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THE GENUS STIPA (GRAMINEAE) IN SOUTHWEST AND SOUTH ASIA

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ABSTRACT. A taxonomic revision of the grass genus *Stipa* L. is presented for the area between the East Mediterranean and the Himalayas with that mountain range included. It is based on herbarium material (about 2000 exsiccatae) and the author's experiences in the area. In the general part reasons are given for including the often separated genera *Achnatherum*, *Lasiagrostis* and *Ptilagrostis* into *Stipa*. The differential characters are critically discussed with respect to their reliability and taxonomic weight. As the 42 species growing in the area represent about 50% of the generic total and almost all sections in Eurasia, some conclusions concerning the evolutionary trends and the infrageneric classification are drawn. Keys are given to the species and infraspecific taxa, using predominantly awn- and lemma-characters. Attention is paid to the ecology and phytogeographical pattern of the individual species. For reasons discussed in detail, a broad species concept has been used; some previously recognized species are reduced to infra-specific rank or even to synonymy. One new species is described: *St. iranica* Freitag from E Anatolia and W Iran. Distribution maps are given for most of the species treated.

ZUSAMMENFASSUNG. Auf der Grundlage von Herbarmaterial (ca. 2000 Exsikkaten) und angeregt durch mehrjährige Geländeerfahrungen des Autors in der Region wird eine Revision der Gattung *Stipa* für den Raum zwischen dem östlichen Mittelmeer und dem mittleren Himalaya vorgelegt. Im allgemeinen Teil wird zunächst die Abgrenzung der Gattung und die Position der oft abgetrennten, hier aber nur als Sektionen anerkannten Gattungen *Achnatherum*, *Lasiagrostis* und *Ptilagrostis* untersucht und begründet. Die morphologischen Merkmale aus dem vegetativen und generativen Bereich werden ausführlich im Hinblick auf ihre Zuverlässigkeit und ihr Gewicht hin diskutiert. Da die 42 *Stipa*-Arten der Region etwa die Hälfte der eurasiatischen Arten dieser Gattung ausmachen und nahezu alle Sektionen vertreten sind, erschien es lohnend, einige offensichtliche evolutionäre Trends herauszuarbeiten und berechtigt, Vorschläge für eine verbesserte infragenerische Klassifikation zu machen. Der Artenschlüssel basiert insbesondere auf Merkmalen der Granne und Deckspelze (Lemma). Bei der Beschreibung der Arten wird u.a. auch auf ihr ökologisches Verhalten und ihre vertikale und horizontale Verbreitung eingegangen sowie der Versuch unternommen, sie jeweils bestimmten Geoelementen zuzuordnen. Letzteres wird durch Verbreitungskarten für die meisten behandelten Arten unterstützt. Mitverursacht durch ein im allgemeinen Teil begründetes relativ breites Spezieskonzept werden zahlreiche bisherige Arten eingezogen oder zu infraspezifischen Einheiten reduziert. Als neue Art wird *St. iranica* Freitag aus E-Anatolien und W-Iran beschrieben.

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INTRODUCTION

In revising the genus *Stipa* for SW Asia the author links up with his earlier treatment of the genus *Piptatherum* of the tribe *Stipeae* for the same region (Freitag, 1975). The starting point and the purpose of the work were very much alike. From the author's geobotanical fieldwork in Afghanistan from 1966–1970 (Freitag, 1971a,b) the urgent need for reliable keys to the most important grasses of the rangelands became evident: the *Flora Iranica* treatment (Bor, 1970) of both genera widely fails to serve that purpose, and the Floras of the adjacent regions of the USSR do not include all species. For instance, Bor mentioned a total of 20 species for Afghanistan, but in the present paper only 8 of those species are confirmed, although another 9 are added. A broad-scale attempt was essential for obtaining a better understanding of the genus in the area, and gradually the work expanded into a revision of the genus between the E Mediterranean and the Himalayas. The decision to include the Himalayas up to Nepal was stimulated by two facts: (1) most species of a more Eastern distribution type enter the monsoon-influenced parts of the Hindukush within the *Flora Iranica* region; (2) a comparison of the last treatment of Indian grasses by Bor (1968) with the new synopsis of the flora of Central Asia (Tzvelev, 1968) looked promising. During the preparation of this paper the treatment of Cope (1982) has been published, but it deals only with the narrow mountain section of Pakistan, and in certain cases I arrive at alternative conclusions.

For practical reasons, the northern boundary of the territory dealt with agrees with that of the *Flora Iranica* for the central part of the area, in the E it follows the frontiers of Pakistan and India, and in the NW it is identical with the main range of the Great Caucasus. The southern boundary is the most natural one as it coincides with the fading out of the genus *Stipa* into the subtropical deserts, semi-deserts, woodlands and forests. Only *St. capensis* penetrates somewhat beyond the region to the south. Most collections ever made from Iran, Afghanistan and Pakistan have been seen. For the Near East countries, Transcaucasia and India, the coverage is less complete, but it should be sufficient to rule out any large gaps. Comparatively few collections from India have been studied due to the lack of material in readily accessible herbaria. Further collections, especially in the drier parts of the Himalayas will probably yield species hitherto known from C Asiatic countries only. With respect to the other parts, I venture to forecast that with a better botanical exploration of the region the distribution maps will certainly gain a much higher density of dots, but with the general pattern remaining unchanged and without spectacular discoveries. Soviet Transcaucasia had been included into the treatment for two special reasons: in that area several very distinct geoelements (Irano-Turanian, E Submediterranean, Pontic-S Siberian) meet and reach their boundaries; Transcaucasian botanists have been very active, and this is reflected in the numerous recently published Floras and special systematic treatments. That resulted in the description of several new taxa, which ought to be compared with those present in neighbouring Anatolia and Iran.

In the case of some species it was rather fascinating to follow the

different ways in which they have been treated in the western or western-influenced Floras starting from Boissier (1884) up to Post (1933), Mouterde (1966), Bor (1968, 1970) and Cope (1982) on one hand, and the Soviet Floras on the other. It was a further challenge from the very beginning to bridge such divergent views. The different concepts with regard to the delimitation of the genus *Stipa*—very narrow by most Soviet authors and wide by the western ones—forced the author to tackle the more general problems of the genus. As the revision resulted in 42 accepted species for the region, about 50% of all Eurasiatic species, and covered almost all infrageneric taxa present in Eurasia, an attempt towards a more natural classification of the genus looked worthwhile.

The revision has been undertaken by traditional herbarium methods. The author's own acquaintance with most of the species from his stay in Afghanistan and field trips to the Himalayas, Iran and Transcaucasia proved to be extremely useful, with much data regarding the ecology and the altitudinal and horizontal distribution of the different species being acquired.

History and Delimitation of the Genus in Eurasia

Nomenclatural history

The genus *Stipa* was published by Linnaeus (1753) with the three species *St. pennata*, *St. juncea* and *St. avenacea* (N America). The rapidly growing number of species soon revealed a greater morphological diversity and resulted in the splitting of the genus. The establishment of new genera started with Palisot de Beauvoir (1812), who separated the genus *Achnatherum*, which included beside the type-species *St. calamagrostis* some species today placed elsewhere and also *St. bromoides*, but the latter with a question mark. According to its author the differential characters of *Achnatherum* are the membranous and apically emarginate (bilobed) lemma and the inarticulated awn, in contrast to the cartilaginous lemma and the articulated awn in *Stipa*. Most later authors restricted the new genus to the type species or else ignored it. Nevski (1937) was first in applying the name to some Asiatic species, and since then many more species have either been transferred to, or described as, *Achnatherum*. The genus is accepted by agrostologists of Asia, such as Tzvelev (1974, 1976) and Keng (1959). In ignorance of the treatment of Palisot de Beauvoir, Link (1827) founded the genus *Lasiagrostis* and based it on the same type-species. Unfortunately, that superfluous name became much better known than the validly published *Achnatherum*, and therefore numerous species are laden with the respective synonym.

Kunth (1815) created the genus *Macrochloa* for the two SW Mediterranean species *St. tenacissima* and *St. gigantea*, but later authors only agreed in its sectional rank. Bertoloni (1833) raised sect. *Aristella* of Trinius to generic level, but he was followed by only few treatments. When Nees van Esenbeck (1841) described the Himalayan *St. roylei*, he put it into the new genus *Orthoraphium*. His view was accepted by Trinius & Ruprecht (1842), who, however, stated that it scarcely differed from *Aristella*, and by Pilger (1954). Grisebach (in Ledebour

1852/53) promoted the section *Leptanthele* of *Lasiagrostis* (=*Achnatherum*) providing it with the new name *Ptilagrostis*. It is based on *St. mongholica*, and in favour of the generic rank the geniculate and plumose awn, the unbearded anthers and the habit were cited; a point of view adopted by almost all subsequent authors of Asiatic Floras. More recently Roshevitz (1916) established the C Asiatic genus *Timouria* with the type-species *T. saposhnikowii*, but Tzvelev (1974) reduced it to a section within *Achnatherum*. Finally, Bor (1954) considered *St. hookeri* as belonging to a genus of its own, *Trikeraia*, differing from *Stipa* by the somewhat awn-like lemma lobes; it has likewise been reduced by Tzvelev (1968) to a section.

DELIMITATION OF THE GENUS STIPA

As mentioned above, some authors separated certain genera which here are reincorporated into *Stipa*. The first conspectus based on a narrower genus concept was published by Trinius & Ruprecht (1842), who mentioned the genera *Stipa*, *Aristella*, *Orthoraphium* and *Lasiagrostis*. The classification of Pilger (1954) differs only little with *Stipa*, *Orthoraphium*, *Achnatherum* and *Timouria*; and Roshevitz (1934), Keng (1959) and Tzvelev (1968, 1974, 1976) agreed in recognizing the genera *Stipa*, *Achnatherum*, *Ptilagrostis*, *Timouria* (the last named not in Tzvelev 1974, 1976) and *Orthoraphium* (only Keng). On the other hand the broader view was first taken by Steudel (1854) who reduced all the cited genera—except *Timouria* which was not yet known—to sections of *Stipa*, and this was forcibly affirmed by Hackel (1887) who referred to them explicitly as weak sections. More recently, a wider genus concept of *Stipa* had been used by Hitchcock (1950) for the N American species, De Winter (1965) for S Africa, Bor (1960, 1968, 1970) for SW Asia, and Cope (1982) for Pakistan. After having worked through the 42 species of the region and checked others from different parts of Eurasia, I accept a broader genus concept as being more appropriate. In the following the reasons are given with respect to the more commonly adopted smaller genera.

Orthoraphium differs from sect. *Aristella* by the deflexed spinules at the top of the lemma. That single character, although unique, scarcely justifies a higher systematic rank.

Ptilagrostis differs from *Achnatherum* (=sect. *Lasiagrostis*), only in its completely pilose to plumose awn. I refuse to accept that criterion for the separation of a genus, because in *Stipa* s.str., even between closely related species and species-groups, the indumentum of the awn differs widely from completely glabrous to plumose. Even in the very closely related sect. *Lasiagrostis* species with pilose awns do occur, e.g. *St. duthiei* and *St. haussknechtii*. It must be mentioned here that despite its somewhat *Stipa*-like callus *St. subsessiliflora* of the monotypic sect. *Pseudoptilagrostis* also exhibits characters of *Ptilagrostis*.

Achnatherum (=*Lasiagrostis*) is separated from *Stipa* by various authors with reference to two different sets of characters both well expressed in the type species (*St. calamagrostis*), but resulting in a different extent of the genus: Pilger and some authors of European

Floras, in following Palisot de Beauvoir, gave emphasis to the membranous lemma and therefore excluded the species of the section *Aristella*. On the other hand, Nevski and the authors of most Soviet Floras stressed the short, obtuse callus and the non-overlapping lemma margins: consequently they included sect. *Aristella*. The *Achnatherum* concept of Pilger is less convincing as it is solely based on a character which, furthermore, lacks stringency: some undoubted *Stipa* species have membranous or almost membranous lemmas, such as the species of sects *Macrochloa*, *Stipella*, *Pseudoptilagrostis*, and some of the more primitive species of sect. *Stipa*.

The second concept is better founded due to the higher number of characters employed, although a clear-cut separation is likewise impossible. The most serious argument against it is the existence of sect. *Achnatheropsis* with a series of geographically vicariant E Asiatic species exhibiting a gradual transition from *Achnatherum* to *Stipa* in shape and size of the callus, as has already been stated by Tzvelev. These species are *St. brandisii*, *St. extremiorientalis* and *St. sibirica*. On the side of *Achnatherum*, *St. duthiei* comes very close to *St. brandisii*, and in other characters *St. haussknechtii* is transitional to *Stipa*. Furthermore, non-overlapping lemma margins are not confined to *Achnatherum*, but are found in many species of the sections around *Stipa*, and occasionally even in *Stipa* s.str. For instance, mature anthecia of *St. arabica* usually show the palea exposed from the base close up to the apex. As a further criterion of *Achnatherum*, the presence of apical lemma lobes is cited by some authors. They are indeed present in almost all species with a membranous lemma, but in sect. *Aristella*, with otherwise dominating *Achnatherum* characters, they are present or absent in a random way, and more rarely they can be seen even in sect. *Stipa*, sometimes in the *St. pennata* group itself. They are very prominent in sect. *Macrochloa*, but there in combination with typical '*Stipa* characters' such as the very long and pointed callus.

For all these reasons I have incorporated the above-mentioned genera into *Stipa*, where they have been given sectional rank. Of course that does not rule out the possibility of grouping certain sections into subgenera, but I prefer to leave that matter to the much needed worldwide monograph of the genus. With regard to other, undoubtedly distinct genera of the tribe *Stipeae* only a few remarks are necessary as I have dealt with this problem already (Freitag, 1975).

Piptatherum is well separated by its dorsally compressed spikelets, anthecia and caryopses in combination with the extremely short, incurved, glabrous callus (Fig. 1a). Nevertheless, in habit and in some characters, certain species look similar to those of sect. *Aristella*, which also have a coriaceous lemma and palea, and a straight awn. Indeed some species were first described in *Piptatherum* (*Oryzopsis* s. lat.) and vice versa.

The N American genus *Oryzopsis* shares the cylindrical shape of the anthecium with *Stipa* and therefore seems to be more closely related (Fig. 1b). It is interesting that hybrids—not known between *Piptatherum* and *Stipa*—have been reported between both genera, and according to Johnson & Rogler (cited in Hitchcock, 1950) several species have even

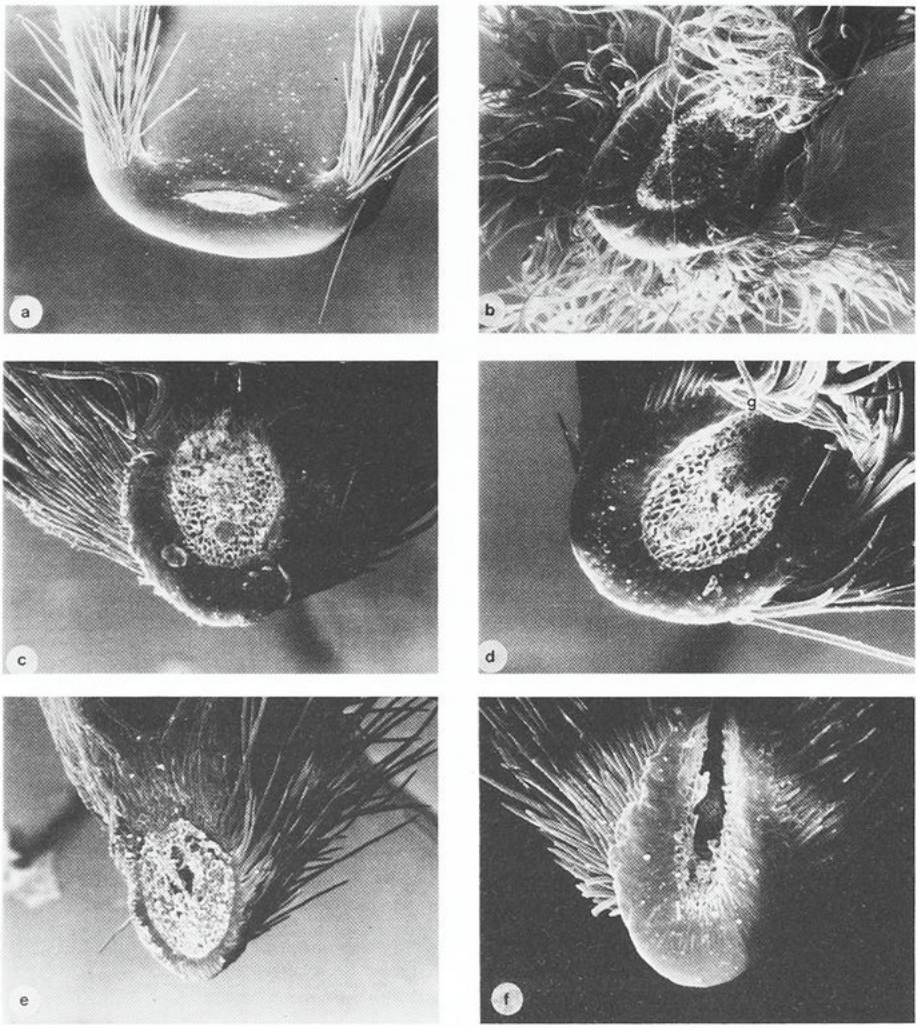

FIG 1. Basal part of anthecium with callus, peripheral ring and scar in species of different sections of *Stipa* and in the related genera *Piptatherum* and *Oryzopsis*, in ventral view: a, *Piptatherum vicarium* (*F.* 2812); b, *Oryzopsis asperifolia* (24 v 1843, *Seymour*); c, *Stipa* sect. *Lasiagrostis*, *St. caragana* (*F.* 3321); d, *St.* sect. *Aristella*, *St. bromoides* (*F.* 13500); e, *St.* sect. *Ptilagrostis*, *St. mongholica* (*Koelz* 2445); f, *St.* sect. *Achnatheropsis*, *St. brandisii* (*F.* 6936).

originated by hybridization. However, *Oryzopsis* differs strikingly by having united styles and two lodicules.

ASSESSMENT OF CHARACTERS

From the very beginning the work with *Stipa* was run parallel to that previously published on the genus *Piptatherum* (*Oryzopsis* auct. non Michx.) of the same region (Freitag, 1975). The difficulties found and the approaches undertaken to overcome them and to achieve a more natural

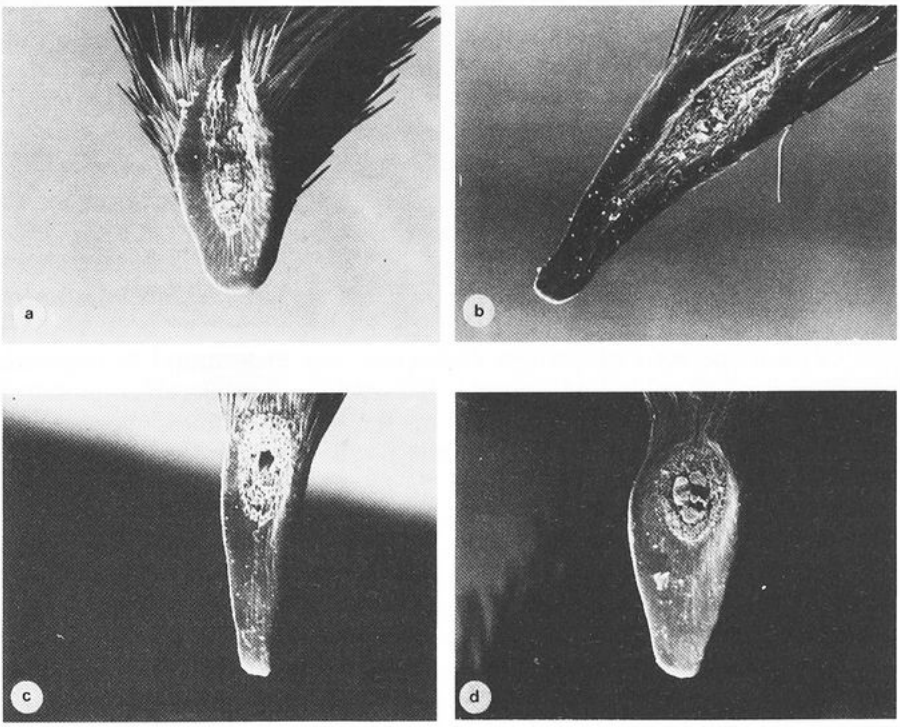

FIG. 2. *Stipa* sect. *Achnatheropsis*: a, *St. regeliana* (*Stew.* 10454); b, *St.* sect. *Pseudoptilagrostis*, *St. subsessiliflora* (30 vii 1886, *Ostensacken*); c, *St.* sect. *Stipella*, *St. parviflora* (*Rech.* 9943); d, *St.* sect. *Barbatae*, *St. arabica* (*F.* 3098).

classification were mostly the same in both genera. The most serious problem at the species level was the high degree of genetically and environmentally controlled variability in numerous quantitative characters. The greatest variability has been observed in widely distributed species with a broad ecological and altitudinal amplitude. In such species a striking correlation usually exists between the size of the individuals and their vegetative and generative organs on the one hand, and the altitude on the other. As yet, neither field observations nor herbarium investigations can resolve whether that gradual change is a result of phenotypic adaptation or genotypic ecoclinal variation.

Another source of difficulty is the tendency towards cleistogamy in some more advanced species, especially in sects *Stipa* and *Barbatae* and most obviously in *St. pennata*. Certainly that trend favours the immediate manifestation of mutations and the origin of distinct local populations in acting as a barrier against gene exchange. Therefore, a classification based on the smallest morphological characters may look reasonable in a local area, and provide a challenge to some taxonomists, with P. Smirnow and J. O. Martinovský as the best known proponents of a very narrow species concept.

The following methods and principles have been used to overcome the problems mentioned above:

1. The search for reliable, hitherto neglected characters. Unfortunately it was less successful than in *Piptatherum*, as much more attention had been paid in the past to *Stipa*. However, a few very useful characters have been found: especially the number of styles, and the relative length of the anterior and posterior lodicules; both characters also proving highly suitable for the definition of certain sections.
2. The large amount of material investigated made it possible to scrutinize the value of certain characters, which in numerous cases resulted in new judgements.
3. At the species level it was essential to make use of quantitative characters, but only after the infraspecific variability had been checked first. Certain species with unique characters, e.g. the annual *St. capensis*, have been used as a kind of 'control'. This way, a considerable number of species established by earlier authors on the basis of limited material has been reduced to synonymy or to infraspecific taxa. In many cases the rather differing ranges of variation from species to species is simply related to the number of specimens investigated.
4. For several reasons the more or less cleistogamous taxa were dealt with according to a broader species concept. Firstly, in no case is the cleistogamy complete and consequently some gene flow takes place, causing the occurrence of numerous more or less transitional forms. Between the species with the highest degree of cleistogamy and the normal outbreeding species all transitions exist (see p. 377). Therefore, any confinement of the microspecies concept to certain taxa must be arbitrary. Secondly, some of the mutations which led to the recognition of separate species (the size of the plant and their organs, the extension of lemma indumentum, the surface of the culm and the leaves etc.) evidently occurred independently in different parts of the area. Thirdly, for most purposes the applicability of a highly intricate system of a great number of microspecies based on incomplete cleistogameons needs no comment.
5. Geographical and ecological data were carefully taken into consideration. Here, the experience of the author with numerous species in the field and the knowledge of the vegetation and the ecogeography of the area proved to be a great help.

For the construction of the keys, such characters were selected that are easily detectable and less influenced by environmental factors. Most of them are linked with the awn, anthecium and lemma in the fruiting stage. In doubtful cases species are keyed out twice.

GROWTH FORM AND DEVELOPMENT

The significance of the growth form, which is intimately related to the mode of branching, the ontogenetic development of the shoots, and the life span of the individual is almost the same in *Stipa* as in the related *Piptatherum* (Freitag, 1975, p. 347). According to the growth form classification of Serebrjakova (1971), the following types can be recognized:

1. *Non-rosulate perennials*. These exhibit extravaginal branching from a creeping rhizome with usually very short internodes. Depending on the number of ramifications, the plants consist of few shoots only as in most species of sect. *Aristella*, and *St. hookeri* of sect. *Lasiagrostis*, or they are

more numerous and form loose tufts as in *St. brandisii* of sect. *Achnatheropsis*. The number of vegetative shoots is small and they may even be absent as in *St. litwinowiana* and *St. kurdistanica*. Only in the last two species and *St. hookeri* are prominent primordia of the next-season shoots, covered by a high number of cataphylls, present.

The non-rosulate species are generally rather tall-growing, with 4–7 noded culms rarely being less than 50cm, but often surpassing 100cm. They grow in habitats with sufficient water supply during the growing season. Except for the alpine *St. hookeri* they inhabit mesophytic forests or woodlands.

2. *Rosulate perennials*. The bulk of the species belong here and they are characterized by rich or even very rich intravaginal branching resulting in a more or less densely tufted habit with a high number of vegetative shoots forming the rosette, and a much smaller number of generative shoots. The culms are erect, arising from a usually slightly curved base. Correspondingly, the size of the only 2–4-noded culms is generally smaller than in the first group. It ranges from 10–70cm, and only rarely up to 100cm or more. The leaves are smaller and usually convolute. The rosulate habit is typical for the species growing under the harsher conditions of semiarid, arid or alpine climates. A few species of sect. *Lasiagrostis* have a more or less transitional mode of branching, most evident in *St. splendens*, which is otherwise unique in its ability to form giant tufts up to 50cm diam. and 2·5m high.

3. *Rosulate annuals*. The only known annual is *St. capensis*. In its mode of branching it is identical with the rosulate perennials, from which it has originated, probably by changing to a monocarpic condition. The adaptive value of the annual habit is evident, enabling the species to make optimal use of the climatic conditions prevailing in hot warm-temperate semi-deserts with low and very variable amount of winter rain.

Developmental studies would certainly reveal further differential characters. For instance, by growing some species from grains quite different germination times have been obtained, ranging from 3–4 days in species like *St. turkestanica* and *St. orientalis*, to 10–15 days in others like *St. brandisii* and *St. arabica*. Generally the grains seem to retain their viability for several years: 5–10 years have been found in several species, even in such a mesophytic one as *St. brandisii*.

SIZE AND STRUCTURE OF CULMS

Besides the fundamental difference in average size which is related to the growth form, this character is scarcely suitable for the recognition and delimitation of species. Correlated to the growth conditions, especially to temperature, water supply and grazing pressure, the size is extremely variable in some species. For instance in the studied material of *St. capensis* it ranges from 5–60cm, and in *St. caucasica* from 10–70cm. However, in other species that are more uniform in their ecological requirements the variation is much smaller: as in the alpine species *St. concinna* with 5–25cm, and *St. subsessiliflora* with 7–35cm. The number of nodes is likewise linked with growth form and other factors influencing the height of the culms. The internodes are usually covered completely or almost so by the sheaths. Of some significance is the length of the

uppermost internode(s) which causes the panicle to be exserted, semi-enclosed or enclosed by the upper sheath(s). But depending on the stage of development or occasional cessation or slowing down of growth, even in species with an elongated uppermost internode the panicle may remain partly enclosed. The internodes are usually terete, smooth and glabrous. Often they have been found to be scabridulous and in numerous cases densely pubescent with short retrorse hairs, especially below the lower nodes. As, in other respects, such individuals are completely like the glabrous ones and often grow together with them, that character has very little importance.

LEAF CHARACTERS

With some exceptions, mostly correlated to the different growth forms, the leaf characters are of limited importance, although in several cases they are useful at the intraspecific levels.

Sheath. In certain species, such as *St. caucasica*, *St. lingua*, *St. parviflora* and *St. haussknechtii*, the sheath margins (and usually the junction with the blade as well) are always distinctly ciliate. Most species lack a ciliate sheath margin, although a few may exhibit either condition, e.g. *St. arabica* and *St. capensis*. In some species only the lowermost sheaths are very shortly ciliate ('ciliolate'). The surface of the sheaths exhibits the same pattern as that of the culms, and frequently it differs between the lower and the upper sheaths of the same plant. In certain more advanced species of sect. *Stipa* the sheaths of the uppermost leaves are more or less broadened and enclose most of the panicle, as in *St. caucasica*, *St. lingua*, *St. capillata* and *St. tirsa*.

Ligule. The shape and size of the ligules exhibit large differences, but unfortunately the variation in the individual species and even in a single plant is often frustratingly high. Generally, the ligules of the culm leaves are longer than those of the vegetative shoots, and in each the length increases from the basal to the upper leaves. To cite an extreme example: in a specimen of *St. arabica* from the USSR, Azerbaijan (*Freitag* 13·501), the lengths of the ligules from the basal to the uppermost leaf of a vegativate shoot are 1mm, 3·5mm and 16mm respectively. However, in other specimens of the same species from the Near East the longest ligules of the respective parts are only 2–3mm. Three types can be distinguished with respect to the ligules of the uppermost leaves on the vegetative shoots:

1. Short (up to 0·5mm) to obsolete, simultaneously truncate and lacerated—in numerous species distributed over all sections, but centred in *Lasiagrostis* and *Aristella*.
2. Short (up to 0·5mm) to obsolete, truncate or bilobed, not lacerated—scattered in different sections.
3. Longer than 0·5mm, with the apex rounded, obtusely tripartite or acute—most species, but centred in sect. *Stipa*.

A ciliate or ciliolate margin of the ligule is often significant. A setulose back is generally associated with the corresponding indumentum of the sheath and is systematically less important.

Blade. Blade dimensions, especially width, are helpful in some cases. Again, the species with extravaginal branching generally differ by having much larger leaves. In the species with intravaginal branching the culm

leaves are always wider, and mostly shorter, than the leaves of the vegetative shoots. In both groups, but much more so in the second, width and length of the blades are strongly influenced by environmental factors and by small-scale genetic variation. To demonstrate the range encountered within the species investigated, the taxa with the widest and the narrowest leaves may be cited: *St. kurdistanica* (4–8mm) and *St. tirsa* (0·2–0·4mm).

The leaf anatomy has not been studied systematically. However, certain anatomical characters, which have been checked in selected cases, are expressed morphologically. Two types are easily discernible:

1. Species with comparatively thin blades, with shallow furrows on the upper side and prominent veins beneath. Under water stress they either roll up in a more or less irregular way, or they change to a regular convolute or involute condition. In the latter cases the external surface is equipped with prominent longitudinal ridges marking the sclerenchymatic tissue which is associated with the main vascular strands. The mesomorphic and moderately xeromorphic species which belong here, form the sections I–VII.
2. Species with comparatively thick blades, deeply furrowed on the upper side and without prominent veins beneath. Under water stress they are regularly involute to conduplicate, without prominent ridges on the external surface and in cross-section almost circular, caused by a continuous layer of sclerenchyma beneath the abaxial epidermis. Most species of sects *Stipa* and *Barbatae*, which are the most xeromorphic ones, belong to this group. Only in *St. tirsa* have all leaves lost the ability to spread out under favourable moisture conditions. In others the leaves of the vegetative shoots may remain fixed in the involute stage, whereas the culm leaves are still able to unfold.

A detailed anatomical study of the venation and distribution of sclerenchyma certainly would produce further criteria, although they will probably prove to be of greater value in the delimitation of infraspecific taxa.

The upper leaf surface may be smooth, more or less scabrous, papillose, puberulent or distinctly pubescent. The lower surface, which becomes the external one in the convolute or folded condition, is usually smooth, or scabrous with very stiff antrorse hairs, or more rarely densely pubescent with retrorse hairs. After the experience gained with the high degree of variability in leaf indumentum of the more common species (*St. arabica*, *St. hohenackerana*, *St. capensis* etc.), and in contrast to the authors adhering to a narrow species concept, no species has been recognized by the structure or colour of the leaf surface alone. Usually, distinct leaf surfaces have been considered only as a criterion justifying the delimitation of varieties, but more often, in the polymorphic species, they are just forms. In the case of a more elaborate indumentum it has been used for separating subspecies, as in *St. pennata*.

PANICLE. Panicle characters are rather useful in recognizing certain species and species-groups. The exserted, enclosed and semi-enclosed types have been mentioned above in the discussion of the culm. The shape of the panicle is another criterion, which is well fixed in most species and varies

only according to the stage of the development. Loose inflorescences with long, spreading branches and usually numerous spikelets appear in most sections; prominent examples are *St. brandisii*, *St. mongholica*, *St. parviflora* and *St. splendens*. More numerous are species with contracted panicles. This latter type is represented either by very dense, many-spiculate panicles as in *St. capensis*, *St. concinna* and *St. litwinowiana*, or by the common few-spiculate subtype as found in *St. bromoides* and most species of sects *Stipa* and *Barbatae*. The number of the branches originating from the lowermost nodes of the panicle is notoriously 1 or 2, with only certain species of sect. *Lasiagrostis* having 2–3, or even up to 5 as in *St. haussknechtii*, *St. splendens* and the species of sect. *Stipella*.

SPIKELET. The length of the spikelet is among the more important characters in most species, but variation is considerable and again highest in widely distributed species with a broad ecological amplitude. Some examples are given in Table 1.

TABLE 1

Length of spikelets and anthecia (in mm) in some *Stipa* species

	No. of sheets examined	spikelets min.	spikelets mean range	spikelets max.	anthecia min.	anthecia mean range	anthecia max.
St. capensis	131	14	17–20	23	4	5–7.5	9
St. arabica	350	22	25–35	40	8	9–12	14
St. caucasica	40	15	45–55	60	8	10–12	13
St. pennata	85	*30	40–70	90	15	17–23	26
St. splendens	40	4	5–7	8·5	4	4·5–6	7·2

When using the length of the spikelet some care is necessary, because in many herbarium specimens of species with long, acuminate glumes the very delicate tips are broken. Another very stable character is the relative length of the lower to the upper glume. Generally, both are more or less equal in size, with the upper one slightly shorter than the lower. However, in certain species the upper glume is much shorter than the lower one, with *St. parviflora* as the most obvious example. On the other hand, in certain members of sect. *Lasiagrostis* the upper glume is longer.

The shape of the glumes is likewise important. It is closely related to the outline of the apex, which may be either acute or more or less acuminate. The colour is less reliable, as it changes during the ontogenesis and may differ according to environmental factors and small mutations. In most alpine species the glumes (as with the culm and the upper sheaths) are more or less purple tinged, with hyaline margins and apex. Contrariwise, in the species of lower altitudes the glumes usually have a pale green back. During maturation of the fruits the colour changes due to necrosis: it fades out and becomes somewhat straw-coloured. In certain species, forms with both pale and purplish-tinged glumes are common, e.g. *St. splendens* and *St. jacquemontii*. The surface of the glumes is either smooth (except the mid-vein which is often setulose) or prickly (aculeolate) at least near the apex. The number of veins is subject to some variation in almost all species. Besides the usual odd numbers, very often

an even number of veins has been found indicating a somewhat different development of the two halves which are separated by the main vein.

ANTHECIUM. In this paper, the pseudo-fruit of the genus *Stipa* is consistently referred to as the 'anthecium'. This term has been used and defined in somewhat different ways by various authors since its first introduction by Stapf (1904) and the proposal for standardization by McClure & Soderstrom (1972). Here, for practical reasons, it is used in a slightly modified way: to consist of lemma, palea and the basal rachilla segment (callus) to which they adhere. The awn of course is a part of the lemma, but for convenience it is not included in the length measurements of the anthecium. The anthecium tightly encloses the single flower or, later on, the caryopsis with the basally appressed lodicules and the remnants of the stamens. It is best developed at the fruiting stage. The size of the so-defined anthecium is a useful character, but the variation found in numerous species is much higher than stated by previous authors. As the examples in Table 1 demonstrate, a variation of 60–125% is regular if an adequate number of specimens is measured.

CALLUS. The length and shape of the callus provide most important criteria for the delimitation of the genus (see p. 361) and its sections. Usually a short callus is devoid of an axis-like upper part or almost so. The oblique articulation line comes very close to the base of the lemma and causes its more or less conical shape in dorsal (or ventral) view. Longer calli have a distinct axis of cylindrical shape which, however, is usually hidden by long and stiff antrorse hairs. Only the base of the callus is oblique, curved or even slightly sinus-shaped. The lowermost part is more or less pointed and bent outwards. In lateral view this may give a curved or even foot-like outline to the basal part of the callus. The shape of the scar may be circular or elliptic. The scar itself is surrounded by the 'peripheral ring' (Coffman, 1964), which may be quite regularly developed, as in sects *Lasiagrostis*, *Aristella* and *Ptilagrostis* (Fig. 1c–e). Very often the peripheral ring is flattened and widened on the dorsal side, and often on that side it is much protruding. In fact, that protruding segment of the flattened margin is the ventral side of the pungent point at the very base of the callus in some sections, especially in *Stipa* itself (Fig. 2b–d).

LEMMA. Of high significance at sectional level are the structure of the lemma (and palea) at the fruiting stage, and the extent of lemma margins with respect to covering the palea. Both characters have already been discussed on p. 361. Very limited use has been made of the first character for the construction of the key because the hardening and darkening of the lemma is usually the result of maturation processes and is not observable at flowering time. The presence or absence of apical lemma lobes surpassing the insertion of the awn is constant in some sections, and the different length of these lobes can be used for recognizing the species. In other species (e.g. *St. pennata*) small apical lemma lobes are sometimes developed and sometimes not. Except in *St. arabica* var. *pamirica*, the lemma is always covered by an indumentum, whose length, structure and

arrangement may differ specifically, but is subjected in some cases to remarkable infra-specific variation, most obvious in *St. arabica* and *St. hohenackerana*. In the literature the presence or absence of a coronula, formed by a distinct ring of hairs just below the insertion of the awn, is often cited for certain species, but in those cases that character proved to be unreliable.

AWN. The awn at the tip of the lemma provides some characters most suitable for determination purposes. Except for very few species such as *St. caragana*, the awn is persistent, notwithstanding the common presence of an articulation at its very base in most species. Only in the species of the sects *Aristella* and *Orthoraphium* is the awn straight and untwisted. In most species it is distinctly uni- or bigeniculate with the lower part (columna) clearly twisted, and the upper part (seta) straight, falcate, flexuose or circinnate. However, in certain species of sect. *Lasiagrostis* the torsion of the columna is only slight and consequently the awn is irregularly or indistinctly bent and not distinctly geniculate. Even the distinction between the uni- and bi-geniculate conditions needs care in certain species (e.g. *St. capensis*, *St. jacquemontii*, *St. turkestanica*), especially if young shoots are examined which have not yet finished sprouting: in such early stages of development the lower geniculation tends to be indistinct. The length of the awn is a useful tool for the recognition of numerous species and species-groups, but the infraspecific variation is at least as high as in the length of spikelets and anthecia (see Table 2). Consequently, some species described by earlier authors on the basis of different awn length have not been maintained.

TABLE 2

Length of awns (in cm) in some *Stipa* species

	length of awn		
	min.	mean range	max.
St. caragana	0·6	0·8–1·1	1·4
St. capensis	4·5	6–9	11
St. arabica	8	10–15	22
St. turkestanica	8	10–16	19
St. holosericea	12	14–22	25
St. pennata	17	25–38	45

A still better criterion is the surface of the awn, which may be scabrous, pilose or plumose throughout or in the upper or lower part only. In pilose and plumose awns the length of the hairs varies only within a limited range. In a few species a pilose or plumose seta is constantly combined with a glabrous, smooth columna, e.g. *St. lessingiana*; in others, forms with both a scabrous and a smooth columna may occur, e.g. *St. turkestanica*. Occasionally even individuals with a prominent indumentum covering the columna may be met with, as in *St. pennata* ssp. *pulcherrima*. They may indicate the evolutionary relationships between the different kinds of awn surfaces and underline the rather limited significance of this character for the delimitation of taxa above the species level.

PALEA. Besides the already mentioned relative length as compared to the lemma, the palea does not provide diagnostically important characters and is therefore somewhat neglected in the descriptive parts. The type of indumentum is about the same as on the lemma, but is often restricted to the area between the two veins.

LODICULES. The number of lodicules is invariably 3 and the relative length of the lower (anterior) ones and the upper (posterior) one proved to be an excellent character for the delimitation of the section *Stipella*. There the posterior lodicule is at its smallest 0·1–0·4mm, being only $\frac{1}{10}$–$\frac{1}{4}$ of the anterior ones. The small one is only apparent at higher magnification (×20–40 are recommended) and up till now the respective species are reported to have only 2 lodicules. In other species the upper lodicule is slightly longer or shorter than the lower ones and differs more or less in shape. The surface of the lodicules is constantly pilose in a few species but glabrous in most. In others they are either sparsely pilose at the apex, or glabrous as, for instance, in *St. holosericea* and *St. jacquemontii*. Furthermore, in certain species only the upper lodicule is pilose. The shape of the apex may be obtuse, acute, or (in the case of the upper lodicule only) bi- or tridentate.

STAMENS. Generally, the size of the stamens is closely connected with that of the lemma and varies in about the same manner. Their colour is usually yellow. The most useful anther character is the presence or absence of two tufts of stiff hairs on the apex of each anther, called 'bearded' or 'unbearded' respectively. As the anthers often differ in that respect in closely related species and in more rare instances even in different individuals of the same species, the character is considered light-weight and has never been used alone for the delimitation of a species.

PISTIL AND CARYOPSIS. The ovaries are similar in all species, but a conspicuous and very valuable new character has been found in the number of styles and stigmata (Fig. 3). Whereas most species invariably have 2 styles, there is one group of closely related species (sect. *Barbatae*) with 3 or 4 styles and stigmata. Of the 3 or 4 styles, one or two may be distinctly shorter; these features are very stable characters for certain species.

The mature caryopses differ in their dimensions along with the anthecia and lemmas. The relative length of the embryo as compared to the caryopsis varies insignificantly from species to species with a maximal range of 1:3 to 1:5. Likewise, the homogeneity of the genus is supported by the hilum, which is constantly linear and reaches up almost to the top.

DISTRIBUTION AND ECOLOGY

Ecologically, *Stipa* is characterized by its adaption to temperate, dry climates. It exhibits its greatest diversity in semi-arid and arid climates, but sects *Lasiagrostis* and *Aristella*, which retain some of the more primitive characters, are concentrated in areas with subhumid climates. Only very few species of the likewise comparatively primitive sects *Achnatheropsis* and *Orthoraphium* penetrate into regions with a fully

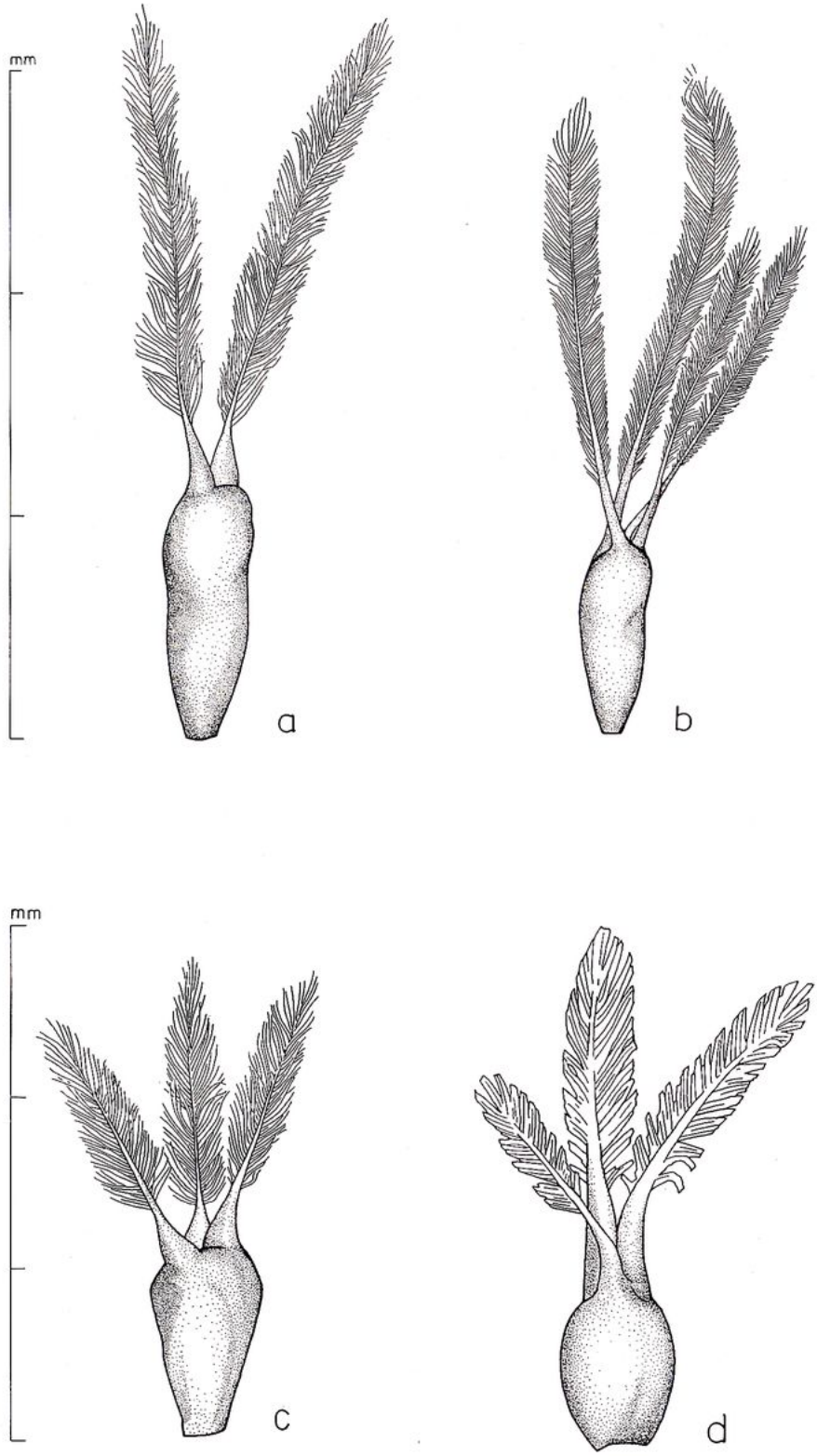

FIG. 3. Shape of pistil in sects *Stipa* (a) and *Barbatae* (b–d); a, *St. caucasica*; b, *St. lagascae*; c, *St. ehrenbergiana*; d, *St. arabica*.

humid climate, and there they occupy the most xeric habitats. The fading out of the genus in W, NW and N Europe is obviously caused by the prevailing humid conditions, which favour more vigorously growing mesic species of other genera and the development of closed forests. The same holds true for the southern ranges of the western and central parts of the Himalayan system and all over the eastern Himalayas. The individual species differ greatly in their respective area of distribution and in their ecology, with most sections strictly centred in certain floristic and ecogeographical regions. For instance, sect. *Barbatae* is both Irano-Turanian and Mediterranean, and sect. *Stipa* has its centre of diversity in C Asia. The size of the distributional areas is extremely different, ranging from the only once-collected *St. chitralensis* and *St. zuvantica*, to *St. capillata* and *St. pennata* which are distributed over almost the whole latitude of Eurasia. The widely distributed species, near the border of their main areas, tend to change to a more disjunct pattern with remarkable gaps in between. This pattern may be the result of climatic changes of the past and/or the marked ability for long-distance dispersal; the latter being affected by means of the highly effective anemochoric structures (species with pilose or plumose awns) or the likewise powerful epizoochoric implementation (species with scabrous awn, having the ability for strong hygroscopic torsions, and a long pungent callus). Numerous species have managed to adapt to several altitudinal belts in the same latitude (e.g. *St. arabica*, *St. caucasica*, *St. ehrenbergiana* etc.), whereas others are more restricted to subtropical lowlands (e.g. *St. capensis*), or to alpine environments (e.g. the members of sect. *Ptilagrostis*). The rich array of geographical and ecological patterns displayed within the genus is evident from the synoptic presentation in Table 3.

The frequency and relative importance of the 42 species differ greatly, as may be judged from the number of exsiccatae which became available (see Table 4). About 40% of the species must be considered as rare. They are either very restricted endemics, with *St. chitralensis* and *St. zuvantica* being collected only once and therefore of doubtful status (the type specimens may represent rare hybrids), or have come in from adjacent regions, with just a few outposts usually located in marginal areas, as in *St. roborovskyi* and *St. breviflora*. The most common species on the other hand are *St. hohenackerana* (215 exs.), *St. capensis* (165) and the unparalleled *St. arabica* (c. 563).

Economic Uses

Some species are structurally and economically important components of the vegetation, from the lowlands up to the alpine belt (see Table 3). *Stipa* species are absent only from salt marshes, riverain vegetation (except *St. splendens*) and closed forests. Most species grow in the primary vegetation types—very rare nowadays—as well as in the overwhelmingly dominating secondary plant communities, which serve as pastures for sheep and goat and are exploited in the search for brush and firewood (see Freitag, 1971a, b and Zohary, 1973). All perennial species, except the Himalayan *St. brandisii* which is feared by pastoralists for its poisoning cyanogenic compounds, are appreciated as pasture plants. Consequently,

TABLE 3

Distribution types and ecological characteristics of the SW Asiatic *Stipa* species. (The terms used here for the subdivision of the greater phytogeographical units are mostly taken from Meusel, Jäger & Weinert (1965). In a few cases new terms have been chosen. They should be considered in a mere geographical sense.)

Distribution type	Species	Altitudinal belt	Climatic character: general	Climatic character: winter-rain	Climatic character: summer-rain	Vegetation type
Mediterranean						
S-Med.–Saharo-Sind.	St. capensis	lowland	arid–semiarid	+	–	open evergreen and deciduous shrublands, seral vegetation
omni-Med.	St. parviflora	lowland–submontane	arid–semiarid	+	–	open evergreen shrublands, seral vegetation
almost omni-Med.	St. lagascae	lowland–submontane	semiarid–arid	+	–	open evergreen woodlands and shrublands
Mediterranean–Submediterranean	St. bromoides	lowland submontane	semihumid–semiarid	+	(+)	open evergreen and deciduous woodlands and forests
E-Med.–W Irano-Turanian	St. ehrenbergiana	lowland–montane	semiarid–arid	+	–	evergreen and deciduous woodlands, seral vegetation
E-Med.–W Irano-Turanian	St. holosericea	lowland–montane	semihumid–semiarid	+	–	evergreen and deciduous woodlands, seral vegetation
Submediterranean–Pontic-S Siberian						
omni submed.–Pontic	St. pennata ssp. pulcherrima	lowland–montane	semihumid–semiarid	+	+	evergreen and deciduous shrublands and woodlands, seral vegetation
E. submed.–Pontic	St. pennata ssp. zalesskii	lowland–montane	semihumid–semiarid	+	+	deciduous shrublands, conifer woodlands, seral vegetation
Pontic–S Siberian	St. pennata ssp. pennata	montane	semiarid	+	+	steppes
Pontic–S Siberian	St. tirsa	montane	semiarid	+	+	steppes
Pontic–S Siberian	St. capillata	montane–subalpine	semiarid	+	+	steppes, seral vegetation in woodland areas
Pontic–S Siberian	St. lessingiana	montane	semiarid–arid	+	+	steppes
Irano-Turanian						
omni Irano-Turanian	St. arabica	lowland–subalpine	semiarid–arid	+	–	shrublands, open deciduous and conifer woodlands, seral vegetation
omni Irano-Turanian	St. hohenackerana	lowland–montane	arid	+	–	open deciduous shrublands, seral vegetation
almost omni Irano-Turanian	St. caragana	submontane–montane	semiarid	+	(+)	deciduous and conifer woodlands
almost omni Irano-Turanian	St. caucasica ssp. caucasica	montane–subalpine	semiarid–arid	+	–	open deciduous shrublands and conifer woodlands, seral vegetation
almost omni Irano-Turanian	St. turkestanica	montane–subalpine	semiarid–semihumid	+	–	open shrublands, preferably in rock crevices

Kurd.–SW Iranian	St. kurdistanica	montane	semihumid	+	–	semi-evergreen woodlands
Kurd.–SW Iranian	St. haussknechtii	montane	semiarid	+	–	open deciduous woodlands and shrublands
Kurd.–SW Iranian	St. iranica	montane–subalpine	semiarid	+	–	woodlands and shrublands, seral vegetation
Arm.–NW Iranian	St. zuvantica	montane	semihumid	+	(+)	?
Arm.–NW Iranian	St. gaubae	montane	arid	+	–	open shrublands on gypsaceous soils
Turcm.–Turkestanian	St. litwinowiana	montane	semihumid–semiarid	+	–	deciduous woodlands
Turcm.–Turkestanian	St. lingua	lowland–montane	semiarid	+	–	deciduous and conifer woodlands
Turcm.–Turkestanian	St. margelanica	montane	semiarid	+	–	deciduous and conifer woodlands
Central Asiatic						
widely distributed	St. splendens	montane–subalpine	arid–semiarid	+	+	meadows and shrublands near ground-water
widely distributed	St. orientalis	subalpine–alpine	arid	+	+	alpine and subalpine steppes, dwarf shrublands
widely distributed	St. mongholica	alpine	arid	+	+	alpine and subalpine steppes, dwarf shrublands
widely distributed	St. pennata ssp. kirghisorum	subalpine–alpine	arid	+	+	alpine and subalpine steppes, dwarf shrublands
widely distributed	St. caucasica ssp. glareosa	subalpine–alpine	arid	+	+	alpine and subalpine steppes, dwarf shrublands
widely distributed	St. breviflora	alpine	arid	+	+	alpine steppes
widely distributed	St. roborovskyi	alpine	arid	+	+	alpine steppes
widely distributed	St. purpurea	alpine	arid	+	+	alpine steppes
widely distributed	St. subsessiliflora	alpine	arid-semiarid	+	+	alpine and subalpine steppes and dwarf shrublands
W and NW C-Asiatic	St. richterana	montane subalpine	arid	+	(+)	open shrublands, seral vegetation
W and NW C-Asiatic	St. regeliana	alpine	semihumid	+	+	alpine mats
W and NW C-Asiatic	St. concinna	alpine	semihumid	+	+	alpine mats
SW C-Asiatic	St. himalaica	montane–subalpine	semiarid–arid	+	+	subalpine dwarf-shrublands, rock crevices
SW C-Asiatic	St. chitralensis	montane	semiarid	+	+	?
S C-Asiatic	St. hookeri	alpine	arid–semiarid	+	+	meadows and shrublands near ground-water
S C-Asiatic	St. koelzii	alpine	arid–semiarid	+	+	meadows and shrublands near ground-water
Sino-Himalayan						
Him.-Chinese	St. brandisii	montane	humid	+	+	evergreen oak and conifer forests, seral vegetation
Himal.	St. roylei	alpine	humid	+	+	alpine mats
Himal.	St. duthiei	alpine	humid	+	+	alpine mats and shrublands
NW-Himal.	St. jacquemontii	montane	semihumid	+	+	rock crevices in conifer woodland
C-Himal.	St. staintonii	montane	semiarid–semihumid	+	+	woodlands, steppes, seral vegetation

TABLE 4

Relative frequency of the 42 species of the region

Number of exsiccates	Number of species
1–5	15
6–20	8
21–40	6
>40	13

under the prevailing conditions of primitive range management systems, selective grazing caused the *Stipa* species usually to be highly under-represented. The occurrence of flowering and fruiting culms is confined to protected microhabitats provided by perennial thorny plants. However, in a sterile condition they survive even under intensive grazing pressure. In very many places, like military areas, afforestations, experimental plots and other fenced areas I have seen a real burst of *Stipa* species. The high ability for regeneration by seeding, the resistence of the once established plants against grazing and the feeding qualities—quite moderate if compared with valuable species from irrigated pastures, but sufficient for sheep and goat and the very best under non-irrigated conditions—indicate that much more attention should be be given to *Stipa* species in measures to improve the quality of the ranges, particularly in the Irano-Turanian subregion. More detailed recommendations to the subject will be given in another paper.

On the other hand, some *Stipa* species are very undesirable in the plant cover of the ranges, if they reach fruiting stage. The pseudo-fruits, by means of the pungent callus and its peculiar indumentum, penetrate deeply into the wool of sheep and even into the skin. Consequently, the quality of raw wool is reduced, and the animals may suffer from many small wounds. The annual *St. capensis* is reputed to be the worst species in this respect. By means of its peculiar growth rhythm and habit it reaches flowering and fruiting stages even under quite strong grazing pressure: it is then avoided by almost all grazing animals, because the pungent pseudo-fruits are particularly dangerous for their mouths and noses. In this way *St. capensis* has become a typical and often dominating plant on overgrazed ranges all over the hot subtropical areas, where its climatic requirements are fulfilled. Indeed, it has many characteristics of a weed.

Hybridization and Breeding Systems

Although most areas do have some sympatric species, which sometimes even belong to the same section, reports on hybrids are comparatively rare and only a few specimens of undoubted hybrid origin have been seen. They are mentioned in the context of the respective parental species. Differences in flowering time are common, and they may contribute to the genetical isolation of sympatric species. However, they are not incorporated into the description because of the large area under review and the resulting extent of variation. The earliest species to flower is *St. capensis* (March–May), and *St. capillata* is the latest (July–August). Most

species bloom between May and June, and most sympatric species differ in that respect only in 2–3 weeks.

The implications of cleistogamy in sects *Stipa* and *Barbatae* have already been discussed on p. 364; in their more advanced species with larger anthecia the lemma and palea usually do not spread. Consequently, the stamens are not released and their pollen grains pollinate the female organs of the same flower. However, in the spikelets of all predominantly cleistogamous species, including the most advanced ones as *St. pennata*, one or two partly or completely released anthers have occasionally been observed, often squeezed in between the lemma and the palea. Furthermore, in such species (e.g. *St. turkestanica*) spikelets with spreading lemma and palea and normally exposed sexual organs have been seen sporadically in herbarium specimens.

Evolutionary Trends in the Genus Stipa

As the 42 species investigated represent more than 50% of the Eurasiatic species and include all sections except the somewhat isolated SW Mediterranean section *Macrochloa,* it seems reasonable to place together what are seen to be the most striking evolutionary trends in the morphology of the vegetative and generative organs (Serebrjakova, 1971; Tzvelev, 1974, 1976). Some other trends, from the generative parts, are here elucidated for the first time. As usual, evolutionary trends in characters are much easier to detect than phylogenetic lines of taxa, because in *Stipa* parallel evolution has taken place in the different sections to a considerable degree. In Table 5 a list of the more obvious putative 'primitive' and 'advanced' characters is given.

Evolutionary Position of the Sections and Infrageneric Grouping

Primitive characters including the chromosome numbers of $2n=24$ are $\pm$ equally distributed in both sects *Lasiagrostis* and *Aristella.* By reason of its loose panicles, membranous lemmas and delicate, often caducous awns, sect. *Lasiagrostis* can be placed closest to the unknown base of the 'generic tree'. *Lasiagrostis* certainly gave rise to the alpine offshoot *Ptilagrostis* which differs, besides the reduction of the chromosome number $2n=22$, by vegetative adaptations to the alpine habitat and the change to anemochory (evolution of plumose awns) as an effective means of dispersal in open and cool alpine environments. The sects *Aristella* and *Orthoraphium* probably separated very early from the common stock by the evolution of a hardening lemma. With the straight awn they retained an even simpler structure than sect. *Lasiagrostis.*

The Mediterranean sect. *Macrochloa* is an isolated group of obscure origin. It combines a perfectly developed long and pungent callus with more primitive characters, such as the membranous lemma with prominent apical lobes, pointing to *Lasiagrostis*-like ancestors.

The sect. *Stipella* is likewise more evolved with a pungent callus, dissimilar glumes, lemma and palea and with the tendency to reduce the upper lodicules. However, the loose panicle, small spikelets, weakly hardened lemma etc., all indicate the close relationships and deviation

TABLE 5

Presumable evolutionary trends in some characters of the genus *Stipa*

Character	Primitive condition	Advanced condition
Ecology	mesophytes, moderate xerophytes	pronounced xerophytes
Growth form	perennial	annual
	tufts loose, by short creeping rhizomes and extravaginal branching	tufts dense, rosulate, intravaginal branching
	with numerous cataphylls	without cataphylls
Culms	many-noded	few-noded
Leaves	sheaths of upper leaves normal	sheaths of upper leaves much widened
	blade plane, with isolated strands of sclerenchyma	blades usually convolute or folded, with a continuous layer of sclerenchyma
	ligule short	ligule long
Panicle	exserted	more or less ensheathed
	many-spiculate	few-spiculate
	loose	contracted
	branches whorled	branches paired or single
	spikelets small	spikelets large
Glumes	subequal	strongly dissimilar
	lanceolate, with acute apex	narrow lanceolate to linear, with acuminate apex
Anthecium	small	large
Callus	obtuse	pointed (pungent)
	conical	cylindrical
	short	long
Lemma	membranous at maturity	coriaceous at maturity
	margins not overlapping	margins overlapping
	indumentum diffuse	indumentum seriate
Awn	short	long
	straight, untwisted	geniculate, twisted
	scabrous	pilose, plumose, smooth
	surface uniform	columna and seta with different surface
	caducous	persistent
Lodicules	subequal	strongly dissimilar
Chromosome numbers (2n)	22, 24, 28	36,38, 44

from *Lasiagrostis*, with *St. jacquemontii* and *St. haussknechtii* in sect. *Lasiagrostis* coming close to sect. *Stipella*, and *St. staintonii* in sect. *Stipella* having conserved very many *Lasiagrostis* characters.

The remaining sections of the genus *Stipa* have probably evolved along different, but more or less parallel lines. Sect. *Achnatheropsis* exhibits striking morphological and ecological affinities to sect. *Aristella*. Its species differ from the latter by their more elaborate geniculate awns and their callus structure. However, the step by step evolution of a longer and pointed callus, so typical for sect. *Stipa* (but also present in *Macrochloa*, *Stipella* and sections of other continents) seems to run parallel to a

gradual ecological change from evergreen submesophytic forest species to plants of deciduous and coniferous woodlands and alpine mats, with *St. brandisii* having retained (or regained?) the greatest number of primitive characters. On the other hand, sect. *Pseudoptilagrostis* seems to have conserved some characters of *Lasiagrostis*- or *Ptilagrostis*-like ancestors, as may be judged from the membranous lemma, the short awn and the callus structure. The bulk of the species is concentrated in sect. *Stipa*, which, besides the long and pungent callus, is characterized by coriaceous fruiting lemmas, a well-developed awn and medium to high chromosome numbers ($2n=32$, 36, 40, 44, 46), indicating a very active speciation by means of polyploidy. The section is clearly centred in Central Asia, particularly all the more primitive species. Its origin and development is obscure. The subdivision into 3 'species-groups' is based on the conventional awn characters, but it has been learned in the course of this treatment that their weight has often been overestimated in the past. It is not at all certain that these species-groups are natural in the sense of monophyletic origin.

The section *Barbatae* is closely related to sect. *Stipa*. It has probably arisen by a splitting off from the moderately advanced species of that section, and shares the same chromosome number of $2n=44$ with all species known in that respect. It differs primarily by its ovary, which at the apex invariably carries 3 or 4 equal or unequal styles. At present it is impossible to ascertain the evolutionary significance of the increased number of styles, which is unusual, not only in the genus *Stipa*, but in the whole Poaceae as well. At first glance, with regard to the possible evolution of the grass flower it is tempting to interpret this condition as primitive and to place the section at the base of the genus. However, a serious reason against it is that all species of the section are comparatively advanced in other respects, some even more so than certain species of sect. *Stipa* itself. The supposed monophyletic character of the section is supported by the fact that all species are adapted to a Mediterranean type of climate with winter rain. Correspondingly, they are distributed in the Irano-Turanian area and merge into the (East) Mediterranean.

From the comparatively few cytological data presently available it is evident that polyploidy is much involved in the evolution of the genus *Stipa* and its sections. But obviously only a limited correlation exists between the chromosome numbers and the height of morphological organization. Whereas certain sections, such as *Stipa*, *Stipella* and *Lasiagrostis*, exhibit a wide range of chromosome numbers, polyploidy seems to be much less represented in the other groups. Much more cytotaxonomic work is needed to detect the evolution of species and the relationship of the sections within the genus *Stipa*.

Finally it should be stressed that this paper covers most Old World species and marginally takes into account those European and Asiatic sections not present within the area of investigation. However, this revision and the infrageneric arrangement proposed herein are just a first step. More thorough results can be obtained only from a monograph, which has to include the c. 100 species of the other continents. For convenience, in the following synopsis a few of the more important infrageneric classifications proposed by previous authors are placed

together. They reflect the increasing state of knowledge, both of species and of characters, and the uncertainties in character weighting.

TRINIUS & RUPRECHT (1842)
Genus Stipa
  Sect. 1–4, species from other continents
  Sect. 5 Eustipa
Genus Aristella
Genus Orthoraphium
Genus Lasiagrostis
  Sect. Leptanthele
  Sect. Lasiagrostis

ROSHEVITZ (1934), USSR only
Genus Lasiagrostis
Genus Ptilagrostis
Genus Stipa
  Ser. Sibiricae
  Ser. Brevigeniculatae
  Ser. Barbatae
  Ser. Pennatae
  Ser. Tortiles
  Ser. Pseudocapillatae
  Ser. Capillatae

STEUDEL (1854)
Genus Stipa
  § 1–4, species from other continents
  § 5 Eustipa
  § 6 Aristella
  § 7 Orthoraphium
  § 8 Lasiagrostis
    subunit Leptanthele
    Subunit Lasiagrostis
  § 9 Macrochloa

TZVELEV (1974, 1976), USSR only
Genus Stipa
  Sect. Achnatheropsis
  Sect. Regelia
  Sect. Pseudoptilagrostis
  Sect. Leiostipa
  Sect. Stipella
  Sect. Barbatae
  Sect. Smirnovia
Genus Achnatherum
  Sect. Aristella
  Sect. Neotrinia
  Sect. Timouria
Genus Ptilagrostis

SYNOPSIS OF THE GENUS STIPA IN SW AND S ASIA

I. Sect. Lasiagrostis (Link) Hackel
  1. *St. caragana* Trin.
  2. *St. splendens* Trin. in Spreng.
  3. *St. chitralensis* Bor
  4. *St. hookeri* Stapf in Hemsl.
  5. *St. jacquemontii* Jaub. & Spach
  6. *St. duthiei* Hook. f.
  7. *St. haussknechtii* Boiss.

II. Sect. Aristella (Trin.) Hackel
  8. *St. litwinowiana* Smirnow ex Pavlov & Lipsch.
  9. *St. kurdistanica* Bor
  10. *St. bromoides* (L.) Doerfler

III. Sect. Orthoraphium (Nees) Hackel
  11. *St. roylei* (Nees) Mez

IV. Sect. Ptilagrostis (Griseb.) Hackel
  12. *St. concinna* Hook. f.
  13. *St. mongholica* Turcz. ex Trin.

V. Sect. Achnatheropsis Tzvelev
  14. *St. brandisii* Mez
  15. *St. regeliana* Hackel

VI. Sect. Pseudoptilagrostis Tzvelev
  16. *St. subsessiliflora* (Rupr.) Rosh. in Fedtsch.

VII. Sect. Stipella Tzvelev emend. Freitag
  17. *St. staintonii* Bor
  18. *St. parviflora* Desf.
  19. *St. capensis* Thunb.

VIII. Sect. Stipa
Species-group 1 ('Eriostipa')
  20. *St. roborovskyi* Rosh.
  21. *St. koelzii* Stewart
  22. *St. breviflora* Griseb.
  23. *St. richterana* Kar. & Kir.
  24. *St. purpurea* Griseb.
  25. *St. orientalis* Trin. in Ledeb.
  26. *St. himalaica* Rosh.
  27. *St. lessingiana* Trin. & Rupr.
  28. *St. turkestanica* Hackel
  29. *St. pennata* L.
    a. subsp. *pennata*
    b. subsp. *kirghisorum* (Smirnow) Freitag
    c. subsp. *pulcherrima* (Koch) Freitag
    d. subsp. *zalesskii* (Wilensky) Freitag
  30. *St. tirsa* (Stev.) Freitag

Species-group 2 ('Brevigeniculatae')
  31. *St. caucasica* Schmalh.
    a. subsp. *caucasica*
    b. subsp. *glareosa* (Smirnow) Tzvelev

32. *St. lingua* Junge

Species-group 3 ('Leiostipa')
33. *St. capillata* L.
34. *St. margelanica* Smirnow

IX. Sect. Barbatae Junge emend. Freitag
35. *St. arabica* Trin. & Rupr.
36. *St. hohenackerana* Trin. & Rupr.
37. *St. ehrenbergiana* Trin. & Rupr.
38. *St. gaubae* Bor
39. *St. zuvantica* Tzvelev
40. *St. iranica* Freitag
41. *St. holosericea* Trin.
42. *St. lagascae* Roem. & Schult.

Taxonomic Enumeration

Stipa L., Sp. Pl. 1:78 (1753); Gen. Plant. ed. 5:34 (1754).
Type species: *Stipa pennata* L.

Perennial, very rarely annual, loosely or densely tufted, with extravaginal or intravaginal branching. *Culms* 5–250cm tall, 2–7-noded. *Sheaths* usually shorter, but sometimes longer than the internodes; ligules usually hyaline, 0·1–15mm long; blades flat or convolute, 0·8–8mm wide. *Panicle* lax or contracted, exserted or ensheathed. *Spikelets* laterally flattened, 1-flowered. *Glumes* usually subequal, often acuminate. *Rhachilla* disarticulating above the glumes. *Mature fruits* (*anthecia*) consisting of the caryopsis enclosed by palea and lemma with the attached callus, cylindric or spindle-shaped, laterally subcompressed, 3–25mm long. *Callus* 0·3–5mm long, straight in dorsal and ventral view, at the base often curved outwards, obtuse or acute in lateral view, densely bearded, very rarely glabrous or almost glabrous; articulation scar longitudinally elliptic, deeply grooved or hollowed. *Lemma* variously pilose, very rarely glabrous, often becoming chartaceous to coriaceous and brown at maturity, apically often bilobed, convolute, with the margins overlapping from the base and covering the palea completely or with the margins not or only near the top overlapping and the palea more or less exposed. Awn inserted at the top of the lemma or at the base of the apical lemma lobes, articulated at the base or not, usually persistent, 5–450mm long, usually uni- or bigeniculate and twisted in lower part, rarely straight and untwisted, scabrous or variously pilose to plumose with hairs up to 11mm. *Palea* usually similar to lemma, but slightly shorter, rarely several times shorter, distinctly narrower, 2-nerved. *Lodicules* always 3, glabrous or pilose, the upper one alike or more or less different from the lower ones, very rarely extremely short. *Ovary* glabrous, styles 2–4, inserted close to each other at the apex, glabrous, bent outwards or parallel, each with a papillose stigma. *Caryopsis* spindle-shaped to cylindrical, laterally flattened, ratio of embryo: caryopsis = 1:3–1:5, hilum always reaching the top of the caryopsis or almost so. Basic chromosome numbers: n = 11, 12.

A genus with a world-wide total of about 300 species including 90–100 species in the Old World; likewise important in N and S America and Australia (c. 65 spp.). In the Old World from Macaronesia, N Africa and SW Europe to China and Japan, and in Asia from N Siberia to S Pakistan and N India; centred in the arid to semi-arid parts of C Asia between the Inner Himalayas, the Pamir and S Siberia, but also well represented in the Irano-Turanian, Mediterranean and Pontic-S Siberian subregions of the Holarctic floristic region; isolated outposts in S Arabia,

E and S Africa (3 species, with the 2 endemics related to Mediterranean ones).

KEY TO THE SW ASIATIC AND E MEDITERRANEAN SPECIES OF STIPA

1a. Awn 7–40mm long 2
b. Awn longer than 40mm 17

2a. Awn plumose throughout, with the hairs at the base at least 1mm long 3
b. Awn scabrous throughout, or only the lower part plumose or pilose. 5

3a. Awn longer than 30mm . . . . . **20. St. roborovskyi**
b. Awn shorter 4

4a. Panicle spike-like, contracted . . . . . **12. St. concinna**
b. Panicle loose, with spreading, flexuose branches **13. St. mongholica**

5a. Awn in lower part plumose or pilose, with hairs of at least 0·4mm 6
b. Awn scabrous throughout 8

6a. Awn in lower part plumose, hairs at its base 2–3mm long **16. St. subsessiliflora**
b. Awn in lower part pilose, hairs at its base 0·4–1mm long . . 7

7a. Callus up to 0·5mm long, rounded; lemma membranous, with 0·5–1mm long apical lobes; hairs at the base of the awn c. 0·5mm long . . . . . **6. St. duthiei**
b. Callus 0·7–1mm long, acute; lemma coriaceous, without apical lobes; hairs at the base of the awn c. 1mm long . . **15. St. regeliana**

8a. Awn bigeniculate; lemma dark brown, coriaceous **14. St. brandisii**
b. Awn straight or variously geniculate, if geniculate or flexuose, the lemma never brown and coriaceous 9

9a. Awn straight, untwisted; mature lemma coriaceous, brown; panicle contracted 10
b. Awn geniculate or flexuose, twisted in lower part; mature lemma membranous, pale or purplish; panicle effuse or contracted . 13

10a. Lemma in upper part with deflexed spinules of 1–2mm **11. St. roylei**
b. Lemma without deflexed spinules 11

11a. Tufts at the base without conspicuous next-season shoots; culm leaves up to 3mm wide; panicle few-spiculate, thin and narrow; lemma with apical lobes of 0·4–0·5mm . . **10. St. bromoides**
b. Tufts at the base with arcuate next-season shoots of 1–3cm, covered by scale-like cataphylls; culm leaves 3–8mm wide; panicle many-spiculate, dense, contracted; lemma without or with minute lobes (up to 0·2mm) 12

12a. Glumes 5·5–7mm; anthecium 4–5mm; awn 10–15mm **8. St. litwinowiana**
b. Glumes 7–8·5mm; anthecium 5–6·5mm; awn 15–22mm **9. St. kurdistanica**

13a. Lemma with prominent apical lobes of 2–3mm 14
b. Lemma lobes only up to 1mm long 15
14a. Glumes 7·5–9·5mm long; lemma lobes awn-like, setaceous; awn 8–14mm long . . . . . **4. St. hookeri**
b. Glumes 9·5–12mm long; lemma lobes not awn-like, plane; awn 18–21mm long . . . . . **3. St. chitralensis**
15a. Panicle contracted, up to 2cm wide; awn 20–35mm long **5. St. jacquemontii**
b. Panicle more effuse, at least 4cm wide; awn 5–14mm long. . 16
16a. Tufts small; culms slender; glumes subequal; apical lemma lobes 0·2–0·4mm long. . . . . **1. St. caragana**
b. Tufts large to very large; culms stout; glumes unequal, the lower 1–2mm shorter; apical lemma lobes 0·5–1mm long; near groundwater . . . . . **2. St. splendens**
17a. Awn scabrous throughout. 18
b. Awn pilose or plumose throughout or in parts 22
18a. Panicle loose, many-spiculate, anthecium up to 7mm. . . 19
b. Panicle contracted, few-spiculate, anthecium at least 9mm. . 21
19a. Lemma with apical lobes of 0·3–0·4mm, callus 0·5mm long, almost rounded . . . . . **7. St. haussknechtii**
b. Lemma without apical lobes or lobes only up to 0·25mm, callus at least 0·5mm long, acute, pungent 20
20a. Callus 1–1·2mm long, lemma without apical lobes **18. St. parviflora**
b. Callus 0·5–0·7mm, lemma with very short apical lobes **17. St. staintonii**
21a. Awn 9–11cm long, upper part falcate; callus 1·5–2mm long; blades on upper surface minutely papillose or pubescent **34. St. margelanica**
b. Awn 12–20cm, upper part circinnate; callus 3–3·5mm long; blades on upper surface densely and long pilose . . .**33. St. capillata**
22a. Awn shortly pilose (up to 0·9mm) in the lower part only, or awn minutely pilose (up to 0·5mm) throughout. 23
b. Awn pilose or plumose throughout, or in upper part only, with longer hairs 30
23a. Awn pilose only in its lower part, upper part scabrous . . 24
b. Awn minutely pilose throughout 27
24a. Anthecium 12–19mm long; awn 12–25cm long . **41. St. holosericea**
b. Anthecium and awn shorter 25
25a. Annual, lemma without apical lobes . . . . **19. St. capensis**
b. Perennials, lemma with 2 apical lobes 26
26a. Upper part of awn and tips of glumes spirally twisted, apical lemma lobes 0·5–0·8mm, callus at least 1mm . . . **21. St. koelzii**
b. Awn and glumes not spirally twisted, apical lemma lobes up to 0·3mm only, callus up to 0·7mm . . . **17. St. staintonii**
27a. Glumes 10–15mm long; anthecium 6–7mm long; awn 6–7cm long 28
b. All parts longer. 29
28a. Panicle very loose; lemma with two prominent apical lobes; awn slightly twisted in lower part . . . . **7. St. haussknechtii**

b. Panicle contracted; lemma without apical lobes; awn in lower part strongly twisted . . . . . **23. St. richterana**

29a. Glumes 30–40mm long; anthecium 9–10mm long; awn 13–18cm long . . . . . **40. St. iranica**
b. Glumes 50–65mm long; anthecium 14–19mm long; awn 20–25cm long . . . . . **42. St. lagascae**

30a. Awn pilose or plumose throughout 31
b. Awn pilose or plumose only in upper part, at least the segment below the first geniculation glabrous 40

31a. Awn pilose, with hairs from 0·6–2·5mm 32
b. Awn plumose, with hairs from 4–11mm 36

32a. Awn 5–7cm long; glumes 12–17mm long 33
b. Awn and glumes longer 35

33a. Awn with hairs of 0·6–1(–1·2)mm . . . **22. St. brevifolia**
b. Awn at least in lower part with longer hairs 34

34a. Panicle contracted, many-spiculate; anthecium 6·5–7·5mm; awn in lower part with longer hairs (1·5mm) than in the upper (1–1·1mm). . . . . **20. St. roborovskyi**
b. Panicle usually loose, few-spiculate; anthecium 8–9·5mm; awn in lower part with shorter hairs (1–1·5mm) than in the upper (2mm) . . . . . **24. St. purpurea**

35a. Lemma indument ascending, 0·2–0·5mm long; awn diameter at the base 0·2–0·3mm; blades externally usually scabrous or pubescent, rarely smooth; longest ligules of the vegetative shoots 3–6(–15)mm . . . . . **35. St. arabica**
b. Lemma indument spreading, 0·7–1·2mm long; awn diameter at the base 0·4–0·5mm; blades externally always smooth; longest ligules of the vegetative shoots 0·5–1(–2)mm . . **37. St. ehrenbergiana**

36a. Awn bigeniculate 37
b. Awn unigeniculate 39

37a. Anthecium 6–7(–9)mm long; awn up to 7cm long, falcate . . . . . **25. St. orientalis**
b. Anthecium at least 9·5mm long; awn longer than 7·5cm, flexuose 38

38a. Anthecium 9·5–11·5mm long; awn 7·5–14cm . **26. St. himalaica**
b. Anthecium at least 15mm long; awn longer than 17cm **28. St. pennata** s.l. (aberrant forms)

39a. Glumes 2·5–6cm long; awn 6–13cm long, upper part falcate with hairs up to 7mm . . . . . **31. St. caucasica**
b. Glumes 5–9cm long; awn 14–19cm long, upper part straight, with hairs of 7–11mm . . . . . **32. St. lingua**

40a. Awn in upper part with 0·8–3mm long hairs 41
b. Awn in upper part with 4·5–7mm long hairs 44

41a. Awn in lower part smooth. 42

b. Awn scabrous in both segments of its lower part, or scabrous in the first and pilose in the second segment 43

42a. Awn bigeniculate; glumes 2·5–3·5cm long; anthecium 9–12mm long . . . . . **27. St. lessingiana**
b. Awn unigeniculate; glumes 6–7cm long; anthecium 13–14mm long . . . . . **38. St. gaubae**

43a. Awn 9–18cm long, with hairs of 1·5–2·5mm **36. St. hohenackerana**
b. Awn 19–22cm long, with hairs of 0·5–1mm . **39. St. zuvantica**

44a. Awn 8–16(–19)cm long; anthecium 9–12·5(–14)mm long . . . . . **28. St. turkestanica**
b. Awn (17–)22–45cm long; anthecium 15–25mm long . . . 45

45a. Blades thread-like, 0·2–0·4(–0·5)mm diam., with a very long bristle-like apex; ligules at the vegetative shoots inconspicuous, 0·1–0·2(–0·4)mm long; lemma with the marginal lines of hairs terminating (2–)2·5–4(–5)mm below the top . . **30. St. tirsa**
b. Blades usually wider, (0·3–)0·4–0·8(–1)mm diam., without a bristle-like apex; ligules at the vegetative shoots conspicuous, (0·5–)0·8–1·5(–3)mm long; lemma lines reaching the top or not . . . . . **29 St. pennata** s.l.

To avoid overloading, in the species accounts that follow misapplied names have not been included in the lists of synonyms, but in some cases they are discussed in the comments to the respective species. For the same reason, from the c. 2000 herbarium specimens examined only a selection of up to 3 per province is normally cited in the main text; at the end of the paper is a list of other exsiccatae which were examined in the course of the study.

In the citations, authorities of plant names and names of collectors are abbreviated according to Meikle (1980). A few collector names are further shortened as follows:

A. —Anders
B. —Bornmüller
D. —P. H. Davis
F. —Freitag
K. —Køie
H. —Hedge & Wendelbo
Neub.—Neubauer
P. —Podlech
Pa.—Pabot
R. —Rechinger
St. —R. R. Stewart
V. —Volk
W.—Wendelbo (et al.)
Z. —Zohary

If no recognized institution is indicated together with the specimens cited, it is preserved in a private herbarium or a smaller institution. A., P. and V. are located in the private herbarium of Prof. Podlech, Munich; A. is also in the Faculty of Science of the University of Kabul. F. is the author's private herbarium.

Distribution maps are presented for most species treated; they do not include the Himalayas, because the collections from that area are still rare and insufficient and the maps consequently would be misleading. Literature records have been accepted in a few cases only, and are marked by open circles.

The distribution maps (Figs 6–17, 19–27, 29) employ simplified base maps; these should be compared with the complementary maps showing altitudinal zones (Figs 4 and 5).

Chromosome counts have not been made, but for convenience the data available from the literature are included in the species descriptions. They have been taken from different review papers, particularly Fedorov (1969), Moore (1973), Tzvelev (1976), Prokulin et al. (1977), Goldblatt (1981) and the IOPB Chromosome Number Reports of A. Löve in *Taxon*.

I. Sect. Lasiagrostis

Stipa sect. **Lasiagrostis** (Link) Hackel in Engl. & Prantl, Nat. Pflanzenfam. 2, 2:46 (1887).

Syn.: *Lasiagrostis* Link, Hort. Berol. 1:99 (1827); *Lasiagrostis* § *Lasiagrostis* Trin. & Rupr., Spec. Gram. Stip.:88 (1842); *Stipa* § *Lasiagrostis* (Link) Steud., Syn. Pl. Glum. 1:132 (1885).

Achnatherum P. Beauv., Ess. Agrost.: 19 (1812). Type species: *St. calamagrostis* (L.) Wahlenb.

Trikeraia Bor, Kew Bull. 9:555 (1955); *Achnatherum* sect. *Trikeraia* (Bor) Tzvelev, Rast. Centr. Az. 4:39 (1968). Type species: *St. hookeri* Stapf in Hemsley.

Achnatherum sect. *Neotrinia* Tzvelev, Novosti Sist. Vyss. Rast. 9:55 (1972). Type species: *St. splendens* Trin.

Type species: *St. calamagrostis* (L.) Wahlenb.

Branching usually extravaginal; leaves usually flat, in case of water stress involute, externally with prominent ribs caused by sclerenchymatic strands around the vascular bundles; *glumes* ovate to lanceolate; *callus* obtuse, conical, less than 0·5mm long, scar circular to broadly elliptic, peripheral ring regular, rarely slightly flattened at the dorsal side; *lemma* membranous, not covering the palea completely, with 2 apical lobes beside the insertion of the awn; *awn* usually less than 4cm long, scabrous or rarely minutely pilose, flexuose or geniculate, lower part more or less twisted.

Moderate xerophytes from montane to subalpine habitats; widely distributed in S Eurasia from Spain to China, centred in the summer rain regions of the Inner Himalayas and of C Asia. 2n = 24, 42, 48 (3 spec.). For callus characters see Fig. 1c.

1. St. caragana Trin., Mém. Acad. Imp. Sci. St. Pétersbourg, Sér. 6, Sci.-Math. 1(1):74 (1830).

Syn.: *Lasiagrostis caragana* (Trin.) Trin. & Rupr., Spec. Gram. Stip.: 90 (1842); *Achnatherum caragana* (Trin.) Nevski, Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1, Fl. Sist. Vyss. Rast. 4:224 & 337 (1937).

Oryzopsis pallescens Westberg, Acta Horti Bot. Univ. Imp. Jurjev 5:147 (1904). Type: (USSR) Caucasus, near Baksanu, 4000ft, 25 vii 1896, *Akinfiev* (holo. LE n.v.).

Oryzopsis asiatica Mez, Repert. Spec. Nov. Regni Veg. 17:210 (1921). Type: (USSR) Altai, *Ehrenberg* (holo. B†).

Type: (USSR, Kazakhstan) e littore oriente maris Caspici ad promont. Tjuk-Karagan, *Eichwald* (holo. LE!).

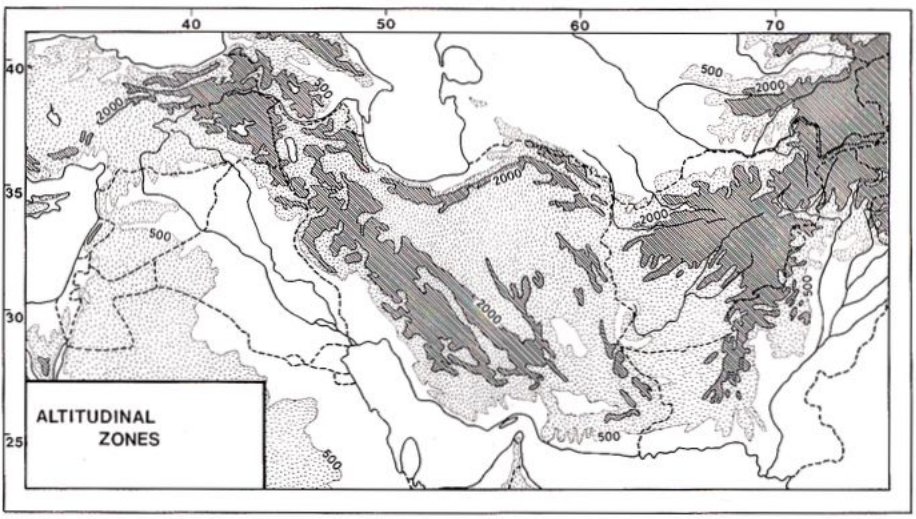

FIG. 4. Base map showing altitudinal zones (Cf. Figs 6, 9, 10, 12, 13, 16, 17, 19–27, 29).

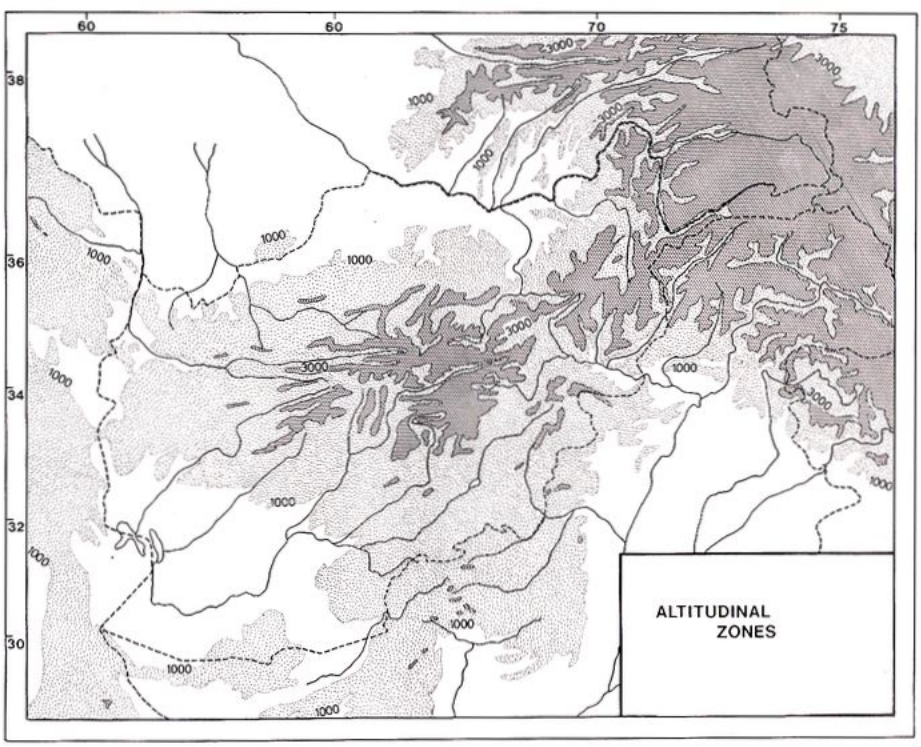

FIG. 5. Base map showing altitudinal zones (Cf. Figs 7, 8, 11, 14, 15).

In small, dense tufts, branching extra- and intravaginal, with some generative and some vegetative shoots; *culms* (40–)50–120cm, 3–4-noded, glabrous, smooth; *sheaths* glabrous, almost smooth to scabrous, with shortly ciliated margins; *ligules* very short, at the culms up to 0·6mm long, at the vegetative shoots 0·2–0·3mm, brown, truncate, sometimes lacerated, glabrous; *blades* flat, up to 25cm × 1·5–3·0mm, in dry condition involute and 0·4–0·6mm diam., greyish-green, the upper surface almost glabrous, scabrous, beneath glabrous, smooth throughout or grading into scabrous towards the apex, with prominent white veins; *panicle* lax or somewhat contracted, long exserted, 20–35(–40)cm long, 4–15cm wide, the branches ascending or spreading, paired or in whorls up to 5, glabrous or setulose, with numerous spikelets concentrated in the upper $\frac{1}{2}$–$\frac{1}{3}$, the longest up to 12(–15)cm; *spikelets* 4·5–6(–7)mm long, the glumes subequal, greenish to hyaline, lanceolate, acute, glabrous, 3-nerved; *anthecium* 3–4·5mm long; *callus* 0·3mm long bearded, scar circular; *lemma* with 2 very short apical lobes of 0·2–0·4mm, pale, completely covered by 0·4–0·6mm long ascending hairs; *awn* (6–)8–11(–14)mm long, scabrous throughout, geniculate or flexuose, in the lower $\frac{1}{3}$–$\frac{1}{2}$ slightly twisted, caducous; *palea* 0·5mm shorter, pilose throughout; *lodicules* oblong to linear, dissimilar, the lower 0·7–0·9mm long, obtuse or bilobed, the upper slightly shorter and narrower, sometimes all or the lower ones only with scattered hairs on the surface and at the apex; *anthers* 1·3–1·5(–2·0)mm long, bearded or glabrous; *ovary* with 2 styles and 2 feathery stigmas; *caryopsis* 2·0–2·3mm long, hilum not reaching the top, sometimes only up to $\frac{3}{4}$, the embryo 0·7mm long; 2n = 24. For callus characters see Fig. 1c.

From E Anatolia and the N Caucasus through N Iran, S Turkmenia, N and E Afghanistan, N Pakistan and the Pamir Alai to the C Tianshan and Altai, to the SE extending into Baluchistan (Pakistan) (Fig. 6).

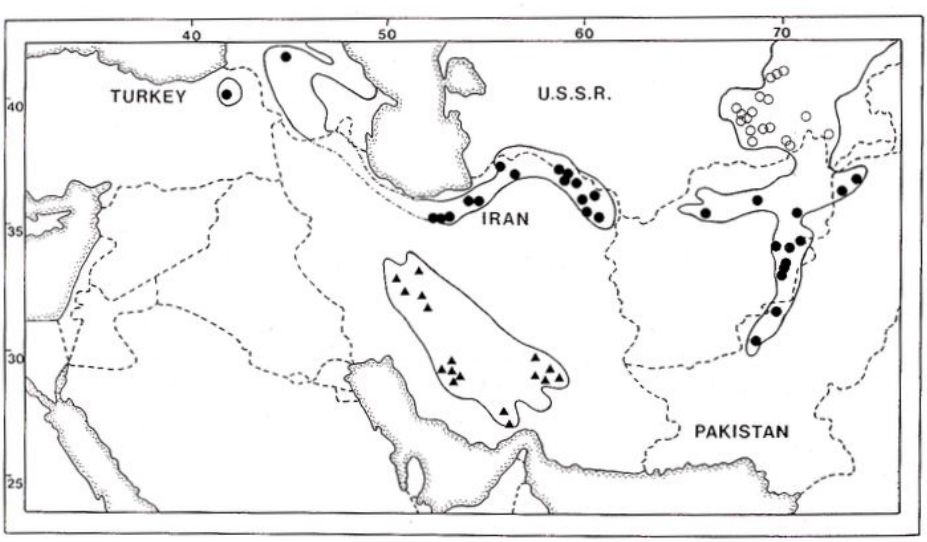

FIG. 6. Distribution of: ● *Stipa caragana*; ▲ *St. haussknechtii*. ○ literature records of *St. caragana* from Transcaucasia according to Grossheim (1939) and from Tadzhikistan according to Ovczinnikov (1957).

A less common species of those semi-arid regions where the winter rains continue to May or additional summer rains occur; in the N predominantly in *Juniperus* woodlands from 1200–2400m, in the E and SE also in *Pinus gerardiana* woodlands, from 2000–2700m, only scattered in seral communities.

Specimens studied (36):

TURKEY. Çoruh: Çoruh vall., 100km S of Artvin, 1100m, *Z. & Plitman* 2565-9 (HUJ).
USSR. Georgia: Ossetia, at military road, 1400m, *Marcevicz* s.n. (JE, L). Turkmenia: Kopet Dagh, near Ashkhabad at Gaudan, *Litv.* 2370 (W); ibid., Firuza near Chan-Jaila, 1200m, *Litv.* 208 (G); Turkm. s.l. *Ledebour* s.n. (GOET). Tadzhikistan: Ilinfer, v 1877, *Regel* (GOET).
IRAN. Tehran: betw. Damavand and Polur, 2500m, *Gilli* s.n. (W); W of Emam Zadeh on S slopes of Damavand, *W.* 1405 (BG, W). Mazanderan: Moh. Reza Shah National Park, plains at road Robat-e-Qareh Bil to Bekadeh, 1200m, *R.* 53013 (W); betw. Bekadeh and Radji, 1200m, 6 vi 1975, *Termé* (IRAN); ibid., 8 vi 1975, *Termé* (IRAN). Semnan: Firuzkuh, 2040m, *Pa.* 4355 (IRAN); S slopes of Shahvar Mts above Nekarman, 2300m, *R.* 5910 (W); ibid., 2000m, *Assadi* 21055 (THR). Khorasan: Mts above Quchan, 1700m, *R.* 1637 (W); Akhlamad, Darreh Abshar, 1500m, 17 vii 1972, *Iranshar* (IRAN); Kuh-e-Bizg, 2200m, *R.* 1458 (W); Gol-e-Dagh, 1000m, 28 vi 1938, *Gauba* (IRAN) (3 more).
AFGHANISTAN. Ghorat/Jawzjan: betw. Dawlatyar and Sar-e-Pul, *Edelberg* 2305 (W). Baghlan: Koh-e-Chungar NW of Pul-e-Khumrie, 2300m, *F.* 6721. Kapisa: Nidjrao, 2500m, *V.* 2345. Logar: Logar vall., *V.* 1731. Altimur pass, 2600–2700m, *R.* 31907 (G, W). Paktya:Chamkanni, above Hazar Derakht, 2400m, *F.* 1629; Maiden Shahidan near Peiwar pass, *V.* 71.500; S of Shahidan, 1800m, *Pa.* 1182 (G): Kurram vall., *Aitch.* 890 (K); Urgun, Bagh Tapa, 2250m,*V.* 71.303; Urgun, 20km S, 2200m, *F.* 3321.
PAKISTAN. Swat: Upper Swat, *M. A. Khan* s.n. (K). Gilgit: Rawat, 2700m, *Ogino* 496 (KYO). Baluchistan: Zandra, Wana, 2650m, *Akbar* 2191 (K, W); Sibi: Ziarat, in Bastergi forest, vii 1959, *Khan* (RAW); ibid., *St.* 607 (K).

The species is somewhat variable in leaf indumentum, in the presence or absence of a small tuft of hairs at the anther apices, and in the length of glumes. The specimen *F.* 6521 from N Afghanistan represents a form with larger glumes (7mm), anthecia (4–4·5mm) and awns (12–14mm).

Some older specimens from Siberia, particularly from the Altai, have been named *St. redovskii* Trin. That species was founded by Trinius (1821) on two sets of plants: (1) cultivated ones from the Botanic Garden in Paris reported as grown from seeds collected by Redovski in Siberia. They were already described by Poiret (1817) under the name *St. conferta*, but are according to the descriptions given by both authors specimens of the European *St. calamagrostis*; (2) young plants of true *St. caragana* from the Arkaul Mts. The description of Trinius mixed up characters of both species, nevertheless he gave a good plate of true *St. caragana* in Ledebour (1829). Even in Eichwald (1831) *St. redovskii* is cited beside *St. caragana*, but later (at least in Trinius & Ruprecht, 1842) the author himself included the Siberian specimens of *St. redovskii* into *St. caragana*. As *St. redovskii*, despite its discordant elements, has to be considered a valid name, it is best typified on the specimens of the Paris Botanic Gardens, thus making it a synonym of *St. calamagrostis*.

The identity of *Oryzopsis pallescens* with *St. caragana* has already been stated convincingly by Roshevitz (1934) and Tzvelev (1976), and that of *O. asiatica* by Tzvelev (1976).

2. St. splendens Trin. in Sprengel, Neue Entd. 2:54 (1821).
Syn.: *Lasiagrostis splendens* (Trin.) Kunth, Rév. Gram. 1:58 (1829);

Achnatherum splendens (Trin.) Nevski, Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1, Fl. Sist. Vyss. Rast. 4:224 (1937).

St. altaica Trin. in Ledeb., Fl. Alt. 1:80 (1829). Type: (USSR) Altai, in arenosis et sterilibus subsalsis, vii 1826, *Ledebour* (lecto. LE n.v., iso. GOET!).

Aristella longiflora Regel, Trudy Imp. S.-Peterb. Bot. Sada 7:645 (1880). Type: (USSR) In valle fluvii Ili pr. Saidun, *Regel* (holo. LE n.v.).

St. schlagintweitii Mez, Repert. Spec. Nov. Regni Veg. 17:208 (1921). Type: (Pakistan) Balti, Sáling, right side of the Shayók to Húshe, *Schlagintweit* (holo. B†, iso. GOET!).

St. kokonorica Hao, Bot. Jahrb. Syst. 68:583 (1938). Type: (China) Kokonor, Sha-chu-yi, *Hao* 1271 (holo. PEK n.v.).

St. munroana Bor, Kew Bull. 1954: 500 (1955). Type: Afghanistan (Bamyan prov.) Siah Sung, West Hindukush, 3000–3500m, *Griffith* 1066 (holo. K!).

Type: (USSR, Transbaicalia) *Agrostis longiaristata*, herb. Fischer (holo. LE!).

In large, dense tufts, branching predominantly intravaginal, with numerous generative and vegetative shoots; *culms* (30–)60–200(–250)cm, (3–)4–5(–7)-noded, glabrous, smooth, only the uppermost part not covered by the sheaths; *sheaths* glabrous, smooth, rarely the margins somewhat ciliate, striate; *ligules* at the culms up to 12mm long, acute, at the vegetative shoots only 1–1·5mm, truncate to obtuse, smooth or scabrous; *blades* flat, up to 60cm long, 2–3·5(–5)mm wide, in dry condition irregularly involute to convolute, upper surface scabrous, deeply grooved, beneath glabrous, smooth, only at the base sometimes scaberulous; *panicle* shortly exserted or at the base ensheathed, usually somewhat contracted, (12–)20–40(–50) × (4–)6–8(–15)cm, the branches ascending, usually in whorls of (3–)5, setulose, up to 15cm long, with numerous spikelets; *spikelets* (4–)5–7(–8·5)mm long, the glumes subequal, lanceolate, purplish with hyaline margins and tip or pale, setulose, the lower 1–1·7mm shorter than the upper; *anthecium* (4–)4·5–6(–7·2)mm long; *callus* 0·3–0·5mm long, bearded, scar broadly elliptic, peripheral ring almost closed, regular; *lemma* with two 0·5–1mm long apical lobes, pale or purplish, diffusely covered by sparse or denser 1–2mm long ascending hairs, setulose; *awn* (5–)6–10(–12)mm long, indistinctly geniculate at a height of 1–2mm or flexuose, slightly twisted at least in the lower part, scabrous, caducous; *palea* subequalling the lemma in length and indumentum; *lodicules* subequal, 0·9–1·1mm long, lanceolate, acutish, glabrous; *anthers* 3–4·5mm long, bearded, yellow; *ovary* with 2 styles, embryo 1mm long, hilum terminating 1mm below the top; 2n = 42, 48.

From the Caspian Sea to E Siberia, S to the Kopet Dagh, Pamir Alai, through C Asia to the E Pamir, Karakorum and inner ranges of the Himalayas; outpost in C Afghanistan (Fig. 7).

A very common and typical plant of cold semi-desert regions, growing on groundwater influenced habitats; in the area only in higher regions from 2100–3800m; usually untouched by grazing animals and therefore expanding on overgrazed meadows at the expense of more palatable

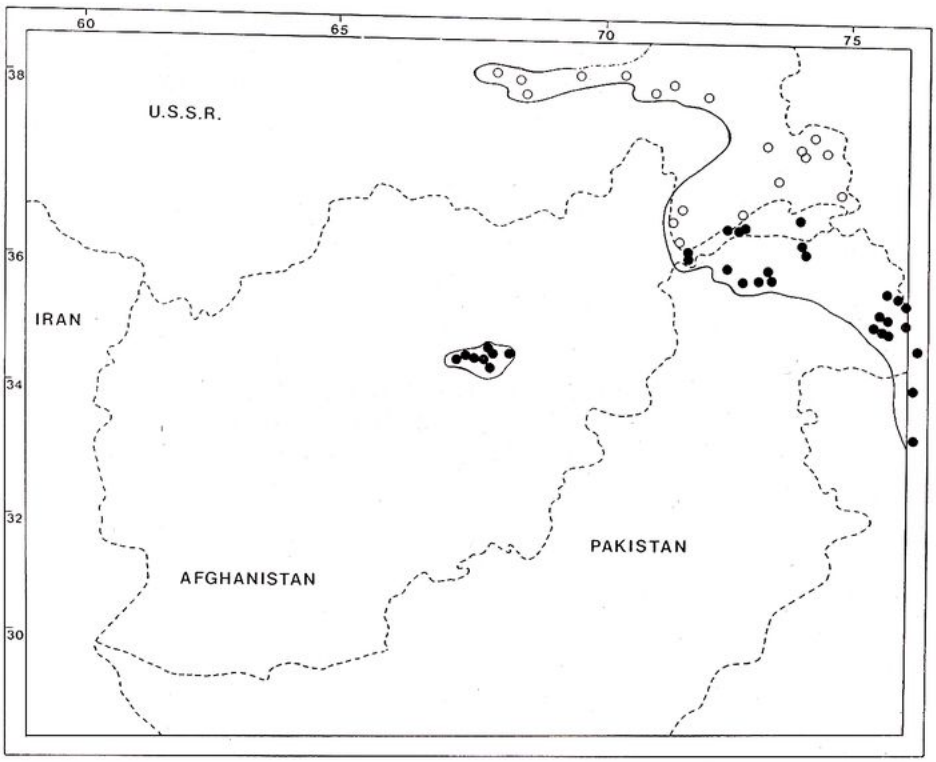

FIG. 7. Distribution of *Stipa splendens*. ○ literature records according to Ovczinnikov (1957).

species; pastoralists try to control the species by burning down the tussocks, but with limited success.

Specimens studied (48):

AFGHANISTAN. Bamyan: Kalu vall. betw. Bamyan and Hajigak pass, 2800m, *F.* 6381; betw. Doab and Bamyan, *Furse* 8370 (K); betw. B. and Band-e-Amir, 2800–3000m, *R.* 18157 (W); (7 more). Parwan: Upper Ghorband vall. betw. Kotak and Botyan, *A.* 4361. Badakhshan: Qazi Deh up to 3000m, *Roemer* 234 (M); Pakoui, *Lindberg* 1094 (W); Wazit vall., middle part, 3500–3800m, *A.* 8201a; (5 more).

PAKISTAN. Chitral: Yarkhun, *Bowes Lyon* 83 (BM, E, W); Paur, 2650m, *Stamm & Wöhrl* 167 (W); betw. Mastuj a. Baroghil, 2600m, *Stainton* 2888, 2889 (BM, E, W). Gilgit: Karakoram, Bad Swat vall., 19–30 ix 1956, *Honda* (KYO); Rawat betw. Ghizar a. Gupis, 2600m, *Ogino* 494 (KYO); ibid., betw. Dahimal a. Gupis, 2450m, *Ogino* 231 (KYO); Dawalgan betw. Yasin a. Gupis, 2380m, *Ogino* 454 (KYO). Baltistan: Indus vall. near Skardu, 2700m, *St.* 20383 (NY); Shayok vall. betwe. Kiris a. Néru, *Schlagintweit* 5787 (BM, GOET); near Balto Glacier, 3600m, 19 vii 1955, *Nakao* (KYO); (5 more).

INDIA. Kashmir: Ladakh, 3000–3300m, *Thomson* s.n. (E, G, GOET, K); Zaskar, Abring, 4200m, *K.* 3001a (NY); Kanu, Indus vall., 3400m, 13 ix 1970, *Bhattacharyya* (BSD); (8 more). Spiti: Ki, 3800m, 4 viii 1972, *Bhattacharyya* (BSD).

The species is rather polymorphic: in particular, the colour of the glumes and anthecia and the size of the respective parts vary considerably. The last character has been used by some authors to define new species. According to the description, *St. kokonorica* Hao differs only by somewhat larger spikelets (about 7mm) from normal populations and has already been retracted by Tzvelev (1968), who nevertheless recently

founded a var. *pamirica* (Tzvelev, 1974) on the same character. A similar case is *St. munroana* Bor from C Afghanistan. Whereas Bor mentioned in the diagnosis spikelets of 9–9·5mm and anthecia of 8·5mm, the type exhibits dimensions of just 8–8·3mm for the spikelets and 6·8–7·2mm for the anthecia. The rather abundant gatherings from C Afghanistan show a range of 6–8·3mm for the spikelets. Indeed there is a contrast to the plants from the Afghan Pamir and from N Pakistan with smaller spikelets of 4–6mm only, but as also in Tadzhikistan, Baltistan and Ladakh forms with larger spikelets up to 7·5mm do occur, even subspecific rank seems to be unjustified. The var. *gracilis* Bor (1960) is based on a specimen with a very small panicle of only 10–15cm (*Clarke* 30097 from Baltistan). Although the type has not been seen I imagine that it is either a young plant or a specimen from an unfavourable site. Smaller variations have been stated in the length and density of the lemma hairs. By including *Aristella longiflora* Regel into the synonymy of *St. splendens* I follow Roshevitz (1934) and subsequent Soviet authors, but not without some doubt, as in the diagnosis the structure of the lemma is described as coriaceous and the lemma exceeds the glumes in length, both features being rather anomalous.

3. St. chitralensis Bor, Kew Bull. 1954: 500 (1955).
Type: Pakistan, Chitral, Guger (Gujar), 9000ft (2750m), 18 v 1895, *Harris* 16800 (holo. K!; iso. E! WU!).

Loosely tufted, branching extravaginal; *culms* 40–55cm, glabrous, smooth; *sheaths* glabrous, smooth; *ligules* up to 0·5mm long, truncate, fimbriate; *blades* flat, at the culms up to 22cm × 6mm, at the vegetative shoots up to 25cm × 2·5mm, in dry condition involute to convolute, glabrous on both surfaces, smooth; *panicle* densely contracted, 9–10 × 2·5cm, the branches ascending, smooth, single or paired, short; *spikelets* 9·5–12mm long, the glumes subequal, lanceolate, hyaline, smooth, 3-nerved, the lower one 0·5–1mm shorter and the upper sometimes 5-nerved; *anthecium* 9–11mm long; *callus* 0·5–0·6mm long, bearded, scar elliptic, peripheral ring almost closed, regular; *lemma* membranous, diffusely covered by 2–2·5mm long ascending hairs, apically with two 2–2·5mm long hyaline, glabrous and smooth lobes widely surpassing the insertion of the awn; *awn* 18–21mm long, unigeniculate, scabrous, indistinctly articulated at the base, columna 5–6mm long, slightly twisted, seta straight; *palea* 9–9·5mm long, surpassing the base of the awn, on the back between the veins with 1–1·5mm long ascending hairs; *lodicules* equal, 1·5–2mm long, lanceolate, acute, glabrous; *anthers* 6mm long, unbearded, yellow; *ovary* with 2 styles; *caryopsis* not seen; 2n unknown.

Endemic to Chitral, and known from the type locality only.

It is closely allied to *St. hookeri*, which has apical lemma lobes of about the same length. However, the structure of the lemma lobes differs in both species. They are scabrous owing to extremely thick-walled, short hairs and setaceous due to the awn-like prolongation of the vein in *St. hookeri*, but almost smooth and plane without a protruding vein in *St. chitralensis*. Furthermore the anthecium and glumes are larger in *St. hookeri* etc. The type specimen of *St. chitralensis* was named

St. hookeri by Stapf himself, and even Bor (1970), the author of *St. chitralensis*, cited it both under *St. chitralensis* and *St.* (*Trikeraia*) *hookeri*. Otherwise, the species shares some features with *St. splendens*. The intermediate position between *St. hookeri* and *St. splendens* and the failure to recollect *St. chitralensis* cast some doubt on its specific rank. The only tussock, from which the type material was collected, may well have arisen from a rare event of hybridization.

4. St. hookeri Stapf in Hemsley, J. Linn. Soc., Bot. 30:120 (1894).

Syn.: *Achnatherum hookeri* (Stapf) Keng, Clav. Gram. Prim. Sin.: 213 (1957); *Trikeraia hookeri* (Stapf) Bor, Kew Bull. 1954:555 (1955).
Timouria aurita Hitchc., J. Wash. Acad. Sci. 23:134 (1933). Type: Kashmir, Rupshu, in sand at Kugzil, c.4300m, 16 vii 1931, *Koelz* 2328 (holo. US n.v.).

Type: (India, Kashmir, Ladakh) Tibet, 4500m, sheltered nullahs near water, vii–ix 1891, *Thorold* 124 (holo. K!, iso. CAL!).

Tufted, branching intravaginal, the young shoots of the next season already present at the base, arcuate, covered by scale-like cataphylls; *culms* 50–70(–90)cm, glabrous, smooth; *sheaths* glabrous, smooth, ciliate at the margins; *ligules* at the generative shoots up to 2mm long, at the vegetative shoots very short, truncate, fimbriate; *blades* flat or convolute, densely pilose on both sides, on the upper surface grooved; *panicle* contracted, 11–17 × 2–3cm, the branches ascending, setulose, up to 4cm long; *spikelets* 7·5–9·5mm long, the glumes subequal, lanceolate, purplish, on the back and at the apex shortly setulose, 3-nerved, the upper one up to 1mm longer and sometimes with a short, up to 0·5mm long awn-like apex and 2 short lobes; *anthecium* 6·5–9·5mm long; *callus* 0·5mm long, bearded, scar elliptic, peripheral ring almost closed, regular; *lemma* membranous, purplish, diffusely covered by 2–2·5mm long ascending hairs, apically with two 2–2·5(–3)mm long setaceous lobes consisting mainly of an awn-like elongated vein with a densely setulose surface; *awn* 8–14mm long, unigeniculate, but often indistinctly only, scabrous, columna 2–3mm long, slightly twisted, seta straight; *palea* slightly shorter than lemma, hyaline; *lodicules* subequal, oblong to lanceolate, glabrous; *anthers* unbearded; *ovary* with 2 styles; *caryopsis* not seen; 2n unknown.

Inner ranges of the Himalayas from Kashmir to Nepal and adjacent parts of China (Tibet).

In semi-arid to arid alpine environments, from 3000–4900m.

Specimens studied (beside the type):
NEPAL. Mt Everest, Tinkye palin, 4270m, *Sufed* 104 (K).
SIKKIM. (Tib. Orient.), 4600–4900m, *Hooker* s.n. (K).
CHINA. Tibet, *Younghusband* 113 (K).

The species is unique among the investigated species of the genus by its somewhat awn-like apical lemma lobes. Bor (1955) gave much weight to that character and erected the monotypic genus *Trikeraia*, although Tzvelev (1968) later reduced it to sectional rank. As long apical lemma lobes occur commonly in sect. *Lasiagrostis*, most clearly in *St. splendens*, and as scaly next-season shoots are typical for sect. *Aristella*, even a separate section seems unwarranted and *St. hookeri* is probably best placed in sect. *Lasiagrostis*. When describing *St. hookeri* Stapf recognized

the affinity to *St. splendens*, but *St. chitralensis* (q.v.) is certainly even more closely related. The type of *Timouria aurita* Hitchc. was not available, but from the diagnosis and the figure it can be recognized as a normal specimen of *St. hookeri*.

5. St. jacquemontii Jaub. & Spach, Ill. Pl. Or. 4:60 (1851).

Syn.: *Lasiagrostis jacquemontii* (Jaub. & Spach) Boiss., Fl. Or. 5:506 (1884).

Stipa sibirica L. var. *pallida* Hook. f. Type: Tibet, N of Kumaun, 15000ft, *Strach. & Winterbottom* (holo. K!, iso. BM!).

Type: (India) ad rupes in excelsis Emodi Cashemyriani, 2750m, 1831, *Jacquemont* 994 (holo. P n.v., iso. K!).

Densely tufted, branching extravaginal, with some generative and vegetative shoots; *culms* (20–)30–75cm, 2–4-noded, glabrous, smooth, sometimes somewhat geniculate near the base; *sheaths* glabrous, smooth, with ciliate margins; *ligules* up to 0·3mm long, truncate, crenulate, at each side with a tuft of hairs; *blades* flat, at the culms up to 30cm long and 3mm wide, at the vegetative shoots up to 20cm long and 1–1·5(–2)mm wide, in dry condition usually involute and 0·4–0·5mm diam., upper surface shortly pubescent, beneath glabrous, smooth, with prominent white veins; *panicle* exserted or ensheathed at the base, contracted, 6–20 (–35) × 1–2(–2·5)cm, the branches ascending to appressed, capillary, paired or in whorls of 3–5, sparsely setulose, up to 6cm long, with numerous spikelets; *spikelets* 5·5–7mm long, the glumes subequal, pale green or purple-tinged, lanceolate, glabrous, smooth, 3-nerved; *anthecium* 4·5–6mm long; *callus* 0·3–0·4mm long, bearded, scar circular, peripheral ring complete, regular; *lemma* membranous, pale, completely covered by diffuse 0·5–0·7mm long ascending hairs, with two 0·3–0·4mm long apical lobes; *awn* 20–25(–35)mm long, bigeniculate at 4–5mm and at about 8mm height, scabrous, columna twisted, with indistinct articulation at the base, seta straight; *palea* 1·5–2mm shorter than lemma, hairy in the upper $\frac{2}{3}$; lodicules dissimilar, the anterior ones 0·7–0·8mm long, linear-lanceolate, acute, sometimes at the apex with a long hair; *anthers* 3·5mm long, bearded; *ovary* with 2 styles; *caryopsis* about 3mm long, embryo 0·7mm long, hilum terminating just below the top; 2n = 24.

NW Himalayas, from E Afghanistan through N Pakistan to N India (Fig. 8).

A common, late flowering species of rock crevices from the upper montane to the alpine belt, from 2100–4000m, depending upon summer rain.

Specimens studied (55):

AFGHANISTAN. Parwan: NW of Kayli, 2100–2500m, *A.* 10786. Kunar: NW of Chawki, pass Darrah-e-Dewagal to D.-e-Mazar, 1700–1900m, *A.* 11121; Chapadarrah, Suleimanshah Darrah above Suleimanshah, Alpay in *A.* 10485. Logar: Spin Jumat vall., 2550m, *Lalande* R1032-E2 (W); Dobanday bassin, 3250m, *Lalande* 1077-E2 (W); Cacobay vall., 3100m, *Lalande* R1073-E2 (W). Paktya: Taraki pass, 2000m, *V.* 71.832 (M); Sikkaram, 3600m, *F.* 1756; Kurram vall., 2450m, *Aitch*, 775 (K, CAL); (3 more).

PAKISTAN. Swat: Mt. Ilam, 2450m, *St.* 24395 (W); beyond Bichigram, *St. & Rahman* 25043 (RAW). Hazara: Thandiani, Sidandi Hills, 2450m, *Nazir & St.* 27846 (K, W); betw. Chail Sar and Ganja Kandas, 2800m, *Burt & Kazmi* 1223 (E); Lower Tofa, 2150m, *St.* 23285 (NY); (4 more). Gilgit: Kichenganga vall., Badwan rocks, 2700m, *St.* 19552 (NY); Astor distr., *Duthie* 12492 (W). Baluchistan: Ziarat, 2700m, *Lace* 4057 (E); Karki Kach, 2750m, *Aslam* 17 (RAW).

INDIA. Kashmir: Above Gurais, *Duthie* 1261 (W); Tilel vall., 2850–3000m, *St.* 18596 (NY);

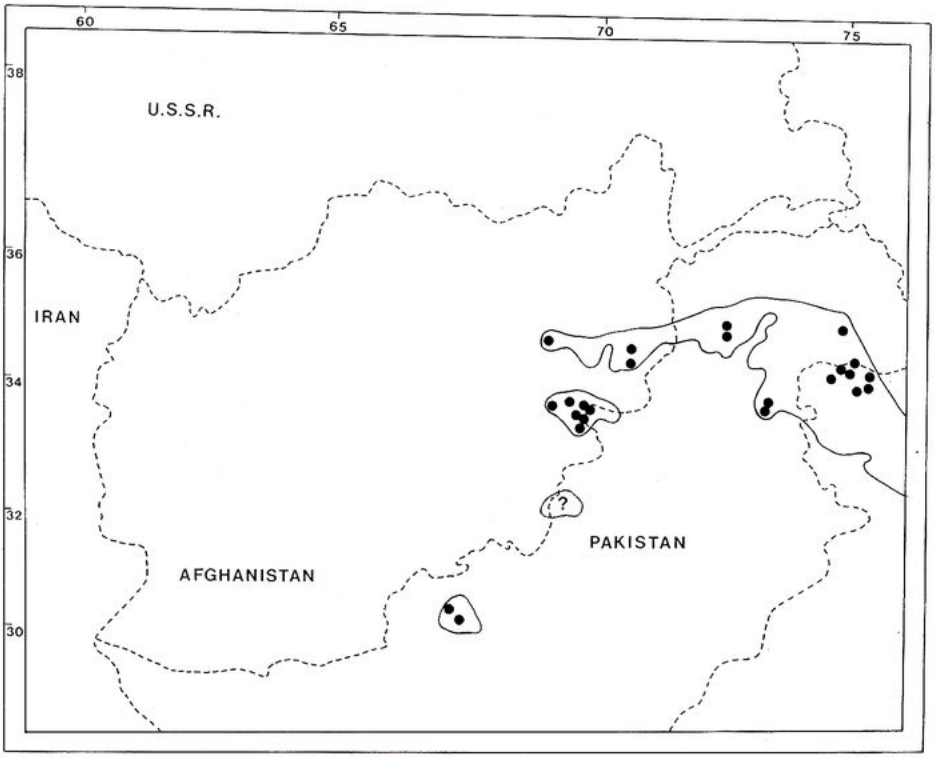

FIG. 8. Distribution of *Stipa jacquemontii*.

Zoji La pass, 3700m, *St.* 7597 (NY); (11 more). Himachal Pradesh: Lahul, Shipting Nullah, 3700m, *K.* 854 (NY); Spiti, Rangrik, 3800m, 4 viii 1972, *Bhattacharyya* (BSD); Koonawur (Kinnaur), 3000m, 1844, *Munro* (E); (3 more). Uttar Pradesh: Mussorie to Dhanaulti, Tehri road, 2300m, *St.* 21217 (K, NY); Jalki, *K.* 21286 (K); Nainital, Deopatta, 2800m, *Champion* 7730 (K). Unlocalized: NW Himalaya, Jaunsar, *Duthie* 15151 (BM, WU).

The species is morphologically and ecologically well delimited and exhibits only normal continuous variation.

6. St. duthiei Hook. f., Fl. Brit. Ind. 7:232 (1897).
Type: (India, Uttar Pradesh) Tehri Garwhal, Lekhus, below Srikanta, 12000–13000ft, 11 viii 1853, *Duthie* 273 (holo. K!).

Densely tufted, branching intravaginal, with some generative and numerous vegetative shoots; *culms* (30–)40–70(–100)cm, 3–4-noded, glabrous, smooth; *sheaths* glabrous, smooth, the upper ones sometimes scaberulous and purplish; *ligules* at the culm leaves 1–3mm long, acute to obtuse, usually somewhat setulose on the back and ciliolate at the margin, at the vegetative shoots 0·5mm long, truncate to obtuse, glabrous; *blades* flat, at the culms up to 10cm long, 1–2mm wide, at the vegetative shoots up to 45cm long and 1·5mm wide, in dry condition usually involute to convolute, 0·3–0·55mm diam., angular, upper surface shortly pubescent, beneath glabrous, smooth, towards the apex scaberulous, with prominent white veins; *panicle* exserted, loose, 10–20(–25) × 3–6cm, the branches ascending to spreading, capillary, solitary or paired, setulose to smooth, up to 8cm long, with up to 4 spikelets; *spikelets* 8–11mm long, the glumes subequal, lanceolate, obtuse, in the upper part aculeate, purplish with

white hyaline margins and tip, the lower 3–4-nerved, the upper 5–6-nerved; *anthecium* 5·5–7mm long; *callus* 0·5mm long, densely bearded, scar narrow elliptic, peripheral ring regular; *lemma* membranous, pale or purplish, on the back up to $\frac{1}{2}$ diffusely covered by 0·5mm long ascending hairs, at the flanks up to $\frac{2}{3}$, the upper $\frac{1}{3}$ including the 0·5–1mm long lemma lobes densely setulose; *awn* 13–20mm long, unigeniculate at 5–6mm, columna twisted, pilose with the hairs decreasing in length from 0·5mm at the base to 0·2–0·3mm at the geniculation, articulation at the base indistinct, seta straight, scabrous; *palea* equalling the lemma in length, sparsely pilose between the veins; *lodicules* dissimilar, the anterior ones 1·2–1·7mm long, oblong, the posterior 1·6–1·9mm long, sometimes bidentate, all or only the upper one pilose near the apex; *anthers* 3–3·5mm long, ochre-yellow, bearded; *ovary* with 2 styles; *caryopsis* not seen; 2n unknown.

Outer ranges of the Himalayas, known from Kashmir to Nepal.

In mats and *Rhododendron* shrublands of the alpine belt at around 4000m in regions with abundant summer rain.

Specimens studied (beside the type):
INDIA. Kashmir: Above Gulmarg, 4000m, *St.* 8188 (NY).
NEPAL. N of Barse, 3960m, *Stainton et al.* 3844 (BM, K, G).
BHUTAN. s. loc., *Griff.* 2694 (BM, G).

The species is known from just a few localities and its taxonomic position is difficult to assess. It is intermediate between two sections: the size of the callus and the outline of the scar point to sect. *Achnatheropsis* where it comes close, both geographically and in panicle structure, to *St. brandisii*; and with the pilose columna it resembles *St. regeliana*. On the other hand, with the membranous, apically lobed lemma and the delicate, unigeniculate awn it is probably better placed in sect. *Lasiagrostis*.

7. St. haussknechtii Boiss., Fl. Or. 5:501 (1884).

Syn.: *St. effusa* Mez, Repert. Spec. Nov. Regni Veg. 17:210 (1921). Type: Persia austro-orient., prov. Kerman, Kuh-e-Dschupar, in reg. alp. et subalp., 2900–3200m, 9 vi 1892, *Bornmüller* 4837 (holo. B†; iso. JE!, W!, WU!).

Type: In rupibus calcareis montis Sawers Persiae occid. supra Gulbar, 9000ft, vii 1868, *Haussknecht* (holo. G n.v.; iso. JE!, WU!).

In small, dense tufts, branching extravaginal, with some generative and few vegetative shoots; *culms* 60–80cm, 3–4-noded, glabrous, smooth; *sheaths* glabrous, smooth, with ciliolate margins; *ligules* at the culm leaves up to 0·5mm long, obtuse, glabrous, at the vegetative shoots up to 0·2mm long, truncate, glabrous; *blades* flat, 1·5–3mm wide, in dry condition convolute and 0·5–0·7mm diam., at the culms up to 17cm long, at the vegetative shoots up to 30cm, upper surface pubescent, beneath glabrous, smooth, with prominent white veins; *panicle* exserted, effuse, 20–30 × 10–18cm, the branches ascending or spreading, paired or in whorls up to 5, capillary, smooth, up to 15cm long, with up to 8 spikelets; *spikelets* 8–11mm long, the glumes subequal, lanceolate, hyaline, the lower 3–5mm longer, tapering into a long tip, setulose on the middle vein, the upper setulose only at the short tip, both 3-nerved; *anthecium* 5.6–6.5mm long; *callus* 0·5mm long, bearded, scar broad elliptic, peripheral ring dorsally flattened and somewhat protruding; *lemma* membranous, pale, densely

covered by diffuse stiff ascending hairs of 0·4–0·6mm, just below the corona almost glabrous, with two apical lobes of 0·3–0·4mm; *awn* 5–8cm long, bigeniculate at 7–9mm and at 14–17mm, but lower knee often indistinct, covered throughout by 0·1–0·25(–0·5)mm long setulose almost appressed hairs, columna twisted, articulated at the base, seta straight, falcate or slightly flexuose; *palea* about 1·5mm shorter than lemma, pilose; *lodicules* subequal, 0·9–1·1mm long, lanceolate, the apex obtuse, the posterior one slightly longer; *anthers* 3–4mm long, bearded; *ovary* with 2 styles; *caryopsis* 4·5–5mm long, embryo 1·2mm long, hilum reaching close up to the apex; 2n unknown.

Endemic to the Zagros Mts in S Iran, probably to be found in Iraq (Fig. 6).

Locally rather common in open dwarf shrublands and woodlands, from 1500–3000m.

Specimens studied (24):

IRAN. Kashan: Shamssar, in montis, 6 viii 1950, *Manoucheri* (IRAN). Esfahan: Kolah Ghazi National Park, c. 25km SE Esf., 1700–2000m, *R.* 46669 (W); Najafbad, 10km N, near Aboujeh, 1800m, vi 1965, *Asefi* in *Pa.* (G); (3 more). Fars: Mts above Persepolis, *W.* 771 (BG, K). Shiraz, Kuh Sabz Bushom, *Stapf* 1525 (W); Shiraz, Darab, 20 xi 1960, *Brown* (IRAN); (5 more). Kerman: Kuh Tagh Ali, 2000–2200m, *B.* 4834 (E, G, JE, K, W, WU); Bam, Dehbakri, 14 vi 1967, *Mirzagan* (IRAN); Gharatal Arab to Gharieyeh Shirinak, 2400–2600m, *Moussavi & Tehrani* (IRAN); (6 more). Hormozghan: Kuh-e-Genu, S side, 1620m, 5 v 1975, s. coll. (THR).

With its loose panicle and in length and shape of the awns this species superficially resembles *St. parviflora*, and some gatherings have been cited by Bor (1970) under that name. Nevertheless, the short, obtuse callus as well as the distinct lemma lobes indicate that it belongs to another group. Taking into account the short pubescence of the awn, Bor (1970) placed *St. haussknechtii* in sect. *Ptilagrostis*. In fact the growth form with extravaginal branching, the short indumentum of the awn, and the ecology and distribution are all in favour of its membership of sect. *Lasiagrostis* where it however takes a more isolated position, which is indicated also by the flattened and somewhat elongated dorsal section of the peripheral ring.

II. Sect. Aristella

Stipa sect. **Aristella** (Trin.) Hackel in Engl. & Prantl, Nat. Pflanzenfam. 2, 2:46 (1887).

Syn.: *Stipa* a. *Aristella* Trin., Fund. Agrost.: 110 (1820); *Aristella* (Trin.) Bertol., Fl. Ital 1:690 (1833); Subgen. *Aristella* (Trin.) Rouy, Fl. Fr. 14:98 (1913): *Achnatherum* sect. *Aristella* (Trin.) Tzvelev, Novosti Sist. Vyss. Rast. 9:55 (1972).

Achnatherum sect. *Paratrikeraia* Chrtek & Hadač, Candollea 24:162 (1969). Type species: *St. kurdistanica* Bor.

Type species: *St. bromoides* (L.) Doerfler.

Loosely tufted, non-rosulate perennials with extravaginal branching; culms at the base with numerous cataphylls, many-noded; *blades* plane, with isolated sclerenchyma strands causing prominent whitish ribs at the lower surface, especially in dried specimens; *glumes* lanceolate; *callus* obtuse, conical, less than 5mm long, scar narrow to broadly elliptic, peripheral ring almost regular; *lemma* at maturity becoming dark and chartaceous to coriaceous, covering the palea only marginally; *awn* straight, untwisted, scabrous; *ovary* 2-styled.

Mesophytes and moderate xerophytes of lowland woodlands and forest margins from the W Mediteranean to the Pamir Alai in the NE and the Zagros Mts in the east. All species of the section are present in the area, except *St. botschantzevii* (which was described recently by Tzvelev (1974) from the Alai Mts under the name *Achnatherum botschantzevii*), and *St. dregeana* Steudel from the mountains of E Africa. The section consists of an assemblage of closely linked species. 2n = 24, 28 (2 species). For callus characters see Fig. 1d.

8. St. litwinowiana Smirnow ex Pavlov & Lipsch., Sovetsk. Bot. 1934 (1):19 (1934).

Syn.: *Lasiagrostis litwinowiana* Smirnow ex Gamajun et al., Opred. elak. Kazakh.: 21 (1948); *Oryzopsis turcomanica* Roshev. in Fedtsch., Fl. Az. Ross. 12:184 (1916); *Achnatherum turcomanicum* (Roshev.) Tzvelev, Novosti Sist. Vyss. Rast. 11:6 (1974), non *St. turcomanica* Smirnow (1925).

Type: (USSR) Turcomania, in montibus supra Firuza pr. Chan Jaila, c. 5000ft (1200m), 18 vii 1897, *Litvinov.* 184a (holo. LE!).

In small tufts, with short creeping rhizomes, branching extravaginal, with few generative and even less vegetative shoots, at the base young shoots of the next season already present, 1–3cm long, arcuate, densely covered by scale-like cataphylls; *culms* 80–120(–150)cm, 4–6-noded, glabrous, leafy up to the panicle; *sheaths* glabrous, smooth; *ligules* at the culms up to 0·8mm long, at the vegetative shoots up to 0·6mm, truncate, often lacerated, glabrous; *blades* flat, in dry condition irregularly involute, at the culms up to 30cm long, 3–7mm wide, at the vegetative shoots shorter and only up to 4mm wide, upper surface pilose, beneath glabrous, smooth, with prominent white ribs; *panicle* shortly exserted or ensheathed at the base, contracted, very dense, 11–20 × 2–3cm, the branches erect, paired, setulose, up to 5cm long, with up to 20 spikelets; *spikelets* 5·5–7mm long, the glumes subequal, lanceolate, obtuse, acutish or tridentate, aculeate in the upper part, pale, 3-nerved; *anthecium* 4–5mm long; *callus* 0·3–0·5mm long, densely bearded, scar and peripheral ring not observed; *lemma* becoming brownish and chartaceous to coriaceous towards maturity, at the apex beside the insertion of the awn projecting into 2 minute, 0·1–0·2mm long rounded lobes, densely covered by 0·4–0·5mm long appressed hairs, below the apex only sparsely hairy; *awn* 10–15mm long, straight or slightly flexuose, untwisted or almost so, scabrous, articulated at the base; *palea* 0·3–0·5mm shorter than the lemma, sparsely pilose between the veins; *lodicules* dissimilar, the anterior ones oblong, obtuse, 0·4–0·6mm long, the posterior bilobed, narrower and slightly shorter; *anthers* 1–2mm long, unbearded, yellow; *ovary* 2-styled; *caryopsis* not seen; 2n = 24.

From Kopet Dagh in S Turkmenia and N Iran along the northern slopes of the Paropamisus and Hindukush in Afghanistan and the outer ranges of the Pamir Alai to the Karatau in Kazakhstan (Fig. 9).

A scattered but very characteristic species of the upper *Pistacia vera*- and the lower *Juniperus*-belt, from 1100–2300m.

Specimens studied:

USSR. Turkmenia: Kopet Dagh, Karanki near Ashkhabad, *Litw.* 2180 (W, WU); ibid., above Firuza, *Litw.* s.n. (W).

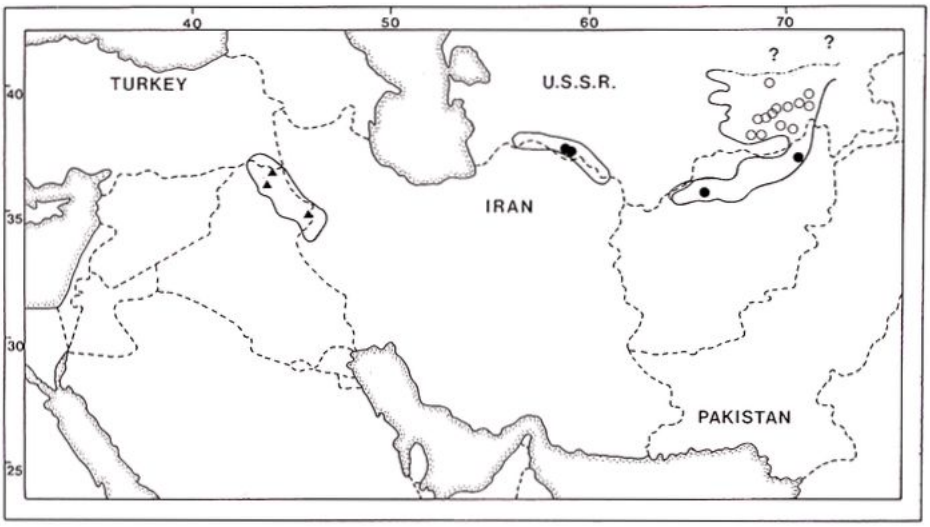

FIG. 9. Distribution of: ● *Stipa litwinowiana*; ▲ *St. kurdistanica*. ○ literature records of *St. litwinowiana* according to Ovczinnikov (1957).

AFGHANISTAN. Faryab: Maimana, Darra-e-Belcheragh, 1200m, *W.* 3776 (BG, E, K, W). Badakhshan: Yawarzan, 30km S of Qeshm, 1500m, *W.* 9289 (GO).

The species is very close to *St. kurdistanica* Bor from N Iran, especially in its peculiar growth form, which very much resembles *Piptatherum latifolium* Rosh. of the same region. However, as all the reproductive parts (glumes, anthecium, awn, anthers) are significantly smaller, the glumes are only 3-nerved and never acuminate and the apical lemma lobes are always distinct, the rank of a separate species is justified. Additionally, both species are separated geographically.

St. litwinowiana is somewhat intermediate between the sections *Aristella* and *Lasiagrostis,* especially between *St. kurdistanica* and *St. caragana,* as the awn is distinctly articulated at its base and the lemma is more chartaceous than coriaceous. In fact, in the specimens studied the change to a deeper brown colour of the lemma, which is so typical for other species of sect. *Aristella,* has never been observed. However, this may be a consequence of the comparatively young stage of the available material, and Smirnow (1935, p. 43) in his most thorough description mentions explicitly '...fructifera fuscescens'.

9. St. kurdistanica Bor, Taxon 16:68 (1967) (as nom. nov.).

Syn.: *Piptatherum longearistatum* Boiss. & Hausskn. ex Boiss., Fl. Or. 5:509 (1884); *Oryzopsis longearistata* (Boiss.) Rosh., Fl. Turkm. 1:82 (1932); *Lasiagrostis longearistata* (Boiss.) Rosh. & Nevski ex Rosh., Fl. SSSR 2:73 (1934) (excl. specs. from Middle Asia); *Achnatherum longearistatum* (Boiss.) Nevski, Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1, Fl. Sist. Vyss. Rast. 4:338 (1937) (excl. specs. from Middle Asia), non *St. longearistata* Steudel (1854).

Type: Iran, Kordestan, ad rupes calcareas montium Avroman et Schahu, 6000–9000ft, *Haussknecht* 1017 (holo. G n.v.; iso. JE!, W!).

In small tufts, with short, creeping rhizomes, branching extravaginal, with few generative and less vegetative shoots, at the base young shoots of the next season already present, 1–3cm long, arcuate, densely covered by scale-like cataphylls; *culms* 80–120cm, 5–6-noded, glabrous or shortly pubescent below the nodes, leafy up to the panicle; *sheaths* glabrous, smooth; *ligules* up to 0·5mm long, truncate, often lacerated, glabrous or bearded at the junction with the sheath; *blades* flat, in dry condition irregularly involute to convolute, at the culms up to 25(–30)cm long, 4–8mm wide, at the vegetative shoots shorter and narrower, upper surface pilose, beneath glabrous, smooth, with prominent white ribs; *panicle* shortly exserted, contracted, dense, 13–25 × 1·5–3cm, the branches erect, paired, setulose, up to 8cm long, with up to 12 spikelets; *spikelets* 7–8·5mm long, the glumes subequal, lanceolate, acuminate, aculeate in the upper part, setulose on the middle vein, pale, prominently 5–6-nerved, the lower one about 1mm longer; *anthecium* 5·3–6·2mm long; *callus* 0·5mm long, densely bearded, scar narrow-elliptic, peripheral ring broad, ± regular; *lemma* coriaceous, becoming brownish at maturity, apically without distinct lobes, up to 1mm below the apex densely covered by 0·5–0·6mm long appressed hairs, the uppermost part densely papillose-setulose, the apex surpassed by a loose coronula of 0·4–0·5 long hairs; *awn* 15–22mm long, straight or slightly flexuose, untwisted, scabrous, indistinctly articulated at the base; *palea* 1mm shorter than the lemma, pilose between the veins; *lodicules* dissimilar, the anterior ones oblong, obtuse, 1·2mm long, the posterior lanceolate with a rounded, sparsely pilose apex, only 1mm long; *anthers* 3–4mm long, unbearded, yellow; *ovary* with 2 styles; *caryopsis* 3·8–4·2mm long, embryo 1mm long, hilum terminating about 1mm below the apex; 2n unknown.

Endemic to the central part of the Zagros Mts, on both sides of the Iran/Iraq border (Fig. 9).

A rather rare, but typical component of the more mesic *Quercus*-woodlands, mostly reported from growing in the shade of trees, from 1300–2500m.

Specimens studied (beside the type):
IRAQ. Rowanduz: Kani Mazu Shirin, 1650m, *Haines* 2015 (E). Amadiya: Sarsang, 1350m, 15 viii 1959, *Haines* (E).

St. kurdistanica is closely related to *St. bromoides*, which is also present in the same area, but grows in probably less xeric and more open habitats. It differs by its taller habit with broader leaves and much stronger primordia of the next-season's shoots, denser panicles with up to 12 spikelets per branch (viz. 1–3), 5–6-veined glumes (viz. 3-veined glumes) and almost absent apical lemma lobes. The differences in the length of the glumes and anthecium mentioned by Bor (1970) are less reliable.

The species was originally placed in the genus *Piptatherum*, but because of the bearded callus it was soon recognized as a species of the genus *Stipa* s.l. by Soviet authors. Unfortunately they caused some confusion by including the allied *St. litwinowiana*. Also Bor (1970), who created the correct new name *St. kurdistanica*, cited specimens from N Iran and from Turkmenia. It was Tzvelev (1974) who first recognized the differences between the two species; these are discussed on p. 399.

10. St. bromoides (L.) Doerfler, Herb. Norm 34:129 (1897).

Syn.: *Agrostis bromoides* L., Mant. 1:30 (1767); *Aristella bromoides* (L.) Bertol., Fl. Ital. 1:690 (1833); *Lasiagrostis bromoides* (L.) Nevski & Rosh., Fl. SSSR 2:72 (1934); *Achnatherum bromoides* (L.) Nevski, Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1, Fl. Sist. Vyss. Rast, 4:223 (1937).

Stipa aristella L., Syst., ed. 12, 3:229 (1768). (nom. superfl.).

Type: Montpellier, *Gouan* 3 (lecto. LINN 94·6, selected here).

In small tufts, with short rhizomes, branching extravaginal, with numerous culms and few vegetative shoots, at the base young next-season shoots already present, up to 1cm long, arcuate, densely covered by scale-like cataphylls; *culms* 40–80cm, (3–)4-noded, glabrous, smooth; *sheaths* glabrous, smooth; *ligules* extremely short, at the culms up to 0·4mm long, at the vegetative shoots up to 0·2mm, truncate, lacerated, glabrous; *blades* flat, 15–20(–30)cm × 1·5–3mm, in dry condition convolute and 0·4–0·6mm diam., glaucous, upper surface pubescent to almost glabrous, beneath glabrous, smooth, grading into scaberulous towards the apex; *panicle* exserted, spike-like, thin, 12–20(–25) × 1(–2)cm, the branches erect, single or paired, smooth to sparsely setulose, up to 5cm long, with 1–3(–4) spikelets; *spikelets* 8–11mm long, the glumes subequal, lanceolate, glabrous, smooth, pale green to straw-coloured, 3-nerved, the upper slightly shorter; *anthecium* 6–8mm long; *callus* 0·3–0·5mm long, densely bearded, scar narrow-elliptic to ovate, peripheral ring ± regular; *lemma* pale to brownish, hardening at maturity, with 2 apical lobes of 0·4–0·5mm, up to $\frac{2}{3}$ diffusely covered by a loose indumentum of 0·5–0·7mm long appressed hairs, upper part papillose, grading into setulose towards the apex, sometimes even with a coronula, more rarely hairy throughout; *awn* 13–23mm long, straight, more rarely (in immature stage) slightly flexuose, untwisted, scabrous, indistinctly articulated at the base; *palea* 2·5–3mm shorter than the lemma, 2-nerved, up to $\frac{1}{2}$ pilose between the veins, the apex setulose; *lodicules* dissimilar, the anterior ones oblong, obtuse, about 1·2mm long, the posterior more lanceolate, acute, somewhat longer; *anthers* about 5mm long, unbearded, yellow; *ovary* with 2 styles; *caryopsis* 5mm long, embryo 1mm long, hilum terminating 0·5mm below the apex; 2n = 28. For callus characters see Fig. 1d.

Almost circum-Mediterranean; along coastal N Anatolia to the Caucasus, Crimea, coastal N Iran; from Syria along the lower mountains through SE Anatolia to N Iraq (Fig. 10).

A common and characteristic species of the Mediterranean area, growing in evergreen woodlands, *Pinus brutia*-forests and seral dwarf-shrublands, marginally entering also submediterranean areas; in the S and W up to 1700m; in the N only in the lowlands.

Specimens studied (49):

TURKEY. Çanakkale: Dardanelles, *Sint.* 1225 (GOET). Istanbul: Prinkipo 31 v 1891, *Aznavour* (G); above Kirfez, 15 viii 1937, *Post* (G). Bilecik: Bilecik, gorge near station, 300m, *D. & Coode* 36513 (E, G). Izmir: Bornova, Schwarz 749 (JE). Manisa: Sardis ruins, 120m, *Buttler & Erben* 17237 (M); near Akhisar, *Buttler* 13559 (M). Isparta: Dedegöl Dag in Siitçüler distr., 1200–1400m, *D.* 15918 (E). Amasya: Near Amasya, 400–600m, *B.* 322 (JE). Çoruh: Lomaschen near Artvin, *Woronow* 256 (H). Antalya: NE of Zerk-Beskonak, 750m, *Ayaşligil* 218 (GOET). Içel: Near Anamur, v 1872, *Peronin* (G); Cilician Gates. 27 vii 1855. *Balansa* (G); Güllek Depe, 1200m, *Siehe* 644 (G). Seyhan: Soğukuluk E of Porzanti, 1000m.

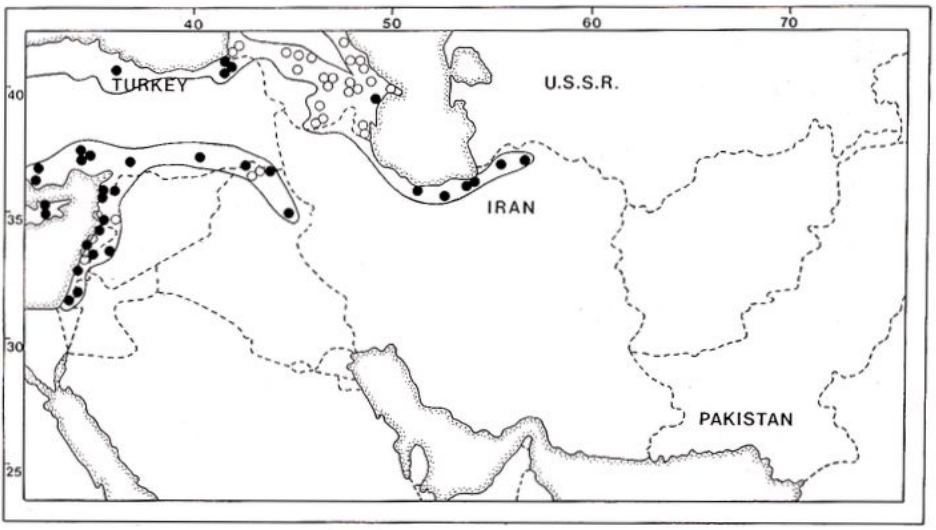

FIG. 10. Distribution of *Stipa bromoides*. ○ literature records from various sources.

Markgraf s.n. (ZÜ); Pozanti, 5km E, 1100m, *Aberd. Univ. Amanus Exped.* A 242 (E). Maraş: Near Maraş, 15 vii 1869, *Hausskn.* (JE); J. Akra, 300–600m, *Haradjian* 3026 (G).

CYPRUS. Prodromo, *Sint.* 660 (GOET); ibid., 1700m, *D.* 1786 (E); Jaila, 500–700m, *D.* 3613 (E); Mt. Halefka, Kyrenia distr., 700m, *D.* 1755 (E).

SYRIA. Ain Halekim, Nussairy Mts, 700–900m, *Haradjian* 3447 (G); Duma, 1300m, 30 vi 1865, *Post* (E, NY).

LEBANON. Tripoli, 14 vi 1869, *Blanche* (E, JE); near Sir, 930m, 8 vii 1934, *Bot. Dept.* (HUJ); (4 more).

PALESTINE. Mt. Carmel, 200m *Meyers & Dinsmore* 6073 (E, G); Motsa near Jerusalem, *Amdursky* 103 (E, G, NY); Bet Guvrin, 290m, *Dinsmore* 4073 (E); (2 more).

IRAQ. Amadiya, 1100m, *A.* 2307 (W); Jeb. Khantur, 1200m, *R.* 10761 (W); Kopi Qara Dagh, 1500m, *Haines* 1144 (E).

IRAN. Mazanderan: Chalus vall., 20km S Ch., 200m, *F.* 14074; Haraz vall. above Emarat, 500m, *W.* 1501 (BG, E, W). Hassanabad, 8 vi 1965, *Sabeti* (IRAN); (3 more). Gorgan: Betw. Nodeh a. Shahrud, 700m, *Gauba* G-11 (W); Moh. Reza Shah National Park, betw. Tang-e-Rah a. Tang-e-Gol, 400–600m, *R.* 52578 (W); ibid., 420–470m, 4 vi 1975, *Termé* (IRAN).

USSR. Azerbaijan: Gobestan, 35km SW Baku, *F.* 13500.

This well-defined species is best characterized by its narrow, spike-like panicle and straight awns. It is rather polymorphic in leaf indumentum, length of the glumes, of the anthecium and the awn. Most striking is the variability of the lemma indumentum, which is hairy throughout in the material from Rhodos, hairy in the lower $\frac{2}{3}$ without coronula in most specimens, and equipped with a distinct coronula in some samples from Lebanon.

In LINN there are two specimens of *St. bromoides,* of which no. 94.6 has been chosen as the lectotype. Linnaeus has written 'Stipa' on the front of the sheet and 'Gouan 3' immediately beneath the specimen. This is in accordance with the statement 'Habitat Monspelii. D. Gouan' in the description of the species, as already suggested by Smith in his statement on the front side, 'certe Agrostis bromoides'. To the name 'Stipa' in Linnaeus' hand Smith has also added 'aristella ex descr.'. The second

specimen is no. 84.4 with the name 'bromoides' written by Linnaeus and the addition by Smith of 'Gr. bromoides angustifolium glabrum locustis majoribus longius aristatis. Scheuchz. Agrost. 292.H.Sherard.'.

III. Sect. Orthoraphium

Stipa sect. **Orthoraphium** (Nees) Hackel in Engl. & Prantl, Nat. Pflanzenfam. 2, 2:46 (1887).

Syn.: *Orthoraphium* Nees, Proc. Linn. Soc. London 1:94 (1841); *Stipa* § *Orthoraphium* (Nees) Steudel, Syn. Pl. Glum. 1:131 (1855).

Type species: *St. roylei* (Nees) Mez.

Similar to sect. *Aristella*, but differing by intravaginal branching, lack of next-season shoots and presence of prominent, deflexed spinules at the apex of the lemma. The section includes only one alpine species of the outer Himalayas. The structure of the lemma, the callus characters and the shape of the awn indicate close relationships both to sect. *Aristella* and *Lasiagrostis*; 2n unknown.

11. St. roylei (Nees) Mez, Fedd. Repert. Spec. Nov. Regni Veg. 17:207 (1921).

Syn.: *Orthoraphium roylei* Nees, Proc. Linn. Soc. London 1:94 (1841); *Stipa orthoraphium* Steudel, Syn. Pl. Glum. 1:131 (1855).

Type: (India, W Himalaya) Kadarkanal, *Royle* (holo. LIV n.v., Kew Neg. no. 18604!, iso. prob. K!).

Loosely tufted, with the creeping rhizome persisting for several years, branching intravaginal, with few generative and vegetative shoots; *culms* 35–70cm, 3–4-noded, glabrous, smooth, completely covered by the sheaths; *sheaths* glabrous, smooth, ciliate at the margins; *ligules* at the culms up to 2·2mm long, at the vegetative shoots up to 1mm, truncate to obtuse, ciliate at the margin; *blades* flat, 2–3·5mm wide, only in dry conditions involute, at the culms up to 20cm long, at the vegetative shoots up to 35cm, upper surface densely pubescent, beneath glabrous, smooth, towards the apex scabrous; *panicle* at the base ensheathed, contracted, 10–20 × 1–1·5cm, the branches erect to ascending, the lower ones paired, up to 5cm long, smooth, with 1–3 spikelets; *spikelets* 7–10mm long, the glumes subequal, lanceolate, pale green or purple tinged, with hyaline margins and tip, glabrous, smooth, 3-nerved, the lower one 1–2mm shorter than the upper; *anthecium* 7·5–12mm long; *callus* 0·4–0·5mm long, bearded, scar broadly elliptic, peripheral ring regular; *lemma* pale, becoming brownish at maturity, chartaceous, in the lower $\frac{1}{4}$–$\frac{1}{2}$ loosely covered by diffuse ascending to appressed hairs of 0·5–1mm, at the apex with 2–6 deflexed spinules of 1–2mm, eventually with a coronula of unequal stiff hairs of up to 1mm; *awn* 11–17mm long, almost straight or indistinctly unigeniculate, slightly twisted in its lower part, scabrous or at the base covered by stiff hairs up to 0·7mm long, without distinct articulation; *palea* 3–3·5mm shorter than the lemma, up to $\frac{1}{2}$–$\frac{1}{3}$ pilose between the veins; *lodicules* dissimilar, the anterior ones oblong, obtuse, 1·5–1·8mm long, the posterior distinctly longer and narrower, acute, sometimes with scattered, thick-walled hairs on the surface; *anthers* 2–

3mm long, unbearded; *ovary* with 2 styles; *caryopsis* 5–6mm long, embryo 1mm long, hilum reaching close up to the top; 2n unknown.

Outer ranges of the Himalayas from Kashmir through Nepal and Sikkim to the Naga Hills.

A component of the undergrowth in *Abies* forests, *Rhododendron* shrublands, and in alpine mats; from 3500–4000m, probably rather common.

Specimens studied (22):
INDIA: Kashmir: Pagu, 1852, *Thomson* (E). Him. Pradesh: Chamba, Sara, 3700m, *Clarke* 24145 (BM, CAL). Utt. Pradesh: Garwhal, Kukina Khal, 3600m, 5 x 1963, *Bhattacharyya* (BSD); ibid., Bundar vall., 3700m, 13 x 1963, *Bhattacharyya* (BSD).
NEPAL. NW of Gurjakhani, 3500m, *Stainton* 3685 (BM, G); Arun-Tamar watershed S of Topke Gola, 4000m, *Stainton* 1728 (BM, G); Nepal, *Wallich* 3795 (BM, WU).
SIKKIM. Jongri, 4800m, *Clarke* 25906 (G); Porie Phoolie, 4800m, 1888, *King's coll.* (G); Kalagohri above Darjeeling, 3300m, *Gamble* 8420 (CAL); Chakung Chu, 3300–3700m, *Smith* 3967 (CAL). E Himalaya, s. loc., *Biswas* (NY).
ASSAM. Naga Hills, 3300m, *Clarke* 41350 (BM); ibid., Japoo, 3000m, *Bor* 6406 (K).

St. roylei looks very much like *St. bromoides*, but it differs from all other species of the genus in the long deflexed spinules at the upper part of the lemma body. That character hardly justifies generic separation. In maintaining the genus *Orthoraphium*, Trinius & Ruprecht (1842) repeated the statement of Nees, 'Styli ... basi contigui' (p. 85), but in fact the styles are as deeply separated from each other by a cleft as in the species of sect. *Aristella*. Hara (1966) mentioned two localities for the Eastern Himalayas from unusually low altitudes of 2000–2800m, but I have not seen any specimens.

IV. Sect. Ptilagrostis

Stipa sect. **Ptilagrostis** (Griseb.) Hackel in Engl. & Prantl, Nat. Pflanzenfam. 2, 2:46 (1887).
Syn.: *Lasiagrostis* § *Leptanthele* Trin. & Rupr., Spec. Gram. Stip.: 87 (1842); *Ptilagrostis* Griseb. in Ledeb., Fl. Ross. 4:447 (1853).
Type species: *St. mongholica* Turcz. ex Trin.

Similar to sect. *Lasiagrostis*, but differing in the completely plumose awns and rich intravaginal branching. Mesophytes and moderate xerophytes of alpine environments from the E Pamir and the outer ranges of the Himalayas to NE Siberia and W United States. The section consists of a group of closely allied species, which have probably derived from *Lasiagrostis*-like ancestors as an alpine offshoot; 2n = 22 (2 spp.). For callus characters see Fig. 1e.

12. St. concinna Hook. f., Fl. Brit. Ind. 7:230 (1896).
Syn.: *Ptilagrostis concinna* (Hook. f.) Rosh., Fl. SSSR 2:75 (1934).
Type: Sikkim-Himalaya, Tibetan region, 14000–16000ft (4250–4900m), 1861, *Hooker* (holo. K!; iso. G!, GOET!, LE n.v.).

In small, dense tufts, branching intravaginal, with few generative and numerous vegetative shoots; *culms* (5–)10–20(–25)cm, 2–3-noded, glabrous, smooth, often purplish; *sheaths* glabrous, smooth; *ligules* at the culms 1–1·5mm long, at the vegetative shoots 0·2–0·5mm, rounded to truncate, glabrous or setulose; *blades* flat, at the culms up to 2cm long, at

the vegetative shoots up to 10cm long, 0·8–1mm wide, in dry condition conduplicate to convolute, 0·3–0·5mm diam., angular with prominent white veins at the lower surface, glabrous and smooth on both surfaces; *panicle* usually exserted, contracted, 2·5–5 × 1–2cm, the branches erect to ascending, paired or solitary, smooth or sparsely setulose, with up to 4 spikelets, the lowermost ones usually subtended by 5mm long hyaline bracts; *spikelets* 5–7mm long, the glumes subequal, broad lanceolate, acute, purplish with the margins and tip hyaline, aculeate at the apex, 3-nerved; *anthecium* 3–4·5mm long; *callus* 0·3–0·4mm long, densely bearded with hairs up to 0·6mm, rounded, scar circular, peripheral ring regular; *lemma* membranous, purplish, apically with two 0·8–1mm long acute lobes, in the lower $\frac{1}{3}$–$\frac{1}{2}$ loosely covered by diffuse 0·2–0·4mm long hairs, the upper third densely aculeate, the lemma lobes sparsely hairy at the margins, otherwise densely setulose; *awn* 8–13mm long, bigeniculate at 2–3 and at 4–6mm, but lower geniculation often indistinct, hairy throughout, columna twisted, without articulation at the base, the hairs 1–1·5mm long, seta straight, with the hairs gradually becoming shorter towards the apex; *palea* equalling the lemma in length and indumentum; *lodicules* dissimilar, the anterior ones 0·75–0·8mm long, obliquely ovate, acute, the posterior 1·3–1·5mm long, linear, acute, all glabrous; *anthers* 1·5–2·5mm long, bearded, yellow; *ovary* with 2 styles; *caryopsis* 2·5mm long, embryo 0·5mm long, hilum reaching up to the top; 2n unknown.

From the Pamirs in one line to the Tianshan, in another along the outer ranges of the Himalayas to Assam and probably further east.

A common component of alpine mats in regions with sufficient summer rain, from 4200–4600m.

Specimens studied:
INDIA. Kashmir: Mt Apharwat above Gulmarg, 4400m, *Polunin* 56/207 (BM, E); ibid., 4300m, *St.* 14769 (NY); ibid., 4600m, *St.* 10372 (NY); ibid., 4300–4600m, *St.* 14817 (NY).
SIKKIM. (the isotypes).

The species is close to *St. mongholica*, but differs by its more contracted panicle, smaller anthecia, shorter ligules and smooth leaves. Furthermore, it is separated ecologically by growing in humid alpine environments of the outer Himalayas only. According to Tzvelev (1974), the populations from the Pamir to the Tianshan belong to subsp. *schischkinii*, which differs by having glabrous or almost glabrous anthers and somewhat more scabrous leaves.

13. St. mongholica Turcz. ex Trin., Mém. Acad. Imp. Sci. St. Pétersbourg, Sér. 6, Sci. Math. 4, pt. 2, Sci. Nat. 1:42 (1886).

Syn.: *Lasiagrostis mongholica* (Turcz. ex Trin.) Trin. & Rupr., Spec. Gram. Stip.: 87 (1842); *Ptilagrostis mongholica* (Turcz. ex Trin) Griseb. in Ledeb., Fl. Ross. 4:447 (1853); *Achnatherum mongholicum* (Turcz. ex Trin.) Ohwi, J. Jap. Bot. 17:403 (1941).

St. tibetica Mez, Repert. Spec. Nov. Regni Veg. 17:207 (1921); *Ptilagrostis tibetica* (Mez) Tzvelev, Rast. Centr. Az. 4: 45 (1968); Type: India. Kashmir, Ladakh (W Tibet), reg. alp., *Thomson* s.n. (holo. B†, lecto. selected by Tzvelev LE!).

Type: (USSR) Sibiria baicalensi in pratis humidis ad torrentem Dschiginai in Oxam influentem, 1830, *Turczaninow* (holo. LE n.v., iso. GOET!).

Densely tufted, branching intravaginal, with few generative and numerous vegetative shoots; *culms* (10–)15–50(–60)cm, 3-noded, leafy throughout, glabrous, smooth, often purplish; *sheaths* glabrous and shining or faintly puberulent, smooth, the upper one often scaberulous and purplish; *ligules* at the culm leaves 1·5–3mm long, at the vegetative shoots 0·5–2mm long, acute, glabrous, the back smooth or setulose; *blades* usually convolute, setaceous, angular, with prominent white veins, at the culms up to 2cm long, at the vegetative shoots up to 15cm long, 0·2–0·3mm diam., the inner surface papillose to faintly puberulent, beneath (outer surface) glabrous, smooth, or scabrous by asperities on the veins; *panicle* shortly exserted or ensheathed at the base, loose, (5–)7–12 (–16) × 3–5(–6)cm, the branches spreading, filiform, flexuose, paired or solitary, smooth or almost so, up to 4cm long, with up to 3(–5) spikelets; *spikelets* (4–)4·5–6(–7·5)mm long, the glumes subequal, broad lanceolate, acute, the back up to $\frac{1}{2}$ or almost completely purplish, the margins and tip hyaline, near the apex aculeate to setulose, both 3-nerved or the lower 5-nerved; *anthecium* 4–6mm long; *callus* 0·3–0·4mm long, bearded, scar circular to broadly elliptic, peripheral ring regular; *lemma* membranous, purplish, at the insertion of the awn with 2 acute bearded lobes of 0·5–1 (–1·3)mm, on the back up to $\frac{1}{2}$ or almost completely covered by a loose, diffuse indumentum of 0·4–0·6mm long ascending hairs, the upper part often only densely aculeate to setulose; *awn* 11–22(–25)mm long, bigeniculate at 2–3 and 5–8mm, but lower geniculation often indistinct, densely pilose throughout with the hairs decreasing from (1–)1·3–1·5mm near the base to 0·6–0·7mm at the second geniculation and 0·4mm at the tip of the seta, columna twisted, without articulation at the base, seta more or less straight or curved; *palea* equalling the lemma in length, with similar, but sparser indumentum; *lodicules* dissimilar, the anterior ones 0·7–1·2mm long, lanceolate, obtuse to acutish or obliquely oblong, the posterior 1–1·5mm long, more linear, acute, all distinctly pilose near and at the apex, particularly the posterior one; *anthers* 1·7–3mm long, unbearded, with a single apical hair or bearded by a tuft of short hairs, yellow, exserted; *ovary* with 2 styles, separated by a cleft; *caryopsis* 2–3mm long, embryo 0·6mm long, hilum almost reaching the top; 2n = 22 (subsp. *mongholica*). For callus characters see Fig. 1e.

From the Inner Pamir Alai and E Pamir NE to E Siberia; through the Karakorum and the inner ranges of the Himalayas to N India, Nepal, Sikkim and Bhutan.

A very common and typical component of alpine steppe-communities from 3000–5000m in semi-arid, summer-rain regions.

Specimens studied (7):

AFGHANISTAN. Badakhshan, Wakhan: Darya-e-Birgula e-Jelga Chelab, NW of Chaqmaqtin, 4400m, *A.* 7578.

INDIA. Kashmir, Ladakh: Tsakzhun Tso, 4950m, *K.* 2401 (NY); Shushal, 4700m, *K.* 2445 (NY).

NEPAL. Near Chalike Pahar, 4700m, *Stainton et al.* 3163 (BM, G).

SIKKIM. Reg. alp., *Hook.* s. loc. (G, GOET); Llourk, 4900m, *Smith & Cave* (CAL).

CHINA. On route at M. Shuotsu, 9 VIII 1931, *Desoulavy* (G).

The specimens seen differ in a few minor morphological characters. So the collections from Nepal and a few, but not all from Ladakh have smooth leaves, whereas others from Ladakh and those from the Pamir

and again from Sikkim have scabrous leaves. Furthermore, the plants from Nepal and from further E have small anthers of 1·7–2mm only, which are usually bearded, and the specimens collected W of Nepal have longer anthers of 2·5–3mm, which are glabrous or have just one single apical hair. On the other hand, variation in length of anthecia and awns, in the extension of lemma indumentum and in length of the plume at the awn is small. With the limited material at hand, and broad gaps in between the localities, I hesitate to use any infraspecific grouping or to follow other authors to split *St. mongholica* into several admittedly closely related species.

Recently Tzvelev (1968) revived *St. tibetica* Mez (under the name *Ptilagrostis tibetica*) as a vicariant of the more northern *St. mongholica* on the basis of a somewhat shorter awn (9–16mm instead of 15–25mm), the shortly pubescent and not almost glabrous upper part of the lemma, and of slightly longer glumes (5–7·5mm instead of 4·5–6mm). By using a higher magnification, typical material of *St. mongholica* shows the same type of lemma indumentum, just a little bit shorter, and with respect to the length of the awns and glumes intermediates do occur. According to the diagnosis, the type of *St. tibetica* has an awn of 15mm and specimens seen from Ladakh have a shorter awn combined with short glumes of only 4·5–5·5mm. Therefore, even varietal rank for *St. tibetica* seems doubtful to me, even with the limited material at hand. Certainly the question can be dealt with more competently, when more collections become available.

V. Sect. Achnatheropsis

Stipa sect. **Achnatheropsis** Tzvelev, Novosti Sist. Vyss. Rast. 9:56 (1972).

Syn.: *Stipa* ser. *Sibiricae* Rosh., Fl. SSSR 2:84 (1934). Type species: *St. sibirica* (L.) Lam.

Stipa sect. *Regelia* Tzvelev, Novosti Sist. Vyss. Rast. 11:13 (1974). Type species: *St. regeliana* Hackel.

Type species: *St. sibirica* (L.) Lam.

Branching, leaves and glumes as in sect. *Lasiagrostis*; callus obtuse or acutish, 0·3–1mm long, conical, scar narrow-elliptic, peripheral ring regular or dorsally flattened and slightly protruding; lemma as in sect. *Lasiagrostis*, but without apical lobes; awn up to 4cm long, bigeniculate; 2n = 22, 24 (3 species). For callus characters see Figs 1f, 2a.

Mesophytes and moderate xerophytes from the Hindukush and Pamir Alai to E Asia and N America, from lowland woodland and steppes up to alpine environments. The species of sect. *Achnatheropsis* form a group, which is intermediate between sects *Aristella* and *Stipa*.

14. St. brandisii Mez, Repert. Spec. Nov. Regni Veg. 17:207 (1921).

Syn.: *St. subeffusa* Ohwi, Acta Phytotax. Geobot. 17:15 (1957). Type: Pakistan, (Hunza) Inter Minapin et Chalt, 22 viii 1955, *Nakao* (holo. KYO n.v., iso. KYO!).

Type: (India) W Himalaya, (Kulu) Kulla, 1876, *Brandis* (holo. K!).

In loose, large tufts, branching extravaginal, with numerous culms and some vegetative shoots; *culms* (70–)80–120cm, 3–4-noded, glabrous,

smooth; *sheaths* glabrous, smooth; *ligules* at the culms up to 1mm long, at the vegetative shoots up to 0·2mm long, truncate, glabrous; *blades* flat, up to 40cm long, 4–8(–10)mm wide, upper surface with shallow grooves, almost glabrous or pilose by scattered 0·5mm long hairs, towards the apex sometimes scaberulous, beneath glabrous, smooth; *panicle* exserted, 10–30 × 4–8cm, the branches ascending, usually paired, setulose, up to 8cm long, with numerous spikelets; *spikelets* 7–10mm long, the glumes subequal, lanceolate, pale green with hyaline margins and tip, glabrous, eventually setulose on the middle vein, 3-nerved; *anthecium* (5·5–)6–7·5mm long; *callus* 0·3–0·4mm long, bearded, scar narrow-elliptic, peripheral ring regular; *lemma* somewhat hardening and darkening at maturity, diffusely covered by 0·5–1mm long ascending hairs surpassing the apex; *awn* (10–)12–15(–18)mm long, bigeniculate with the lower geniculation usually indistinct and the upper at or just below the middle, scabrous throughout, columna twisted, articulated at the base, seta almost straight; *palea* 1–1·5mm shorter than lemma; *lodicules* dissimilar, the anterior ones 0·6–0·7mm long, the posterior about 0·4mm, all bidentate, oblong, glabrous; *anthers* 4–5mm long, densely bearded, yellow; *ovary* with 2 styles; *caryopsis* 4·5–5·5mm long, embryo 1–1·2mm long, hilum reaching up to the top; 2n unknown. For callus characters see Fig. 1f.

From E Afghanistan along the Himalayas to Nepal and S China, at least up to Yunnan (Fig. 11).

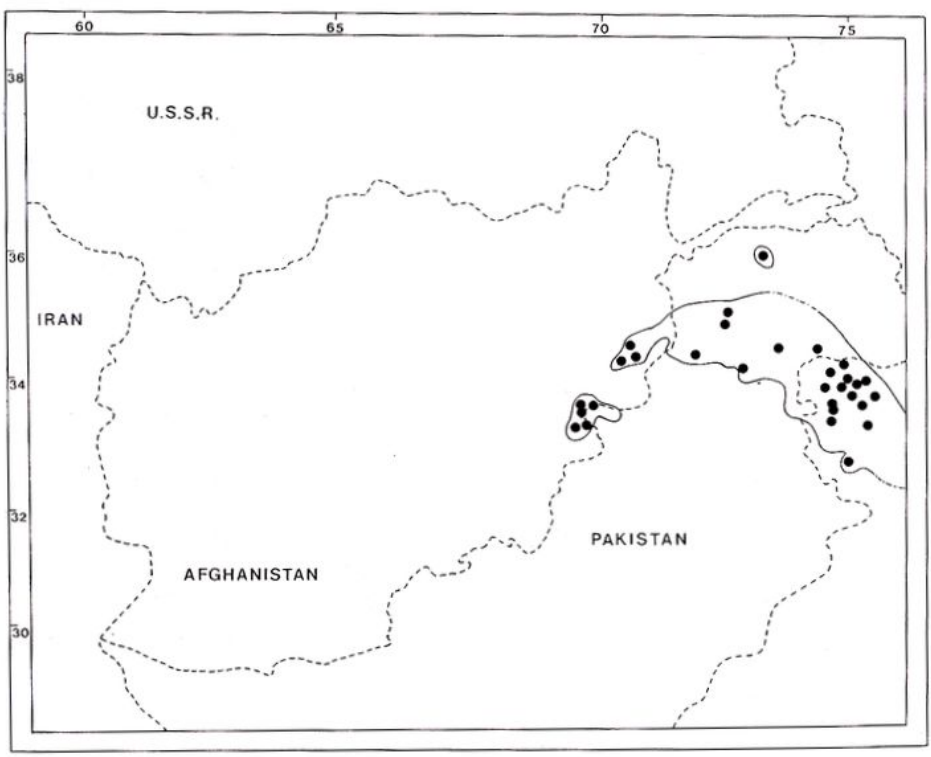

FIG. 11. Distribution of *Stipa brandisii*.

Restricted to the monsoon-influenced mountain ranges at altitudes of 1500–3500m; in evergreen oak forests (*Quercus dilatata*, *Q. semecarpifolia*) and mesophilous coniferous forests, especially in clearings and at forest margins, often in luxurious growth; favoured by the fact that it is not grazed by cattle and sheep.

Specimens studied (79):

AFGHANISTAN. Paktya: Taraki pass, 2000m, *V.* 71.832a; Kotgay, Mandaher forest, 2800m, *F.* 6936; Kurram (evt. Pakistan side), *Aitch.* 753 (K), 897 (K, CAL); (4 more). Kunar: Ashpi pass, *Neub.* 1042 (W). Nangarhar: Dar-e-Nur near Lamatak *A.* 9472.

PAKISTAN. Kurram vall., *Harsukh* 15504 (K). Swat: Bahrein, 2000m, *St.* 2449 (K, NY); ibid., *Rodin* 5580 (NY). Gilgit: Yasin, 2600m, *Ogino* 354, 380, 382 (all KYO); Dawalgan, betw. Gupis a. Yasin, 2350m, *Ogino* 461 (KYO); Gilgit, *Giles* s.n. (CAL). Baltistan: betw. Baltal a. Nunner, *Schlagintweit* 4808 (M). Hazara: Black Mts, fort near Kalri Galli, 2450–2750m, *Duthie* 7609 (K, W); hill terr. near Khator, 2000m, *Burtt* 1214 (E); Bhonja Kagán, 31 VII 1897 *Inayat* (CAL); (8 more).

INDIA. Kashmir: Sind vall., 1850–2150m, *Duthie* 11455 (W); Tangmarg, 2000m, *Polunin* 56/333 (E, K); Nil Nag in Pir Panjal Rge., 2200m, *St.* 23080 (K, NY); (20 more). Him. Pradesh: Chamba betw. Salgraon a. Margraon, 2800m, *Lace* 2011 (E); Lahul, Rassi, Upper Chenab, 3000m, 15 viii 1971, *Bhattacharra* (BSD); Kumaun, Kali vall. near Garbeyang, *Duthie* 3505 (CAL); (7 more).

NEPAL. Above Chong, near Tibrikot, 2600m, *Polunin et al.* 3314 (BM, G); Annupurna Himal, Manang, 3850m, *Wraber* 502 (BM); Tukucha, Kali Gandaki, 3500m, *Stainton et al.* 7363, 7813, 7837 (all BM).

CHINA. SE Tibet, Mira La, *Ludlow et al.* 6018 (BM). Yunnan, Mekong vall., 1900–2000m, *Hand.-Mazz.* 8466 (E); Litiping Rge. E of Weihsi, *Rock* 11576 (E).

Most authors including Hara et al. (1978) and Cope (1982) identified *St. brandisii* as *St. sibirica*, and certainly both species are closely allied. However, careful investigation of *St. sibirica* material from the Alai Mts and from the region of Lake Baical resulted in some substantial differences and justifies the separation of a distinct species (see Table 6), which with its shorter and rounded callus agrees with the sect. *Achnatherum*. Even more puzzling is the relation to *St. extremiorientalis* Hara, which has the same callus structure but significantly longer awns and glumes, and short but distinct apical lemma lobes. Whereas Mez (1921) did not discuss the relationships of his new species, Ohwi (1957) when describing *St. subeffusa* recognized the differences to the E Asiatic *St. pekinensis*, which according to Tzvelev (1974, 1976) is identical with

TABLE 6

Some distinguishing characters of *St. brandisii* Mez, *St. sibirica* (L.) Lam. and *St. extremiorientalis* Hara.

	St. brandisii	St. sibirica	St. extremiorientalis
Panicle	effuse	contracted	effuse
Glumes, length (mm)	7–10	8–10	11–13
Glumes, colour	pale	purplish tinged	pale or purplish tinged
Anthecium, length (mm)	5·5–7·5	6–7	6·3–8·5
Callus, length (mm)	0·3–0·4	0·5–0·7	0·3–0·5
Callus, base	rounded	pointed	rounded
Lemma, length of hairs (mm)	0·5–1·0	1–2	0·6–1·0
Lemma, apical lobes	absent or very short	absent	distinct
Awn, length (mm)	10–17(–18)	14–20	20–25
(specimens investigated)	(25)	(4)	(3)

St. extremiorientalis. However, the type of *St. subeffusa* agrees in all respects with *St. brandisii*.

The repeatedly reported poisonous character of this grass to stock (Hance, 1877; Aitchison, 1880) is caused by cyanogenic glycosides.

15. St. regeliana Hackel, Akad. Wiss. Wien, Sitzungsber., Math.-Naturwiss. Kl., Abt. 1, 89:130 (1884).
Type: (USSR Kirgisia) Issikul, Musart, 2300–2650m, viii 1877, *Regel* (holo. W!).

Densely tufted, branching intravaginal, with few culms and numerous vegetative shoots; *culms* 30–40cm, 2–3-noded with all nodes basal, without leaves in upper half, glabrous, smooth; *sheaths* glabrous, smooth; *ligules* at the culm leaves and at the vegetative shoots 3–4mm long, acute, glabrous; *blades* usually convolute, 0·4–0·5mm diam., at the culms up to 5cm long, at the vegetative shoots up to 15cm, on the upper surface shortly pubescent, beneath scabrous by small asperities above the veins; *panicle* contracted 9–11 × 1–1·5cm, the branches erect, glabrous, in 2–4, up to 3·5cm long, with up to 3 spikelets; *spikelets* 8–9(–10)cm long, the glumes subequal, ovate to broadly lanceolate, acutish, purplish with the margins in the upper half and the tip hyaline, glabrous, smooth or slightly setulose near the apex, both 5-nerved; *anthecium* 5–5·5mm long; *callus* 0·7–1mm long, acute but not curved, conical, densely bearded by up to 1mm long stiff hairs, scar narrow-elliptic, peripheral ring dorsally flattened and moderately elongated; *lemma* at maturity becoming brown and coriaceous, up to the top loosely covered by diffusely arranged 0·5–0·7mm long hairs, also faintly papillose to puberulent, the margins not overlapping and not fused at the top; *awn* 14–16mm long, bigeniculate at 3–4 and at 7–8mm with the lower geniculation sometimes indistinct, columna twisted, hairy with the hairs decreasing in length from 1mm near the base to 0·3–0·4mm below the second geniculation, articulated at the base, seta straight, scabrous by 0·3mm long setulose hairs; *palea* equalling lemma in length, between the veins pilose up to the apex; *lodicules* dissimilar, the anterior ones 1·3mm long, obliquely ovate, acute, the posterior 1·8–2mm long, almost linear, acute; *anthers* 3–3·5mm long, unbearded, yellow, expulsed; *ovary* with 2 styles; *caryopsis* about 3·5mm long, embryo 1mm long, hilum terminating at the top; 2n unknown. For callus characters see Fig. 2a.

From the Tianshan through the Pamirs to the Himalayas, imperfectly known.

A species of alpine mats in regions with sufficient summer rain.

Specimens studied:
INDIA. Kashmir: Apharwat Mt above Gulmarg on N side of Pir Panjal, vii 1926, *St.* (NY); Ladakh, ascent to Lanak pass, 13 ix 1847, *Thomson* p.p. (K).

Only the few specimens mentioned above have been seen from the area. As the species is reported from the S Pamir too (Tzvelev, 1968) its occurrence in Kashmir is not surprising. The Himalayan specimens differ from the examined Tianshan material and the type in smaller size of the glumes (8–10 vs. 10–12mm) and of the anthecium (5–5·5 vs. 6–7mm), but they agree well in any other respect, even in the length of the awn. It seems reasonable to include them in *St. regeliana*.

Tzvelev (1974) based his monotypic sect. *Regelia* on *St. regeliana*. In separating it from sect. *Achnatheropsis* he stressed the intravaginal branching pattern, the longer ligule and longer callus. In fact, the callus characters agree well with those of the other species in the section, even with the more remote *St. brandisii*, as can be judged from Figs 1f and 2a. Also, the other features of *St. regeliana* scarcely justify a section of its own, and hence it should be retained in the *Sibiricae* (=*Achnatheropsis*) where it has already been placed by Roshevitz (1934). One statement in Tzvelev's description needs to be corrected: the base of the awn is distinctly articulated, even in material from the Tianshan.

VI. Sect Pseudoptilagrostis

Stipa sect. **Pseudoptilagrostis** Tzvelev, Novosti Sist. Vyss. Rast. 11:13 (1974).

Type species: *St. subsessiliflora* (Rupr.) Rosh.

Branching intravaginal; glumes lanceolate; callus 0·5–1mm long, pointed, scar narrow-elliptic, peripheral ring dorsally flattened and protruding; *lemma* membranous, its margins not completely covering the palea; *awn* up to 30mm long, bigeniculate, articulated at the base, with the columna being plumose and the seta scabrous. 2n=? For callus characters see Fig. 2b.

Two Asiatic species only, growing as moderate xerophytes of alpine summer rain regions from the Inner Himalayas and E Pamir to Mongolia. The second species is *St. penicillata* Hand.-Mazz. (=*St. laxiflora* Keng) from C and SW China, which has not been included in the survey.

The section holds an intermediate position between *Ptilagrostis* and *Stipa*, with the habit, short awn and exposed back of the palea resembling the first section, but with callus characters and the articulated awn like the latter one.

16. St. subsessiliflora (Rupr.) Rosh. in B. Fedtsch., Fl. Az. Ross. 12:128 (1916).

Syn.: *Lasiagrostis subsessiliflora* Rupr. in Ost.-Sack. & Rupr., Mém. Acad. Imp. Sci., St. Pétersbourg. Sér. 7, 14:35 (1869); *Ptilagrostis subsessiliflora* (Rupr.) Rosh., Fl. SSSR 2:74 (1934).

St. basiplumosa Munro ex Hook. f., Fl. Brit. Ind. 7:229 (1897). Syntypes: Western Tibet (India, Kashmir, Ladakh), Nubra, and the Lanak pass, 15000–17000ft (see Thomson's gatherings cited below).

Type: (China, Sinkiang) Mittlerer Tianshan, Toyandy-Tal (c. 70km NNW of Kashgar), 30 vii 1886, *Osten-Sacken* (holo. LE!).

Densely tufted, branching intravaginal, with few culms and numerous vegetative shoots; *culms* (7–)20–30(–35)cm, 2–3-noded, glabrous, smooth; *sheaths* smooth or faintly puberulent to setulose; *ligules* at the culm leaves 2–3·5(–5)mm long, at the vegetative shoots 1–3mm long, acute, setulose, with ciliolate to ciliate margins and tip; *blades* greyish green, convolute, at the culms up to 7cm long, at the vegetative shoots up to 12cm long, 0·2–0·3mm diam., upper surface pubescent, beneath scabrous, only at the base sometimes pilose on the somewhat prominent veins; *panicle* shortly

exserted or ensheathed at the base, contracted, (4–)5–10(–11) × 1–1·5cm, the branches erect, single or paired, setulose, up to 3·5(–4)cm long, with up to 5 spikelets; *spikelets* 6·5–11mm long, lanceolate, the glumes subequal, acuminate, purplish with narrow hyaline margins and tips, smooth, glabrous, 3–5-veined, the lower one 1–2mm longer; *anthecium* 4–6mm long; *callus* 0·7–1·0mm long, pointed, bearded, scar narrow elliptic, peripheral ring dorsally flattened and long protruding; *lemma* membranous, the margins not overlapping, up to the top covered by a diffuse indumentum of 0·5mm long ascending silky hairs; *awn* 12–21mm long, bigeniculate at 3–6 and 7–10mm, columna twisted, articulated at the base, plumose with the hairs from 2–3mm length at the base decreasing to 0·3–0·5mm below the upper geniculation, hairs very dense and almost tuft-like near the base, much sparser in the upper part, seta scabrous, straight; *palea* equalling lemma in length, pilose between the veins; *lodicules* dissimilar, the anterior ones 1·2–1·3mm long, lanceolate, the posterior slightly shorter with an obtuse apex, all glabrous; *anthers* 1·5–2·5mm long, unbearded, purplish; *ovary* with 2 styles; *caryopsis* 3–4mm long, embryo 1mm long, hilum reaching the top; 2n unknown. For callus characters see Fig. 2b.

C Asiatic alpine; from the Altai Mts through the Tianshan and E Pamir to the inner ranges of the Himalayas, at least up to Ladakh.

A plant of alpine steppes around 4500–5000m in summer-rain regions, usually heavily grazed.

Specimens studied (beside the types):

INDIA. Kashmir, Ladakh: ascent to Lanak pass, 13 ix 1847, *Thomson* (K); ravine below Lanak pass, 5000m, 14 ix 1847, *Thomson* (E, K); s. loc., 22 viii 1848, *Thomson* (K); Tsakzhin Tso, dry sand plain, 5000m, *K.* 2386 (NY); ibid., *K.* 2387 p.p. (K); Debring, Rupshu, 4600m, 4 ix 1970, *Bhattacharyya* (BSD).

The species is rather variable in length of spikelets, anthecia and awns, even in the limited material available and most strikingly so in Thomson's gatherings at E and K, which include individuals of both the smallest forms with 12–13mm long awns and the largest ones with awns of 18–21mm. They differ also by the venation of the glumes, which are either 3- or 5-nerved. However the gap is bridged by one Thomson gathering (14 ix 1847) that consists of individuals with 15–17mm long awns and 3–4-nerved glumes.

Originally the Himalayan populations were described by Hooker (1897) as *St. basiplumosa*. A very close affinity to *St. subsessiliflora* was first detected by Tzvelev (1968), and later by Bor (1970), who discussed the possibility of both taxa being identical. Comparison with material of *St. subsessiliflora* from the Tianshan and with the descriptions given by various authors led me to include *St. basiplumosa* in *St. sessiliflora*. The only difference according to the material known to me is a somewhat shifted range of variation in the length of the awn, which is 18–26mm in the more northern populations. Furthermore the columna above the first geniculation is slightly more densely haired than in the Himalayan populations. *St. basiplumosa* var. *longearistata* Munro ex Hook. f. belongs to *St. roborovskyi* (see p. 420).

St. subsessiliflora is unique among all *Stipa* species of the area by its combination of a long pungent callus with a short awn being plumose

only in the lower part. Tzvelev (1968) was the first in recognizing the presence of true *Stipa* characters in this species hitherto placed in *Ptilagrostis*.

VII. Sect. Stipella Tzvelev emend. Freitag

Stipa sect. **Stipella** Tzvelev, Novosti Sist. Vyss. Rast. 11:15 (1974).

Syn.: *Stipa* ser. *Tortiles* Rosh., Fl. SSSR 2:103 (1934). Type species: *St. capensis* Thunb.

Stipa ser. *Inaequiglumes* Bor, Fl. Ir. 70:387 (1970). Type species: *St. parviflora* Desf.

Type species: *St. capensis* Thunb.

A ceteris sectionibus eurasiatibus differt: palea 2–4plo breviora quam lemma, lemma sub apice constrictum, lodicula superiora brevissima.

Differs from all other Eurasiatic sections by the palea being significantly (usually 2–4 × shorter than the lemma and the latter therefore usually more or less constricted below the apex, and by the extremely short and until now overlooked upper lodicule; growth form and callus usually as in the more primitive species of the sect. *Stipa*; leaves, glumes and structure of inflorescence similar to sect. *Lasiagrostis*.

The section includes 5 species distributed from Macaronesia to C Nepal and Ethiopia along the southern border of the area of the genus in Eurasia and Africa, with 2 species in areas with predominent summer rain (*St. staintonii* in Nepal, *St. tigrensis* in Saudi Arabia and Ethiopia) and 3 species in areas with a winter rain regime. Three species are treated here, the two remaining ones are *St. nitens* from NW Africa and *St. tigrensis*, both being closely related to *St. parviflora*. 2n = 28, 34, 36. For callus characters see Fig. 2c.

Tzvelev (1974, 1976) considered sect. *Stipella* to be monotypic and stressed the annual habit of *St. capensis* as the most important feature. However, the morphological characters of the lodicules, lemma and palea are certainly more important. With the extended circumscription of the section four perennial species, most closely allied to *St. capensis*, are now also included.

17. St. staintonii Bor, Bull. Bot. Surv. India 7:133 (1965).

Type: Nepal, near Seng Khola, 12500ft, exposed cliffs, 4 x 1954, *Stainton, Sykes & Williams* 4677 (holo. K!, iso. BM!).

In small to medium-sized tufts, with short creeping rhizomes, branching extravaginal, with many culms and few vegetative shoots; *culms* 60–100 (–120)cm, (3–)4–5(–6)-noded, glabrous; *sheaths* glabrous to scaberulous, sometimes purplish, the lower ones with ciliate margins, beside the ligule densely bearded by 2 tufts of 1–1·5mm long hairs; *ligules* very short, truncate, lacerated, at the culms up to 0·5(–0·7)mm long, at the vegetative shoots c. 0·2mm long; *blades* flat, at the culm leaves up to 2·5–3mm wide and 10–15(–20)cm long, at the vegetative shoots up to 35cm long, in dry condition involute, 0·7–0·9mm diam, upper surface pubescent with c. 0·5mm long hairs, at the base rather densely so, higher up thinning out, also with a very short and dense indumentum, glabrous beneath, without

prominent veins; *panicle* usually exserted, 20–25 × 3–5(–8)cm, the branches ascending to spreading, setulose, the lower ones in whorls of (3–)5, the upper in 3 or paired, up to 10cm long, with numerous spikelets; *spikelets* 11–13mm long, the glumes unequal, lanceolate-acuminate, membranous, with a purplish back and hyaline margins and apex, glabrous, the lower one 11–13mm long, 3–5-nerved, the upper 8·5–9mm long, 3-nerved; *anthecium* 5·5–6mm long; *callus* 0·5–0·7mm long, densely bearded, with the longest hairs c. 1mm long, curved, acute, scar oval, peripheral ring dorsally flattened and protruding; *lemma* slightly coriaceous, brownish, with 2 apical lobes of 0·2–0·25mm, diffusely covered by long ascending hairs of 0·8mm (at the base) to 2–2·2mm (below the top), the long apical hairs distinctly twisted; *awn* 4–6cm long, bigeniculate at 0·6–0·8 and 1·2–1·6cm, columna twisted, densely pubescent by 0·2–0·3mm long hairs, seta capillary, flexuose, scabrous; *palea* 1·5–2mm shorter than lemma, with obtuse apex, loosely pilose; *lodicules* dissimilar, glabrous, the anterior ones 1mm long, obtuse to acutish, the posterior only 0·2–0·3mm long, somewhat spathulate; *anthers* (2–)2·3–2·7mm long, bearded, yellow, exserted; *ovary* with 2 styles, separated by a cleft; *caryopsis* not seen; 2n unknown.

So far known only from W and C Nepal.

A quite common species of open rocky slopes and woodlands (*Cupressus*), also invading arable lands, from 3300–4200m; presumably in semi-arid to semi-humid environments with monsoonal influence.

Specimens studied (6):

NEPAL. W Nepal: Barsung Kho-la, 3300m, *Stainton* 4417 (BM). C Nepal: Tukucha (Kali Gandaki), 3500m, *Stainton et al.* 7352 (BM, K); betw. Pudamigaon and Ringmigaon, *Polunin et al.* 3553 (BM, K); Marsyandi vall., Manang, 3800m, 12 x 1969, *Wraber* (BM); Ringmo, 3400m, *Einarsson et al.* 3128 (BM); Cha Lungpa, 3300m, *Miehe* 5/580 (BM).

This rather recently discovered species seems to have a restricted area of distribution, but there it is a common plant. *St. staintonii* flowers very late, according to the specimens seen from late August to the end of September, and its development evidently responds to the monsoon season.

With regard to its characters *St. staintonii* is of particular interest. It is placed here as the first—and that means the most primitive—species of sect. *Stipella*, because it agrees with other species of that section in all essential characters: the unequal glumes, different length of lemma and palea, 3 lodicules with the upper being much smaller (and overlooked in the diagnosis by Bor), the shape of the many-spiculate inflorescence and even the structure of the ligule including the distinctly bearded junction of blade and sheath. However, it is clearly more primitive and narrows the gap with sect. *Lasiagrostis* where it was first placed by Bor, by its still extravaginal branching, short creeping rhizomes, the comparatively long palea and the smaller size of all parts of the spikelet.

18. St. parviflora Desf., Fl. Atl. 1:98 (1798).

Syntypes: In coll. aridis prope Mascar (Mascara, Algeria) et in regno Tunetano, *Desfontaines* (syntypes P n.v.).

In small, dense tufts, branching intravaginal, with some culms and numerous vegetative shoots; *culms* 30–50(–70)cm, (2–)3-noded, glabrous;

sheaths papillose or shortly pubescent, at the margins up to 0·8mm long, ciliate, and in addition to the ligule densely bearded with 1–1·3mm long hairs; *ligules* very short, at the culms up to 1·5mm long, at the vegetative shoots 0·2mm long, truncate to rounded, usually lacerated; *blades* flat, at the culm leaves up to 5(–8)cm long, at the vegetative shoots 3–10(–20)cm long, 0·8–1·5mm wide, in dry condition convolute and 0·5–0·6mm diam., upper surface densely pubescent, beneath glabrous or papillose, smooth, with prominent white veins; *panicle* usually long exserted but sometimes ensheathed at the base, effuse or contracted, (10–)12–20(–23) × 3–6(–7)cm, the branches ascending to spreading, capillary, glabrous or setulose, the lower ones usually in whorls of 5, the upper in 3 or paired, up to 8cm long, with numerous spikelets; *spikelets* 9–14mm long, the glumes unequal, lanceolate, hyaline with a green or purplish back, setulose in upper part, 3-nerved, the upper only $\frac{1}{2}$–$\frac{2}{3}$ of the lower, almost obtuse; *anthecium* (4–)4·5–5·5(–6)mm long; *callus* 1–1·2mm long, densely bearded, scar circular, peripheral ring dorsally flattened and much protruding; *lemma* slightly coriaceous, pale, constricted below the apex, diffusely covered by 0·4–0·5mm long ascending to appressed hairs up to 0·5–1mm below the densely papillose apex; *awn* 7–10(–13)cm long, indistinctly bigeniculate, with the distinct upper geniculation at 1–2cm, scabrous throughout, columna twisted, articulated at the base, seta falcate or flexuose; *palea* only $\frac{1}{2}$ of the lemma, 2–3mm long, with obtuse apex, pilose; *lodicules* extremely dissimilar, obtuse, glabrous, the anterior ones 1–1·1mm long, the posterior only 0·1–0·2mm long; *anthers* 2–3mm long, bearded, yellow, exserted; *ovary* with 2 styles; *caryopsis* 3–4mm long, embryo 1mm long, hilum reaching the top; 2n = 28.

S Mediterranean: from Spain and Morocco through N Africa to Sinai, Jordan, N Saudi Arabia, W Iraq and Syria, with outposts in the mountains of the C Sahara (Ahaggar) and in Khorasan (Iran) (Fig. 12).

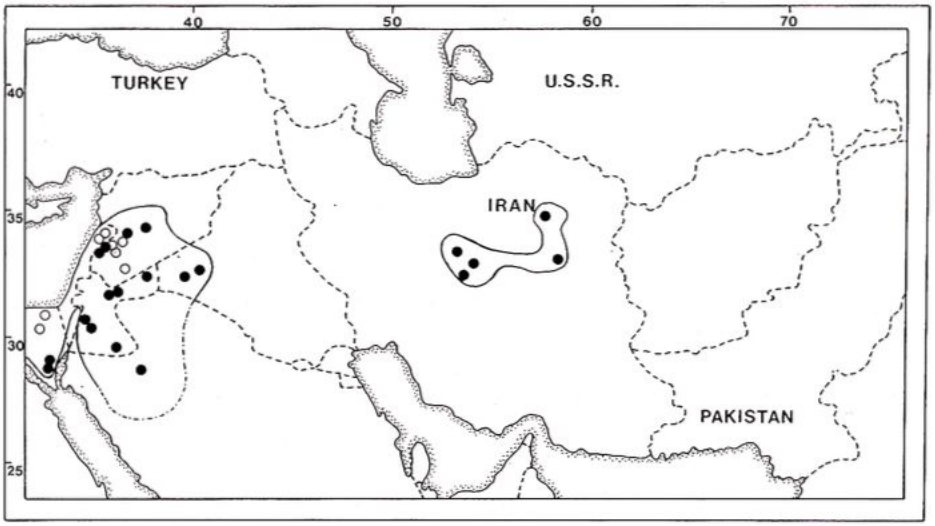

FIG. 12. Distribution of *Stipa parviflora*. ○ literature records according to Post (1933) and Mouterde (1966).

A typical and common species of semi-desert communities existing under hot summers and mild winters, in woodland areas restricted to seral and secondary communities; from sea-level up to 1000m, in the southernmost localities up to at least 2000m.

Specimens studied (35):

EGYPT. Sinai: Foothills of Mt. Sinai, *Schimper* 102 (E, G, GOET, JE, NY); ibid., *Aucher* 3029 (G); ibid., Sud de Convent, 7 v 1891, *Cramer* (G).

PALESTINE. Betw. Wadi Daika el Amirin a. W. Bakra, 450m, 9 v 1950, *Boyko* (K).

JORDAN. Sandy wadis W of El Inab, *Hunt. Aero. Surv.* 81a (E); betw. Wadi Musa vill. and the Siq, *D.* 9496 (E); desert 163km E of Amman, *R.* 12907 (W); (7 more).

SAUDI-ARABIA. Hijaz, near Shigri, Tabuk road, 1030m, *Collenette* 4364 (K).

SYRIA. Antilibanon, 12km W of Damascus, *R.* 13142 (E, G, W); betw. Damascus a. Palmyra, *Kotschy* 1030 (W); Palmyra, in desert, 500m, *Roessler* 4853 (W).

IRAQ. Western desert, 20km S of Rutba, 700m, *R.* 9943 (E, W); between Ramadi and Rutba, 500m, *R.* 13941 (W).

IRAN. Yazd: 18km ENE Chupanan, 850m, *R.* 51947 (W); 15km W Chah Malek to Chupanan, 800–900m *R.* 51853 (W); ibid., 16 v 1975, *Iranshar* (IRAN). Khorasan: E border of Dasht-e-Kavir near Ozbagu, *Ruttner* 79, 206, 217, 284 (W); Dihuk, 12–18km E, 11 iv 1975, *Iranshar* (IRAN); N of Anarak, road to Tabas, 1500m, *Amin & Rejamand* 32988 (W).

The species exhibits the usual range of variation, especially in length of the anthecium and awn. The recently described subsp. *sinaica* (Chrtek & Martinovsky, 1969) with awns of (60–)66–85(–95)mm marks but an end-point of that variation, which remains connected to the longer-awned forms by all transitions. Specimens with shorter awns of c. 80mm have been collected in Syria, Jordan and Iraq, but from any area specimens with awns of 100–120mm can be seen. According to the description and figures, *St. hoggariensis* Chrtek & Martinovsky (1969) also belongs here.

From the citation in Boissier & Buhse (1860, p. 231) of *St. parviflora* in the desert between Dshendak (Jandak) and Yazd at Bunegu and the recent collections of Rechinger in Yazd prov. it can be concluded that the species probably has a wider distribution along the hot desert margins in C Iran.

19. St. capensis Thunb., Prodr. Fl. Cap. 1:19 (1794).

Syn.: *St. retorta* Cav., Obs. regno de Valencia 1:119 (1795). Type: Prob. in MA n.v.

St. tortilis Desf., Fl. Atl. 1:99 (1798). Type: (Prob. Maroc). In arvis (holo. P n.v.).

Type: Promontorium Bonae Spei Africae, *Thunberg* 2560 (holo. UPS!).

Annual, in small, dense tufts, branching intravaginal, with some culms and numerous vegetative shoots; *culms* (5–)12–35(–60)cm, (2–)3(–4)-noded, often geniculate at the base, glabrous; *sheaths* either completely glabrous or with ciliate margins, or shortly pubescent, or shortly pubescent and with scattered long hairs of about 1·5mm, or loosely pilose only by long hairs, beside the ligule always densely bearded by 0·5–1·5mm long hairs, the uppermost sheath usually much broadened and often partly enclosing the panicle; ligule very short, up to 0·5mm long, truncate, ciliolate; *blades* flat, up to 13cm long, 1·5–3mm wide, in dry condition involute, the upper surface glabrous or scabrous or pilose, sometimes distinctly ciliate at the margin, beneath glabrous or pubescent or pilose with spreading to retrorse hairs of up to 1mm, with prominent white veins; *panicle* long exserted or more or less ensheathed, spike-like

contracted, very dense, 3–8 × 1–1·5cm, eventually a second panicle in the axil of the uppermost leaf, the branches erect to appressed, setulose, the lower ones whorled in 3–4, the others paired, up to 4cm long, with up to 5 spikelets; *spikelets* (14–)17–20(–23)mm long, the glumes unequal, lanceolate, hyaline with greenish back, more rarely purplish tinged, glabrous, smooth, 3-nerved, the upper 2–4mm shorter; *anthecium* (4–)5–7·5(–9)mm long; *callus* (1–)1·5–2.5mm long, densely bearded, but laterally at each side with an almost naked line, scar circular, peripheral ring dorsally flattened and much protruding; *lemma* slightly coriaceous, pale, constricted below the apex, covered completely by almost diffuse ascending hairs of 0·3–1·5mm beside a prominent dorsal row, the uppermost hairs usually longer and forming a coronula; *awn* (4·5–)6–9(–11)cm long, bigeniculate at 1·3–2·3 and at 2·5–4cm, the lower geniculation often indistinct, columna strongly twisted, articulated at the base, pilose with the hairs at the base 0·4–0·8mm long and decreasing in length towards the second geniculation, seta almost straight or somewhat flexuose, scabrous; *palea* much shorter than lemma, 1·7–2·0mm long, obovate, with the apex obtuse, entire or crenulate, glabrous; *lodicules* unequal, the anterior ones 1·0–1·4mm long, linear, obtuse, glabrous, the posterior only 0·2–0·4mm long, ovate to oblong; *anthers* 2–3mm long, bearded, yellow; *ovary* with 2 styles; *caryopsis* 2·5–4mm long, spindle-shaped, embryo 0·8–1·3mm long, hilum reaching the top; 2n = 18, 26.

S Mediterranean: from Macaronesia around the Mediterranean Sea, in N Africa penetrating far into the Sahara, through Iraq and S Iran to W Pakistan, E and S Afghanistan; outposts in C Iran and along the southern shore of the Caspian Sea from Azerbaijan to Turkmenia; S Africa (Cape prov., probably naturalized), in marginal areas widely synanthropic (Fig. 13).

A very common component of dry mediterranean and subsaharian semi-desert communities dominated by therophytes (see p. 376); in the

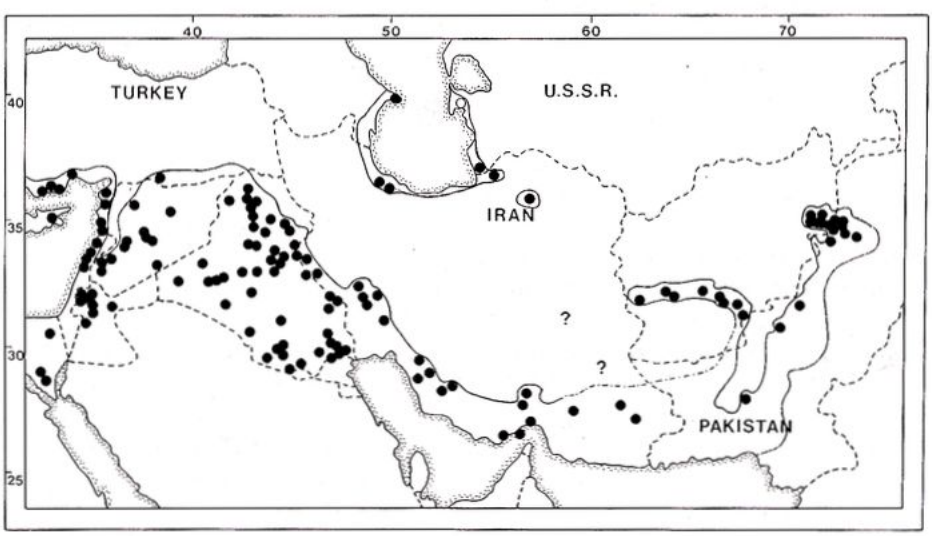

FIG. 13. Distribution of *Stipa capensis*. ○ literature records according to various sources.

adjacent Saharo-Arabian and Sudano-Sindian semi-deserts strongly bound to regions with some additional winter rain; highly favoured by overgrazing; from sea-level to medium altitudes, only in the S exceeding 1000m and reaching up to about 1700m.

Specimens studied (165):

EGYPT. Sinai: Hamme vall., *Schimper* 893 (W); ibid., *Schimper* 395 (E, G, NY); Wadi-ush-Shaykh betw. Sinai and Serbal Mts, *Kneucker* 250 (E, G, W).

PALESTINE. Jericho, 300m, *B.* 1618 (E, G, JE); Ain Duk, *Barbey* 932 (G); Philistean Plains, 26 iii 1880, *Peyron* (G). Judaean Desert, 19 iv 1933, *Feinbrun & al.* (E, NY).

JORDAN. Wadi Ithirn, 650m, *D.* 9301 (E); J. Aniczi, *D.* 9222 (E); Mt. Hor, E side, 1000–1200m, *D.* 8603 (E). J. Ataruz, 650–720m, *D.* 8726 (E); (12 more).

SYRIA. Banias, *Peyron* 1522 (G); Aleppo 15 v 1867, *Haussk.* (JE); Palmyra, near salt lake, *D.* 5918 (E); Damascus, *Labill.* (G); (4 more).

CYPRUS. Near Kythraea, *Sint. & Rigo* 391 (G); near Larnaca, *Kotschy* 78, 222, 725 (all JE); ibid., *Ball* 2400 (E).

TURKEY. Izmir: above Bornova, 100m, *Schwarz* 158 (B). Muğla: Reşadiye to Cumali, 300m, *D.* 41237 (E); Bodrum, 0–10m, *D.* 40896 (E). Içel: Plain near Mersin, 10 v 1855, *Bal.* (G); betw. Silifke a. Lamas, 10 v 1933, *Scheibe* (JE); Silifke, *Alava* 6657 (E); Mut, at road to Karaman, 300m, *Coode & Jones* 922 (E); betw. Anamur a. Gilindire, 20m, *D.* 26003 (E). Seyhan (prob.): Taurus, *Kotschy* s.n. (G). Hatay: betw. Belen a. Kirikhan, 100m, *Coode & Jones* 574 (E); Sertia Anthakya (Hatay), *Aucher-Eloy* (G).

IRAQ. Sulaimaniya: At Chamchamal, 6 iv 1929, *Rogers* (G); Derbendikhan, 470m, 29 iii 1960, *Haines* (E); ibid., 7km S. *Barkley* 5137 (W). Niniveh: At Mindan bridge, 400m, *A.* 1269 (W); Wadi Hager near Hit, *Barkley & Palmatier* 1065 (E). Kirkuk: Khanaqin, *R.* 9039 (G, W); ibid., *R.* 14111 (W). Ghurfa: Samarra, 24km E, *R.* 13407 (W); ibid., 12km E, *R.* 13467 (W); Jab. Hamrin, *B.* 1118 (B). Western Desert: Ramadi, 180km W, *R.* 12675 (W); ibid., 210km W, *R.* 9820 (E, W); ibid., 40km W, *Bashir* 68 (E, W); betw. Hit and Ana, 1 v 1894, *Strauss* (JE). Centr. Alluv, Plain: Tikrit, 26 ii 1960, *Haines* (E); Baghdad, *Haines* 108 (E); Iskanderiya, *Agnew & Shawqi* 112 (G, JE, W); Diwaniya, 380m, *R.* 13660 (W). East. Alluv. Plain: Badra, 16km SE, *R.* 13968, 14076 (W). South. Marsh distr.: Amara, 60km N, *R.* 14267; ibid., 70km N, *R.* 14198 (W). South. Desert: Safwan, 6km ESE, *R.* 8708 (E, G, W); Jab. Sanam, *R.* 8576, 14497 (W); Basra, 40km SW, *R.* 14303 (W); Salman, 80km SSW, *R.* 13713 (W); (11 more).

SAUDI ARABIA. E prov.: Dhahran, *Mandaville* 101 (NY).

IRAN. Gilan: Betw. Rasht a. Qazvin, 400m, *B.* 8364 (B); W of Sefid Rud dam, 350m, *Pa.* 3657, 79a (G).—Mazanderan: Rustamabad, 26 v 1893, *Lipsky* (B, JE). Gorgan: Near Gonbad, 24 iv 1958, *Pa.* (G); Gonbad, Agriboghaz, 7 v 1956, *Sharif* (IRAN); Gonbad, Ghari Ghir, 5 v 1959, s. coll. (IRAN). Semnan: Touran Protected Area, c. 50km ENE of Biarjomand, 800–850m, *F.* 13962. Kordestan: Sanandaj to Homand, Salvatabad pass, 2 vii 1971, *Termé* (IRAN). Kermanshah: Khosrovi, 8 vi 1950, *Behboudi* (IRAN). Ilam: Mehran, Halet, 27 iii 1945, *Behboudi* (IRAN); ibid., *Behboudi* 214, 245 (W); Mehran, Mohna 27 iv 1967, *Kashkuli & Soltani* (IRAN). Khuzestan: Sheshom, 300–350m, *Jacobs* 6414 (BG, E); Andimeshk, Polezal, 580m, *Gheissari* 2748 (THR). Ahraz, 35km N, 7 iii 1959, *Pa.* (G); (4 more). Yasuf: Gach Saran, 9 v 1968, *Zagri* (IRAN). Bushehr, Borazjan, *Stapf* 1850 (W); Bushehr, *Stapf* 1849 (W); ibid., *B.* 711b (B).—Fars: Betw. Shiraz a. Dalaki, 1000m, iv 1868, *Haussk.* (B. JE); Dalaki, *Kotschy* 90 (G, E, JE); Kazerun, Chenarshahi, 920m, *Foroughi* 5032 (THR); Firuzabad, Ahram iv 1951, *Kashbouli* (IRAN); (6 more).—Hormozgan: Bandar-e-Lengeh, *B.* 710 (JE); betw. Chah Choghuk pass a. Tarom, 1400m, *R.* 3201 (E, G, W); Kuh-e-Gohreh betw. Bander Abbas a. Sirdjan, 800m, 10 iii 1971, *Iranshar & Termé* (IRAN) Qeshm Island, *Behboudi* 401E (IRAN, W); (9 more). Kerman: W of Jaz Murian, 360m, *Leonard* 5826 (BR); ibid., 450m, *Leonard* 5693 (BR). Baluchistan: Iranshar, Daman, 10 iv 1950, *Manoutcheri* (IRAN); near Bazman, 950m, *Leonard* 6314 (BR).

USSR. Azerbaijan: Near Baku, *Schevljakov* 96 (BAK, E, H); Baku, Zych, 18 v 1930, *Prilipko* (BAK); Flyloi Island, 24 iv 1941, Gurvich (BAK); ibid., 14 v 1964, *Akhundov* (BAK). Turkmenia: Kizyl Atrek, Chaljuk, 31 v 1955, *Nikitin* (E, JE, W).

AFGHANISTAN. Hilmand: Garmab N of Gereshk, 1200m, *Kerstan* 385 (W). Kandahar: Kandahar, 60km W, *Pa.* 4442 (G); hills 15km WSW, 1000m, *F.* 2352; Ispoli, 25km NNE Spin Boldak, 1400m, *W.* 7082 (BG). Laghman: Alingar, 3km N, *Breckle* A 1641; Darunta, 600m, *A.* 2999; Shahidan, at main road Jalalabad-Sarobi, *P.* 28692; (2 more). Nangarhar: Seh Baba E of Tizin, *Scheibe* 68 (W); betw. Nimla a. Jalalabad, 600m, *Kerstan* 629 (W);

Kunar vall. 5km below Chauki, 650m, *P.* 20355 (M); Torkham, 650m, *F.* 4257; (7 more). PAKISTAN. Peshawar: Khyber pass, 1000m, *R.* 30307 (W); Peshawar, Islamic College, *St.* 10183 (E, G); Jamrud, *St.* 28990 (RAW); (3 more). Kohat: betw. Kohat and Hangu, *Rahman* 25824 (K).

St. capensis is one of the most widely distributed species and the only annual of the genus. Despite ample variability no convincing infraspecific grouping is detectable. Even the var. *pubescens* Ball (1878) (sub. *St. tortilis*) is linked with the normal glabrous forms by all intermediates. Despite the contrary view of Chrtek & Hadač (1969) the Mediterranean and the S African material is conspecific, as must be concluded from the study of the type and other S African materials (some gatherings have been seen in W). Because of the unique annual habit in the genus *Stipa*, this species has often been grouped into a series or section of its own. Nevertheless, the very short palea, the lemma with the constriction just below the apex, the highly reduced posterior lodicule and the high number and small size of spikelets per panicle suggest a close affinity to *St. nitens* Ball and to *St. parviflora* Desf. Further arguments are the very similar climatological requirements and the distribution type.

Scholz (1982) observed branched macrohairs at the edge of the ligule and from that he inferred a very isolated systematic position for *St. capensis*. However, few other species have as yet been checked for that character and I am not at all sure of its significance.

VIII. Sect. Stipa

Densely tufted perennials with intravaginal branching; *leaf blades* with continuous sclerenchyma tissue, and accordingly regularly involute in dry condition; *panicle* few-spiculate; *glumes* usually long acuminate; *callus* at least 1mm long with a distinct cylindrical upper section and a pungent base, scar circular to elliptic, peripheral ring dorsally flattened and much protruding; *lemma* margins covering the palea; *awn* at least 3cm long, uni- or bigeniculate; *palea* only slightly shorter than lemma; *lodicules* more or less similar; *ovary* with 2 styles; $2n = 36, 40, 44$ (most species).

Moderate xerophytes of steppes and other open plant communities, centred in S Siberia, C Asia and in the Pontic area, entering the Irano-Turanian region only in its northern parts and in higher altitudes, usually in areas with at least some summer rain.

Species-group 1 ('Eriostipa')

Syn.: *Stipa* sect. *Eriostipa* Dumort., Observ. Gram. Belg.: 134 (1823).
Stipa sect. *Stipa* sensu Tzvelev, Novosti Sist. Vyss. Rast. 11:17 (1974).

Here the species with a bigeniculate and hairy to plumose awn are united. The sectional rank, given to this group by Dumortier and Tzvelev over-emphasizes the conventional awn characters separating the three species-groups.

20. St. roborovskyi Rosh., Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 1 (6):1 (1920).

Syn.: *St. basiplumosa* var. *longearistata* Munro ex Hook. f., Fl. Br. Ind. 7:229 (1896). Type: (India, Kashmir, Ladakh) Tibet occid., *Thomson* s.n. (holo. K!).

Type: (China, N Tibet) Chantan, N slopes of the Russkyi Mts, around Kara Sai in upper Aksu vall., 3300–4200m, 3 vii 1890, *Roborovsky* (holo. LE n.v., iso. W!).

In small, dense tufts, with numerous vegetative and some generative shoots, branching predominantly intravaginal; *culms* 25–40cm, 2-noded, glabrous; *sheaths* shortly puberulent to distinctly pubescent; *ligules* acute, setulose at the back, ciliolate to ciliate at the apex, at the vegetative shoots up to 7mm, at the culms up to 5mm long; *blades* greyish green, usually involute to conduplicate, 0·3–0·5mm diam., upper surface densely pubescent, beneath scabrous, at the culms up to 7cm long, at the vegetative shoots up to 13cm long; *panicle* 15–18cm × 1cm, contracted, few-spiculate, interrupted, exserted, the branches ascending to appressed, the lower ones single or paired, up to 4cm long, more or less setulose, with 1–2 spikelets; *spikelets* 13–15mm long, the glumes subequal, purple-tinged, with hyaline margins and tip, narrow lanceolate, acuminate, 3-nerved, smooth, the main vein setulose in upper part; *anthecium* 6·5–7·5mm long; *callus* 1–1·5mm long, densely bearded, pungent, shape of scar and peripheral ring not documented; *lemma* pale to brownish, completely covered by a diffuse indumentum of 0·3mm long ascending to semi-appressed hairs, subapical hairs up to 0·8mm long, lemma with 2 distinct apical lobes; *awn* 3·2–3·7cm long, pilose to plumose throughout, bigeniculate at 0·5–0·6 and 1–1·2cm, lower geniculation often indistinct, seta almost straight, hairs at the columna about 1·5mm long, at the base of the seta 1–1·1mm and decreasing in length towards the apex; *palea* about as long as lemma, glabrous; *lodicules* subequal, lanceolate, about 0·8mm long, glabrous, the lower ones with obtuse to crenulate apex, the upper slightly narrower with acute apex; anthers 3mm long, delicate, unbearded; *ovary* with 2 styles and 2 feathery stigmas; *caryopsis* about 4mm long, embryo 0·7mm; 2n unknown.

C Asiatic; from E Pamir to N Tibet and the Inner Himalayas.

In alpine steppes from 3300–5500m.

Specimens studied:
Only the type of *St. basiplumosa* var. *longearistata* (see above).

With its short awn and columna indumentum, which is longer than that of the seta, the species could hold a position between sects *Stipa* and *Pseudoptilagrostis*, but unfortunately I was not aware of the importance of the callus characters when I investigated the specimen.

By including *St. basiplumosa* var. *longearistata* into *St. roborovskyi* I follow Tzvelev (1968). According to the description the northern populations differ by their somewhat longer awns (4·5–9cm) and shorter ligules of the vegetative shoots (0·5–1·5mm). That casts some doubt on the identity of both taxa. A thoroughly based decision on that matter will be possible only when more material is available. It has already been realized by Bor (1960) that on base of the different awn structure *St. basiplumosa* var. *longearistata* is quite different from normal *St. basiplumosa*. On the type he attached a label with the statement: 'This looks very like a different species.'

21. St. koelzii R. R. Stewart, Brittonia 5(3):441 (1945).
Type: (India) Kashmir, Ladakh, Gya, 13/14 viii 1933, *Koelz* 6432 (holo. US n.v.).

In small, dense tufts, with a few culms and numerous vegetative shoots, branching intravaginal; *culms* (8–)15–30(–35)cm, often geniculate, glabrous, smooth, leafy only in the lower half with the 3 nodes close to each other near the base; *sheaths* pubescent or faintly puberulent, the upper ones sometimes glabrous and often purplish; *ligules* truncate, ciliate or ciliolate at the margin, setulose on the back, at the culms 0·4–0·6 (–0·7)mm long, at the vegetative shoots 0·1–0·3(–0·4)mm; *blades* plane or involute to convolute, upper surface papillose, beneath with a dense or loose indumentum of 0·2–0·4mm long ascending to spreading hairs, more rarely almost glabrous, smooth, at the culm leaves up to 7cm long, at the vegetative shoots 3–6(–7)cm long, 1·3–1·6mm wide or 0·5mm diam.; *panicle* (5–)6–10(–13) × 0·5–1cm, long exserted, the branches erect, up to 3cm long, the lower ones paired or in whorls of 3, glabrous, with up to 4 spikelets, bent together by the awns; *spikelets* 1·5–2·5cm long, the glumes subequal, pale green, purplish tinged, tapering into a very long hyaline and often flexuose tip, glabrous, smooth, the lower one 3-nerved, the upper about 3mm longer, 5-nerved; *anthecium* 6·5–8·5mm long; *callus* (1·2–)1·3–1·8(–2)mm long, densely bearded with up to 0·9mm long hairs, at the base long and sharply pointed, almost straight; *lemma* subcoriaceous, pale brown to purplish, with the margins not completely overlapping, apically beside the insertion of the awn with two pointed lobes of 0·5–0·8mm, in lower third sparsely covered by 0·2–0·3mm long ascending hairs, except the dorsal row more or less diffuse, from $\frac{1}{3}$–$\frac{2}{3}$ glabrous on the back, but sparsely pilose near the margins, the upper third densely pilose with hairs up to 0·6–0·8mm; *awn* 4·2–5(–6)cm long, bigeniculate at (6–)7–10 and (10–)12–17mm, columna twisted, seta straight in the lower half, spirally twisted, very delicate and fragile in upper half, columna in lower part distinctly pubescent by up to 0·9mm long hairs, other parts of the awn 0·2–0·4mm long setulose, scabrous; *palea* equalling lemma in length, glabrous; *lodicules* dissimilar, the anterior ones obliquely lanceolate, acute, 1·2mm long, the posterior one almost linear, acute, 1·5–1·7mm long; *anthers* 2·5–3·5mm long, yellow, unbearded, remaining included; *ovary* with 2 styles and 2 feathery stigmas; *caryopsis* 4–5mm long, embryo 1·2mm long, hilum reaching almost up to the top; 2n unknown.

Himalayan: from Kashmir to Sikkim along the Inner Himalayas, also on the Tibetan side.

Reported from wet alpine meadows only up to 5000m.

Specimens studied (10):
INDIA. Him. Pradesh: Spiti, Rangrik, *K.* 7141 (NY).
NEPAL. Langtang, 3900m, *Dobremez* 522 (BM). Mustang, 4300m, *Stainton et al.* 2150 (BM, K). Kyangjin, 4000m, *Richards* 103 (BM). Kali Gandaki, Thulo Bugin, 3100m, *Miehe* 6/762b (BM).
BHUTAN. Janghotang, near Ngile La, 4400m, *Dunbar* 24 (BM).
SIKKIM. Chugyn, 4900m, *Rohmoo Lepcha* 276 (E, K); Sikkim, *Cave* s.n. (CAL).
CHINA. E Tibet: Kiala, near Tongolo, *Soulie* 341 (G, K). S Tibet: Karpo, Char Chu, 4000m, *Ludlow & Sherriff* 2025 (BM).

This rarely collected species has been considered as conspecific with *St.*

consanguinea by Bor (1960) and that view has been upheld by Cope (1982). However, the bigeniculate awn (vs. unigeniculate), the spirally twisted part of the seta (vs. slightly flexuose) and the awn indumentum with a distinct pubescence only on the columna (vs. throughout, and longer on the lower section of the seta) clearly underline its specific rank. A closely related taxon, or even the same one, is depicted by Keng (1959, tab. 547) under the name *St. capillacea*, but that name was published with a Chinese description only. I have not seen the relevant material.

22. St. breviflora Griseb., Nachr. Königl. Ges. Wiss. Georg-August-Univ. 3:82 (1868).

Syn.: *St. aliciae* Kanitz in Széchenyi, Wissensch. Ergebn. Reise Béla Széchenyi 2:736 (1898). Type: (China) Prov. Kan-su, 24 vi 1879, *Lóczy* 62 (holo. prob. BP n.v.).

Type: (China) Tibet, Gnari (Nari) Khorsum, *Schlagintweit* 7105 (holo. GOET!, iso. LE n.v.).

In small, dense tufts, branching intravaginal, with some culms and numerous vegetative shoots; *culms* 18–45cm, 2–3-noded, glabrous, almost completely covered by the sheaths; *sheaths* glabrous, smooth, the lower ones at the margins ciliate by 0·3–0·5mm long hairs, the upper ones at the culms somewhat widened up to 2mm; *ligules* shortly pubescent, the margin ciliate by short hairs up to 0·3mm, at the vegetative shoots up to 0·3mm long, truncate, at the culm leaves up to 1mm long, obtuse to lacerated; *blades* at the culm leaves up to 5cm long, at the vegetative shoots up to 10cm long, usually involute to conduplicate, about 0·4mm diam., greyish green, upper surface pubescent, beneath glabrous, smooth; *panicle* at the base usually enclosed by the somewhat broadened sheath of the uppermost leaf, 8–25 × 1·5–3cm, contracted, the branches ascending, glabrous, the lower ones single or paired, up to 5cm long, with 1–3 spikelets; *spikelets* 12–17mm long, the glumes narrow-lanceolate, acuminate, tapering into a very delicate tip, hyaline throughout, 3-nerved, the upper 3–5mm shorter; *anthecium* 5–7mm long; *callus* 1mm long, bearded, with the longest hairs on the ventral side up to 2mm, scar ± circular, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, pale, up to $\frac{1}{2}$–$\frac{2}{3}$ loosely covered by 0·4mm long ascending to appressed hairs arranged in indistinct rows, the upper 1–1·3mm covered by pointed prickles directed towards the apex and grading into a corona of unequal hairs from 0·2–0·4mm; *awn* 5–7cm long, very delicate, hairy throughout, bigeniculate at 0·5–1cm and 1·1–1·7cm, lower part of columna strongly twisted, upper part slightly twisted, seta falcate to somewhat flexuose, hairs at the base of the columna c. 0·6mm long, gradually increasing up to 1–1·5mm in lower part of seta and again shorter towards the tip; *palea* about 1mm shorter, very delicate, almost glabrous except for a tuft of hairs at the apex; *lodicules* 0·5–0·6mm long, lanceolate, acute, glabrous; *anthers* c. 3mm long, yellow, unbearded; *ovary* with 2 styles; *caryopsis* 3·5–4mm long, embryo 0·6mm, hilum up to the top; 2n unknown.

C Asiatic: between E Pamir, Mongolia and the Inner Himalayas.

In subalpine and alpine semi-deserts from 3000–4000m.

Specimens studied (beside the type):
INDIA. Ladakh: s. loc., 4100m, *Lance* 320 (K).
NEPAL. Muktinath, 3800m, *Stainton et al.* 5647 (BM, G, K).
CHINA. Tianshan, Ous-tschiat vall., 3000m, *Brocherel* 282 (G).
USSR. Tianshan, Issyk-kul lake near Tschoktal, 1800m, 23 vi 1931, *Smirnow*.

The species is certainly more widely distributed in the inner ranges of the Himalayas than the very few records suggest. The records of *St. breviflora* from Gilgit in Kitamura (1964) belong to various other species, mainly *St. himalaica*. *St. breviflora* seems to be more closely related to *St. richterana*, *St. bungeana* and *St. orientalis*. From the description and illustration it looks likely that *St. aliciae* belongs to the synonymy of *St. breviflora*, as has already been concluded by most Soviet authors.

23. St. richterana Kar. & Kir., Bull. Soc. Imp. Naturalistes Moscou 14:862 (1841).

Syn.: *St. woroninii* Krasnov, Bot. Zapiski Bot. Sada St. Pétersb. Univ. 2(1):22 (1887). Type: (USSR, Kirgizia Tianshan) in montibus Andrakai et Dala Kainar, v 1886, *Krasnov* (syn. LE n.v.).

St. kuhitangi Drobov, Fl. Uzbek. 1:537 (1941): Type: (USSR, Uzbekistan) crest of Kuhitang Mts near Kisyl-Alma, 27 vi 1927, *Popov* 157 (holo. TAK n.v.).

St. jagnobica Ovcz. & Czukav., Izv. Akad. Nauk Tadžik. SSR, Otd. Estestv. Nauk 17:51 (1957); *St. richterana* subsp. *jagnobica* (Ovcz. & Czukav.) Tzvelev, Novosti Sist. Vyss. Rast. 11:14 (1974). Type: (USSR, Tadzhikistan) Hissar Mts, northern slope, Jagnob vall. 5km S of Tanfona, 2600m, 4 vi 1949, *Grigoriev* (holo. LE n.v.).

Type: (USSR, E. Kazakhstan) in lapidosis mont. Arganaty, 1840, *Karelin* 907 (lecto. LE!, selected by Tzvelev).

Densely tufted, branching intravaginal, with few culms and many vegetative shoots; *culms* 50–60cm, 3-noded, densely pubescent below the nodes; *sheaths* densely pubescent, up to 0·3mm long ciliate at the margins, at the junction with the blades densely bearded, shorter than the internodes; *ligules* obscure, up to 0·2mm long, ciliate at the margin; *blades* at the culm leaves up to 7cm long, at the vegetative shoots up to 15cm long, usually involute, 0·3–0·5mm diam., upper surface densely pubescent, beneath pubescent at the base, grading into glabrous and smooth or scaberulous toward the middle and the apical part; *panicle* exserted or the base enclosed by the uppermost leaf sheath, 20–25 × 2cm, the branches ascending, paired or solitary, setulose, with up to 5 spikelets; *spikelets* 10–15mm long, the glumes subequal, acuminate, the back usually purple with a narrow green centre, margins and tip hyaline, setulose along the middle vein, the lower 3–5-nerved, the upper 7-nerved; *anthecium* 6–7mm long; *callus* 0·6–0·8mm long, densely bearded with the longest hairs up to 0·7mm, scar circular, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, pale, indumentum broadly seriate of 0·5mm long ascending hairs, only the marginal hairs almost reaching the top, the other ones terminating about 1–2mm below, the top with a coronula of 0·5–1·5mm long hairs; *awn* 6–7cm long, bigeniculate at 1·4–1·6 and 2·5–2·7cm, minutely pubescent throughout, columna densely

twisted, with 0·2mm long hairs, seta falcate with 0·5mm long hairs; *palea* equalling lemma in length, glabrous except a tuft of a few hairs at the apex, minutely papillose in upper part; *lodicules* 1·5mm long, lanceolate, glabrous, the posterior one slightly shorter and distinctly narrower; *anthers* 3–4mm long, yellow, unbearded, exserted; *ovary* with 2 styles; *caryopsis* not seen; 2n unknown.

Central Asiatic: from the Northern Transcaspian lowlands and SW Pamir Alai to the Tianshan and the W Gobi.

In the area and in adjacent Pamir Alai in montane and subalpine cushion- and other shrublands, 2700–3000m.

Specimens studied:

AGHANISTAN. Ghazni: Okak NE of Dashte-e-Nawor, 3000m, *R.* 17729 (W, E); Nawor pass, 6km E, 2960m, *Veldkamp* 7323 (L).

These are the first records of *St. richterana* for the *Flora Iranica* region. The next locality is the Kuhitang just N of the Amu Darya. In Bor (1970) the Rechinger specimen was erroneously cited under *St. bungeana*, which is somewhat similar in habit, but clearly differs in its scabrous awn, anthecium of 4·5–5mm only and a different lemma indumentum. For comparison the type and a Lipschitz gathering from the Tianshan have been used. The Afghan specimens differ only in minor details: the lemma indumentum is only 0·5mm long instead of 0·5–1mm, the awn is longer with 6–7cm against 4–4·5 and the seta hairs are longer with 0·5mm at the base against 0·2–0·3 in the type.

Beside the generally accepted inclusion of *St. woroninii*, *St. kuhitangi* and *St. jagnobica* are also placed as synonyms under *St. richterana*. This has been done already by Pazij (1968) and more moderately, in retaining subspecific level, by Tzvelev (1974, 1976). *St. kuhitangi* has the same comparatively long awns as the Afghan specimens. The closest relatives of the species are probably *St. bungeana* and *St. breviflora*.

24. St. purpurea Griseb., Nachr. Königl. Ges. Wiss. Georg-August-Univ. 3:82 (1868).

Syn.: *Ptilagrostis purpurea* (Griseb.) Rosh., Fl. SSSR 2:76 (1934).

Lasiagrostis tremula Rupr. in Ost.-Sack. & Rupr., Mém. Acad. Imp. St. Pétersb., Sér. 7, 14 (4):35 (1869). Type: (China, Sinkiang) Sarymeki Tal, südl. Abhang des Tianschan, 28 vii 1867, *Osten-Sacken* (holo. LE n.v.).

St. semenowii Krasnov, Bot. Zapiski Bot. Sada St. Pétersb. Univ. 2(1):22 (1887). Type: (USSR, Kirgizia) in valle flum. Sary-Jassy in monte Thian-Schan non procul ab alpe Chan-tengri et in trajectum Turguen-Aksu 1886, *Krasnov* (syn. LE n.v.).

St. pilgeriana Hao, Bot. Jahrb. Syst. 68:583 (1938). Type: (China Tsinghai) Kokonor, im Tsi-gi-gan-ben Gebiete, 3900m, 25 viii 1930, *Hao* 1009 (holo. PEK n.v.).

Type: (China) Tibet, Gnari (Nari) Khorsum, 5000m, 5–15 ix 1855, *Schlagintweit* 7116 (holo. GOET!; iso. BM!, LE n.v.).

In small, dense tufts, branching intravaginal, with few culms and numerous vegetative shoots; *culms* (18–)25–40cm, 2–3-noded, glabrous, below the panicle scaberulous, except the uppermost part covered by the sheaths; *sheaths* glabrous, scaberulous or pubescent, the margins not

ciliate; *ligules* acute, ciliate at the apex, at the culm leaves up to 6mm, at the vegetative shoots up to 4mm long; *blades* greyish green, usually involute, 0·3–0·4mm diam., at the culms up to 8cm long, at the vegetative shoots up to 15cm long, upper surface pilose to pubescent, beneath glabrous, grading into scaberulous to almost smooth towards the apex; *panicle* usually exserted, lax, 5–12 × 1–5cm, the branches ascending, filiform, often somewhat flexuose, the lower ones usually paired, up to 5cm long, sparsely setulose, with 1–2 spikelets; *spikelets* 14–16mm long, the glumes subequal, purple with hyaline margins, smooth, lanceolate, tapering into a long hyaline tip, 5-nerved; *anthecium* 8–9mm long; *callus* 1·5–2mm long, densely bearded, with the longest hairs up to 0·8mm, sharply pointed, scar narrow-elliptic, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, brownish or purple, with 2 minute apical lobes of 0·1–0·25mm, completely covered by a loose, diffuse indumentum of 0·3mm long ascending to appressed hairs; *awn* 5–7cm long, plumose throughout, bigeniculate at 1 and 1·7cm, lower part of columna strongly twisted, upper part slightly so, seta falcate or somewhat flexuose, hairs at the base of columna 1–1·5mm long, increasing in length to 2mm at the base of the seta and again gradually becoming shorter towards the apex; *palea* 0·3mm shorter than lemma, 2-nerved, with a line of 0·5mm long hairs up to $\frac{3}{4}$ between the veins; *lodicules* subequal, 1·2–1·4mm long, lanceolate, acute, glabrous; *anthers* 2·5mm long, yellow, unbearded; *ovary* with 2 styles and feathery stigmas; *caryopsis* 5–6mm long, embryo about 1mm long; 2n unknown.

Central Asiatic: from the Pamir NE-wards to the Tianshan and SE-wards to Tibet (see Tzvelev 1968, map 4); expected also in the Afghan Pamir.

A characteristic species of alpine steppes, particularly on sandy ground, from 4000–5000m.

Specimens studied (6):
INDIA. Kashmir; Tibet occ. (Ladakh), *Thomson* s.n. (K); Rupshu, Salt Lake, 5000m, *Lance* 322 (K).-Him. Pradesh: Garhwal, Mana to Sarsutti, c. 3500m, *Schlagintweit* 8622 (G).
CHINA. Tibet, Chumbi et Phari, 1879, *Dungboo* (CAL).
USSR. Tadzhikistan: Pamir, Akberdy, 1862, *Nasarow* (G).—Kirghizia: Tianshan, Sary-tschat vall. near Kolpakovski glacier, 3400m, 10 viii 1947, *Wyschiwkin* (E).

Roshevitz (1934) and Ovczinnikov & Czukavina (in Ovczinnikov, 1957) placed the species in the genus *Ptilagrostis*, but the resemblance is merely superficial. By its long, pointed callus and totally enclosed palea *St. purpurea* is a typical member of the genus '*Stipa* s. str.', as has already been realized by Tzvelev (1968). However, by its narrow elliptic scar it comes closer to sect. *Pseudoptilagrostis*. Against this placement are again the long cylindrical part of the callus, and the awn indumentum with longer hairs at the seta than at the columna.

The diagnoses of *Lasiagrostis tremula*, *St. semenowii* and *St. pilgeriana* justify their inclusion in *St. purpurea*, in which I follow Pazij (1968) and Tzvelev (1968).

25. St. orientalis Trin. in Ledeb., Fl. Alt. 1:83 (1829).
Type: (USSR, E Kazakhstan) in rupium fissuris montis Arkaul, 17 v 1826, *C. A. Meyer* 171 (lecto. LE!, selected by Tzvelev).

Densely tufted, branching intravaginal, with some culms and numerous vegetative shoots; *culms* (7–)15–30(–45)cm, (2–)3-noded, often somewhat geniculate, glabrous or shortly pubescent; *sheaths* glabrous or shortly pilose, the lower ones at the margins 0·5–0·7mm long ciliate, the uppermost one inflated, up to 4mm wide, often purplish, ensheathing the panicle, the lower usually shorter than the internodes; *ligules* at the culms 1–3mm long, acute, at the vegetative shoots 1–2·5mm long, obtuse to acute, densely and up to 1mm long ciliate at the margins, setulose on the back; *blades* usually involute, (0·2–)0·3–0·4mm diam., upper surface densely pubescent, beneath glabrous or shortly pubescent near the base, scabrous or scaberulous throughout or in lower part only, at the culm leaves up to 5cm long, at the vegetative shoots 5–12cm long; *panicle* (4·5–)5–7(–8) × 1cm, more or less enclosed, the branches erect to ascending, up to 1·5cm long, setulose, the lower ones paired with up to 2 spikelets; *spikelets* 1·6–2·2cm long, the glumes subequal, lanceolate, hyaline with a pale green back, eventually somewhat purplish tinged, glabrous, the lower one 3-nerved, the upper 4–6-nerved; *anthecium* (6–)7–9mm long; *callus* 1–1·3mm long, densely bearded, with the longest hairs up to 1mm, scar circular, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, greenish to pale brown, indumentum seriate, of 0·5–0·8mm long appressed to ascending hairs, with the dorsal and the marginal rows reaching up to $\frac{2}{3}$ or to the top, the lateral ones sometimes shorter, below the apex with a coronula of 0·5–0·8mm long hairs, otherwise papillose; *awn* (4–)5–7(–10)cm long, bigeniculate at 0·8–1·1 and 1·5–2cm, but lower geniculation often indistinct, columna in lower part strongly twisted, in upper part only slightly so, seta falcate, hairy throughout, with the hairs increasing in length from 0·2–0·5mm at the base of the columna to 4·5–6mm in the lower part of the seta and again gradually shorter towards the apex; *palea* equalling lemma in length, glabrous; *lodicules* 1·5–1·9mm long, subequal or the upper one shorter, lanceolate, acute; *anthers* 3–4mm long, yellow or purplish, unbearded, exserted; *ovary* with 2 styles; *caryopsis* 5–6(–7)mm long, embryo 1·7–2mm long, hilum reaching the top; 2n = 44.

Central Asiatic: continuously distributed from NE Afghanistan via Kazakhstan to E Siberia and via the inner ranges of the Karakorum and the Himalayas through N Pakistan, N India and S China; outposts in C Afghanistan and in the Alburz Mts of N Iran (Fig. 14).

A typical component of steppes and steppe-like communities of the upper montane, subalpine and lower alpine belts, in the area from 2800–4800m.

Specimens studied (24):

IRAN. Mazanderan: W Alburz Mts below Kuh-e-Valadj, Kats-eban, 3485m, *Klein*.

AFGHANISTAN. Ghazni: Nawar pass betw. Okak and Behzud, 3150m, *R.* 17863 (W).—Badakhshan (Wakhan): Upper Darya-e-Istmoch, 3900–4000m, *A.* 8115; Upper Wazit vall., 3800–4000m, *A.* 8193; Qala-e-Panja, 2km S, 2800m, *A.* 8230; Kishnikkan vall., 3600–4000m, *Gamerith* 95 (W); (4 more).

PAKISTAN. Chitral: Yarkhun, Vedinkot, 3300m, *Bowes Lyon* 1012 (BM, E, K).—Gilgit: N of Hindukush, *Giles* 27 (E, K).—Baltistan: Satpura Nullah above Skardu, 2900–3300m, *St.* 20331 (NY); Shyok vall. betw. Blaghar a. Kuru, 2600m, *St.* 20864 (NY).

INDIA. Kashmir, Ladakh: Zaskar, betw. Padam a. Abrang, *Schlagintweit* 7163 (BM, GOET); Tog, 3950m, *Koelz* 2619 (NY), 2620 (K).—Him. Pradesh: Spiti. Kibar, 4250m, 3 VIII 1972, *Bhattacharyya* (BSD); Losar, 4100m, 26 vii 1972, *Bhattacharyya* (BSD).

USSR. Tadzhikistan; Pamir: Murghab vall., Tzvelev 254 (W).—Kirghizia: Ajagus, *Kar. & Kir.* 522 (G).

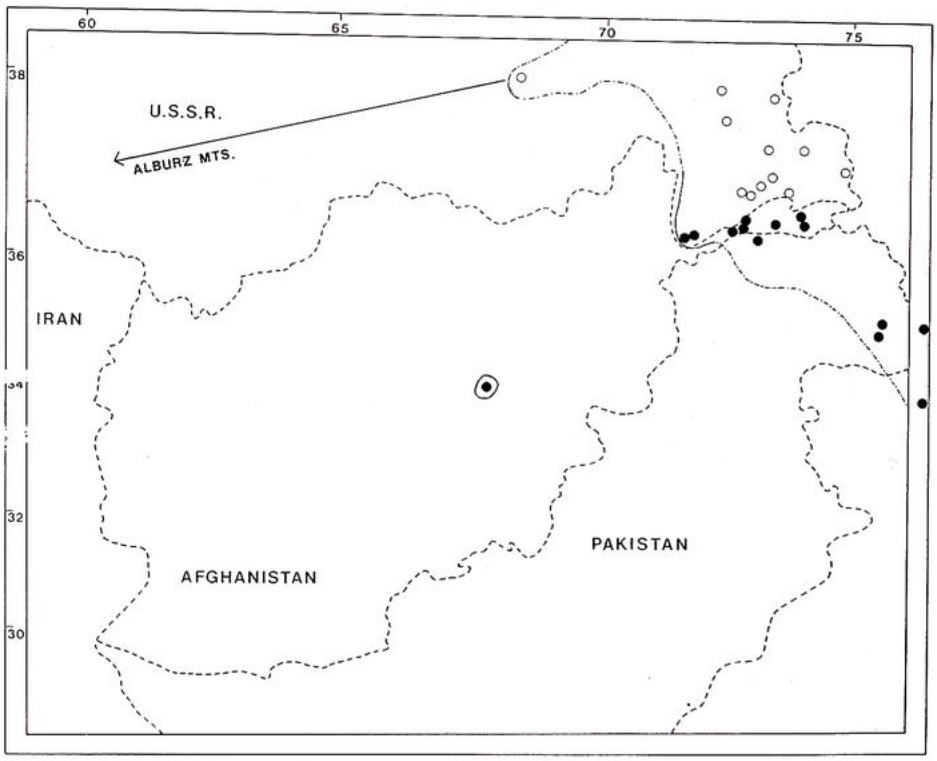

FIG. 14. Distribution of *Stipa orientalis*. ○ literature records according to Ovczinnikov (1957).

The species displays only moderate variation. Most characteristic is the combination of a short awn with a long plume on the seta. Most similar in that respect and likewise in general habit is *St. caucasica*, which grows in the same area and often alongside *St. orientalis*. Accordingly, both are occasionally found mounted together on the same sheet, and thus confused in several herbaria. The most useful discriminating characters of *St. caucasica* are the distinctly unigeniculate awn and the much shorter ligule. For the relationship between both species and hybridization see p. 450.

26. St. himalaica Rosh., Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 5:11 (1924).
Type: (Pakistan) Gilgit, Bres, 2200m, *Giles* 417 (lecto. LE n.v.; iso. K!, E!, selected by Tzvelev).

Densely tufted, with some generative and numerous vegetative shoots, branching intravaginal; *culms* (20–)25–40(–45)cm, 3-noded, pubescent; *sheaths* glabrous or pubescent, the lower ones at the margins up to 0·7mm long ciliate, the upper ones somewhat inflated and ensheathing the panicle; *ligules* acute, ciliolate, at the vegetative shoots 1–3mm long, at the culm leaves up to 6mm; *blades* involute to conduplicate, 0·3–0·4mm diam., upper surface densely pubescent, beneath glabrous, scaberulous or

scabrous, at the vegetative shoots up to 15cm long, at the culms up to 8cm; *panicle* (5–)10–15 × 1cm, at the base or up to half enclosed by the sheath of the uppermost leaf, the branches erect to ascending, up to 3cm long, glabrous to sparsely setulose, the lower ones paired, with up to 2 spikelets; *spikelets* 2–3·5cm long, the glumes subequal, almost linear, hyaline with green veins, at the dorsal line eventually scattered setulose, 7-nerved; *anthecium* 10–11·5mm long; *callus* 1·5mm long, pungent, densely bearded, with the longest hairs on the ventral side up to 2mm, scar circular, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, greenish to pale brown, completely covered by a seriate indumentum of 0·7–1mm long ascending hairs, below the apex with a coronula of 1–2mm long hairs; *awn* 9–12(–14)cm long, bigeniculate at (1–) 1·4–1·7 and at 2–2·5cm, but lower geniculation often indistinct, plumose throughout, hairs increasing in length from 2–3·5mm at the base of columna to 4–5mm in the lower part of the seta, towards the apex again gradually shorter, columna slightly twisted, seta somewhat flexuose; *palea* about as long as the lemma, with scattered hairs between the veins; *lodicules* lanceolate, 1·3–1·6mm long, the upper one slightly longer and with acute apex; *anthers* 5–6mm long, unbearded, exserted; *ovary* with 2 styles; *caryopsis* 7–8mm long, embryo 2mm long, hilum reaching the top; 2n unknown.

NW Himalayan: from E Afghanistan through N Pakistan to NW India, probably also in SW China (Tibet) (Fig. 15).

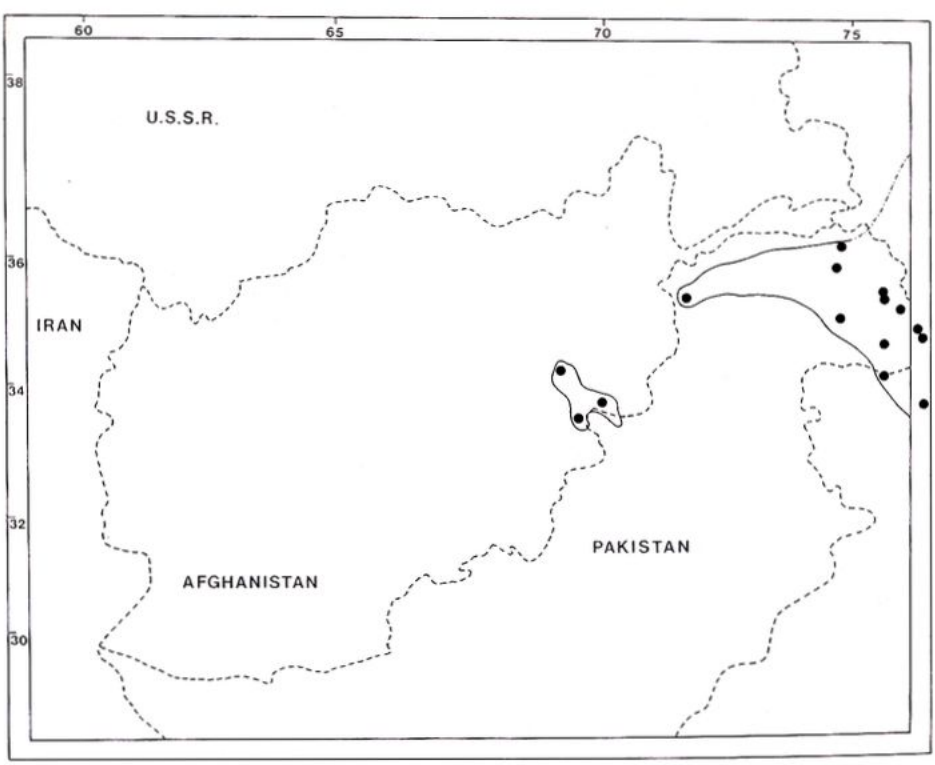

FIG. 15. Distribution of *Stipa himalaica*.

According to the scarce information the species is a rather common component of montane and subalpine steppes and open shrublands on rocky slopes from 1800–3500m and is restricted to areas with some summer rain.

Specimens studied (32):

AFGHANISTAN. Kabul: Above Spul Baba N of Maipar, 1700m, in rocks, *F.* 2863.—Paktya: Kurram vall. betw. Chamkanni a. Ahmad Khel, 1850m, *R.* 35641 (W, E); ibid. in Sakhway Tangi, 1850m, *F.* 1837.—Nangarhar: N slopes of Safed Koh S of Oghz, 1800–2100m, *A.* 10312.

PAKISTAN. Chitral: Bambaret, 2500m, *Bowes Lyon* 638 (BM, E) Gilgit: Betw. Astor a. Bunji, 1300–2300m, *Schmid* 1811 (G); ibid., *Achmad* 3 (K); Hunza betw. Nagir a. Baltit, 2300–2500m, *Lobbichler* 429 (M); Oltali Chish, 3100m, 10 vi 1955, *Nakao* (KYO).—Baltistan: Biafo glacier, 3100m, *Reiser* (Z); Barpu glacier, 2900–3600m, *Scott-Russell* 1152 (BM, E) lowermost Shyok vall., *Schlagintweit* 5820 (GOET); Blaghar to Kuru, Shyok vall., 2600m, *St.* 20864 (RAW); (5 more).

INDIA. Kashmir: Dras, Malaqan, *Gammie* s.n. (K); Jatpur Nullah, 3000–3300m, *Duthie* s.n. (CAL, K).—Ladakh: Reg. alp., 1861, *Thomson* (E, G, GOET, K, W); Tankse, 4000m, *Koelz* 2458 (NY); Leh, *Schlagintweit* 1337 (WU); Suru, 3000m, *Meerbold* 1950 (G); (4 more).—Himachal Pradesh: Pooh, Kinnaur distr., above PWD resthouse, 3050m, 7 vi 1972, *Janardhanan* (BSD).

Although *St. himalaica* was described as early as 1924, it has very often been confused with either *St. orientalis* or *St. arabica.* Indeed, its area overlaps with that of *St. orientalis* in the N and NE and with *St. arabica* in the W and NW, but the differences are striking. From *St. arabica* it differs by the much longer hairs of the awn, especially in its lower part, the 2-styled ovary and the clearly seriate lemma indumentum. The closest relative of *St. himalaica* is certainly *St. orientalis*, but from that it is easily distinguishable by its longer spikelets and anthecia, by the lemma covered up to the top by much longer hairs and by the longer plume of the awn, particularly in its lower segment.

The records from Afghanistan are cited here with some hesitation. The localities are rather distant from the main area of the species and at somewhat lower altitudes, but in areas which likewise receive a certain amount of summer rain. The identity in all important characters does not allow another placement.

27. St. lessingiana Trin. & Rupr., Spec. Gram. Stip.: 79 (1842).

Type: (USSR, S Ural) In gubernio Orenburg, *Lessing* 413 (holo. LE!).

Densely tufted, with some generative and numerous vegetative shoots, branching intravaginal; *culms* (40–)50–70(–85)cm, (2–)3(–4)-noded, glabrous, papillose or pubescent, often only below the nodes; *sheaths* glabrous or papillose, at the margins very short or up to 0·4mm long ciliate, longer than the internodes; *ligules* truncate to rounded, ciliolate with hairs up to 0·3mm long, at the vegetative shoots up to 0·2mm or almost undeveloped, at the culm leaves up to 2(–5)mm long; *blades* involute to conduplicate, 0·3–0·5mm diam., upper surface densely pubescent, beneath either scabrous throughout or only in the apical part, at the vegetative shoots up to 35cm long, at the culms up to 10(–15)cm; *panicle* (10–)15–20(–25) × 1·5cm, partly enclosed by the uppermost sheath, the branches erect to ascending, up to 4(–7)cm long, more or less setulose, the lower ones paired, with up to 3 spikelets; *spikelets* 2·5–3(–3·5)cm, the glumes subequal, narrow-lanceolate to almost linear, hyaline with a

greenish back or purplish tinged, setulose at the dorsal line, the lower one 3–5-nerved, the upper 7–9-nerved; *anthecium* 9–11(–12)mm long; *callus* 1·5–2mm long, pungent, densely bearded, with the longest hairs on the ventral side up to 1·5mm, scar elliptic, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, pale, almost continuously covered by a very dense indumentum of 0·6–1·3mm long hairs, eventually the uppermost 0·5–2·5mm glabrous and scabrous, below the apex usually with a coronula of 1–1·5mm long hairs; *awn* (14–)17–22cm long, bigeniculate at 2·5–3·5(–4) and at 3·5–5(–5·5)cm, columna glabrous, smooth, strongly twisted, seta plumose with 2–2·5(–3)mm long spreading hairs, somewhat flexuose; palea equalling lemma in length, glabrous; *lodicules* lanceolate, acute, glabrous, the lower ones 2–2·5mm long, the upper only 1–1·3mm; *anthers* 3·5–5mm long, unbearded or, more rarely, bearded, yellow, usually remaining included; *ovary* with 2 styles; *caryopsis* 6–8mm long, embryo 1·5–2mm long, hilum reaching the top; 2n = 44.

From Romania through S Russia to Mongolia, southwards down to C and E Anatolia, Transcaucasia, W and N Iran, Soviet Middle Asia (Fig. 16).

The species is a typical component of steppes and steppe-like communities and strictly bound to areas with some summer rain. In the area under concern it grows from 900 to 2700m, but outside Transcaucasia it is rare.

Specimens studied (34):

TURKEY. Ankara: hills near Ankara, *Birand & Z.* 2941 (HUJ). Sivas: above Karabaïr, 1910–2000m, *Buttler* 15657 (M); 65km W Sivas, 1300m, *V.* 71.587. Kars: 8km from Kars to Susuz, 1800m, *D.* 30590 (E). Van: Güzel Dere pass, 34km from Başkale to Hoşap, 2800m, *D.* 45975 (E).

IRAN. Tehran: Ab Ali, 2390m, *Klein* 7453. Markazi: Arak, 1902, *Strauss* (JE). Mazanderan: Moh. Reza Shah Nat. Park, Almeh, 1500–1800m, *R.* 53065 (W); Kuh-e-Shahvar near Hadjilang, 2400–2600m, *R.* 6200 (W). Semnan: Pass N of Firuzkuh, 2100m, *Pa.* 4327 (G); Kuh-e-Nizva near Tarou, 2250m, *W.* 1161 (BG, E, K, W, IRAN); Kuh-e-Ghatry N of

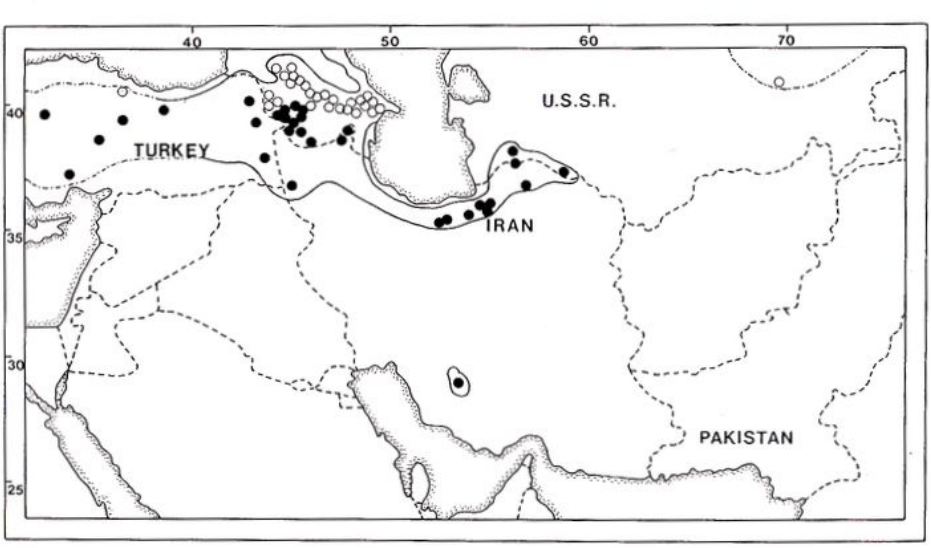

FIG. 16. Distribution of *Stipa lessingiana*. ○ literature records according to various sources.

Shahrud, 1920m, *Foroughi* 8995 (THR); Abr pass NE of Shahrud, 1800–1850m, *R.* 55463 (G, W); ibid., 1650m, *Pa.* 8139 (G). Fars: Kuh Chah Siah near Sivand, *Stapf* 1526 p.p. (K, W). USSR. Armenia: Novo-Bajazet. Near Karavansaraj Darasi, 2200m, 18 vii 1923, *Grossh.* (ERE); above Satanakhach, 2300–3000m, 17 vii 1923, *Grossh.* (ERE); Keity-Janych, near Kyzil-Wank, 2470m, 28 vii 1923, *Grossh. & Zedelmeier* (ERE); near Kyzil-Bulach, 2100m, 28 vii 1923, *Grossh. & Zedelmeier* (ERE). Spitak. Near Nalbaid, 15 vii 1955, *Karapetian & Aslanian* (ERE). Leninakan: Dzhadhzur pass, 7 viii 1954, *Mulk.* (ERE). Araban. Near Karadjoran, 8 vii 1926, *Schelk.* (ERE). Abovon. Near Vokhgaberd, 30 vi 1965, *Gabrielian & Avetisian* (ERE); Ilan-Dagh, Ararat vall., 6 vi 1959, *Gabrielian* (ERE). Vedi. Betw. Khosrov a. Birali, 31 vii 1963, *Mulk.* (ERE). Ashtarak: Muradtapa, 15 v 1951, *Mulk.* (ERE); Egvard plains, 1 vii 1959 Mulk. (ERE). Kotaik: Gadis Mts, 1700m, 1 vii 1926, *Schelk.* (ERE).— Azizbekov: above Khachik, 2300m, 4 viii 1955, *Gabrielian* (ERE). Nakhichevan: Darri-Dagh Mts, 21 v 1923, *Grossh.* (ERE); betw. Aznaberd a. Karaush, 2 v 1960, *Takhtajan et al.* (ERE). Azerbaijan: Kazakh: Near Tatlu, 6 v 1937, *Gurvich* (NY). Turcomania: Ludsha in Ashkhabad region, 2100m, *Litv.* 2172 (W); SW Kopet Dagh, Kara Kalinsk. distr., 1200m, 5 vi 1974, *Nikitin* (L).

The examined material is very homogeneous. The var. *zederbaueri*, described by Hackel (in Zederbauer, 1905) from Erdschias (Erçiyas) Dagh in Anatolia and characterized by the absence of the coronula is here included within the normal range of variation, because transitional forms with a few scattered coronula hairs are not rare. Superficially, *St. lessingiana* resembles *St. hohenackerana*, particularly in awn characters. However, it differs in several important respects: the completely smooth surface of the columna, the different lemma indumentum and the much shorter ligules. Furthermore, with its 2-styled ovary it belongs to another section.

28. St. turkestanica Hackel, Trudy Imp. S.-Peterburgsk. Bot. Sada 26:59 (1910).

Syn. *St. trichoides* Smirnow, Repert. Spec. Nov. Regni Veg. 21:233 (1925). Syntypes: USSR, Turcmenia, Ludsha near Ashkhabad, 2150m, *Litvinov* 2222 (LE!) and Tadzhikistan, Alai Mts near Langar, 28 vi 1904, *Fedtschenko* (LE!).

Type: (USSR, Tadzhikistan) Shugnan, Dshidak, in valle fl. Badam-dara, 27 vii 1904, *Fedtschenko* (holo. W!).

Densely tufted, with some generative and numerous vegetative shoots, branching intravaginal; *culms* (20–)25–50cm, 3-noded, scabrous, below the nodes often shortly pubescent, often scarcely surpassing the leaves; *sheaths* glabrous and smooth or scaberulous, more rarely the lower ones pubescent, at the margins usually up to 1·5mm long ciliate; *ligules* acute, at the margins or only at the tip ciliate or ciliolate, on the back glabrous or papillose, at the vegetative shoots 2–6mm long, at the culm leaves 5–8mm; *blades* involute to conduplicate, 0·2–0·4(–0·5)mm diam., glaucous to greyish green, usually stiff, upper surface pubescent, beneath glabrous, very scabrous, at the vegetative shoots up to 35cm long, at the culm leaves up to 12cm; *panicle* 8–12(–14) × 1·5–2·5cm, exserted or at the base ensheathed by the uppermost leaf, the branches erect, up to 2·5cm long, setulose, paired or solitary, with 1–2 spikelets; *spikelets* (2·2–)2·6–3·5 (–4·2)cm long, the glumes subequal, acuminate, with pale green back and hyaline margins and tip, on the main vein in the upper part setulose, the lower one 5-nerved, the upper 7–9-nerved; *anthecium* (9–)9·5–12·5(–14)mm long; *callus* (1·2–)1·5–2(–2·5)mm long, pungent, densely bearded, with the

longest hairs on the ventral side up to 1·2mm, scar elliptic, peripheral ring dorsally flattened and much protruding; *lemma* pale green, indumentum of 0·5mm long ascending to spreading hairs distinctly 7-seriate, the dorsal line up to $\frac{1}{2}$–$\frac{2}{3}$ the marginal lines up to 2–3mm below the top, otherwise densely papillose, coronula absent; *awn* (8–)10–16(–19)cm long, bigeniculate at (1·3–)2–2·6(–3·5) and at (2·3–)3–4(–4·5)cm, lower geniculation sometimes indistinct, columna glabrous or scaberulous, twisted, seta plumose with 4·5–6·5mm long hairs, flexuose; *palea* equalling lemma in length, glabrous or with a dorsal line of hairs up to $\frac{1}{2}$; *lodicules* subequal, 2–2·3mm long, lanceolate, acute, glabrous, the upper one narrower; *anthers* 5–6mm long, purple, unbearded, exserted or not; *ovary* with 2 styles; *caryopsis* 6·5–7·5mm long, embryo 2mm long, hilum almost reaching the top; 2n = 40.

From the Alburz Mts in N Iran through the Kopet Dagh, the higher mountain ranges in Khorasan, Kerman and the mountains of Afghanistan up to Baluchistan, N Pakistan and Himachal Pradesh; northwards via the Pamir-Alai ranges up to the Tianshan (Fig. 17).

A very common and typical component of open woodlands and primary and secondary open communities from the montane to the lower alpine belt from (1300–)2000–3400(–4000)m with a moderately dry summer but high winter and early spring precipitations, preferably on shallow soils and often in fissures of rocks.

Specimens studied (57):

IRAN. Tehran: Hazarband, *Gauba* 1234 (W). Semnan: betw. Shahmirzad a. Chashme, 2800m, 1 viii 1972, *Iranshar & Zargani* (IRAN); Nekarman c.15km N Shahrud, 2000m, *Assadi* 21055 (THR); Kuh-e-Peyghambar in Touran Protected Area, 1600–2200m, *F.* 13764. Kerman: Laleh Zar, Khormuj, Kuh-e-Faramarz, 2800–3400m, *Moussavi & Tehrani* s.n. (IRAN); Baghin-Sanghur pass., *R. et al.* 2996e (IRAN).

AFGHANISTAN. Bamyan: Band-e-Amir, 3200m, *V.* 2251, 2773 (W); ibid., Jedacel vall. 3200m, *Dieterle* 1350 (M); 15km E of Band-e-Amir, 3350m, *Kukkonen* 7263 (H). Ghazni: 16km W

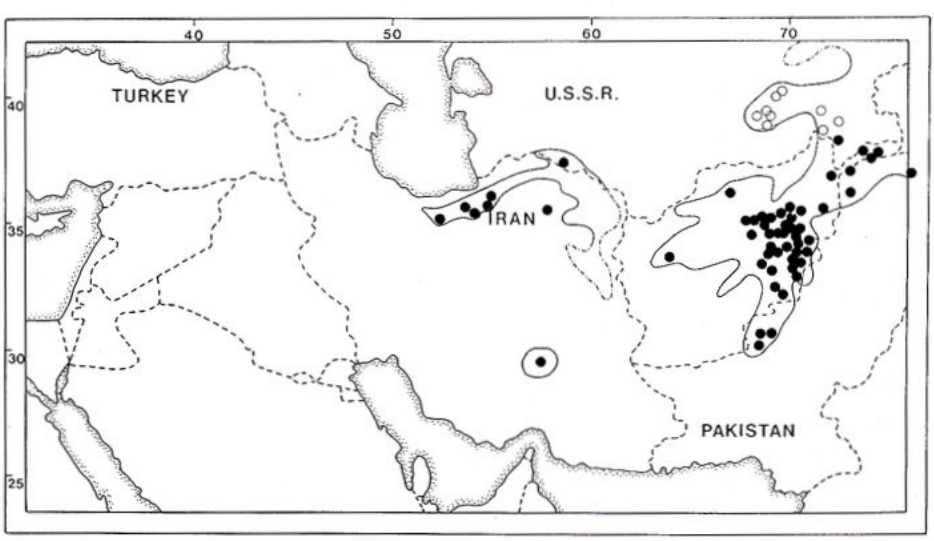

FIG. 17. Distribution of *Stipa turkestanica*. ○ literature records according to Ovczinnikov (1957).

of Ghazni at road to Nawor, 2300m, *Grey-Wilson & Hewer* 662 (K); Mts SW of Dasht-e-Nawor, 3300m, *F.* 1514; betw. Miradina a. Ghouch pass N of Sang-e-Masha, 3300m, *R.* 17627 (W). Parwan: S Salang vall. at Jabal-us-Saraj, 1350m, *F.* 2663. Kapisa: Nidjrao vall., 2500m, *Neub.* 230a, 294 (W); ibid., 3300m, *Neub.* 232 (W). Kabul: Paghman Mts above Razak, 2500m, *F.* 1008; Kabul-Aliabad, *V.* 1555; Korogh Koh SW of Kabul, 2800m, *Gilli* 404, 416, 417 (W); Shewaki, 8km E of Kabul, 2400m, *Gilli* 415 (W); Upper Tang-e-Gharu, 1750m, *F.* 2824, *P.* 30256. Usman Khel near Sarobi, *V.* 1047. Maydan: Wardak, V. 1950; Unai pass, *Neub.* 527 (W). Paktya: Altimur pass NW Gardez, 2800m, *R.* 32005 (W); ibid., *V.* 71.242; Sete Kandaw pass, 2700m, *V.* 71.413a; Kurram vall., *Aitch.* 445 (K); Kotgay, *V.* 71.080, 71.082; Wec Paray, 3220m, *V.* 71.369; Urgun, 9km S, *V.* 71.203; Urgun, *V.* 71.211; betw. Zerok a. Spera, *V.* 71.312. Kunar: Spuk pass from Waigalak to Bardadesh, 2500m, *Kerstan* 1197 (W).—Badakhshan: Zebak, 10km SE, 2800–2900m, *Aichhorn* in *F.* 6991. Wakhan, upper Darya-e-Istmoch, 3900–4000m, *A.* 8113; betw. Qara Qabchal pass a. Samestan-e-Bahrak, 3300–4500m, *A.* 7306; upper Baroghil vall., 3300–3800m, *A.* 7922; betw. Samestan and Langar, 3300–3800m, *A.* 7338.

PAKISTAN. Baluchistan: Loralai Rge., Karhi Kach, 2000m, *Azlam* 18 (K); Ziarat, 2600m, *St.* 657 (K); ibid., *Lace* 3818 (E); Bastargi Ziarat, *Khan* 14 (ISL); Quetta, Hannah vall., 2000–2700m, *Schmid* 128 (G); Khatuba near Quetta, 2700m, *Forest officer* 144 (ISL). Chitral: Rosh Gol NE of Tirich Mir, 3300m, *Stainton* 2806 (BM, G). Swat: Betw. Diwangal a. Dadarli pass, 3800m, *Ogino* 218 (KYO). Gilgit: Biafo glacier, 3230m, *Hartmann* 209 (Z); ibid., 3400m, 22 vii 1955 *Nakao* (KYO).

USSR. Tadzhikistan: Shugnan, Koh-e-Tezen at Dshilandy, 20 vii 1901, *Fedtsch.* (B, W).

INDIA. Kashmir: Tibet occ., 4600m, *Thomson* (K, NY). Him. Pradesh: Spiti, Hull, 3900m, 8 viii 1972, *Bhattacharyya* (BSD).

Stipa turkestanica looks like a delicate *St. pennata*. It differs mainly in the much smaller reproductive parts. Like most species distributed over a broad altitudinal range it is rather variable, especially in the length of the anthecium and awn. Furthermore, the surface of the lemma may be scaberulous as in the type, or smooth, with the latter case being much more common.

St. trichoides, which has been treated as a subspecies of *St. turkestanica* by Tzvelev (1974, 1976), is considered here as a mere form of *St. turkestanica* with somewhat larger reproductive parts. When Smirnow, loc. cit., described *St. trichoides*, he stressed as the most important difference 'a *S. turkestanica* Hack. aristis in parte nuda laevibus nec scabridis differt'. However, this statement is wrong: probably due to the fact that Smirnow did not see the holotype in W, but only a second specimen at LE identified by Hackel himself and collected by Fedtschenko three years earlier at Dshilandy. Erroneously, that one was cited as the type of *St. turkestanica* in Tzvelev (1976). In fact, the lower part of the arista in the type of *St. turkestanica* is glabrous and smooth, whereas in the second specimen it is distinctly scaberulous. Hackel's description broadly covers both conditions with the statement 'glabra vix scaberula'. As well as in Shugnan, specimens with smooth and scaberulous lower parts of the awn occur in many other parts of the region. Other morphological differences between the types of *St. turkestanica* and *St. trichoides*, as they have been summarized in Table 7 and in the keys of the Soviet Floras, seem to be better substantiated. However, with the material currently available from the area it becomes very difficult to separate two species or even subspecies, as their characters grade continuously into each other. As in many other species it is obvious that the plants with smaller organs represent mainly, but not exclusively, high-altitude populations.

A puzzling specimen is *V.* 71.242 from the Altimur pass NW Gardez in

TABLE 7

Morphological differences between the type specimens of *St. turkestanica* and *St. trichoides*

	Glumes, length in mm	Anthecium, length in mm	Awn, total length in cm	Columna, length in cm
St. turkestanica	25–30	10–11	8–10	2–2·5
St. trichoides	30–45	10–13	14–20	3–4·5

Afghanistan; it differs from *St. turkestanica* in having an almost unigeniculate awn, smooth external leaf surface and ligules with ciliate margins. Because *St. caucasica* frequently occurs with typical *St. turkestanica* in that same area, the specimen is perhaps most likely to be a hybrid, rather than representative of a new species. Similar individuals have been described as *St. alaica* by Pazij (1968). Another abnormal specimen from the Central Kopet Dagh has been described as *St. kopetdaghensis* by Czopanov (1970), but has not been seen by me. According to the author it is very close to *St. turkestanica*, differing by the unigeniculate to sub-bigeniculate awn and a coronula below the top of the awn. However, Tzvelev (1976) suggested that it might be a hybrid between *St. caucasica* and *St. zalesskii* subsp. *turcomanica* (=*St. pennata* subsp. *zalesskii*).

29. St. pennata L., Sp. Pl., ed. 1:78 (1753).

Densely tufted, branching intravaginal; *culms* (25–)30–70(–100)cm tall, glabrous or hairy below the nodes and below the panicle, usually 4-noded; *sheaths* glabrous or pubescent, the upper ones usually scabrous; *ligules* at the culm leaves rounded to acute, 2–4(–6)mm long, at the vegetative shoots acutish or bluntly tridentate (0·5–)1–1·5(–3)mm long, often ciliolate at the margin; *blades* plane, conduplicate or convolute, upper surface pilose by hairs up to 0·7mm long or glabrous, scabrous, beneath setulose to pilose by 0·3–0·7mm long ascending trichomes, or glabrous and eventually setulose at the apex, scabrous throughout or only at the base and at the apex, up to 30(–50)cm long, 1·5–3(–4)mm wide or (0·3–)0·4–0·9mm diam., *panicle* (5–)7–15cm long, 1·5–2·5cm wide, usually partly enclosed by the sheath of the uppermost leaf and surpassed by its blade, more rarely exserted, the branches erect, up to 5cm long, smooth or long setulose, paired or solitary, with 1–4 spikelets; *spikelets* (3–)4–7(–9)cm long, glumes long acuminate with a pale green back and hyaline margins and apex, occasionally purplish tinged, glabrous or sparsely setulose on the middle vein, subequal or the lower one up to 1·5cm longer, the lower usually 3–5-nerved, the upper 5–9-nerved: *anthecium* (15–)17–23(–26)mm long; *callus* (3–)4–5(–6)mm long, densely bearded, with the longest hairs on the ventral side up to 2mm, pungent, scar circular, peripheral ring dorsally flattened and much protruding; *lemma* pale brown, with a 7-seriate indumentum of 0·4–0·7mm long ascending to appressed hairs; usually the 3 dorsal ones fused up to half of their length or throughout, more rarely all fused in the basal part or all free from each other, the marginal ones always longer and often reaching up to the top or surpassing it on two minute lemma lobes, the other ones always shorter,

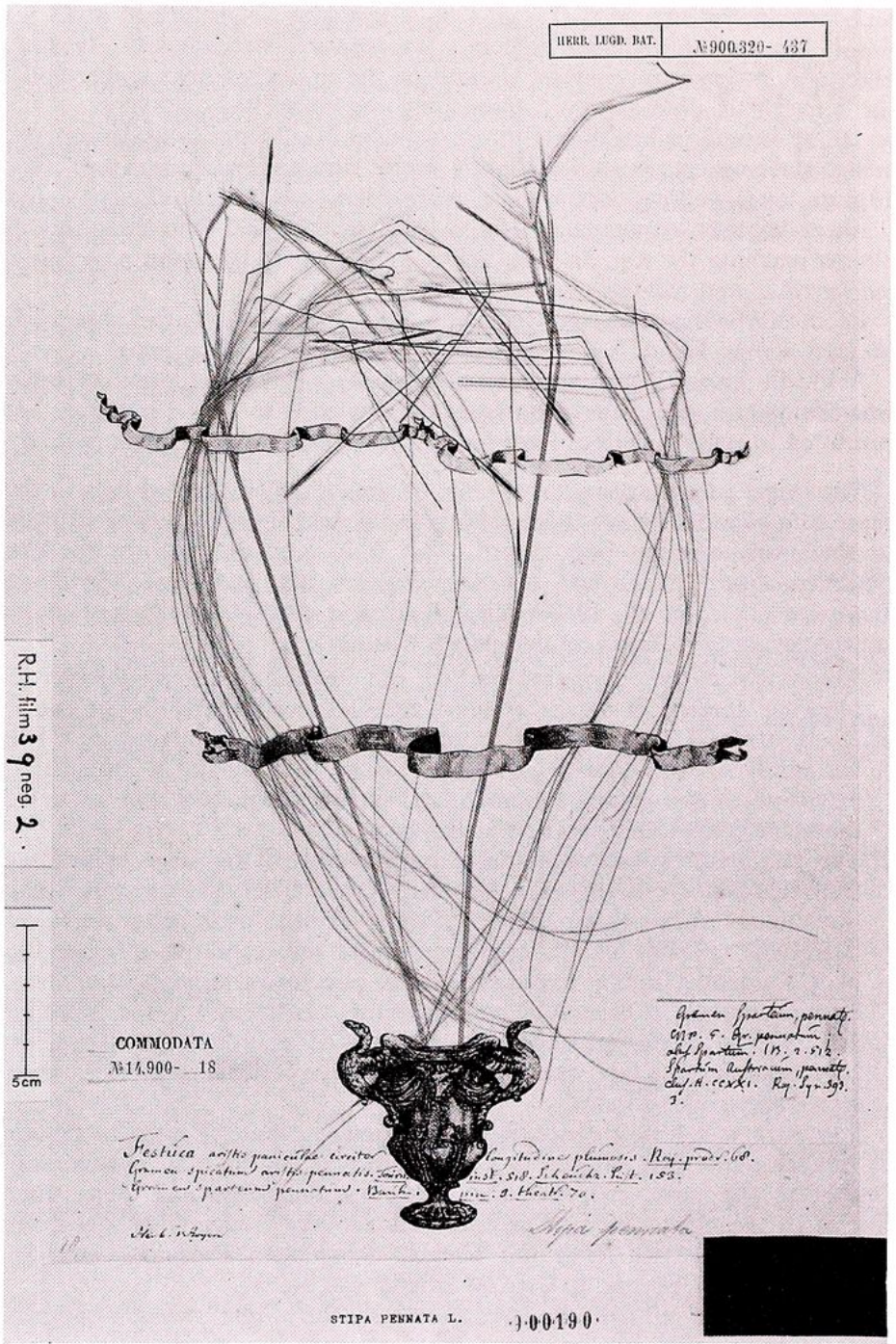

FIG. 18. Lectotype of *Stipa pennata* L.; photo B. Kieft, Rijksherbarium, Leiden, by courtesy of Dr J. F. Veldkamp.

the middle line usually longer than the adjacent ones and terminating at half way to the top; *awn* (17–)25–38(–45)cm long, bigeniculate at (3·5–)4·5–7(–9) and (5·5–)6–8(–10·5)cm, the lower part densely twisted, glabrous or very rarely pilose, smooth or the upper segment scaberulous, the upper part plumose by 5–6mm long spreading hairs, flexuose; *palea* equalling lemma in length, glabrous; *lodicules* 2·2–2·5mm long, lanceolate, acute, glabrous, the posterior slightly longer and narrower; *anthers* 5–10(–13)mm long, yellow or purplish, unbearded; *ovary* with 2 styles and feathery stigmas; *caryopsis* 10–18mm long, embryo 2–3·5mm long, hilum almost reaching the top; 2n = 32 (subsp. *kirghisorum*), 44 (subspp. *pennata, pulcherrima,* and *zalesskii* (sub. *ucrainica*).

From NW Africa and SW Europe to Siberia; southwards to S Anatolia, W Iran, Kopet Dagh, NE Afghanistan, N Pakistan and Kashmir.

A locally important component of open steppe-like communities, open woodlands and seral vegetation from the lowlands to alpine habitats, but restricted to regions with at least some summer or late springtime rain.

The '*Stipa pennata*-complex' (except *St. tirsa* Stev.) is treated here in the sense of a broad Linnean species *St. pennata,* and subspecies rank is given to the more coherent populations. This is in contrast to most modern treatments of the group (Martinovský, in his treatment for *Flora Europaea* (Tutin et al., 1980) split *St. pennata* into 24 species and many subspecies), and is based on two points mainly:

1. The weight of the characters used for the creation of a great number of separate 'species' in the *St. pennata*-complex, particularly by Smirnow, Roshevitz and Martinovský, is very light, if it is compared with the variability of the other *Stipa* species of the area: length of anthecium, extension of the lemma indumentum, surface characters and width of the blade, pubescence of the sheaths, etc.
2. The study of abundant material, particularly of the large collections from Russian Transcaucasia preserved in ERE has shown that many transitional forms exist between some of the extremely narrowly delimited 'species'. Details are given under the respective infraspecific taxa. Evidently, similar experiences have also forced other authors, e.g. Tzvelev (1974, 1976) and Scholz (unpubl. treatment for the *Flora of Turkey*), to begin reducing the number of accepted *Stipa* species. Nevertheless, they still retain many more species and subspecies than seems reasonable to me.

The extremely wide distribution of *St. pennata* may be cited in favour of smaller units. But it must be taken into account that *St. pennata* has developed the most effective anemochorous diaspores and that other species of the genus are similarly distributed over tremendous areas, for instance *St. capensis* from the Canary Islands to Pakistan, and *St. capillata* from W Europe to Central Siberia and Nepal.

Despite some efforts the treatment of the *Stipa pennata*-complex remains provisional and imperfect, since no fully convincing method has been found to deal with the wealth of populations, which differ only in minor, intergrading characters. In a predominantly cleistogamous group with a pronounced tendency towards morphological variation any hierarchical grouping poses difficulties. On the other hand, the application

of the microspecies concept is hampered by the very many transitional forms, besides the well-known immanent difficulties in its use for the non-specialist. Therefore, the subdivision of *St. pennata* into several subspecies should be considered as a compromise. In fact, they unite populations, which have one or very few comparatively small morphological characters in common. But as they might have arisen in different parts of the distributional area by parallel mutation they do not necessarily fulfil the requirements of a common origin. Furthermore, not rarely different 'species' have been collected at the same place, but as the species grows in marginal areas of the Irano-Turanian region only, no personal observations of the variability could be made in the field.

1a. Blades beneath (externally) with 0·3–0·7(–1)mm long, stiff, semi-appressed to ascending setulose hairs, very scabrous; lemma with the marginal lines of hairs reaching up to the top or almost so . . . . . subsp. **zalesskii**

b. Blades beneath smooth or scabrous, but not long setulose . . 2

2a. Young leaves usually with a fragile apical tassel of hairs; lemma with the marginal lines of hairs terminating (2–)3–4(–5)mm below the top subsp. **pennata**

b. Young leaves without a fragile apical tassel of hairs; lemma with the marginal lines of hairs reaching higher up 3

3a. Lemma with the 3 dorsal lines free from the base or shortly fused at the very base only, the marginal lines terminating 1–2mm below the top . . . . . subsp. **kirghisorum**

b. Lemma with the 3 dorsal lines fused at least along half of their length 4

4a. Plant green, lemma with marginal lines always reaching the top subsp. **pulcherrima** var. **pulcherrima**

b. Plant conspicuously glaucous, lemma with marginal lines usually terminating 1–2mm below, more rarely reaching the top subsp. **pulcherrima** var. **araxensis**

a. subsp. **pennata**

Syn.: *St. joannis* Čelak., Oesterr. Bot. Z. 34:318 (1884) (nom. superfl.).
St. lejophylla Smirnow, Bjull. Moskovsk. Obšč. Isp. Prir., Otd. Biol. 75(4):113 (1970); *St. joannis* subsp. *lejophylla* (Smirnow) Tzvelev, Novosti Sist. Vyss. Rast. 11:18 (1974). Type: (USSR) Armenia, prope pag. Karadshoran, in vulcano Karny Janych, c.2400m, 9 viii 1929, *Smirnow* (holo. MW n.v.; iso. E!, H!).

Type: Sine loc., *A. van Royen* 900.320-437 (lecto. L!, selected here) (Fig. 18).

From C Europe to Siberia, southwards scattered through Transcaucasia to NE Anatolia and NW Iran (see map 135 in Grossheim, 1939) (Fig. 19).

The subspecies *pennata* is a very rare component of steppe-like communities of subalpine and alpine environments from about 2300–3000m.

Specimens studied (19):
TURKEY. Gümüşane: Karagöl Dağ above Jaila, *Sint.* 7383 (B, JE).

USSR. Azerb.: Aginsk. Near Dcarakap, 1960m, 17 vii 1950, *Aslanian* (ERE). Azizbekov: Dzhershuk, 26 vii 1945, *Karapetian* (ERE). Echegiadzor. Karmir Sachal Mt. near Chachik, 2100–2400m, 12 vii 1972, *Malakian* (ERE). Kotaik. Gadis Mts, 14 vi 1960, *Maniakian* (ERE). Mikojan. Near Giulshduz, 15 vi 1957, *Gabrielian* (ERE). Novo Bazajet: mountains above Satanachatsk, 2700–3000m, 17 vii 1923, *Grossheim* (ERE); near Novo Bazajet, 1 viii 1925, *Novopokrovski* (ERE); (7 more).
IRAN. Azerb.: Kaleybar, c.20km SW near Aliabad, 2300–2500m, *R.* 44360 (W); ibid., *Lamond* 4916 (E); ibid., *Termé* (IRAN); Berdesin vall., 1000m, 20 v 1929, *Cowan & Darlington* (K).

The 19 specimens, which have been investigated in detail, exhibit the following characters: *sheaths* usually glabrous, more rarely covered by short, retrorse hairs; *ligules* at the vegetative shoots 1–2(–3)mm long; *blades* 0·4–0·7(–0·8)mm diam., upper surface glabrous, scabrous or loosely to densely pilose, beneath smooth, scaberulous or scabrous, at the apex usually with a tassel of caducous hairs; *glumes* 5–7(–9)cm long; *anthecium* 15–19·5mm long, marginal lines terminating (2–)3–4(–5)mm below the top; *awn* 27–37cm long.

Apart from the much shorter marginal lines of the lemma indumentum and the presence of a fragile apical tassel of hairs on the young leaves, subsp. *pennata* is much like subsp. *pulcherrima*. However, the apical tassel is sometimes missing. That may be caused in some cases by their caducous nature, but in some populations they evidently never develop. Such forms have been described as *St. lejophylla* by Smirnow (1970) and the same condition is reported from the more northern populations described as *St. pennata* subsp. *joannis* f. *sabulosa* Pacz. (=*St. pennata* subsp. *sabulosa* (Pacz.) Tzvelev). In the middle and upper Aras valley and its tributaries specimens without a tassely leaf are found, which intergrade to subsp. *pulcherrima* var. *araxensis* in some leaf characters (scabrous and pruinose surface and width of the blades) and even in the length of the marginal lines of the lemma.

The name *St. pennata* has been rejected by Scholz (1968) as a nomen ambiguum. But earlier Mansfeld (1939) tried to pin-point the name to those populations, which have often been called *St. joannis* Čelak. Rauschert (1970), Kerguelen (1975) and most soviet authors followed Mansfeld. Confusingly, Martinovský (in Tutin et al., 1980) maintained *St. pennata* in the sense of Mansfeld and *St. joannis* Čelak. as well, but the discriminating characters cited by him are not at all convincing. After the investigation of the syntypes of *St. pennata* in LINN, UPS (Burser herb.) and L (van Royen herb.) it was possible to choose a specimen which fulfills the technical requirements of lectotypification. The specimen consists of 4 culms with abundant anthecia of 14·5–17mm, the marginal lines of hairs on the lemma terminating 1·5–3mm below the top and the dorsal row being 1–1·5mm longer than the lateral ones.

b. subsp. **kirghisorum** (Smirnow) Freitag, **comb. et stat. nov.**
Syn.: *St. kirghisorum* Smirnow, Repert. Spec. Nov. Regni Veg. 21:231 (1925).
Type: (USSR, Kazakhstan) Prov. Semipalatinsk, m. Bokaj, *Kossinsky* (holo. LE n.v.).

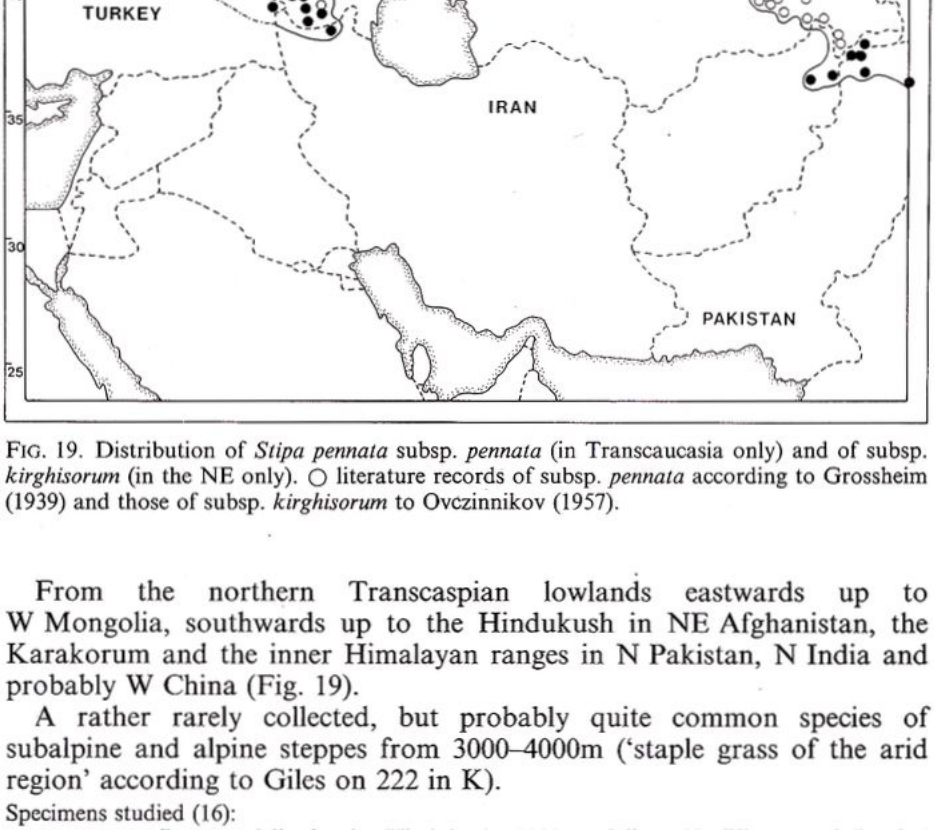

FIG. 19. Distribution of *Stipa pennata* subsp. *pennata* (in Transcaucasia only) and of subsp. *kirghisorum* (in the NE only). ○ literature records of subsp. *pennata* according to Grossheim (1939) and those of subsp. *kirghisorum* to Ovczinnikov (1957).

From the northern Transcaspian lowlands eastwards up to W Mongolia, southwards up to the Hindukush in NE Afghanistan, the Karakorum and the inner Himalayan ranges in N Pakistan, N India and probably W China (Fig. 19).

A rather rarely collected, but probably quite common species of subalpine and alpine steppes from 3000–4000m ('staple grass of the arid region' according to Giles on 222 in K).

Specimens studied (16):

AFGHANISTAN. Parwan: Mir Samir, Hindukush, 3900m, *Gilbert* 32 (K); central Parshui valley, 3000–4200m, *Frey* 414 (W). Kunar: W side of Semenek pass, 3410m, *Kerstan* 1509 (W). Badakhshan: Wakhan, upper Baroghil vall., near B.-pass, 3300–3800m, *A.* 1913, 7883 (M).

PAKISTAN. Chitral: Upper Yarkhun vall., *Achmad* 24 (K); ibid., 4000m, *Schmid* 2335 (G), 24 (ISL). Gilgit: Ghizar, from Daderili pass to Amberzth, 3700m, *Honda* 173 (KYO); Habe pass, *Giles* 222 (K). Baltistan: Deosai region, Shingo vall., 3900m, *St.* 22201 (NY); Chatpani Nullah, 3600m, *Duthie* 13857 (CALC, K).

INDIA. Himachal Pradesh: Spiti, Losan, 4100m, 27 vii 72, *Bhattacharyya* (BSD); Kulu-Lahaul, *Drummond* 23332, 23333, 23344 (E, K). Kinnaur, Gerboo, 4200m, *Maclagan* 740 (E).

In length of the marginal lemma lines, which terminate 1–2mm below the top, subsp. *kirghisorum* is intermediate between the subsp. *pennata* and *pulcherrima*, and ecologically it is very close to subsp. *pennata*. A separate status looks justified by the three dorsal lines, which in contrast to other subspecies, are completely free from each other or fused only at their very base. Furthermore, the chromosome number of $2n = 32$—if the count is correct—supports the separate position of this subspecies. Further characteristics are: *sheaths* glabrous or pubescent, the lowermost ones with ciliate margins (up to 0·5m long); *ligules* of the vegetative shoots 1–1·5mm long; *blades* 0·5–0·7mm diam., on the upper surface densely pilose with 0·2–0·4mm long hairs, beneath scabrous, without an

apical tassel of hairs; *glumes* 35–45mm long; *anthecium* 14–18mm long; *awn* (16–)18–26cm long.

c. subsp. **pulcherrima** (K. Koch) Freitag, **stat. nov.**
var. **pulcherrima**

Syn.: *St. pulcherrima* K. Koch, Linnaea 21:440 (1848); *St. pennata* var. *pulcherrima* (K. Koch) Halascy, Consp. Fl. Graec. 3:352 (1904).
St. grafiana Stev., Bull Soc. Imp. Naturalistes Moscou 30:116 (1857). Type: (USSR, Ucrainia) In campis maeoticis versus fontes rivi Kaltschik, *Graff* (holo. H!).
St. crassiculmis Smirnow, Feddes Repert. Spec. Nov. Regni Veg. 22:375 (1926); *St. pulcherrima* subsp. *crassiculmis* (Smirnow) Tzvelev, Novosti Sist. Vyss. Rast. 11:18 (1974). Type: (USSR, Turcomania) Montes Kopet-Dag, in transvall. Arvas, 2300m, *Kultiassow* (holo. TAK n.v.).
St. lithophila Smirnow ex Roshev., Flora SSSR, 2:741 (1934); *St. pennata* subsp. *lithophila* (Smirnow) Martinovský, Preslia 44:18 (1972); *St. eriocaulis* subsp. *lithophila* (Smirnow) Tzvelev l.c. 11:18 (1974). Type: (USSR, Ucrainia) Tauria, Jaila, m. Demerdshi, 24 v 1905, *Busch* (holo. LE!).
St. cretacea Smirnow, Bjull. Moskovsk. Obšč. Isp. Prir., Otd. Biol. 49(1):90 (1940). Type: (USSR) Rossia austro-orient., ad Tanain med. in collibus cretaceis lapidosis ad fontes Gulubaja flumen, prope pag. Sirotinskaja, c.220m, 8 vi 1938, *Smirnow* (holo. MW n.v.; iso. E!, LE!).
St. turcica Martinovský, Preslia 39:274 (1967). Type: (Turkey, Çankiri) Montes Ilgas Dagh, 1600–2000m, *Pilat* 2179 (holo. PR n.v.).
St. epilosa Martinovský, Preslia 39:274 (1967); *St. pulcherrima* subsp. *epilosa* (Martinovský) Tzvelev, l.c. 11:18 (1974). Type: (Turkey) In montis Ak-Dagh, 1600–1900m, 9 vii 1889, *Bornmüller* 317 (holo. B!, iso. JE!).

Type: (USSR, Transcaucasia) Tatarisch Grusien, 1848, *K. Koch* (lecto. GOET!, selected here).

An iso-syntype in GOET has been chosen as the lectotype of *St. pulcherrima*, because the first set of Koch's Caucasian collection was destroyed in B during World War II. It seems to be the only remaining specimen of the original material.

From the SW Mediterranean through southern C and SE Europe to SW Siberia, and through Anatolia to northern Iraq and to the Kopet Dagh in Turcmenia (Fig. 20).

Submediterranean woodlands and open seral communities at medium altitudes, usually from 1000–2500m.

Specimens studied (70)

TURKEY. Istanbul: Buyukdereh-Belgrad, v 1865 *Hausskn.* (JE); Yacadjik, 23 v 1901, *Aznavour* (G); Aydos Dağı, Altipinar civari, *Yaltirik* 3346 (E); Kocuali, Aidinly vall., Pendik forest, *Aznavour* s.n. (G). Eskişehir: E., 5·8km S, pass at road to Akpinar, 970m, *Buttler* 13407 (M). Kastamonu: Ilgaz Dagh, 2000m, *Darrah* 36 (E). Çorum: Near Osmançik, 600m, *Tobey* 2663 (E); Kargi, below Kös Dağ, 400m, *Tobey* 2663A (E). Amasya: Soghuk Pinar near A., 14 v 1892, *Manissadjan* (E); Abadshi Dağ, 1300–1500m, *B.* 316 (JE). Niğde: Ala Dağ, Narpiz gorge, 2650m, *Wood & Gibson* 205 (E). Maraş: Berit Dağı, 2450m, 9 viii 1865 *Hausskn.* (JE). Erzurum: Kop Dağı geçidi betw. Aşkala and Bayburt, *Holtz* 981 (GOET).

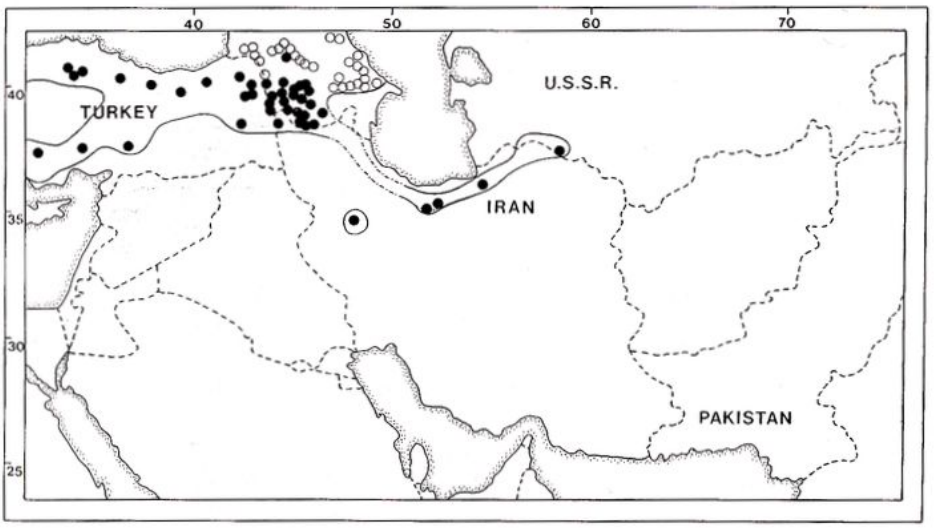

FIG. 20. Distribution of *Stipa pennata* subsp. *pulcherrima*. ○ literature records according to Grossheim (1939).

Bitlis: Süphan Dağ, 2950m, *Stileman* 59 (E). Kars: Iğdir, Ararat, 1970m, *Brown* 569A (E).
USSR. Georgia: Tbilissi, *Grossh.* 101 (Z); ibid., *F.* 13714; ibid. 2 vi 1882, *Schumann* (JE). Armenia: At Lake Sevan near Shordsha, 1950m, 23 vii 1939, *Smirnow* (E); between Megri and Qala-dash Mts, 1000–1300m, 20 vi 1934, *Karjagin* (Z); Azizbekov. distr., near Dzhermuka, 3 viii 1945, *Karapetian & Aslanian* (ERE); Sari-Günei Mts near Djil, 2300–2700m, 4 vii 1928, *Schelk. & Kara-Murza* (ERE); Artik distr., between Alagez and Getap, 7 vi 1956, *Gabrielian* (ERE); (39 more). Azerbaijan: Kuba, Alty gach, *Shevljakov* s.n. (Z).
IRAN. Azerbaijan: Maku, Kuh-e-Ghodjeh Dagh, 2100–2250m, 16 viii 1971 *Termé* (IRAN); ibid., *R.* 44007 (W). Tehran: Kalok near Karaj, 3 vii 1934, *Gauba* (IRAN). Ab-e-Sefid E Tehran, *Klein* 8654. Hamadan: Tuyserkan, 10 vi 1959, *Pa.* (G). Mazanderan: Gorgan, Marrowe Tape, 700m, 27 v 1939, *Gauba* (IRAN). Shavar Mts near Hadjilang, *R.* 6072 (W).

var. **araxensis** (Grossh.) Freitag, **stat. nov.**

Syn.: *St. araxensis* Grossh., Beih. Bot. Centralbl. 44, 2. Abt.: 200 (1928); *St. pulcherrima* subsp. *araxensis* (Grossh.) Tzvelev, Novosti Sist. Vyss. Rast. 11:18 (1974).

Type: (USSR) Transcaucasia, Nakhichevan distr., inter Negram et Darosham, 16 v 1923, *Grossheim* (holo. TGM? n.v.).

From the Aras valley in E Anatolia, Armenia and Nakhichevan to most parts of Soviet Azerbaijan; not yet recorded from Iran, but certainly present along the Soviet border.

Ecology: as for var. *pulcherrima*, but some populations more xerophytic and growing under true semi-desert conditions.

Specimens studied (13):
USSR. Armenia: Kotaik distr., Gadis Mts, 2000m, 1 vii 1926, *Schelk.* (ERE); Azizbekov. distr., Terpchai vall., 22 v 1957, *Gabrielian et al.* (ERE); Mikojan distr., near Khachuk, 22 vii 1950, *Takht. et al.* (ERE); Sevan area, near Shordzha at Ada-Tapa, 24 vi 1928, *Schelk & Kara-Murza* (ERE); ibid., 1950m, 23 vii 1929, *Smirnow* (E); (9 more). Nakhichevan: near Ordubad, 26 v 1923, *Grossh.* (ERE).

Most populations of the area belong to the var. *pulcherrima*, which is rather variable with respect to some vegetative characters: leaves green or slightly glaucous; *sheaths* either glabrous or pubescent, with or without

ciliolate margins; *ligules* of the vegetative shoots (0·5–)1–2(–3)mm long, rounded to truncate, with ciliate margin; *blades* (0·4–)0·5–0·8(–1)mm diam., upper surface glabrous, scabrous or pilose by short hairs (sometimes along the median rim), more rarely by longer hairs up to 0·6mm, beneath glabrous, smooth or scabrous, margins near the apex often distinctly setulose, but never with an apical tassel of hairs; *glumes* (5–)6–8(–10)cm long; *anthecium* (17–)18–24(–26)mm long; *lemma* with the marginal lines of hairs always reaching or surpassing the top, the 3 dorsal lines ± fused with each other; *awn* (20–)25–35(–40)cm long.

Specimens with tall and thick culms and with correspondingly large anthecia (21–24mm) and awns have been described as *St. crassiculmis*. Delicate ones with small anthecia (14–17·5mm) caused the descriptions of *St. lithophila* (Krym), *St. turcica* (Anatolia) and *St. eriocaulis* (SE Europe). In fact, those 'species' mark just the end-points in a range of variability, which has been observed to a similar extent in several other species of the genus. Such variants may be favoured by environmental conditions, with the smaller populations in higher altitudes (*St. turcica*) or in lowlands with a pronounced summer drought (*St. eriocaulis*, *St. lithophila*), but populations of the normal-sized var. *pulcherrima* still exist over the whole area of the species. Another very variable character is the upper blade surface. On that Martinovský (1967) founded not only some new species, but even subseries. From the area under concern he separated *St. epilosa* from *St. pulcherrima* only by the glabrous and scabrous leaves. *St. araxensis* needs a longer comment. It was founded by Grossheim on populations of the Aras valley with a distinct glaucous appearance and with the marginal lemma lines usually terminating 1–2mm below the top, but sometimes also reaching the summit. Many specimens have been seen, and it was tempting to give them at least a higher infraspecific rank, since most of them agree additionally in wide leaves (0·7–1mm diam.), which are scabrous above and smooth beneath. However specimens with such wide and glaucous leaves have been seen from the Balkan peninsula through Anatolia to the E Alburz. A most remarkable character of the specimens from the Aras valley is the development of the marginal lemma lines. In that respect they just bridge the gap between the subspecies *pennata* and *pulcherrima*. Some specimens approach subsp. *pennata* even in the hairy leaf apex, but the hairs are never as long, delicate and condensed as in subsp. *pennata*. Scattered throughout the area of the subsp. *pulcherrima* are individuals with a distinct indumentum covering the columna. It starts at the base or about 1cm above the base with minute hairs and grades into a veritable short plume of 1–2mm long hairs below the second geniculation. Such forms were first described as *St. grafiana* var. (subsp.) *paradoxa* by Junge, and later accorded specific rank by Smirnow under the names *St. paradoxa* and *St. syreistschikovii*. Tzvelev (1974), in maintaining *St. syreistschikovii*, discussed the possibility of a hybrid origin, but more convincing is the interpretation of Scholz (unpubl.) that it is just 'an assemblage of temporary aberrant forms or mutants which come and go here and there in the area'. Such forms occur both in the var. *pulcherrima* (e.g. TURKEY, Eskişehir: 5·8km E, *Buttler* 13407 (M). IRAN. Azerb.: War, 29 v 1884, *Knapp* (H) and in var. *araxensis* (USSR, Armenia: Mikojan

distr., near Khachuk, 22 vii 1950, *Takht. et al.*—collected together with the normal form!).

d. subsp. **zalesskii** (Wilensky) Freitag, **comb. et stat. nov.**

Syn.: *St. zalesskii* Wilensky, Dnevn. Vserossisjsk. Sezda Russk. Bot. 1:41 (1921).

St. rubens Smirnow, Repert. Spec. Nov. Regni Veg. 21:231 (1925). Type: (USSR, Kazakhstan) In steppis pr. u. Akmolinsk, *Ganeschin* (holo. MW n.v.).

St. turcomanica Smirnow l.c.: 234 (1925); *St. zalesskii* subsp. *turcomanica* (Smirnow) Tzvelev, Novosti Sist. Vyss. Rast. 11:18 (1974). Type: (USSR) Turcomania, in montibus pr. Ash(kh)abad, distr. Karakalinsk, in cretaceis, 1000m, 9 v 1897, *Litvinov* 177 (holo. prob. MW n.v.; iso. LE!, E!, JE!, W!).

St. pontica Smirnow, l.c. 26:268 (1929); *St. zalesskii* subsp. *pontica* (Smirnow) Tzvelev l.c.: 17 (1974). Type: (Turkey) In vineis ad Amasia, 400m, 20 vi 1890, Bornmüller 2577 (holo. LE n.v.; iso. B!, E!, JE!, G!, Z!).

St. canescens Smirnow ex Rosh., Fl. SSSR 2:741 (1934); *St. zalesskii* subsp. *canescens* (Smirnow) Tzvelev l.c.: 17 (1974). Type: (USSR) Armenia, distr. Nor-Bajazet, in viciniis pag. Elenovka, 2 vii 1929, *Zedelmeier & Geideman* (holo. LE!).

Type: (USSR, Kazakhstan) Near Saratov, slopes in Kalubanov distr., 5 vi 1918, *Zalesskij* (lecto. LE n.v.; selected by Tzvelev).

From C Europe (Bohemia) through E Europe to Siberia, and through Anatolia, Transcaucasia and N Iran to the Kopet Dagh in Turcmenia (Fig. 21).

A locally important component of woodlands and open communities, predominantly at medium and higher altitudes.

Specimens studied (25):

TURKEY. Eskişehir: Near Mamure Köyü at road Alpu-Hamidiye, 980m, *Buttler* 13284 (M). Ankara: Beynam forest, 1200m, *Markgraf* 11057 (Z). Kaysari/Sivas: W side of pass from Pinarbaşi to Gürün, 2000m, *D.* 21980 (E, G). Hatay: Amanus, 16km SW Yarpuz, N slopes of Çamlik tepesi, 1850–2000m, *Buttler & Erben* 17902 (M). Ercincan: From E. to Refaiye, *Z. & Plitman* 2664-18 (HUJ). Ağri: Tahir pass W of Ağri, 2420m, *V.* 71.604; ibid., E side of Tahir pass, 2400m, *D.* 47106 (E). Kars: Ararat, 2650m, *Post* 2114 (G).

USSR. Armenia: Near Shordsha at Sevan Lake, 1950m, 28 vii 1929, *Smirnow* (E); Agin distr., near Ani, 8 vi 1956, *Gabrielian* (ERE); Sevan area, near Zagalu, 2800m, *Schelk & Kara-Murza* (ERE). Agmagan Mts, near Jelidja, 2300m, 23–25 vii 1926, *Schelk.* (ERE); Vedi vall., between Azizkend and Dajnoz, 2000m, 27 v 1960, *Maniakian & Bobrov* (ERE); (9 more). Nakhichevan: Alma Bulag, 1900–2000m, 10 vi 1947, *Grossh. et al.* (E); Kabakhly-Tau, 1250–1300m, 18 v 1947, *Grossh. et al.* (E). Turcmenia: SE Kopet Dagh, from Makhtum-Qala to Desht, 1100m, 24 v 1970, *Proskurjakova et al.* (E, H, W).

IRAN. Azerbaijan: Rezaiyeh, Gardaneh Ghoush-Tchi, 20 vi 1970, s. coll. (IRAN). Mazanderan: N side of Kandevan pass, *W.* 2136 (GB); Golidagh N of Gonbad, *Hewer* 3877 (W).

All *St. pennata*-forms of the region with the marginal lines of the lemma reaching to the top or almost so, and with a distinctly setulose external blade surface are united here into subsp. *zalesskii*. In any other respect the subspecies *zalesskii* and *pulcherrima* are alike, at least in the area under concern: horizontal and altitudinal distribution, variation of lemma with respect to its length (15–26mm), extension of the marginal lemma lines, surface and colour of the leaves etc. It is interesting that

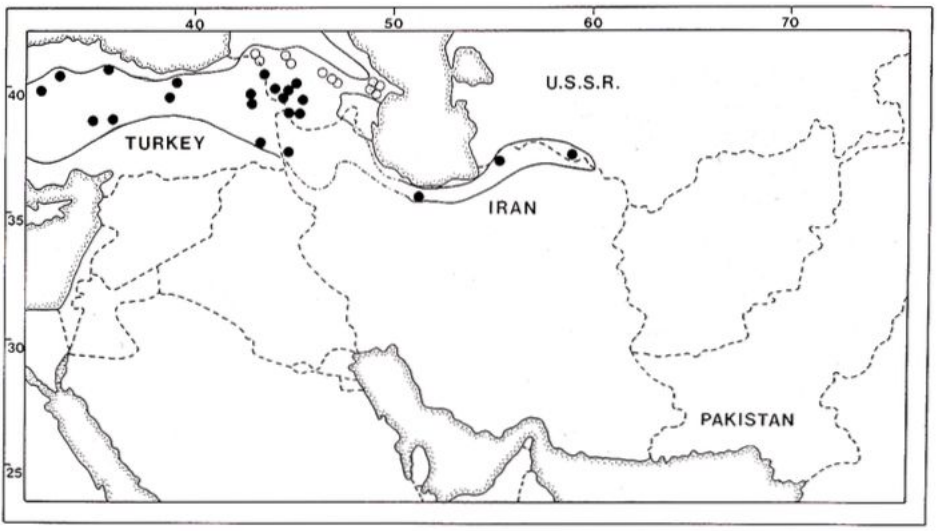

FIG. 21. Distribution of *Stipa pennata* subsp. *zalesskii*. ○ literature records according to Grossheim (1939).

certain variations occur parallel in local populations of both subspecies, for instance large fruits in the Kopet Dagh, thinning out of the marginal lemma lines around Lake Sevan, blue-green leaves around the Aras valley etc. With respect to the setulose external surface of the blades, several specimens from Anatolia and Transcaucasia have been seen which are completely intermediate to subsp. *pulcherrima*, both to its green and its glaucous forms. Narrow-leaved forms of subsp. *zalesskii* superficially, very much resemble *Stipa tirsa*. They tend also to form dense tufts, and the leaves gradually taper into an awn-like apex, but the ligule is always much more developed and the lemma indumentum differs significantly. The four species in the list of synonyms were founded by Smirnow on specimens differing in minor characters from each other, as may be seen in the key of Tzvelev (1976): pubescence of the sheaths, green or greyish colour of the blades, density and length of the setae, and length of the anthecia. However, the differences are often extremely small and not always consistent. For instance, *St. turcomanica* ought to be characterized by the largest anthecia of (18–)19–21mm, but measurements in the specimens from Armenia, which are identified by Smirnow himself as *St. canescens* have shown that they are in the same range, with (17·5–)18–21(–22)mm. Individuals from Anatolia, which should belong to *St. epilosa*, also have large anthecia up to 21mm. Indeed the populations called *St. canescens* have generally broader or thicker leaves and the setae tend to become hair-like. With such characters they approach *St. dasyphylla* from E Europe, which has not been studied in detail, but certainly belongs to *St. pulcherrima* as well. Unfortunately, the types of *St. zalesskii* and *St. rubens* have not been examined, but I have seen several specimens from SE Russia identified by Smirnow himself. They agree well with the material of the area, particularly with the narrow-leaved forms. According to the principles used in this revision for polymorphic *Stipa* species, the four taxa of Smirnow could be considered at most as varieties.

30. St. tirsa Stev., Bjull. Soc. Imp. Naturalistes Moscou 30(2):115 (1857), emend. Čelak., Oesterr. Bot. Z. 34:318 (1884).

Syn.: *St. pennata* var. *stenophylla* Czernj. ex Lindemann, Fl. Cherson. 2:283 (1882); *St. stenophylla* (Czernj. ex Lindemann) Trautv., Trudy Imp. S.-Pétersburgsk. Bot. Sada 9:351 (1884). Type: (USSR, Ucrainia) Charkov region, steppe near Rogan, 29 vi 1853, *Czernjaev* (holo. LE n.v.).

St. schmidtii Woronow ex Grossh., Fl. Kavk. 1:66 (1928). Type: (USSR, Georgia) Jalno Mts near Tiflis, 30 vii 1919, *Schischkin* (holo. LE!).

Type: (USSR, Ucrainia) Kaltschik, camp. Maeotic., *Graff* (lecto. H!, selected by Martinovský & Skalický, 1969).

In dense, large tufts, branching intravaginal; *culms* (25–)30–65cm tall, usually completely hidden by the somewhat inflated sheaths, below the nodes densely pubescent by short retrorse or antrorse hairs, usually 3-noded; *sheaths* glabrous to faintly papillose, the upper ones often with ciliate margins, sheaths at the culm leaves very long and often almost reaching the top of the panicle; *ligules* inconspicuous, at the vegetative shoots truncate to bilobed, with ciliolate margin, 0·1–0·2(–0·3)mm long, at the culm leaves rounded to somewhat lacerated, with setulose back and ciliate margin, up to 2mm long; *blades* thread-like, setaceous, even under moist conditions never plane, tapering into a long, bristle-like apex, inner surface covered by a dense indumentum of very short hairs or by more scattered longer hairs, outer surface scabrous by 0·1–0·3mm long ascending setae, at the culm leaves up to 12(–15)cm long with the uppermost surpassing the panicle, at the vegetative shoots up to 25 (–30)cm long, (0·1–)0·2–0·3(–0·4)mm diam.; *panicle* ± ensheathed, (5–)10–18(–25)cm long, 1·5–2cm wide, contracted, the branches erect, up to 4(–5)cm long, in 1–2, usually with 1, more rarely the lower with 2 spikelets, setulose; *spikelets* 4–5(–7)cm long; *glumes* subequal, long acuminate, tapering into a very delicate fragile tip, in the lower part with pale green back, otherwise membranous; *anthecium* (16–)17–19mm long; *callus* (3–)4–4·5mm long, densely bearded, with the longest hairs on the ventral side up to (1·5–)1·7(–2)mm, pungent, scar almost circular, peripheral ring dorsally flattened and much protruding; *lemma* pale brown, with a 7-seriate indumentum of 0·5–0·7mm long ascending to appressed hairs, the 3 dorsal lines fused up to about half of their length, the marginal lines terminating 2–3mm below the top, the submarginal and the dorsal line somewhat surpassing half of the lemma, the remaining ones much shorter, two short apical lemma lobes present; *awn* (29–)30–40(–44)cm long, bigeniculate at 4·5–6·5(–7)cm and (5–)6–8(–9)cm, the lower part densely twisted, glabrous, smooth, the upper part plumose by 5–6mm long spreading hairs, falcate to slightly flexuose; *palea* equalling lemma in length, glabrous; *lodicules* 2·4–2·8mm long, lanceolate, acute, glabrous, the posterior slightly longer and narrower; *anthers* 5–7mm long, yellow, unbearded; *ovary* with 2 styles and feathery stigmas; *caryopsis* 12–15mm long, embryo 2–3mm long, hilum almost reaching the top. $2n=44$.

From C and SE Europe to W Siberia, southwards to Transcaucasia and, very scattered, to NE Anatolia and NW Iran; outpost in Spain.

Occurs in steppe communities of higher altitudes.

Specimens studied (36):
TURKEY. Kars: Between Sarikamiş and Promezhutoznoje, *Litv.* 4902b (W).
USSR. Armenia: Nor-Bajazet distr., near Sultan Ali Kishlaki, 29 vii 1928, *Zedelmeier* (ERE); Karny-Janych Mts, 2300m, 9–13 vii 1926, *Schelk.* (ERE); Agbaba, near Gelli, 14 vii 1934, *Takht.* (ERE); Mikojan distr., between Khachika and Gnishika, 24 vii 1950, *Takht.* (ERE); Aragats Mts, 28 vii 1958, *Gabrielian* (ERE); Kotaik distr., near Kaputan, 17 vii 1961, *Aslanian & Galetian* (ERE); (27 more). Nakhichevan: betw. Bichenakh and Angelant, 25 viii 1926, *Grossh. et al.* (ERE).
IRAN. Azerbaijan: Rezaiyeh, Suluk, 2300m, *Sabeti* 5065 (IRAN).

The species is closely related to *St. pennata* and at first I was inclined to place it there as a subspecies. However, it differs in four very constant vegetative characters: the blades are extremely fine, remain unfolded even if fully saturated, and taper into a very long delicate tip, and the ligules of the vegetative shoots are extremely short. The absence of transitional forms to *St. pennata* seems to justify specific rank. The resemblance to narrow-leaved forms of *St. pennata* subsp. *pulcherima* and subsp. *zalesskii* is only superficial.

SPECIES-GROUP 2 ('UNIGENICULATAE')
Syn.: Ser. *Brevigeniculatae* Rosh., Flora SSSR 2:85 (1934); Sect. *Smirnovia* Tzvelev, Novosti Sist. Vyss. Rast. 11:20 (1974).

The species of the group 'Unigeniculatae' differ from other species of sect. *Stipa* by their unigeniculate awn, which is plumose throughout or at least in its upper part. They are not considered as a formal systematic group, because in my opinion they cannot be distinctly separated from other groups. *St. caucasica* is clearly very closely linked to *St. orientalis* of the species-group 'Eriostipa', and to *St. himalaica* (also of the same group) which occasionally bears an almost unigeniculate awn. *St. lingua* and its relatives from Soviet Middle Asia stand much more apart with their very short columna and unusually straight and long-bearded seta.

31. St. caucasica Schmalh., Ber. Deutsch. Bot. Ges. 10:293 (1892).

Densely tufted, branching intravaginal, with a few culms and numerous vegetative shoots; *culms* (10–)15–50(–70)cm, 3(–4)-noded, pubescent, at and below the nodes with longer hairs; *sheaths* scabrous or pubescent, striate, at the margins ciliate with c.0·5mm long hairs, the 2 upper ones at the culms flat, 5–7mm wide, straw-coloured, ensheathing and surpassing the panicle; *ligules* at the culm leaves up to 0·7mm long, rounded or acute, at the vegetative shoots up to 0·5mm long, truncate or 2-lobed, densely ciliate by 1·5–1·8mm long hairs; *blades* usually glaucous, more rarely green, convolute, 0·3–1·0mm diam., at the culm leaves up to 20cm long, at the vegetative shoots up to 30(–35)cm long, upper surface minutely pubescent, beneath glabrous, smooth, more rarely scaberulous; *panicle* (4–)5–25 × 1–2cm, contracted and enclosed, the branches erect, single or paired, up to 3·5cm long, smooth or setulose, with 1–2 spikelets; *spikelets* 1·5–4·5cm long, the glumes subequal, narrowly lanceolate to almost linear, tapering into a long hyaline apex, hyaline throughout or with a purplish tinged back, 5–7-nerved, smooth; *anthecium* 8–12(–13)mm long, 0·5–1·2mm wide; *callus* 1–2mm long, densely bearded, with the longest hairs up to 0·8–1mm, scar elliptic, peripheral ring dorsally

flattened and much protruding; *lemma* coriaceous, pale to brownish, indumentum seriate throughout or at least in upper part, with 7 lines of ascending, 1–2mm long hairs, at least the marginal lines reaching the top or almost so, the dorsal line usually the densest, terminating 2–3mm below the top, the top usually surpassed by a coronula of unequal hairs up to 2·5mm; *awn* (5–)6–12(–13)cm long, unigeniculate at 1–3cm, hairy throughout, columna densely twisted, seta strongly falcate, hairs increasing in length from 0·7–1·5mm at the base to about 3·5mm below the geniculation, in lower part of the seta 6–7mm long, often for about $\frac{1}{3}$ of seta more or less unilateral, towards the apex gradually decreasing in length; *palea* equalling lemma in length, glabrous or with scattered hairs in a dorsal line, eventually with a minute tuft of apical hairs; *lodicules* subequal, 1·8–2mm long, narrow-lanceolate, acute, glabrous; *anthers* 5–6mm long, yellow, unbearded, exserted; *ovary* with 2 styles and feathery stigmas; *caryopsis* (5–)7–8mm long, embryo 1·5–2mm long, hilum reaching up to the top; 2n = 44 in both subspecies. For shape of pistil see Fig. 3a.

1a. Plant coarse: leaves 0·5–1·1mm diam., usually glabrous, culms at least 20cm, glumes more than 3cm long, anthecium at least 0·9mm wide, awn usually more than 8cm long, with the geniculation at (1·5–)2–3cm, diameter near the base 0·4–0·6(–0·7)mm
subsp. **caucasica**

b. Plant delicate: leaves 0·25–0·6mm diam., usually scaberulous to scabrous, culms 10–20cm, glumes usually not more than 1·5–2·5cm long, anthecium 0·5–0·8mm wide, awn 5–8cm long, with the geniculation at 1–1·8cm, diameter near the base 0·2–0·4mm
subsp. **glareosa**

a. subsp. **caucasica**

Syn.: *St. orientalis* var. *grandiflora* Rupr. in Ost.-Sack. & Rupr., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 7, 14:35 (1869). Syntypes from Tianshan (Kirgizia and NW Sinkiang) in LE n.v.

St. orientalis var. *trichoglossa* Hack. ex Pauls., Vidensk. Meddel. Dansk. Naturh. Foren. Kjøbenhavn 65:164 (1903) p.p. Syntype: Alai Mts, Sufi Kurgan, 2400m, 18 vi 1898, *Paulsen* 404 (C!).

St. bella Drobov, Repert. Spec. Nov. Regni Veg. 21:37 (1925), non Phil. (1870); *St. caucasica* subsp. *drobovii* Tzvelev, Novosti Sist. Vyss. Rast. 11:20 (1974), nom. nov. Type: (USSR, Kirgizia distr., Aulie-ata, mont. Kara-tau, c.lacum Ala-kul, 1 vi 1922, *Drobov* 285 (holo. LE!).

St. caucasica subsp. *iskanderkulica* Tzvelev, l.c. 11:20 (1974). Type: (USSR, Uzbekistan) ad lacum Iskander-kul, 21 v 1914, *V. Dubjansky* (holo. LE!).

Type: (USSR, Daghestan) Temir Chan Schura, 6 v 1891, *Lipsky* (lecto. LE!, selected by Tzvelev).

From Caucasia and Transcaucasia through N Iran, the Kopet Dagh and Afghanistan to Pakistan in the SE, and along the Pamir Alai ranges up to the Tianshan in the NE (Fig. 22).

An important component of very different montane and subalpine semi-desert and woodland-communities from about (1200–)1300–3500 (–4000)m in the area.

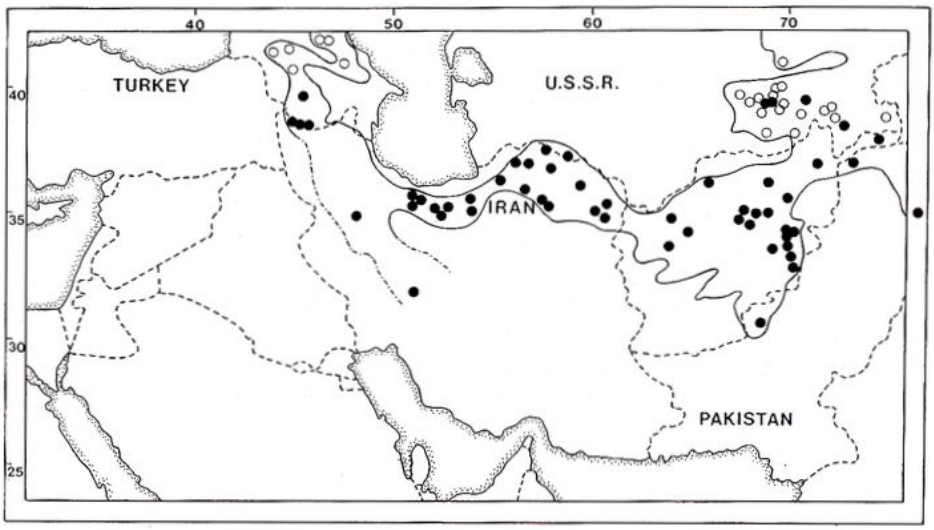

FIG. 22. Distribution of *Stipa caucasica* subsp. *caucasica*. ○ literature records according to Grossheim (1939) and Ovczinnikov (1957).

Specimens studied (57):
USSR. Armenia: at Lake Sevan near Shordsha, 1950m, 27 v 1929, *Smirnow* (B, E, H). Nakhichevan: Near Dzhulfa, 27 v 1932, *Geideman* (BAK); betw. Dzhulfa a. Aza, 24 v 1928, *Grossh.* (ERE); betw. Dzhulfa a. Daroshan, 4 vi 1928, *Grossh.* (ERE). Azerb.: Gandzha, Kazakh distr., near Tatlu, 18 vi 1928, *Kolakovsky* (BAK). Turkmenia: Kopet Dagh, 16 v 1911, *Michelson* (WU); Ashkhabad distr., Suluklü (Saratovka), *Sint.* 882 (G, Z, W). Tadzhikistan: Kuramsk. Khrebet, Lashkaren vall., *Nikitin* 232 (M); Seravshan, at Kasyr-Chashme, *Nikitin* 1366 (B); Lake Isskander-kul, 2100m,*B.* 364 (B); Jagnob, 2300m, *B.* 540 (B).
IRAN. Hamadan: Aq Bulaq, 90km N of Hamadan, 2000m, *Rioux & Golvan* in *Pa.* AB75 (G). Bakhtiari: betw. Kush-i-Dar a. Dehgirdu, ix 1885, *Stapf* (WU). Mazanderan: Kandevan pass, 2900–3000m, *Frey Vo.* 991; ibid., *Pa.* 4511, 4543, 4887 (G); Nizva Kuh, 2900–3000m, 29 vii 1948, *Behboudi & Aellen* (IRAN). Tehran: Karaj, Hazarband, 3000m, 24 viii 1935, *Gauba* (IRAN); E of Tehran, betw. Imam Zadeh and Ab-e-Ali, 2800m, *W.* 1415 (BG); 103km E of T., near Doli Tchai, 1960m, *Pa.* 4299 (G); (5 more). Semnan: 35km ENE of S., at pass to Damghan, 1800m, *F.* 14090; Touran Protected Area SE of Shahrud, Kuh-e-Peyghambar, 1600–1800m, *F.* 13765; Khosh Yeilagh, S side of pass ENE of Shahrud, 1800m, *W.* 12878 (W, THR); (1 more). Gorgan: 127km E of Gonbad-e-Kabus, 1340m, *Pa.* 7813 (G); Moh. Reza Shah Nat. Park, Almeh, N of Robat-e-Qarez Bil, 1200m, *R.* 52843 (W). Khorasan: betw. Mashhad and Quchan, *Merton* 3950 (W); Darreh Gaz to Gardaneh Allah Akbar, 24 vii 1972: *Iranshar & Zargani* (IRAN); Torbat-e-Jam, Bizg, *Alava* 10961 (W); (2 more).
AFGHANISTAN. Ghorat: Cherzakh pass betw. Sharak and Chisht, 2450m, *R.* 19182 (W). Farah: Band-e-Farsi, 10km SW of Farsi, 2700–3300m, *F.* 6834. Bamyan: N of Panjao, 3000m, 15 x 1958, *Pa.* (G); Band-e-Amir, *Pa.* A 1309 (G); Hajigak pass, N side, 3320m, *F.* 6368. Parwan: W of Kandi, *A.* 10834. Ghazni: Loman, 20km above Warka, 2500–2900m, *F.* 3477. Oruzgan: Gardesh pass at road to Dehkundi, 2900m, *P.* 19063 (M). Maydan: Wardak, *V.* 1281 p.p.—Logar: Logar vall., *V.* 1726 p.p. Paktya: Mts 55km S of Gardez above Arma, 2600m, *F.* 3279; Sete Kandaw pass, 2700m, *V.* 71.414; Urgun, Bagh Tapa, 2250m, *V.* 71.301; (3 more). Baghlan: Koh-e-Chungar NW of Pul-e-Khumrie, 2300m, *F.* 6517. Badakhshan: SE of Faizabad, near Jurm, 2000–2650m, *Furse* 6326 (K); Wakhan, Darya-e-Birghula-e-Jilga Chelat NW of the Chaqmaqtin, 4000–4100m, *A.* 7557 p.p.
PAKISTAN. Baluchistan: sine loc. 'coll. by foresters' (RAW).

b. subsp. **glareosa** (Smirnow) Tzvelev, Novosti Sist. Vyss. Rast. 11:20 (1974).

Syn.: *St. glareosa* Smirnow, Repert. Spec. Nov. Regni Veg. 26:266 (1929).
St. orientalis var. *trichoglossa* Hackel ex Paulsen, Vidensk. Meddel. Dansk. Naturh. Foren. Kjøbenhavn 65:164 (1903) p.p. Syntype: Pamir, dry plain near Sary Mullah, 4100m, 5 vii 1898, *Paulsen* 683 (C!).
St. caucasica f. *desertorum* Rosh., Fl. SSSR 2:74 (1934); *St. caucasica* subsp. *desertorum* (Rosh.) Tzvelev, l.c. 11:20 (1974). Type: (USSR, Kirgizia) C Tianshan, distr. Przhevalsk, ad fl. Tamaczi pr. pagum lacum Issykkul, in arenis, 19 vi 1907, *Roshevitz* 574 (holo. LE!).

Type: (Mongolia, Changai) steppum glareosum in depressione lac. Orok-nor, 7 ix 1924, *Pavlov* 169 (holo. MW n.v., iso. LE!).

From N Pakistan to the Inner Himalayas in N India, and from the Inner Pamir to Mongolia, probably also in all higher mountain ranges of W and C China.

A typical and very common component of subalpine and alpine steppes up to 5000m.

Specimens studied (5):
PAKISTAN. Chitral: Zagar pass, 4500m, *Ogino* 548 (KYO).
INDIA. Kashmir, Ladakh: Taktale Tal (upper Indus vall., 4500m, 23 viii 1969, *Bruhn*; Nima Mud, 4800m, *Koelz* 2342a (NY); Salt Lake, Rupshu, 5000m, *St.* 442a (NY); Reg. alp., 1861, *Thomson* (G, GOET, W).

St. caucasica is one of the most polymorphic species of the area, particularly with regard to the size of the whole plant and all organs except the length of the anthecium. Most authors agree that this variation is infraspecific, the only exceptions being Drobov (1925) with *St. bella* and Smirnow (1929) with *St. glareosa*. *St. bella* was based on forms with a completely pilose lemma and a somewhat longer plume at the awn, and Ovczinikov (1957) additionally emphasized a denser pubescence of the upper leaf surface. The first and certainly more important criterion renders it difficult to place. For example, most of the numerous specimens from Afghanistan exhibit a wide range of variability in lemma indumentum, but in most of them the marginal rows come very close to, or even reach, the top, with the dorsal one terminating about 1mm below and the lateral ones being even a bit shorter. The pubescence of the leaf surface varies independently and consequently does not support Drobov's view of a separate species. *St. bella* has since been reduced to subspecies level by Tzvelev (1974), but to me even varietal rank is difficult to accept.

Stipa glareosa requires more attention: it was founded on specimens from high altitudes in Mongolia and described as an eastern vicariant of *St. caucasica*. The morphological differences are listed above in the key to subspecies. They are most obvious if specimens of *St. glareosa* are compared with plants of *St. caucasica* from lower altitudes, but the overlapping of characters starts in lowland and medium-altitude populations of *St. caucasica*. Short-awned (45–55mm!) and small-sized individuals have been collected in Armenia (Nakhichevan) and described as var. *breviaristata* by Roshevitz (1934), and forms with very delicate leaves have developed here and there among the normal coarse-leaved populations (e.g. *Pabot* 7813 from 1350m near Gonbad-e-Kabus with thread-like leaves of 0·3–0·4mm diam.). With increasing altitude and

harsher environmental conditions individuals of *St. caucasica* generally assume a smaller stature with correspondingly smaller organs—a phenomenon noted for several other *Stipa* species (e.g. *St. ehrenbergiana*). This has been studied in the field, particularly in C Afghanistan around the Hajigak pass where the size of the plants decreases from 30 to 12cm, and the length of the awns correspondingly from 11 to 6cm. Most subalpine populations of *St. caucasica* in SW Asia have smooth leaves, but scaberulous ones occur here and there, and conversely, even from Mongolia specimens of *St. glareosa* with almost smooth leaves have been seen. For all these reasons I follow Tzvelev (1974) in reducing *St. glareosa* to a subspecies. From the area further north, Tzvelev (1974, 1976) added two subspecies which are here, after having seen the types, included in subsp. *caucasica* and subsp. *glareosa* respectively.

Despite its unigeniculate awn, *St. caucasica* is probably most closely allied to *St. orientalis*, and in C Asia both species very often grow side by side. Hybridization between these two species is reported by Tzvelev (in schedis), but the specimens involved look more like normal *St. caucasica*, and cytological evidence is lacking. Tzvelev (1976) considered the possibility of a hybrid origin of *St. caucasica* subsp. *glareosa* from typical *St. caucasica* and *St. orientalis*, but morphological evidence is poor. A possible hybrid between *St. caucasica* and *St. pennata* subsp. *pulcherrima* has been described as *St. gegarkunii* by Smirnow (1970) from Armenia (holo. MW—n.v., iso. E!). Another product of hybridization is probably *Volk* 1726 from the Logar valley in Afghanistan. It was collected together with *St. caucasica* and *St. turkestanica* and shares characters of both species, including the unigeniculate awn of *St. caucasica*. By using the keys of the modern Russian Floras the determination of that specimen technically runs down to *St. alaica* Pazij and the description agrees well. Tzvelev (1976) has already supposed that *St. alaica* might be a hybrid between *St. caucasica* and, either *St. kirghisorum* (=*St. pennata* subsp. *kirghisorum*), or *St. trichoides* (=*St. turkestanica*).

32. St. lingua Junge, Izv. Imp. S. Petersburgsk. Bot. Sada 10:129 (1910).

Syn.: *St. barbata* var. *platyphylla* Hackel ex Paulsen, Vidensk. Meddel. Dansk. Naturh. Foren. Kjøbenhavn 65:163 (1903). Type (USSR) Alai Mts, Sufi Kurgan, 2400m, 18 vi 1898, *Paulsen* 407 (holo. C!).

St. ovczinnikovii Rosh., Fl. SSSR 2:87 (1934). Type: (USSR) Tadzhikistania, in jugo Seravshan prope pagum Sjuzhena, 3 vi 1932, *Ovczinnikov* 144 (holo. LE!).

St. platypoda Bor, Biol. Skr. 14(4):81 (1965). Type: Afghanistan, Herat, profuse over the whole plain, *Aitchison* 1137 (holo. K!, iso. BM!).

Type: (USSR, Turkmenia) prope Germab, 30 v 1889, *Antonov* (holo. LE!).

In small, dense tufts, with few culms and numerous vegetative shoots, branching intravaginal; *culms* 25–45(–60)cm, 3–4-noded, usually completely enclosed by the sheaths, below the nodes scabrous to densely pubescent; *sheaths* scaberulous or pubescent, striate, usually distinctly ciliate (up to 1mm) at the margins, the upper ones at the culms up to 30cm long and 4–9mm wide, ensheathing and surpassing the panicle;

ligules at the culm leaves up to 1mm, at the vegetative shoots up to 0·5mm long, truncate, densely ciliate by 0·5–1mm long hairs; *blades* glaucous, at the culm leaves flat, up to 3mm wide or involute, up to 7cm long, at the vegetative shoots usually convolute, 0·5–0·7mm diam., up to 15cm long, the upper surface pubescent, beneath glabrous or with scattered short hairs, smooth; *panicle* 10–20 × 1–2cm, contracted, the branches erect, single or paired, up to 2cm long, setulose, with 1–2 spikelets; *spikelets* 5–9cm long, the glumes subequal, narrow lanceolate to almost linear, hyaline to straw-coloured, tapering into a long hyaline tip, smooth, the lower one 3–5(–7)-nerved, the upper 5–7-nerved; *anthecium* 12·5–14(–16)mm long; *callus* 1·5–2mm long, bearded only just below the lemma or almost glabrous, near the base foot-like expanded, scar circular, peripheral ring flattened and widened all around, dorsally protruding; *lemma* densely papillose, with 7 lines of 1–1·5mm long stiff ascending hairs, the 2 marginal lines reaching the top, the top surpassed by a corona of 2–3mm long hairs; *awn* 14–19cm long, unigeniculate at 1·5–2cm, columna twisted, usually at the base densely pilose, in upper part sparsely plumose, seta straight, densely plumose, hairs at the base 7–8mm long, gradually shorter toward the apex; *palea* equalling the lemma in length, with 2 strong and 2 more delicate veins, glabrous; *lodicules* subequal, 2·5–3mm long, narrow lanceolate, acute, glabrous; *anthers* 6–7mm long, yellow, unbearded; *ovary* with 2 styles and 2 feathery stigmas; *caryopsis* 7·5–8·5mm long, embryo 2·5mm long, hilum reaching the top; 2n = 44.

From the Kopet Dagh through Khorassan and Afghanistan to the Pamir Alai (Fig. 23).

Scattered in different woodland types, particularly in the upper *Pistacia vera-* and the *Juniperus* (*J. excelsa, J. seravschanica*) belts, and in different steppe-like seral communities; usually from 1400–2500(–3200)m.

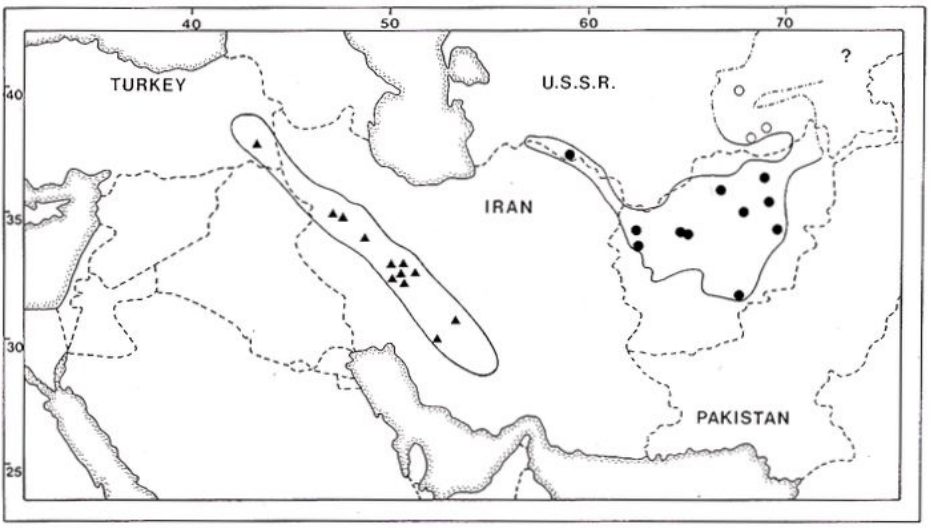

FIG. 23. Distribution of: ● *Stipa lingua*; ▲ *St. iranica*. ○ literature records of *St. lingua* from Tadzhikistan according to Ovczinnikov (1957).

Specimens studied (15):
USSR. Turcmenia: Kopet Dagh, in Ashkhabad distr., *Michelson* 319 (W, WU); ibid., near Vannovski, *Michelson* 234 (G, W, WU).
AFGHANISTAN. Herat: betw. Herat and Farah, *Gilli* 413 (W). Ghorat: Dolaini, Darra-e-Garmak betw. Sharak a. Naourak, 2540m, *R.* 18898 (W); Charzakh pass betw. Sharak a. Chisht, 2540m, *R.* 19128 (E, W). Jawzjan: Sangcharak, 30km SSW near Damardan, 1900m, *F.* 6588. Baghlan/Samangan: Top of Rabotak pass betw. Samangan a. Pul-e-Khumrie, *F.* 3144; 2km E of Rabotak pass, 1380m, *P.* 31631. Bamyan: Band-e-Amir, 3200m, *V.* 2256, 2277 p.p. Parwan: upper Ghorband vall. below Shibar pass, 2600m, *P.* 12051 (E, K, M); top of Shibar pass, 2900m, *Pa.* A 1110 (G). Maydan: Wardak, *V.* 281, 801. Kandahar/Zabul: Tarnak vall., *Griffith* s.n. (K).

St. lingua is a most characteristic species and easily recognized by its unigeniculate, plumose awn with a long and straight seta, and the expanded callus base. Variation is moderate. Only one specimen, *V.* 1726 (Afghanistan, Logar valley, 2000m), needs consideration. It differs from normal ones by a longer columna (2·8–3cm) carrying a short plume just below the geniculation and being otherwise scaberulous, and by scabrous leaves. As in that area *St. lingua* and *St. turkestanica* are rather common, it may be best explained as a hybrid, but the characters of *St. lingua* are clearly dominant including the expanded callus base. Unigeniculate species with a very similar awn structure are *St. lipskyi* Rosh. and *St. longiplumosa* Rosh. from Soviet Middle Asia, but comparison with authentic material has shown that the Logar-specimen differs from both.

St. ovczinnikovii has been separated from *St. lingua* on account of its smaller anthecia (12–13 viz. 14–16mm) and a more sparsely bearded columna. It is cited by Ovczinnikov & Czukavina (1957) as the only species of the group occurring in Tadzhikistan, retained by Tzvelev (1974, 1976), but retracted by Pazij (1968). An investigation of the Afghan material supports the latter view, as most of the specimens are intermediate between *St. lingua* and *St. ovczinnikovii*, in the sense of their original descriptions.

St. platypoda is mentioned by Bor for the type locality only. He gave special emphasis to the foot-like expanded callus, but that character is present in any specimen of *St. lingua*, the closely related *St. aktauensis* Rosh., and *St. magnifica* Junge from adjacent Soviet Middle Asia as well. Together with those species, *St. lingua* holds a somewhat isolated systematic position, differing from *St. caucasica* by the short columna, the straight seta and expanded callus. Roshevitz (1934) was well aware of the comparatively broad gap between *St. lingua* and *St. caucasica* and placed both species in different series.

SPECIES-GROUP 3 ('LEIOSTIPA')

Syn.: *Stipa* sect. *Leiostipa* Dumort., Obs. Gram. Belg.:134 (1823). Type species: *St. capillata* L.
Ser. *Capillatae* Rosh., Fl. SSSR 2:106 (1934), non rite publ., Bor, Fl. Ir. 70:397 (1970), diagn.

The 'species-group 3' includes the species of sect. *Stipa* with glabrous and scabrous bigeniculate awns. Even after the exclusion of the short-plumed species considered by Tzvelev (1974, 1976) as belonging to the sect. *Leiostipa*, the group remains an artificial one for the following

reasons: (1) no real gap exists between the species with a scabrous awn and those with pilose or plumose awns; (2) the different shape of the awn, particularly of the seta, and of the leaf sheaths subtending the inflorescence indicates other relationships than suggested by the surface structure of awn.

33. St. capillata L., Sp. Pl., ed. 2:116 (1762).

Syn.: *St. anisotricha* Smirnow, Bjull. Moskovsk. Obšč. Isp. Prir., Otd. Biol., N.S. 85:115 (1970); *St. sareptana* subsp. *anisotricha* (Smirnow) Tzvelev, Novosti Sist. Vyss. Rast. 11:14 (1974). Type: (USSR, Armenia) ad lacum Sevan, prope pagum Schordsha, c.1950m, 23 v 1929, *Smirnow* (holo. MW n.v.; iso. E!, H!).

Type: Bohemia, *Burser* I:127(1) (lecto. UPS, selected here).

Densely tufted, with few culms and many vegetative shoots, branching intravaginal; *culms* (30–)40–70(–90)cm, (2–)3–4)-noded, glabrous or pubescent by ascending hairs below the nodes, almost hidden by the sheaths; *sheaths* glabrous or scabrous, at the margins glabrous; *ligules* acutish to acute, often lacerated, at the margins and (or) at the tip often ciliolate or ciliate, at the culm leaves 5–10(–15)mm long, at the vegetative shoots 1–2mm long; *blades* plane or convolute, upper surface densely pilose, beneath either glabrous and smooth or scabrous throughout, or sparsely pilose with hairs up to 0·4mm, at the culms and the generative shoots up to 30cm long, 2–2·5mm wide or 0·4–0·7mm diam.; *panicle* 15–20 × 2–3cm (including the awns up to 6cm), usually enclosed by the widened uppermost leaf sheath and surpassed by its short blade, the branches up to 5cm long, setulose, the lower ones in whorls of 3–4, with up to 3 spikelets; *spikelets* (2–)2·5–3·5cm long, the glumes subequal, hyaline, long acuminate, setulose along the main vein, the lower one 3- or 5-nerved, the upper 5- or 7-nerved; *anthecium* (10–)11–13(–14)mm long; *callus* 3–3·4mm long, sharply pointed, almost straight, densely bearded with the longest hairs up to 1·2mm, scar circular, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, brown, with seriate indumentum of 0·3–0·4mm long ascending hairs, the dorsal row up to $\frac{1}{2}$, the marginal ones up to 2(–3)mm below the top, without a distinct coronula, but sometimes with scattered short hairs below the articulation; *awn* (12–)14–18(–20)cm long, bigeniculate at (3·6–)4·4–5(–5·5) and (5–)6–7cm, scabrous throughout, columna densely twisted, seta circinnate; *palea* equalling lemma in length, glabrous; *lodicules* 1·3–1·8(–2)mm long, lanceolate, acute, glabrous, the posterior one often somewhat longer; *anthers* (3–)4–5mm long, yellow, unbearded, usually remaining enclosed; *ovary* with 2 styles and feathery stigmas; *caryopsis* 7–8mm long, embryo 1·8–2mm long, hilum almost reaching the top; $2n = 44$ (more rarely 46).

From Spain and S Sweden to E Siberia, southwards to Anatolia, N Iran, E Afghanistan and the Inner Himalayas (Fig. 24).

In the area a rare, but locally common component of primary and secondary steppe-like communities at medium altitudes, in the W from 1000–2400m, in the E from 2500–3500m; its very late development, with flowering time in July and August, correlates well with its restriction to areas with some summer rain.

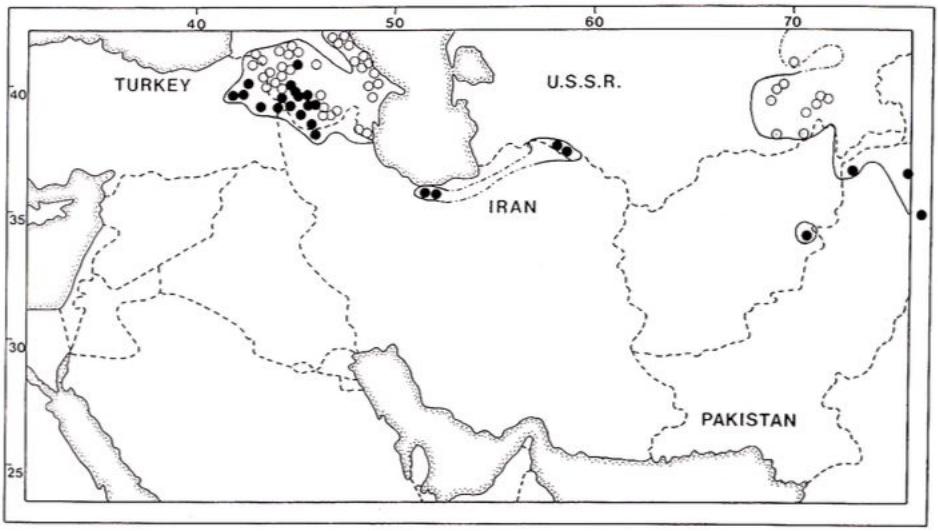

FIG. 24. Distribution of *Stipa capillata*. ○ literature records from Transcaucasia according to Grossheim (1939), from Tadzhikistan according to Ovczinnikov (1957).

Specimens studied (42):

TURKEY. Erzurum: c.6km SE Ovacik, *Jenkins* 2335 (E). Kars: Ararat, 1000m, s. coll. (Z). Agri: 20km E of Agri, *V.* 71.605.

USSR. Georgia: Tbilissi, 21 viii 1907, *Koenig* (H); ibid., *F.* 13713. Armenia: Sevan island, 5 vii 1923, *Zedelmeier* (ERE); Keity Janych, near Kyzil-Vans, 2470m, 28 vii 1923, *Grossh. & Zedelmeier* (ERE); Martunin distr., near Dzoragjukh, 14 vii 1947, *Karapetian* (ERE); Krasnoselsk distr., near Bashkend, 1500–1600m, 26 ix 1960, *Mulkidzhanian et al.* (ERE); Novyberjansk distr., near Kokht, 21 vii 1960, *Gabrielian* (ERE); (14 more).—Nakhichevan: betw. Kelany and Bitsheakh, 24 viii 1926, *Grossh. & Jaroshenko* (ERE).—Turcmenia: Kopet Dagh, Arvaz, *Litv.* 2210 (W); ibid., at Khan-Jaila, *Litv.* 207 (E); ibid., above Firyuza, *Litv.* 2340 (W).

IRAN. Azerb: Ahar, Hassano, 5 viii 1965, *Termé* (IRAN).—Mazanderan: Jadouk, Chalmish, 2300m, 23 vii 1948, *Behboudi & Aellen* (IRAN); Chalus road N of Kandevan pass, 2300m, F. 14058a; ibid., *Pa.* 4516 (G, K). .

AFGHANISTAN. Paktya: Kotgay, S slopes of Safed Koh, *V.* 71.841 p.p.., 71.845 p.p.; ibid. *Alpay* in *A.* 11292; ibid., Maidan Shahidan *V.* 71.496; ibid., Mandaher forest, 2700m, *A.* 5315.

PAKISTAN. Chitral: viii 1949, *Hassan ud Din* (RAW). Gilgit: Baltistan, Chaprol, *Winterbottom* 962 (K); Shingo vall., 3300–3600m, *Duthie* 11927 (K, W).

INDIA. Kashmir: Drás vall., 3300–3600m, *Duthie* 13714 (CAL, W); ibid., *St.* 9986a (K, NY); ibid., Kharhu to Drás, 2900–3300m, *St.* 21127 (NY); Bangla, 3300m, *Clarke* 29560 (K); Jilail, 3300m, *Clarke* 30723 (K). Him. Pradesh: Lahul, Koksar, 3200m, 4 viii 1970, *Bhattacharyya* (BSD).

Stipa capillata is one of the most widely distributed species of the genus. Beside some variation in external leaf surface it is rather uniform, even in the dimensions of the glumes, anthecium and awn. From the other species with scabrous awns it is best distinguished by its circinnate seta, which suggest a close relationship with *St. koelzii.*

The description of *St. anisotricha* and an investigation of the isotypes did not yield any substantial differences from quite usual *St. capillata.* Tzvelev (1974, 1976) placed it as a subspecies of *St. sareptana*, but the densely pubescent upper leaf surface, length of ligules, size of anthecium etc. are all in favour of *St. capillata.* The less pronounced circinnate

structure of the seta is certainly due to the young stage of the type specimens, which were collected before anthesis. The leaves are somewhat more delicate, but that may have resulted from environmental influences.

The lectotypification may need a comment, as the syntype material belongs to different species. The only specimen in LINN with the remark '3 capillata' in Linné's handwriting is the *Clayton* no. 621 and is indeed the type of *Stipa avenacea* L., described in *Sp. Pl.* 1, ed. 1, p. 78 (see also Veldkamp, 1984). Another one with the remark 'capillata?' on the reverse side is *Gouan* no. 3 and has been selected here (see p. 50 & 52) as the lectotype of *St. bromoides* L. The only other existing syntypes are the specimens *Burser* I: 127 and 127 (bis). They carry the polynomial 'Festuca longissimis aristis' from Bauhin, which is cited as the first synonym of *St. capillata* in *Sp. Pl.* 1, ed. 2, p. 116 (1762) as 'Pin. 10, Theatr. 153'. According to information kindly supplied by Dr Jarvis and based on the paper of Savage (1937), they have been studied by Linné himself.

The first of the two Burser specimens has been selected as the lectotype, because it comes from a better defined locality and furthermore it carries the old German name 'Nadeltwalch'. That name has been adopted by Bauhin (1623) from Tabernaemontanus (1588, 1599), who gave a locality and a rough woodcut-illustration (p. 235) of *St. capillata* from the Rhine valley. I have not seen the specimens at UPS, but their identity has been stated by Juel (1936) and kindly rechecked by Dr Moberg.

In fact, the typification was even more intricate, as most and the best syntypes of *Stipa juncea*, described in *Sp. Pl.* 1, ed. 1, p. 78 (1753) are also specimens of *St. capillata*. Furthermore, Linné's description of *St. juncea* as 'Stipa aristis nudis. calycibus semine longioribus' fits completely to our species. Therefore the name *St. capillata* has formally to be regarded as superfluous. However, in the 17th and 18th century French and Italian botanists transferred the name *St. juncea* to a Mediterranean species with a clearly pilose lower awn segment. That taxon has since been described as *St. offneri* by Breistroffer (1950), who rejected the name *St. juncea* because of its secular confusing misuse and appealed for the use of the name *St. capillata* for our species. According to the Code at present the correct name of our species is still *St. juncea*; as yet no official proposal or decision for the rejection of the name *St. juncea* under Art. 69.1 has been made. That will be done now, and the name *St. capillata* is retained here for sake of convenience and in expectation for this proposal to be accepted by the nomenclatural commission.

34. St. margelanica Smirnow, Repert. Spec. Nov. Regni Veg. 26:264 (1929).

Type: USSR, (Tadzhikistan) Fergana, inter val. fluv. Isfairamet praed. Chodsha-aryk, ad trajectum in decl. sicca petrosa, 31 v 1913, *Dessjatova* 892 (holo. LE!).

Densely tufted, with few culms and numerous vegetative shoots, branching intravaginal; *culms* 40–60cm, 3-noded, glabrous; *sheaths* glabrous or papillose, shorter than the internodes, at the margins glabrous; *ligules* obtuse to acutish, often lacerated, setulose on the back, at the culm leaves 2–4mm, at the vegetative shoots 1–3mm long; *blades* plane or convolute, upper surface papillose to minutely pubescent,

beneath glabrous or papillose, at the base minutely pubescent, at the culms up to 10cm long, at the vegetative shoots up to 17cm long, 1·5–2mm wide or 0·5–0·6mm diam.; *panicle* 13–23 × 2–3cm, at the base often ensheathed by the uppermost leaf, the branches erect, up to 7cm long, setulose, the lower ones paired, with up to 3 spikelets; *spikelets* 19–23mm long, the glumes subequal, the upper eventually up to 3mm shorter, long acuminate, pale green with hyaline margins and tip, setulose along the middle vein, the lower one 3–5-nerved, the upper 5–7-nerved; *anthecium* 9–10mm long; *callus* 1·5–2mm long, densely bearded with hairs up to 1mm long, sharply pointed, slightly curved, scar circular, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, pale, indumentum 7-seriate with the rows of 0·5–0·6mm long ascending hairs reaching up to $\frac{3}{4}$, upper part denticulate, below the top with a small coronula of scattered 0·2–0·3mm long hairs; *awn* 9–11cm long, bigeniculate at 1·8–2·5 and 3–3·6cm, scabrous throughout, columna densely twisted, seta falcate; *palea* 0·55m shorter than lemma, sparsely pilose on the back; *lodicules* 2–2·3mm long, lanceolate, often pilose at the apex, the posterior somewhat shorter; *anthers* 3mm long, yellow, unbearded, exserted; *ovary* with 2 styles and 2 feathery stigmas; *caryopsis* 5·5–6·5mm long, embryo 1·5mm long, hilum almost to the top; 2n unknown.

From N Afghanistan through the Alai ranges up to the Tianshan.

In the area only seen in luxuriant *Prangos pabularia* community in the *Juniperus seravschanica* belt from 2000–2400m.

Specimen studied:

AFGHANISTAN. Baghlan/Samangan: Koh-e-Chungar NW of Pul-e-Khumrie, 2300m, *F.* 6518.

This is the first record of this species from the area of the *Flora Iranica*, and it probably has a wider distribution along the comparatively moist N slopes of the Paropamisus and Hindukush in Afghanistan. The Afghan specimen fits the diagnosis and agrees sufficiently with the type; the only difference being the surface of the ligule, which is almost glabrous, but densely pubescent in the type. *St. margelanica* differs from *St. capillata*—the only other species of the area with a long and scabrous awn—most obviously by the falcate (not circinnate) shape of the upper awn segment and by the absence of leaf sheaths around the panicle. The relationships of *St. margelanica* are difficult to assess, and placing the species in a group with *St. capillata* is supported by technical reasons only.

IX. Sect. Barbatae Junge emend. Freitag

Stipa sect. **Barbatae** Junge, Izv. Imp. S. Petersburgsk. Bot. Sada 10:130 (1910) p.p.

Type species: *St. barbata* Desf., Fl. Atlant. 1:97, tab. 27 (1798).

A ceteris sectionibus stylis et stigmatis 3 raro 4 diversa est.

Like sect. *Stipa*, but ovary always with 3, more rarely 4, equal or unequal styles and stigmas (Fig. 3b–d); for callus characters see Fig. 2d.

Moderate to pronounced xerophytes from SW Europe and N Africa up to the Hindukush, centred in the Near and Middle East; ecologically adapted to winter rain regions, from subtropical lowlands up to subalpine belts. Eight species in the area. 2n = 44.

35. St. arabica Trin. & Rupr., Spec. Gram. Stip.: 77 (1842).

Syn.: *St. szovitsiana* Trin. in Hohen., Bull. Soc. Imp. Naturalistes Moscou 11:243 (1838), nom. nud.; *St. arabica* var. *szovitsiana* Trin. & Rupr., Spec. Gram. Stip.: 77 (1842); *St. szovitsiana* (Trin. & Rupr.) Griseb. in Ledeb., Fl. Ross. 4:450 (1852); *St. barbata* Desf. var. *szovitsiana* (Trin. & Rupr.) Hackel, Akad. Wiss. Wien, Math.-Naturwiss. Kl., Denkschr. 50, 2. Abt.: 8 (1889). Type: Transcaucasia (Azerbaijan), in collibus aridis lapidosis pr. Tatuni tractus Suwant (Zuvant), vii 1837, *Hohenacker* 1253 (syn. LE!).

St. arabica var. *meyeriana* Trin. & Rupr., Spec. Gram. Stip.: 78 (1842); *St. meyeriana* (Trin. & Rupr.) Grossh., Fl. Kavk. 1:66 (1928). Type: (Transcaucasia, Azerbaijan) In locis lapidosis mont. Talysch prope pagum Perimbal at Swant (Zuvant), 2400–4020ft, 1830, *C. A. Meyer* 36 (iso. LE!)

St. caspia K. Koch, Linnaea 21:440 (1848); *St. arabica* subsp. *caspia* (K. Koch) Tzvelev, Novosti Sist. Vyss. Rast. 11:16 (1974). Type: (Azerbaijan) Am Ufer des Kaspischen Meeres, zwischen Baku und Derbend, auf Meersand, *K. Koch* (holo. B†, iso. GOET!).

St. pennatiformis Figari & de Notaris, Mem. Reale Accad. Sci. Torino, Ser. 2, 12:250 (1852). Type: (Egypt, Sinai) in regione Wadi Ferran ad montium pedes (holo. prob. LE n.v.).

St. damascena Boiss., Diagn. Sér. 1, 13:45 (1854). Type: (Syria) In collibus aridissimis pone urbem Damascum, v 1846, *Boissier* (holo. G n.v., iso. W!).

St. koenigii Woronow, Bot. Mater. Gerb. Glavn. Bot. Sada SSSR 5:61 (1925). Type: (Turkey, Kars) Culta in sect. cauc. Horti Tiflisiensis e seminibus a cl. E. Koenig e distr. Olty prov. Kars a 1906 allatis, iv 1923. (holo. LE!).

St. badachschanica Rosh., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 1949: 19 (1949). Type: (USSR, W Pamir) Schugnan, in valle Darschai, inter pontem Pul-i-Furs et ostium fl. Darschai, 9 vi 1914, *Tuturin & Bessedin* 183 (lecto. LE!, selected by Tzvelev).

Type: (Egypt) Inter lapides ad radices montis Sinai, 15 v 1835, *Schimper* 107 (holo. LE!; iso. BM!, E!, G!, L!, NY!, W!).

Densely tufted, branching intravaginal, with some culms and numerous vegetative shoots; *culms* (35–)50–70(–100)cm, 2–3-noded, scaberulous or densely pubescent, more rarely glabrous and smooth; *sheaths* often pubescent, at the margins eventually shortly ciliate; *ligules* at the culm leaves up to 15mm, at the vegetative shoots 2–8(–15)mm long, acute, usually ciliolate; *blades* flat, at the culms up to 10cm long, at the vegetative shoots up to 20cm, 2–3mm wide, in dry condition usually involute to convolute and 0·4–0·6mm diam., on the upper surface densely pubescent by retrorse hairs, beneath scabrous, sometimes so only at the base, more rarely glabrous throughout; *panicle* at the base ensheathed, narrow, 15–35 × 1–2cm, the branches erect to ascending, setulose or glabrous, the lower ones in 2 or 3, up to 12cm long, with up to 6 spikelets; *spikelets* (2·2–)2·5–3·5(–4)cm long, the glumes subequal, linear, hyaline with a pale green back, at the dorsal line often setulose, usually 5-nerved; *anthecium* (8–)9–12(–14)mm long; *callus* 1–1·5mm long, usually

bearded, more rarely almost glabrous, scar circular to elliptic, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, light brown, up to $\frac{1}{2}$–$\frac{4}{5}$ covered by 0·2–0·5mm long ascending to almost appressed hairs, either in indistinct rows with at least the dorsal one marked, or more diffuse, the marginal ones reaching higher up, at the apex often with a coronula of about 0·4mm long hairs, but sometimes missing, below the apex somewhat papillose, rarely completely glabrous or almost so; *awn* (8–)10–15(–22)cm long, bigeniculate at 1·5–2 and at 2·5–3·5cm, slender, with a basal diameter of 0·2–0·3mm, with the length of the hairs increasing from 0·3–0·5mm at the base up to 2mm below the second geniculation, columna twisted, seta flexuose or falcate, plumose, with the hairs 2–2·5mm long in the lower part and decreasing in length towards the apex, occasionally only about 1mm long; *palea* equalling the lemma in length, with a dorsal line of ascending hairs up to $\frac{2}{3}$ or $\frac{3}{4}$, at maturity usually partly exposed; *lodicules* subequal, the anterior ones 1·2–1·7mm long, lanceolate, glabrous, smooth, the posterior slightly shorter; *anthers* 4–6mm long, yellow or purple, unbearded; *ovary* with 3 styles and stigmas, one of them shorter; *caryopsis* 6–7·5mm long, embryo 2–2·5mm long, hilum reaching the top; 2n = 44. For callus characters see Fig. 2d, for ovary Fig. 3d.

From C Anatolia and S Sinai through all countries of the Near and Middle East up to Pakistan and NW India in the E and the Tianshan in the NE (Fig. 25).

The most common and typical *Stipa* species of SW Asia, from moderate semi-desert communities to open woodlands and most of their seral communities; from the lowlands in the N up to 3000m; most common in regions with about 200–500mm annual precipitation and a long, dry summer.

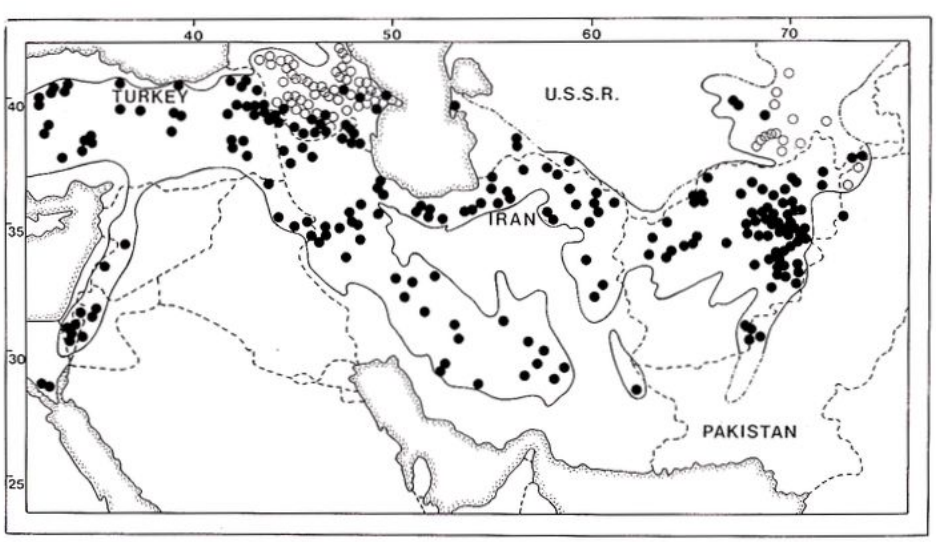

FIG. 25. Distribution of *Stipa arabica*. ○ literature records from Transcaucasia according to Grossheim (1939), from Tadzhikistan according to Ovczinnikov (1957).

1a. Awn up to 17cm long 2
b. Awn 18–22cm long . . . . . **b**, var. **prilipkoana**

2a. Lemma hairy . . . . . **a**, var. **arabica**
b. Lemma completely glabrous or almost so . . **c**, var. **pamirica**

a. var **arabica**

Specimens studied (551):

TURKEY. Eskişehir: betw. E. and Çifteler, *Birand & Z.* 3300 (HUJ). Çankiri: Ilgaz, 40km S, 20 viii 1959, *Z.* (HUJ); near Çankiri in Çakmakli vall., 800m, *B.* 14696 (B, E, G). Kastamonu: Tonsa (Tosya), *Sint.* 4266 (E). Ankara: Çandir, 20 viii 1959, *Z.* (HUJ); Gölbaşi, 900m, *Z.* 38631, 18638 (HUJ); Ankara, 15km N, *Coode & Jones* 2132 (E). Konya: Cihanbeyli, 25 v 1953, *Kasapl.* (HUJ); Karapinar, near Acigol, *Birand & Z.* 3429 (HUJ); Konya, 7km W, 1120m, *Holtz* 560 (GOET). Içel: Gülük Tepe, *Siehe* 479 (JE). Çorum: Ç., 13km SW, 780m, *Z. & coll.* 11739 (HUJ); Sungurlu, 36km NE, 1080m, *Z. & coll.* 11762, 11761 (HUJ). Amasiya: at Amasiya, 400m, *B.* 2577b (B); ibid., 400–1000m, *B.* 456 (B). Sivas: S., 65km W, *V.* 71587 p.p.; Zara, 12km W, 1300m, *V.* 71594; Boluçan, 7·5km N, 1440m, *Buttler* 15741 (M). Kayseri: Ali Dagh, summit, 1711m, *Bal.* 837 (W, Z); W of Kayseri, 1250m, *Bal.* 837 (E, GOET); 20km NW of Kayseri, 1000m, 29 viii 1959, *Z.* (HUJ).—Ercincan: E., 10km N, 1520m, *Z.* 31797 (HUJ); ibid., 13km W, 1400m, *Z.* 870135 (HUJ); near E., 1200m, *Orshan* 87214 (HUJ). Elazig: Pertek, 14km N, 1050m, *Orshan & Plitman* 472218 (HUJ). Erzurum: Pasinler, 10km E, *V.* 71.594. Kars: Kağizman, in Bajam-Su vall. near Kötek (Kiotak), *Woronow* 12590 (W); betw. Kars a. Ardahan, 1790m, *Z. & Plitman* 2463–38 (HUJ); betw. Iğdir a. Tuzluca, *Z. & Plitman* 2266-22 (HUJ). Agri: betw. Doğubayazit a. Iğdir, 1620m, *Z. & Plitman* 2264-13 (HUJ); betw. Agri a. Horasan, 2000–2500m, *R.* 32784 (W). Bitlis: Nemrut Dagh, *Tong* 168 (E); at Van lake, 1740m, *Z. & Plitman* 2165-13 (HUJ); Bitlis-Tatvam, 1800m, *D. & coll.* 22360 (E). Van: Edremit Grevas, 2000m, *D. & col.* 22642 (E, K).

EGYPT. Sinai: Hammara Arab, *Bove* 13 (G); Bestan, *Schimper* 107 (GOET, JE, WU).

PALESTINE. Negev: Wadi Ramon, iv 1946, *Helevi* (HUJ); Khirbat-e-Ras, 10km N, 28 v 1942 *Z.* (HUJ); Revivim, *D'Angelis & Grizzi* 594 (G, HUJ, E, NY, W, WU); Wadi Mugra 11 iv 1964, *Feinbrun* (HUJ); at Wadi Butami, 26 iv 1946, *Tadmor* (HUJ); betw. Matrada a. Wadi Boqqara, 26 iv 1946, *Tadmor* (HUJ); Jeb. Samoe, 23 iv 1946, *Tadmor* (HUJ); betw. Asluj a. Hafir, iv 1928 *Eig & coll.* (HUJ); Beersheba, 10km N, 29 v 1942, *Z.* (HUJ); Jerusalem, 88km S at road to Beersheba, 23 iv 1934, *Eig et al.* (HUJ); betw. Hebron and Bani Naim, 10 v 1934, *Eig et al.* (HUJ). Edom: Jurf-ed Derawish, 2km N, 950m, 28 iii 1936, *Eig et al.* (HUJ).

SYRIA. Sahl-es-Sahra W of Damascus, 2 vi 1818, *Gaill.* (JE); Damascus, 14 v 1931, *Z.* (HUJ); El Qaryatein, 23 vi 1932, *Eig & Z.* (HUJ); Hama, Aqerbat near Sélémiyé, *Blanche* 3867 (JE).

IRAQ. Kani Mazu Shirin N of Rowanduz, *Agnew & coll.* 2021 (W); Kirkuk, *B.* 1837 (B); Mossul, Sharanish, 2000m, *R.* 10979 (W); Sulaimaniya, Penjwin pass, 1400m, *R.* 10463 (E, W).

USSR. Georgia: Kakhetia, v 1886, *Kuntze* (NY); Tbilissi, 20 vi 1882, *Schumann* (GOET, JE); ibid., 1868, *Hausskn.* (JE); ibid., *Grossh.* 1 (Z); ibid., *F.* 12710; ibid., *Holmberg* 1015, 1264, 1397 (W); ibid., *D.* 33896 (E); (2 more). Armenia: Sevan, near Shordzha, 1950m, 23 vii 1929, *Smirnow* (E, H); Erevan, near Svartnoz, 7 vi 1931, *Tamamshian & Malev.* (ERE); Daralag near Azizbek, 1550m, 30 vi 1935, *Takht.* (ERE); Megri distr., near Bugakias, 2 vii 1929, *Schelk & Kara-Murza* (ERE); Mikojan distr., near Kavusug, 16 vi 1957, *Avetisian et al.* (ERE); (87 more). Nakhichevan: Norashen distr., near Achura, 1240m, 20 v 1947, *Grossh.* (E); Aznaberd, 2 vi 1960, *Gabrielian* (ERE); near Saltakh in Ilanlu-dagh Mts, 13 vi 1929, *Schelk. & Kara-Murza* (ERE); (26 more). Azerbaijan: Baku, at Sumgait, 13 v 1901, *Alexeenko* (E, JE); Baku, *B.* 8367 (W); ibid., 28 v 1932, *Grossh.* (NY); Karabagh, above Chanakhchi, 28 vii 1912, *Schelk.* (JE); at Shusha, 1868, *Hausskn.* (JE); Gobistan, 35km SW Baku, 100m, *F.* 13500; (6 more). Turcmenia: Kizil Arwat, *Sint.* 1645 (E, G, JE, W, WU); near Ashkhabad, *Litv.* 185 (G, JE, WU); Kara-Kalinsk distr., 3–4km N of Koshtemira, 7 vi 1974, *Nikitin* (GOET); at Krasnovodsk, *Litv.* 1449 (G, H); (3 more). Tadzhikistan: Seravshan, betw. Sary Dagh a. Iskander Kul, 2100–2200m, *B.* 330 (B); Alai Rge., 27 vi 1901, *Fedtsch.* (W).

IRAN. Azarbaijan: Khvoy, 30km E, 1300m, *R.* 32396 (W); Ghoyon Dasht at Rezaiyeh Lake, 1330m, *W. & Assadi* 12105 (THR, W); Qareh Aghaj to Germi, 600m, *Lamond* 3279 (E); 14km SW Ali Rezaabad, 21 v 1971, *Iranshar* (IRAN). Gilan: betw. Rasht and Qazvin, 400m,

B. 8365 (W); Sefid Rud vall. N of Rudbar, *Pa.* 2657 (G). Kordestan: Sanandaj to Hamadan, Salavatabad pass, 2400m, 2 vii 1971, *Termé* (IRAN); ibid., Salavatabad, 16 vi 1956 *Sabeti* (IRAN). Zanjan: Z., 8–20km SW to Bijar, 1700m, *Lamond* 4272 (E); Mianeh gorge, 1200m, *Furse & Synge* 307 (E). Qazvin, Kuh-e-Namar at Fashand, 1800m, *Gauba* G23 (W). Tehran: At Kalak, R. 124 (NY, W); Karaj, 90km N, 2300m, *Furse* 2700 (E, W); Tehran, Evin, 2000m, 30 v 1967, *Mirzapan* (IRAN); Ab-e-Ali N of Pulur, 2260m, *Pa.* 4073 (G. IRAN). Kermanshah: Sarab-e-Kerend, 1620–2030m, 29 vii 1967, *Iranshar & Termé* (IRAN); betw. Kerend and Biwanii, 25 vi 1968, *Iranshar* (IRAN); Shahabad, 16–18km NE, 1700m, *Pa.* 1875 (G). Hamadan: NW of Malayer, 1980m, *Archibald* 2641 (E); H., 100km N at Aq Bulaq, *Rioux & Golvan* 77 (G, W); 21km from H., 2250m, *Pa.* 1420 (G, IRAN); Bahar, 4 vi 1964, *Babai* (IRAN). Markasi: Saveh, 19km N, 1370m, *Pa.* 7247 (G). Mazanderan: Haraz vall. at Mamgol, 500m, *W.* 496 (BG, W); Rustamabad, 26 v 1893, *Lipsky* (JE); N-side of Kandevan pass, 2400m, *Riazi* 2147 (THR). Semnan: Sorkheh near Semnan, 1300–1400m, *R.* 52157 (W); Semnan, 20km NE on Damghan road, 1620m, *Riazi* 5176 (THR); Shahrud, *Bunge* 80 (NY); Shahmirzad, Kuh-e-Nizva, 2800m, 1 viii 1972, *Iranshar & Zargani* (IRAN). Khorasan: Shirvan, 30km W, vi 1966, *Remandieu* (IRAN); betw. Chenaran a. Quchan, 1200–1300m, *R.* 4712 (M, W), 4713 (G, W); Kuh-e-Hazar Masjid, betw. Ardak a. Tolgor, 1200–1600m, *R.* 4975 (IRAN, W), 5005 (W). Lorestan: Aligudarz, 52km SE, 2340m, *Pa.* 2124 (G); Tidar, 2000m, *R.* 17548 (W). Esfahan: WNW of E., 10km SE of Damcyneh, 2300m, 31 viii 1960, *Z.* (HUJ); SE of Ardestan on road to Taleghan, 20 vi 1974, *W. & Foroughi* (W); Kolah Ghazi Wildlife Refuge, 1700–2000m, *R.* 46739 p.p. (W). Bakhtiari: Borujen, 12km NW, 2300–2700m, *R.* 47086 (W); Kuh Rang, 41km SE, 2340m, *Pa.* 2219 (G). Yazd: 115km SE Yazd, 1650m, 16 v 1961, *Z. & Orshan* (HUJ). Fars: Kuh-e-Estehbanat, 2000m, *Bobek* 139 (W); Abadeh, Eqlid, Kuh-e-Bil, 2700–3600m, 4 vi 1969, *Termé & Izadjar* (IRAN); Kuh-e-Sabz Bushom near Shiraz, *Kotschy* 413 (G). Kerman: Betw. Zarand a. Rafsanjan NW of Kerman, 28 vi 1960, *Pa.* (G); betw. Sirjan a. Kerman-Bardtir, 9 vi 1960, *Pa.* (G); K., 87m SE to Bam, 13 vi 1960, *Pa.* (G). Baluchistan: S-slopes of Taftan near Torshab, 1900–2300m, *R.* 54785 (G, W).

AGHANISTAN. Herat: SW Herat, *Neub.* 3455 (W); H., 60km S, 1700m, 21 x 1958, *Pa.* (G); Herat, 73km ENE on road to Qala-e-Naw, 1620m, *P.* 29938. Badghis: Betw. Qala-e-Nau a. Murghab, 1100m, *Furse* 7736 (W); ibid., 5km NE of Qala-e-Naw, 900m, *P.* 29866 p.p.; W of Maymana near Gormach, 480m, *P.* 29926. Faryab: Maymana, 18km E on Kattakam pass, 960m, *P.* 29948; betw. Belcheragh a. Maymana, 1000m, *W.* 3794 (E, BG); near Khest Pul, 16km E of M., 800m, *W.* 8295 (E); (3 more). Farah: Farsi, 5km SW, 2250m, *P.* 21985 (M, W); ibid., 15km SSW, Band-e-Farsi, 2500–2700m, *F.* 6823. Ghorat: Sharak, 2000m, *R.* 19142 (E, W); ibid., 20km WSW, 2450m, *P.* 21960 (M); betw. Sharak a. Naonyak at Dolaini, 2450m, *R.* 18899 (W); Hari Rud vall. at Usturkhan W of Chakhcharan, 2210m, *P.* 19133 (M); (3 more). Balkh: 2km W Shadyan, 1400m, P. 31577; 5km SE Sultan Baba Ali Sher, 1250m, *P.* 31554. Samangan: S., 32km SE, *Hewer* 1257 (W); Koh-e-Chungar S of Rabotak pass, 1300–1600m, *F.* 3098; Rabotak pass, 1400m, *Kukkonen* 6404 (H); (2 more). Bamyan: Ajar vall., 1300–1500m, *R.* 41775 (W); Band-e-Amir, 2800–2900m, *R.* 18484 (E, W); Aq Robat W of Bamyan, *Griffith* 6589 (E, K, W); Panjaw, 2600m, *R.* 36519 (W); (26 more). Oruzgan: 22km NE O., at road to Malestan, 2640m, *P.* 31913; Dehkundi, 3–30km NE Sharestan, 2200m, *R.* 37205 (W). Baghlan: SE-side of Rabotak pass, *Hewer* 1257 (E); Andarab vall. at Ghazan, 1000m, *F.* 3053; ibid., betw. Bannu a. Kishnaba, 1450m, *P.* 11293 (E, M); Narin, 2km N, 1050m, *P.* 21636; (7 more). Takhar: betw. Taluqan a. Qeshm at Gazestan, 1350m, *P.* 21521 (M); Farkhar, 10km NW, 1070m, *P.* 30123. Maydan: near Kash Kul bridge at Hilmand, 2560m, *W.* 8678 (E, GO); Upper Hilmand vall. at Tebar, 2920m, *P.* 18726 (M); Dohane Abdullah, 35km E Sar-e-Chashma, 2800m, *R.* 18608 (W); (7 more). Ghazni: Dasht-e-Nawor, E side, at Binidarzak pass, 3000m, *F.* 1422; ibid., *A.* 3978; ibid., *R.* 37273 (W); Ghazni, 35km SW, 2100m, *R.* 35360 (W); Sar-e-Ab vall. 52km W of Ghazni, 2700m, *R.* 37205 (E, W); (13 more). Parwan: Surkh-e-Parsa, 2150m, *F.* 1157; Gulbahar, *V.* 218, 229; Lower Panjir vall. opposite Korawa, 1700m, *P.* 9748; (6 more). Kabul: Upper Paghman vall., 2300–2800m, *R.* 17100 (W); ibid., 2700m, *P.* 11601 (M); ibid., *Gilli* 402 (W); ibid., *Yosii* 74 (KYO); near Kabul, 1800–1900m, *Collett* 44 (W); ibid., *K.* 4005 (E); ibid., *V.* 555, 907, 1459, 1555, 1561; ibid., *W.* 3167 (E, GO); ibid., *R.* 17008 (E, W); ibid., *Gilli* 400, 401 (W); *ibid.*, Kerstan 490a (W); Sarobi, 1430m, *Gilli* 398 (W); (25 more). Logar: Pul Alam, 20km SE, 2100m, *F.* 3217a; ibid., 1900m, *R.* 31485 (W); *ibid.*, Lamond 2152 (E); Altimur pass, W side, 2850m, *R.* 31877 (W); ibid., *Lamond* 2349 (E); Shutur Gardan pass, 3250m, *F.* 5795; (6 more). Paktya: betw. Chamkanni a. Ahmad Khel, 1850m, *F.* 1837; ibid., *R.* 35641 (W); Sata Kandao pass E of Gardez, 2220–2800m, *R.* 32133 (W); ibid., *Lamond* 2451 (E);

Urgun, 50km NW, 2200–2400m, *R.* 35947 (W, E); (7 more). Kandahar: Betw. Arghandab dam and Tirin, 1400–1700m, *R.* 34965 (W). Zabul: Tarnak vall., *Griffith* s.n. (E, W). Kapisa: Nidjrao, Dara-e-Pota above Pajan, 2200–2500m, *F.* 3203a. Badakhshan: Jurm SE Faizabad, 2000–2600m, *Furse* 6326a (W); Lower Munjan vall., at Pajuka pass, 2850m, *Frey* 175 (M); Wakhan. Sar-e-Skhaur, 2700m, *Roemer* 35 (M).

PAKISTAN. Baluchistan: betw. Chaman a. Quetta at Qila Abdullah, 1600–1900m, *Lamond* 1054 (E, W); ibid; *R.* 29060 (W); Quetta, *Schmid* 1609 (G); Khushdil Khar W of Quetta, 1800m, *Duthie* s.n. (W); Maslakh Range, *Fazil Shah* 57 (W); Maslakh near Sultan, 1600m, *St.* 27958 (E, W, RAW); Kach, 1600–2000m, *Duthie* s.n. (W); Urak, 24km W of Quetta, *Repp* s.n. (W); Khojak pass, 2300m, *R.* 29069 (W); Baluchistan, *Lace* 3818 (K, W). Chitral: Jambatai, 3300m, *Harris* 16784 (W, WU); Bumoglasht, 2300–2600m, *A. Rahman Beg* 26739 (W); Yarkhun, Shohgoz, 2700m, *Stamm & Wöhrl* 240 (M).

b. var. **pamirica** (Rosh.) Freitag, **stat. nov.**

Syn.: *St. pamirica* Rosh., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 11:20 (1949); *St. badachschanica* Rosh. subsp. *pamirica* (Rosh.) Tzvelev, Novosti Sist. Vyss. Rast. 11:16 (1974).

Type: (USSR, Tadzhikistan) Pamir Occ., Vakhan, distr. Ischkaschim. In semideserto stiposo-salsoloso-artemisioso probe pagum Vrang; 3120m, 9 viii 1935, *Ovczinnikov & Afanassiev* 1735 (lecto. LE!, selected by Tzvelev).

Specimens studied (6):

AFGHANISTAN. Bamyan: Band-e-Amir, *V.* 2256, 2257, 2277 (all W); NE of B., 3000m, *Gilli* 409 (W); near Bulola, 2780m, *Gilli* 411 (W). Badakhshan: Wakhan, betw. Qala-e-Ust and Baba-e-Tangi, 2850m, *A.* 7075.

c. var. **prilipkoana** (Grossh.) Freitag, **stat. nov.**

Syn.: *St. prilipkoana* Grossh., Trudy Geobot. Obsl. Pastb. Azerbajdžana, Ser. A, 2:56 (1929); *St. arabica* subsp. *prilipkoana* (Grossh.) Tzvelev, Novosti Syst. Vyss. Rast. 11:16 (1974).

Type: (USSR) Azerbaijan, Mugan, inter Alpaut et Karadonly ('prov. Baku, distr. Saljany'), 18 v 1928, *Prilipko* (holo. LE!).

Specimens studied (2):

IRAN. Azarbaijan: Mogan, hills S Parsabad, 100m, *Pa.* 3020 (G); Meshkindshabr, 35km W, 1000m, *Pa.* 3183 (G).

St. arabica is the most widespread and frequent species of the genus in the area. Unfortunately its nomenclature is most confusing, and the name has scarcely been used since its valid publication by Trinius & Ruprecht (1842). In most Floras of the Soviet parts of Middle Asia it has been called either *St. szovitsiana* or *St. caspia*. Indeed the name *St. szovitsiana* is the older one, but it has been validated by Trinius & Ruprecht (1842) only for a variety of *St. arabica*, and valid species rank was not conferred upon it until 1852. *St. caspia* was published five years later than *St. arabica*.

In the Floras of Soviet Transcaucasia the species was split up, most vigorously by Grossheim (1939), who recognized the four species *St. koenigii*, *St. meyeriana*, *S. szovitsiana* and *St. prilipkoana*. Only recently Tzvelev (1974, 1976) stated the identity of *St. arabica* and *St. meyeriana*, but he maintained *St. caspia* and *St. prilipkoana* as subspecies. In the western floras from Boissier (1884) to Bor (1960, 1970), Mouterde (1966) and Täckholm (1974), the species had been cited under the name *St. barbata*. The detailed examination of the oriental material hitherto called *St. barbata* has shown that it belongs to *St. ehrenbergiana* and *St. arabica*,

two different species with peculiar morphological, ecological and chorological characters. Both are well distinguishable from *St. barbata* of the W and SW Mediterranean. The most striking differential characters between the three species are given in Table 8.

TABLE 8

Differential characters of St. arabica, St. ehrenbergiana and St. barbata

	St. arabica	St. ehrenbergiana	St. barbata
Leaf blade, lower (external) surface	usually scabrous, rarely smooth or densely pubescent	always smooth	smooth or scabrous
Ligules of vegetative shoots, length (mm)	acute, 3–6 (15)	truncate to obtuse, (0·3) 0·5–1 (2)	truncate to obtuse, 0·5–1 (2)
Glumes, length (cm)	(2·2) 2·5–3·5 (4)	(2·5) 3–4 (5)	(3) 3·5–5 (5·5)
Anther tips	unbearded	usually bearded	unbearded or with scattered hairs
Anthecium, length (mm)	(8) 9–12 (14)	(10) 11–13 (15)	(11) 12–14 (16)
Callus, length (mm)	1–1·5 (1·8)	1–1·5 (2)	2–3·5
Lemma indumentum	indistinctly seriate, ascending to appressed	strictly seriate, ascending to spreading	indistinctly seriate at least at base, ascending to appressed
Lemma length (mm)	0·2–0·5	0·7–1·2	0·4–0·6
Awn, diameter at base (mm)	0·2–0·3 (0·4)	0·4–0·5	0·4–0·6
shape of seta	usually flexuose, rarely falcate	falcate	falcate
Distribution	Irano-Turanian	E Med. and E Submed.	W Med. and SW Med.

The species exhibits wide morphological variation, particularly in length of awn, anthecium and ligules, in distribution of lemma- and callus-indumentum, in the indumentum of the culms, sheaths and the lower surface of the blades, and in the width of the blades. Transcaucasia is the area with the highest diversification of forms. Shorter awns had been used already by Trinius & Ruprecht (1842) for separating their var. *meyeriana* from var. *szovitsiana*. Using the same character, Grossheim distinguished the three species *St. meyeriana* with awns of (5–)7–10cm, *St. szovitsiana* with awns of 10–17cm, and *St. prilipkoana* with awns of 20–22cm. With more material at hand that subdivision proves arbitrary, except for *St. prilipkoana*, which stands somewhat apart. However, reinvestigation of the type revealed a variation of awn length from 18–22cm. Furthermore, the abundant material of *St. arabica* from Armenia and Azerbaijan stored in ERE and BAK includes several specimens, which link the type of *St. prilipkoana* with normal forms of *St. arabica*. One sheet, 25 iv 1963, *Mulkidzhanian* (ERE) differs even more from normal *St. arabica* by 19–23cm long and unusually strong awns and by 13–15mm long anthecia with a very pronounced callus of 2–2·5mm. With those characters it comes close to *St. barbata*, but as the very long and acute ligule (up to 10mm) indicates an affinity to *St. arabica*, and the locality is far from the area of *St. barbata*, this individual may represent no more than a local

aberrant form of *St. arabica*. The same may be true for the citation of *St. barbata* from the Apsheron peninsula by Tzvelev (1976), which is based on one specimen only.

With limited material and restriction to smaller regions, forms with a shorter plume at the awn (0·8–1mm only) may seem to deserve higher taxonomic importance. However that character had been observed here and there in specimens from very different parts of the area and in combination with other diverse variations, indicating an origin by parallel mutation: Jordan (7 v 1927, *Eig & coll.*), Iraq (*Regel* 81), S Iran (*R.* 3524, 3527; *Stapf* 1532–1534) and Afghanistan (*F.* 5641a). The short-plumed specimens from Jordan and Iraq have rather long anthecia ranging from 12–15mm, but occasionally anthecia of that length also occur in individuals with normal awn, e.g. *F.* 2278 from Afghanistan.

The extension and density of the indumentum covering the anthecium varies considerably. Usually at least the dorsal line is distinct, often also the adjacent ones, but sometimes the indumentum is uniformly dense. Specimens with glabrous or almost glabrous anthecia were described as *St. pamirica* by Roshevitz (1949), and Tzvelev (1974, 1976) later united that taxon with *St. badachschanica* Rosh., which beside a dense leaf indumentum always has a more or less glabrous callus but a pilose lemma. In fact, some hairs are always present on the ventral side of the anthecium at the junction between callus and lemma. Whereas specimens with a more or less glabrous callus are widespread among the material from S Iran to the Pamir Alai, individuals with almost completely glabrous anthecia are restricted to the Pamir region and a small area in C Afghanistan. These latter ones are here accorded varietal rank.

The occurrence of a dense indumentum of retrorse hairs on the culms below the nodes led to the establishment of *St. koenigii* Woronow, which in all other respects is identical with normal specimens of *St. arabica*. More attention has been given to *St. badachschanica* Rosh., which differs by the same type of indumentum on the sheaths and lower surface of the blades. The type of *St. arabica* has slightly scabrous leaves, and in the bulk of the specimens seen they are distinctly scabrous. Specimens with pubescent leaves occur throughout the area of the species. From Syria and Palestine they have been described as *St. damascena* Boiss. Quite a lot of specimens are just slightly pilose, with the indumentum mostly restricted to the base of the blade and the sheaths, as in *F.* 1623, 3237, 3322 etc. Furthermore, in many places pubescent and scabrous individuals have been seen growing side by side with all intermediates, and I therefore consider *St. badachschanica* and *St. damascena* to be just hairy forms of *St. arabica*. Obviously they have arisen independently by small mutations in different parts of the area and were favoured by selection under the most xeric conditions, but without being able to displace the normal forms. Another subject of variation is the length of the ligule at the vegetative shoots. Whereas the longest ligules are usually 3–8mm long, they are only 2–3mm in some plants from the Near East, but 12–15mm in two of my own collections from E Azerbaijan (*F.* 13501, 13561). Generally the range of variability in most characters is very similar to that of the closely allied sympatric *St. hohenackerana*, and the reasons for maintaining both these species are discussed on p. 467.

36. St. hohenackerana Trin. & Rupr., Sp. Gram. Stip.: 80 (1842).

Syn.: *St. pennata* L. var. *minor* Boiss., Fl. Or. 5:502 (1884), nom illeg.

St. barbata Desf. var. *seminuda* Hackel, Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl. 50, 2. Abt.: 8 (1885). Type: (Iran) In collibus ad viam versus Dauletabad (Malayer), *Polak* 882 (holo. W!).

St. assyriaca Hand.-Mazz., Ann. K. K. Naturhist. Hofmus. 28:26 (1914). Type: (Iraq) Gipssteppe auf dem Rücken des Dschebel Makhul u. D. Chanuka im Zuge des D. Hamrin S von Kalaat Schergat (Assur) am Tigris, 200–300m, 10 v 1910, *Handel-Mazzetti* 1062 (hol. WU).

St. subbarbata Keller, Bot.-geogr. Issl. Zaisan 2:53 (1912). Type: (USSR, Kazakhstan) Semipalatinskoj obl., Zaisansk. Ujezda, Kal Kadzhirskaja dolina, 4 vii 1908, *Keller* (holo. LE!).

St. stapfii Rosh., Bot. Mater. Gerb. Glavn. Bot. Sada 5:11 (1924). Type: Persia (Fars. prov., near Shiraz) 1885, *Stapf* 1530 (holo. W!).

St. iraqensis Martinovský, Preslia 42:375 (1970). Type: (Iraq) 40km ad orientem a Rutba positus, 27 iv 1961, *Hadač* 4375 (holo. PR n.v.).

St. atriseta Stapf ex Bor, Fl. Ir. 70:389 (1970). Type: (Iran, Fars prov.) In summo monte Kuh Bul, 4600m, 6 ix 1885, *Stapf* 1536 (holo. W!).

St. hohenackerana subsp. *grossheimii* Tzvelev, Novosti Sist. Vyss. Rast. 1966: 21 (1966). Type: (USSR, Transcaucasia, Nakhichevan) distr. Norashen (Iljiczevsk), in decl. lapid. Mjunch-Bala. Ogly, prope pagum Ulja-Norashen, c.900m, 15 v 1947, *Grossheim & Kirpicznikov* (holo. LE!).

St. hohenackerana subsp. *nachiczevanica* Tzvelev, ibid.: 21 (1966). Type: (USSR, Transcaucasia, Nakhichevan) distr. Ordubad, decl. lapid. in regione mont. inf. Zangezurici orientem versus ad opp. Ordubad, 6 vi 1956, *Jegerova & coll.* 128 (holo. LE!).

St. hohenackerana subsp. *ordubadica* Tzvelev, ibid.: 22 (1966); *St. hohenackerana* subsp. *nachiczevanica* Tzvelev var. *ordubadica* Tzvelev, Tzvelev, ibid. 11:16 (1974). Type: (USSR, Transcaucasia, Nakhichevan) distr. Ordubad, prope marginem sept. opp. Ordubad, 7 vi 1956, *Jegerova & coll.* 280 (holo. LE!).

Type: (USSR, Azerbaijan) Transcaucasia, circa Shusha et Helenendorf (Kirovabad), *Hohenacker* 1253 (holo. LE!).

Densely tufted, branching intravaginal, with some culms and numerous vegetative shoots; *culms* 40–80(–90)cm, 2(–3)-noded, glabrous, scabrous or shortly pubescent by retrorse hairs, sometimes even on the nodes; *sheaths* glabrous, scaberulous or densely pubescent; *ligules* at the culm leaves up to 14mm long, at the vegetative shoots up to 7mm, acute, setulose; *blades* greyish green, at the culms flat, up to 10cm × 2·5mm, at the vegetative shoots involute, up to 20cm long, 0·4–0·6mm diam., on the upper surface densely pubescent, beneath usually scabrous, more rarely pubescent or scabrous only at the base or smooth throughout; *panicle* at the base enclosed by the sheath of the uppermost leaf, narrow, 15–35 × 1–2·5cm, the branches erect or ascending, glabrous or sparsely setulose, the lower

ones paired, up to 11cm long, with 2–3 spikelets; *spikelets* (2·2–)2·5–4 (–4·7)cm long, the glumes subequal, almost linear, hyaline, at the dorsal line sometimes sparsely setulose, 3–5-nerved; *anthecium* (8–)10–13(–15)mm long; *callus* 1–2·5mm long, bearded to (rarely) almost glabrous, scar circular to elliptic, peripheral ring dorsally flattened and distinctly protruding; *lemma* coriaceous, light brown at maturity, up to $\frac{2}{3}$–$\frac{3}{4}$ covered by 0·3–0·4mm long ascending hairs, either in indistinct rows with at least the dorsal one marked, or completely diffuse, the indumentum on the flanks reaching higher up, at the apex usually a coronula of 0·4–0·6mm long hairs, below the coronula somewhat papillose; *awn* (9–)10–15(–18)cm long, bigeniculate at (1·7–)2–2·5 and at 3·2–4(–5)cm, lower geniculation sometimes indistinct, pale or purplish, columna twisted, articulated at the base, usually glabrous and scabrous, more rarely pilose to plumose above the first geniculation and glabrous only at the first segment, seta flexuose or falcate (in short-awned forms), plumose by 1·5–2(–2·5)mm long hairs; *palea* equal in length, with a dorsal line of ascending hairs up to $\frac{3}{4}$; *lodicules* subequal, lanceolate, glabrous, smooth, the anterior ones 1·2–1·7mm long, the posterior slightly shorter; *anthers* 4–5mm long, unbearded, yellow; *ovary* with 3 styles and stigmas, one of them distinctly shorter; *caryopsis* 7–8(–10)mm long, embryo 2mm long, hilum reaching up to the top; 2n unknown.

From C Anatolia and Jordan through Syria, Iraq, northern Saudi Arabia, Transcaucasia, Iran and Afghanistan to Baluchistan in the SE and through Soviet Middle Asia to southern W Siberia in the NE (Fig. 26).

A very common and typical component of semi-desert communities throughout the Irano-Turanian area; from the lowlands up to more than 4000m in S Iran and 3300m in Baluchistan; most common in areas with about 100–300mm of annual precipitation.

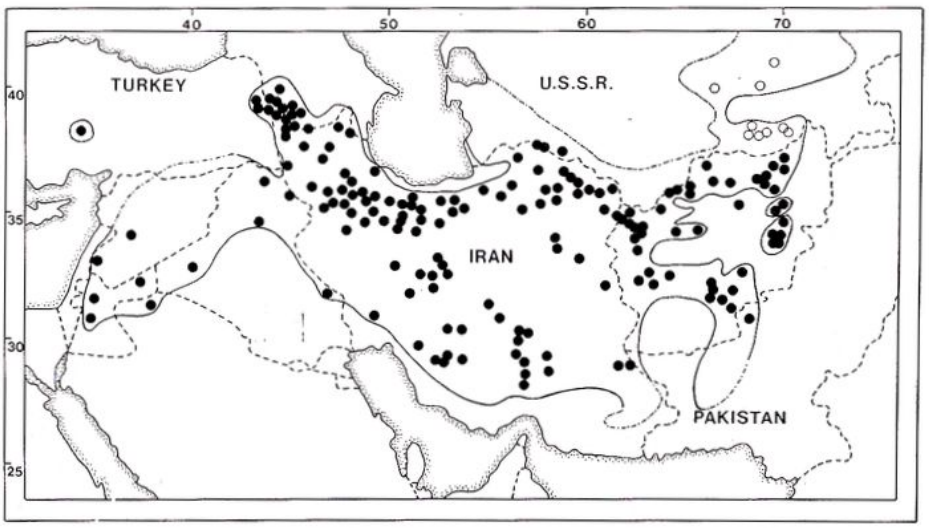

FIG. 26. Distribution of *Stipa hohenackerana*. ○ literature records from Tadzhikistan according to Ovczinnikov (1957).

Specimens studied (215):

TURKEY. Kayseri: W of K., 28 vi 1856, *Bal.* (G). Kars: Ararat, 2500m, 19 vii 1957, *Regel* (G); ibid., 29 vi 1967, *Ross* (E); Iğdir, 3km SW, Aras vall., 800m, *D.* 43779 (E); ibid., SE of Aralik, 900m, *D.* 43690 (E).

JORDAN. Amman, betw. El Muwaqqar a. El Kharana, 7 v 1927, *Eig & coll.* (HUJ); Dab'a, 600m, *Dinsmore* 2999 (G); 40–220km E of Amman at Rutba road, *R.* 12861 (W).

SAUDI ARABIA. Northernmost part, Turayf camp, 960m, *Collenette* 4238 (E, K).

SYRIA. Damascus, 21km W, 800m, 3 v 1933, *Eig & Z.* (HUJ); El Qaryatein, Kasy s.n. (W); Syria, s. loc. *Labill.* s.n. (G).

IRAQ. Rutba, 2km E, *R.* 12807 (W, M); betw. Rutba a. Ar Ramadi 260km W Ramadi, 500m, *R.* 9847 (E, W); Jab. Hamrin near Kasrabad, 20 iv 1961, *Haines* (E); Chamchamal, on Sulaymaniyah road, *Haines* 2011 (E).

USSR. Armenia: Erevan, Dalma, 14 vi 1933, *Tamamshian & Araratian* (ERE); Echmiadzin distr., Shorbulakh, 14 v 1966, *Gabrielian* (ERE); Vedi distr., Ilandag, 1 vi 1954, *Gabrielian* (ERE); Ararat vall. near Dahannatlu, 9 v 1961, *Takht. & Gabrielian* (ERE); (13 more). Nakhichevan: Near Norashen, 900m, 7 v 1947, *Grossh. et. al* (E); near Ordubad, 26 v 1928, *Grossh.* (ERE); ibid., 20 v 1933, *Grossh.* (G); betw. Dzhulfa a. Aza, 24 v 1928, *Grossh.* (ERE); betw. Negram a. Darosham, 16 v 1928, *Grossh.* (ERE); (3 more). Turcmenia: Kopet Dagh, at Sablonka, *Litv.* 186 (G, JE, WU); Suluklü near Ashkhabad, *Sint.* 1076 (E, G, JE, L, WU, W).

IRAN. Azerbaijan: Moghan, 5km S of Borah, 140m, *Pa.* 3115 (G); Maku, 1400m, *Damnebi* 15 (IRAN); Lake Rezaiyeh, SW side, 1300m, *Jacobs* 6946 (BG, W); (6 more). Gilan: N of Rudbar, 300m, *B.* 8365 (B); ibid., 250m, *Pa.* 3617 (G); W of Sefid Rud dam, 350m, *Pa.* 3644 (G). Kordestan: 107–109km SW Zanjan at road to Bijar, 1700m, *R.* 42457 (W); Bijar, 72km SW to Sanandaj, 1950m, 1 vii 1971, *Termé* (IRAN); Bijar, Kuh-e-Bash, 2000–2200m, 10 vii 1968, *Iranshar & Desfoulian* (IRAN); (1 more). Zanjan: Z., 8–22km SW to Bijar, 1800m, *R.* 42354 (W); near Z., 1600m, *R.* 56560 (W); Takestan, 14·5km W, 1400m, *Pa.* 2677 (G). Tehran: Near Karaj, Gauba in *B.* 139a, b (B); ibid., 1300m, *R.* 1049 (W); Tehran, Ariamehr Bot. Gard., 1320m, 26 v 1974, *Sanii & Assadi* (THR); Vardavar vall. W of T., 1700m, 27 v 1974, *W. et al.* (THR, W); (23 more). Kermanshar: Sunqur, 15km NW, 1850m, *Pa.* 1825 (G). Hamadan: Near H., *Pichler* 882 (W); Aq Bulaq, 100km N of H., *Rioux & Golvan* 77b (G, IRAN, W); Kuh-e-Alvand, 7 vi 1965, *Pa.* (IRAN); ibid., 1882, *Pichler* (WU). Markazi: Arak, 4km W, 1950m, *Pa.* 1127 (G); near Arak, 1645m, *Archibald* 1738 (E). Mazanderan: Shah Reza Nat. Park, 1750m, *Riazi* 9005 (THR). Semnan: Firuzkuh, 2140m, *Furse* 3064 (E); Siah Kuh, Kavir Nat. Park, 900m, *R.* 46351 (W); betw. Shahmirzad and Chishme, 2800m, 1 viii 1972, *Iranshahr & Zargani* (IRAN); (7 more). Khorasan: betw. Chenaran and Quchan, 1100m, *R.* 4713 (E, IRAN); at Sabzevar, *R.* 5263 (M, W); Mashad, 50km E, 1965, *Remondier* (IRAN); (23 more). Lorestan: Azna, 5km W, 1930m, 5 vii 1959, *Pa.* (G). Khuzestan: Haft Gel, 23km E to Izeh, 650m, 17 iv 1959, *Pa.* (G). Esfahan: Betw. Damaneh a. Khunsar, 2740m, *Archibald* 2718 (E); Ardestan, 20km W to Taleghan, 1700m, *W. & Foroughi* 11496 (THR, W); Kolah Ghazi Wildlife Refuge S of Esfahan, 1700–2000m, *R.* 46739 p.p. (W); (6 more). Bakhtiari: Chelgerd, near tunnel Kuh Rang, 2500–2600m, *Pa.* 2149 (G); Falard, 2km from Dalvara, 2000m, 4 vi 1973 *Iranshahr & Moussavi* (IRAN). Yazd: Y., 101km SE to Anar, 1620–1660m, *Pa.* 7009 (G); Taft, Hedech, 2280m, 11 vi 1976, *Moussavi & Tehrani* (IRAN); Chupanan: 14km ENE, 850m, 17 v 1975, *Iranshahr* (IRAN). Yasuj: Dogumbadam, 3km S, 630m, *Pa.* 1039 (G); Kuh-e-Zeydun, 2230m, *Archibald* 1278 (E). Fars: Shiraz, *Stapf* 1527 (W); Abadeh, Eqlid, Kuh-e-Bil, 3000m, 3 vi 1969, *Termé & Iranshahr* (IRAN); Kazerun, 22km E, 1200m, *Pa.* 947 (G, IRAN); (9 more). Kerman: Kuh-e-Nasr, 2700m, *B.* 4841 (B, JE, W); betw. Baghin and Sangpur pass, 2200m, *R.* 2986 (M, W); betw. Sirjan and Baft, 45km E of S., 2200m, 27 v 1975, *Moussavi & Tehrani* (IRAN); (6 more). Hormozgan: Sirjan, 101km S, 1680m, *Pa.* 6810 (G). Baluchistan: Betw. Zahedan and Khash, 1300–1600m, *R.* 4262 (W); E foothills of Bazman, 1400–1700m, *R.* 55135 (G, W); S. slope of Taftan, near Torshab, 1900–2300m, *R.* 54785 (W).

AFGHANISTAN. Herat: Eslam Qala, 14km ESE at road to Herat, 720m, *P.* 29377; Khusan, 40km NE, 950m, *F.* 5490; near Herat, *Aitch.* 415 (K); (7 more). Farah: pass N of Shindand at Herat road, 1160m, *W.* 7691 (E, GO); Shindand, 34km N, 1320m, *F.* 5241; Gulestan, 15km N, 2100m, *W.* 7288 (E, GO). Ghorat: Dolaini betw. Sharak a. Naourak, 2500m, *R.* 18899 (W); Koh-e-Hawzd, 30km NE Pasaband, 2600m, *P.* 21852 p.p. (M). Badghis: Qala-e-Naw, 5km NE, 900m, *P.* 29866 p.p. Faryab: Betw. Gormach a. Qaisar at Bay Kham, 960m, *P.* 29931; near Khesht Pul, 16km E of Maymana, 800m, *W.* 8295 (GO). Balkh: Betw.

Chashma-e-Shafal a. Aq Kupruk, 800–1000m, *R.* 16285 (W, M). Baghlan: Rabotak pass NW of Pul-e-Khumrie, 1400m, *R.* 16447 (M, W); near Pul-e-Khumrie, *V.* 456; Andarab vall., 20km E of Doshi, 1900m, *Dobson* 48 (K). Bamyan: Band-e-Amir, 2800m, *Dieterle* 1341 (M). Maydan: 60km SW of Kabul, at main road, *Pa.* A 976 (G). Kabul: Exp. farm at Khair Khona pass NW of K., 1900m, *V.* 71.245 (M); Pul-e-Charkhi E of Kabul, 1780m, *A.* 10451; Dehsabz NE of Kabul, 2700m, *A.* 5417. Ghazni: Sar-e-Ab vall. 42km NW of Gh., 2750m, *F.* 1399; Mts around Dasht-e-Nawor, 3250m, *Breckle* 4607. Logar: Near Pul Alam, 1900m, *R.* 31485 (G, M, W); Dasht-e-Koshi NE Pul Alam, 2200m, *Breckle* A 458. Paktya: Tera pass NW Gardez, 2800m, *V.* 71.242 (M); Gardez, 25km S, 2150m, *F.* 3252; Urgun, 25km NW at road to Ghazni, 2300m, *F.* 1943. Kandahar: At Dahla, about 70km N. of K., 1450m, *F.* 846. Shah Maqsud above Darweshan, 2000m, *W.* 7110 (E, GO); ibid., 16 iv 1958 *Pa.* (G); Mts 7km W of Kandahar, 1150m, *F.* 536; 60km NW of Kandahar, near main road, *Pa.* A 546 (G). Takhar: Kalifgan, 2000–2600m, *Furse* 8127 (K); ibid., *Pa.* A 1214 (G); Naqel, at road Khanabad to Taluqan, 620m, *A.* 6719. Badakhshan: Keshem vall., side vall. E Kangurchi, 1300–1700m, *A.* 6696.

PAKISTAN. Baluchistan: Chaman, 31 v 1955, *Kitamura.* (KYO); Zarghun, 3300m, *Santapau* 6740 (K).

St. hohenackerana is most closely allied to *St. arabica.* It differs only in the scabrous lower part of the awn and in its ecology in being a truly semi-desert species. Whereas the two species have a similar general distribution, they behave in fact like ecological vicariants. In a strictly geographical sense overlapping is quite common in areas with c.250–350mm of annual precipitation, but then *St. hohenackerana* occupies the more xeric, and *St. arabica* the more mesic habitats. The different ecology of *St. hohenackerana* certainly reflects a better physiological adaptation to arid conditions.

The species is variable in the same characters and to a similar degree as *St. arabica*: leaf indumentum, length of anthecium and callus, lemma indumentum, and furthermore, the surface structure of the lowermost awn segment. Such variability is reflected by the high number of synonyms, because several new species were founded on single specimens differing from the bulk of *St. hohenackerana.* The investigation of the rich material from the area has shown that these characters vary independently and continuously and that no significant geographic pattern is recognizable. Therefore the taxon is here treated as one polymorphic species. One character stressed in defining new species, here included into *St. hohenackerana* (viz. *St. assyriaca*, *St. stapfii* and *St. iraqensis*), is the distinct pilosity of the second segment of the awn, which is usually glabrous and scabrid. However, transitions to normal forms are present and such specimens occur scattered all over the area from Syria (*Labillardiere*) through S Iran (*R.* 31485) and Khorasan (*Bunge*) to E Afghanistan (*F.* 1399). Anatomically the difference is just in the length of the respective trichomes: short and causing the rough surface as in typical forms, or longer and in the form of distinct hairs. In any case, the forms with a partly pilose columna come very close to *St. arabica* and may have arisen by occasional hybridisation.

St. atriseta Bor is based on S Iranian plants with dark purplish awns, but such forms occur together with normal ones in other regions as well, and the character itself is of minor taxonomic value. The absence of a coronula at the top of the lemma has likewise been noted in a few specimens scattered over the whole area (e.g. *Sintenis* 1076 from the Kopet Dagh, *R.* 3527 from S Iran, *W.* 7691 from W Afghanistan, and *F.*

1943, 3252 from E Afghanistan). The lemma indumentum tends to be denser and almost diffuse in some plants from Syria to W Afghanistan and simultaneously it reaches higher up, in *F.* 5422 even to the top. But more typical forms with a somewhat seriate arrangement of lemma hairs are also common in the west and intermediates in indumentum structure have been seen very often. In a few specimens the callus is almost glabrous, as in *W.* 7110 from S Afghanistan and *R.* 31485 from E Afghanistan. Whereas densely pubescent leaves have been seen in specimens from all over the area, forms with glabrous and smooth leaves tend to concentrate in the lowlands of the west up to W Afghanistan, as is the case with *St. arabica.* Remarkable also is the variation in length of the anthecia. Forms with pseudo-fruits of 12–15mm (partly caused by longer callus) are concentrated in the west and have been most commonly collected in E Anatolia and Iraq, but, nevertheless, they also occur in W and E Afghanistan. As all the characters mentioned vary independently and continuously I hesitate to adopt a formal infraspecific grouping, which would necessarily result in a wealth of taxa. Tzvelev (1966) gave an example, and I think a discouraging one: for the small area of Nakhichevan he recognized four subspecies (see list of synonyms). I have seen the types, and they fall within the normal range of variation. Tzvelev (1976) later reduced the number of subspecies to two: subsp. *ordubadica* was subsumed into subsp. *nachiczevanica* and subsp. *grossheimii* into subsp. *hohenackerana*; the remaining two being arbitrarily separated by awn length (7–11cm and 11–16cm respectively). Tzvelev (1974, 1976) supposed a hybrid origin of *St. hohenackerana* from *St. arabica* and *St. lessingiana.* I find it difficult to accept this view, because I know of no area, where both species meet or, at least come, sufficiently close. Furthermore, the characters of *St. lessingiana*—2 styles, long lemma indumentum, smooth columna, extremely short ligules—have never been observed in the rich material of *St. hohenackerana* from the region.

37. St. ehrenbergiana Trin. & Rupr., Sp. Gram. Stip.: 75 (1842).

Syn.: *St. tauricola* Čelak., Oesterr. Bot. Z. 33:349 (1883). Type: (Turkey, Konya/Içel) Bulgar Dagh, prope montem Gisyl Deppe (Kizil Tepe), 8000ft, 21 vii 1853, *Kotschy* (holo. PR n.v.).

St. armeniaca Smirnow ex Rosh., Fl. SSSR 2:740 (1934). Type: (Turkey, Kars) Kagysman, in valle fl. Araxis, 2 vi 1913, *Woronow* 12588 (holo. LE!, iso. W!).

St. froedinii Meld. in Rech. f., Symb. Bot. Ups. 11:53 (1952). Type: (Turkey) 6km S of Bitlis, 1450m *Frödin* II/30 (holo. UPS n.v., iso. WU!).

St. tenerrima Bornm. & Gauba, Repert. Spec. Nov. Regni Veg. 47:129 (1939). Type: (Iran) Elburz, Paschand, Kuh-e-Nemar, 1800m, 3 vi 1937, *Gauba* 1233 (iso. IRAN!, W!).

St. barbata Desf. var. *longiaristata* Martinovský, Preslia 42:373 (1970) Type: Iraq, Shaqlava, 11 iv 1960, *Hadač* (holo. PR n.v.).

Type: Syria, *Ehrenberg* (holo. LE!).

Densely tufted, branching intravaginal, with some culms and numerous vegetative shoots; *culms* 40–90cm, 2–3-noded, glabrous, smooth; *sheaths* glabrous, smooth, more rarely pubescent, with ciliolate margins; *ligules* at the culms up to 5mm long, at the vegetative shoots (0·3–)0·5–1(–2)mm long, obtuse, ciliolate; *blades* at the culms flat or involute, up to 10(–20)cm long, 1·5–3mm wide, at the vegetative shoots usually involute, up to 24(–30)cm long, 0·4–0·6mm diam., on the upper surface densely pubescent, beneath glabrous, smooth, very rarely pubescent; *panicle* at the base ensheathed, narrow, 12–35 × 1–3cm, the branches erect to ascending, glabrous, the lower ones paired, up to 10cm long, with up to 2 spikelets; *spikelets* (2·5–)3–4(–5)cm long, the glumes subequal in length, linear to narrow-lanceolate, acuminate, tapering into a fragile hyaline tip, at the dorsal line sparsely setulose, the lower one 3–5-nerved, the upper 5–7-nerved, stronger; *anthecium* (7–)10–13(–15)mm long; *callus* 1–1·5(–2)mm long, densely bearded by 1·5–2mm long hairs, scar broadly elliptic, peripheral ring dorsally flattened and long protruding; *lemma* coriaceous, green to light brown, with an indumentum of 0·7–1·2(–1·5)mm long ascending to spreading stiff hairs strictly arranged in 5 dense lines, the dorsal line reaching up to $\frac{1}{3}$–$\frac{1}{2}$, the lateral ones very short, the marginal ones up to $\frac{2}{3}$, below the apex usually with a coronula of about 1mm long hairs, more rarely coronula lacking and only papillose in the upper part; *awn* (10–)13–17cm long, bigeniculate at (1·8–)2–2·5 and at (2·5–)3–4cm, plumose throughout, rather strong with a basal diameter of 0·4–0·6mm, columna twisted, articulated at the base, pilose with the hairs increasing in length from 0·2mm at the base to 0·7–1mm below the second geniculation, seta falcate, rarely somewhat flexuose, with 1–1·5(–2)mm long hairs, towards the apex slightly shorter; *palea* equalling the lemma in length, glabrous; *lodicules* 1·2–1·8mm long, lanceolate, glabrous, the posterior one slightly longer and with a more rounded apex; *anthers* 5–7mm long, bearded; *ovary* with 3 styles and stigmas of equal size; *caryopsis* 7–10mm long, embryo 2–3mm long, hilum reaching up to the top; 2n unknown. For the ovary see Fig. 3c.

From Anatolia through Transcaucasia to the Central Alburz Mts and along the Zagros ranges to SW Iran, southwards via Syria and Lebanon to Palestine (Fig. 27).

A rather common component of very diverse woodland and seral shrubland communities, predominantly in *Quercus-*, *Juniperus-* and *Cedrus-*regions; from the lowlands up to 2000(–2300)m.

Specimens studied (88):

TURKEY. Amasya: A., 600m, *B.* 2578 (JE), B. 456 (Z). Niğde: Vall. N of Maden, *Darrah* 310 (E); Ala Dağ, Emli Bogazi, 2150m, *Wood & Gibson* 139 (E). Seyhan: Hadjin to Karakilisse, *Post* 242 (E); Toklu Dağı, 1400m, *Kotschy* 163 (W). Sivas: Zara, 20km E at road to Imranli, 1650m, *R.* 57556 (W). Gümüşane: G., 8 vi 1862, *Bourgeau* (GOET, Z); Torul, 950m, *Henderson & Stainton* 5030 (E); Taltaban, *Sint.* 5776 (E, W, WU); Trabzon to Gümüşane, 2500m, *Balls* 526 (E). Erzincan: 20km NW of E., 1400m, 8 vii 1963, *Z.* (HUJ); Altikivei at Kemaliye, *Sint.* 2365 (JE, G, W). Tunceli: Munzur Dağ above Ovacik, 2400m, *D.* 31353 (E); Pertek Tunceli, 1400m, *D.* 29131 (E). Elazig: Harput, *Sint.* 526 (JE). Maraş: Beryt Dağı, 2400m, 10 viii 1865, *Hausskn.* (JE). Adiyaman: Nemrud Dağı, 1600–2250m, *Hand.-Mazz.* 438 (W), 2099 (WU). Hatay: Amanus Mts, 3·5km N Belen Geçedi, 930–1000m, *Buttler* 13005 (M); 16km SW of Yarpuz, 2000m, *Buttler & Erben* 17975 (M). Gaziantep: at. G.,

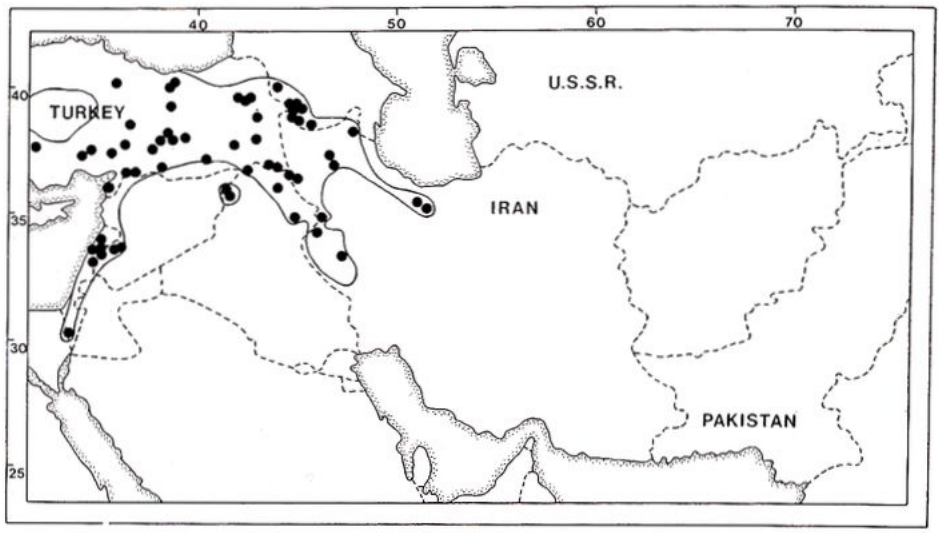

FIG. 27. Distribution of *Stipa ehrenbergiana.*

Aucher 3025 (G); betw. G. and Birecik, 600m, 6 v 1865, *Hausskn.* (JE, W); Soff Dağı, 1300m, 28 vi 1865, *Hausskn.* (JE). Urfa: Near U., 400m, 16 v 1865, *Hausskn.* (JE, W); Betw. U. and Sürüc, *Hausskn.* 487 (JE). Kars: Kağisman, *Woronow* 12587 (W); Akh-chaj vall. below Novo-Nikolajevka, *Woronow* 12591 (W). Bitlis: 3–5km N of Baykan, 1100m, *D.* 43161 (E). Van: 8km from Van to Erçek, 2100m, *D.* 44410 (E). Hakkari: 8km from Semdinli to Yüksekova, 1900m, *D.* 44996 (E); ibid., 26km, 2000m, *D.* 45049 (E); Sat Dağı, first ridge betw. Yüksekova a. Varegöz, 2150m, *D.* 45645 (E).

CYPRUS. Othalana, 230–300m, 27 iii 1936, *Lyngrassides* (HUJ); near Xeroleno, 20 iv 1944, *Evenari* (HUJ).

SYRIA. Kurd Dagh, 1300–1600m, *Harajian* 1118 (E, G); ibid., vi 1891, *Post* (W); Homs, 156km S, 1430m, 2 v 1933, *Eig & Z.* (HUJ); Jabal Qayoun, 17 iv 1816, *Gaill.* (JE); ibid., 38km W of Damascus, *R.* 13217 (W); ibid., *B.* 12956 (Z); betw. Mezzé and Raboué W of Damascus, 28 v 1819, *Gaill.* (JE); Antilibanon, at Zebdani, 1400m, *B.* 1617 (JE, W, WU); Deir Atiyah 80km N of Damascus on way to Homs, *Barkoudah* 757, 1199 (E).

LEBANON. Jab. Sannine, 19 vi 1886, *Peyron* (G); Ain Geddaiyé near Zahlé pass, *Peyron* 1271 (G); near the cedars, *Peyron* s.n. (G); Beqaa, Hammara, *Peyron* s.n. (G); Antilibanon above Baalbek, 1150–1300m, *B.* 12955 (E, JE, W, WU); betw. Hasbaya a. Hermon, *Letourn.* 360a (G, W); above Ain Zehaltah, 1600–2200m, 25 v 1877, *Ball* (E); S slopes of Libanon at Jom Niha, 1500–1800m, 13 v 1877 *Ball* (E).

IRAQ. Jab. Sinjar, 27km W of summit, 460m, 28 iv 1933, *Eig & Z.* (HUJ); ibid. at Rasheed, *A.* 2705 (W); ibid., Chel Miran, 1400m, *Hand.-Mazz.* 1523 (W, WU); Jab. Khantur NE of Zakho, 1480m, *R.* 10827 (E, W); ibid., at Sharanish, 2000m, *R.* 10979 (W); Kuh Sefin NE of Erbil, *B.* 1838 (Z); Shaklavash 37km NE Erbil, 1300m, *Haines* 679 (E); Kani Mazu Shirin near Shirwan Mazin, 1500m, *Agnew & coll.* 2021 (E, W).

USSR. Azerbaijan: Ilan-dagh, Ararat vall., 6 VI 1959, *Gabrielian* (ERE); Eranos pass, 1100–1300m, 12 v 1961, *Takht. & Gabrielian* (ERE); Daralagiz, upper Arpa vall., 27 vi 1946, *Dolukhanov* (ERE); Mikojan distr., near Kavushug, 1200–1300m, 15 vi 1957, *Avetisian et al.* (ERE); (9 more). Nakhichevan: Sojukh Mts above Ordubad, 2640m, 15 vi 1957, *Avetisian et al.* (ERE); ibid., Shahbuzk, *Grossh. & Gurvich* s.n. (Z); Norashen distr., 900m, 8 V 1947, *Grossh. et al.* (E); ibid., near Achura, 1240m, 20 v 1947, *Grosh. et al.* (E); (3 more).

IRAN. Azerbaijan: Mianeh gorge, 1320m, *Furse & Synge* 307 (IRAN).—Kordestan: Marivan, 1500m, *Jacobs* 6482 (E, W); Sanandaj, 75km WNW to Marivan, *Archibald* 2047 (E). Tehran: Kuh-e-Nemar near Karaj, 1600–2000m, *R.* 665 (E, NY); Karaj vall., 1600–1700m, *Pa.* 7335 (G); Tehran, 15–20km NW, betw. Kan and Sangan, 1400–1800m, *R.* 54531 (W); Alburz Mts near Shemshak, 2200m, *R.* 57177 (W). Kermanshah: Kuh-e-Parou, 2000–2300m, *Jacobs* 6753 (BG, E).

The position of *St. ehrenbergiana* has been discussed together with the differential characters of the closely related *St. arabica* and *St. barbata* on p. 462 (see Table 8). Even in areas where *St. arabica* is present in forms with externally glabrous blades and ciliolate sheath margins, *St. ehrenbergiana* remains easily detectable by the much shorter ligules of the vegetative shoots and the long, spreading and strongly seriate lemma indumentum. The type of *St. armeniaca* agrees completely with that of *St. ehrenbergiana* except for slightly shorter ligules at the vegetative shoots which reach up to 1mm only, whereas in the latter they are up to 2mm long. The types of *St. tauricola* and particularly *St. froedinii* have smaller anthecia and finer leaves, but as they have been collected in higher mountains from cooler habitats these differences seem to be caused by environmental factors. Transitional specimens to the more robust forms of the lowlands are common, and therefore they are here considered only as synonyms. The most delicate forms have been described as *St. tenerrima* from the Alburz Mts, NW of Tehran, reaching a height of only 30cm, with *Festuca ovina*-like leaves, anthecia of 7–8mm and awns of only 10–12cm. However, with more material to hand it became clear that they merely represent the end-point of a continuous variation and barely merit varietal rank.

38. St. gaubae Bor, Fl. Ir. 70:388 (1970).
Type: Iran. Qazvin, Ravandeh prope Karaj, *Gauba* 1632 (holo. W!; iso. IRAN (5 sheets)!, TEH!, THR!).

Densely tufted, branching intravaginal, with few culms and some vegetative shoots; *culms* 50–70cm, 3-noded, pubescent below the nodes; *sheaths* pubescent, as long or longer than the internodes; *ligules* at the culm leaves 8–12(–20)mm long, at the vegetative shoots 1·5–3·5mm, acute, ciliate at the margins; *blades* at the culms up to 13cm long and 3mm wide, flat, at the vegetative shoots involute, up to 15cm long, 0·5–0·6mm diam., at the upper surface densely pubescent, beneath puberulent; *panicle* at the base ensheathed, narrow, 20–30 × 1·5cm, the branches erect, setulose, paired or solitary, up to 5cm long, with 1–3 spikelets; *spikelets* 5–6cm long, the glumes pale green near the base, hyaline, linear, glabrous or sparsely setulose along the dorsal line, the lower one about 0·5–1cm longer and 3–5-nerved, the upper 5–7-nerved; *anthecium* 13–15mm long; *callus* 1·2–1·8mm long, bearded in the upper half, scar circular to broadly elliptic, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, pale, up to 1–1·5mm below the top densely covered by a diffuse indumentum of 0·5mm long ascending hairs, coronula absent; *awns* 18–26cm long, unigeniculate in 2·2–2·6cm, columna glabrous, smooth, twisted, articulated at the base, seta plumose with 2·5–3mm long hairs, flexuose; *palea* equalling the lemma in size, sparsely pilose; *lodicules* dissimilar, 1·7–2·2mm long, linear-lanceolate, glabrous, the posterior one much smaller; *anthers* 3·5–4·5mm long, unbearded, exserted; *ovary* with 3 styles and stigmas, one of them shorter; *caryopsis* 9–11mm long, embryo about 2·5mm long, hilum reaching up to the top; 2n unknown.

Endemic to a small area from Nakhichevan to N Iran.

A very rare species of gypsaceous slopes from the lowlands to 1700m.

Specimens studied (beside the type):
IRAN. Tehran: Karaj, 1700m, 3 vii 1934, *Gauba* (KAR).
USSR. Nakh. ASSR, near Aznaberd, 1 vi 1960, *Takht. et al.* (ERE).

Beside the type only two specimens have been seen, but owing to their stage of development they allow some additions to the original description of Bor. The affinity of this species remains obscure: the unigeniculate awn favours its inclusion in the series *Brevigeniculatae*, where it was placed by Bor, although the long ligules, 3-styled ovary and shape of the callus bring it more close to sect. *Barbatae*. A hybrid origin for the specimens looks unlikely, as no other unigeniculate species is present in the area.

39. St. zuvantica Tzvelev, Novosti Sist. Vyss. Rast. 1966:18 (1966).
Type: (USSR, Azerbaijan) In campis et collibus aridis lapidosis prope pagum Swant, 20 vi 1830, *C. Meyer* (holo. LE!).

Densely tufted, branching intravaginal; *culms* 40–75cm, shortly pilose below the nodes; *sheaths* of the lower leaves shortly and densely pilose, of the upper ones subglabrous to glabrous; *ligules* at the culm leaves 8–14mm long, at the vegetative shoots 1·5–3mm, acute, with ciliate margins and densely setulose back; *blades* at the culm leaves flat, up to 4mm wide, at the vegetative shoots involute to conduplicate, 0·7–1·2mm diam., upper surface densely pubescent, beneath scabrous or puberulent; *panicle* narrow, contracted; *spikelets* 4–4·5cm long, the glumes long acuminate; *anthecium* 13–15mm long; *callus* 2·5mm long, shape of scar and peripheral ring not documented; *lemma* covered by a seriate indumentum of 0·5–0·7mm long hairs, the dorsal line up to half, the marginal ones almost reaching the top, coronula consisting of about 0·5mm long hairs; *awn* 19–22cm long, bigeniculate at 3–3·5 and 5–5·7cm, columna twisted, articulated at the base, with the first segment scabrous and the second pubescent with hairs up to 0·4mm below the second geniculation, seta pilose with up to 1mm long hairs; *anthers* unbearded; *palea*, *lodicules*, *ovary* and *caryopsis* not seen; 2n unknown.

Endemic to SE Transcaucasia.

Ecology: no information available.

The species is known to me from the type only. Tzvelev (1976) mentioned it also from N Iran, but I did not succeed in discovering a single specimen among the abundant collections available from there. Trinius & Ruprecht (1842) referred the Meyer specimen to *St. holosericea*, but Tzvelev was correct in stating significant differences, particularly in the awn indumentum (see Table 9). The species is maintained here with some reservation, because it may prove to be just an aberrant form of *St. holosericea* or a hybrid between *St. holosericea* and *St. arabica*. Its systematic position could be in sect. *Barbatae*, but the number of styles is not known.

TABLE 9

Diagnostic characters of some Stipa species with minutely pubescent awn

	St. iranica	St. holosericea	St. lagascae (E Med. forms)	St. zuvantica
Ligule (veg. shoots) length (mm)	0·8–1·2	0·5–1	0·5–2	1·5–3
Glumes, length (cm)	3–4	(2) 2·5–4 (4·3)	(3·5) 4–6	3–4
Anthecium, length (mm)	9–12	(12) 14–17 (19)	14·5–15·5	13–15
Callus, shape	curved	curved	almost straight	curved
Callus, length (mm)	1–1·5 (2)	2–2·6	4	2·5
Callus, indumentum (mm)	0·5	1	1	1·4
Lemma indumentum	almost diffuse	seriate	indistinctly seriate to diffuse	seriate
Awn, length (cm)	13–18	(12) 14–22 (25)	21–25	19–22
Awn, surface	pubescent throughout	pubescent below, scabrous above	scabrous below, pubescent above	scabrous below, pubescent above
Awn, hairs (mm)	0·15–0·3	0·2–0·4	0·2–0·4	0·8
Ovary, number of styles	3	3	4	?

40. St. iranica Freitag, **sp. nov.** (Fig. 28).

Type: SW Iran, Kuh Daena [Kuh-e-Dinar], in collibus aridis planitei edite Kakau, 17 vii 1842, *Kotschy* 685 (holo. G!; iso. W!, E!, K!); cited as *S. lagascae* by Boissier, Fl. Or. 5:501, 1884].

Gramen perenne, dense caespitosum, ramificatione intravaginali. *Culmi* (40–)50–75(–90)cm alti, 3-nodes, basi geniculati, glabrae vel sub nodis dense pubescentes. *Vaginae* foliorum glabrae vel papillosae vel pubescentes, margine ciliatae. *Ligulae* in foliis culmorum (1–)1·5–2mm longae, obtusae, margine ciliolatae vel ciliatae, in foliis surculorum basalium 0·8–1·2mm longae, truncatae, ciliolatae. *Laminae* planae vel convolutae, in foliis culmorum usque ad 20cm × 2·5mm, in foliis surculorum basalium ad 25cm × 1·5–2·2mm, in statu convoluto 0·5–0·7mm diam., supra sulcatae, pilosae, subtus aut scabrae aut scaberulae aut pubescentes. *Panicula* (10–)15–25(–35)cm × 1·5–2(–4)cm, basi saepe vagina folii supremi inclusa; rami erecti, bines vel singulares, glabri aut setulosae, usque ad 4cm longi, 1–3-spiculati. *Spiculae* lanceolatae, 3–4cm longae, longe acuminatae. *Glumae* subaequales, hyalinae tantum dorsalis pallide virides, 5–9-nerves, laeves. *Anthecium* 9–12mm longum. *Callus* 1–1·5(–2)mm longus, acutus, apice laeviter curvatus, dense barbatus. *Lemma* pallide viride, coriaceum, usque ad $\frac{2}{3}$ pilis ascendentibus 0·4–0·9mm longis tectum, sub arista vulgo pilis usque ad 1mm longis coronulatum. *Arista* 13–18cm longa, bigeniculata in 2·0–2·8 et in 3·4–4·5cm, tota longitudine pilis miniusculis 0·15–0·3mm longis dense tecta; columna torta; seta falcata. *Palea* lemma subaequans, inter nervos sparse pilosa. *Lodiculae* 3, 1·4–1·6mm longae, lanceolatae, glabrae, posterior ad $\frac{1}{2}$ breviore. *Staminae* 3, antherae 3·5–5mm longae, luteae, apicis glabris. *Ovarium* tristylosum. *Caryopsis* fusiformis, 9–12mm longa, scutello 1·5mm longo, hilo lineari apicem fere attingenti.

Densely tufted perennial, branching intravaginal; *culms* (40–)50–75 (–90)cm, 3-noded, geniculate at the base, glabrous or densely pubescent below the nodes; *sheaths* longer or as long as the internodes, glabrous or papillose or densely pubescent, at the margins ciliate; *ligules* at the culm leaves (1–)1·5–2mm long, obtuse, with ciliate or ciliolate margin, at the vegetative shoots 0·8–1·2mm long, truncate, ciliolate; *blades* flat or convolute, at the culm leaves up to 20cm × 2·5mm, at the vegetative shoots up to 25cm × 1·5–2·2mm, convolute 0·5–0·7mm diam., upper surface pilose, furrowed, beneath either scabrous or scaberulous or pubescent; *panicle* (10–)15–25(–35)cm × 1·5–2(–4)cm, at the base often covered by the sheath of the uppermost leaf; the branches erect, paired or solitary, up to 4cm long, glabrous or setulose, with 1–3 spikelets; *spikelets* lanceolate, 3–4cm long, the glumes subequal, tapering into a delicate tip, hyaline, only at the back pale green along the veins, 5–9-nerved, smooth; *anthecium* 9–12mm long; *callus* 1–2mm long, acute, with a curved base, densely bearded by stiff hairs of c.0·5mm length, scar broadly elliptic, peripheral ring dorsally flattened, much protruding; *lemma* pale green, coriaceous, up to $\frac{2}{3}$ diffusely covered by 0·4–0·9mm long ascending hairs, below the apex usually with a coronula of hairs up to 1mm; *awn* 13–18cm long, bigeniculate at 2·0–2·8 and 3·4–4·5cm, minutely pubescent throughout by 0·15–0·3mm long hairs, the lower part twisted, the upper falcate; *palea* subequal, sparsely pilose between the veins; *lodicules* 1·4–1·6mm long, lanceolate, glabrous, the posterior one much (up to $\frac{1}{2}$) smaller; *anthers* 3·5–5mm long, yellow, unbearded, exserted; *ovary* with 2 long and 1 short styles and feathery stigmas; *caryopsis* c.9mm long, embryo 1·5mm long, hilum almost reaching the top; 2n unknown.

Endemic to the higher mountains in W Iran and SE Anatolia. (Fig. 23).

A quite common species of the higher montane belt from (1600–)2000–2500(–3000)m.

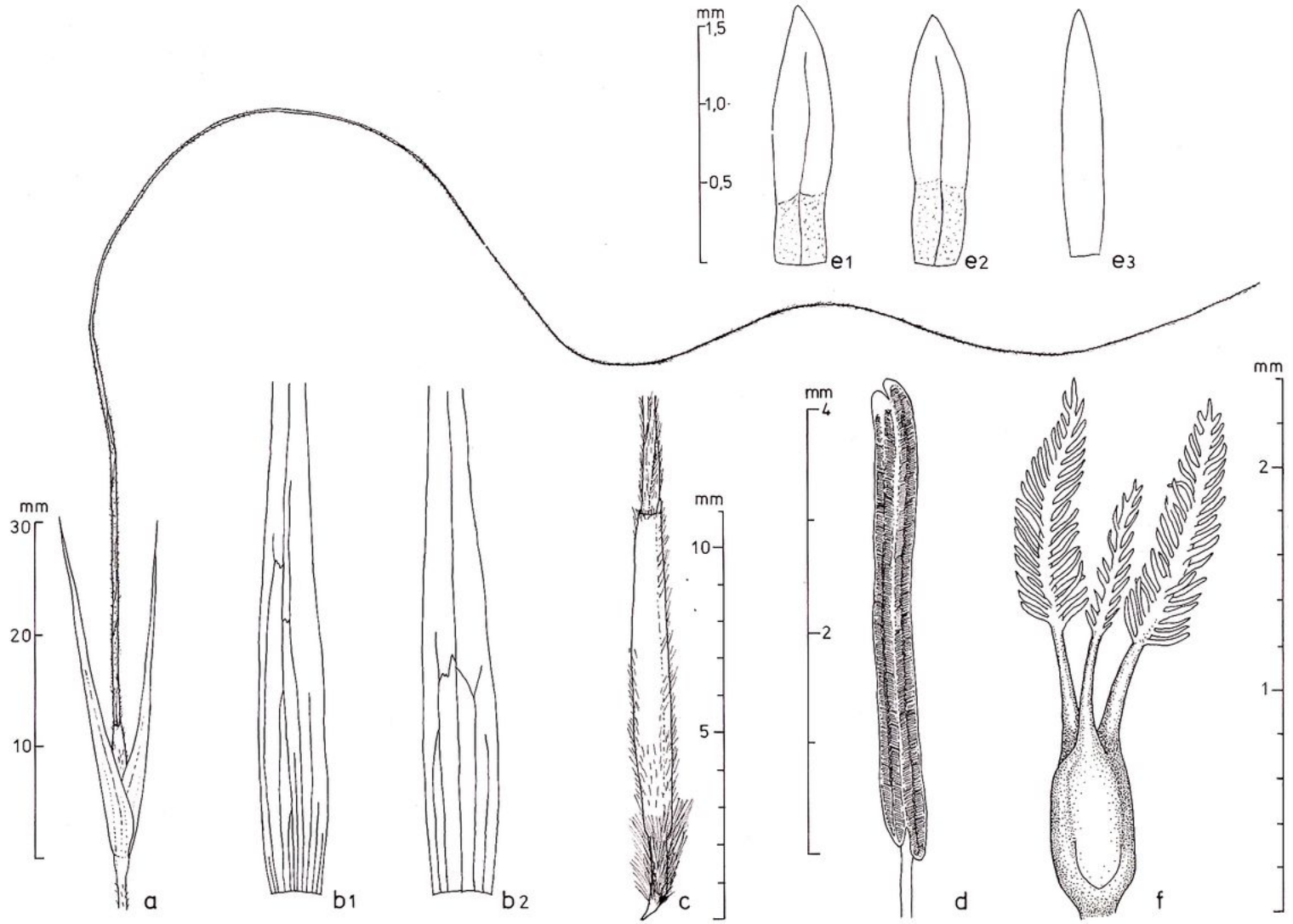

FIG. 28. *Stipa iranica*: a, spikelet; $b_{1,2}$, lower and upper glume; c, anthecium with base of awn; d, stamen; e, lodicules; f, pistill (a–c *Davis* 23082, d–e *Rech.* 42790, f *Pabot* 1545).

Specimens studied (13):
TURKEY. Van: Satak distr., Kavussahap Dağ, 2200m, *D. & Polunin* 23082 (E).
IRAN. Kordestan: At Salavatabad, 25km E of Sanandaj, 2300m, *R.* 42790 (W). Hamadan: 40km SW of H., 2350m, *Pa.* 1545 (G). Markazi: 26km W of Arak, 2020m, *Pa.* 1235 (G). Lorestan: Kuh-e-Sawers, 3300m, *Hausskn.* s.n. (W); 45km SE of Aligudarz, 2380m, *Pa.* 2107 (G); ibid., 52km SE of A., 2340m, *Pa.* 2113 (G). Esfahan: 10km W of E., 1600m, *Pa.* 3460 (G); Golpayegan, Hendeh, 2200m, 26 vi 1969, *Iranshahr* (EVIN); Damaneh-Daran, 2410m, 6 vii 1959 *Pa.* (G). Bakhtiari: 41km SE Kuh Rang tunnel, 2340m *Pa.* 2220 (G). Shiraz: 75km SE of Abadeh, 2400m, *Frey* VO. 2545.

The new species resembles delicate forms of *St. lagascae* or *St. holosericea*, but besides the smaller size of the glumes, anthecium and awn it differs in the strictly curved and much shorter callus (see Table 9), and no transitional forms have been seen. *St. iranica* is probably also closely related to *St. arabica*, as can be supposed from the overall similarity in the structure of the anthecium and the 3 unequal styles. However, it is easily distinguished by the much shorter hairs of the awn, the longer hairs covering the lemma, the longer glumes and the comparatively short and truncate ligules at the vegetative shoots. As the characters of the new species are somewhat intermediate between *St. holosericea* and *St. arabica*, one may speculate that the new species is just a collection of hybrids. Such a possibility cannot be ruled out with certainty, but the rather common occurrence in a well-circumscribed area, the clear morphological separation from both related species and the normal development of pollen grains and caryopses are in favour of the specific rank given to the populations. Furthermore, *St. holosericea* has never been collected together with, or near the localities of, the new species, but unfortunately I have had no opportunity to study the species in the field.

41. St. holosericea Trin., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math. 1:81 (1830).

Syn.: *St. fontanesii* Parl., Fl. Ital. 1:167 (1848). Type: Syntypes collected by Sibthorp and Smith in Greece (prob. in FI n.v.).
St. kotschyana Hochst. ex Steudel, Syn. Pl. Glum. 1:130 (1855). Type: Aleppo, *Kotschy* 112 (holo. P?; iso. G!, GOET!, W!).
St. transcaucasica Grossh., Trudy Bot. Inst. Azerb. Fil. Akad. Nauk SSSR 2:245 (1936); *St. holosericea* subsp. *transcaucasica* (Grossh.) Tzvelev, Novosti Sist. Vyss. Rast. 11:14 (1974). Type: (USSR, Azerbaijan) Zuvant, Kis-Jurdy Mts near Gevedara, 17 vii 1930, *Prilipko* (holo. BAK n.v.).

Type: (Iran, Azerbaijan) In siccis montosis circa Badalan, 8 vi 1829, *Szovits* 410 (holo. LE!).

Densely tufted, branching intravaginal, with some culms and numerous vegetative shoots; *culms* (30–)45–70(–80)cm, 3-noded, glabrous or pubescent below the nodes; *sheaths* glabrous, papillose or pubescent, the lower ones at the margins eventually 0·3–0·5mm long ciliate, bearded beside the ligule, longer than the internodes; *ligules* at the culm leaves up to 10(–15)mm long, at the vegetative shoots 0·5–1mm long, acute or rounded, usually ciliolate at the margins, glabrous or pubescent at the back; *blades* at the culms flat, up to 20cm long and 4mm wide, at the vegetative shoots usually involute to conduplicate, up to 40cm long, 1·5–

4mm wide or 0·6–1mm diam., upper surface shortly pubescent, eventually in addition with scattered hairs of 0·3–0·5mm, beneath glabrous and smooth throughout, or scaberulous at least in the apical part, or densely pubescent; *panicle* at the base usually enclosed by the somewhat broadened sheath of the uppermost leaf, (10–)20–30(–35) × 3–6cm, the branches ascending, almost glabrous or densely setulose, the lower ones paired, up to 10(–17)cm long, with up to 3(–5) spikelets; *spikelets* (2·0–) 2·5–4(–4·3)cm long, the glumes subequal, narrow-lanceolate, acuminate, the back green or purplish, the margins and the tip hyaline, setulose at the veins, the lower one 1–3-nerved, the upper 3–5-nerved; *anthecium* (12–) 14–17(–19)mm long; *callus* 2·0–2·6mm long, densely bearded, scar circular to broadly elliptic, peripheral ring dorsally flattened and much protruding; *lemma* coriaceous, pale, indumentum strongly seriate, hairs 0·4–0·7mm long, ascending to appressed, the 5 dorsal lines usually up to $\frac{1}{2}$, more rarely up to $\frac{2}{3}$, the 2 marginal ones almost reaching the top, below the top usually a coronula of hairs up to 0·8mm long, more rarely coronula absent, otherwise densely papillose; *awn* (12–)14–22(–25)cm long, bigeniculate at (2·2–)2·5–4(–4·5) and (3·8–)4–6(–6.3)cm, columna densely twisted, pubescent, with the hairs at the base 0·2–0·4mm long, gradually decreasing in length toward the second geniculation, articulated at the base, seta flexuose, scabrous; *palea* equalling lemma in length, sparsely pilose between the veins; *lodicules* subequal, 1·8–2·1mm long, apically often pilose, lanceolate, the posterior one slightly shorter and narrower; *anthers* 4–6mm long, yellow, bearded, usually included; *ovary* apically sometimes sparsely hairy, with 3 styles and stigmas, but one much shorter than the others; *caryopsis* 8–12mm long, embryo 2·3–3mm long, hilum reaching up to the top; 2n = 44.

From S Greece through Turkey, S Transcaucasia, N Iran to SW Turcmenia and from E Anatolia along the Zagros Mts to S Iran, from SE Anatolia through Syria and Lebanon to Jordan (Fig. 29).

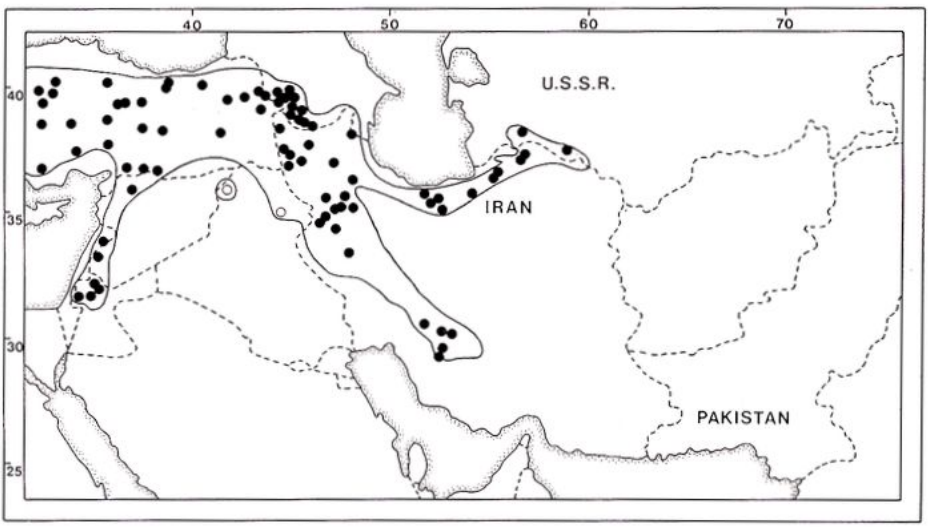

FIG. 29. Distribution of *Stipa holosericea*. ○ literature records from Iraq according to Bor (1968).

A very common species of open secondary communities and of woodlands; from the Mediterranean lowlands up to medium altitudes, only in the S reaching up to about 2800m.

Specimens studied (115):

TURKEY. Izmir: Nif Dağı, *Schwarz* 609 (JE); ibid., 1150–1250m, *Buttler & Erben* 17370 (M); Yamanlar Dağı, 600–700m, *B.* 10128 (B); E of Koukouloudja, *Bal.* 4 (JE, G, E, GOET); (5 more). Muğla: Marmaris, Yarimadasi, 150m, *D.* 41401 (E). Uşak: 5·5km E of U. towards Sivash, *Coode & Jones* 2406 (E). Denizli: 27km S of D., Kazikbeli, 1250m, *Holtz* 482 (GOET). Antalya: Elmalu, 17 VI 1860, *Bourg.* (E, G, GOET, W); Tscheltickchi, v 1845, *Heldr.* (E, G); NE of Kizilpinar near Çander Tepe, 2000m, *Ayaşhgil* 316 (GOET). Bilecik: Vasir-Han, 300–400m, *B.* 14698 (B). Eskişehir: c.20km from Polatli to Sivrihisar, *Coode & Jones* 2248 (E). Çankiri: At Ç., 800m, *B.* 14697b (B). Ankara: Kawakli-dere, 900m, *B.* 14697 (B); 40km E of Ankara, *Jardine* 342 (E). Konya: Yavşan Memlehasi near Tuz Gölü, *D.* 18686 (E, G, JE, W); Sultan Dağlari above Akşehir, 1500m, *B.* 5636 (B, E, G). Içel: 6·5km from Mut to Karaman, 300m, *Coode & Jones* 921 (E). Niğde: 1km NW of Ulukislar, 1480m, *Holtz* 619 (GOET). Nevşehir: Aciksaray near Gülşehir, 1150m, *Roper* 132 (E); ibid., 20km from G., 500m, *McNeill* 378 (E). Amasya: Geldinghaan plain, 350m, *B.* 455 (B, G, GOET, JE, W). Sivas: 65km W of S., 1300m, *V.* 71.587; Yasibel to Şarkişla, 1580m, *Buttler* 13922 (M); Zara, 20km E towards Imranli, 1650m, *R.* 57557 (W). Malatya: Hekimhan, 1300m, *Stainton & Henderson* 5412 (E, K). Gaziantep: 7km N of G., Dülük Baba, 1100m, *D.* 28050 (E); Soff Dağ, 1300m, 1865, *Hausskn.* (JE, W). Urfa: Birecik, *Sint.* 551 (GOET, W); Ceylanpinar, 400m, *D.* 42382 (E); 32km from Urfa to Hilvan, 700m, *D.* 28209 (E). Gümüşane: near Baibout, *Bourg.* 253 (E, GOET, JE, W). Erzurum: Horasan-Pasinler, 1650m, *D.* 30787 (E); W of Ilica, 18 vi 1967, *Ross* (E). Kars: Kağizman, Aras vall. betw. Daghizman and Zarab-chan, *Woronow* (W); N side of pass betw. Dogubayazit and Igdir, 1500m, *R.* 57406 (W). Bitlis: Bitlis vall. 10km N of B., 3 vii 1939, *Frödin* (W).

SYRIA. Betw. Hama a. Homs, *Blanche* 3134 (G); Damascus, *Gaill.* 2310 (JE); ibid., 13 v 1892, *Peyron* (G); betw. Kasbeia a. Hermon, 13 vi 1881, *Letourn.* (K).

LEBANON. Above Baalbeck, 1150–1300m, *B.* 12957 (B, G); ibid., *B.* 12955 p.p. (G); Wadi el-Harir, *Peyron* 1802 (G); from Deir el-Ahmar to Aineta, 1500–1800m, *B.* 12958 (B).

PALESTINE. Jerusalem, 800m, *Meyers & Dinsmore* 4721 (E, L); 25 iv 1961, *Danin* (K).

JORDAN. Gilead: Jab. Qulayb, 1400m, *Dinsmore* 10721 (G); Wadi Warran, 10 V 1927 *Eig & coll.* (HUJ). Moab: W of Madaba, 700m, *Dinsmore* 12721 (G). Dhiban, D. 9178 (E).

IRAN. Azerbaijan: Golman Khaneh, W side of Lake Rezaiyeh, 1400m, *W et al.* 11988 (THR, W); SW side of Lake R., 1400m, *Jacobs* 6846 (E, W), 6629 (E); Tabriz, 1400m, *Grossh.* 225 (B); ibid., *Grossh.* 226 (G); (5 more). Kordestan: Divandarreh, 33km NW to Saqquez, 2100m, *R.* 40612 (W). Zanjan: Z., 53km SE, 1850m, *Pa.* 3915 (G). Tehran: W of Firuzkuh, 2300m, *Furse* 610 (E, IRAN); Pulur, 7km N, 2280m, *Pa.* 4114 (G); Pulur, 2470m, *Klein* 7551. Kermanshah: Nawa Kuh, 24km NW of Karand, 2200m, *Archibald* 1901 (E, K); Bisotun, 56km N to Sonqor, 1170m, *Pa.* 1802 (G); Shahabad, 16km SW, 1650m, 25 vi 1965, *Pa.* (G); (1 more). Hamadan: H., 100km N at Aq Bulaq, 2000m, *Rioux & Golvan* 76 (G, W); H., 33km W, 2070m, *Pa.* 1486 (G). Mazanderan: Chalus vall. near Hassanabad, 10 vi 1956, *Sabeti* (K, IRAN); N side of Kandevan pass, 2800m, *Gilli* s.n. (W); Gonbad-e-Kabus, 96km W, 1000m, *Pa.* 7777 (G, IRAN); (4 more). Semnan: Parvar Protected Area betw. Shahmirzad and Foulad Mahalleh, 53km NE Semnan, 2000m, *R.* 52260 (W); ibid., 2200m, 17 vi 1970 *Termé* (IRAN); Pass N of Firuzkuh, 2100m, *Pa.* 4329 (G). Lorestan: Harsin, 73km SE, 1870m, *Pa.* 1014 (G, IRAN); Dow Rud, 2500m, *R.* 17699, 18303 (W); Safeh Kuh, 1550m, *R.* 17604 (W). Fars: Mts above Sivand, *Stapf* 1526 p.p. (W); Kuh-e-Barf near Shiraz, 2800m, *Stapf* 1531 (W); ibid., 2109 (WU); Shiraz, 32km W near Hosseinabad, 1970m, *Pa.* 6097 (G).

USSR. Azerbaijan: Ashtarak distr., above Arzii near Chatkrian, 1 vii 1959, *Mulkidzhanian* (ERE); Novo-Bazajet distr., Sevan, 13 vii 1928, *Grossh. & Zedelmeier* (ERE); Eranos, 15 vi 1931, *Tamamshian & Maleev* (ERE); Kotaik distr., Gadis Mts, 1 vii 1926, *Schelk.* (ERE); (7 more). Nakhichevan: Norashen distr., at Akhura, 1250m, 13 v 1947, *Grossh. et al.* (E, ERE); near Bichenakh, 25 vi 1932, *Prilipko* (BAK); near Kjukju at Zimel-chaj river, 30 vi 1936, *Gadzhiev* (H); (3 more). Turcmenia: SW Kopet Dagh, Kara Kalinsk. distr. at Saivan, 10 vi 1972, *Franzkevich* (E, H, W); C Kopet Dagh, near Nokhur, c.1000m, 31 v 1963, *Gubanov* (E, W); ibid., S of Suluklü, *Litv.* 2303 (W); ibid., above Ashkhabad, *Litv.* 176 (E, G, JE).

Among the *Stipa* species with a minutely pubescent awn, *St. holosericea*

is the most common one in the Near East. Except for the Soviet Floras it has been widely misunderstood. Whereas Boissier (1884) and Bor (1968) lumped it together with *St. lagascae*, in most other floras it has been named *St. fontanesii* Parl.

Unfortunately the type of *St. fontanesii* was not available to me, but from the many specimens seen from different parts of Greece and from the description of Parlatore (loc. cit.) it is most likely that it is conspecific with *St. holosericea*. The type of *St. kotschyana* agrees completely with *St. holosericea*. According to the diagnosis *St. transcaucasica* differs in its more delicate habit (smaller leaves) and absence of an indumentum from the lower leaf sheaths. It was described from higher altitudes, but the rich Anatolian and Transcaucasian material clearly demonstrates that the size of the vegetative and generative parts of the plants decreases gradually with altitude, as is the case with *St. ehrenbergiana*. It has been stated already by Prilipko in *Flora Azerb.* (Karjagin, 1950) that there exists a series of transitional forms between *St. holosericea* and *St. transcaucasica*. Even subspecific rank, as has been given to *St. fontanesii* and *St. transcaucasica* by Tzvelev (1974, 1976) does not seem justified to me. For the diagnostic characters of *St. holosericea* and related species see Table 9.

42. St. lagascae Roemer & Schultes, Syst. Veg. 2:333 (1817) [nom. nov. for *St. pubescens* Lag.], emend. Hackel, Oesterr. Bot. Z. 27:119 (1877).

Syn.: *St. pubescens* Lag., Gen. Spec. Pl.: 3, no. 29 (1816), non R. BR.

St. gigantea Lag., ibid.: 3, no. 27 (1816), non Link in Schrader. Syntypes from C Spain (holo. prob. MA n.v.).

St. letourneuxii Trabut, Bull. Soc. Bot. France 36:405 (1889); *St. lagascae* subsp. *letourneuxii* (Trabut) Battand. & Trabut, Fl. Alg. Mon.: 165 (1895). Type: Tunesia, in planitie excelsa inter Khranguet Douara et Fernana, v 1887, *Letourneux* (holo. prob. P n.v.).

St. lagascae β *pellita* Trin. & Rupr., Spec. Gram. Stip.: 71 (1842); *St. pellita* (Trin. & Rupr.) Tzvelev, Novosti Sist. Vyss. Rast. 1966: 19 (1966). Type: Sicilia, Heckel s.n., (lecto. LE!, selected by Tzvelev).

Type: Syntypes from Spain (holo. prob. MA n.v., iso. LE!).

Densely tufted, branching intravaginal, with few culms and numerous vegetative shoots; *culms* 40–75cm, 3-noded, pubescent below the nodes; *sheaths* densely pubescent or almost glabrous, with ciliolate or ciliate margins; *ligules* at the culm leaves 8–12mm long, at the vegetative shoots 1·5–5(–7)mm, acute, ciliate at the margins or at the tip only; *blades* usually convolute, 0·5–0·8(–1)mm diam., upper surface densely pubescent, beneath either glabrous and smooth throughout or pubescent at the base; *panicle* contracted, 15–30 × 1·5cm, at the base often ensheathed, the branches erect, setulose, paired or solitary, up to 9cm long, with 1–3 spikelets; *spikelets* 5–6cm long, the glumes subequal, lanceolate, acuminate, glabrous, membranous; *anthecium* 14·5–18·5mm long; *callus* (3·0–)3·5–4mm long, densely bearded, scar broadly elliptic, peripheral ring dorsally flattened, much protruding; *lemma* coriaceous, brown, up to $\frac{1}{2}\frac{2}{3}$ diffusely covered by 0·5–0·6mm long appressed to ascending hairs, but with a marked dorsal row, otherwise scabrous, without a distinct

coronula, the tip surpassed by 2 apical bearded lemma lobes of 0·5mm; *awn* 20–25cm long, bigeniculate at 2·5–3·2 and 3·5–4·2cm, the lower geniculation often obscure, minutely pubescent throughout with hairs up to 0·2mm in the lower part and up to 0·3mm in the upper part or scabrous in the lower part and minutely pubescent in the upper part only, columna twisted, articulated at the base, seta falcate; *palea* equalling the lemma, sparsely pilose between the veins up to ½; *lodicules* subequal, 1·5–1·7mm long, acute, glabrous, the posterior one slightly smaller; *anthers* 4–5·5mm long, yellow, unbearded; *ovary* with 4 styles and 4 stigmas, 2 longer and 2 shorter ones; *caryopsis* 8·5–9mm long, embryo 2mm long, hilum almost reaching the top; 2n = 44. For the ovary see Fig. 3b.

From Sicily along the southern shore of the Mediterranean to N Egypt, montane Sinai and Transjordania; outpost on the Apsheron peninsula in Transcaucasia.

Locally abundant in open communities under semi-arid to extreme semi-arid climates; in Transcaucasia only on calcareous sands at the shore of the Caspian Sea.

Specimens studied (4).

CYPRUS. Athalassa, 180m, 6 v 1950, *Champion* (K); near Nikosia, *D.* 3197 (K).

JORDAN. Naqb Ashir, *Hunting Aero Surv.* 49a (E); near Petra, foot of Mt Hot, *D.* 8660 (E).

USSR. Azerbaijan: Apsheron peninsula, near Mardakjan, 25 v 1932, *Sheviljakov* (E, H); ibid., E of Zyria, 18 vi 1932, *Grossh.* (NY).

St. lagascae has a very extended area of distribution from Spain, along the southern shores of the Mediterranean Sea up to Cyprus and Transjordania where it meets its eastern vicariant, *St. holosericea.* The species is rather polymorphic and several attempts have been made to subdivide it into a number of intraspecific taxa. That began with Trinius & Ruprecht (1842) who separated an unclassified subunit *'pellita'* from Sicily and N Egypt, and that culminated in an elaborate hierarchical system of subspecies, varieties and forms to be found in NW Africa (Maire, 1952). The taxon of Trinius & Ruprecht was raised to species level by Tzvelev (1966) on account of its long callus (3–4mm against 2–3mm in W Mediterranean specimens) and the absence of a marked dorsal row of hairs on the lemma. However, even from Spain and N Africa robust specimens have been seen with long anthecia and calli (up to 4·5m in material from Algeria—18 v 1851, *Bal.*) and no real gap to populations with smaller anthecia, calli and awns, which usually grow at higher altitudes, was detectable. Similar statements have already been made by Hackel (1883) when comparing a great number of specimens from Spain, formerly regarded as belonging to the more robust species *St. gigantea* Lag. (non Link) and the more delicate *St. pubescens* Lag. For the time being the specimens from the E Mediterranean are named *St. lagascae.* Maybe a detailed reinvestigation of specimens from throughout the area of *St. lagascae* will justify the separation of an E Mediterranean subspecies or even a distinct species. The number of styles could become relevant in that respect, as the E Mediterranean specimens seen—and they alone have been used for the description given above—always have 4 styles, and those from Spain only 3. But from NW African material, both conditions have been reported, and Trabut (loc. cit.) has already described a 4-styled species from Tunisia under the name *St. letourneuxii.* However,

that differs from the E Mediterranean plants in its hairy ovary and densely pubescent leaves.

A closely allied species, *St. thessala* Hausskn. emend Scholz from the Balkan peninsula, is considered by Scholz (1984) to belong to the series Capillatae on account of its glabrous awn. However, the 3 styles and the more or less falcate seta indicate its position in sect. Barbatae.

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References

AITCHISON, J. E. T. (1880). On the flora of the Kurram valley, etc., Afghanistan. *J. Linn. Soc. Bot.* 18: 1–113.

BALL, J. (1878). Spicilegium florae Maroccanae. *J. Linn. Soc. London* 16: 281–772.

BAUHIN, C. (1623). *Pinax Theatri Botanici.* Basel.

BERTOLONI, A. (1833/34). *Flora Italica sistens plantas in Italia et insulis circumstantibus sponte nascentes.* Vol. 1. Bologna.

BOISSIER, E. (1884). *Flora Orientalis*, vol. 5, Geneva.

—— & BUHSE, F. (1860). Aufzählung der auf einer Reise durch Transkaukasien und Persien gesammelten Pflanzen. *Nouv. Mém. Soc. Imp. Nat. Mosc.* 12: 1–246.

BOR, N. L. (1954). Notes on Asiatic Grasses XII. New species. *Kew Bull.* 8: 269–276.

—— (1955). Notes on Asiatic Grasses XIX. New species and new names. *ibid.* 9: 497–502.

—— (1960). *The grasses of Burma, Ceylon, India and Pakistan.* Oxford.

—— (1968). Gramineae, in TOWNSEND, C. C., GUEST, E. & AL-RAWI, A., eds., *Flora of Iraq,* vol. 9. Baghdad.

—— (1970). Gramineae, in RECHINGER, K. H., ed., *Flora Iranica.* no. 70. Graz.

BREISTROFFER, M. (1950). Sur une Graminée méditerranéenne. Stipa offneri n.n. *Procès-Verbaux Soc. Dauph. Étud. Biol.* 13: 2–4.

CHRTEK, J. & HADAČ, E. (1969). A contribution to the grass flora of Iraq. *Candollea* 24: 159–181.

—— & MARTINOVSKÝ, J. (1969). Infraspezifische Taxa von Stipa parviflora Desf. und Stipa hoggariensis Chrtek et Martinovský sp. nova. XXI. Beitrag zur Kenntnis der Federgrassippen. *Webbia* 24: 391–399.

COFFMANN, F. A. (1964). Inheritance of morphological characters in Avena. *Techn. Bull.* No. 1308. ARS. USDA Washington.

COPE, T. A. (1982). Poaceae, in NASIR, E. & ALI, S. I., eds., *Flora of Pakistan*, no. 143. Karachi.

CZOPANOV, P. (1970). Graminearum species novae e Turcomania. *Novosti Sist. Vyss. Rast.* 6: 22–24.

DROBOV, V. V. (1925). Gramineae novae turcestanicae I. *Repert. Spec. Nov. Regni Veg.* 21: 37–46.

EICHWALD, E. (1831/33). *Plantarum novarum vel minus cognitarum quas in itinere caspio-caucasico observavit.* 2 vols. Vilnae.

FEDOROV, A. A. (1969). *Chromosomnyje čisla svetkovych rastenii.* Leningrad.

FREITAG, H. (1971a). Die natürliche Vegetation Afghanistans. *Vegetatio* 22: 285–344.

—— (1971b). Studies in the natural vegetation of Afghanistan, in DAVIS, P. H. et al., eds., *Plant life of South-West Asia,* 89–106. Edinburgh.

—— (1975). The genus Piptatherum (Gramineae) in Southwest Asia. *Notes RBG Edinb.* 33: 314–408.

GOLDBLAT, P. (ed.) (1981). Index to plant chromosome numbers 1975–1978. *Missouri Bot. Gard. Monogr. Syst. Bot.* 5. St Louis.

GROSSHEIM, A. A. (1939). *Flora Kavkaza,* vol. 1. Baku.

HACKEL, E. (1883). Über einige Gräser Spaniens und Portugals. *Oesterr. Bot. Z.* 27: 118–125.

—— (1887). Gramineae, in ENGLER, A. & PRANTL, L. (eds.) *Die natürlichen Pflanzenfamilien,* vol. 2(2). Leipzig.

HANCE, H. F. (1877). Supplementary note on intoxicating grasses. *J. Bot.* 6: 267–268.

HARA, H. (ed.) (1966). *The flora of Eastern Himalaya.* Tokyo.

—— *et al.* (1978–1982). *An enumeration of the flowering plants of Nepal.* 3 vols. London.

HITCHCOCK, A. S. (1950). *Manual of the grasses of the United States.* 2nd ed., Misc. Publ. USDA, no. 200, Washington. [Reprinted, New York 1971].

HOOKER, J. D. (1897). *Flora of British India*, vol. 7. London.

JUEL, H. O. (1936). Joachim Burser's Hortus siccus. *Symb. Bot. Upsal.* 2(1).

KARJAGIN, I. I. (ed.) (1950). *Flora Azerbaĭdzhana.* Vol. 1. Baku.

KENG, Y. L. (1959). *Flora illustralis plantarum primarum sinicarum. Gramineae.* Peking (prob.).

KERGUELEN, M. (1975). Les Gramineae (Poaceae) de la Flore Francaise. Essai de mise au point taxonomique et nomenclaturale. *Lejeunia* 75: 1–343.

KITAMURA, S. (1964). Flowering plants of West Pakistan and Afghanistan. *Results Kyoto Univ. Sci. Exped.* 1955, vol. 3. Kyoto.

KUNTH, C. S. (1815). *Considérations générales sur les Graminées.* Paris.

LEDEBOUR, C. F. (1829). *Flora Altaica*, vol. 1. Berlin.

—— (1852/53). *Flora Rossica*, vol. 4. Stuttgart.

LINK, H. F. (1827/33). *Hortus regius botanicus Berolinensis descriptus*, vol. 1. Berlin.

LINNAEUS, C. (1753). *Species Plantarum*, ed. 1. Stockholm.

MAIRE, R. (1952). *Flore de l'Afrique du Nord*, vol. 1. Paris.

MANSFELD, R. (1939). Zur Nomenklatur der Farn- und Blütenpflanzen Deutschlands, VII. *Repert. Spec. Nov. Regni Veg.* 47: 263–287.

MARTINOVSKÝ, J. (1967). Neue submediterrane Stipa-Arten und die taxonomische Einteilung der Federgrassippen der Serie Pulcherrimae Martinovský. XI. Beitrag zur Kenntnis der Federgrässer der Sektion Pennatae. *Preslia* 39: 260–275.

—— & SKALICKÝ, V. (1969). Zur Nomenklature einiger Stipa-Sippen der Pennatae-Grupe. XVI. Beitrag zur Kenntnis der europäischen Federgrassipen. *Preslia* 41: 327–341.

MCCLURE, F. A. & SODERSTROM, T. R. (1972). The agrostological term anthecium. *Taxon* 21: 153–154.

MEIKLE, R. D. (ed.) (1980). *Draft index of author abbreviations compiled at the herbarium Royal Botanic Gardens*. Kew.

MEUSEL, H., JÄGER, E. & WEINERT, E. (1965). *Vergleichende Chorologie der zentraleuropäischen Flora*. 2 vols. Jena.

MEZ, C. (1921). Gramineae novae vel minus cognitae. IV. Stipeae. *Repert. Spec. Nov. Regni Veg.* 17: 204–214.

MOORE, R. J. (1973). Index to plant chromosome numbers 1967–1971. *Regnum Veg.* 90. Utrecht.

MOUTERDE, P. (1966). *Nouvelle Flore du Liban et de la Syrie*, vol. 1. Beirut.

NEES VAN ESENBECK, C. G. (1841). A descriptive catalogue of the Gramineae and Cyperaceae contained in the Indian herbarium of Dr Royle. *Proc. Linn. Soc. London* 1: 92–95.

NEVSKI, S. A. (1937). Materialy k flore Kugitanga i ego predgorij. *Trudy Bot. Inst. Akad. Nauk SSSR, Ser. 1, Fl. Sist. Vyšš. Rast.* 4: 199–346 (in Russian).

OHWI, J. (1957). New species from Afghanistan and Karakorum collected by the Kyoto University Scientific Expedition 1955. *Acta Phytotax. Geobot.* 17: 14–16.

OVCZINNIKOV, P. N. (ed.) (1957). *Flora Tadzhik. SSR*, vol. 1. (In Russian). Moskva.

PALISOT DE BEAUVOIR, A. M. F. J. (1812). *Essai d'une nouvelle Agrostographie*. Paris.

PAZIJ, V. K. (1968). Stipa, in KOVALEVSKAJA, S. S., ed., *Opredelitel'-rastenij srednej Azii, (Conspectus Florae Asiae Mediae)* 1: 64–82. (In Russian) Taschkent.

PILGER, R. (1954). Das System der Gramineae. *Bot. Jahrb. Syst.* 76: 281–384.

POIRET, J. L. M. (1817). Botanique, in *Encyclopedie méthodique, Suppl.* vol. 5. Paris.

POST, G. E. (1933). *Flora of Syria, Palestine and Sinai*, ed. 2 (DINSMORE, J., ed.), vol. 2, Beirut.

PROKUDIN, Y. N. *et al.* (1977). *Elaki Ukrainy*. (In Russian). Kiev.

RAUSCHERT, S. (1970). Die älteste Emendation von Stipa pennata L. *Taxon* 19: 900–903.

ROSHEVITZ, R. JU. (1916). Gramineae, in FEDTSCHENKO, B. A., ed., *Flora Aziatskoj Rossij* (*Flora of Asiatic Russia*), vol. 12. (In Russian) St Petersburg.

—— (1934). Stipa, in KOMAROV, V. L., ed., *Flora SSR,* Vol. 2. (In Russian). Leningrad.

—— (1949). Gramineae novae, 5. *Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSR* (*Not. Syst.*) 11: 18–31.

SAVAGE, S. (1937). Caroli Linnaei Determinationes in Hortum Siccum Joachimi Burseri, *Cat. Manuscr. Libr. Linn. Soc. London* 2: 1–78.

SCHOLZ, H. (1968). Die Artengruppe Stipa pennata L. in Frankreich, in der Schweiz und angrenzenden Gebieten. *Willdenowia* 4: 299–315.

—— (1982). Über Mikro- und Makrohaare einiger Piptatherum- und Stipa-Arten (Stipeae, Gramineae). *Willdenowia* 12: 235–240.

—— (1984). Stipa thessala Hausskn. emend (Gramineae). *Willdenowia* 14: 131–134.

SEREBRJAKOVA, T. I. (1971). *Morfogenez pobjegov i evolucija žisnennych form elakov.* (In Russian). Moskva.

SMIRNOW, P. (1919). Neue Stipen. *Repert. Spec. Nov. Regni Veg.* 26: 264–271.

—— (1935). Über Oryzopsis turcomanica Rosh. *Bull. Soc. Nat. Mosc. Biol.* 44: 41–44.

—— (1970). Stiparum armeniacae minus cognitarum descriptiones. *Ibid.* 75: 113–115.

STAPF, O. (1904). Xerochloa R. Br. (descr. emend.) in DIELS, L. & PRITZEL, E., Fragmenta Phytogeographiae Australiae Occidentalis. *Bot. Jahrb. Syst.* 35: 64–68.

STEUDEL, E. G. (1854). *Synopsis plantarum glumacearum,* vol. 1. Stuttgart.

TABERNAEMONTANUS, J. T. (1588). *Neuw Kreuterbuch.* Franckfurt.

—— (1570). *Icones Plantarum.* Francofurti.

TÄCKHOLM, V. (1974). *Student's Flora of Egypt.* Ed. 2. Cairo.

TRINIUS, C. B. (1821). Agrostographische Beiträge, in SPRENGEL, K., *Neue Entdeckungen im ganzen Umfang der Pflanzenkunde* 2: 33–94. Leipzig.

—— & RUPRECHT, F. J. (1842). *Species graminibus Stipacearum.* - Petersburg.

TUTIN, I. G. *et al.* (1980). *Flora Europaea,* vol. 5, p. 247–252. Cambridge.

TZVELEV, N. (1968). Gramineae, in GRUBOV, V. I., ed., *Rastenija central'noj Azii* (*Plantae Asiae Centralis*) 4. (In Russian). Leningrad.

—— (1974). Notulae de tribu Stipeae Dum. (Fam. Poaceae) in URSS. *Novosti Sist. Vysš. Rast.* 11: 4–21. (In Russian).

—— (1976). *Elaki SSSR* (*Poaceae URSS*). (In Russian). Leningrad.

WINTER, B. DE (1965). The South African Stipeae and Aristideae (Gramineae). *Bothalia* 8: 201–404.

VELDKAMP, J. F. (1984). The identity of Andropogon nutans Linnaeus (Gramineae). *Taxon* 33: 95–97.

ZEDERBAUER, E. (1905). Ergebnisse einer naturwissenschaftlichen Reise zum Erdschias-Dagh (Kleinasien), 2. Botanischer Teil. *Ann. K. K. Naturhist. Hofmus. Wien* 20:429.

ZOHARY, M. (1973). *Geobotanical foundations of the Middle East,* 2 vols. Stuttgart/Amsterdam.

ADDITIONAL LIST OF EXSICCATAE

The exsiccatae listed below are not cited in the text. The numbers in brackets refer to the species number.

Achmad: 3, K (26).
Alava: 10432, E, W (35); 10637, W (35).
Albury et al.: 1503, K (27).
Alcock: 17786, BM (25).
Amdursky: 103, E, G, NY (10).
Anders: 5379 (14); 7557 p.p. (25); 7641 (25); 7780 (25); 3486 (35); 3900 (35); 4168 (35); 4244 (35); 4424 (35); 4526 (35); 4548 (35); 4562 (35); 6313 (35); 6843 (35); 9275 (35); 9318 (35); 9687 (35); 9991 (35); 10116 (35); 10222 (35); 10837 (35); 11222 (35).
Andersen & Petersen: 73, W (36); 327, E (36).
Araratian: 12 V 1927, ERE (35).
Archibald: 2315, E (10).
Aslanian: 13 VII 1950, ERE ($29c_1$); 30 VI 1950, ERE ($29c_1$); 28 VII 1950, ERE ($29c_1$); 21 VI 1956, ERE ($29c_1$); 16 VI 1956, ERE ($29c_1$).
Aslanian et al.: 22 VI 1957, ERE ($29c_1$); 1 VI 1954, ERE (35); 1 VI 1954, ERE (36).
Assadi & Shirdelpur: 13130, THR (35); 13208, THR (36); 26 VI 1974, THR, W (36).
Aucher: 3024 G (19).
Avetisian et al.: 16 VI 1952, ERE, ($29c_1$); 9 VII 1957, ERE (33); 16 VI 1957, ERE (35); 18 VI 1957, ERE (35); 22 VI 1957, ERE (35); 7 VII 1966, ERE (35).
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Ball: 998, E (19); 1024, E (19); 1196, E (19).
Bazargan et al.: 19 V 1973, K (41).
Behboudi & Aellen: 23 VII 1948, IRAN (35).
Belanger: 1825, G (36).
Bent & Wright: 423/211, K (19).
Bhattacharyya: 8 IX 1970, BSD (2); 15 VII 1971, BSD (5).
Billiet & Leonard: 6781, K (28).
Bimal Misri: 351, K (25).
Bobrov: 27 V 1960, ERE ($29c_1$).
Boissier: 1846, G (18).
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Breckle: A 1082 (19); A 1788 (35).
Brown: 15 XI 1960, IRAN (7).
Burtt & Kazmi: 1235, E (5).
Bush: 20 VIII 1932, ERE ($29c_1$); 13 VIII 1932, ERE (30).
Buttler & Erben: 17432, M (41).
Callier: 764, L (27).
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Damanabi: 25 VII 1965, IRAN (35).
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Duthie: 12105, K (2); 12595, K, W (5); 12617, K, W (5); 13609, K (5); 13944, K, W (5); 23082, K (5); 3568, BM (11); 23084, K (11); 147, K (14); 3364, BM (14); 3583, BM (14); 7612, W (14); 12594, K (14); 15504, K (14); X 1888, BM (14); 11927, K (26); 11904, K (29b).
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Furse: 1179, K (19); 3084, E, W (35); 7276, K (41); 7373, K (41).
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Gamble: 15151, K (5); 25784, K (5).
Gatarce: 13 IX 1895, WU (14).
Gauba: 28 VI 1938, IRAN (1); 156, B (31a); 29 VI 1934, IRAN (31a); 24 VIII 1935, IRAN (31a); 138, B (35); 5 VII 1934, IRAN, (36).
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Giles: 416, K (2); 719, K (15).
Gilli: 414, W (2); 399, W (35); 402, W (35); 404, W (35); 405, W (35); 406, W (35); 407, W (35); 408, W (35); 410, W (35).
Grant: 16224, W (35); 15736, W (19).
Grey-Wilson & Hewer: 110, W (19).
Griffith: 142, K (19); 6587, K (19); 6589, K (19); 6588, CAL, W (35).
Grigorian: 5 VI 1963, ERE ($29c_2$); 10 VII 1963, ERE ($29c_2$); 3 VI 1965, ERE ($29c_2$); 12 IX 1963, ERE (30).
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Hassan ud Din et al.: 2656, RAW (19).
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Hennipman et al: 2002, L (35); 1543, K, L (37); 2001, L (41); 727, L (41).
Holtz: 604, GOET (35).
Ilyna: 6 VII 1951, ERE ($29c_1$); 14 VII 1951, ERE (36).
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Koelz: 22114, K (11); 2004, NY (14); 2562a, NY (25); 2619 p.p., NY, L (25); 2620, NY (25).
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Kukkonen: 5894, H (36); 7592, H (36).
Lace: 594, E, CAL, K (5).
Lalande: R473-E4, W (35); R506-E6, W (35).
Lamond: 1979, E (35); 3130, E (35).
Levinge: 27445, BM (14).
Loginovan: 3 VI 1951, ERE (35).
Ludlow: 416, BM (2).
Ludlow & Sheriff: 6998, BM (14); 8464, E, BM (26).
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Schwarz: 170, JE (41); 346, B (41); 580, B (41).
Sharif: 462, K, W, IRAN (41); 9090, IRAN (41).
Shelkovnikov: 27 V 1922, ERE (29a); 9/13 VII 1926, ERE (29a); 28 VI 1920, ERE ($29c_1$); 9/13 VII 1926, ERE ($29c_1$); 23/25 VII 1926, ERE ($29c_1$); 4 VII 1920, ERE (30); 19 VII 1920, ERE, (30); 9 VIII 1920, ERE (30); 20 VII 1922, ERE (30); 2 VIII 1921, ERE (33); 26 VIII 1926, ERE (33); 31 VII 1920, ERE (35); 4 VI 1924, ERE (35); 22 VI 1925, ERE (35); 25 VI 1925, ERE (35); 27 VI 1925, ERE (35); 23 V 1926, ERE (35); 29 V 1926, ERE (35); 1 VI 1926, ERE (35); 5 VI 1926, ERE (35); 27 VI 1926, ERE (35); 22 V 1936, ERE (35); 22 V 1926, (36); 5 VI 1926, ERE (36); 27 VI 1926, ERE (36).
Shelkovnikov & Kara-Murza: 28 VI 1925, ERE (29a); 17 VI 1928, ERE (29a); 4 VII 1928, ERE (29a); 4 VII 1926, ERE ($29c_1$); 14 VII 1927, ERE ($29c_1$); 17 VII 1927, ERE ($29c_1$); 1 VIII 1927, ERE ($29c_1$); 26 VII 1928, ERE ($29c_1$); 2 VIII 1928, ERE ($29c_1$); 2 VIII 1927, ERE (29d); 26 VII 1928, ERE (29d); 2 VIII 1928, ERE (29d); 4 VII 1927, ERE (30); 14 VII 1927 (30); 24 VII 1927, ERE (30); 25 VII 1927, ERE (30); 11 VIII 1927, ERE (30); 17 VIII 1927, ERE (30); 17 VII 1927, ERE (30); 10 VIII 1927, ERE (33); 18 VIII 1927, ERE (33); 30 VII 1927, ERE (35); 15 VII 1927, ERE (35); 23 VII 1927, ERE (35); 29 VII 1927, ERE (35); 30 VII 1927, ERE (35); 16 VIII 1927, ERE (35); 13 VII 1928, ERE (35); 5 VI 1929, ERE (35); 7 VI 1929, ERE (35); 8 VI 1929, ERE (35); 9 VI 1929, ERE (35); 11 VI 1929, ERE (35); 13 VI 1929, ERE (35); 2 VII 1929, ERE (35); 3 VII 1929, ERE (35).
Shishkin: 16 VII 1915, ERE (35); 5 VI 1916, ERE (35).
Shishkin & Abianiodse: VIII 1915, ERE (35).
Siami et al.: 5 VII 1976, K (41).
Sintenis: 2 VIII 1900, L (1); 479, L (36).
Sishirevskajia: 28 V 1960, ERE (37).
Soltani: 9 VI 1964, IRAN (35); 12 V 1966, IRAN (35).
Southampton Univ. Exp.: 137, BM (26); 46, K (28).
Stapf: 1522, W (7); 1523, W (7); 1524, W (7); 1848, W (19); 1851, W (19); 1521, W (36); 1528, W (36); 1529, W (36); 1537, W (36); 1538, W (36).
Stewart: 20788, NY (2); 4042a, NY (5); 4338, NY (5); 6860, NY (5); 7187, NY (5); 7371, NY (5); 8967, G, K (5); 9262, K (5); 18384, NY (5); 19213, NY (5); 22616, K (5); 23310, NY (5); 23343, K, NY (5); 23344, K (5); 23270, NY (5); 29213, K (5); 3317, NY (14); 3411, K (14); 4760, NY (14); 4947, BM (14); 5641, NY (14); 5743, NY (14); 6864, NY (14); 7973, NY (14); 12440, K (14); 18120, NY (14); 26093, K (14); 532, BM (28).

Stolitzky: s.n., CAL, K (2).
Takamura: 24 VIII 1958, KYO (2).
Takhtadjan: 29 VII 1934, ERE ($29c_1$); 19 VII 1950, ERE ($29c_1$); 24 VI 1970, ERE ($29c_1$); 30 VI 1935, ERE (35); 26 VI 1936, ERE (36); 22 VI 1950, ERE (35); 4 VII 1950, ERE (35); 22 VII 1950, ERE (35); 19 VIII 1950, ERE (35); 20 VII 1950, ERE (36); 26 V 1960, ERE (36); 18 VI 1970, ERE (36); 20 VII 1950, ERE (41).
Takhtadjan et al.: 23 V 1959, ERE (35); 27 V 1959, ERE (35); 28 V 1960, ERE (35); 1 VI 1960, ERE (35); 3 VI 1960, ERE (35); 9 V 1961, ERE (35); 9 VIII 1961, ERE (35); 2 VIII 1963, ERE (35); 2 VII 1972, ERE (35); 26 V 1960, ERE (36); 29 V 1960, ERE (36); 9 V 1961, ERE (36); 28 V 1960, ERE (37).
Tamamshian: 30 V 1933, ERE (35); 30 VI 1936, ERE (41).
Tamamshian et al.: 15 VI 1931, ERE ($29c_1$); 19 V 1931, ERE (35); 31 V 1931, ERE (35); 7 VI 1931, ERE (35); 12 VI 1931, ERE (35); 13 VI 1931, ERE (35); 17 VI 1931, ERE (35); 20 II 1936, ERE (35); 14 VI 1933, ERE (36); 31 V 1931, ERE (41).
Tanardhanan: 10 X 1971, BSD (15); 25 VIII 1973, BSD (15).
Tatli: 4417, Univ. Erz. (35).
Teodorov: 14 VI 1936, ERE (41).
Termé: 26 V 1968, IRAN (35); 2 VII 1968, IRAN (35); 22 V 1968, IRAN (36); 27 V 1968, IRAN (36); 17 VI 1970, IRAN (41); 6 VI 1975, IRAN (41).
Termé et al.: 28 V 1969, IRAN (35); 4 VI 1969, IRAN (35).
Thomson: 15 X 1841, K (2); 17 IX 1847, K (2); 4 VIII 1848, K (2); 28 VIII 1848, K (2); 1852, E (2); 11 VIII 1847, K (14); 1861, G (14).
Townsend: 65/171, K (18); 65/282, K (18); 65/312, K (18).
Trotter: 132G, K (14).
Uotila: 17268, H (35); 18544, H (35); 16220, H (36).
Vanezian: 26 V 1920, ERE (36).
Vartapetian: 26 V 1920, ERE (36).
Volk: 2243 (2); 71 (15); 1109 (15); 71.841 (15); 1967 (19); 71.468 (31a); 126 (35); 237 (35); 467 (35); 622 (35); 737 (35); 796 (35); 852 (35); 882 (35); 1047 (35); 1604 (35); 1725 (35); 1769 (35); 2257 (35); 2786 (35); 71.085 (35); 71.180 (35); 71.201 (35); 71.228 (35); 71.229 (35); 71.281 (35); 71.287 (35); 71.300 (35); 71.306a (35); 71.312 p.p. (35).
Webster & Nasir: 6330, K, W (2).
Wendelbo: 11996, THR (35); 1592, BG (41).
Wendelbo et al.: 11939, THR, W (35); 15 V 1974, W (35); 2 VII 1974, W (35); 19 VI 1974, W (41).
Winterbottom: 890, K (29b).
Young: VIII 1880, BM (14).
Zagri: 9 V 1968, IRAN (19).
Zedelmeier: 2 VII 1923, ERE ($29c_1$); 5 VII 1923, ERE (33); 16 VII 1923, ERE (33); 27 VII 1923, ERE (33); 24 VI 1923, ERE (35); 16 VII 1923, ERE (35).
Zohary: 15 VIII 1960, HUJ (35); 50341, HUJ (35).
Zohary et al.: 30 VI 1963, HUJ (35); 31028, HUJ (35); 31029, HUJ (35); 2164-9, HUJ (35); 28116, HUJ (35); HA01/14, HUJ (36); H001/7, HUJ (36); 5508, HUJ (36); 5552/14, HUJ (36); 9964/10, HUJ (36).