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Author(s): N. L. Bor

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## NOTES ON ASIATIC GRASSES : XXIV.

The Genus *Arundinella* Raddi in India, Burma and Ceylon.

N. L. BOR

The genus *Arundinella* was established by Guiseppe Raddi in his book *Agrostographia Brasiliensis* 37 (1823) t. 1, fig. 3, where he gives an adequate description of the genus *Arundinella* and of the species *A. brasiliensis*, which are, moreover, supported by a figure. The generic name is apparently the diminutive of the Latin word "arundo" and means a "little reed". While the name is quite suitable for some of the species, there are many which are truly herbaceous.

The discrimination of the species of the genus has given a great deal of trouble because of the effect that changes in habitat have upon the vegetative parts and upon the size of the panicle. The plants respond to a richness of habitat with such exuberance as to be quite different in appearance from the same species growing on poor soil. Consequently when numerous collections from all kinds of habitats were made, the range of adaptability of the species to its environment became plain and therefore a clearer picture of the limits of a species could be drawn. When Sir Joseph Hooker was writing the seventh volume of the Flora of British India he had in some instances only meagre collections to work on, and therefore it is not at all surprising, in fact, it was inevitable, that species were established which were only habitat forms. The writer has had the advantage of very much richer collections than his predecessors had, but even now, far more material is needed from South India and Ceylon to be quite sure of the status of a few species.

The writer is under great obligation to the authorities of St. Xavier's College, Bombay, for making available the rich Blatter collections, and to Shri M. B. Raizada, Forest Botanist, Forest Research Institute, Dehra Dun, for sending certain critical specimens. The specimens cited are in the Kew Herbarium, except where otherwise stated.

## HISTORICAL

Trinius was the first to give a generic name to the genus when he described *Goldbachia mikani* in Sprengel, *Neue Entdeckungen* 2, 81 (1821). Unfortunately the generic name *Goldbachia* is a later homonym of De Candolle's cruciferous genus *Goldbachia*. Reichenbach tried to put this right in 1828, when he pointed out that Trinius' *Goldbachia* was invalid and proposed the name *Calamochloe* in its place. In the meantime (1823), unfortunately for him, Raddi had published the generic name *Arundinella*, by which name the genus must be known. From 1829-1834 the genus received four more names.

From the start the relationship of the genus to the other genera in the family was a puzzle to the many who worked on the *Gramineae* in the 19th century. Kunth, for example, compared his genus *Brandtia* with *Eriachne*, a genus which he placed in the *Avenaceae*. Trinius simply described *Goldbachia mikani* without assigning it to any section or tribe. When Reichenbach replaced *Goldbachia* by *Calamochloe*, he included the latter in the *Saccharinae*, among other andropogonous genera. Presl described his *Thysanachne* as belonging to the *Gramineae Bromeeaceae*, while *Riedelia*,

an unpublished name of Trinius, was placed among the synonyms of *Arundinella brasiliensis* Raddi, and with the latter was reduced in synonymy to *Ischaemum hispidum* Humb. et Kunth in Kunth, Enum. Pl. **1**, 515 (1833).

Coming down to Link, we find that he placed his *Acratherum* in *Tristeginae*, a suborder described as "Spiculae semibiflorae. Valvula exterior neutra a glumae valvis structura differt", a formula which was sufficiently nebulous as to embrace genera which did not easily fall into tribes or groups already described. Hackel, *The True Grasses*, 68 (1896), retained this name for one of his tribes, considering it to be a transitional tribe between *Andropogoneae* and *Paniceae*. He, however, defined the tribe a little more precisely as "spikelets all hermaphrodite, 1-2-flowered in paniced racemes, axis continuous. Empty glumes three, the third sometimes hairy, having the function of a flowering glume of a male flower." He succeeded in placing in this tribe, besides *Arundinella*, *Melinis*, *Beckera*, *Phaenosperma*, *Triscenia*, *Thysanolaena* and *Andropogon*, genera which would to-day be placed in at least five distinct tribes.

Bentham and Hooker maintained the tribal name *Tristeginae* with Hackel's characters more or less unchanged, remarking that it was a tribe connecting the *Paniceae* with *Andropogoneae* and *Agrostideae*. In this tribe were maintained all the genera so placed by Hackel except *Beckera* and *Arthropogon*. Moreover, to it were added such genera as *Garnotia* and subsequently in Stapf's handwriting, *Cyathopus*, *Woodrowia* and others whose relationships were not at once apparent.

Stapf realised in 1898, that the time had come to rescue *Arundinella* from a group with which it had little in common, and in which even the remainder of the genera could with advantage be placed logically elsewhere. For this purpose he created the tribe *Arundinelleae* in *Flora Capensis* **7**, 314 (1898). This tribe has been recognised by C. E. Hubbard [in Hutch. *Families of Flowering Plants, Monocots*. 224 (1934)] and in the latest attempt at the classification of the *Gramineae* by Pilger in *Bot. Jahr.* **76**, 326 (1954), and is now firmly established.

#### CLASSIFICATION

In all Floras in which this genus occurs, use is made of the awned or awnless condition of the spikelets for a primary division. A sub-division makes use of the fact that in some species the awn is flanked on each side by a bristle. Other characters used to delimit species are woolly base, annual or perennial habit, spikelets in pairs or solitary, and so on. It will be worth while to examine some of the characters upon which reliance is based to separate species.

It may be mentioned quite briefly that no reliance whatever can be placed on panicle shape (except *A. spicata* Dalz.) or size, hairiness or its absence on leaves or stem, hairs or bristles or their absence on spikelets and pedicels. *A. spicata* Dalz. is exceptional by reason of its *Setaria*-like panicle which readily separates it from all other species.

The most recent study on the genus *Arundinella* is that published by Keng in Science Reports of the National Central University, China, ser. B, Biology, 2, no. 3 (1936). I am indebted to Mrs. Agnes Chase for

kindly presenting me with a photostat copy of this important paper. The author of the present study comes to somewhat different conclusions from Prof. Keng in respect of a number of species. This may be ascribed to the very ample material the author had at his disposal.

#### *Awns*

“Awned” and “awnless” as used in floras, are merely relative terms. The awned forms usually have a well marked awn several millimetres in length which can be readily separated into a twisted chestnut-coloured column and a colourless bristle. The “awnless” forms either have no trace of an awn (*A. leptochloa*, etc.) or possess a very short awn which can also be separated into a twisted column and colourless bristle, the tip of the latter hardly exceeding the spikelet.

It will come as a shock to some agrostologists to learn that awns may be present in some plants of the same species and not in others.

The classic example of this is *A. laxiflora* Hook. f. Gardner's sheet no. 1007 which is the basis of the species has two plants upon it—the spikelets show no trace of an awn. His 1009 has also two plants upon it—each spikelet has a geniculate awn. The specimens on both sheets are identical in every other way. All other species which are said to be awned, leave traces of the awn, which is readily shed, if they appear to be awnless.

The species *A. setosa* Trin. shows very great variation in size of panicle; the spikelets, however, are of a characteristic shape not readily put into words. The typical form has a geniculate awn to the upper lemma and two bristles, one on each side. These bristles can, however, be completely absent or very short, as in *C. setosa* var. *lanifera*. The absence of the side bristles and the dropping of the central awn were responsible for the erection of *A. mutica* Nees, which is no other than *A. setosa*.

It will, therefore be plain that a dichotomous key cannot with safety be based on the presence or absence of awns or their number. Provision must be made in the key for deviations from this state, where known. The writer has endeavoured to do this in the key in this paper.

#### *Woolly base*

*A. setosa* var. *lanifera* C. E. C. Fischer has a silky rather than a woolly base. *A. villosa* Nees, however, has a crisp curly, yellowish-white wool at the base and this character can be relied upon.

#### *Habit*

The writer's confidence in the reliability of the annual or perennial habit as an indication of specific difference, has been gravely shaken by the fact that the spikelets of *A. nervosa*, an undoubted annual, are identical with those of *A. setosa*, a typical perennial. It is true that there is a definite facies about the annual, particularly in the second arrangement of the spikelets on the branches, but one looks in vain for something tangible, apart from the habit, which could be used to separate them.

Fischer [*Flora of Madras* 1801 (1934)] actually reduced *A. nervosa* to the synonymy of *A. setosa*, but the writer is not prepared to go so far. It is hoped that some botanist in Bombay or Madras will be able to solve the

problem of *A. nervosa*. Is the species a true annual or is it a perennial flowering freely in its first year ?

The following species are unmistakable by reason of certain peculiarities.

*A. bengalensis* (Spreng.) Druce is easily distinguished from all other species by the ascending short branches densely covered with secund awnless or very shortly awned spikelets.

*A. purpurea* Hochst. ex Steud. has leaves and sheaths which turn yellowish-green as they dry.

*A. laxiflora* Hook. f. is remarkable for its long-pedicelled spikelets which are often solitary and alternate on the branches.

The pedicels of *A. setosa* Trin. almost always have setae just below the spikelet, and are a guide to many doubtful or immature specimens.

*A. tuberculata* Munro is distinguished by its unusually long spikelets and being covered by a dense covering of tubercle-based hairs.

#### SPECIES IN INDIA, CEYLON AND BURMA

Hooker recognised 24 species as growing in the area concerned. Their fate in this revision is revealed in the following table :—

Species in Flor. Brit. Ind.	Species in the revision.
<i>A. avenacea</i> Munro ex Thw.	<i>Jansenella griffithiana</i> (Muell) Bor
<i>A. tuberculata</i> Munro ex Lisboa	<i>A. tuberculata</i> Munro ex Lisboa
<i>A. mesophylla</i> Nees ex Steud.	<i>A. mesophylla</i> Nees ex Steud.
<i>A. nervosa</i> Nees ex Steud.	<i>A. nervosa</i> Nees ex Steud.
<i>A. setosa</i> Trin.	<i>A. setosa</i> Trin.
<i>A. khaseana</i> Nees ex Steud.	<i>A. khaseana</i> Nees ex Steud.
<i>A. agrostoides</i> Trin.	{ <i>A. ciliata</i> (Roxb.) Nees <i>A. holcooides</i> (Kunth) Trin.
<i>A. tenella</i> Nees ex Steud.	<i>A. pumila</i> (Hochst.) Steud.
<i>A. pygmaea</i> Hook. f.	<i>A. metzii</i> Hochst. ex Miq. (de-pauperate)
<i>A. metzii</i> Hochst. ex Miq.	<i>A. metzii</i> Hochst. ex Miq.
<i>A. lawii</i> Hook. f.	<i>A. metzii</i> Hochst. ex Miq.
<i>A. villosa</i> Arn. ex Steud. var. <i>wightii</i>	<i>A. villosa</i> Arn. ex Steud.
<i>A. villosa</i> Arn. ex Steud. var. <i>heynei</i>	<i>A. vaginata</i> Bor
<i>A. villosa</i> Arn. ex Steud. var. <i>himalaica</i>	<i>A. hookeri</i> Munro
<i>A. birmanica</i> Hook. f.	<i>A. birmanica</i> Hook. f.
<i>A. brasiliensis</i> Raddi	<i>A. nepalensis</i> Trin.
<i>A. brasiliensis</i> Raddi in part	<i>A. intricata</i> Hughes
<i>A. fuscata</i> Nees ex Buese	<i>A. purpurea</i> Hochst.
<i>A. capillaris</i> Hook. f.	<i>A. setosa</i> Trin.
<i>A. laxiflora</i> Hook. f.	<i>A. laxiflora</i> Hook. f.

Species in Flor. Brit. Ind.	Species in the revision.
<i>A. wallichii</i> Nees ex Steud.	<i>A. bengalensis</i> (Spreng.) Druce
<i>A. clarkei</i> Hook. f.	<i>A. decempedalis</i> (O. Ktze.) Janowsky
<i>A. leptochloa</i> Hook. f. } <i>A. lawsoni</i> Hook. f. } <i>A. gigantea</i> Dalz. }	<i>A. leptochloa</i> (Nees ex Steud.) Hook. f.
<i>A. blephariphylla</i> Hook. f.	<i>A. blephariphylla</i> Hook. f.
<i>A. thwaitesii</i> Hook. f.	<i>A. thwaitesii</i> Hook. f.
<i>A. spicata</i> Dalz. in <i>dubia</i>	<i>A. spicata</i> Dalz.

The reasons for the reduction of certain species to synonymy as well as the promotion of certain varieties will be found under the species concerned or in the discussion of groups of critical species. The reason for present-day nomenclature as opposed to that of Hooker will be found in the references to the literature and to the synonymy. *Arundinella avenacea* Munro was made the basis of a new genus, *Jansenella*, in Kew Bull. 1955, 93 (1955) by the writer.

#### GROUPS OF CRITICAL SPECIES

*Arundinella setosa* Trin., *A. nervosa* (Roxb.) Nees and *A. mutica* Nees.

*A. nervosa* (Roxb.) Nees is the only annual in this group and can therefore be separated easily on this character alone. The justification for its inclusion in the group is the extraordinary similarity of its spikelets to those of *A. setosa* Trin., in fact they are identical, and this similarity extends even to the pedicels which are decorated with the same characteristic bristles. This similarity evidently led Fischer [Flor. Madras 1801 (1934)] to reduce *A. nervosa* to the synonymy of *A. setosa*. The present writer is not prepared to go so far, but he must confess that this similarity between an annual and a perennial is disturbing, since one is led to believe that the genetical make-up of an annual must be profoundly different from that of a typical perennial.

*A. setosa* Trin. is a very variable species as regards size of panicle and vegetative parts, pubescence and so on, but when normal it can be easily recognised by the large spikelets, the awn of the upper lemma being flanked by two bristles and by the tips of the pedicels being almost always decorated with stiff bristles. It is, however, not always normal and the awns of the upper lemma upon which so much reliance has been placed in the past, are sometimes reduced in size or, rarely, absent altogether. It is this latter circumstance which has given rise to the species *A. mutica* Nees.

*A. mutica* Nees was called *A. capillaris* by Hooker on the grounds that the latter epithet was more appropriate for a species, which, although apparently awnless, possessed spikelets from which the awns had fallen away and, therefore, not really muticous.

The specimen upon which Nees based his *Arundinella mutica* is the specimen which bears the Wallichian number 8665A to which Wallich added the provenance of the specimen, as *Andropogon capillaris* Herb. Heyn. The specimen on the sheet in the Wallich Herbarium at Kew has a hairy base. The spikelets in shape are typically those of *A. setosa*, the

central awn has fallen off and the side bristles are not evident. The specimen is a good match for Fischer's *A. setosa* var. *lanifera* Fischer. It is pertinent to recall that Fischer mentioned that the side bristles in his variety were very short.

I can find no evidence that Heyne ever called a specimen in his Herbarium *Andropogon capillaris*. This name is not mentioned in Roth's *Novae Plantarum Species* (1821) in which Heyne's specimens were written up, nor by Roemer and Schultes in the 15th edition of Linnaeus' *Systema Vegetabilium*, to whom Roth lent the mss. of his book. There is, however, a sheet in the Kew Herbarium from Rottler's Herbarium, with a label on which is written in Rottler's hand, "Andropogon capillare nob." Is it possible that Herb. Heyne. was written in mistake for Herb. Rottl. ? It may, indeed, be so, for Hooker identified this very sheet from Rottler's Herbarium as *A. capillaris*. The specimen, however, is typical *Arundinella setosa* Trin.

Hooker also mentions no. 3338 in Herb. Wight. from the Pulney Hills, Madras State. I have not been able to trace this number in the Herbarium at Kew, but there is a sheet no. 3378 from the Pulney Hills. Hooker identified the specimen as *A. capillaris* Hk. f. ? and noted, "very near *A. capillaris* but branches of the panicle more numerous, shorter, spikelets more numerous, smaller". From Hooker's remarks under *A. capillaris* on p. 75, Flora of British India, regarding Wight's Pulney specimens, I feel sure he is referring to the sheet no. 3378. The species on the sheet is *Arundinella nepalensis* Trin.

One wonders what Lisboa had in mind when he mentioned [*Journ. Bomb. Nat. Hist. Soc.* 5, 344 (1890)] that *Arundinella mutica* was common all over Bombay. Blatter & McCann saw no specimens, and there are none in the Blatter Herbarium of St. Xavier's College, Bombay.

The only conclusion that can be drawn from the above is that *A. mutica* Nees (*A. capillaris* Hook. f.) was based on abnormal specimens of *A. setosa*, and the name must be merged in the synonymy of the latter.

*A. gigantea* Dalz., *A. lawsonii* Hook. f. and *A. leptochloa* (Nees ex Steud.) Hook. f.

One can only say with regard to the above named species that when compared, their panicles and vegetative parts show a variation in size and shape which is no whit greater than that exhibited by such species as *A. nepalensis* or *A. setosa*. There is no specific difference in spikelet size and structure. Hence I propose to name the species *A. leptochloa* with the other two names as synonyms. I would also have added *A. blephariphylla* were it not for the fact that it has a different geographical distribution and almost solitary long-pedicelled spikelets. There is only one specimen of the latter at Kew and further collections are badly needed.

*Arundinella metzii* Hochst. *A. lawii* Hook. f. and *A. pygmaea* Hook. f.

J. D. Hooker described the new species *Arundinella lawii* Hook. f. in Trimen, *Handb. Flor. Ceyl.* 5, 180 (1900). He went on to say that this

\* In the interleaved copy of Steudel's *Synopsis* at Kew, I find Munro has remarked with reference to *A. mutica*, "A form of No. 2, *A. setosa*, from which the two awns have fallen away". But a later note reads, "Hb. Hk. Wall. Cat. 8665 ! I now believe *mutica* to be distinct." This does not alter the opinion expressed above.

species had been considered in the *Flora of British India* to be a form of *A. agrostoides* Trin., having been named as such by Munro (in Herb. Ind. Or., Hook. f. and Thoms.). The species was, however, re-examined with aid of specimens collected by Woodrow in the Konkan, Madras State, and Hooker came to the conclusion that it must rank as a distinct species, characterised by its perennial habit, much taller stems, long leaves and very long, drooping, pyramidal panicle.

An examination of the type folder of the species at Kew revealed that two sheets collected by Law in the Konkan, and two others collected by Woodrow in the same place, possessed spikelets which matched those on the fragment from the type sheet which is in the Herbarium at Peradeniya. Of the four sheets, only Woodrow's shows the base of the plant. The base, however, is not that of a perennial but of an annual.

It was quite possible, however, that the type sheet in the Peradeniya Herbarium might prove to be a perennial. In order to settle the question, Mr. Senaratne, Research Assistant in Systematic Botany, was good enough to forward the sheet for examination. It proved to be incomplete, merely consisting of the panicle and a portion of the culm with leaves. The base is not present, and therefore one must assume that Hooker misinterpreted Woodrow's plant which was the only complete gathering of the species seen by him.

The fact that the plant is an annual and not a perennial, puts a different complexion on its status as a distinct species. Actually there is no difference whatever in the shape and size of the various parts of the spikelet in *A. lawii* from that of those in *A. metzii*. The spikelets of the latter are indeed glabrous and those of the type of *A. lawii* more or less hairy with tubercle-based hairs, but the amount of indumentum present on the spikelets of species of *Arundinella* is of no account, and indeed, its absence altogether, even though it gives a different "look" to a plant, is not of any value as a specific difference. I have therefore, after an examination of very numerous sheets from the Blatter Herbarium in Bombay, come to the conclusion that *Arundinella lawii* must be considered as synonymous with *A. metzii*. The hairy spikelets of *A. lawii* are nearly always accompanied by nodes which are covered by an appressed silky pubescence. Even this, however, is not constant and there are specimens which have glabrous spikelets and silky nodes.

As sometimes happens, it is the type of a plant which is atypical when a whole population is studied. So it is with *A. metzii*. The specimen upon which Hochstetter based *Arundinella metzii* is a rather poor example of the dimensions which that species can attain, and, moreover, it is far rarer. In fact it is the hairy form previously known as *A. lawii*, which is probably the most frequent species of the genus in Western India.

The writer published a paper in the Journ. Ind. Bot. Soc. **26**, 62 (1948) in which he detailed the differences between *A. pumila* and *A. pygmaea*. The differences are, of course, considerable, and the paper was prompted by the fact that Keng in Sci. Rep. Nat. Cent. Univ. China 2, 3, 43 (1936) had reduced *A. pygmaea* to the synonymy of *A. pumila*. Hooker says that *A. pygmaea* is closely allied to *A. tenella* (*A. pumila*) but very much smaller.



Having steeped himself in *Arundinella* for some months, the writer is now of the opinion that while there are no grounds whatever for sinking *A. pygmaea* in *A. tenella*, there are no spikelet differences between *A. pygmaea* and *A. metzii*. *A. pygmaea* is obviously an extremely depauperate specimen of the latter.

*Arundinella holcooides* (Kunth) Trin., *A. agrostoides* Trin. and *A. birmanica* Hook. f.

*Arundinella holcooides* (Kunth) Trin. is based on a species collected by a Mr. Raynaud at Pegu in Burma. Kunth, in his *Révision des Graminées* (1829) made this species the type of a new genus which he called *Brandtia*. The species is illustrated in t. 170 of that work and is an undoubted *Arundinella*. This was recognised by Trinius who made the transfer in 1836 [in *Bull. Acad. Sci. Petersb.* **1**, 71 (1836)]. In the same year Trinius in his *Species Graminum, Icones*, **3** (1836) t. 265, described a new species of *Arundinella* under the name of *A. agrostoides*. If the figure of Kunth is compared with that of Trinius, it is quite evident, allowing for the variation in panicle size in this genus, that the two species are the same. In this way *A. agrostoides* entered the synonymy of *A. holcooides* (Kunth) Trin. There is a sheet of *A. agrostoides* Trin. at Kew from the "locus classicus" and there is no doubt about what Trinius considered this species to be.

*Arundinella agrostoides* Trin. was one of the species described by Hooker in the *Flora of British India*. The material of the species so named by Hooker falls into two distinct parts. There are the specimens collected in Burma and those collected in Madras State. The Burmese specimens are identical with *Arundinella agrostoides* Trin. or, to call it by its correct name, *A. holcooides* (Kunth) Trin. In this species the tip of the lower glume equals or slightly exceeds the tip of the lower lemma in the spikelet, a feature which is well brought out in the drawings of *A. agrostoides* and *Brandtia holcooides*.

The species which grows in India is quite different in this respect. The lower glume exceeds by a great deal the tip of the lower lemma and this grass has an altogether different facies. Fortunately there is no need to describe a new species, for Roxburgh described this very species as *Holcus ciliatus* in his *Flora Indica*, 1, 321 (1820), where he states the provenance of the plant to be Coromandel. In the *Icones Roxburgheanae*, preserved at Kew, there is an excellent drawing of *Holcus ciliatus* which leaves no doubt whatever what Roxburgh meant by this species. The same species was given the name *Arundinella (Acratherum) ciliata* in Wight's Catalogue n. 1666 (1834), though I have not been able to ascertain if Nees knew of Roxburgh's *Holcus ciliatus* or not. I am assuming that he did\* and am calling this plant *Arundinella ciliata* (Roxb.) Nees. Steudel did not have the name *A. ciliata* and he could make nothing of Roxburgh's description of *Holcus ciliatus*. A description of *A. ciliata* Nees was given by Miquel in Verh. Konink.-Nederl. Inst. **3**, pt. 4, 30 (1851) mainly because of the need to give descriptions to certain species of which this was one, which up till then existed merely as names. It is obvious that Miquel was quite ignorant of Roxburgh's drawing.

\* If he did not know that Roxburgh's *Holcus ciliatus* was the plant he called *Arundinella ciliata*, it is a remarkable coincidence that they both use the same specific epithet.

Another species which is closely allied to the above two species is that called *Arundinella birmanica* by Hooker. The type was collected in Pegu, which it will be remembered is the "locus classicus" of *Brandtia holcooides* Kunth. The construction of the spikelets is similar to that of *A. holcooides* but the spikelets are consistently larger, and it is altogether a more robust plant. The spikelets are 4.5-5 mm. long, as against 3.5 mm. in *A. holcooides* (Kunth) Trin.

#### GENERIC DESCRIPTION

**Arundinella** Raddi, Agrost. Bras. 37 (1823) t. 1, fig. 3.

*Goldbachia* Trin. in Spreng., Neue Entdeck. 2, 81 (1821)\*.

*Calamochloe* Reichb., Consp. 52 (1828).

*Thysanachne* Presl, Sym. Bot 1, 11 (1829) t. 6.

*Brandtia* Kunth, Rév. Gram. 2, 511 (1830) t. 170.

*Riedelia* Trin. ex Kunth, Enum. Pl. 1, 515 (1833).

*Acratherum* Link, Hort. Berol. 1, 230 (1834).

Spikelets imperfectly jointed on the tips of long or short scabrid pedicels, in pairs, rarely solitary (*A. laxiflora* Hook. f.), occasionally supported by bristles from the tip of the pedicel, arranged in open decompound panicles, in either very dense or loose racemes on a short or long rhachis, usually ascending, or rarely in a spiciform inflorescence, lanceolate or even ovate, acute or acuminate, usually gaping; rhachilla readily disarticulating between the florets, tardily between the upper glume and lower floret. *Florets* 2, heteromorphous; the lower floret ♂ or barren; the upper hermaphrodite, smaller than the lower. *Glumes* persistent; the lower lanceolate, ovate or nearly orbicular, membranous, 3-5-nerved, acute or aristulate, about half to two-thirds the length of the upper; the upper almost as long as the spikelet, 5-7-nerved, elliptic in the lower two-thirds, linear compressed and beaked in the upper third, acting as a scabbard for the awn of the upper lemma, both smooth and glabrous or scabrid on the nerves or densely hispid with tubercle-based hairs on the nerves and sometimes on the internerve spaces. *Lower floret* subsistent; *lemma* acute or subapiculate, oblong- or ovate-oblong-obtuse, usually 5-nerved with lateral pair close together and well separated from the central nerve, smooth and glabrous; *palea* 2-keeled as long as, or somewhat shorter than the lemma. *Upper floret* subterete or more often dorsally compressed with an obtuse callus which is glabrous or long or short bearded at the sides; *lemma* membranous to chartaceous, eventually thinly coriaceous, scaberulous to scabrid in the upper-half, faintly 5-nerved, rounded or 2-lobed or 2-aristate at the tip, usually awned between the lobes but the unawned condition even in the same species is frequent; *palea* of the same texture, smooth and glabrous or scabrid or subpapillose between the keels; *stamens* 3; *styles* 2; *stigmas* plumose; *lodicules* 2, cuneate; *grain* ellipsoid; *hilum* punctiform; *embryo* half as long as the grain.

Perennial or annual grasses; leaves elliptic-acuminate, oblong or linear, sometimes very broad and cordate at the base; ligules very narrow, membranous; spikelets pale, green or dark purple.

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\* *Goldbachia* DC. (1821) is a genus of *Cruciferae*.

K the species of *Arundinella*

Inflorescence cylindrical densely spicate, 7.5–10 mm. wide, 2–5 cm. long ; plant look artificially like a *Setaria* . . . 1. *A. spicata*

Inflorescence not at spicate, either a dense panicle of racemes of spikelets or in an or contracted panicles :—

Upper lemma with setae, one on each side of the awn, at the tip :—

Perennials :—

Spikelets usually loose, distinctly pedicelled, 4.5–7.5 mm. long, usually but not always supported by stiff setae at the tip of the pedicel :—

Base glabrous ; spikelets 6.5–7.5 mm. long

2. *A. setosa* var. *setosa*

Base woolly ; spikelets 4.5–5.5 mm. long

2. *A. setosa* var. *lanifera*

Spikelets crowded, sessile or very shortly pedicelled in a panicle made up of short crowded spicate racemes :—

Culms stout, very densely bearded at the nodes ; spikelets 6–8 mm. long ; upper lemma 3–4 mm. long ; panicle at least 15 cm. long, reaching 50 cm. long . 3. *A. khaseana*

Culms slender, glabrous or very slightly pubescent at the nodes ; spikelets 4–5 mm. long ; upper lemma 2 mm. long ; panicle 4–12 cm. long . . . 4. *A. mesophylla*

Annuals :—

Whole plants covered with tubercle-based hairs ; spikelets long, acuminate, 7.5–9.5 mm. long . . . 5. *A. tuberculata*

Plants not entirely covered with tubercle-based hairs ; spikelets at most 5–6 mm. long ; similar in appearance to *A. setosa* and often supported by bristles at the tip of the pedicel, but upper glume even more acuminate ; size of panicle very variable

6. *A. nervosa*

Upper lemma with a single awn or the awn absent :—

Plants woolly at the base ; spikelets awned :—

Panicle of short racemes (3 cm. long or less) of crowded spikelets 7.5 mm. long, short-pedicelled, covered with tubercle-based bristles . . . . . 7. *A. villosa*

Panicle spreading, of long slender branches up to 12 cm. long ; spikelets 4.5–5.5 mm. long, long-pedicelled, few, distant

2. *A. setosa* var. *lanifera*

Plants not woolly at the base though the sheaths may be hirsute or the basal buds silky :—

Upper lemma not awned, if so, awn not more than 2 mm. long ; base of upper lemma naked :—

Spikelets 4–7.5 mm. long ; tips of the pedicel with stiff setae ; basal buds silky . . . . . 2. *A. setosa* var. *lanifera*

Spikelets 2.5–3.5 mm. long ; tips of the pedicel devoid of setae ; basal buds glabrous :—

Panicle very large 30–70 cm. long by 15–20 cm. wide ; branches long undivided 8–20 cm. long ; very stout grass

8. *A. decempedalis*

Panicle very much smaller ; culms not more than 3 mm. thick below the panicle :—

Leaves conspicuously cordate or rounded at the base :—

Panicle of very numerous branches bearing densely crowded spikelets ; spikelets 2.5 mm. long ; leaves 45 cm. long, 3–4 cm. wide, coriaceous, glabrous ; peduncle glabrous below the panicle

9. *A. leptochloa*

Panicle rather open of few branches and more or less distant pairs of spikelets, never dense ; spikelets 3–3.5 mm. long ; leaves 25 cm. long, 2–2.5 cm. wide, chartaceous, with a fringe of bulbous-base hairs along the margins ; peduncle below the panicle with spaced tubercle-based hairs . 10. *A. blephariphylla*

Leaves narrowed at the base or slightly rounded :—

Panicle cylindrical ; branches up to 5 cm. long, usually 2–3 cm. long, covered with densely crowded secund spikelets with hispidulous glumes ; occasionally an awn present, not more than 2 mm. long

11. *A. bengalensis*

Panicle not as above :—

Spikelets solitary on the branches, shorter than the pedicels ; panicle axis and branches quite glabrous . . . . . 12. *A. thwaitesii*

Spikelets binate on the branches ; branches and axis of panicle scabrid, pilose at junction of branch and axis ; spikelets 2.25–3.75 mm. long ; stout plants with large dull purple panicle or slender with greenish panicles . . 9. *A. leptochloa*

Upper lemma bearing a geniculate awn :—

Spikelets small, not more than 2 mm. long ; upper lemma 1 mm. long ; leaf-blades elliptic-acute or elliptic-acuminate, membranous to chartaceous 3–25 cm. long, 5–25 mm. wide ; inflorescence a very effuse panicle 10–30 cm. long with many spikelets . . . . . 13. *A. pumila*

Spikelets well over 2 mm. long ; leaves not as above :—

Spikelets glabrous or with a few short hairs on the keels of the glumes :—

Perennial grasses :—

Panicle 10—45 cm. long, usually very effuse ; axis smooth and glabrous :—

Panicle 10—15 cm. long ; pedicels much longer than the spikelets . . . . . 14. *A. laxiflora*

Panicle 10—45 cm. long ; pedicels shorter than the spikelets or not much longer . 15. *A. nepalensis*

Panicle usually contracted ; axis very scabrid or markedly ciliate :—

Leaves rounded at the base or subcordate, usually collected at the base of the plant, drying yellowish green ; sheaths and leaf-margins with tubercle-based hairs :—

Pedicels short ; panicle compact

16. *A. purpurea* var. *purpurea*

Pedicels very long ; panicle effuse ; spikelets sometimes proliferous

16. *A. purpurea* var. *pedicellata*

Leaves linear-acuminate, not rounded at the base

17. *A. intricata*

Annual grasses :—

Pedicels of the spikelets very long, up to 16 mm. long ; panicle not more than 6 cm. long . 14. *A. laxiflora*

Pedicels of the spikelet much shorter ; panicles up to 50 cm. long :—

Spikelets pale with nerves conspicuous, green, not more than 3.5 mm. long, quite glabrous or with a few bristles on the back of the glumes ; panicle very variable up to 20 cm. long . 18. *A. metzii*

Spikelets 3.5—4.5 mm. long, almost glabrous but at least with a few cilia on the keel of the upper glume, or showing the tubercle bases of the fallen bristles ; panicle 6—30 cm. long, lower glume 2.5—3, upper 3.5—4 mm. long 18. *A. metzii*

Spikelets very bristly from tubercled-based hairs on the nerves of the glumes and/or on the interspaces, or at least the bases of the bristles remaining :—

Spikelets 6—7 mm. long, densely crowded on the short branches of the panicle ; perennials :—

Peduncle hairy below the inflorescence ; basal sheaths very long, crowded at the base of the culm

19. *A. vaginata*

Peduncle glabrous below the inflorescence ; basal sheaths much shorter . . . . 20. *A. hookeri*

Spikelets up to 5 mm. long ; annuals :—

Panicle up to 50 cm. long, very effuse and drooping ; with long branches ; spikelets 3–4 long ; glumes unequal . . . . . 18. *A. metzii*

Panicle usually compact, if rather effuse then with the glumes more or less equal :—

Lower glume considerably exceeding the lower lemma in the spikelet ; glumes very densely covered in the lower half with tubercle-based bristles :—

Panicle very dense, linear or rather open

21. *A. ciliata*

Lower glume aristulate, a little shorter than, equal to or slightly exceeding the lower lemma in the spikelet :—

Leaves rounded at the base ; spikelets 4·5–5 mm. long . . . . . 22. *A. birmanica*

Leaves not rounded at the base ; spikelets 3·5 mm. long . . . . . 23. *A. holcooides*

1 ***Arundinella spicata*** Dalz. in Dalz. et Gibs., Bomb. Flor. 293 (1861).

An annual grass. *Culms* erect or decumbent, rooting at the lower nodes, up to 30 cm. tall, very slender, long-exserted from the topmost leaf, simple, striate, scabrid to minutely hairy below the inflorescence, smooth, glabrous and shining below. *Leaf-blades* lanceolate-acute, elliptic-acute, up to 3·8 cm. long by 6 mm. broad (fide Blatter), covered on both surfaces and on the margins with dense or sparse tubercle-based hairs, soft, green or somewhat glaucous ; *sheaths* overlapping at the base, short, striate, covered all over with tubercle-based hairs, rather loose, thickly ciliate on one margin ; *ligule* a narrow membrane, long and thickly ciliate on the upper edge.

Inflorescence a very dense cylindrical spike of crowded spikelets ; axis of the spikes rather thick, shortly hairy. Spikelets 5·5–6 mm. long, subsessile. *Lower glume* 2–3 mm. long, lanceolate-acuminate when flattened, the tip being produced into a short arista, 3-nerved, covered sparsely on the outer surface with tubercle-based hairs ; *upper glume* as long as the spikelet, lanceolate-acuminate, the distal two-thirds being very narrow, plicate and carrying the awn of the upper floret, 3-nerved, scabrid, most often quite glabrous but occasionally with a few simple hairs. *Lower floret* ♂ or empty ; *lemma* lanceolate-acute, about 2·5 mm. long, hyaline, 5-nerved ; *palea* 1·5 mm. long, hyaline. *Upper floret* ♀ ; *lemma* 1 mm. long, oblong in shape when flattened, with two rather obtuse lobes at the apex, awned between the lobes ; *palea* shorter and of same texture,

elliptic-obtuse; *styles* 2 (?); *stigmas* plumose; *stamens* 3; *anthers* 0.25 mm. long; *grain* not seen; *awn* 5–6 mm. long; column chestnut-brown, 3 mm. long, twisted.

IND. OR. : Bombay, Mahableshwar, *T. Cooke*; *W. A. Talbot*; Panchgani : first tableland, Oct. 1920, *Blatter and Hallberg* B1287.

*Arundinella spicata* Dalz. was relegated in the Flora of British India to the indeterminable species by Hooker, although it had been described over thirty years before volume seven of the Flora of British India appeared. It is most strange that Hooker never saw the species as it is extremely common in Bombay.

2. ***Arundinella setosa* Trin.**, Gram. Panic. 63 (1826).

*Miquelia setosa* Nees, Nov. Act. Acad. Caes. Leop. Carol. Nat. Cur. **19**, Suppl. 1, 46 (1846).

*Arundinella stricta* Nees in Hook., Kew Journ. **2**, 102 (1850).

*Berghausia barbulate* Endl. in Miq., Anal. Bot. Ind. **2**, 20 (1851).

*Arundinella hirsuta* Nees ex Steud., Syn. Pl. Glum. 115 (1854).

*A. zollingeri* Steud., loc. cit. 115.

*A. setifera* Steud. loc. cit. 115.

*A. mutica* Nees ex Steud., loc. cit. 116.

*Danthonia neuroelytrum* Steud., loc. cit. 245.

*D. luzonensis* Steud., loc. cit. 245.

*Arundinella capillaris* Hook. f., Flor. Brit. Ind. **7**, 74 (1896).

*Milium cimicinoides* Roxb. ex Hook. f., Flor. Brit. Ind. **7**, 70 (1896).

*Arundinella sinensis* Rendle in Journ. Linn. Soc. Bot. **36**, 342 (1904).

*Garnotia barbulate* (Nees) Merr. in Philipp. Journ. Sci. Bot. **13**, 130 (1918).

*Arundinella bidentata* Keng in Journ. Wash. Acad. Sci. **21**, 159 (1931).

A perennial grass without a rhizome but with many dormant basal buds on a hard rootstock. *Culms* up to 100 cm. tall, slender to fairly stout, terete, smooth and glabrous, striate, erect or very rarely branched low down, glabrous at the nodes. *Leaf-blades* very narrow, linear, tapering to an acuminate tip, up to 25 cm. long, 5 mm. broad, very variable in the amount of indumentum present, at times almost glabrous with a very sparse pubescence consisting of short tubercle-based hairs to densely hirsute on both surfaces with similar hairs and densely ciliate along the margins; *sheaths* clasping the culms, tight, very striate, again very variable in the extent and density of the indumentum, at times almost glabrous below and densely hairy above, at others, sparsely hairy over the whole length of the sheath; *ligule* definitely a membrane which, when young, is densely and long-ciliate, breaking up at maturity and the cilia often caducous.

Inflorescence a drooping panicle which is extremely variable in size and density, a few centimetres up to 30 cm. long; axis terete, striate, smooth or scaberulous below, becoming angled and sulcate above and very scabrid, almost hispid on the angles, in the upper portion much exceeded by the branches; branches up to 15 cm. or more long, angled,

arranged alternately on the axis or almost whorled, close or distant, carrying the pedicelled spikelets which are often in pairs, one long- one short-pedicelled; pedicels slender, angled, scaberulous, dilated below the spikelet and almost always with 1-several conspicuous bristles at or just below the tip. *Spikelets* very variable in size, 5-7 (8) mm. long, gaping, the beak of the upper glume often reflexed. *Lower glume* 3.5-5 (6) mm. long, elliptic-acuminate, almost shortly aristate, membranous becoming rather firm, 3-nerved, the nerves anastomosing at the tip, scabrid on the nerves or otherwise smooth and glabrous, or irregularly furnished with a few tubercle-based colourless hairs; *upper glume* 5.5-7 (8) mm. long, elliptic-acuminate, the upper third contracted into a narrow beak in which the awn lies, 5-nerved, scabrid on the nerves, smooth and glabrous or furnished with several to many tubercle-based hairs. *Lower floret* ♂ or neuter; *lemma* 3-4.5 (5.5) mm. long, chartaceous, rounded on the back, oblong-obtuse in shape, smooth and glabrous, 5-nerved, the outer two rather close together; *palea* elliptic-obtuse, a little shorter and narrower than the lemma, 2-nerved, 2-keeled; *stamens* 3; *anthers* 1.5 mm. long. *Upper floret* ♀; *lemma* up to 3 mm. long, with a hairy callus, becoming indurated at maturity and turning brown or black, lanceolate in outline with a stout twisted awn at the apex and two setae up to 3.5 mm. long, smooth and glabrous in the lower half but scabrid near the tip; *palea* of the same texture; *awn* up to 9.5 mm. long, perfect, kned; *column* chestnut-brown to black, twisted, 3.5 mm. long; *stamens* 3; *anthers* 1.5-2 mm. long; *styles* 2; *stigmas* plumose; *hilum* ovate, small; embryo more than half the grain.

#### var. *setosa*

IND. OR. : Assam; Griffith 6786; Khasi Hills, Boga Panee, 2 Jul. 1850, Hook. f. et T. Thoms.; ibidem, Nunkhlow, 28 Jul. 1850, Hook. f. et T. Thoms.; ibidem, Myrung, 29 Jul. 1850, Hook. f. et T. Thoms.; ibidem, Ungot river, 25 Sept. 1850, Hook. f. et T. Thoms.; ibidem, Myrung, 13 Oct. 1850, Hook. f. et T. Thoms.; ibidem, Shillong, 1500 m., 7 Aug. 1885, C. B. Clarke 38577; ibidem, Shillong 1800 m., 16 Aug. 1885, C. B. Clarke 38835, 43562; ibidem, Jowai, 31 Aug. 1886, 1200 m., C. B. Clarke 44767; Naga Hills, Shibang, 900 m., Dec. 1907, Meebold 7496; Shillong, 1650 m., 7 Sept. 1943, N. L. Bor 17918.

Bombay; N. Kanara, Dandeli, 630 m., 11 Jan. 1890, W. A. Talbot 2266.

Bihar; Soane River, in woods, Hook. f. 1847?; Manbhumi, Jhulda, 7 Dec. 1874, 300 m., C. B. Clarke 25212; Lohardugga 600 m., 26 Oct. 1883, C. B. Clarke 33920; Singhbhum 450 m., 15 Nov. 1883, C. B. Clarke 34252; ibidem, Oct. 1899, H. H. Haines 235—dry hills; Ranchi, 600 m., 9 Mar. 1901, A. Cooke 173; Ranchi, Palamau, 900 m., Oct. 1910, H. H. Haines 4495.

N.W. India; Herb. Royle (Type of *A. hirsuta* Nees); Sutlej Valley near Rampore, 1847, T. Thoms.; Simla, 2100 m., Sept. 1877, J. S. Gamble 5153; Tehri, Jumna Valley, 1 Sept. 1883, J. F. Duthie 317; ibidem, 2100 m., 4 Sept. 1883, J. F. Duthie 335; Kumaon, near Dolchini, 5 Oct. 1884, J. F. Duthie 3483; Garhwal, Lobah, 1500-1800 m., 23 Sept. 1885, J. F. Duthie 5038; Kumaon, 1500-1800 m., 22 Aug. 1886, J. F. Duthie 6135; near Simla, 24 Aug. 1889, J. F. Duthie 10104; Mussoorie, Sept. 1897, J. F. Duthie 23047; Tehri road below Landour, 1800-2100 m., 25 Sept. 1895, J. F. Duthie 17838; Mohand pass, Oct. 1898, J. F. Duthie; Mussoorie, Baurg, 16 Sept. 1899, J. F. Duthie; Kanital, Aug. 1899, J. F. Duthie 23407; Mussoorie, Landour, 2250 m., 4 Sept. 1930, R. R. Stewart 11409.

Madhya Pradesh; Pachmarhi, 19 Feb. 1891, J. F. Duthie 10612.

Madras; Palmacottah, 28 Oct. 1795, Rottler (*Andropogon capillare*); Nilgiris, 1851, Hochst. 920 (Type of *A. setifera* Steud.); Conoor, 1800 m., Sept. 1883, J. S. Gamble 12716; Bellary, 1886, J. S. Gamble; Naduvatam 1800 m., Nov. 1888, W. A. Lawson; Cuddapah, 900 m., Aug. 1889, J. S. Gamble 21332;



Pulneys, Silver Cascade, 27 May 1898, *Bourne* 1942 ; *ibidem*, Periya Shola, 18 Jun. 1898, *Bourne*, 3004 ; *ibidem*, Kodaikanal, Lidcot, 1 Jul. 1898, *Bourne* 1915 ; Ootacamund, Aug. 1899, *Bourne* ; Pulneys, Gundar Valley, 10 Jun. 1901, *Bourne* 1447 ; Ganjam, Mahendragiri, 9 April. 1904, 1260 m., *Fischer & Gage* 112—very common grass ; Santaveri Babab (sic) 1200 m., Oct. 1908, *Meebold* 10450 ; Mysore, Kumsi, 600–900 m., Oct. 1908, *Meebold* 10776 ; Tinnevely, Naberikal, 1200 m., 12 Feb. 1913, *Hooper & Ramaswami* 38506 ; High Wavy Mountains, May 1917, *Blatter & Hallberg* 709 ; Chittur, Horsleykonda, 1200 m., 15 Sept. 1918, *Fischer* 4456 ; Pulneys, Kodaikanal, May 1921, 2100 m., *L. Anglade* 2205 ; Madura, High Wavy mountains, 6 Sept. 1925, *Cherian Jacob* 17548.

Burma : Maymyo Plateau, 1050 m., 21 Sept. 1911, *J. H. Lace* 5428 ; Amherst, Kwin below Mulayit, 1890 m., 3 Feb. 1927, *C. E. Parkinson* 5162 ; Shwe-u-daung Game Reserve, 1800 m., 25 Feb. 1930, *H. C. Smith*—Padaw myet.

Ceylon ; Trincomalee, Dec. 1885, *U. T.*

var. **lanifera** C. E. C. Fisch. in Gamble, Flor. Madras 1801 (1934).

Madras ; Cuddapah 1050 m., Aug. 1889, *J. S. Gamble* 21307 (Typus in Herb. Kew.).

This species, while it does not vary in the size of its vegetative parts to the same extent as *A. nepalensis* Trin., has in other ways given a great deal of trouble. The large spikelets are reasonably constant in shape and size and are usually supported by well-defined bristles or setae from the pedicel at or just below the tip. These bristles are not, however, always present. The upper lemma, which nearly always is decorated with a perfect awn arising at the tip between two bristles, sometimes is devoid of the bristles or both the bristles and awn. The spikelets have a characteristic look, not easy to put into words, which as a rule makes the plant easy of discrimination.

3. **Arundinella khaseana** Nees ex Steud., Syn. Pl. Glum. 115 (1854).

A perennial coarsely tufted grass from a thick woody rootstock. *Culms* up to 105 cm. tall, stout, robust, terete, smooth and glabrous, or scabrid below the panicle, simple, thickly but shortly pubescent on the nodes. *Leaf-blades* up to 30 cm. long on herbarium specimens, probably twice as long on the living plant, 4–6 mm. wide in herbarium specimens, minutely scaberulous on both surfaces, scabrid on the margins, usually folded or rolled in various ways, stiff, mostly glabrous but often with a thick or sparse growth of stiff hairs from tubercle-bases in the neighbourhood of the collar on both surfaces, or rarely pubescent on both surfaces, linear-acuminate, the upper leaves hardly rounded to the base ; *sheaths*, at least the uppermost, tight, clasping, glabrous but scaberulous in the lower half, covered between the striations in the upper half with tubercle-based hairs which fall off with age, leaving the rough bases behind ; *ligule* a very narrow membrane, less than 1 mm. wide, lacerate and ciliate on the upper margin, usually backed by dense hairs on the leaf-surface.

Inflorescence a dense or comparatively open panicle up to 45 cm. long by 10 cm. wide consisting of an erect central sulcate and ridged axis which is excessively scabrid on the angles and which bears alternate, fascicled or subwhorled, ascending branches, either closely or distantly spaced ; branches simple or sparingly branched, up to 11 cm. long, angled and sulcate, scabrid on the angles, bearing densely or distantly arranged spikelets usually in pairs and seated on scabrid pedicels, usually shorter

than the spikelets. *Spikelets* 5.5–6 mm. long, dark purple in colour, bristly. *Lower glume* 4–4.5 mm. long, elliptic-acuminate in shape, the upper quarter much compressed, 5-nerved, scabrid on the nerves and with a few stout tubercle-based bristles on the dorsal surface; *upper glume* 5.5 mm. long, ovate-acuminate, 5-nerved, compressed towards the tip, scabrid on the nerves, with a few tubercle-based bristles on the dorsal surface. *Lower floret* ♂; *lemma* shape of and almost as long as the upper glume but more delicate and not so strongly suffused with purple, 2-nerved, glabrous and smooth on the dorsal surface; *palea* lanceolate, 3.5 mm. long, obtuse or notched at the tip, hyaline, 2-keeled, smooth and glabrous; *stamens* 3; *anthers* 1.5 mm. long. *Upper floret* ♀; *lemma* with a bearded callus, 2 mm. long, hyaline, smooth and glabrous except for a slight scabridity towards the top, 5-nerved, the two lateral on each side anastomosing and carried out as short, scabrid bristles, between which issues the stout awn; *palea* of same texture, 2-nerved, 2-keeled, flaps expanded below; *styles* 2; *stigmas* plumose; *stamens* 3; *anthers* 2 mm. long; *awn* 5–6 mm. long; *column* 2 mm. long, chestnut-brown, twisted.

IND. OR. : Khasi Hills; Khusiya, *Griffith*; ibidem, Kalapanee 26 Jun. 1850, *Hook. f. et T. Thoms.*; Myrung, 30 Jul. 1850, *Hook. f. et T. Thoms.*; Sohra 1350 m., 28 Oct. 1887, *C. B. Clarke* 16406; Shillong, 1800 m., 16 Aug. 1885, *C. B. Clarke* 38828A & B; Soyung, 1500 m., 12 Sept. 1886, *C. B. Clarke* 44726D; Jugum, Khasea, *Wallich* 8672. (Typus in Herb. Kew.)

Naga Hills; Kohima, 1500 m., 20 Aug. 1935, *N. L. Bor* 5328; ibidem, Bopungwemi, 1200 m., 9 Sept. 1935, *N. L. Bor* 6476.

Wallich 8672 is quoted by Steudel in *Syn. Pl. Glum.* 115 (1854) as the plant in Wallich's Herbarium upon which the species was based by Nees. As Nees' herbarium has been completely destroyed, I select the cotype of the species preserved in the Kew Herbarium as the type.

#### 4. *Arundinella mesophylla* Nees ex Steud., *Syn. Pl. Glum.* 115 (1854).

An annual grass. *Culms* often very many from the base and then markedly decumbent or erect and few, often branched from the lower nodes, terete, smooth and glabrous, even at the nodes, striate, up to 45 cm. tall. *Leaf-blades* linear-acuminate, up to 10 cm. long, 4–6 mm. wide, tapering towards the base or rounded to the sheath, closely many-nerved, sparsely or densely covered on both surfaces with tubercle-based hairs, ciliate on the scaberulous margins with similar hairs, hairs very dense behind the ligule; *sheaths* tight towards the top, clasping, striate, those lower down inclined to slip from the culms, glabrous or sparsely hairy with tubercle-based hairs on the lower third, with the hairs increasing in density from below upwards and often very densely hairy towards the collar; *ligule* membranous, 1 mm. wide, densely ciliate on the lacerate upper margin.

Inflorescence a somewhat dense panicle almost 7 cm. long, 2 cm. wide, consisting of an angled and sulcate somewhat flexuous axis, hirsute with tubercle-based hairs or almost glabrous, with several raceme-like branches; branches up to 1.8 cm. long, straight, glabrous or hirsute similar to the axis, carrying usually densely crowded spikelets in pairs; spikelets shorter than the pedicels. *Spikelets* 5–5.5 mm. long, gaping at anthesis. *Lower glume* 4 mm. long, lanceolate-acuminate, almost aristulate, 3-nerved, the nerves joining towards the apex, with tubercle-based hairs on the scabrid nerves, otherwise smooth and glabrous, or more usually

with a dense covering of short tuberculate-based hairs between the lateral nerves and the margins ; *upper glume* 5.5 mm. long, lanceolate-acuminate when flattened, the upper half tapering to a bifid or blunt tip, 5-nerved, covered with tubercle-based hairs on the nerves, otherwise smooth and glabrous, or hairy as in lower glume. *Lower floret* ♂ ; *lemma* 2.5 mm. long, hyaline to sub-chartaceous, elliptic in shape when flattened, 3-nerved, the two lateral very broad, smooth and glabrous ; *palea* 2 mm. long, 2-nerved, 2-keeled, oblong-obtuse ; *stamens* 3 ; *anthers* 0.5–1.75 mm. long. *Upper floret* ♀ ; *lemma* with a shortly bearded callus, 1.5–1.75 mm. long, oblong-elliptic, hyaline becoming indurated and brown in colour, glabrous and smooth below, coarsely scabrid above, 3-awned, the two lateral 2.5 mm. long, filiform, the median 6 mm. long with a twisted brown column 3 mm. long ; *palea* same texture as the lemma ; *stamens* 3 ; *anthers* 1–1.25 mm. long ; *styles* 2 ; *stigmas* plumose.

IND. OR. : Madras ; Wallich's 8663B ex Herb. Wight. (Typus in Herb. Kew.) ; Pulney Mountains *Wight* 1836 ; Travancore, Jun. 1835 *Wight* ; Nagercoil, 24 Dec. 1894, *M. A. Lawson* 231 ; Pillar Rocks, 19 Jul. 1895 *Bourne* ; Kodai-kanal Waterfall, 1 May 1899, *Bourne* ; Jesmond Hill, 9 Jul. 1899 ; Villimalai-Anaimalai Hills, 1050 m., 25 Oct. 1913, *C. E. C. Fischer* 3650 ; Travancore, Vendamattu, 1500 m., Dec. 1910, *Meebold* 13068 ; Upper Palnis 2160 m., 19 Aug. 1911, *C. E. C. Fischer* 2878 ; Malabar, Palghat, 30 Dec. 1919, Madras Herb. 16344.

This very distinct species could hardly be mistaken for anything else.

5. ***Arundinella tuberculata*** *Munro ex Lisboa* in Journ. Nat. Hist. Soc. Bomb. 5, 344 (1891).

An annual grass. *Culms* several from the base which is sometimes decumbent, usually erect, simple, up to 80 cm. tall, terete, smooth and glabrous, bearded at the nodes with downwardly directed tubercle-based hairs. *Leaf-blades* oblong-acuminate or narrowly elliptic-oblong-acuminate, tapering towards the base and slightly rounded to the sheath, up to 12 cm. long by 11 mm. wide, hispid on both surfaces with colourless longish hairs from small tubercle-bases, ciliate all along the margins with similar hairs, minutely scaberulous with a stout midrib on the lower surface which is carried down on the sheath as a keel ; *sheaths* tight, clasping, very striate, covered all over with colourless tubercle-based hairs which are more numerous in the upper half and are sometimes almost absent in the lower half ; *ligule* a membranous ring, densely and shortly ciliate on the upper margin.

Inflorescence a narrow panicle up to 14 cm. long, 3 cm. wide, consisting of a flexuous sharply-angled axis densely and coarsely scabrid on the angles ; branches similar, alternate, distant or several together carrying bristly spikelets in pairs, one long- one short-pedicelled, or of one of a pair aborted. *Spikelets* 8–9 mm. long, gaping at anthesis. *Lower glume* 5 mm. long, ovate-acute, produced at the tip into a short arista, 3-nerved, scabrid on the nerves and furnished on the nerves with stout colourless tubercle-based hairs ; *upper glume* 8–9 mm. long, lanceolate-acute in the lower half with the upper half produced into a blunt beak, 5-nerved, with nerves decorated with similar hairs. *Lower floret* ♂ ; *lemma* hyaline, elliptic-acute when flattened, 4.5 mm. long, smooth, glabrous, shining ; *palea* 3.5 mm. long, hyaline, elliptic-acute, 2-keeled ; *stamens* 3 ; *anthers* 2 mm. long. *Upper floret* ♀ ; callus bearded ; *lemma* 2.5 mm.

long, elliptic-oblong in shape, chartaceous, glabrous below, scabrid above, with two very slender setae at the tip and a rather stouter awn which is 9 mm. long, with a brown twisted column 4.5 mm. long ; *palea* elliptic in shape, of the same texture as the lemma, scabrid on the adaxial surface, 2-nerved and 2-keeled ; *stamens* 3 ; *anthers* 3 mm. long ; *styles* 2 ; *stigmas* plumose.

IND. OR. : Madras ; *Stocks* : Deccan, May 1880, *Woodrow*.  
Madhya Pradesh ; 1868, *G. King*.

The long spikelets, together with the sheaths and leaves, covered with longish tubercle-based hairs, distinguish the species at a glance. It seems to be comparatively rare, judging from the frequency of the gatherings, and appears to be confined to the hotter and drier parts of the Concan and Central India.

6. **A. nervosa** (*Roxb.*) *Nees ex Hook. & Arn.*, Bot. Beechey Voy. 237 (1836).

*Holcus nervosus* *Roxb.*, Flor. Ind. 1, 320 (1820).

An annual grass. Culms varying greatly in height, from 15 cm. to over 80 cm. tall, often many from the base, at other times solitary, usually unbranched, terete, striate, smooth and glabrous, even at the nodes and below the panicle, often rooting from the lower nodes. *Leaf-blades* up to 24 cm. long, 7 mm. wide, linear-acuminate, rounded to the sheath at the base, very variable in the amount of indumentum, from almost glabrous to densely covered on both surfaces with short tubercle-based hairs ; *sheaths* on the upper part of the culm tight, clasping, those lower down inclined to slip from the culm, from almost glabrous to densely hairy in the upper half and sparsely hairy in the lower half ; *ligule* a narrow membrane with an irregular upper margin.

Inflorescence a panicle very variable in size from 6 cm. to 25 cm. long, erect or drooping ; axis terete below, angled and sulcate above, extremely scabrid on the angles ; branches branching and rebranching, arrayed in fascicles or alternate on the axis, very scabrid on the angles ; pedicels with a few white bristles below the spikelet. *Spikelets* 5–6 mm. long, gaping at anthesis, in second pairs on the branches. *Lower glume* 3.5 mm. long, ovate-acuminate, shortly aristate, 3-nerved, scabrid and bristly on the nerves from tubercle-based bristles or glabrous ; *upper glume* about 6 mm. long, elliptic-acute in the lower half with upper half much narrowed into a plicate beak in which the awn lies before anthesis, 5-nerved, scabrid and bristly or glabrous on the nerves with tubercle-based bristles. *Lower floret* ♂ or neuter ; *lemma* 3.5 mm. long, hyaline-sub-chartaceous in texture, rounded on the back, elliptic-obtuse in shape when flattened, 3-nerved with lateral nerves rather broad ; *palea* oblong-acute, 3 mm. long, 2-nerved and keeled ; *stamens* when present 3 ; *anthers* 1.25 mm. long. *Upper floret* ♀ ; *lemma* with a shortly and sparsely bearded callus, narrowly oblong-elliptic, 2.5 mm. long, glabrous in the lower half, coarsely scabrid at the apex; milky in colour or brownish at maturity, chartaceous, 3-awned at the tip, the two lateral filiform about 2 mm. long, the central perfect 5–9 mm. long, the lower 2–4 mm. being a twisted chestnut coloured column, rather slender ; *stamens* 3 ; *anthers* 1.4 mm. long ; *styles* 2 ; *stigmas* plumose.

IND. OR. : Bombay ; Siddharpur, Oct. 1919, 480 m., *L. J. Sedgwick* 7253—laterite flats—rainfall 100 ins.

Madras : Wight Cat. 1669b, 2387 ; Palmacottah, Dec. 1838, *Wight* 1315 ; *Wight* 3242 ; *Wallich* 8665 ; Mysore, Ananthapura, 600–900 m., Oct. 1908, *Meebold* 10456 ; Pulneys, Kodaikanal Ghat, 31 May 1898, *Bourne* ; ibidem, 11 Dec. 1898, *Bourne* 1914 ; ibidem 13 Dec. 1898, *Bourne* 3005 ; Tinnevely, Mundanthorai Ghat, 14 May 1901, *C. A. Barber* 2775 ; Tinnevely, Courtallam, 11 Nov. 1908 *Bourne* 5304 ; Hosur, Salem Dist., 29 Dec. 1916, *Bourne* ?

Several references to this plant have been made in the preceding pages, occasioned by the similarity of the spikelets to those of *A. setosa* Trin.

There is a most excellent figure of this plant in the collection of Roxburgh's drawings in the Kew Herbarium, which leaves no doubt of the identity of his *Holcus nervosus*.

### 7. *Arundinella villosa* Arn. ex Steud., Syn. Pl. Glum. 115 (1854).

*A. villosa* Arn. ex Steud. var. *Wightii* Hook. f., Flor. Brit. Ind. 7, 73 (1896).

A perennial grass with a hard woody base clothed below with short sheaths which are covered with a dense curly pale yellow wool. Culms up to 60 cm. tall, glabrous or very slightly pubescent below the panicle or minutely scaberulous, terete, somewhat striate. Leaf-blades up to 45 cm. long, 5 mm. wide, flat, involute or rolled, linear-acuminate in shape, densely covered on both surfaces with colourless hairs from tubercle-base or quite glabrous, tapering to a capillary tip ; sheaths of two kinds, the upper up to 12 cm. long, clasping the culm, smooth and glabrous, shining, with a very short leaf, the lower short up to 5 cm. long, carrying a long leaf, loose, slipping from the culm, sparsely villous from tubercle-based hairs and densely covered at the base with pale yellow crisp curly wool ; ligule a very narrow membrane.

Inflorescence a strict panicle consisting of a central axis upon which is arranged alternately, a series of short densely spiculate racemes ; axis straight or flexuous, terete between the lowest node, which carries a rudiment of a raceme, and the first true raceme, above the latter angled, densely pubescent and scabrid on the angles and surface ; racemes 2.5 cm. or less long, alternate, rarely two at a node, consisting of a villous rhachis upon which the spikelets are arranged in pairs. Spikelets 7 mm. long. Lower glume 5–6 mm. long, elliptic-acuminate when flattened, with the tip almost aristulate, 3–5-nerved, very bristly on the nerves or between, with tubercle-based hairs 2.5 mm. long, sometimes hirsute between the lateral nerves and the margins ; upper glume 6–6.5 mm. long, elliptic-acuminate, the upper third forming a stout beak, 5–7-nerved, the lateral nerves with similar tubercle-based bristles, which are also found on the surfaces between. Lower floret ♂ or neuter ; lemma 5 mm. long, oblong-acute when flattened, very smooth and glabrous, 5-nerved with the two lateral close together ; palea 3.5–4 mm. long, 2-keeled ; stamens 3 ; anthers 1 mm. long. Upper floret ♀ ; lemma 2.5 mm. long, shortly bearded on the callus, chartaceous, oblong, scabrid on the dorsal surface in the upper third ; palea 2-keeled, a little longer ; stamens 3 ; anthers 2 mm. long ; styles 2 ; stigmas plumose ; awn 6 mm. long ; column 2.5 mm. long, chestnut-brown, twisted.

IND. OR. : Ceylon ; Herb. Wight no. 2037 (type of *A. villosa* Arn.) ; *Gardner* 997 ; Pupuressa, 1 Nov. 1931, *N. D. Simpson* 8759—bank of roadside stream ; Uva Province, Rendapola on Badulla road below Hakgala, 1590 m., 25 Dec. 1950, *F. Ballard* 1223—rock crevices in roadside cliff, large tufted grass ; Corbetts Gap, 1200 m., 7 Jan. 1951, *F. Ballard* 1404—on high bank by roadside ; large tufted grass.

This endemic species is distinguished from all others in the area under consideration by the development of crisp wool at the base of the plant. *A. hookeri* Munro ex Keng and *A. vaginata* Bor were considered by Hooker to be synonymous with it, but there can be no doubt whatever that they are better kept apart. Occupying, as they do, elevated habitats in widely separated localities, they must have had an independent existence for many scores of thousands of years.

8. ***Arundinella decempedalis*** (*O. Ktze.*) *Janowsky* in Fedde, Rep. Sp. Nov. 17, 84 (1921).

*Panicum decempedale* O. Ktze., Rev. Gen. Pl. 783 (1891).

*Arundinella clarkei* Hook. f., Flor. Brit. Ind. 7, 75 (1896).

A perennial grass from a stout woody rootstock which emits thick rhizomes covered with coriaceous overlapping scales. Culms up to 3 m. tall and more, stout, woody, simple, terete, minutely scabrid below the panicle, otherwise smooth and glabrous save for the nodes which are densely covered with a white shining appressed pubescence. Leaf-blades 1 m. or more in length, up to 3 cm. wide, linear, tapering to a long acuminate tip, smooth and glabrous on both surfaces or more often covered sparsely with rather short tubercle-based hairs to densely hairy behind the very short ligule, coarsely scabrid on both surfaces or smooth, very scabrid on the margins and the adjacent nerves, tapering to the base, with a very broad white midrib on the upper surface ; sheaths clasping the stem, loose below, very firm, striate, usually glabrous but becoming densely hirsute at the collar ; ligule a membrane less than 1 mm. wide which is very shortly ciliate on the upper margin.

Inflorescence a gigantic erect panicle up to 50 cm. long by 15 cm. wide, consisting of a very stout central, sulcate, glabrous, scaberulous, angled axis upon which the spikelet-bearing branches are arranged in distant whorls ; branches hirsute at the junction with the axis, ascending, up to 15 cm. or more long, scabrid, ridged, rarely branching ; pedicels longer or shorter than the spikelets, slightly dilated at the apices, scabrid and often with a few short hairs below the spikelet. Spikelets 3.5–4 mm. long, pale, gaping, usually shortly awned. Lower glume 2.5–3 mm. long, lanceolate-acute, strongly 3-nerved, very scabrid on the nerves, otherwise smooth and glabrous ; upper glume 3.25–3.5 mm. long, lanceolate-acute, 3-nerved, smooth and glabrous. Lower floret ♂ or neuter ; lemma elliptic- or oblong-obtuse, chartaceous, 3-nerved, 2.5 mm. long, smooth and glabrous ; palea lanceolate, 2-keeled, hyaline ; stamens if present 3 ; anthers 1 mm. long. Upper floret ♀ ; lemma 2 mm. long, finally indurated and brown in colour, lanceolate-acute in outline, with a short bearded callus, smooth and glabrous or minutely scabrid above ; palea of the same texture and colour ; stamens 3 ; anthers 1.25–1.5 mm. long ; styles 2 ; stigmas plumose ; hilum punctiform ; embryo more than half the length of the grain ; awn perfect, often present, if so 2–4 mm. long ; column twisted, chestnut-brown 1–2 mm. long.

IND. OR. : Bengal ; Sikkim Terai, in the jungle between Goreedora and Kuparil, 26 Oct. 1868, *S. Kurz* ; Darjeeling Terai, 150 m., 2 Dec. 1875, *C. B. Clarke* 26483 (Type of *Arundinella clarkei* Hook. f.) ; Sikkim, Bamunpokri, 300 m., Nov. 1879, *J. S. Gamble* 7401 ; Dulkajhar, 150 m., 16 Oct. 1884, *C. B. Clarke* 36758A ; West Duars, Oct. 1895, *H. H. Haines* 565. Assam ; Goalpara, 25 May 1912, *R. S. Hole*.

This colossal species, so far as is known to the writer, is found only in the plains of Bengal and Assam, north of the Brahmaputra river. Owing to the enormous size of its panicle of mostly unawned spikelets, it is hardly likely to be mistaken for any other species. The spikelets are often awned with a short awn which can be divided into twisted column and bristle. In the Naga Hills the panicles of *A. nepalensis* Trin. approach those of *A. decempedalis* in size.

This species has a most extensive root system in which thick meandering rhizomes, covered with thick scales, play a conspicuous part.

9. ***Arundinella leptochloa*** (*Nees ex Steud.*) *Hook. f.*, *Flor. Brit. Ind.* **7**, 76 (1896).

*Panicum leptochloa* *Nees ex Steud.*, *Syn. Pl. Glum.* 62 (1854).

*Arundinella gigantea* *Dalz. in Dalz. et Gibs.*, *Bomb. Flor.* 293 (1861).

*Panicum zeylanicum* *Arn. ex Hook. f.*, *Flor. Brit. Ind.* **7**, 76 (1896) nomen.

*Arundinella lawsonii* *Hook. f.*, *Flor. Brit. Ind.* **7**, 76 (1896).

A tall perennial grass. *Culms* up to 2 m. (fide *Hook. f.*) terete, smooth and glabrous, even at the nodes, simple, striate. *Leaf-blades* a few centimetres up to 60 cm. long, 4 mm. to 3.5 cm. broad, linear-lanceolate, tapering to a fine acuminate scabrid tip, rounded or almost cordate at the base in the large and broad leaves, scabrid on the margins, glabrous but usually with a few tubercle-based hairs towards the base which are often dense behind the ligule, smooth on both surfaces ; *sheaths* tightly clasping the stems above, very striate, usually with a sparse covering of tubercle-based hairs ; *ligule* a very narrow membrane.

Inflorescence a panicle, very variable in length and breadth and density, up to 45 cm. long by 20 cm. wide, with spaced spreading branches or very short and dense and flabellate with closely ascending branches thickly crowded with spikelets, consisting of an erect central scabrid angled axis upon which are arranged a series of parallel ascending branches up to 15 cm. long, carrying densely crowded spikelets ; branches often subwhorled with a tuft of white hairs at the junction with the axis. *Spikelets* 2.5–3.5 mm. long, rather squat and turgid, often suffused with purple. *Lower glume* 2 mm. long, broadly ovate-acute, smooth and glabrous except on the scabrid nerves ; *upper glume* 2.5–3 mm. long, extremely broadly ovate-acute, 5-nerved, smooth and glabrous except on the scabrid nerves. *Lower floret* neuter, ♂ or ♀ ; *lemma* broadly elliptic-acute, hyaline, 5-nerved with the two outer nerves rather close together, smooth and glabrous ; *palea* elliptic-oblong-obtuse, hyaline, 2-keeled ; *stamens* 3 ; *anthers* 1 mm. long. *Upper floret* ♀ ; *callus* naked ; *lemma* 1 mm. long, oblong-elliptic-obtuse, becoming chartaceous, minutely scabrid, brown when mature, unawned ; *palea* of the same texture and colour ; *styles* 2 ; *stigmas* plumose ; *stamens* 3 ; *anthers* 1 mm. long ; *caryopsis* about 1 mm. long ; *embryo* half the length of the grain.

IND. OR. : Bombay ; ex Herb. Munro ; Belgaum, 15 Jan. 1915, *R. S. Hole* ; N. Kanara, Yellapur, 600 m., Nov. 1919, *Sedgwick* 3469 ; Concan, *Stocks* (type of *A. gigantea* Dalz.).

Madras ; Herb. Rottl. (Typus in Herb. Kew.) ; Herb. Wight 1621, 3205 ; Nilambur, 18 Nov. 1888, *M. A. Lawson* 50—wet open places ; North Malabar, Badagara 28 Oct. 1900, *Bourne* ; Tinnevely Dist., Sengalteri, 24 Sept. 1915, Madras Herb. 12450 ; Travancore, *V. Narayanaswami* 1392 and 1743. Cochin, *Johnstone* (Typus of *A. leptochloa* var. *gracillima* Hook. f.) ; Malabar, June 1836, *Wight* 1332 ; Goodaloor, 900 m., 15 Nov. 1888, *M. A. Lawson* 12—swamps (Typus of *A. lawsonii* Hook. f.) ; Nilgiris, Devala, 900 m., Nov. 1884, *J. S. Gamble* 15079 ; Nilgiri Wynaad, Benne, 840 m., 21 Sept. 1920, *C. E. C. Fischer* 4489—in swamps.

The above cited sheets are those in Kew Herbarium. There is a fine series of sheets in the Blatter Herbarium at Bombay which I have been privileged to see. These sheets, with the above, form a complete series from the narrow-leaved, slender open panicle of *A. leptochloa* through the more robust and broader leaves of *A. lawsonii* to the very broad-leaved and open or closed panicle of *A. gigantea* Dalz. The size and shape of the spikelets vary only within specific limits.

Hooker erected a variety of *A. leptochloa* calling it var. *gracillima*. There is no point in keeping up this variety in such a variable species.

10. **Arundinella blephariphylla** *Trim. ex Hook. f.*, Flor. Brit. Ind. **7**, 77 (1896).

*Panicum blephariphyllum* Trim. in Lond. Journ. Bot. **22**, 272 (1885).

An annual grass. Culms up to 60 cm. tall, erect, simple, terete, sparsely hairy with tubercle-based hairs below the panicle, smooth and glabrous elsewhere even at the nodes. Leaf-blades rounded at the base to the sheath, tapering gradually to the acuminate tip, very thin, smooth and glabrous on both surfaces but decorated on the margin with a fringe of hairs from rather stout tubercles, up to 35 cm. long, 2.5 cm. broad, chaffy in texture, nervation obscure ; sheaths below smooth, glabrous, shining, thin, those above sparsely hairy with hairs from tubercle bases ; ligule nearly absent, an obscure membranous ring.

Inflorescence flabellate or oblong with eventually widely spreading branches consisting of a central erect axis, angled and sulcate, scabrid on the angles ; the undivided branches are arranged alternately at the top of the panicle, but tend to be subwhorled or fascicled lower down. Spikelets 3.5 mm. long, gaping. Lower glume 2.5 mm. long, elliptic-acute, when flattened, 3-nerved, smooth and glabrous on the dorsal surface but scabrid on the nerves, especially towards the tip, suffused with purple ; upper glume very broadly elliptic-acuminate, 5-nerved, smooth and glabrous except on the nerves, which are scabrid. Lower floret ♂ or neuter ; lemma 2.75 mm. long, rounded on the back, boat-shaped, 3-nerved, very smooth and glabrous ; palea elliptic obtuse in outline, 2-keeled ; stamens 3 ; anthers 1-1.2 mm. long. Upper floret ♀ ; lemma 1.75 mm. long, brown at maturity, oblong-obtuse, not awned, with a glabrous callus, minutely scaberulous ; palea oblong-elliptic-obtuse with a decoration of stout, almost papillose, hairs on the adaxial surface in the upper-half (cf. *Jansenella*) ; styles 2 ; stigmas plumose ; stamens 3 ; anthers 1-1.2 mm. long.

IND. OR. : Ceylon, Runawelle, Nov. 1883, *Trimen*.



This appears to be the only collection of this interesting grass. The very stout thick-walled hairs on the palea recall those of the palea of the upper floret of *Jansenella griffithiana*. I am not at all convinced that this species will stand the test of time. In my opinion it will eventually join the rest of so-called species which make up the synonymy of *Arundinella leptochloa* (Nees ex Steud.) Hook. f. The only collection, however, seems to indicate that it is an annual.

11. ***Arundinella bengalensis*** (*Spreng.*) *Druce* in Rep. Bot. Exchng. Club, Brit. Isles, 605 (1916).

*Panicum bengalense* Sprengel, Syn. **1**, 311 (1825).

*Arundinella wallichii* Nees ex Steud., Syn. Pl. Glum. 114 (1854).

*Panicum strictum* Roxb., Flor. Ind. **1**, 303 (1820) non R. Br. (1810) nec Pursh. (1814) nec Bosc ex Roem. et Schult. (1817).

*Arundinella stricta* (Roxb.) Janowsky in Fedde, Repert. Sp. Nov. **17**, 84 (1921).

A perennial grass from a stout often woody rhizome covered with silky scales. Culms up to 2 m. tall, most often erect, occasionally shortly decumbent at the base, smooth and glabrous below the panicle, simple or rarely branched below, terete, glabrous at the nodes or thickly bearded. *Leaf-blades* extremely variable in length and width, up to 60 cm. long, 20 mm. wide, linear-acuminate, rounded at the base to the sheath, attenuate to a long acuminate point, in the short plants more or less collected at the base, in the taller evenly distributed along the culms, with a well-marked midrib, covered on both surfaces with an indumentum of short tubercle-based hairs, which is extremely variable in amount, from sparse to dense, scabrid and often thickly ciliate on the margins; *sheaths* particularly the uppermost, tight, clasping, the lower inclined to slip from the culm, leathery, striate, sparsely to thickly covered with tubercle-based hairs, densely ciliate along one margin; *ligule* a very narrow membrane, uneven on the upper margin.

Inflorescence a very dense, erect, contracted panicle, up to 30 cm. long, 2-3 cm. (or more) broad, consisting of a central sulcate and grooved axis, which is almost smooth to almost hispid on the angles; axis carrying short, alternate, rarely whorled, ascending (rarely spreading) branches flowering to the base, (1-2.5 cm. (5) long), which are scabrid or hispid on the angles, carrying secund spikelets in pairs on pedicels which are shorter than the spikelets. *Spikelets* 2.5-3.5 mm. long, gaping at maturity, very shortly awned or unawned. *Lower glume* 2-2.75 mm. long, 3-5-nerved, oblong-elliptic-acute when flattened, spinously scabrid on the nerves, otherwise smooth and glabrous or with a few tubercle-based hairs on or between the lateral nerves; *upper glume* 2.3-3.5 mm. long, elliptic-acute or acuminate, compressed in the upper quarter, 5-nerved, scaberulous or smooth on the nerves, glabrous or with a few tubercle-based hairs on the nerves or between them. *Lower floret* ♂ or neuter; *lemma* 2.5-3 mm. long, lanceolate-acute in shape, hyaline-chartaceous, absolutely smooth and glabrous, translucent, 5-nerved, the outer two very close together; *palea* lanceolate-acute in outline, 2-keeled, with flaps widened at the base; stamens 3; anthers 1-1.25 mm. long. *Upper floret* ♀;

*lemma* 2 mm. long, unawned or with a rudimentary awn, oblong-acute, chartaceous, 3-nerved, becoming somewhat indurated at maturity, glabrous, minutely scaberulous in the upper third, with a short sparsely bearded callus ; stamens 3 ; anthers 1.5 mm. long ; *styles* 2 ; stigmas plumose ; awn, when present, often perfect with a twisted chestnut-coloured column 1 mm. long, with a bristle the same length.

IND. OR. : Assam ; Silhet, de Silva, *Wallich* 8669 (Type of *Arundinella wallichii* Nees ex Steud.) ; Khasia, Nunklow 11 Jul. 1850, *Hook. f. et T. Thoms.* ; Myrung, 17 Oct. 1850, *Hook. f. et T. Thoms.* ; Theria 450 m., 19 Oct. 1871, *C. B. Clarke* 15506 ; Khasia, Shillong, 1950 m., 19 Oct. 1872, *C. B. Clarke* 18656 ; Mao-lingkaden, 1200 m., 2 Sept. 1886, *C. B. Clarke* 44803 ; N. Cachar Hills, Haflong, 750 m., 5 Aug. 1905, *W. G. Craib* 167 ; Lohit Valley, 1350 m., 3 Aug. 1950, *Kingdon-Ward* 20100.

Bengal, Sikkim ; *Wallich* 6789, 8700 ; Sikkim Terai *J. D. Hooker* ; Runjeet, 330 m., 22 Aug. 1875, *C. B. Clarke* 27128 ; Bamunpakri, 300 m., Nov. 1879, *J. S. Gamble* 7404 ; *ibidem*, Aug. 1880, *J. S. Gamble* 8326 ; *ibidem*, Aug. 1881, *J. S. Gamble* 9730 ; Calcutta, 31 Aug. 1884, *C. B. Clarke* 35801A ; West Duars, Jalpaiguri, Aug. 1895, *H. H. Haines* 543 ; Purnea, July 1932, *Wenger* 14.

N.W. India ; Dehra Dun, Jul. 1832, *J. F. Duthie* 2456 ; Kumaun, Ranikhet, 1500 m., 18 Sept. 1886, *J. F. Duthie* 6134 ; Kangra, between Dadh and Palampur, 1200 m., 23 Sept. 1896, *G. A. Gamble* 18696 ; Dehra Dun, 660 m., Aug. 1898, *J. S. Gamble* 27144.

Bihar ; Summit of Parasnath, 900 m., 1 Oct. 1873, *C. B. Clarke* 20768.

Burma ; Shan Hills, Koni, 1320 m., Aug. 1888, *H. Collett* ; Maymyo Plateau, 1050 m., 29 Aug. 1908, *J. H. Lace* 4242 ; Hmawbisakhan, 3 Jul. 1947, *U Thein Lwin*—Burmese name—Padat-myet.

This is one of the commonest species in the plains and low hills of north and north-east India, and shows the same wide variation in indumentum, size of the vegetative parts and panicle as in most species of *Arundinella*. The spikelets are usually unawned, but some spikelets in each panicle often display a rather weak awn, which can be divided into a very short column which twists, and an even shorter bristle. The lower sheaths of some specimens are covered with a shaggy pubescence, while others are quite glabrous. The habit of the plant, however, is very regular, and the dense panicle with its ascending short branches covered with secund spikelets hardly allows for a misidentification.

12. ***Arundinella thwaitesii*** *Hook. f.*, *Flor. Brit. Ind.* **7**, 77 (1896).

An annual grass. *Culms* erect, up to 90 cm. tall, simple, slender, terete, smooth and glabrous, or hairy at the nodes. *Leaf-blades* linear-acuminate, up to 20 cm. long and 6 mm. wide, rather stiff, apparently smooth and glabrous on both surfaces apart from a sparse covering of hairs on the upper surface at the base, rounded to the sheath and often decorated on the margins by spaced tubercle-based hairs, finally rolled or plicate ; *sheaths* overlapping, tight, clasping, smooth and glabrous, finally slipping from the culms, striate ; *ligule* a narrow membrane.

Inflorescence an erect ellipsoidal panicle up to 18 cm. long by 5 cm. wide, consisting of a smooth sulcate angled rhachis on which the alternate branches carry long pedicelled spikelets ; branches often rebranching, usually naked at the base, glabrous and smooth. *Spikelets* 3.25–3.5 mm. long, very turgid. *Lower glume* 2 mm. long, almost orbicular in shape when flattened, 3-nerved, the space between the lateral and median nerve wide, smooth and glabrous on the dorsal surface, slightly scabrid on the nerves, suffused with purple ; *upper glume* 3 mm. long, very broadly

elliptic- or orbicular-acute, 5-nerved, smooth and glabrous except for the minutely scaberulous nerves, suffused with purple. *Lower floret* ♂; *lemma* 3 mm. long, broadly ovate-acute, 3-nerved, smooth and glabrous; *palea* oblong-elliptic-obtuse, 2-keeled with narrowly inturned flaps, hyaline. *Upper floret* ♀; *lemma* with a glabrous callus, 2.25 mm. long, smooth and glabrous, milky in colour, elliptic-oblong-obtuse; *palea* of the same texture, 2-keeled, glabrous on the adaxial surface; *styles* 2; *stigmas* plumose; *stamens* 3; anthers 2.25 mm. long; *awn* absent.

IND. OR.: Ceylon, Ambayanava Dist., *Thwaites* C.P. 3782 (Typus in Herb. Kew.); *Thwaites* C.P. 4019.

The only species with which *A. thwaitesii* is likely to be confused is the awnless form of *A. laxiflora*. They can, however, be easily distinguished as follows. *A. thwaitesii* has a lower glume which is almost orbicular in shape when flattened as against an elliptic-acute lower glume in the other. The anthers of the upper floret are also larger, being 2.25 mm. long as against 1.5 mm. long.

13. ***Arundinella pumila*** (Hochst.) Steud., Syn. Pl. Glum. 114 (1854).

*Acratherum pumilum* Hochst. in A. Rich., Tent. Fl. Abyss. 2, 414 (1851).

*Arundinella tenella* Nees and Wight ex Steud. Nom. Bot. ed. 2, 1, 143 (1840), nom. nud.: Steud., Syn. Pl. Glum. 115 (1854).

An annual grass. *Culms* from a few centimetres up to 60 cm. tall, very weak and decumbent, or robust and erect, terete, smooth and glabrous but hairy at the nodes with a shiny white pubescence. *Leaf-blades* broadly linear-elliptic-acute or -acuminate, varying in length from 3 cm. to 25 cm. long and from 5 mm. to 25 mm. broad, rather thin and flaccid or somewhat firm, smooth and glabrous or covered with hairs from tubercle-bases, usually scabrid on the nerves and the margins towards the tip; *sheaths* almost always overlapping and concealing the hairy nodes, tight and clasping or slipping from the culm below, striate, smooth and glabrous or quite shaggy from numerous hairs arising from tubercles placed between the nerves, densely ciliate along one margin; *ligule* a very narrow membrane.

Inflorescence a delicate, very effuse panicle, 4–30 cm. long, of very numerous branches and minute spikelets; branches and branchlets ascending but spreading widely at maturity, not whorled, alternate; axis of the panicle erect, angled, usually with a few tubercle-based hairs towards the base, glabrous upwards, angled, smooth or scaberulous below, definitely scabrid towards the tip; branchlets capillary, scaberulous; pedicels longer than the spikelets. *Spikelets* 2 mm. long, usually gaping. *Lower glume* 1.25 mm. long, 0.8 mm. wide when flattened, elliptic-acute, apiculate, 3-nerved, glabrous or with a few bulbous-based bristles on the nerves; *upper glume* 1.75 mm. long, 1 mm. wide, elliptic-acuminate in shape when flattened, 3-nerved, rather pale and translucent, smooth and glabrous or with a few bulbous-based hairs from the nerves. *Lower floret* neuter or ♂; *lemma* 1.25 mm. long, broadly elliptic-acute when flattened, 3-nerved or often with an additional faint nerve outside the lateral nerves, smooth and glabrous; *palea* a 2-nerved hyaline scale; *stamens* if present 3; *anthers* 0.2–0.3 mm. long. *Upper floret* ♀; *callus* shortly pilose at the base; *lemma* 0.6–0.9 mm. long, elliptic-obtuse, chartaceous, rather

coarsely scabrid on the dorsal surface towards the tip, entire or minutely 2-lobed at the tip, awned ; *palea* oblong-elliptic in shape, 2-keeled, as long as the lemma ; *awn* 3–3.5 mm. long ; column 1–1.5 mm. long, chestnut-brown, twisted ; *stamens* 3 ; *anthers* extremely minute, 0.1–0.3 mm. long.

IND. OR. : Assam ; Khasi Hills, Umswai, 23 Oct. 1871, 1050 m., *C. B. Clarke* 16584E.

Bihar ; Hazaribagh, 600 m., 10 Oct. 1878, *C. B. Clarke* 21202 ; Ranchi, 600 m., 16 Oct. 1873, *C. B. Clarke* 21229B & C ; Parasnath, 1260 m., 6 Oct. 1883, *C. B. Clarke* 33670 & 33676.

Madhya Pradesh ; Mt. Abu, 1200 m., Nov. 1888, *J. S. Gamble* ; By the Prehita, 16 Jan. 1890, *J. F. Duthie* 9914 ; Pachmarhi, Oct. 1911, *H. H. Haines* 200P ; Mt. Abu, 27 Apr. 1917, *Blatter*.

W. Himalaya ; N.W. India, *Royle* ; Dehra Dun, Rajpur, 17 Sept. 1888, *J. F. Duthie* 7693 ; Dehra Dun, 600 m., Oct. 1892, *J. F. Duthie* 23965 ; Rajpur, 900 m., Sept. 1898, *J. S. Gamble* 27236 ; Dehra, Nakund, Sept. 1899, *J. F. Duthie* 23046 ; Mussorie Road, 1350 m., 10 Sept. 1930, *R. R. Stewart* 11470.

Bombay, Khandala, 6–700 m., 19 Oct. 1893, *V. Schiffner* 1579 ; Bombay, *W. A. Talbot* ; Satara, Mwar, Oct. 1909, *W. A. Talbot* ; Igatpuri, Oct. 1917, *McCann* ; Mahableshwar, Oct. 1923, dry hill slope, with forest, under trees, *McCann*.

Madras ; Herb. Wight. (type of *A. tenella* Nees) ; Nilgiris, Naduvatam, 1500 m., Oct. 1886, *J. S. Gamble* 18304 ; Pykara waterfalls, Sept. 1898, *Bourne* ; Kodaikanal Ghat, 7 Dec. 1898, *Bourne* ; Malabar, Tellicherry, 3 Nov. 1900, *K. Rungachari* ; Kulhutti Babab, 1200–1500 m., Oct. 1908, *Meebold* 10452 ; Ghat Road, Coorg to Malabar, Oct. 1911, *C. A. Barber* 8718 ;

Ceylon ; Bibita Dist., Oct. 1925, *J. M. Silva* Madugoda, 18 Apr. 1932, *N. D. Simpson* 9464—rocks near stream ;

Burma ; Pegu Yoma, 24–26 Feb. 1871, *S. Kurz* 2798.

This extremely handsome species is easily recognised by its effuse, often very large, panicle, of very minute spikelets, and the thin papery leaves. It has a very side distribution.

#### 14. *Arundinella laxiflora* Hook. f., Flor. Brit. Ind. 7, 75 (1896).

*A. nervosa* Thw., Enum. Pl. Ceyl. 362 (1864) non Nees.

An annual or subperennial grass. *Culms* many from the base, often coalescing into a hard rootstock, up to 70 cm. tall, smooth, glabrous, terete, simple, very slender, glabrous at the nodes. *Leaf-blades* linear-acuminate in shape, abruptly contracted or rounded to the sheath, flat, folded or rolled, glabrous and smooth on both surfaces, or sparsely covered on both surfaces with tubercle-based hairs, but scabrid on the margins and scaberulous at the filiform tip, up to 15 cm. long by 7 mm. broad ; *sheaths* usually tight and clasping, striate, absolutely glabrous or with a sparse covering of tubercle-based hairs ; *ligule* membranous, narrow, densely ciliate on the upper irregular margin and finally disintegrating into a row of hairs.

Inflorescence a panicle up to 6 cm. long, seated on a long-exserted glabrous and shining peduncle ; axis glabrous, angled and sulcate ; branches arising alternately with often one or two long-pedicelled spikelets at the same point of origin, glabrous, smooth, branching and re-branching, carrying long-pedicelled spikelets ; pedicels 4–5 times or more longer than the spikelets, smooth or slightly scaberulous, dilated at the apices. *Spikelets* 4.5 mm. long, gaping. *Lower glume* 3 mm. long, ovate-elliptic-acute, compressed at the tip, 3-nerved, membranous, glabrous

but scaberulous on the nerves; *upper glume* 4.25 mm. long, broadly ovate-elliptic with the upper quarter forming a short beak, 5-nerved, scaberulous on the nerves, otherwise smooth and glabrous. *Lower floret* ♂ or neuter; *lemma* 3 mm. long, lanceolate-acute, rounded on the back, compressed at the apex, smooth and glabrous, 3-nerved; *palea* a little shorter, 2-nerved, 2-keeled, hyaline; stamens 3; *anthers* 1.25 mm. long. *Upper floret* ♀; *lemma* 2 mm. long, elliptic-oblong-obtuse in shape, hyaline, becoming chartaceous, with a short bearded callus, glabrous but very minutely scaberulous on the back, notched at the apex and awned; *palea* 2-nerved, oblong-elliptic, rather coarsely scabrid on the adaxial surface; *awn* perfect or rarely absent, 4 mm. long; *column* chestnut-brown 1 mm. long; *stamens* 3; *anthers* 1.5 mm. long; *styles* 2; *stigmas* plumose.

IND. OR.: Ceylon; Central Province 900–1500 m., *Thwaites* C.P. 919 (Typus in Herb. Kew.); *Thwaites* C.P. 3782; 1847, *Gardner* 1007.

This species should present no difficulty for the “look” of it is quite different from all others. One disturbing fact about it is that one of the specimens is awnless and was collected at the same time as an identical awned specimen—so much for the constancy of the character of the awn. It could not, however, be confused with any of the species which are characteristically without an awn.

15. ***Arundinella nepalensis* Trin.**, Gram. Panic. 62 (1826).

*Acratherum miliaceum* Link, Hort. Berol. 1, 230 (1827).

*Arundinella glabra* Nees ex Hook. et Arn., Bot. Beechey Voy. 237 (1836).

*A. acratherum* Nees ex Steud., Nom. Bot. ed. 2, 1, 143 (1840) nomen.

*A. miliacea* (Link) Nees in Hook., Journ. Bot. 2, 102 (1850).

*A. ritchei* Munro ex Lisboa in Journ. Bomb. Nat. Hist. Soc. 5, 343 (1890).

*A. virgata* Janowsky in Fedde, Rep. Sp. Nov. 17, 84 (1921).

A stout perennial with a woody, widely spreading rootstock or rhizome. *Culms* almost woody, up to 3 m. tall, in unfavourable habitats very much shorter, erect from the base, rarely somewhat decumbent, simple or in certain circumstances intricately branched, terete, striate, smooth and glabrous save at the nodes which are usually strongly bearded with appressed, rarely spreading, silky pubescence. *Leaf-blades* in robust specimens up to 1 m. long, 1.5–2 cm. broad, linear, rounded at the base to the sheath, long-attenuate to a filiform scabrid tip, very variable in the amount of indumentum present, often glabrous on the surfaces save from a sparse covering of hairs at the base on the upper surface to extremely densely hirsute with short hairs from tubercle-bases either on the upper surface alone or on both surfaces, often glaucous on the lower or on both surfaces; *sheaths* tight, clasping, smooth and glabrous, striate, or sparsely to densely covered with tubercle-based hairs, the older becoming coriaceous almost crustaceous; *ligule* a membrane less than 1 mm. wide.

Inflorescence usually a gigantic panicle 30–45 cm. long but which, in unfavourable habitats, shrinks to a few centimetres long, erect at first then usually drooping, consisting of a central axis which is usually terete below, becoming sulcate and angled and more and more scabrid towards the tip, carrying branches which are alternate or pseudo-whorled or

fascicled ; branches up to 15 cm. long, angled, scabrid, usually simple, carrying pedicelled spikelets often arranged in pairs, one short- the other long-pedicelled ; pedicels slender, slightly dilated at the apex, never setose at the tips ; *spikelets* usually purplish, sometimes green, 3.5–4.5 mm. long, gaping at anthesis. *Lower glume* 2.5–3 mm. long, elliptic-lanceolate-acuminate, almost aristate, 3-nerved, scabrid on the nerves and keels, otherwise smooth and glabrous ; *upper glume* set 0.5 mm. above the lower glume, 3–4 mm. long, 5-nerved, elliptic-acuminate, rounded on the dorsal surface, strongly compressed in the upper half or third, scabrid on the nerves and keel, otherwise smooth and glabrous. *Lower floret* ♂ or neuter ; *lemma* chartaceous, 2.5–3 mm. long, boat-shaped, rounded on the dorsal surface, 5-nerved, the outer pairs very close together, smooth and glabrous, oblong-obtuse ; *palea* elliptic-acute, 2-keeled, 2-nerved, hyaline ; *stamens* 3 ; *anthers* 1 mm. long. *Upper floret* ♀ ; *lemma* 2 mm. long, oblong-elliptic, with a short rounded bearded callus, dull white becoming brownish at maturity, scaberulous on the back at the tip ; *palea* oblong-acute, hyaline 2-nerved ; *awn* 6 mm. long, geniculate ; *column* 2 mm. long, chestnut-brown, twisted ; *stamens* 3 ; *anthers* 1.2 mm. long ; *styles* 2 ; *stigmas* plumose.

IND. OR. : Assam ; *Griffith* 1072, 6791, and several other sheets ; Khasi Hills, Nunklow, 14 Jul. 1850, *Hook. f. et T. Thoms.* ; ibidem, towards Mahadeb, 13 Aug. 1850, *Hook. f. et T. Thoms.* ; ibidem, Cherra, 15 Aug. 1850, *Hook. f. et T. Thoms.* and several other sheets ; ibidem, Shillong, 1500 m., 14 Oct. 1867, *C. B. Clarke* 5754 ; ibidem, Sohra, 1200 m., 22 Oct. 1871, *C. B. Clarke* 15653 ; ibidem, Theria, 19 Oct. 1871, 450 m., *C. B. Clarke* 15509 ; Shillong, 1200 m., 23 Oct. 1872, *C. B. Clarke* 17650 and a dozen other sheets by the same collector ; Manipur, Irang 1200–1500 m., Nov. 1907, *Meebold* 5903 ; ibidem, Kowpam, 1500 m., Nov. 1907, *Meebold* 6334 ; ibidem, Palel, 720 m., 6 Oct. 1943, *N. L. Bor* 17735—in wet grassland ; ibidem, Palel, 14 Nov. 1942, *N. L. Bor* 17100 ; Khasi Hills, Peak, 1740 m., 16 Nov. 1943, *N. L. Bor* 18073—in swampy places ; Naga Hills, Losami, 1500 m., 16 Jul. 1942, *N. L. Bor* 16017—a grass 6 ft–7 ft. tall on open burnt hillsides ; ibidem, Thevopesimi, 1500 m., 6 Aug. 1942, *N. L. Bor* 16298, and several more by the same collector in the Naga Hills.

Sikkim ; Lachoong, 2 Oct. 1849, 1800 m., *Hook. f.* ; Chuikoong and Chang-achelling and several other sheets, *Hook. f.* 1849 ; Dumsong, 1890 m., 16 Nov. 1875, *C. B. Clarke* 26382 ; Goke, 750, 2 Oct. 1875, *C. B. Clarke* 24881 ; Gangtok, 1800 m., 22 Sept. 1945, Dr. Bor's collector.

Bengal Terai ; Jalpaiguri, Dec. 1893, *H. H. Haines* 419 ; ibidem, 90 m., 1898, *Dr. Hedley Wood* 173.

N.W. India ; 1848 *Wallich* 6666A. (probably the type number of *A. nepalensis* Trin.) ; Pir Pinjal and Peshawar, *Jacquemont* 1230 ; Radjaori, *Jacquemont* 1340 ; Herb. *Royle*, several sheets ; Paoree, Jun. 1845 *T. Thoms.* ; Sutlej Valley near Rampore, Aug. 1847, *T. Thoms.* ; Simla, *Madden* ; Pathankote, 450 m., 9 Sept. 1874, *C. B. Clarke* 21994 ; Dalhousie, 1800 m., 22 Sept. 1874, *C. B. Clarke* 22976 ; Chumba, 1200 m., 2 Oct. 1874, *C. B. Clarke* 24108 ; Jhelum Valley, 600–900 m., Oct. 1875, *C. B. Clarke* 27447 ; Kasumti, Simla, 1950 m., 12 Sept. 1877, *J. S. Gamble* 4948 ; Kumaon, Gori Valley 1200–1500 m., 20 Aug. 1884, *J. F. Duthie* 3566 ; Garhwal, above Lobah, 22 Sept. 1885, *J. F. Duthie* 5040 ; Dehra Dun, Sept. 1887, *J. F. Duthie* 6839 ; Hazara-Kagan, 1350 m., 20 Aug. 1889, *E. W. Trotter* 1209 ; Jaunsar, Koli Bawar, May 1891, *J. S. Gamble* 22751 ; Tehri Garhwal, Sakloa, 2100 m., May 1893, *J. S. Gamble* 24212 ; Mohand Pass, Oct. 1897, *J. F. Duthie* ; Punjab, Sakesar, 24 Aug. 1902, *J. R. Drummond* 14451 ; Uttar Pradesh, Haldwani, 19 Dec. 1911, *R. S. Hole* leg. ; Tehri, Ghunti, 1200 m., 15 Sept. 1948, *W. Koelz* 21795 ; Jammu-Kashmir road, Kao, 1500 m., 28 Aug. 1931, *R. R. Stewart* 12514.

Madras ; Pulneys, Herb. Wight, 3378 ; Deccan, May 1880, G. M. Woodrow—Type of *A. ritchiei* Munro ; Pulneys, Gundar Valley, 10 Jun. 1901, *Bourne* 1448 ; Mysore, Nov. 1908, 1050 m., *Meebold* 10757 ; Travancore Muvathapuzha, Dec. 1933, *Mayuranathan*.

Bombay ; North Canara, Lisboa.

Burma ; Rangoon, 10 Jan. 1850, *Dr. McClelland* ; Maymyo Plateau 1050 m., 9 Oct. 1908, *J. H. Luce* 4290 ; Tongdong, Nov. 1826, *Wallich* 8667.

The variation in size of the vegetative parts exhibited by this species is so fantastic that, were it not for the comparative regularity in the shape and size of the spikelets, one would, in despair, give up hope of dealing with it in a rational manner. One has to accept the fact that the species responds extremely readily to changes in habitat and it is safe to speculate that in this species, *sensu lato*, we have possibly a polyploid series corresponding to the state of affairs in *Poa pratensis* Linn. The height of the plants varies from a few centimetres to several metres, the thickness of the culms from several millimetres to one centimetre, the panicle varies in length from a few centimetres to half a metre, the spikelets are green, brown or purple, dense or sparse on the branches, and let it be remembered that all combinations of these and intermediates between them occur.

The species reaches its greatest luxuriance in the eastern Himalayas and the mountains between Assam and Burma. These are areas of high rainfall and high humidity. In the western Himalayas where the rainfall is not so generous, it is rare to find the species growing luxuriantly. A specimen in the Herbarium at Kew, from Haldwani, U.P., has, however, a panicle about 40 cm. long.

Were it not for the well developed awn of the Assam species, they could easily be confused with *A. decempedalis* of the plains of Assam and Goalpara.

This species is not common in Bombay and in the drier parts of India.

16. **Arundinella purpurea** *Hochst. ex Steud.*, Syn. Pl. Glum. 115 (1854).

*A. fuscata* Hook. f., Flor. Brit. Ind. 7, 74 (1896) non Nees ex Buese.

A perennial grass. *Culms* up to 85 cm. tall, terete, striate, scabrid and pilose below the panicle and nodes with hairs from tubercle-bases, or rarely glabrescent and smooth, simple, hairy at the nodes. *Leaf-blades* drying a yellowish-green, rounded at the base or suddenly contracted to the sheath, lanceolate, oblong or linear, eventually tapering to a stoutish tip or gradually contracting from base to tip, which is usually scabrid, densely covered on the upper surface with a thick coat of tubercle-based hairs, less hairy on the lower surface to almost glabrous, glabrescent with age, up to 20 cm. long by 1 cm. wide, scabrid and often ciliate on the margins, in low specimens crowded at the base ; *sheaths* tight, clasping, striate, pilose to densely hirsute with tubercle-based hairs ; *ligule* obscure, at most a very narrow membrane.

Inflorescence a very dense, rarely a lax panicle consisting of an erect sulcate angled densely hispid axis with the hispid scabrid spikelet-bearing branches arranged alternately upon it ; branches ascending, straight, parallel, carrying crowded spikelets. *Spikelets* 3.5–4.5 (5.5) mm. long, usually longer than their pedicels. *Lower glume* 2.5–3 mm. long, almost orbicular-acute, 3-nerved compressed at the apex, scabrid on the nerves, otherwise smooth and glabrous ; *upper glume* 3.5–4 mm. long, broadly elliptic-acuminate, 5-nerved, compressed and keeled in the upper third, scabrid on the nerves, otherwise smooth and glabrous. *Lower floret* ♂ or

neuter ; *lemma* 3-3.5 mm. long, rounded on the back, membranous, smooth and glabrous, 3-nerved, somewhat compressed at the tip ; *palea* elliptic-acute, rather shorter than the lemma, 2-keeled, smooth on the keels, hyaline, elliptic-acute in shape ; *stamens* 3 ; *anthers* 0.75 mm. long. *Upper floret* ♀ ; *lemma* 1.5 mm. long, milky-white, rather chartaceous, papillose-scabrid at the tip, awned in a notch, naked on the rounded *callus* ; *palea* oblong obtuse, 2-keeled, of same texture as the lemma, papillose hairy in the upper half ; *styles* 2 ; *stigmas* plumose ; *stamens* 3 ; *anthers* 1.25 mm. long ; *awn* geniculate, 3 mm. long ; *column* chestnut-brown, twisted, 1 mm. long.

var. **purpurea**.

IND. OR. : Madras ; Nilagiri 1818-1835, *B. Schmid* ; Herb. Wight. ; Nilagiri, 1851, *Hohenacker* 928 (Type of *A. purpurea* Hochst. in Herb. Kew.) ; Nilgiri Hills, Ochterloney Valley, 18 Aug. 1878, *G. King* ; Nilgiris, Conoor Peak, Aug. 1883, 1040 m., *J. S. Gamble* 12287 ; ibidem, Oct. 1884, 1950 m., *J. S. Gamble* 15401 ; ibidem, Naduvatam, 1500 m., Oct. 1886, *J. S. Gamble* 18299 ; Nylgherries, *Sir G. Adam* ; Naduvatam, 1800 m., 1888, *M. A. Lawson*—open pastures ; very common on the western side of the Nilgiris ; Mysore, Bababudan Hills, 20 Oct. 1890 ; Pulneys, river bed, Silver Cascade, 26 May, 1898, *A. G. Bourne* ; Kodaikanal Falls, 5 Jul. 1898, *Bourne* ; Pykara, June 1900, *Bourne* ; Pulneys, 1901, *Bourne* ; Downs, Ootacamund, 25 Sept. 1908, *Bourne* 5241 ; Gersoppa Falls, 600 m., Oct. 1908, *Meebold* 10461 ; Mysore, Kumsi, Oct. 1908, 6-900 m., *Meebold* 10762 ; Downs, Ooty, 30 Aug. 1900, Bourne 5349 ; near Naduvattam, Sept. 1934 *Barnes* 875 ; Herb. Wight 1667 (Type of *A. fuscata* Nees in Herb. Kew.).

var. **laxa** *Bor*, var. nov. a typo panicula laxa, spiculis longi-pedicellatis differt.

Madras ; Sispara, 2100 m., Nov. 1883, *J. S. Gamble* 13365 ; ibidem 2100 m. May 1889, *J. S. Gamble* 20617.

In the Flora of British India this species appears under the name of *A. fuscata* Nees ex Buese. The leaves of this species dry a greenish-yellow, which is quite different from the colour of dry leaves of any of the other species in the area under consideration. Moreover, they and the sheaths are thickly covered with tubercle-based hairs. The panicle is usually dense and the spikelets purplish, but a well-marked variety with a lax panicle is found at Sispara in the Nilgiris. Apparently this is a good variety for Gamble collected it at Sispara on two occasions separated by an interval of six years. One of the latter specimens exhibits proliferation of the spikelets, the only instance in the genus known to the writer.

When, through the courtesy of Prof. H. J. Lam, the type of *A. fuscata* Nees ex Buese was obtained from Leiden, it was discovered that the Indian species could not be referred to *A. fuscata* Nees. *A. fuscata* Nees is an annual, the leaves do not dry the peculiar greenish-yellow colour of the Indian specimens and the spikelets are very pale. The hispid angled rhachis of the Indian plant is a complete contrast to the smooth and glabrous rhachis of the Javanese *A. fuscata*. Fortunately there is no need for a new name since the type of the Indian plant is Hohenacher's no. 928 from the Nilgiris which was called *Arundinella purpurea* by Hochstetter and the description was published by Steudel. See page 414.

17. **Arundinella intricata** *Hughes* in Kew Bull. 1920, 112 (1920).

A perennial grass with many tough rhizomes. *Culms* densely caespitose, erect or somewhat geniculate, very tough, branching, smooth and



glabrous, even at the nodes. *Leaf-blades* linear-acuminate, up to 20 cm. long, 5 mm. wide, very firm, flat eventually involute, furrowed on the upper surface with a thick midrib ending in a very stout scabrid tip, often densely ciliate on the margins with short hairs on the upper surface just above the ligule, smooth and somewhat scabrid below; *sheaths* firm, tough, smooth and glabrous, except one margin which is densely ciliate; *ligule* a narrow membrane which is long and densely ciliate.

Inflorescence a panicle up to 13 cm. long, 1.5–2 cm. wide, consisting of a straight or flexuous axis irregularly branched or the branches sub-whorled; axis angled, sulcate, densely and finely ciliate along the angles. *Spikelets* pedicelled, gaping 4–4.5 mm. long; pedicels shorter than the spikelets, hairy, slightly expanded at the tips. *Lower glume* elliptic-acute, compressed at the tip, 3 mm. long, 3–5-nerved, glabrous, purplish, smooth on the nerves; *upper glume* broadly elliptic-acuminate, as long as the spikelet, 5-nerved, scabrid on the nerves, otherwise smooth and glabrous. *Lower floret* ♂; *lemma* rather thinner than the upper glume, suffused with purple, elliptic-acute, 5-nerved, the outer two being close together, slightly keeled towards the tip; *palea* smaller, lanceolate-acute, 2-keeled, ciliate on the flaps above and toothed below; *stamens* 3; *anthers* 1 mm. long. *Upper floret* ♀; *lemma* 2–3 mm. long, with an obtuse hairy callus, elliptic in shape, milky, minutely scabrid, 3-nerved, very minutely lobed at the apex; *palea* of same texture, 2-nerved, shorter and narrower; *awn* 5–6 mm. long; *column* chestnut, twisted; *styles* 2; *stigmas* plumose; *stamens* 3; *anthers* 1 mm. long.

IND. OR. : Khasi Hills, Mawflong wood, 1200–1800 m., 26 Oct. 1850. *Hook. f. et T. Thoms.*; Amwee, 1200–1500 m., 1850, *Hook. f. et T. Thoms.*; Mausmai, 1200 m., 23 Oct. 1871, *C. B. Clarke* 16588; Mahadeo, 900 m., 22 Oct. 1871, *C. B. Clarke* 15622; Pangtum Forest, Dawki Road, 28 Aug. 1935, *Shri Ram Sarma* 12327 (sheet in Dehra Dun Herb.).

Hughes also quotes a sheet (in Herb. Cal.) collected by Burkill on the banks of the Dihang river in northeast Assam, near Ritung (Burkill 373), on which the collector made the following remarks. "A grass which makes tussocks and in places quite clothes the bank above the river. It mats its tussocks together with its roots which come out of the top of the soil as well as run all through it." The species is obviously of supreme value as a soil binder.

18. ***Arundinella metzii*** *Hochst. ex Miq.* in Verhand. Nederl. Inst. **3**, pt. 4, 31 (1851).

*A. lawii* Hook. f. in Trim., Handb. Flor. Ceyl. **5**, 180 (1900).

*A. decomposita* Janowsky in Fedde, Rep. Sp. Nov. **17**, 84 (1921).

*A. pygmaea* Hook. f., Flor. Brit. Ind. **7**, 72 (1896).

An annual grass. *Culms* slender, terete, striate, very minutely scabrid or smooth, glabrous or sparsely hairy below the panicle with soft white hairs from tubercle-bases, glabrous at the nodes or with an appressed silky pubescence, simple, erect or somewhat geniculate below. *Leaf-blades* linear from a somewhat rounded base, tapering to an acuminate scabrid tip, up to 40 cm. long, 9 mm. wide, but usually much shorter and narrower, in depauperate specimens a few centimetres long and millimetres broad, pilose on both surfaces with a very variable amount of indumentum consisting of tubercle-based hairs, slightly scabrid on the

margins ; *sheaths* tightly clasping, very striate, usually hispid with spreading tubercle-based hairs, densely ciliate on one margin ; *ligule* a narrow membrane, 0.5–1 mm. broad, uneven or lacerate on the upper edge.

Inflorescence an erect panicle up to 50 cm. long, 25 cm. wide, usually much shorter and narrower, consisting of a straight erect central axis, angled and sulcate, scabrid on the angles, bearing ascending slender branches up to 15 cm. long ; branches simple, slender, carrying the spikelets in pairs, one short- one long-pedicelled. *Spikelets* 3–4.5 mm. long, gaping, pale or suffused with purple, quite glabrous or slightly to very bristly with tubercle-based hairs. *Lower glume* 2–2.5 mm. long, lanceolate or elliptic-acute when flattened, 3-nerved, scabrid on the nerves which are strongly marked, otherwise smooth and glabrous, or covered with a variable amount of tubercle-based hairs between the nerves and on the margins ; *upper glume* 2.75–4.25 mm. long, elliptic-acuminate when flattened, upper quarter very narrow and folded to take the awn of the upper lemma, smooth and glabrous or hairy like the lower glume. *Lower floret* ♂ ; *lemma* 1.75–2.5 mm. long, oblong-acute, hyaline, 3-nerved ; *palea* smaller, hyaline 2-nerved ; *stamens* 3 ; *anthers* 0.6–1 mm. *Upper floret* ♀ ; *lemma* 1 mm. long, elliptic-oblong in shape, notched at the apex, flat on the dorsal surface, smooth and glabrous except somewhat scabrid towards the tip, awned, bearded on the callus ; *palea* same texture, 2-keeled ; *styles* 2 ; *stigmas* plumose ; *stamens* 3 ; *anthers* 0.9–1 mm. long, *awn* 3 mm. long ; *column* chestnut-brown 1–3 mm. long.

IND. OR. : Madras ; Canara, near Mangalore, *Hohenacker* 297 (Typus in Herb. Kew. ) ; Wynaad, Dec. 1876 *Rottler* ; Canara, Dec. 1871, *Thomson*, Eclipse Expedition ; Malabar, Taliparamba, March 1907, *Bourne* ? ; Herb. Heyne, *Wall.* 8668 ; Talgappa, Mysore, 600 m., Oct. 1908, *Meebold* 10596 ; Upin Ongadi, Nov. 1908, *Meebold* 10497A ; Mangalore, Nov. 1908, *Meebold* 10760 ; Saga, Mysore, 600–900 m., Oct. 1908, *Meebold* 10759 ; Suadi, S. Kanara, Nov. 1908, *Meebold* 10761 ; Coimbatore, 3 May 1940, I.F.C. student ; Telli-cherry, in Urti evergreen forests, 3 May 1940, I.F.C. student ; Deccan, *Woodrow* (considered by Hook. f. to be identical with type of *A. lawii*).

Bombay ; N. Kanara 540 m., 15 Jan. 1890, W. A. Talbot 2249 ; Poona Dist., 15 Dec. 1906, W. A. Talbot 5047 ; Mungod Range, 3.5.1940, I. F. *College Student* ; North and South Concan, *Law* ; Purandhar, 1911, *Blatter* ; Belgaum, 15 Jan. 1915, R. S. *Hole* 9 ; Sion, Bombay Isl., Nov. 1916, *Blatter*, 5232 ; Campuli, foot of Ghats, March 1917, *Blatter* 5343 ; Igatpuri, Oct. 1917, *Blatter* 4329, 4332 ; Khandala, *Blatter* ; Purhandhar, 1200 m., Dec. 1917, *Blatter* ; Igatpuri, 600 m., Feb. 1918, *Sedgwick* 3542 ; Khandala, Tata's Lake, Oct. 1918, *Blatter* ; Yellapur, in teak, 3 May, 1940 I.F.C. *Student* ; North Canara, *Lisboa* (type of *A. pygmaea*).

As with most species of *Arundinella* the search for stable characters within this species, whereby some of the forms could be separated as good varieties, has been in vain. At one time the hairy nodes and spikelets of *A. lawii* offered some hope of valid grounds for preserving Hooker's specific epithet as a varietal name. This has proved to be impossible, as intermediates and specimens with hairy spikelets and glabrous nodes or glabrous spikelets and hairy nodes, as well as every possible degree of hairiness are to be found.

19. ***Arundinella vaginata*** Bor in Journ. Ind. Bot. Soc. **27**, 66 (1948).

*A. villosa* Arn. ex Steud. var. *Heynei* Hook. f., Flor. Brit. Ind. **7**, 73 (1896).

A perennial grass with a very stout woody rootstock, covered at the base with numerous leaf-sheaths. *Culms* erect, up to 70 cm. tall, densely villous below the panicle, villous on the upper parts of the internodes and glabrescent towards their base, villous on the nodes, terete, with extremely short internodes at the base. *Leaf-blades* up to 40 cm. long, 7 mm. wide, linear, long-attenuate, involute or rolled, very villous on the lower surface with tubercle-based hairs, less so on the upper surface or glabrescent, scaberulous on both surfaces, ending in a blunt scaberulous tip; *sheaths* very much longer than the internodes, especially the lower ones, very loose and slipping from the culms, usually very villous from tubercle-based hairs, but the older sheaths glabrescent, striate, smooth; *ligule* a very narrow membranous ring.

Inflorescence a narrow erect interrupted panicle consisting of a central axis upon which are arranged ascending racemes of congested spikelets; axis about 15 cm. long, angled, very villous with usually the lowest raceme much separated from the others; racemes about 3 cm. long with spikelets seated in pairs on a very villous rhachis. *Spikelets* mostly in pairs, one short-pedicelled, one longer-pedicelled, 6.5–7 mm. long. *Lower glumes* 6–6.5 mm. long, elliptic in shape, aristulate, 5–3-nerved, the lateral close, bristly with tubercle-based hairs on all five nerves; *upper glume* 6.5–7 mm. long, elliptic-acute with tip compressed into a beak 2 mm. long, 5-nerved with occasionally an extra faint nerve outside the others, bristly on the dorsal nerves as in the lower glume. *Lower floret* ♂; *lemma* 6 mm. long, elliptic-acute when flattened, compressed at the apex, 5-nerved with the two lateral close together, smooth and glabrous, scabrid on the keel and at the apex; *palea* lanceolate-acute, 2-keeled, 4.5 mm. long; *stamens* 3; *anthers* 1.75 mm. long. *Upper floret* ♀; *lemma* bearded on the callus, 3.5 mm. long, elliptic-oblong-acute, 2-lobed and awned at the apex, faintly 5-nerved, scaberulous on the dorsal surface; *palea* as long, 2-keeled; *stamens* 3; *anthers* 1.5–2.25 mm. long; *awn* 5.5 mm. long; *column* twisted, 3 mm. long.

IND. OR.: Madras; Herb. Heyne. *Wall* 8663A (type of *A. villosa* Arn. ex Steud. var. *Heynei* Hook. f.); Pulney Hills, 1914, Rev. Saulière 817; Kodaikanal Pulney Hills, 2100 m., Feb. 1922, *L. Anglade* 2202; Kodaikanal Ghat, 18 May 1898, *Bourne*; Attapadi Hills, south Malabar, 14 Oct. 1910, *Fischer* 2290; Kulhutti Babab, 1800 m., Oct. 1908, *Meebold* 10455.

The numerous basal long villous sheaths, villous spikelets and very villous peduncle distinguish the species. It was erroneously stated in the article in the Journ. Ind. Bot. Soc. that the type was Saulière's no. 817. This is not so, for Hooker based this variety on Wallich's 8663A.

20. ***Arundinella hookeri*** *Munro ex Keng* in Rep. Nat. Centr. Univ. Sci. sér. B. Biol. **2**, no. 3, 50 (1936).

*A. villosa* Arn. ex Steud. var. *himalaica* Hook. f., Flor. Brit. Ind. **7**, 73 (1896).

A perennial grass, completely bare at the base or with a few white hairs in the grooves of the basal sheaths. *Culms* up to 45 cm. tall, erect or only slightly decumbent at the base, terete, smooth and glabrous, usually long-exserted from the topmost leaf-sheath, glabrous on the nodes. *Leaf-blades* up to 12 cm. long, usually much less, 6 mm. wide, usually flat, lanceolate-attenuate in shape from a slightly rounded base, many-nerved

covered on both surfaces with soft white hairs from tubercle-bases, very minutely scabrid on both surfaces and on the margins ; *leaf-sheaths* slipping from the culms, markedly striate, villous with soft white hairs from tubercle-bases situated in the grooves, glabrescent in the lower half or even quite glabrous ; *ligule* a very narrow membranous ring.

Inflorescence an interrupted panicle of short racemes up to 15 cm. long ; axis terete below, angled above, glabrous, becoming more and more villous towards the tip ; racemes alternate on the axis, 1.5–2 cm. long consisting of an angled scabrid rhachis, spiculate to the base and covered with long soft colourless bristles. *Spikelets* 5–6 mm. long, usually paired on short and long pedicels. *Lower glume* 4–4.5 mm. long, elliptic-acuminate when flattened, 3–5-nerved, bristly on the nerves on the dorsal surface with tubercle-based hairs, otherwise smooth and glabrous ; *upper glume* 5–6 mm. long, elliptic-acuminate in shape when flattened, 5-nerved, the two lateral, but not the median nerves, with tubercle-based bristles. *Lower floret* ♂ ; *lemma* 4 mm. long, 5-nerved, the two lateral close together, oblong-acute in shape, compressed at the apex, rounded on the back, smooth and glabrous, scabrid on the keel above ; *palea* 3.5 mm. long, 2-keeled ; *stamens* 3 ; *anthers* 1.25 mm. long. *Upper floret* ♀ ; *lemma* long-bearded on each side of the callus, 2.25–2.5 mm. long, membranous, oblong, rounded and slightly 2-lobed at the apex, faintly 5-nerved, awned, minutely scaberulous in the upper half ; *palea* oblong-acute, slightly longer than the lemma, 2-keeled ; *awn* 3–4 mm. long ; *column* twisted, chestnut, 1.5 mm. long ; *stamens* 3 ; *anthers* 1.5 mm. long ; *styles* 2 ; *stigmas* plumose.

IND. OR. : Bhutan, *Griffith* 6788 (type of *A. villosa* var. *himalaica*) ; Sikkim, Lachung meadows, 3000 m., 31 Jul. 1849 *Hook. f.* ; Mintokong, south-east of Yoksum, June 1888, Dr. King's collector ; Burkeem, 2,250 m., 12 Oct. 1875, *C. B. Clarke*.

Tibet ; Yatung, 1897, *H. E. Hobson*.

This striking species seems to be confined to Sikkim, Bhutan and Tibet, and is only found at high altitudes.

21. ***Arundinella ciliata*** (Roxb.) Nees ex Miq. in Verhand. Nederl. Inst. **3**, pt. 4, 30 (1851).

*Holcus ciliatus* Roxb., Flor. Ind. **1**, 321 (1820).

*Arundinella pilosa* Hochst. ex Miq. in Verh. Nederl. Inst. **3**, pt. 4, 30 (1851).

*A. agrostoides* Hook. f., Flor. Brit. Ind. **7**, 71 (1896) non Trin.

*A. hirsuta* Nees non Hochst. ex Steud., Syn. Pl. Glum. 115 (1854).

An annual grass. *Culms* slender or stout, erect from a narrow or much thickened base, up to 60 cm. tall, often completely covered by the sheaths, erect, simple, very smooth and glabrous or sparsely pilose, particularly below the panicle with spaced hairs from tubercle-bases, pilose at the nodes. *Leaf-blade* rounded, almost cordate at the base, flat, flaccid, covered on both surfaces with a thick covering of tubercle-based hairs, or almost glabrescent below, lanceolate- or oblong-acute, up to 15 cm. long, 14 mm. wide ; *sheaths* often overlapping, tight, clasping, very striate, more or less thickly covered with spreading tubercle-based hairs, densely ciliate on one margin ; *ligule* a narrow membrane 1 mm. broad, lacerate and sometimes ciliate on the upper edge.

Panicle erect, consisting of an angled sulcate axis which is scabrid on the angles and occasionally pilose with tubercle based hairs, upon which are arranged alternately or subwhorled, branches up to 3 (5) cm. long, which may rebranch and carry densely or loosely arranged spikelets seated on pedicels which are usually shorter than the spikelets, the whole forming a very dense or rarely loose cylindrical or narrowly ellipsoidal panicle. *Spikelets* up to 3.5 mm. long, often very bristly, with the lower glume much exceeding the lower lemma in length. *Lower glume* 2.5–3.5 mm. long, elliptic acute with tip produced into a short seta, 3-nerved, the nerves anastomosing at the tip, often covered on the dorsal surface with dense tubercle-based hairs; *upper glume* about as long as the lower glume or 0.5 mm. longer, 5-nerved, elliptic-acuminate, the upper third being very narrow, plicate and holding the awn in the young state, often very bristly on the dorsal surface with tubercle-based hairs. *Lower floret* ♂; *lemma* 1.25–2.5 mm. long, membranous to hyaline, elliptic-oblong-acute, 3-nerved, glabrous and smooth, awned; *palea* elliptic-obtuse, shorter and narrower than the lemma; *stamens* 2 or 3; *anthers* minute, 0.25 mm. long. *Upper floret* ♀; *lemma* 1–1.5 mm. long, whitish smooth below, papillose, scabrid above; *palea* of same texture and colour, elliptic, 2-keeled; *stigmas* plumose; *stamens* 3; *anthers* 0.5 mm. long; *awn* 5–7 mm. long; *column* chestnut-brown 2.5–3 mm. long.

IND. OR. : Madras; Herb. *Wight* 1666 (Type of *A. ciliata* Nees); Herb. *Wallich* 8664 and 8671; Nilgiris, Naduvatam, 1800 m., Oct. 1884, *Gamble* 14886 (type of *A. agrostoides* Hk. f. non Trin. var. *ciliata* Hook. f. in Herb. Kew.); Annamalais, Poonachi, Oct. 1901, *C. A. Barber* 3751; Travancore, Kutatupuzha, Nov. 1901, *Bourne*; Coimbatore, Baiher, 1200 m., 23 Nov. 1905, *Fischer* 744; ibidem, Bellagi, 1500 m., 17 Nov. 1906, *Fischer* 1359; Mysore, Aglatti, 1050 m., Nov. 1908, *Meebold* 10570; Vellimalai-Annamalai Hills, 1050 m., 25 Oct. 1913. *Fischer* 3651.

The type specimen of *Holcus ciliatus* Roxb. is not extant, but there is an excellent drawing of the grass in the *Icones Roxburghianae*. Nees' *A. ciliata* matches the drawing in all essentials. This species, which is quite unmistakable, is endemic in Madras State.

## 22. *Arundinella birmanica* Hook. f., Flor. Brit. Ind. 7, 73 (1896).

An annual grass. *Culms* up to 35 cm. tall, terete, striate, rather stout, softly and sparsely pilose below the panicle, profusely bearded at the nodes, simple, erect or somewhat decumbent at the base. *Leaf-blades* rounded or somewhat cordate at the base, linear, tapering to an acuminate scabrid tip, up to 27 cm. long, 14 mm. wide, soft, flaccid, softly hirsute on both surfaces with tubercle-based hairs, but the amount of indumentum is extremely variable and many leaves are glabrescent, ciliate along the margins with similar hairs, upper leaves lanceolate; *sheaths* tight clasping, striate, covered with tubercle-based hairs, the lower sheaths slipping from the culms; *ligule* a narrow membrane less than 1 mm. broad, uneven on the upper margin.

Inflorescence a panicle, at times moderately dense, consisting of an erect central axis which is sulcate, angled, scabrid on the angles and very sparsely adorned with soft tubercle-based hairs, upon which are to be found ascending branches not more than 4 cm. long, which are alternate, subfascicled or subverticillate; branches angled, scabrid, carrying spikelets, in pairs or singly, on short scabrid pedicels of unequal length.

*Spikelets* 4.5–5.5 mm. long, gaping widely, bristly. *Lower glume* (2.75) 3–3.75 mm. long, elliptic-acuminate, shortly aristulate at the tip, 3- rarely 5-nerved, the nerves anastomosing near the tip, hairy all over the dorsal surface with soft hairs from small tubercle-bases ; *upper glume* 4.5–4.75 mm. long, elliptic-acuminate in shape with the upper third very narrow and nearly always recurved, somewhat plicate, the awn when young lying in the fold, 5-nerved ; the nerves anastomosing near the tip, scabrid on the midnerves. *Lower floret* ♂ or neuter ; *lemma* 3 mm. long, broad-elliptic-obtuse when flattened, smooth and glabrous, membranous, 3-nerved, rounded on the back below, keeled for a short distance above ; *palea* 2 mm. long, 2-nerved, hyaline, delicate ; *stamens* 3 ; *anthers* 0.75–1 mm. long. *Upper floret* ♀ ; *lemma* with a hairy callus, elliptic-oblong-obtuse, turning brown at maturity, smooth in the lowest three-quarters becoming scabrid-papillose in the upper quarter, awned ; *palea* of the same texture and colour, 2-nerved, covered all over the adaxial surface with papillose asperities ; *styles* 2 ; *stigmas* plumose ; *stamens* 3 ; *anthers* 1 mm. long ; *awn* 6 mm. long ; *column* 2.5 mm. long, chestnut-brown, twisted.

BURMA ; Moulmeyn, *Griffith* ; Rangoon, *Kurz* 3161 (Typus in Herb. Kew) ; Pazwoandoung, *Kurz* 1132 ; Rangoon 1854, *McClelland* ; Insein, Mingladon 9 m., 14 Nov. 1950, *Po Khant* 1809—Grass about 2 ft. high with white flowers, growing in open places.

This species is close to *A. holcooides* but it is a more robust grass, the spikelets are larger and the panicle stiffer and more dense. It may be that future collections will show a series of intermediates which would justify sinking *A. birmanica* in *A. holcooides*, but such a series is not yet at hand for examination. I have therefore decided that it is better to keep the two species apart for the present.

23. ***Arundinella holcooides*** (*Kunth*) *Trin.* in Bull. Acad. Sci. Petersb. **1**, 71 (1836).

*A. agrostoides* Trin., Sp. Gram. Ic. **3**, (1836) t. 265.

*Brandtia holcooides* Kunth, Révis. Gram. **2**, 511 (1830) t. 120.

An annual grass. *Culms* up to 45 cm. tall, terete, usually shortly decumbent at the base, smooth and glabrous or sparsely pilose below the panicle, hirsute at the nodes. *Leaf-blades* rounded at the base to the sheath, lanceolate-acute or linear-acuminate up to 15 cm. long by 1 cm. wide, usually much shorter and narrower, covered on both surfaces with tubercle-based hairs, often more or less congregated at the base, flaccid, ending in a stout scabrid tip ; *sheaths* of two kinds, those at the base very loose, slipping from the culm, very short, pilose from tubercle-based hairs, glabrescent, smooth, those higher up tight, clasping, striate, villous with numerous tubercle-based hairs situated between the nerves ; *ligule* a very narrow membrane.

Inflorescence up to 15 cm. long, 2 cm. broad, a narrow panicle consisting of an axis, at each node of which arise 1–several branches ; axis terete below, angled above, more or less pilose with tubercle-based hairs and scabrid on the angles ; branches at each node 1–5 or –6, short or up to 3 cm. long, branching and rebranching, scabrid, sparsely pilose but very pilose at the junction with the axis. *Spikelets* 3–3.5 mm. long, solitary or paired, one short, the other longer-pedicelled. *Lower glume*

2-2.5 mm. long, elliptic-aristulate when flattened, strongly 3-nerved, somewhat bristly from tubercle-based hairs on the nerves and sometimes on the interspaces; *upper glume* 3-3.5 mm. long, elliptic-acuminate in shape, the upper half narrowed and compressed into a beak which holds the awn of the upper lemma, 5-nerved, more or less bristly on the back with tubercle-based hairs. The tip of the lower glume reaches the tip of the lower lemma and just exceeds it. *Lower floret* ♂ or neuter; lemma 1.5-2 mm. long, oblong-acute in shape when flattened, chartaceous, very smooth and glabrous, 3-nerved; *palea* as long as the *lemma*, 2-keeled; *stamens* 3; *anthers* 0.25 mm. long. *Upper floret* ♀; *lemma* chartaceous becoming firmer, with an obtuse callus bearded on the sides, 1 mm. long, elliptic or oblong in outline, scabrid on the dorsal surface in the upper half; *palea* as long and of the same texture, 2-keeled; *stamens* 3; *anthers* 0.4 mm. long; *styles* 2; *stigmas* plumose.

IND. OR. : Burma; Tenasserim, *Helper*; Hb. Mergui, *Griffith* 334, 698; *Griffith* 6790.

Enquiries at Paris and Berlin have failed to locate the type sheet of *Brandtia holcooides* Kunth, but the excellent figure of the plant in Kunth's Révision des Graminées leaves little room for doubt about the characteristics of the plant. The type of *Arundinella agrostoides* Trin. is at Kew and it agrees well with Griffiths' specimens cited above. This plant has been much confused with *A. ciliata* (Roxb.) Nees, but the two are very different as pointed out on p. 384.

Note added in page-proof.

The greenish yellow colour of the leaves of *A. purpurea* Hochst. suggested that it might be an aluminium-accumulator. Dr. Chenery, of the Kawanda Research Station, Uganda, confirms that this is so, and that *A. fuscata* is without any reaction whatever. Incidentally, this is the first occasion in which such a reaction has been found in a species of the Gramineae.

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**Bibliography on Southwestern Asia.\***—Universities and libraries everywhere will welcome this second compilation of the Anthropogeographical Bibliography of selected titles to cover the areas Istanbul to the Hindu Kush on the north, Aden to the Makran coast on the south, and the Suez Canal on the west to the eastern boundary of Afghanistan.

The countries dealt with are Turkey (Anatolia), Syria, Lebanon, Israel, Egypt (Sinai), Jordan, Saudi Arabia, Yemen, Aden (Colony, Western and Eastern Protectorates and Socotra and Abd-el-Kuri islands), Dhufar, Oman (including Trucial Oman Coast), Qatar Peninsula, Bahrain Island, Neutral Zones (2), Al Kuwait, Irak, Iran, Caucasus (mainly Transcaucasia), Afghanistan and West Pakistan (formerly Baluchistan).

As in the previous part this useful bibliography contains a list of abbreviations and is divided into (1) Anthropogeography and (2) Natural History, followed by the author index.

H. S. MARSHALL.

\* Bibliography on Southwestern Asia : II. A Second Compilation. By Henry Field. Pp. xviii + 126. University of Miami Press. 1955. (No price stated).