1380m, 14 ix 1998, *NPSW* 200 (E).

The species appears to be restricted to chir pine forest between 700 and 1500m in the hot, dry valleys of eastern Bhutan, but is to be expected in the adjacent Indian state of Arunachal Pradesh.

Cymbopogon munroi

The distinction between *Cymbopogon* and *Andropogon* is problematic, and in Bhutan two taxa highlight the difficulties. Traditionally the genera have been separated thus:

1a. Plants aromatic; raceme bases subequal, flattened, deflexed, scarcely exserted from spathes, racemes paired ——— **Cymbopogon**

1b. Plants not aromatic; raceme bases unequal, terete, not deflexed, exserted from spathes, racemes often digitate ——— **Andropogon**

But exceptions are allowed, in particular species, for all of these characters. For example, in our area *C. microtheca* (Hook. f.) A. Camus is not aromatic but has traditionally been retained in *Cymbopogon* (Soenarko, 1977; Clayton & Renvoize, 1986). Another intermediate species occurs in Bhutan, until recently known only from the inadequate type specimen collected by Griffith in 1838. This was described as *Andropogon hookeri* Hack., but transferred by Bor to *Cymbopogon*, following a suggestion of Stapf. It is extremely similar to *C. microtheca*, except in having slightly larger spikelets and non-swollen raceme internodes and pedicels.

Andropogon munroi C.B. Clarke was based on a single inadequate specimen from the Naga Hills of NE India, which I regard as atypical in having most of the racemes arranged in digitate partial inflorescences. On the type, however, there are several partial inflorescences of deflexed, paired racemes. Up until now this species has been retained in *Andropogon*, despite Clarke's comment that 'this species appears to me more a *Cymbopogon* than a *Gymnandropogon* [i.e. *Andropogon*]'. Soenarko (1977) was correct in identifying the type of *A. hookeri* as being conspecific with the earlier *A. munroi*.

Clayton (1972) added an extra complication by sinking, without discussion, the NW Himalayan *A. tristis* Nees ex Hack. and the Tibetan *C. tibeticus* Bor under *A. munroi*. This synonymy was accepted in the accounts for Pakistan by Cope (1982) and China by Chen (1997). Having examined a large number of specimens from India and China it is clear that *A. tristis* is not synonymous with *A. munroi* (see below), which leaves a problem of the correct name for the latter. Although the epithet *munroi* has priority, the generic position remains problematic. Because of the tendency of some of the racemes to deflex, and the evident close relationship to *C. microtheca*, there seems no choice but to place it in *Cymbopogon*, next to the other non-aromatic species – *C. gidarba* (Buch.-Ham. ex Steud.) Haines and *C. microtheca*. The following new combination is therefore required:

Cymbopogon munroi (C.B. Clarke) Noltie, **comb. nov.**

Basionym: *Andropogon munroi* C.B. Clarke, in J. Linn. Soc. Bot. 25: 87 (Feb. 1889). Type: India, Nagaland, Mythi Phuni, Muneypore [Manipur], 3500ft, 13 xi 1885, *Clarke* 41961 (holo. K).

Syn.: *A. hookeri* Hack. in DC. Monogr. Phan. 6: 614 (April 1889). Type: Bootan, *Griffith HEIC (KD)* 6767 [probably *Griffith* 709, descent to Tongsa, 9500ft.] (holo/iso. K).

C. hookeri (Hack.) Stapf ex Bor, in Indian For. Rec. 1: 92 (1938).

C. tibeticus Bor, in Kew Bull. 8: 275 (1953). Type: China, Tibet, Kyi Chu valley, 15 miles E of Lhasa, viii 1904, *Walton* s.n. (holo. K).

A. yunnanensis Hack., in DC. Monogr. Phan. 6: 440 (April 1889). Type: China, Yunnan, supra Mo-so-yn, prope Lan-Kong, *Delavay* 1782 (holo. P, *n.v.*).

It can be distinguished from *Andropogon tristis* as follows:

1a. Lower glume of sessile spikelet deeply grooved, linear, c.0.7mm wide; some racemes usually deflexed; most racemes paired; branching intravaginal, basal sheaths flattened, conspicuously keeled (Bhutan, NE India, SE Tibet, Yunnan) ——— **Cymbopogon munroi**

1b. Lower glume of sessile spikelet shallowly grooved, oblanceolate, c.1mm wide; no racemes deflexed; most racemes digitate; branching extravaginal; basal sheaths not conspicuously flattened or keeled (NW Himalaya, Nepal) ——— **Andropogon tristis**

Themeda

There has been confusion in herbaria over the identification of Himalayan members of this difficult genus, in particular between the widespread and very variable species *T. triandra* Forssk. and *T. quadrivalvis* (L.) Kuntze, and the less well-known *T. laxa* (Andersson) A. Camus. In the following discussion an additional complication comes from the fact that Andersson (1856) and Hooker (1897) used the genus *Anthistiria*, and both they and Hackel (1889) used different epithets for the first two species.

T. laxa was based by Andersson on a single specimen from Nepal, *Wallich* 8775. The holotype has not been seen, but isotypes at E, K and K-W all represent the same taxon and agree with the protologue, so there seems no reason to doubt that the holotype is identical. Andersson commented on its similarity to what he called *A. ciliata* (=*T. quadrivalvis*) and in particular to certain specimens in Royle's herbarium which Nees had identified as a variety of that species.

Hackel (1889) reduced *A. laxa* to a variety of what he called *T. forskalii* (=*T. triandra*). Although he listed it as a '*varietas dubia*' there is no doubt that he made a valid new combination; the doubt is over the type specimen which he thought was probably a shade form and commented that more material required to be seen before deciding on its identity.

The confusion started with Hooker (1897), who identified a Duthie specimen from the Central Provinces of India as *A. laxa*. This specimen has smaller, more hispid, involucral spikelets, and I would refer it to *T. quadrivalvis*. Hooker (1897) also described var. *roylei* of *A. imberbis* (now *T. triandra*) based on the Royle specimens mentioned above. Hooker thought this variety was probably annual, but this is difficult to tell from the specimens he saw. In fact this common Himalayan plant is perennial, the annual habit being a characteristic of *T. quadrivalvis*, which also differs in having much more hispid involucral spikelets. Stapf (on specimens at Kew), Bor (1960) and other Indian Flora writers appear to have ignored the type of *A. laxa* and misapplied the name to specimens matching the Duthie one.

The type of *A. laxa* exactly matches some Bhutanese specimens, which grade into others of what is the commonest representative of the genus in the temperate Himalayan from Simla to Bhutan. The type is atypical only in having rather numerous partial inflorescences and in the vast majority of the glumes of the involucral spikelets lacking apical bristles (though some have them). In fact *A. imberbis* var. *roylei* and *A. laxa* are one and the same thing.

T. triandra is an extremely variable species occurring throughout the tropics and subtropics of the Old World and numerous varieties have been described, based on rather subjective characters. Clayton & Renvoize (1982) comment that 'the traditional varieties are of little value', the characters being poorly correlated with distribution/habitat. Compared with other Indian material, however, the temperate Himalayan form appears relatively distinct and to merit varietal recognition. No doubt it is merely a slender montane form and similar ones have been seen from the Nilgiri Hills of southern India. It differs from the typical variety in being more

slender, having smaller clusters of spikelets, shorter spathes, less hairy, shorter involucral spikelets and shorter, weaker awns. Specimens from Khasia appear mainly to be more robust, but some are similar to var. *laxa*. In Bhutan the taxon occurs very commonly at altitudes of 1400–3200m.

Domin recombined var. *roylei* under *T. triandra*, but the epithet *laxa* has priority at varietal rank, so the following new combination and synonymy must be made:

Themeda triandra Forssk. var. **laxa** (Andersson) Noltie, **comb. nov.**
Basionym: *Anthistiria laxa* Andersson, in Nov. Act. Reg. Soc. Upsal., ser. 3, 2: 241 (1856). Type: Nepalia, *Wallich* 8775 (holo.?S *n.v.*; iso. K, E, K-W).
Syn.: *Themeda forskalii* var. *laxa* (Andersson) Hackel, in A. & C. DC., Monogr. Phan. 6: 663 (1889).

Anthistiria imberbis var. *roylei* Hook.f., Fl. Brit. India 7: 213 (1897). Type: 'N.W. India, Hb. Royle' (lecto. selected here: left hand specimen (the only one with roots), on a sheet also bearing two flowering stems collected by T. Thomson, K).

Themeda triandra var. *roylei* (Hook. f.) Domin, in Bibl. Bot. 85: 280 (1915).

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NOTES RELATING TO THE FLORA OF BHUTAN: XL. *GRAMINEAE* III, THE GENUS *POA*

H. J. NOLTIE*

The following new species are described from the E Himalaya: *Poa pseudotibetica* Noltie (Tibet, Sikkim); *P. rohmooiana* Noltie (Sikkim); *P. chumbiensis* Noltie (Tibet); *P. dzongicola* Noltie (Bhutan, Sikkim); *P. cooperi* Noltie (Sikkim); *P. longii* Noltie (Sikkim); *P. lachenensis* Noltie (Sikkim); *P. rajbhandarii* Noltie (India, Nepal, Bhutan). *Poa himalayana* Nees ex Steud. has been misunderstood and a new lectotype is chosen, replacing that of Bor; *P. stewartii* Bor is reduced to its synonymy.

Keywords. E Himalaya, lectotypification, new taxa, *Poa*.

INTRODUCTION

With 29 species, *Poa* is the largest grass genus in the *Flora of Bhutan* area. Despite a recent revision of the Himalayan species (Rajbhandari, 1991) and Bor's authoritative treatment of the genus for the Indian region (Bor, 1951a, 1952) it has been found necessary to describe several new species and to disentangle a muddle arising from an erroneous typification of one of the commonest species of the area, until now known as *P. himalayana*.

It should be noted that the genus is very poorly collected in Bhutan, compared with Sikkim, and that given the number of new taxa from Sikkim more species can be expected when northern Bhutan is more fully explored.

NEW TAXA

Poa pseudotibetica Noltie, **sp. nov. Fig. 1A–D.**
Syn.: *P. tibetica* Stapf var. *aristulata* Stapf, in Hook.f., Fl. Brit. India 7: 339 (1897).
A *P. tibetica* Stapf ramis inflorescentiae longioribus rigide erectis, spiculis majoribus (plus quam 6.5mm longis, haud usque ad 5.5mm), lemmatibus longioribus (infimo plus quam 5mm, non usque ad 4.5mm) crassioribus et tenuiter acuminatis (haud subacutis) differt.

Differs from *P. tibetica* Stapf in having longer, stiffly erect inflorescence branches; spikelets larger (over 6.5mm, not up to 5.5mm), lemmas longer (the lowest over 5mm, not to 4.5mm), thicker textured and finely acuminate (not subacute).

Type: India, Sikkim, Chholhamoo, 17,820ft, 16 viii 1972, *Pradhan, Norbu & Naku* 206 (holo. E).

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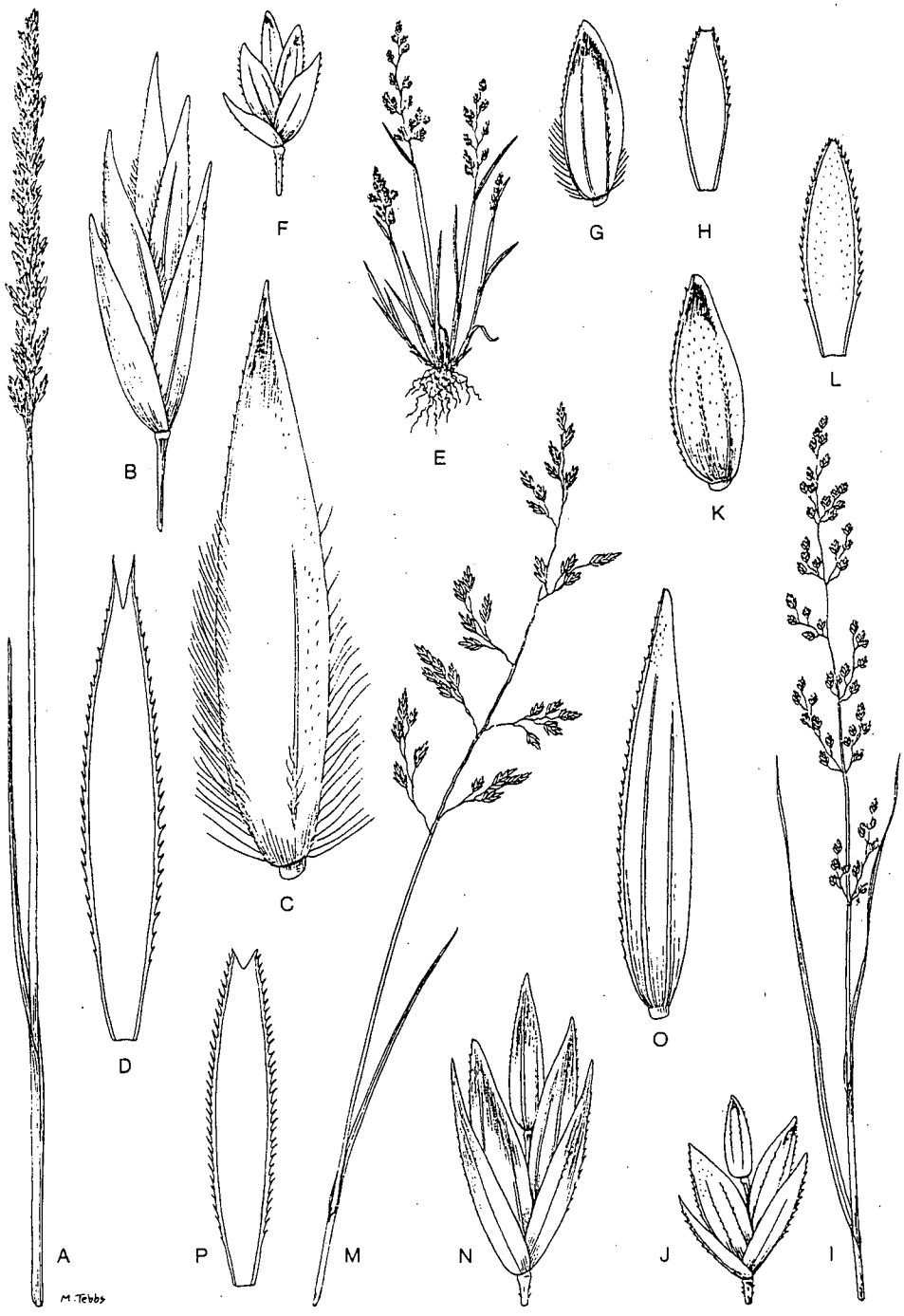

FIG. 1. A–D, *Poa pseudotibetica* Noltie (*Pradhan, Norbu & Naku* 206): A, inflorescence; B, spikelet; C, lowest lemma; D, lowest palea. E–H, *P. rohmooiana* Noltie (*Rohmoo* 284): E, habit; F, spikelet; G, lowest lemma; H, lowest palea. I–L, *P. chumbiensis* Noltie (*Bor & Kirat Ram* 20148): I, inflorescence; J, spikelet; K, lowest lemma; L, lowest palea. M–P, *P. dzongicola* Noltie (*Sinclair & Long* 5396): M, inflorescence; N, spikelet; O, lowest lemma; P, lowest palea. Infls. × ⅔; spikelets × 8; lemmas & paleas × 16.

Perennial, with slender, creeping rhizomes. *Culms* to 45cm, smooth, leafy for lower ½ to ⅔. *Culm leaf blades* 4–16cm, coriaceous, strongly ribbed above and beneath, scabrid on ribs above, pungent; sheaths smooth; ligule of uppermost leaf 1.5–5.5mm, subacute, irregularly dentate. *Inflorescence* to 9cm, dense, narrowly cylindric, branches smooth, naked only at base, stiffly appressed, the lowest in whorl of c.4, the longest to 4cm. *Spikelets* pale brownish purple, 6.6–8.2mm, narrowly elliptic, florets 3–4, callus wool absent. *Glumes* papery, acuminate, margins minutely ciliate below: the lower 4–4.6 × 1.5–1.7mm, 1- or 3-veined; the upper 4.8–6 × 2–2.4mm, 3-veined, surface minutely hairy at base. *Lemmas* oblong-lanceolate in profile, finely acuminate, chartaceous, lateral veins obscure, the lowest 5.3–5.7mm, half-width 1–1.2mm, keel and outer lateral veins with long (1–2mm), woolly hairs in lower half, apex narrowly hyaline, flushed purple subapically. *Palea* of lowest floret 4.1–4.9mm, keels scabrid, apex deeply bidentate. *Anthers* 2.2–3.1mm.

Other specimens seen. TIBET. Sandy dunes, Thibet, N of Sikkim, [1849], *J.D. Hooker s.n.* (K; type of var. *aristulata*). C. Tibet, vii 1929, *Prof. Kashyap s.n.* (K). Kala, Gyantse, 14,500ft, 1935, *Ludlow* 139 (BM).

Poa tibetica var. *aristulata* was described by Stapf based on a specimen consisting of the upper part of a culm with a single leaf and inflorescence. Bor (1952) wrote 'the impression one gets is that the inflorescence is not quite normal', but later (Bor, 1960) this had become 'possibly a diseased form'. Now, with more material available one can see that we are dealing with a distinct species. The varietal epithet has not been used for the species as there is already a *Poa aristata*, which would be confusingly similar, and the type of the variety is not complete enough for a proper description. The plant is an extreme alpine from southern central Tibet and northern Sikkim; the only habitat note is on the Ludlow specimen which reads 'boggy ground'.

Poa rohmooiana Noltie, **sp. nov. Fig. 1E–H.**

Poa tibeticola Bor habitu annuo et spiculis glabriusculis similis sed a qua multo humiliore (culmis usque ad 3cm altis, non plus quam 10cm), spiculis in omnibus partibus minoribus minus compressis et lemmatibus latioribus carinis inferne ciliatis (haud glaberrimis) differt.

Resembles *P. tibeticola* Bor in its annual habit and almost glabrous spikelets, but differs in being much smaller (culms to 3cm, not over 10cm), spikelets smaller in all parts, less compressed, and lemmas wider, the keels ciliate below (not glabrous).

Type: India, Sikkim, Chugya, 15,000ft, 12 ix 1912, *Rohmoo* 284 (holo. E).

Diminutive, tufted annual. *Culms* to 3cm, scabrid beneath inflorescence, leafy for lower ⅔ or to base of inflorescence. *Culm leaf blades* to 1.7cm, flat, linear, to 1.4mm wide; sheaths scabrid; ligule of uppermost leaf c.0.5mm, rounded. *Inflorescence* to 3cm, narrowly triangular in outline, branches scabrid, deflexed, the lowest paired, the longer 0.9–1.3cm. *Spikelets* greenish, to 2.3mm, widely elliptic, florets 3, callus wool absent. *Glumes* herbaceous, margins narrowly hyaline: the lower 1.6 × 0.7mm,

lanceolate, acuminate, 1-veined; the upper 1.6 × 0.9mm, oblong-ovate, acuminate, 3-veined. *Lemmas* narrowly elliptic in profile, blunt, the lowest c.1.5mm, half-width c.0.5mm, keel ciliate below, scabrid above, lateral veins minutely scabrid above, glabrous or minutely hairy near base, surface smooth between veins, apex narrowly hyaline, sometimes flushed purple subapically. *Palea* of lowest floret c.1.4mm, keels scabrid above. *Anthers* c.0.5mm.

Bor (1951a) identified this specimen as his *P. tibeticola*, but commented on its small size. Closer examination shows it to be a distinct species. *Poa tibeticola* is a species from southern Tibet (Khambajong and Lhasa), of which there appear to be no recent collections. The new species, known only from the type gathering, is from a much higher elevation in Sikkim. Its name commemorates its discoverer – Rohmoo, a Lepcha (native Sikkimese) collector, who collected many interesting plants in Sikkim and Chumbi for the Calcutta Botanic Garden.

Poa chumbiensis Noltie, **sp. nov. Fig. 1I–L.**

Poa triviali L. ligulis longis et vaginis foliorum scabridis similis sed a qua lana calli carenti, pilis secus carinam et venas laterales lemmatum nullis, antheris minoribus (c.0.5mm longis, non plus quam 1mm) differt.

Similar to *P. trivialis* L. in its long ligules and scabrid leaf sheaths, but differs in lacking callus wool, lacking hairs on the keel and lateral veins of the lemmas, and in its smaller anthers (c.0.5mm, not over 1mm).

Type: Tibet, Chumbi Valley, Yatung, 10,000ft, 18 vi 1945, *Bor & Kirat Ram* 20148 (holo. K).

Tufted perennial. *Culms* to 30(+?)cm, scabrid beneath inflorescence, probably finally leafy for most of length. *Culm leaf blades* to 13cm, flat, to 4mm wide, scabrid on veins, especially above; sheaths keeled, very scabrid; ligule of uppermost leaf to 4.3mm, those of lower leaves to 6mm, acute. *Inflorescence* (not fully expanded) to 14cm, probably finally narrowly triangular in outine, lax, branches very scabrid, probably finally spreading, the lowest in whorls of 3, the longest to 5.7cm. *Spikelets* greenish, c.2.7mm, widely ovate, florets 3, callus wool absent. *Glumes* lanceolate, acuminate, herbaceous, margins hyaline, keels very scabrid: the lower 1.5 × 0.6mm, 1-veined; the upper 2.1 × 0.9mm, 3-veined. *Lemmas* oblong-elliptic in profile, blunt, the lowest 1.9mm, half-width 0.6mm, keel scabrid above, lateral veins raised, minutely scabrid, surface minutely scabrid between veins, apex narrowly hyaline, flushed purple subapically. *Palea* of lowest floret 1.8mm, keels hispid, back scabrid between keels. *Anthers* c.0.5mm.

Known only from the type collection, which grew on 'wet sand'. This specimen was identified as *P. trivialis* by Bor (1952); however, he annotated the sheet as 'cf. trivialis? var. nov.?', indicating his uncertainty. It is quite different from *P. trivialis* and worth describing, despite the fact that the specimen is not fully mature.

Poa dzongicola Noltie, **sp. nov. Fig. 1M–P.**
A *P. royleana* Nees ex Steud. ligulis longioribus, spiculis majoribus et habitu humiliore differt. A *P. pagophila* Bor carinis lemmatis sine ciliis basalibus antheris minoribusque recedit.

Differs from *P. royleana* Nees ex Steud. in its longer ligules, larger spikelets and smaller habit. From *P. pagophila* Bor it differs in its glabrous lemma keels and smaller anthers.

Type: Bhutan, Upper Mo Chu district, Lingshi Dzong, 4100m, 28 ix 1984, *Sinclair & Long* 5396 (holo. E, iso. K).

Tufted perennial. *Culms* 13–22cm, smooth, or occasionally scabrid beneath inflorescence, leafy for just above half its length. *Culm leaf blades* 4.7–22cm, flat, 2–3mm wide, scabrid only on margins; sheaths smooth or occasionally scabrid; ligule of uppermost leaf 4–6mm, acute. *Inflorescence* 6.5–16cm, triangular in outline, lax, branches minutely scabrid above, spreading, the lowest single or paired, the longer 3–8cm. *Spikelets* flushed purple, 4–7.4mm, narrowly oblong, florets (2–)3–6, callus wool absent. *Glumes* lanceolate, acuminate, thickly herbaceous, margins hyaline, surface sometimes punctate: the lower almost reaching tip of lowest lemma, 2.9–3.8 × 1.3mm, 1- or 3-veined; the upper 3.3–4.3 × 1.5mm, 3-veined. *Lemmas* thickly herbaceous, narrowly lanceolate in profile, subacute, the lowest 3.1–4.1mm, half-width 0.6–0.9mm, keel scabrid throughout, lateral veins glabrous or minutely scabrid, surface smooth or minutely scabrid between the veins, apex widely hyaline, often flushed purple subapically. *Palea* of lowest floret 2.6–3.4mm, keels scabrid, the back sometimes scabrid near base. *Anthers* 0.9–1.5mm.

Other specimens seen. BHUTAN. Upper Mo Chu district, Jambethang, Lingshi Hill, *Dunbar* 43 (K); Soi Yaksa, *D.J. Miller* 291 (K); above Laya, *Sinclair & Long* 5131 (E, K); Zambuthang, *Sinclair & Long* 5455A (E, K).
INDIA. Sikkim, unlocalised, [1892], *Gammie s.n.* (K); Patang La, *King's Collector s.n.* (K); S of Thanggu, *Edinburgh Expedition to Northern Sikkim (EENS)* 280 (E).

This species is distinctive in the combination of lack of callus wool, lemmas lacking cilia on the keels or veins, and length of glumes relative to lemmas. It is known from several collections from N Bhutan and Sikkim where it grows in disturbed places (waste places near houses; banks among cultivation; on walls; among rocks in scrub), 3760–4100m. The epithet is taken from the habitat of the type specimen, the walls of Lingshi Dzong. The Dzongs are one of the most spectacular forms of architecture in Bhutan, being combined monastic and district administrative centres.

Poa cooperi Noltie, **sp. nov. Fig. 2A–D.**
A *P. pagophila* Bor antheris minoribus (longitudine minus quam 1mm, non plus quam 1.7mm), ligulis brevioribus, lemmatibus brevioribus magis acutis, et spiculis florum magis numerosorum compositis differt.

FIG. 2. A–D, *Poa cooperi* Noltie (*Cooper* 118): A, inflorescence; B, spikelet; C, lowest lemma; D, lowest palea. E–H, *P. longii* Noltie (*ESIK* 286): E, inflorescence; F, spikelet; G, lowest lemma; H, lowest palea. I–L, *P. lachenensis* Noltie (*J.D. Hooker*, *Poa* 17, p.p.): I, inflorescence; J, spikelet; K, lowest lemma; L, lowest palea. M–P, *P. rajbhandarii* Noltie (*ESIK* 748): M, inflorescence; N, spikelet; O, lowest lemma; P, lowest palea. Infls. × ⅔; spikelets × 8; lemmas & paleas × 16.

Differs from *P. pagophila* Bor in having shorter anthers (under 1mm, not over 1.7mm); ligules shorter; lemmas shorter, more acute; and the spikelets with more numerous florets.

Type: India, Sikkim, Laghep, 10,000ft, 1 vii 1913, *Cooper* 118 (holo. E).

Tufted perennial. *Culms* to 13(+?)cm, smooth, leafy to inflorescence. *Culm leaf blades* 4.5–6.9cm, flat, becoming inrolled, c.2.2mm wide, glabrous; sheaths purple, smooth; ligule of uppermost leaf 1.5–2.2mm, truncate-dentate. *Inflorescence* (not fully expanded) to 16cm, lax, branches minutely scabrid, probably spreading at maturity, the lowest borne singly, to 7.7cm. *Spikelets* flushed purple, 4.5–5.5mm, narrowly wedge-shaped, florets (3–)4, callus wool absent. *Glumes* lanceolate, subacte, herbaceous, margins hyaline, surface scabrid, tinged purple: the lower c.2.5 × 0.8mm, 1-veined; the upper 3.1–3.4 × 1.3mm, 3-veined. *Lemmas* thickly herbaceous, oblong-lanceolate in profile, acute, the lowest 3.6–3.8mm, half-width 0.9mm, keel ciliate in lower half, outer lateral veins shortly hairy at base, surface scabrid above and shortly hairy near base between the veins, apex very narrowly hyaline, flushed purple subapically. *Palea* of lowest floret c.3.5mm, keels scabrid, the back shortly hairy. *Anthers* c.0.9mm.

Known only from the type gathering. The epithet commemorates R. Edgar Cooper (1890–1962), who collected for the nursery firm of Bees in Sikkim in 1913 and who made a fundamentally important contribution to our knowledge of the flora of Bhutan in the years 1914 and 1915.

Poa longii Noltie, **sp. nov. Fig. 2E–H.**
A *P. polycolea* Stapf rhizomata tenuia carenti, antheris glumisque minoribus, lana calli praesenti et lemmatibus ad apicem anguste tantum hyalinis differt. A *P. pagophila* Bor antheris minoribus, ligulis brevioribus, lemmatibus magis acutis cum apice magis anguste hyalina et venis lateralibus ad bases hirsutis recedit.

Differs from *P. polycolea* Stapf in lacking slender rhizomes, anthers and glumes smaller, callus wool present and lemmas only narrowly hyaline at the apex.

Differs from *P. pagophila* Bor in its smaller anthers, shorter ligules, and the lemmas more acute, with a more narrowly hyaline apex and the lateral veins hairy at base.

Type: India, Sikkim, Bikbari, Choktsering Chu Valley, 27°30′53″N, 88°08′28″E, 4000m, 12 vii 1992, *Edinburgh Expedition to Sikkim and Darjeeling (ESIK)* 286 (holo. E).

Densely tufted perennial. *Culms* to 31cm, smooth, leafy for ⅔ length. *Culm leaf blades* 3–6.5cm, flat, 1–2mm wide, glabrous; sheaths sometimes flushed purple, smooth or very minutely scabrid; ligule of uppermost leaf 1–1.8mm, blunt. *Leaves* of vegetative shoots short, to 8cm. *Inflorescence* 6.5–13cm, very lax, triangular in outline, branches filiform, scabrid, deflexed, naked for more than half-length, the lowest borne in pairs, 3s or 4s, the longest to 7.5cm. *Spikelets* flushed purple,

3.6–5.6mm, narrowly wedge-shaped, florets 2–4, callus wool present, scanty or copious. *Glumes* flushed purple, lanceolate, subacute, surface scabrid: the lower 1.1–2.2 × 0.6–0.9mm, 1-veined; the upper 2.5–3.2 × c.1.2mm, 3-veined. *Lemmas* narrowly lanceolate in profile, subacute, the lowest 2.9–3.8mm, half-width c.0.7mm, keel ciliate below, outer and sometimes intermediate lateral veins shortly hairy near base, apex narrowly hyaline, flushed purple subapically. *Palea* of lowest floret 2.3–2.4mm, keels scabrid. *Anthers* 0.7mm.

Ecology. An alpine species of open habitats (edge of yak pasture by river bank; base of cliff on acidic soil), 3430–4000m.

Other specimen seen. INDIA, Sikkim, Phune, 3430m, 13 vii 1996, *Edinburgh Expedition to Northern Sikkim (EENS)* 147 (E).

It gives me great pleasure to name this graceful species after David G. Long, who took part in the two expeditions on which it was found.

Poa lachenensis Noltie, **sp. nov. Fig. 2I–L.**.
In superficie *P. rajbhandarii* Noltie (*P. himalayana* sensu Bor) similis et *P. khasianae*. Stapf similis ab ambabus lana calli carenti, carinis paleae pilos breves crispatos ferentibus et carina venis lateralibus lemmatum glabris differt. A *P. khasiana* recedit etiam gluma inferiore in proportione lemmate infero breviore.

Similar in overall appearance to *P. rajbhandarii* Noltie (*P. himalayana* sensu Bor) and *P. khasiana* Stapf. From both of these it differs in lacking callus wool, the palea keels bearing short, crisped hairs, and the keel and lateral veins of the lemmas glabrous. From *P. khasiana* it also differs in having the lower glume shorter relative to the lowest lemma.

Type: India, Sikkim, Lachen, 11,000ft, 11 vi 1849, *J.D. Hooker Poa* 17 (p.p.) (holo. K).

Tufted perennial. *Culms* 20–40cm, smooth, leafy to inflorescence, leaves rather widely spaced. *Culm leaf blades* 3.7–11cm, flat, 1.9–3.2mm wide, glabrous; sheaths smooth; ligule of uppermost leaf to 0.6–0.9mm, truncate. *Inflorescence* 6–13.5cm, narrow, lax, branches scabrid, ascending, the lowest paired or in 3s, the longest 3–7cm. *Spikelets* greenish, 4.1–6.2mm, wedge-shaped, florets 3–4, rachilla internodes slender, exposed, callus wool absent. *Glumes* lanceolate, acuminate, subacute, herbaceous, margins hyaline: the lower 1.8–2.7 × 0.8mm, 1-veined; the upper 2.5–3.6 × 1.2mm, 3-veined. *Lemmas* linear-lanceolate in profile, acute, the lowest 3.1–4.2mm, half-width c.0.6mm, keel minutely scabrid above, lateral veins glabrous, surface punctate, apex narrowly hyaline, sometimes flushed purple subapically. *Palea* of lowest floret 2.3–2.9mm, keels with crisped hairs on upper parts. *Anthers* 0.7–1.1mm.

Other specimens seen. There are three other sheets at Kew, one with a field label with the same data as the holotype, another collected at Lachen, but on a different date (20 vi 1849) and at a different altitude (13,000ft). The third bears only the distribution label '*Poa* 17'; there is a duplicate of this last in BM and no doubt also in other herbaria.

Known from several Hooker gatherings and not collected since 1849. These Sikkim specimens were part of Stapf's original circumscription of *P. khasiana*: Hooker's '*Poa* 17' is cited in the protologue and the characters of scanty wool and subglabrous outer lemma veins in the description refer to this element. However, from the epithet, the fact that Stapf's analytical drawing is attached to a Khasia specimen, and that Stapf did not annotate any of the Sikkim specimens with the name, Bor (1951a) was no doubt right to [lecto]typify *P. khasiana* on a specimen from Khasia (Cherrapunji, 2000m, *J.D. Hooker s.n.*, 18 vi 1850, K). Bor did not, however, deal with the excluded Sikkim element. Given the small differences between other taxa in the genus, and for the sake of consistency, there seems little choice but to describe this as a new species, though further work is required on this and the related taxa *P. himalayana*, *P. khasiana* and *P. rajbhandarii*.

POA HIMALAYANA

The name *Poa himalayana* has been misapplied to one of the commonest E Himalayan members of the genus. The name was first published by Steudel, based on a description and name by Nees von Esenbeck. In the original publication (Steudel, 1854–1855), the locality was given as Nepal, but no specimens were cited. Stapf (1897) took up the name in *Flora of British India*, and included specimens collected by Royle, Wallich, Griffith and Hooker. Bor (1951b) realised that among the specimens cited by Stapf were two taxa: one with ciliate, the other with scabrid, palea keels, though Stapf's description referred only to the former. Bor argued that the most likely Nepalese material available to Nees was Wallich's, and designated *Wallich* 8885 as the [lecto]type. This specimen belongs to the taxon with scabrid keels, and unfortunately Bor's choice turns out not to have been from the original material.

Steudel (1854–1855), in his Preface, stated that he had access to a Nees manuscript entitled 'Supplementa Graminearum'. By great good fortune a Nees manuscript has turned up at Glasgow which, if not the actual one used, is certainly a copy of the manuscript cited by Steudel (Noltie, 2000). In this, the description of *P. himalayana* consists of two paragraphs; only the first of these is quoted by Steudel, who gives it verbatim, though the two halves of the paragraph are reversed. The more detailed second paragraph is omitted as are the specimen numbers cited: *Royle* 104 and 163. In the manuscript the locality is given as 'Nepalia', and Nees appears to have been mistakenly informed that Royle's specimens were from Nepal. Fortunately the specimens are extant at LIV and the locality on the label is found to be 'Mussooree', i.e. in the Indian state of Uttar Pradesh.

Despite the fact that Steudel's description does not mention the character of the palea keels, Bor's lectotypification must be rejected as it was not based on specimens seen by the original author (Art. 9.13). In fact *P. himalayana* applies to the plant with the ciliate palea keels and I here designate *Royle* 163 as lectotype. Because Bor (1951b) typified on the other element, he had to re-describe this species, as *P. stewart-*

iana, which is therefore a superfluous synonym of *P. himalayana*. This means that the element with scabrid keels has yet to be described, and I do so below.

Poa rajbhandarii Noltie, **sp. nov. Fig. 2M–P.**
Syn.: *P. himalayana* sensu Bor, in Kew Bull. 6: 184 (1951), non Nees ex Steud.

A *P. himalayana* Nees ex Steud. et *P. khasiana* Stapf emend. Bor glumis in proportione lemmatibus brevioribus differt, a *P. himalayana* recedit etiam carinis palearum scabridis (haud ciliatis).

Differs from *P. himalayana* Nees ex Steud. and *P. khasiana* Stapf emend. Bor in having the glumes shorter relative to the lemmas and from the former in having the palea keels scabrid (not ciliate).

Type: India, Sikkim, Phedang to Tsoka, S of Dzongri, 27°26′N, 88°10′E, 3500m, 26 vii 1992, *Edinburgh Expedition to Sikkim and Darjeeling (ESIK)* 748 (holo. E).

Slender, tufted ?annual or short-lived perennial, sometimes producing short, filiform stolons. *Culms* 16–45cm, smooth, leafy almost to inflorescence. *Culm leaf blades* 4–12cm, flat, 0.9–2.5mm wide, glabrous or scabrid on upper surface; sheaths smooth; ligule of uppermost leaf 0.4–1.8(–2.3)mm, truncate, sometimes hispid on back. *Inflorescence* 8–18cm, triangular in outline at anthesis, lax, branches filiform, minutely scabrid, naked for c.⅔ length, nodes widely spaced, the lowest of 1–4 branches, the longest 3–7cm. *Spikelets* green, 3.7–5.2mm, narrowly wedge-shaped, florets 2–3(–4), callus wool sparse. *Glumes* very unequal, oblong-lanceolate, subacute, herbaceous, margins widely hyaline: the lower not reaching halfway along lowest lemma, 1.5–2.2 × c.0.6mm, 1-veined; the upper 2.2–3.3 × 0.9–1.5mm, 3-veined. *Lemmas* herbaceous, narrowly lanceolate in profile, subacute, the lowest (2.8–)3.3–3.8(–4.2)mm, half-width c.0.8mm, keel ciliate in lower half, outer lateral veins shortly hairy at base, surface smooth or sometimes minutely punctate between the veins, apex narrowly hyaline. *Palea* of lowest floret 2.1–2.8mm, keels scabrid. *Anthers* 0.6–0.9mm.

Distribution and ecology. Nepal, India (Sikkim, Darjeeling, Arunachal Pradesh), Tibet (Chumbi), Bhutan. Also recorded from Yunnan, but this requires confirmation. For further details see Rajbhandari (1991) under *P. himalayana*. Common especially in fir forest, 2700–3960(–4270)m.

It gives me great pleasure to name this plant after Dr Keshab R. Rajbhandari of the Department of Plant Resources, His Majesty's Government of Nepal, in recognition of the elegance of his study of Himalayan *Poa*.

It should be noted that work is still required on *P. rajbhandarii*, *P. himalayana* and the related *P. khasiana*. The stability of the palea keel indumentum character, in particular, needs to be assessed, as occasional individuals of *P. rajbhandarii* are found with ciliate keels and of *P. himalayana* with scabrid keels. Such work might

reduce them all to a single species, or recognise infraspecific taxa; until then, however, a conservative course has been followed.

The following lectotypification and synonymy must also be made:

P. himalayana Nees ex Steud., Syn. Pl. Glum. 256 (1854).
Type: India, Uttar Pradesh, Mussooree, Shalma, Royle 187/163 (lecto. selected here, LIV).
Syn.: *P. stewartiana* Bor, in Kew Bull. 6: 185 (1951). Type: India, Jaunsar, 2000m, 5v 1897, Duthie 19777 (holo. K).

Distribution. NW Himalaya; for further details see Rajbhandari (1991) under *P. stewartiana.*

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