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A REVISION OF MALESIAN GIGANTOCHLOA (POACEAE - BAMBUSOIDEAE)

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ABSTRACT

Eighteen species of *Gigantochloa* are recognized from the Malesian area, of which ten species are wild and the rest are known only in cultivation. Besides morphological and anatomical evidences, data derived from chemotaxonomical analyses are also utilized in the systematic study of these species. A new combination *(G. pseudoarundinacea)* and four new species *(G. achmadii, G. airoviolacea, G. manggong* and *G. prurient)* are proposed. Moreover a doubtful species *(G. hetcroclada)* is also mentioned. Full illustrated descriptions, complete list of synonymy and typification as well as sundry notes for each species treated are presented. Keys to all species and varieties recognized (based on the inflorescence and vegetative characters) are given and an index of all specimens examined is also appended.

ABSTRAK

Delapan belas jenis *Gigantochloa* diakui identitasnya dari Malcsia, sepuhih jenis diantaranya merupakan jenis-jenis liar dan lainnya hanya dijumpai da) am pembudidayaan. Di samp ing bukti-bukti secara morfotogi dan anatomi, data yang dihasilkan dari analisis kemotaksonomi juga digunakan dalam mempelajari jenis-jenis tersebut. Kombinasi baru *(G. pseudoarundinacea}* dan empat jenis baru *(G. achmadii, G. atroviolacea, G. manggong* dan *G. pruriensi* diusulkan. Selanjutnya suatu jenis yang diragukan *(G. heteroclada)* juga disinggung. Pertelaan lengkap bergambar disertai daftar sinonim dan tipe serta catatan penting setiap jenis dikemukakan. Kunci identifikasi jenis dan varietas yang dikenai berdasarkan ciri-ciri perbungaan dan vegetatif diberikan dan indeks spesimen herbarium yang diperiksa juga disertakan.

INTRODUCTION

The generic name *Gigantochloa* was created for the first time by Kurz (1864) in his list of Bangka plants. In introducing *Gigantochloa,* Kurz did not give any reason for proposing the genus and he did not also give the circumscription of the newly erected taxon. He merely transferred four species into it, namely *G. atter, G. maxima, G. apus* and *G. nigrociiiata,* which had been described previously by many people under *Bambusa* (Willdenow 1799, Schultes & Schultes 1830, Ruprecht 1839, Hasskarl 1848, Miquel 1855). Nowadays *Gigantochloa* is accepted as a good genus by most

plant taxonomists.

A few years later, Munro (1868) published "A monograph of Bambusaceae", in which he treated three species of *Gigantochloa,* namely *G. verticillata, G. alter* and *G. heterostachya* Munro. The first species of the genus *Gigantochloa* he described was *G. uerticillata,* which he considered to represent the correct name for G. *maxima.* He separated this genus from *Bambusa* in having filaments which were joined together to form a firm tube. He referred *G. nigrociliata* to *Oxytenanthera* because it had long pointed anthers, and no keel on the palea of the fertile floret.

In 1876 Kurz revised Munro's work and recognised six species of *Gigantochloa* which he provided with more detailed descriptions. The six species were *G. maxima, G. atter, G. apus, G.nigrociliata, G, robusta* and G. *heterostachya,* most of which were found only in cultivation. He included *Gigantochloa* in a group of bamboo genera which was characterized by small fruits with membranous pericarp, deciduous styles and 2-keeled palea. His delimitation of the genus *Gigantochloa* reads "oval to oval lanceolate spikelets, paleas gradually shorter down and upwards; anthers apiculate, fruit oblong to ovoid. Gigantic bamboos 60 to 150 feet high; the halms for 2/3 from the ground free of branchings".

Gamble (1896), who studied the Bambuseae of British India included nine species in the genus *Gigantochloa,* eight of which were known from Burma and Malaya, and one species found in the north of Chittagong and Assam. He also mentioned two species which grew in Java and other islands in Indonesia namely *G. atter* and G. *robusta.*

Until 1928 identifications of Indonesian species of *Gigantochloa* were based either on Munro's monograph or Kurz's work. This situation changed when Backer (1928) treated the species of *Gigantochloa* growing in Java. The presence of lodicules on the spikelets of *G. verticillata* mentioned by Gamble was not noted by Backer. He united the three species recognized by Kurz *(G. maxima, G. atter* — both the green and the black varieties — and G. *robusta)* under the name *G. verticillata.* The other species were *G. apus, G. nigrociliaia* and *G. hasskarliana;* this last species was accepted by most people, although Kurz (1876) assigned- it doubtfully to *Schizostachyum.* Backer's (1928) treatment of *Gigantochloa* remained unchanged when the *Flora of Java III* was published in 1968 by Backer & Bakhuizen van den Brink f. (1968), where the Gramineae was elaborated by Ch. Monod de Froideville.

Holttum (1958) studied carefully the bamboos of the Malay Peninsula. Prior to the publication of this excellent work, he proposed *G. atter* as the type species of the genus (Holttum 1956) largely because the uncertainty of the taxonomic status of the *G. verticillata* — G. *maxima* complex treated earlier by Munro (1868). Holttum (1958) gave a good delimitation of this genus based on the characters of the uppermost flower, which consists of a

long and narrow empty lemma, and also on the consistent presence of a rather firm and very distinct filament tube. He described nine species of *Gigantochloa* growing wild and cultivated in the Malay Peninsula, namely *G. apus, G, maxima, G. ligulata, G. latifolia, G. Icuis, G. scortechinii, G. ridleyi, G. wrayi* and G. *hasskarliana.*

Those who are familiar with *G. alter* in the field will be dissatisfied with the treatment of this species because to consider it as a mere variant of *G. verticillata* means that one ignores the ample taxonomic evidence (the habit and the colour of the culms, the auricle of the culm sheaths, lodicule etc.) which can be used to justify its recognition as distinct species. Similarly the available morphological and anatomical features would seem to indicate that the black bamboo should also be treated as a separate species.

From the above historical sketch, it is clear that the taxonomy of the genus *Gigantochloa* needs careful and extensive reappraisal. Detailed information, especially well documented field observations, are required for a better understanding of this genus. An attempt has been made therefore to produce a taxonomic revision of the genus *Gigantochloa* in Malesia. The present study indicates that eighteen species should be recognized as occurring in Malesia; moreover another doubtful species occurs in Sabah but its true affinity requires further confirmation from additional specimens. Among those species treated, ten species *(G. nigrociliata, G. hasskarliana, G. manggong, G. achmadii, G. wrayi, G. scortechinii, G. ligulata, G. latifolia, G. holttumiana* and *G. levis)* are found wild, whereas the remaining species *(G. apus, G. pseudoarundinacea,* G, *ridleyi, G. robusta, G. atter, G. atroviolacea, G. rostrata, G. pruriens)* are found only in cultivation. However, it is almost certain that the number of species recognized will have to be increased when more extensive collections are undertaken in Sumatra, north Borneo and Kalimantan, or the northen part of the Malay Peninsula.

In preparing the present systematic account of the genus *Gigantochloa,* besides relying on morphological and anatomical evidences, data derived from a chemotaxonomic study (Widjaja & Lester 1987) have also been fully utilized.

MORPHOLOGICAL AND ANATOMICAL CHARACTERS AND THEIR TAXONOMIC SIGNIFICANCE

The genus *Gigantochloa* presents special difficulties to the plant taxonomists because of the rarity of flowering specimens represented in the herbaria. Furthermore the vegetative activity which generally prevails in the life of a bamboo species often becomes atypical during the flowering period because the whole clump may become defoliated. This means that a complete herbarium specimen, consisting of both vegetative structures and inflorescences, will be difficult to prepare even when flowering does take place.

Moreover very few collectors have been willing to collect bamboo specimens properly as required by the bamboo taxonomists (Dransfield 1980). Consequently there are only a few correlated morphological characters of *Gigantochloa* which have passed the test of time and which can be used effectively for the recognition of bamboo taxa. Therefore it is important to evaluate carefully the few available morphological as well as anatomical characters which are useful for taxonomic purposes in this genus.

MORPHOLOGY

dump habit

Within certain limits the growth habit of each species of *Gigantochloa* is specific. In general most species form densely tufted to very densely tufted clumps. The culms of this type of clump are caespitose or very close to each other so that they are often touching, and as a consequence as the clump grows older its centre is raised irregularly above the ground. In a few other species such as *Gigantochloa atroviolacea* and *Gigantochloa nigrociliata* the same habit of growth is not shown. Their culms do not grow very densely so that their clumps do not produce a mound above the ground.

If one looks very closely at the individual culm this feature seems to be correlated with the number of new culms produced at one time at the base of an old culm. In *Gigantochloa atroviolacea* only one new culm (or at the most two) will arise at the base of an old culm, whereas in *Gigantochloa apus* more than two new culms will be formed, so that the resulting clumps are denser and ultimately their centres arise above the ground.

Shoots

A new culm arises from the bud at the base of an old culm. This shoot grows slowly and often shows a characteristic colour at the apex. The shoot consists of an unextended massive "stem" and protected by numerous overlapping rigid sheaths. The colour of the hairs which cover the edges of the sheaths is also characteristic for each species. When the shoot elongates, the portions of the sheaths which are visible will also increase because the sheaths will become separated following the elongation of the culm internodes. Consequently the shoot colour will also undergo changes, generally becoming somewhat paler.

Waxy substances are produced sometimes on the shoots, so that the latter appear whitish. This feature also can be of a diagnostic value.

Culms

Culms developed from the shoots. The culms usually grow very rapidly and reach their full height within a few days. In *Gigantochloa* the young

culm grows to its full height before starting to produce branches. The culms are composed of internodes of medium length, mostly under 50 cm. The basal nodes of certain species *(G. pseudoarundinacea, G. robusta, G. levis, G. atroviolacea* and *G. atter)* characteristically bear aerial roots. These roots do not grow beyond the rudimentary stage. In G. *levis* even the lower dominant lateral branches bear roots.

The upper part of the internodes of young culms of certain species *(G. levis* and G. *apus)* are covered with waxy powder. Sometimes variously coloured scattered hairs adom the upper parts of these internodes. The wax and the scattered hairs disappear when the culms become old. These features are of considerable importance in differentiating species of *Gigantochloa.*

Most species of *Gigantochloa* have culms which are erect with curved apices but none of them has really pendulous tips. The height and diameter of the culms, the thickness of culm walls, the length of the longest internodes and the features of the nodes are also useful characters but they should be used with caution because these characters sometimes are influenced by soil conditions and the density of the plants themselves.

Branching system

Observations on the growth of branching systems of species of *Gigantochloa* growing in Bogor Botanic Gardens indicated that after the culms have reached their full height, the lateral branches begin to grow by emerging from buds enclosed by the sheaths. The lateral branches emerge by breaking through the culm sheaths and at each node form a group of branches which consists of a relatively large and strongly dominant primary lateral branch followed by the two secondary lateral branches ana other smaller lateral branches.

Branching is initiated at about 8 — 11 nodes from the tip of the culm, and is followed by the growth from the next two nodes down, and then development continues both up and down the culm from this area until branches have been produced from all nodes above 2 — 3 m from the ground. This pattern of branching system has been observed to take place in *G. atter* and several other species without any significant differences; however in *GigantochIoa atroviolacea* this branching pattern is preceded by the formation of rudimentary branches at the first node from the ground.

Although the branching system does not provide taxonomic discrimination at the species level, it can be used as a diagnostic generic character, because only *Gigantochloa, Dendrocalamus and Bambusa* show this peculiar branching system with one dominant lateral branch in each branch group.

Culm sheath

Along the stem or culm, the leaves of bamboos are modified into culm

sheaths which consist of two parts, culm sheaths proper and leaf-like extensions called culm sheaths blades. The culm sheaths have an important function to protect the buds and the developing internodes. Depending on the species the sheaths may be persistent (e.q. *G. apus)* or deciduous. In some species *(G. alter* and *G. atroviolacea)* the sheaths on the lower culms may be persistent while those above are deciduous. In *G. scortechinii, G. nigrociliata, G. wrayi, G. manggong* and *G. hasskarliana* they are somewhat tardily deciduous.

The culm sheaths proper have two kinds of principal appendages in their apices called ligule and auricle. These appendages vary in size and shape depending on the species. The ligules face the culm and are usually fragile, membranous and much thinner than the culm sheaths themselves. The margins of the ligule may be dentate, denticulate, laciniate or entire. They may be fringed by fine hairs or by long hairs depending also on the species. The ligule may be close to the auricle and may or may not be joined to the auricle. The auricles may extend towards the blade base, and may be enlarged towards their outer ends to form ear-shaped extensions *(G. atter, G. pruriens, G. atroviolacea, G. achmadii, G. robusta, G. leuis),* or they may be no more than a low firm rim along the top edges of the culm sheaths *(G. apus, G. ridleyi, G. hasskarliana, G. wrayi, G. rostrata* and *G. manggong).* The size and form of the auricles vary in different species and they may bear bristles which are quite fragile and also vary' in size and numbers. Sometimes, the culm sheaths put out outgrowths from below the auricle which extend beyond the auricle and curve towards the middle (.*G. hasskarliana* and *G. ntgrociliata).*

The tops of the sheaths are slightly narrowed and carry the blades. The blades are either reflexed or ere'ct and may be persistent but mostly they are deciduous. When the blades are erect, the line of junction between the sheath and the blade is not detectable externally, but when the blade is reflexed this line is quite conspicuous. Sometimes the line of junction is almost horizontal but more often it is upcurved in the middle sheaths. In some species *(G. atter, G. atroviolacea* and *G. hasskarliana* - from the Singapore Recreational Park and Malay Peninsula) the blades on the lower culm, sheaths are erect, while those above are reflexed. In *G. nigrociliata* the blades are spreading. It is necessary to handle the culm sheaths carefully during examination of specimens since their appendages and the blades, which show the best diagnostic characters for taxonomic purposes, are quite fragile.

Leaf

Each branch bears some more smaller branches at its nodps, and so on. The apical branches are leafy. The leaves consist of leaf sheath, pseudopetiole

and leaf blade. The *leaf sheaths* are different from the culm sheaths by having a greener coloration, but they have the same function of protecting the developing internodes. The leaf sheaths are relatively small and overlapping, each one nearly covering the one above it. As in the culm sheaths, there are variously developed auricles which spread along the top of the leaf sheaths on each side of the leaf blade. The auricles sometimes bear bristles. The auricles and their bristles are very fragile, so it is necessary to observe them in the field and to collect slightly young bamboo leaves, before the auricles and their bristles fall off. Though well developed, the auricles of *G. apus, G. hasskarliana* and *G. nigrociliata* quite often could not be seen in herbarium specimens because they had already fallen off. The ligules are usually quite small but in some species *(G. nigrociliata* and *G. robusta)* the ligules are well developed, In *G. ligulata* the ligules are quite large so giving this specie;; a distinctive character. Sometimes a pair of upward extensions called callus can be seen on the top of the leaf sheath where it meets the petiole. The callus is sometimes rounded or else elongate and "very thin. In *G. ligulata* the callus is well developed and could be used as a diagnostic character. In *G. rostrata* the callus is more prominent on one side than on the other.

In *Gigantochloa* the size and shape of the *leaf blades* could not be used as a good character because in all species are more or less the same. In some species *(G. levis, G. robusta, G. scortechinti, G. rostrata, G. nigrociliata)* the leaves are hairy whereas in other species by they are glabrous.

Inflorescence and fruit

As is generally known the basic structural unit of the bamboo inflorescence is called a spikelet. In the inflorescence of *Gigantochloa* a small bud is formed in the axil of each bract and a one-keeled prophylla encloses the branch primordia. The spikelet (pseudospikelet, McClure 1966) consists of 2 — 3 glumes, 2 — 4 fertile florets and 1 sterile floret. The glumes or empty bracts are usually quite small, then gradually increasing in size as they go up. The apex of the glumes is quite variable in shape, and in some species *(G. scortechinii, G. robusta, G. levis)* the hairiness of the glume and lemma show very distinct characters. The fertile florets consist of a lemma (upperbract), a palea (second bract), one stigma and carpel, 6 stamens which are united by the filament tube and, in some species, 3 lodicules. The rachilla is very short.

The lemma apex has a distinct shape for each species. In some species *(G. apus, G. hasskarliana, G. wrayi, G. nigrociliata)* the lemma apex is pointed, but in others *(G. pseudoarundinacea, G. atter, G. atroviolacea)* it is acute. The fringe colour of the lemma can also be a distinctive character. In *G. apus, G. hasskarliana, G. wrayi, G. nigrociliata, G. manggong* the

lemmas are dark brownly fringed whereas in others they are brownishly fringed. The lower lemma usually is shorter than the upper ones. The palea apex, is distinct for each species. In some species it is bifid, but in others the apex of the palea is either notched or pointed.

The sterile floret, called the imperfect floret, consists of a narrow lemma which is longer than all the other florets.

The united filament tubes found in the genus *Gigantochloa* were used by Munro (1868) and also by later authors as a character of a few bamboo genera, because this character occurs only in a small number of genera such as *Neohouzeana* and *Schizostachyum.* Thus this character of united filaments isneither unique to *Gigantochloa,* nor can it be used to distinguish species within this genus. However in *G. robusta* and *G. levis* only 3/4 of the filament is united whereas the remaining 1/4 of the top part is free. In some species *(G. apus, G. wrayi, G. rostrata, G. manggong, G. hasskarliana, G. nigrociliata)* the anthers have maroon to dark magenta colours, whereas the majority of species of *Gigantochtoa* have yellow anthers. This character can be used as a means of distinguishing species because it can be seen easily even in herbarium specimens. Thelodicules which occur in some species *(G. pseudoarundinacea, G. achmadii G. pruriens, G. holttumiana)* can also be regarded as useful characters for distinguishing species, despite of the fact that some authors failed to notice their presence (Backer 1928, Holttum 1958, Monod de Froideville 1968). Gamble (1896) already reported and illustrated lodicules of *G. uerticillata (G. pseudoarundinacea)* which was copied by McClure (1966). The size and shape of the lodicules are different from one species to another.

The fruits found in the field thus far are only those of *G. apus* and G. *rostrata.* The gross morphology of these fruits is slightly different, especially their size.

ANATOMY

Anatomical studies of grasses have provided a great deal of valuable information for taxonomic work in recent years, and some workers have paid special attention to the anatomy of bamboo leaves. Therefore it is of interest to evaluate some anatomical characters such as the epidermal cells, hairs, stomata, bulliform cells and the midrib patterns, which may help in characterizing species of *Gigantochloa.*

Leaf surface anatomy

The detailed work of Ohki (1929, 1932) revealed that characters of the epidermis are useful in classifying bamboos. Similarly Brandis (1907), Metcalfe (1960), Page (1947) and Wu (1958, 1960,1962) have suggested

that important characteristics are shown by the elements of epidermis of bamboo leaves.

Epidermis

The lower or abaxial epidermis consists of rows or files of alternating long rectangular cells with sinuous lateral walls and pairs of short rectangular cells (a cork cell and a saddle-shaped silica body). Long and short epidermal cells are arranged in several rows, over the veins (costal zones) and between the veins (intercostal zone). It appears that the number and arrangement of epidermal rows are distinctive for some species and hence have a diagnostic value in identifying species. On the costal zone there are 1 — 3 rows of long and short epidermal cells. The intercostal zones are usually composed of 3 — 4 rows (only 2 rows in *G. nigrociliata)* of alternating stomatal and interstomatal cells on each side of 5 — 8 rows of long cells (only 2 — 3 rows in *G. nigrociliata).*

Hairs

Hairs are very useful in bamboo systematics. According to Metcalfe (1960) there are three kinds of hairs. The macro hairs for long hairs of Wu 1958) which have swollen bases occur on the costal zone; they are mostly less than 300 µm long except in *G. nigrociliata* which are 300 — 1000 µm long and characteristically absent in *G. apus* and *G. hasskarliana.* In the intercostal zone the macro hairs are very rare and found only in *G. nigrociliata* and G. *ridleyi*

The bicellular micro hairs (or geniculate hairs of Wu 1958) are always present and they arise from short cells of the lower epidermis; their distal cells (measuring 26 — 46/um) are more or less equal in length to the basal cells (which measure 29 — 43 *µm)*. Every species is characterised by different densities of these hairs.

Prickle hairs (the spines and bristles of Wu 1958) are always present and vary in size (12 — 50 *µ*m) and shape, acute or cuspidate at the apex, often with rather long points and show transition to hooks. Their abundance differs from one species to the other.

Stomata

The stomata of species of *Gigantochloa* are more or less elliptical in shape and are disposed together with long interstomatal cells in rows on each side of a vein. Each stoma possesses overarching finger-like protuberances (papillae) arising from the cuticle of the epidermal cells. Normally there are 7 — 9 papillae overarching each stoma (but only 0—4 long papillae can be seen in G. *nigrociliata).*

Transverse section of leaf lamina

The importance of transverse sections of bamboo leaves for systematic purposes have been recognized by many workers (Brandis 1907, Metcalfe 1960, Page 1947, Wu 1958, 1960, 1962). To some extent they are also applicable for species of *Gigantochloa* as the following account will show. -

Buliiform cells

The buliiform cells are arranged in the adaxial epidermis as fans of rows of cells. The number of cell rows varies according to the distance from the midrib. In most cases these fan-shaped groups usually consist of 3 — 5 cells. The central cell in the group is appreciably larger than the remainder and penetrating deeply into the mesophyll. All groups more or less are equal in depth, but each with an extension of colourless cells which are elongate to rhomboidal in shape, 33 — 83μm by 39 — 82μm and reaching nearly to the abaxial surface.

In *G. atroviolacea* the buliiform cells protude above the epidermis whereas in *G. alter* they are sunk below the epidermis. The intermediate type is shown by a few species such as *G. pseudoarundinacea* and *G. robusta.* Besides the position, the size of the buliiform cells is also different for each species.

Mesophyll

The mesophyll of *Gigantochloa* belongs to the festucoid type. The mesophyll chlorenchyma cells are arranged parallelly consisting of 1 — 3 layers of arm-cells. Two translucent fusoid cells are present between a pair of vascular bundle of the lamina. There are 14 — 16 fusoids cells present between the largest vascular bundles; noteworthy owing to the vertical diameter (19 — 47 */am)* being smaller than the horizontal diameter (59 — 115,11m). It is very difficult to use data provided by mesophyll for taxonomic purposes in *Gigantochloa.*

Midrib pattern

The first person who defined the peculiarity of the midrib of bamboo leaf was Wu (1958). She described the pattern of bamboo midribs briefly in a later paper (Wu 1960) in which she recognized 4 patterns. The midrib pattern in *Gigantochloa* can be generally included in the pattern 2 and 3. The midrib on the pattern 2 consists of seven vascular bundles : one major and two minor vascular bundles embedded in the abaxial side, another two minor vascular bundles in the middle of the midrib and a further two minor one in the adaxial side. This pattern can be modified as one minor vascular bundle in the adaxial side and one major with four minor vascular bundles on the abaxial side. On the pattern 3 the midrib consists of 11 vascular

bundles : three minor vascular bundles are present in the adaxial side and three major and four or five minor vascular bundles are in the abaxial side. The midrib pattern of *Gigantochloa* consists of 9 — 10 vascular bundles (except in *G. nigrociliata* which has only two vascular bundles and in *G. robusta* which has five vascular bundles). Mostly two or four minor vascular bundles are embedded on the adaxial side and always one major in the middle and the two, four or five are on the abaxial side.

Culm epidermis

Much of the work on bamboo culm anatomy has been applied to the solution of taxonomic problems (Gosh & Negi 1960, Pattanth & Rao 1969, Grosser 1970, Grosser & Liese 1971, 1973, Grosser & Zamuco 1971). The anatomical data have been employed either for practical purposes (such as in confirming identification), for major grouping of genera as well as for studying phylogenetic trends and degrees of relationship.

The culm epidermis are also arranged in rows of alternating of long cells and pairs of short cells. The long cells are 70 — 240μrn long, thick-walled, not sinuous (but moderately sinuous in G. *atter),* usually rectangular (except in G. *atter* which are rhomboidal). Short cells are abundant, in pairs, rectangular in shape but may also occur in various other forms such as trapezoid, 10 — 20 yum long. Silica bodies are of various shapes such as tall and narrow, rectangular- or trapezoid, smaller than short cells. The interstomatal cells are long, with concave ends. The stomata are parallel-sided, 25 — 50 /um long and 25 — 30 yum wide in the middle of the culm, their guard cells in some species are covered by papillae which do not obscure the pores of stomata. Unicellular hairs, which are stiff and pointed at the apex and the shrunken base of which are surrounded by specialized epidermal cells are present on the surface of culm epidermis.

TAXONOMY

GIGANTOCHLOA Kurz ex Munro

Gigantochtoa Kurz ex Munro *in* Trans. Linn. Soc. 26 : 123. 1868; Kurz *mind.* For. 1 : 342.1876; Gamble *in* Ann. R. Bot. Gard. Calc. 7 : 61. 1896; Hook, f., Fl. Brit. Ind. 7 : 398.1897; Ridley, Fl. Mai. Pen. 5 ; 260. 1925; Backer, Handb. Fl. Jav. 2 : 273. 1928; Holttum *in* Gard. Bull. Sing. 16 : 104. 1958; Monod de Froideville *in* Backer & Bakh. v.d. Brink f., Ft. Jav. 3 : 634.1968.— *GigantochloaKurz in* Nat. Tiidschr. Ned. Ind. 27 : 226. 1864 (nomen) - TYPE SPECIES: *Gigantochtoa atter* (Hassk.) Kurz (see Holttum in Taxon 5 : 28 - 30. 1956).

Culms arising from sympodially branched rhizomes, strongly caespitose, small to large size, hollow, erect, with moderately thick walls, lower parts

always unbranched, upper parts slightly curved but never pendulous. When young the culms may be covered by scattered coarse hairs, and in some species they are sometimes waxy.

Branching only appears on the upper parts of adult culms, forming small branch groups at the nodes, the branching complements on each node consist of a dominant lateral branch .and two to three subdominant and several smaller ones; similar branching systems are reiterated on dominant lateral branches.

Culm sheaths usually dark hairy from the presense of dense or occasionally scattered and loosely appressed hairs on the outside, whereas the inside is glabrous and shining, pale brownish yellow and paler than the outside; auricles firm and mostly low but sometimes laterally elongate, dark greenish brown when young, with or without marginal bristles; ligule well developed, usually membranous, more or less dentate or denticulate or sometimes laciniate, in some species prolonged into bristles; blades of middle sheaths rather narrow and ovate-oblong, sometimes green and leaf-like.

Leaf sheaths are deeply imbricate, each one nearly covering the one above it, with leaf ligules well developed in some species, membranous. The leaf sheaths have pseudopetioies and are relatively small and inconspicuous in relation to their blades. The pseudopetioies are bounded on their adaxial side by the conventional ligules and are surrounded on the outer side by an upward extension of the leaf sheath by a little cup-like or collar-like callus. Blades or foliage leaves are rather large, linear or linear lanceolate.

Spikelet-groups in large paniculate pseudo-inflorescences in alternate clusters along leafless hranches, spikelets narrowly ovate or ovate-lanceolate, laterally compressed; rachilla with very short joints, not articulate; each sp'ikelet consists of several basal bracts and 2—3 glumes, 2 — 4 perfect florets and an imperfect terminal flower represented by the longest and narrowest empty lemma without palea; lower glumes and lower lemmas are shorter than upper ones; lemmas many veined, acute or apiculate and usually fringed; paleas thin and translucent with 2 well developed keels, tips narrow and sometimes bifid, keels usually fringed; lodicules mostly absent, if present 3 in number, sometimes of unequal size; stamens 6, the filaments joined to form a firm tube which at an thesis is somewhat longer than the palea; anthers long with a distinct tip, yellowish white or maroon to dark magenta; ovary with hairy tip, style long ending in a single hairy stigma; fruit cylindric, hairy on the tip, pericarp thin towards the base, slightly grooved along the line of the hilum.

DISTRIBUTION : South and South East Asia, in Malesia as far as the Moluccas. Some species are introduced and cultivated elsewhere.

KEYS TO MALESIAN SPECIES OF GIGANTOCHLOA

Based on inflorescence

1. a. **Anthers maroon to dark** magenta; **blackish brown** hairs **on the** spikelets, spikelets narrowly ovate 2

   b. Anthers **yellowish white; bTownuh white** hairs **on the** spikelets, **spikeleta Broadly ovate** .....

2. a. Lemma with an apical marginal zone covered with dark brown hairs 3
   b. Lemma with a glabrous apical marginal zone 4
3. a. Lemma lanceolate with rostrate apex; anthers tips rostrate ..... 6, *G, rostrato*
   b. Lemma ovate with acuminate apex; anthers tips shortly apiculate ..... 5. *G. nigrociliata*
4. a, Palea notched to bifid; anthers up to 8 mm 5
   b. Palea pointed ; anthers 9 — 11 mm ..... 11. *G. apus*
5. a. Palea notched, keels coarsely hairy 6
   b, Palea bifid, keels finely hairy ..... 16. *G. manggortg*
6. a. Spikelets 20 — 25 mm long; 5 — 6 veins between keels ..... 7. *G. hasskariiana*
   b. Spikelets up to 20 mm long; 3 — 4 veins between keels ..... 8. *G. wrayi*
7. a. Full length of the filaments joined into a slaminal tube 8
   b. Only three fourth of the length of the filaments joined into a stamina! tube ... 16
8. a. Lodicules present 9
   b. Lodicules absent 12
9. a. Palea tips pointed 10
   b. PaJea tips blunt or notched 11
10. a. Lodicuies less than 1 mm; 2 -• 3 veins between keels .... 1. *G. pseudoarundinacea*
    b. Lodicules 2 — 3 mm; 6 veins between keels ..... 18. *G. achmadii*
11. a. Palea blunt, as iong as or longer than lemma, glabrous ..... 13. *G. holttumiana*
    b. Palea notched, shorter than lemma, covered with very fine hairs ..... 17. *G. pruriens*
12. a. Spikelets with 2 fertile florets ..... 14. *G. latifolia*
    b. Spikelets with 4 fertile florets or more 13
13. a. Spikelets pubescent ..... 9. *G. acortechinii*
    b. Spikelets glabrous 14
14. a. Palea bifid ..... 15. *G. ligulato*
    b. Palea blunt to pointed 15
15. a. Palea blunt ..... 3. *G, alter*
    • b. Palea pointed ..... 4. G. *atrouiolacea*
16. a. Glume mucronate; lemma apex almost rounded ..... 12. *G. levis*
    b. Glume acute; lemma apex acuminate ..... 2. G. *robusta*

Based on vegetative characters

1. a. Culm sheath auricles rim-like, extended, less than 2 mm high; auricles of the leaf distinct 2
   b. Culm sheath auricles rounded, discrete, more than 3 mm high; auricles of **the** leaf inconspicuous 12

2. a. Blades of the calm sheaths erect, deltoid, articulation inconspicuous 3
   b. Blades of the culm sheaths spreading to reflexed, ovate, articulation consnicuous 6
3. a. Ligules of the culm sheaths less than 5 mm high 4
   b. Ligules of the culm sheaths 10 — 25 mm high 5
4. a. Ligules of the culm sheaths sometimes incised but glabrous, 3 mm high ..... 10. G. *ridleyi*
   b. Ligules of culm sheaths toothed with fine hairs, 5 mm high ..... 16. *G. manggong*
5. a. Ligules of culm sheaths higher at the ends than in the middle; ligules of the leaf 11 — 30 mm high ..... 15. *G. ligulata*
   b. Ligules of culm sheath lower at the ends than in the middle; ligules of the leaf up to 5 mm high ..... 14, G. *latifolia*
6. a. Auricles of the leaf rim-like, inconspicuous, higher at the end and joined to the ligules 7
   b. Auricles of the leaf small, rounded, not higher at the ends *6*
7. a. Culm sheath extension near auricle absent; culm green with yellow strip at the base ..... 6, *G, ro&trata*
   b. Culm sheath extension near auricle present; culm light green Ft the base ..... 5. *G. nigrociliata*
8. a. Culm sheath ligules {including bristles) more than 10 mm 9
   b. Culm sheath ligules {including bristles) less than 5 mm 11
9. a. Culm waxy; auricles of thfl culm sheath ended by few bristles; leaf hairy ^beneath ..... 9. *G. acoriechinii*
   b. Culm not waxy; auricles of the culm sheath- ended by many bristles; leaf slightly hairy to glabrous beneath 10
10. a. Ligules of the leaf glabrous; bristle of the leaf auricles less than 4 mm long .... 8. G. *uirayi*
    b. Ligules of the leaf with fine brown bristles, 4 — 8 mm long; bristles of the leaf auricles 5 — 12 mm long ..... 13. *G. holttumiana*
11. a. Culm not waxy; culm sheath deciduous (sometimes persistent and appressed on the lower part in Singapore plants), and extended beyond the auricle, auricles without bristles ..... 7. *G. hasskariianu*
    b. Culm waxy; culm sheath persistent, not extended beyond the auricle, auricles with few bristles ..... 11. *G. apus*
12. a. Culm green with yellow stripes, upper part of the internodes with brownish-yellow hairs 13
    b. Culm dark green or violet, upper part of the internodes with sparse blackish-brown hairs 15
13. a. Culm sheath auricles more than 6 mm high, bearing medium to long bristles; culm sheath ligule with longer bristles; leaf slightly hairy to hairy 14
    b. Culm sheath auricles 4 mm high or less, bearing short bristles; culm sheath ligules short, bearing short bristles; leaf glabrous ..... 1. G. *pseudoarundinacea*

14. a. Culm not waxy, few scattered hairs on the upper part of the intemodes ..... 2. *G. robusta*
    b. Culm waxy, scattered brown hairs forming a ring on the upper part of the inter nodes ..... 12. *G. levis*
15. a. Culm sheath auricles rounded, bearing short bristles and ending in a projection of the sheath 16
    b. Culm sheath auricles curved, glabrous, no obvious sheath projection ..... 18. *G. achmadii*
16. a. Culm dark green; culm sheath auricles joined to base of the blade 17
    b. Culm purplish to violet; culm sheath auricles not joined to base of the blade .. 4. *G. atroviolacea*
17. a. Culm sheath ligules 2 mm high or less, with long bristles; leaf hairy beneath ... 17. *G, pruriens*
    b. Culm sheath ligules more than 6 mm high, with short bristles; leaf glabrous beneath ..... 3. G. *alter*

1. Gigantochloa pscudoarundinacea (Steud.) Widjaja, *comb. nov.* — Fig. 1 & 2

Bambusa pseudoarundinacea Steud., Syn.Glum. 1 : 330. 1854. —TYPE : *Zollinger 3479* (P—Holotype, n.v.;L—Isotype), Java. Fl.

Gigantochloa veriicillata (Willd.) Munro *in* Trans. Linn. Soc. 26 : 124. 1868 (p.p.) ; Gamble *in* Ann. R. Bot. Gard. Cak. 7 : 63. 1896 (p.p.) ; Camus, Les Bambusae. 138. 1913; Camus & Camus, FI. Ind. China 7 : 622. 1922; Backer, Handb. Fl. Jav. 2 : 275. 1928 (p.p.) ; Heyne, Nutt. Plant.Ind, 1 : 300. 1950 (p.p.) ; McClure, Bamboos. 172. 1966 ; Monod deFroideville *in* Backer & Bakhuizen v.d. Brink f., Fl. Jav. 3:635. 1968 (p.p.).— *Bambusa verticittata* Willd., Spec. PI. 2 : 245. 1799 (excl. syn.) — TYPE : *fib. Willdenow 7007 Thunberg s.n,* (B — Hototype +, L-microfiche), Java. Fl.

Gigantochloa maxima Kurz (ut *"G, maxima* :mihi *(Bambusa maxima* Poiret)") sensu Kurz *in* Tijds.Ned.Ind. 27 : 226. 1864 ; Kurz *in* Ind. For 1 : 343. 1876 ; Hotttum in Gard. Bull. Sing. 16 : 114. 1958.

• Clumps densely tufted, their centres irregularly raised above the ground with verticillate aerial roots on the lower nodes.

Young shoots yellowish green, flushed with orange on the sheath apex and green striped, with appressed acute brown to golden brown hairs.

Culms 7 — 30 m high, 5 — 13 cm diameter, culm walls up to 20 mm thick, the longest intemodes 40 — 45 (—60) cm long, green to yellowish green and yellow striped, with scattered brown hairs appressed on the upper part of the internodes, afterwards glabrous and smooth.

Culm sheaths covered by brown hairs when young and glabrous afterwards, dark green and papery at the margin when fresh, deciduous, up to *35* cm long but sometimes longer than this on the long internodes, with truncate apex : auricle with a variable low and wavy rim up to 4 mm high by 17 mm lateral extent, wlien young bristly up to 5 mm long; ligule up to 5 mm high, dentate, with fine hairs ; blades spreading to reflexed, ovate-oblong, acute at the apex, leaf-like, on the young culm blades sometimes as long as sheaths.

Leaf blades glabrous, lanceolate, apex acuminate 22 — 25 cm long by 2.5 — 5.0 cm wide, pseudopetiole 6 mm long ; auricle firm, raised at the end

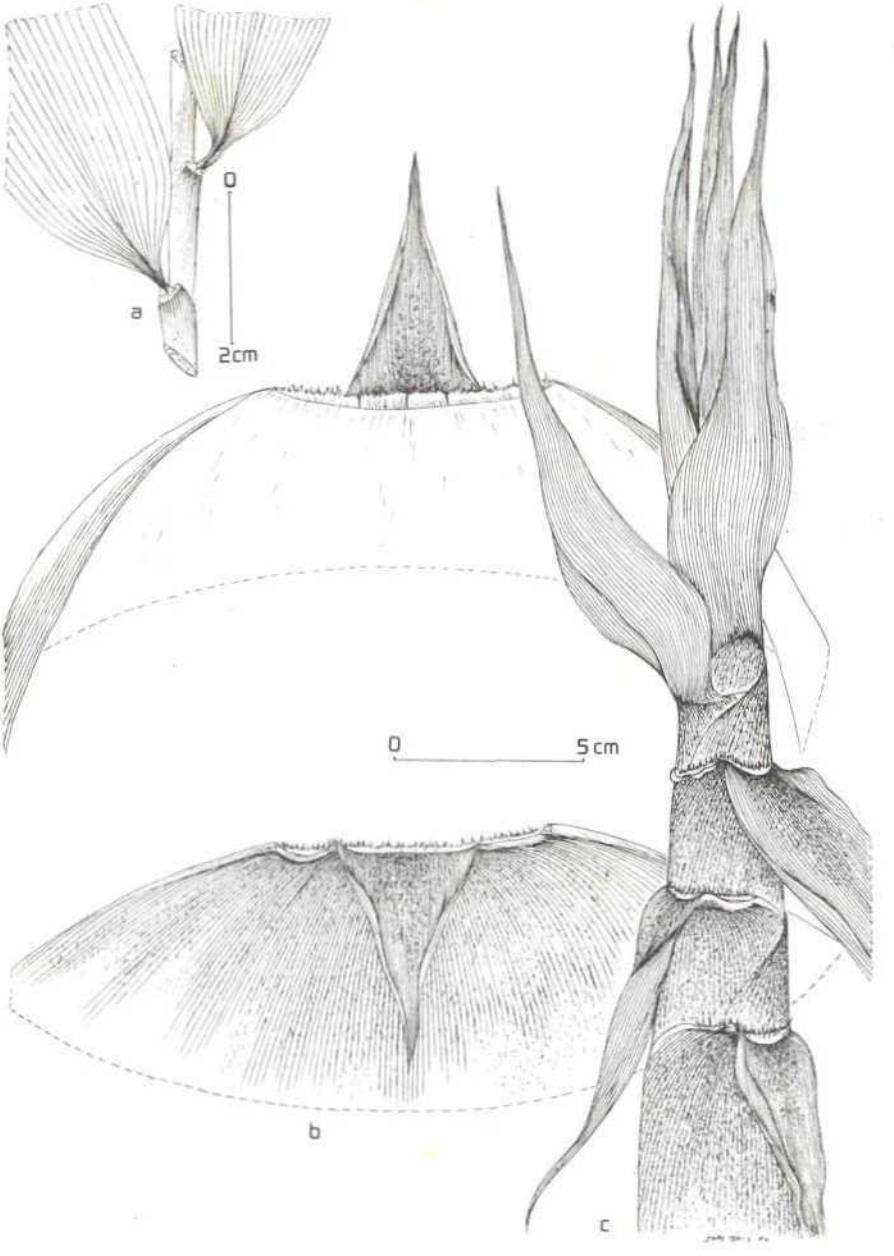


Fig. 1. *Gigantochha pseudoarundinacea* {Steud.)Widjaja: a. leaf sheath; h. culm sheath; c. young shoot. From *Widjaja 1462.*

up to 1 mm and joint with the ligule, glabrous ; ligule entire base part up to 2 mm, toothed irregularly with fine hairs, the lower leaf sheaths with slightly emarginate collar-like callus.

Spikelet-groups on the leafless culm, up to 148 spikelets in a cluster, ovate, subacute, 7.5 — 10 mm long, with 4 perfect florets and 1 sterile floret; glumes 3 — 4 mm long with short white hairs on the apex margin, broadly ovate, broadly acute and mucronate at the apex ; lemmas 4—9 mm with short white hairs on the apex margin ; acute and with a mucronate apex ; palea 3 — 7 mm acute at the apex, 2 — 3 veins between keels and 2 veins between keels and edge; lodicules variable, 1 to 3, usually 3 in the uppermost fertile floret, oblanceolate, fimbriate, generally with one slenderer than the others, up to 1 mm high ; anthers 6, yellow, whole length of the stamens form the staminal tube ; ovary pyriform ; caryopsis not seen.

ANATOMY. Macrohairs of leaf lamina few and slightly short, 107 — 175μm ; microhairs with distal cells (23 — 36 μm) slightly smaller than basal cells (33 — 40 μm). Prickle-hairs numerous, 29 — 33 μm. Papillae, 4 long and 4 short, overarching each stoma. Stomata in 3 — 4 files, outlines obscured by overarching long papillae. Long cells in 7 files on intercostal zone, with sinuous walls.

In transverse section of leaf lamina it appears that the fusoid cells are 59 — 66 μm in horizontal diameter and 15 — 25 μm in vertical diameter. Seven small vascular bundles between successive large vascular bundles. Bulliform cells 3 cells together, elongated, 40 — 45 μm by 52 — 62 μm.

Epidermis of culm : Short cells mostly rectangular, 10 μm in pairs with rectangular and narrow silica bodies. Papillae surrounding the stomata not covering the pores of the stomata. Stomata 40 μm long by 25/um wide. Long cells 150 — 230μm long, rectangular, slightly rounded at the ends, walls not sinuous and only slightly wavy.

DISTRIBUTION AND ECOLOGY

This bamboo is cultivated in Java and West Sumatra (Bukittinggi and Payakumbuh) ; according to the local people in West Sumatra, it grows also in Mentawai Islands. It has been introduced into the Malay Peninsula (Holttum 1958) and cultivated in the Calcutta Botanic Gardens as well (McClure 1966). McClure also pointed out that the plain green bamboo collected by Fairchild and Dorsett in Sibolangit Botanic Gardens (North Sumatra) in May 1926 and planted in the western Hemisphere was this species. However, I have not seen any collections of bamboo, from Sibolangit area which belongs to *G. pseudoarundinacea.*

VERNACULAR NAMES

JAVA : awi andong, awi gombong (Sundanese) ; pring gombong, pring surat (Javanese), BALI : tiying jajang suwat. SUMATRA : buluh batuang dan to (West Sumatra).

USES

In Indonesia this species is the second most important bamboo after *G.*

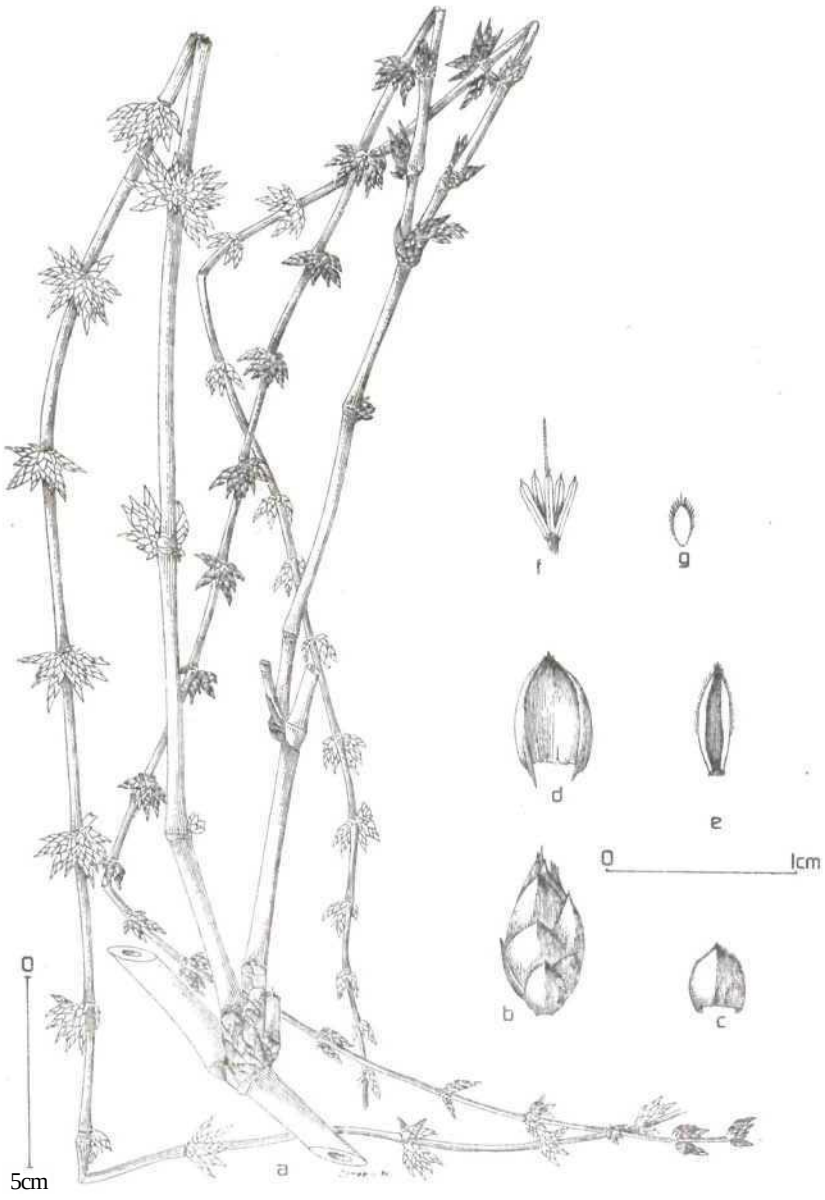


Fig. 2. *GigantochSoa pscudoarundinacea* (Stem**I.) Widjaja: a.** inflorescence; b. spikelet-c. (flume; d. lemma; e. palea; f. anthers; g. lodicui.v From ***Widjaja 1462***

apus. It is widely used for building materials, water pipes, furniture and musical instruments. The local people also use it for handicrafts and for making basketry, although the result is not as good as those made of *G. apus.*

NOTES

The flowers of *Bambusa pseudoarundinacea* have already been described a long time ago by Steudel (1854), but no fruit has been reported thus far. During 1982 this species flowered in many areas in Indonesia but the search for fruit ended without success.

In West Java the population of *G. pseudoarundinacea* is somewhat variable. Ochse & Bakhuizen v.d. Brink (1931) described 3 kinds of cultivated bamboos under the vernacular names "awi andong", "awi andong leah", "awi andong keukeus" recognized by the Sundanese from their culm sizes. The other difference seen is in the number of bristles present on the auricles of the culm sheaths, but otherwise they cannot be recognized as formal infraspecific taxa. On the other hand in Central Java and East Java the whole population of *G. pseudoarundinacea* is apparently uniform because there is only one kind known, called "pring surat". Kurz (1876) described 2 variants of *G verticillata* under vernacular names "bambu andong besar" *(G. maxima* Kurz var. *major* Kurz *in* Teijsm. & Binn., Cat.Hort.Bog. 20. 1866, *nom.nud.)* and "bambu andong kecil" *(G. maxima* Kurz var. *minor* Kurz *in* Teijsm. & Binn., Cat.Hort.Bog. 20. 1866, *nom.nud.)*based on their culm sizes and spikelets. The first variant has green spikelets and large sized culm, and probably corresponds to "awi andong" of Ochse. The second variant apparently was based on a different species because Kurz said that it has purplish anthers. Hasskarl's (1848) extensive description of this species might have been based on other species because he did not mention any culm markings, and the anthers were said to be yellow with the purple stripe. The vernacular name "awi tamiang" he used pointed to an affinity with *Schizostachyum iraten.*

Munro (1868) quoted *Bambusa verticiilata* Willd. as a basic name (excluding the synonym) for this species, but Kurz (1876) rejected *Bambusa uerticillata* simply because the vernacular names indicated on its type specimen was "tring atter" which normally was applied to *Gigantochloa after.* In introducing the name *Gigantochloa maxima* Kurz for this species for a bamboo from Bangka Island, Kurz (1864) apparently took the idea from Bam*busa maxima* Poiret, but the latter species had a spiny stem. In describing *G. maxima* in 1876 Kurz did not mention again about the synonymy of *B. maxima* Poiret. Holttum (1958) objected to the treatment by Munro (1868) and accepted Kurz's (1876) interpretation. He also objected to the treatment by Backer (1928), which included *G. maxima* and *G. atter* **(Hassk.)** Kurz as well as *G. robusta* Kurz under the present species. Backer's treatment was followed by Monod de Froideville (1968),

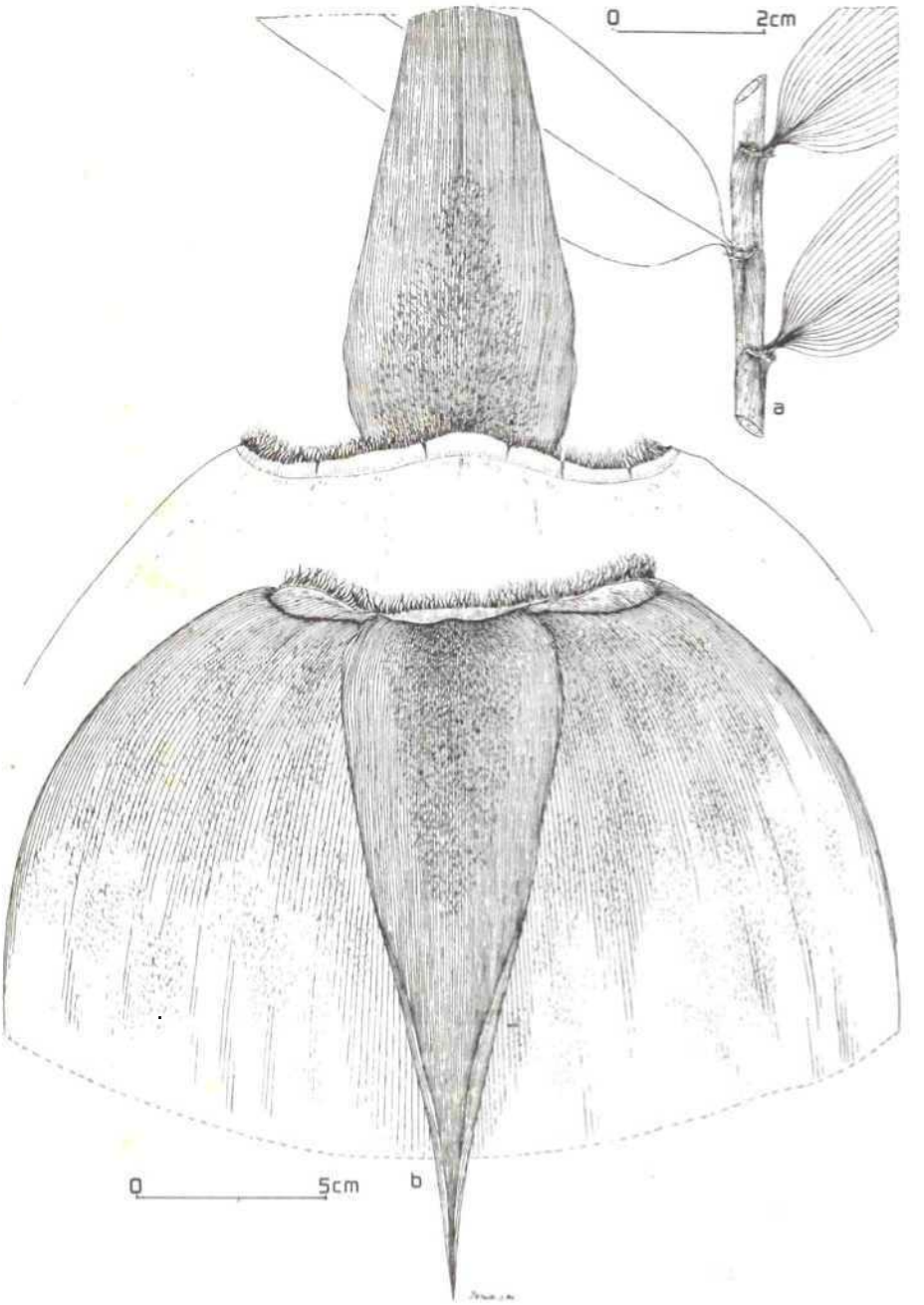


Fig. 3. *Gigantochloa robusta* Kurz: a. leaf sheath. From *Widjaja s.n.;* b. **culm** sheath; From *Widjaja 1456.*

I agree with Holttum's interpretation, but Steudel (1854) had described a new species for a bamboo collected by Zollinger in Java as *Bambusa pseudoarundinacea.* This name was published ealier than *G. maxima* sensu Kurz, so a new combination is proposed for this species.

The leaves of *G, pseudoarundinacea* resemble those of *G. alter* and *G. atroviolacea* in some cases, but its culm sheaths and anthers tip do not. The culm colour of *G. pseudoarundinacea* resembles *G. robusta* but its culm sheath and pseudospikelet characters are different. This separation was also supported by numerical analysis (Widjaja & Lester 1987).

One of the varieties recognized by Holttumas *G. maxima* var. *minor* has been described as *G. rostrata* Wong (1982). Another variety, *G. maxima* var. *uiridis,* has many similarities to the wild *G. wrayi* (Wong, 1983, pers. com.) and I agree with him since I saw that the spikelets of its type specimen resemble those of *G. wrayi,* as do the culm sheaths.

2. GIGANTOCHLOA ROBUSTA Kurz - Fig. 3, 4 & 5

Gigantochloa rohus,ta Kurz *in* IIMI. For. 1 : 344. 1876 ;Gamble in Phil. J. Sci. Bot. 8 : 204. 1913.

Gigantochloa uerticiltata (Willd.) Munro scnst; Backer, Handb. PI. Jav. 2 : 275. 1928 (p.p.) ; Monod de Froideville in Backer & Bakh. v.d. Brink f., Fl. Jav. 3 : 635. 1968 (p.p.).

Clumps densely tufted, rhizome at the centre of the old clumps often slightly raised above the ground, with yellow striped culms and aerial roots on the nodes at the basal part of the culms.

Young shoots stubby and massive, brownish green, covered with iong dark hairs.

Culms up to 20 m high, 7 — 9 cm diameter, walls 18 mm thick on the base, the longest intemodes about 40 cm, dirty yellowish to light green with yellow stripes on the lower part (to about 2 m high), with scattered brownish hairs on the upper part of the non-waxy internodes.

Culm sheaths appressed on the young culm and deciduous with age, 17 — 35 cm long, deltoid but with truncate apex, covered with long dark hairs (2 mm long) ; auricles well developed along the sheath apex, crisped and joined to the blade's base, up to 7 mm high with bristles up to 5 mm long; ligules 5 mm, irregularly incised and ending in 10 mm long bristles; blades reflexed, triangular, 10 — 14 cm long by 3.5 — 5 cm wide.

Leaf blades lanceolate, 15 — 27 cm long, 2.5 — 5 cm wide, hairy on the lower surface, with about 4 mm long pseudopetioles; leaf sheath auricles low, firm, 1 mm high, with long bristles up to 5 rrrm; ligules denticulate, 1 mm high with 3 mm long fine hairs.

Spikelet-groups of up to 110 spikelets in a cluster, spikelets ovate, flat, slightly hairy on the tips, 9 — 10 mm long, 4 mm wide, consist of 4 perfect florets and 1 imperfect one; glumes 2—3 ovate, acute at the apex, slightly hairy on the tips and provided with brownish hairs along the margin, 3 — 5 mm long; lemmas ovate, narrowly acuminate at the apex and also slightly

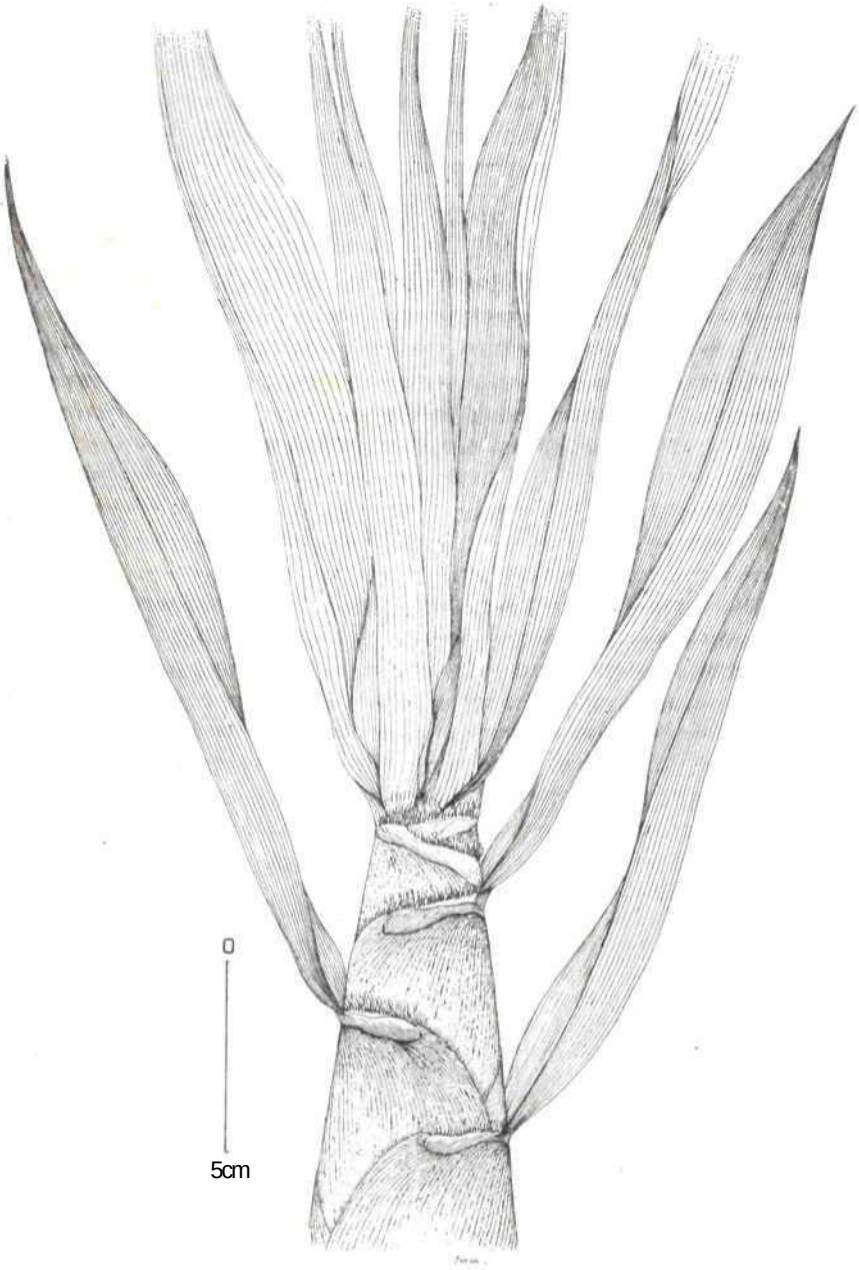


Fig. 4. *Gieantochloa robusta* **Kurz: young** shoot. From *Widjaja s.n.*

Fig. 5. *Giganlochloa robusta* Kurz: a, inflorescence; b. spikelet; c. glume; d. lemma; e. palea; f. anthers. From *Widjaja s.n.*

hairy and fringed with brown hairs along the margin, 7 — 8 mm long; paleas 6 —7mm long, with notched apex and broad; anthers 6, yellowish, apiculate, slightly hairy at the tips.

ANATOMY. Macrohairs on abaxial leaf lamina epidermis few and very short, 40 — 67 μm; microhairs with distal cells (26 — 34 μm) slightly smaller than basal cells (29 — 37 ,μm) ; prickle hairs few, 26 — 50 μm long; papillae 4 long and 4 short, overarching each stoma; stomata in 3 — 4 files, outlines obscured by overarching long papillae ; long cells in 6 — 8 files on intercostal zones, with sinuous walls.

In transverse section of leaf lamina it can be observed that there are two smaller vascular bundles on the adaxial side and two on the abaxial side of the large vascular bundle in the middle of the midrib ; fusoid-cells 55 — 65 μm by 25 — 35μm, seven small vascular bundles between successive large vascular bundles ; bulliform cells of 3 — 5 cells together, broadly elongated, 75 — 90 μm bv 45 - 55 *μm.*

Epidermis of culm : Short cells mostly rectangular, 15μm, in pairs with rectangular, hardly visible silica bodies, papillae surrounding the stomata not obscuring the pores : stomata 50 μm long by 25 urn wide ; long cells long, rectangular, slightly polygonal, 140 - 160 *μm* long, slightly smaller at the ends, with sinuous walls.

DISTRIBUTION AND ECOLOGY

This species was originally reported by Kurz (1876) from the hilly regions of West Java, namely Bandung, Southern Bogor and Banten. Collections have been seen from Banyuwangi (East Java) and I also found this bamboo in Bali and in the highlands of West Sumatra. According to the people in West Sumatra, this species also occurs in Mentawai Islands. Moreover a collection has been seen from the Moluccas (P. Jemdana). It seems therefore that this species ranges from the lowlands up to highland areas 1000 m above sea level.

VERNACULAR NAMES

JAVA : awi mayan (Banten). BALI : tiying jelepung. SUMATRA : buluh riaw (West Sumatra), buluh poring (Batak Tapanuli).

USES

This bamboo was used for making "kele", a typical water carrying vessel of the Baduy tribe in West Java and also for making angklung, a tradisional musical instrument. They also use this bamboo for building materials such as floors and walls.

The people in Southern Banten sold the young shoots of the present species to Jakarta. The close similarity of the young shoots of this bamboo

and those of *Dendrocaiamus asper* (the most edible one) may deceive customers in the city.

NOTES

When it was first described no type or any other specimen was cited by Kurz (1876). He gave the vernacular name bambu wulung for this species (which represents *G. atroviolacea)* whereas the present bamboo species is called awi mayan in Banten and Southern Bogor as written by Ochse & Bakhuizen v.d. Brink (1931), who pointed out that it was probably a form of *Dendrocaiamus asper.* However, Kurz's illustration clearly shows that this species has yellowish green culms with yellow stripes ; his identification key indicated that this bamboo was green but the other vegetative characters were correctly described. I have reason to believe that the bamboo collection numbers XIV B 1 and 1a, XIV B 20 and 20a which are now still growing in Bogor Botanical Gardens were named *G. robusta* by Kurz when he was the keeper of the Bogor Botanical Gardens in 1859 — 1863. These plants were planted during Hasskarl's time (see Catalog plantarum in Horto Bogoriensi Cultarum Alter, 1844. 106. under the name *Bambusa sp.*. Bantam expedition no. 92, bambu mayang). This description presented above is based on a flowering herbarium specimen of *E.A . Widjaja s.n.* collected from Java, Rangkasbitung, Bojongbarang, Cimarga and also on a living plant in Bogor Botanical Gardens XIV B 20.

In the herbarium this bamboo is very similar to *G. levis* but differs in having a non-waxy culm without brown hairy rings on the upper part of the intemodes, slightly persistent culm sheaths, narrow and acuminate lemma apex, and long hairs on the anther tips. Because of the difficulty in separating this species from *G. levis* without having good field notes, Gamble (1913) reported doubtfully that *G. robusta* occured in the Philippines. Merrill (1918) also mentioned that this species probably was identical with *G. levis.*

3. GIGANTOCHLOA ATTER (Hassk.) Kurz - Fig 6, 7, 8 & 9

Gigantochloa alter (Hassk) Kurz *in* Nat. Tijdschr. Ned. Ind. 27 : 226.1864, Munro *in* Trans, Linn. Soc. 26 : 125, 1868 ; Kur?: in J, As, Soc, Bengal 39 (2) : 67. 1870 ; Kurz in Ind. For. 1 : 344. 1876 ; Camus. Lea Bambuse'es : 140. 1913 ; Camus & Camus, Fl. L'Indo Chine 7 : 622. 1922 ; Ochse & Bakh. v.d. Brink, Veg. Dutch E. Indies 317 - 319. 1931 — *Bambusc thouarsii* Kunth. *0. atter* Hassk., Plant. Jav. Rar. : 41. 1848.— TYPE : *Kurz s.n.* (K-Neotype), Java ex Herb. CB Clarke 8/88. Fl.

Gigantochloa uerticillata ^Willd.) Munro sensu Backer, Handb. Fl. Jav. 2 : 275.1928 (p.p.) ; Heyne, Nutt, Plant. Ind. 1 : 300. 1950 : Monod de Froideville in Backer & Bakh. v.d. Brink f.. Fl. Jav. 3 : 635. 1968 (p.p.).

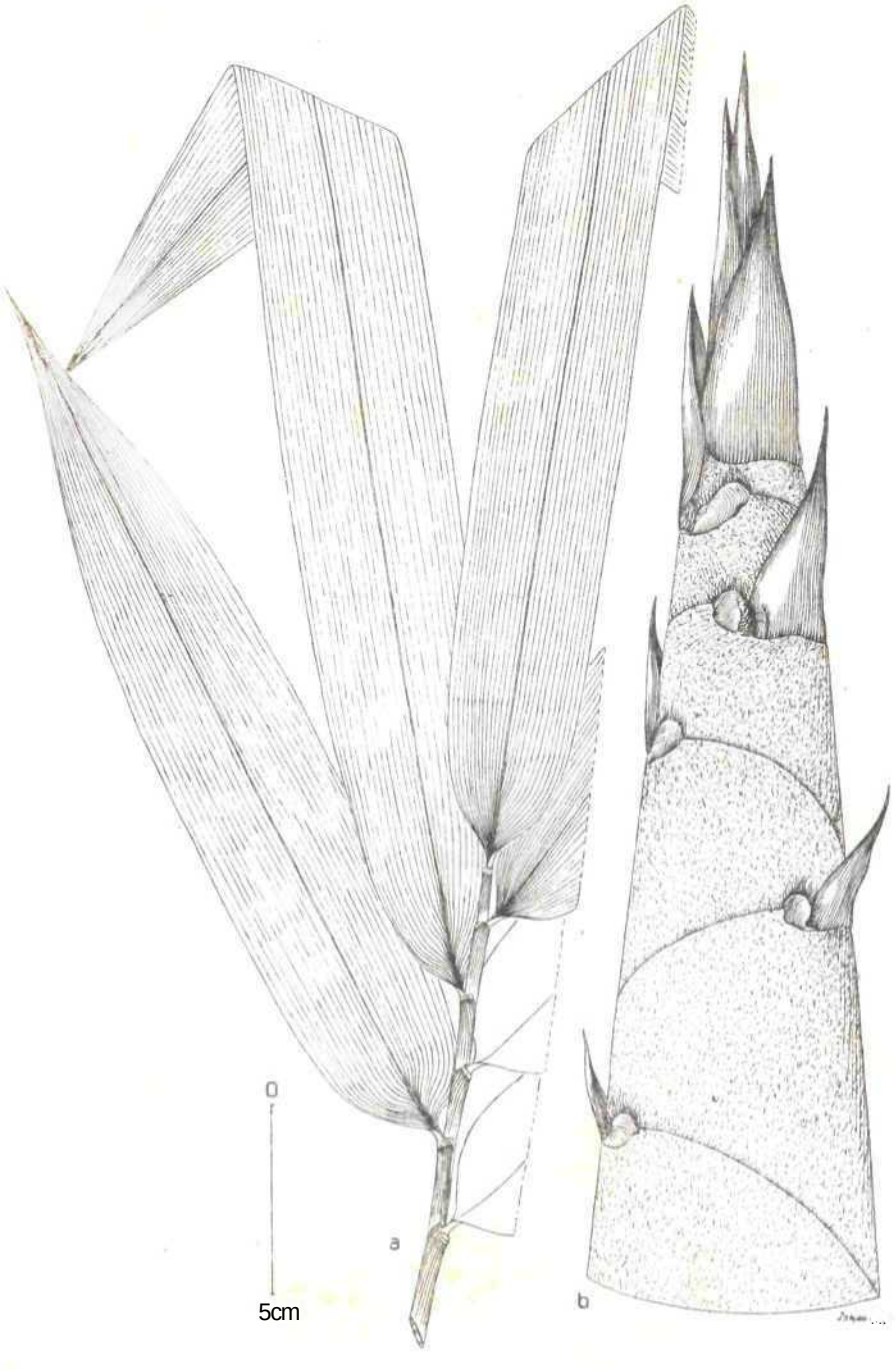
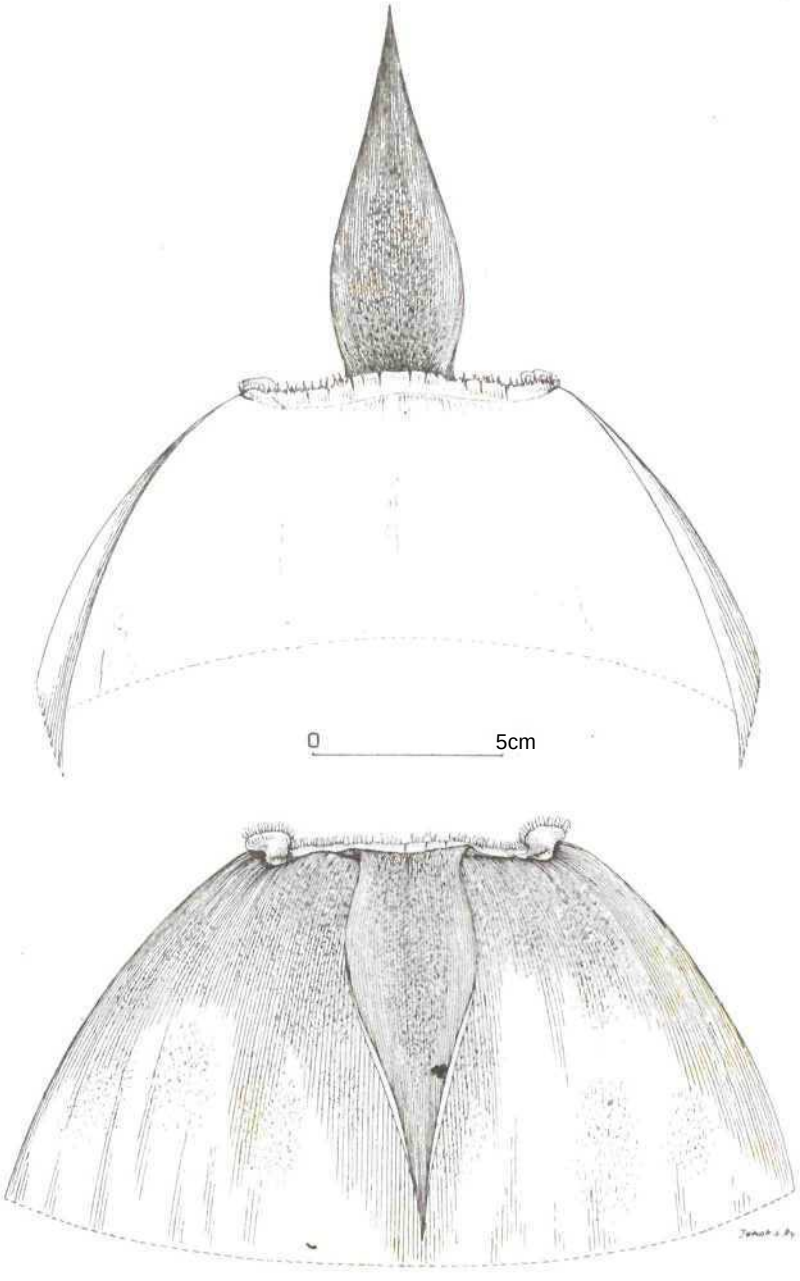


Fig. 6. *Gigantochloa alter* (Hassk.) Kurz; a. leaf; b. young shoot. From *Widjaja 1783.*



Fie. 7. *Gigantochloa alter* (Hassk.) Kurz: a. culm shpath. From *Widiaia 1 783.*

Fig. 8. *Gigantochha alter* (Hassk.) K rz;a. inflorescence; b. spikelet; c. g)ume;d. lemma e . palea; f. anther. **From** *Widjaja 1783.*

Clumps densely tufted, irregularly raised above the ground especially in the centre, aerial roots on the lower part. On the whole the clumps appear light green.

Young shoots slender, green to dark green with appressed black hairs.

Culms up to 22 mm high on old clumps, 5 —10 cm in diameter, culm wall up to 8 mm thick ; the longest intemodes 40 — 50 cm, with dark brown hair appressed on the upper part of the internode ; colour evenly light green with distinct pale rings on the nodes.

Culm sheaths with black hairs, 21 — 36 cm long, deciduous, or sometimes only the lower ones rather long persistent, narrowly triangular with truncate apex ; auricle rounded to slightly curved outward, 3—7 mm high, 6 — 9 mm in lateral extent, with bristles 4—6 mm long ; ligules 3—6 mm high, irregularly toothed ; blades deciduous, reflexed.

Leaf blades lanceolate, oblong, acuminate at the apex, 20 — 44 cm long by 3 — 9 cm wide, glabrous ; pseudopetioles 3—5 mm long ; auricles firm and low, 1 mm high, 2 mm in lateral extent, yellowish brown ; ligules 2 mm high.

Spikelet-groups with up to 35 spikelets in a cluster, ovate lanceolate, flattened at the base, 9 — 12 mm long by 3 — 4 mm wide, consisting of 4 perfect florets ; glumes acute-mueronate at the apex with brownish cilia, — 6 mm long ; lemmas with brownish cilia, broadly acuminate at the apex, 6—9 mm long ; paleas shorter than lemmas, acuminate apex blunt, with brownish to white cilia, 3—4 veins between keels and 1—2 veins between keel and margin, 5 — 8 mm long ; anthers 6, yellow, 5 mm long, with slightly long pointed and hairy tip ; caryopsis not seen.

ANATOMY. Macrohairs on the abaxial epidermis of leaf lamina few, on the costal zone, 182 — 360 μm long ; microhairs with distal cells (36 — 46 μm) longer than basal cells (33 — 36μm) ; prickle-hairs relatively few, 23 — 39 μm ; papillae, 4 long and 3—4 short, overarching each storaa ; stomata in 3 — 4 files, outlines obscured by overarching long papillae ; long cells in 6 — 7 files on intercostal zone with sinuous walls.

In transverse section of leaf lamina it can be observed that there are two smaller vascular bundles on the adaxial side and 6 on the abaxial side of the large vascular bundle in the middle of the midrib ; moreover there are seven small vascular bundles between successive large vascular bundles ; fusoid-cells 80 — 90,μm in horizontal diameter and 20 — 22μm in diameter ; bulliform cells 3 — 4 cell together, about 80 - 85μm by 70 — 80 μm.

Epidermis of culm : Short cells mostly trapezoid, some rectangular, 10 μm long, in pairs with rectangular silica bodies ; papillae surrounding the stomata but not obscuring the pores ; stomata 40 μm long by 30 μm wide : long cells short 40 — 70 μm, very sinuous, thicked, rhomboidal in shape, broadest in the middle and slightly tapering at the ends.

DISTRIBUTION AND ECOLOGY

This bamboo is found in the lowland and it has been observed growing from near the coast to about 1400 m above sea level. In Java and Sumatra this bamboo is commonly cultivated in village areas and very rarely it is

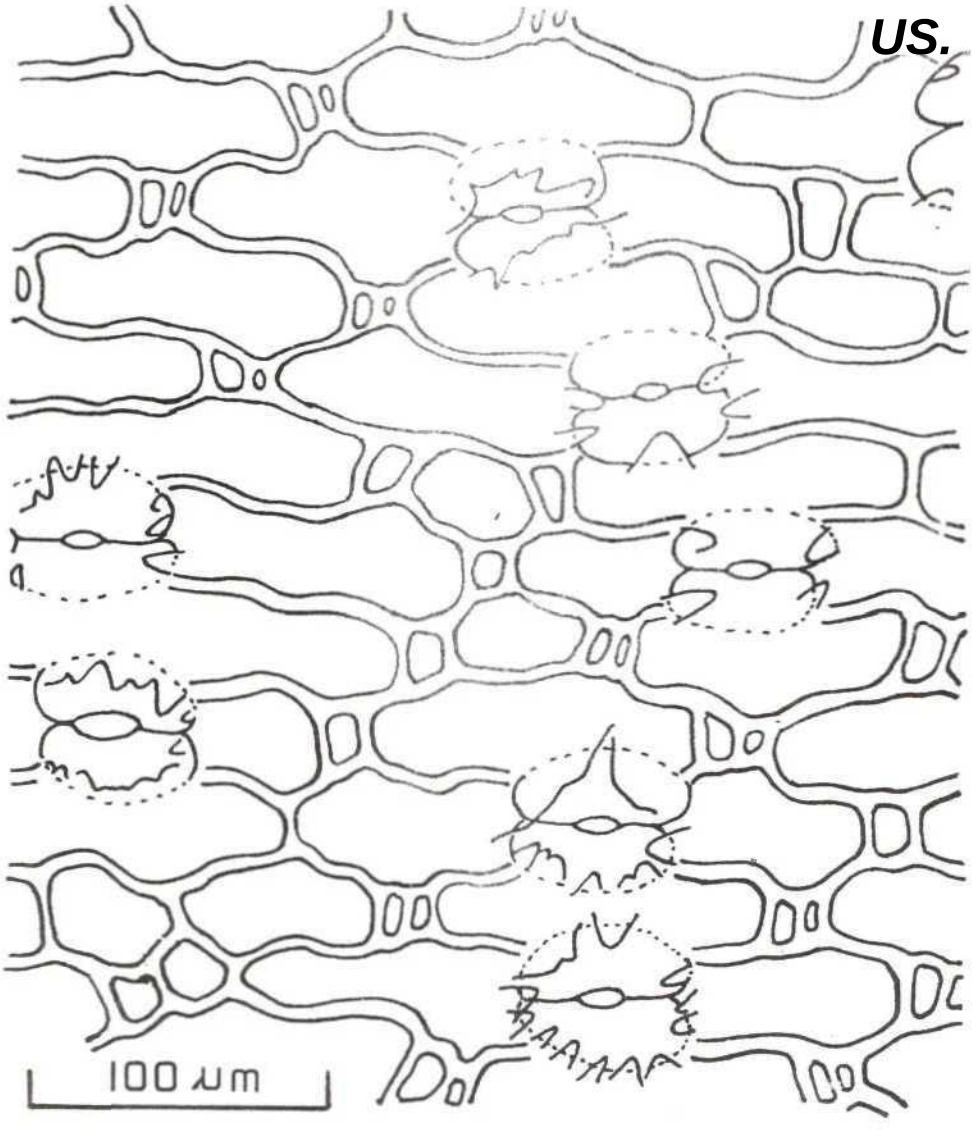


Fig. 9. Cuim epidermis of *Cigantochloa ctter* (Hassk.) Kurz.

found near the forest, on the forest edge and in other disturbed areas probably as remnants from previous human settlement. This bamboo grows faster than *G. atroviolacea,* but slower than *G, pseudoarundinacea* or *G. apus.*

VERNACULAR NAMES

JAVA : pring Jawa, pring legi (Javanese), awi ater, awi temen (Sundanese), perreng keles (Madurese).

USES

In Central Java people called this species "bambu legi" which means sweet bamboo. According to the people in Central Java, young shoots of this bamboo are as delicious as those of *Dendrocalamus asper.*

The culm of "bambu ater" is very useful for building material although it is not as strong as *G. pseudoarundinacea* or *G. apus.* In West Java this bamboo is used also for making bamboo musical instruments and other handicraft, but of inferior quality compared to *G. atroviolacea.*

NOTES

Hasskarl (1848) described *Giganlochloa atter* under the name *Bambusa thouarsii* Kth. *P atter* Hassk. as having green culms, internodes with white-hairs at the base and apex ; he did not mention other variation such as black culms. His delimitation was followed by Munro (1868). Later Kurz (1876) gave a short description and culm illustration of this species, in which however he included also the black-culmed *G. atroviolacea* as a variety, and his opinion was followed by Camus (1913), Backer (1928) and Monod de Froideville (1968) by including these two species together with *G. maxima* and *G. robusta,* under the name *G. verticillata,* Kurz (1876) explained that this species could be separated from G. *verticillata* in having erect culm sheath blades and yellow or purple anthers as opposed to reflexed blades and yellow anthers of the latter. However it has been found that most of the culm sheath blades are reflexed although sometimes it could be seen that the blades on the lower part may be erect. The anthers of all these species have been found to be yellow.

Gamble (1896) mentions that the sheath of G. *verticillata* somewhat resembles G. *atter* and *Dendrocalamus giganteus.* However in the field, except for the culm colour, *G. atter* could also be distinguished from G. *pseudoarundinacea* and *Dendrocalamus giganteus* because the culm sheaths have rounded auricles well separated from the blades. In G. *pseudoarundinacea* and *D. giganteus* the auricles extend to the base of the blades. The sterile

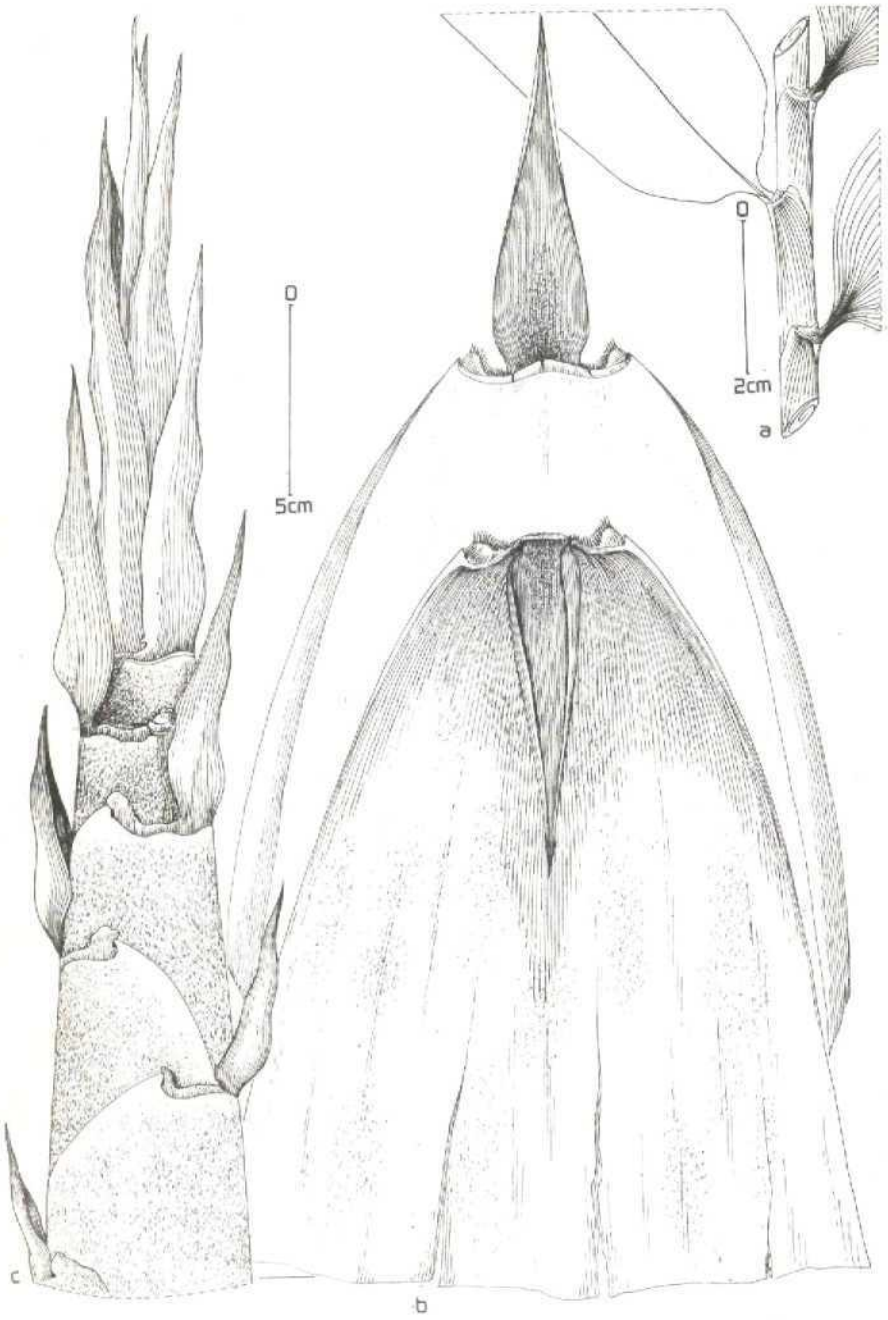


Fig. 10, *Gigantochloa atroviolacea* Widjaja: a. leaf sheath; b. culm sheath; c. young shoot. From *Ramlanto s.n.*

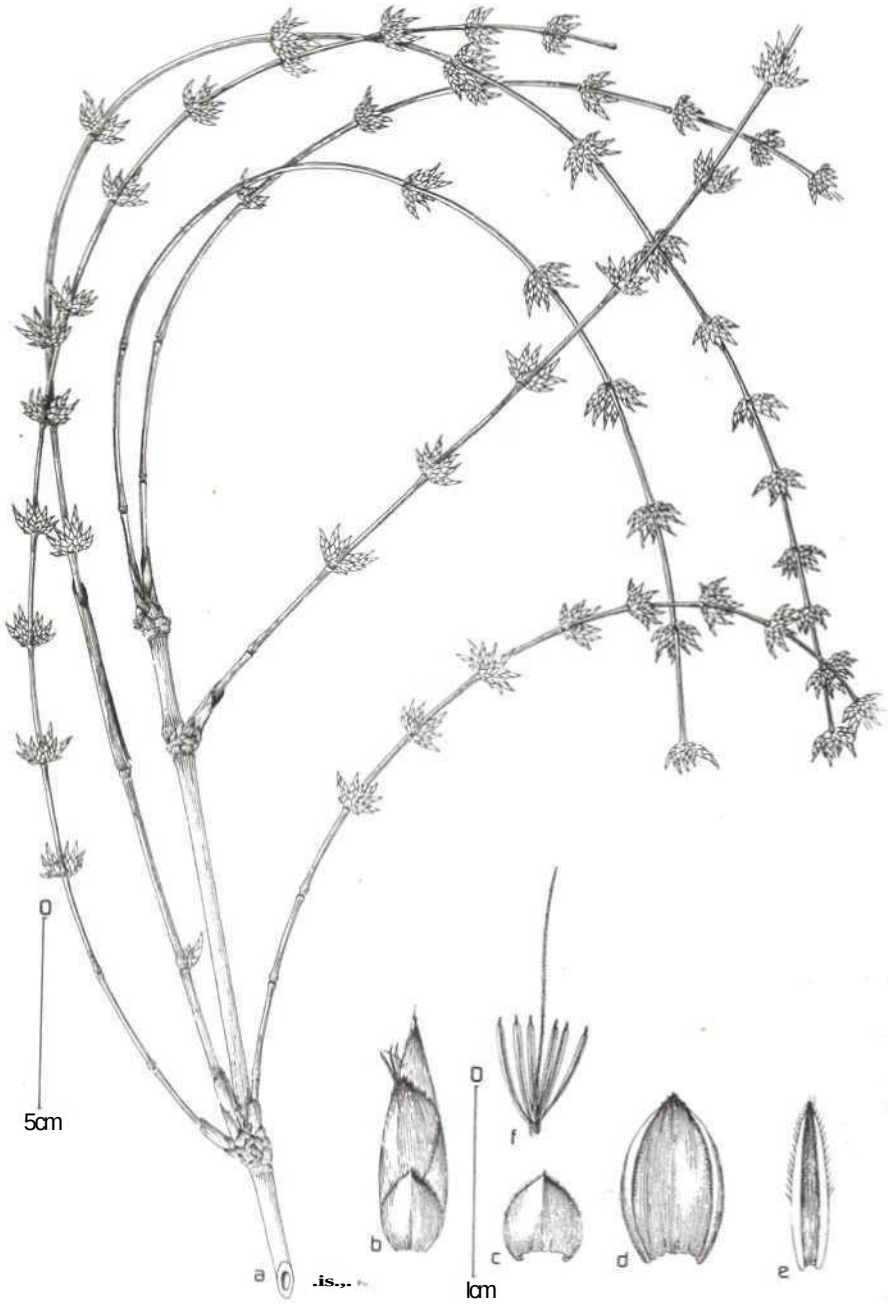


Fig. 11 *Gigantochloa atroviniacea* Widjaja: a. inflorescence; b. spikeiet; c. glume; d. lemma; e. palea; f. anthers. From *Ramtanto* **ff.n.**

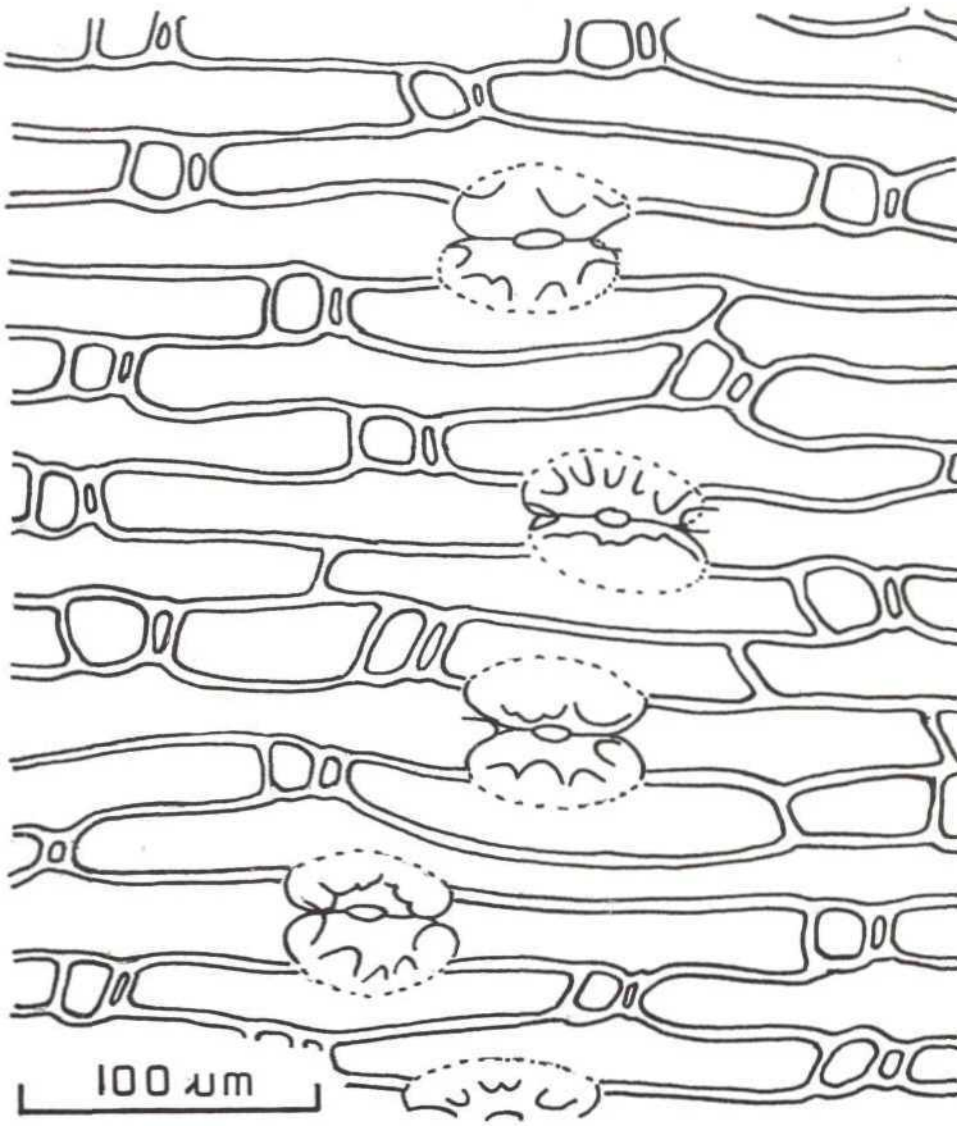


Fig. 12. Culm epidermis of *Gigantochtoa atroviolacea* Widjaja.

floret; glumes mucronate at the apex, broadly ovate, 3 — 5 mm long, covered with brownish hairs, lemmas acuminate at the apex 6 — 10 mm long ; paleas shorter than lemmas, acute and pointed-tipped, 4 veins between keels and 1 — 2 veins between each keel and the margin, 5 — 9 mm long ; anthers 6, ysllow, 4 — 5 mm long, slightly hairy tipped and short pointed ; lodicules absent ; ovary hairy, oblong ; caryopsis not seen.

ANATOMY. Macrphairs on the costal zone of leaf lamina few, 180 — 190 *Jam ;* microhairs with basal and distal cells equal in length, 33 — 40 um. Prickle-hairs relatively few, 26 — 40 um. Papillae, 4 — 5 long and 3 — 4 short overarching each stoma. Stomata in 3 — 4 files, outlines obscured by overarching long papillae. Long cells in 4 — 5 files on intercostal zone, w&iis sinuous.

In transverse section of leaf lamina it appears that there are four smaller vascular bundles on adaxial side and 5 on the abaxial side of the large vascular bundle in the middle of the midrib. Fusoid cells 75 — 85 /Um in horizontal diameter, vertical diameter 40 —45/um. Seven small vascular bundles between successive large vascular bundles. Bulliform cells 3 cell together, 45 — 55 Aim by 35-45^m.

Epidermis of culm : Short cells mostly rectangular, a few trapezoid, 15 Aim, in pairs with narrow and rectangular, hardly visible, silica bodies. Papillae surrounding stomata but not obscuring the pores. Stomata 40 —47 um in length and 28 — 32/um in width. Long cells long (35 — 45 um), rectangular, not s*inuous, slightly tapering at the ends. Tanin occurs in the culm and can be seen in transverse section just below the epidermis or in the cortical cells.

DISTRIBUTION AND ECOLOGY

This species was brought from Java to Calcutta Botanical Gardens 100 years ago. According to Wertz (1983, pers. comm.) a large clump of black bamboo was imported from Java many years ago and planted at Mirk Wood, N. Queensland.

This bamboo is grown widely in West Java especially in Banten and Sukabumi district as well as in Central Java. It has been successfully introduced into South Sumatra as well, and was" also introduced recently into Thailand.

It seems that *G. atroviolacea* likes to grow in dry areas on soil rich in limestone. The preferred purplish colour of the culm is more prominent when it grows in dry areas.

VERNACULAR NAMES

INDONESIA : bambu hitam (Indonesian). JAVA : pring wulung, pring ireng, pnng ulung (Javanese), awi hideung (Sundanese).

USES

The famous musical instruments of West Java — angklung, calung, gambang, and celempung —are made from black bamboo. Apparently the thin culm of this species has specific features so that it is very suitable for musical instruments. The peculiar colour of the culm makes this species much sought after by handicraft industries as well. The recent exploitation of black bamboo for making furniture has jeopardized the future of this plant, since no new planting is being made.

NOTES

This species is closely related to *Gigantochloa atter.* However, *G. atroviolacea* can at once be distinguished from *G, atter* by the purplish culm. rounded to curved culm sheath auricJe and narrow palea with acute tips. Anatomically it is very easy to separate the two species because the configuration of the culm epidermis of the two species is very different. The long cells of this bamboo are longer and less wavy than in *G, atter.*

As has been indicated above this bamboo has the vernacular name "pring (bambu) wulung" which means black bamboo. Kurz (1876) identified this vernacular name with *G. robusta.* There must be some confusion here because the vernacular name of G. *robusta* is bambu mayan.

Kurz (1876) considered this species as a variety of *Gigantochloa atter* (Hassk.) Kurz. Backer (1928) and Monod de Froideville (1968) followed Kurz and also included this species as a part of *G. atter* which they put together with G. *maxima* Kurz and G. *robusta* under G. *verticillata.* The latter, however, is a lodiculate species.

5. GIGANTOCHLOA NIGROCILIATA (Buse) Kurz. — Fig. 13 & 14

Gigantochloa nigrociliata (Buse) Kurz *in* Nat. Tijdschr. Ned. Ind. 26 : 226. 1864; in Ind. For. 1 : 345. 1876; Backer, Handb. Fl. Jav. 2 : 276. 1928; Ochse & Bakh. v.d. Brink, Veg. Dutch B, Ind. 1931; Monod de Froideville in Backer & Bakh. v.d. Brink f., Fl. Jav. 3 : 638.1968. — *Bambusa nigrociliata* Buse *in* Miq., PI. Jungh, 389. 1854.; Miquel, Fl. Ned. Ind. 3 : 416. 1855 — *Oxytenanthera nigrociliata* (Buse) Munro in Trans. Linn. Soc. 26 : 128. 1868. {p.p. quod typus); Kurz (ut *Bambusa (Oxytenanthera) nigrociliata* Buse) *in* J, As. Soc. Bengal. 39 (2) : 61. 1870; Koorders, Exk. Fl. Jav 1 : 177. 1911. — TYPE : *Junehuhn s.n.* ~~K~~— Isotype, *h*—Holotype), Java, Tjibeuretim. Fl.

Schizostachyum serpentinum Kurz *in* Ind. For. 1 : 351 — 352. 1876; Koorders, Rxk. Fl. Jav. 1 : 179. 1911; Koorders, Atlas Exk. Fl. Jav. 1 : 76. 1913 - TYPE: *Kurz n.n.* (K—Holotype), Java. Steril.

USES

The famous musical instruments of West Java — angklung, calung, gambang, and celempung —are made from black bamboo. Apparently the thin culm of this species has specific features so that it is very suitable for musical instruments. The peculiar colour of the culm makes this species much sought after by handicraft industries as well. The recent exploitation of black bamboo for making furniture has jeopardized the future of this plant, since no new planting is being made.

NOTES

This species is closely related to *Gigantochloa alter.* However, *G. atroviolacta can* at once be distinguished from *G. alter* by the purplish culm, rounded to curved culm sheath auricle and narrow palea with acute tips. Anatomically it is very easy to separate the two species because the configuration of the culm epidermis of the two species is very different. The long cells of this bamboo are longer and less wavy than in *G. alter.*

As has been indicated above this bamboo lias the vernacular name "pring (bambu) wuiung" which means black bamboo. Kurz (1876) identified this vernacular name with *G. robusta.* There must be some confusion here because the vernacular name of *G. robtistu* is bambu mayan.

Kurz (1876) considered this species as a variety of *Gigantochloa alter* (Hassk.) Kurz. Backer **(1928)** and Monod de Froideville (1968) followed Kurz and also included this species as a part of G. *alter* which they put together with *G. maxima* Kurz and *G. robusta* under *G. verticillata.* The latter, however, is a **lodiculate** species.

5. GIGANTOCHLOA NIGROCILIATA (Buse) Kurz. — Fig. 13 & 14

Gigantnchloa ***nigrociliata*** (Buse) Kurz ***in*** Nat. Tijdschr. Ned. Ind. 26 : 226. 1864; ***in*** Ind. For. 1 : 345. 1876. Backer, Handb. Ft. Jav. 2 : 276. 1928; Ochso & Bakh. v.d. Brink, Veg. Duicli E. Ind. 1931; Monod de **Froideville fn** Backer & Bakh. v.d. Brink f,. PL Jav. 3 : 638. 1988. — *Bambusa* ***nigrociliata*** Buse fn **Micj., PL** Jungh. 389. 1854.; Miquel, Fl. Ned. Ind. 3 : 41(5. 1S5T> — *Oxytenantheru* ***nigrociliata*** i Buse) Munro *in* Trans. **Linn,** Soc. 26 : 128. 1868. (p.p. quod lypus); Kurz (ut ***Bambusa (Oxytenanthera)*** *nigrociliata* Ruse) ***in*** J. As. **Soc.** Bengal. 39 (2) : 61. 1870; Kooiders, **Exk. Ft.** Jav 1 ; 177. **1911.** - **TYPE** ; *Jutufhuhn s.n. (K~* Isciype, L,—Holotype *t,* Java. Ttibeureum. K).

Hchizostackyiim ***serpentinum*** Kurz ***in*** Ind. For. 1 ; 351 — 352. 1876; Koorders, **Rxk. PL** Jav. 1 : 179. **1911;** Koorders. ALlas Exk. Fl. Jav. *I :* 76. 1913 - TYPE: *iiurz s.n.* (K—Holotype), Java. Steril.

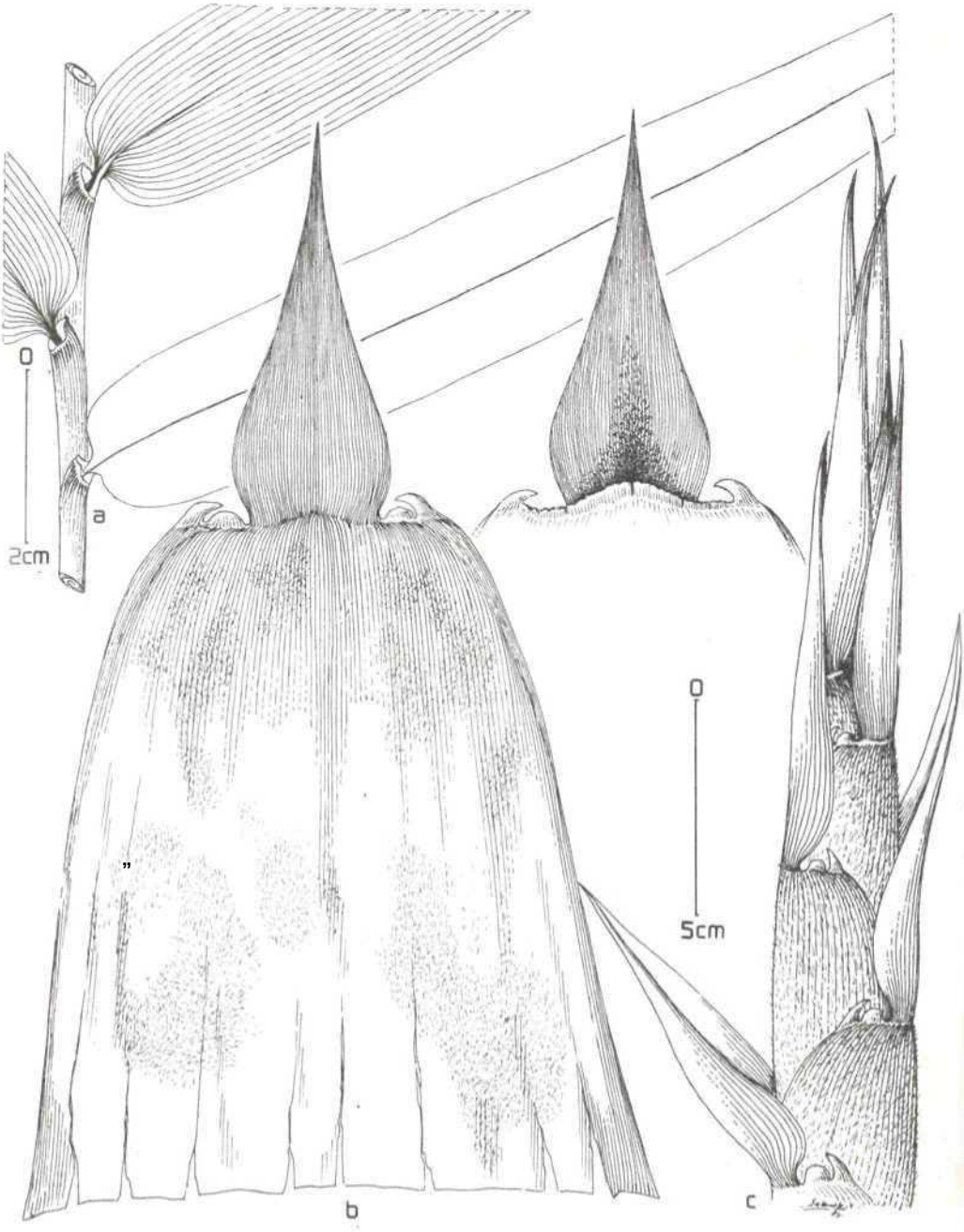


Fig. 13. *Gigantochloa nigrociliatn* (Buse) Kurz: a. leaf sheath. From *Junghuhn s.n.;* b. culm sheath; c. young shoot. From *Widjaja s.n.*

Clump somewhat loosely tufted, the centre hardly raised from the ground, conspicuously clean and bright green-

Young shoots greyish green with appressed dark brown and white appressed dark brown hairs and white hairs so that it looks grey.

Culms up to 20 m tall, 3 — 6 cm in diameter, walls thin and only up to 6 mm thick at the basal internode ; the longest internodes up to 35 cm (but may be up to 50 cm according Backer), bright green with dark brown hairs on the upper part of the internodes.

Culm sheaths slightly persistent, with brown appressed hairs on the backs of the culm sheaths, 11 — 18,5 cm long, triangular with raised rounded auricles and ending in curved sheath extensions,'2 — 4 mm high ; ligules 2 — 3 mm high, irregularly dentate ; blades triangular with broad base and acute apex, 6 — 10 cm long by 2 — 3.5 cm wide, erect to spreading.

Leaf blades lanceolate, 19.5 — 35 cm by 2.5 — 4.5 cm, glabrous above, hairy beneath, on short pseudopetiole 3—6 mm long ; auricles rim-like along the leaf sheath up to 1 mm high, at the apex curved and joined to ligulus ; ligules 1—2 mm high, ciliate.

Spikelet-groups of up to 11 spikelets in a cluster, spikelets ovate—lanceolate, tuender, flattened at the base, with dark brown cilia, 15 — 22 mm long by 3 — 4 mm, consisting of 3 perfect florets ; glumes ovate, mucronate at the apex, 4 — 19 mm long ; lemmas also mucronate, covered with dark brown hairs on the margin at the apex, dark brown oilia spread on the back of lemma margin, 8—20 mm long ; paleas scabrid with dark brown hairs, bifid at the apex, 7 — 20 mm long, 3 - 4 veins between keels, 1 — 2 veins between keels and margin ; anthers 4 — 0 mm Long, maroon to dark magenta, slightly hairy at the shortly apiculate lips, style simple or with 1—2 short branches, stigma purplish ; caryopsis ovate-lanceolate, 15 mm long with hairy apex, according to Backer (1928)

ANATOMY. Macrohairsof leaf lamina many, very long (up to 1000μm), present on both the costal and intercostal zones; microhairs few, distal cells (24 — 40/um) slightly longer than the basal cells (30 - 35μm). Prickle hairs numerous, 15 — 36Aim. Papillae mostly absent but sometimes 4 long papillae overarching the individual stomala. Stnmata in 2 files outline could be seen clearly. Long cells in 2 — 3 files in intercostal zone, with sinuous walls.

Tn transverse section of leaf lamina it can be observed that there is no vascular bundles in the adaxial side but 1 vascular bundle is on the abaxial side of the large vascular bundle in the middle of the midrib. Fusoid cells 90 — 100 μm horizontal length, 40 — 45 μm vertical length. Six to seven small vascular bundles between successive large vascular bundles. Bulliform cells 3 cells together, isodiametric, 80 — 85 urn.

Epidermis of culm : Short cells mostly rectangular, 10 — 15 μm, in pairs with narrow rectangular silica bodies. Papillae none. Stomata 40 um long by 25 |im wide. Long cells 70 — 120 um long, rectangular, thicked, with slightly w^vy walls.

DISTRIBUTION AND ECOLOGY

According to Monod de Froideville (1968) this species was only cultivated in the western part of Priangan (West Java) ; but Ochse & Bakhuizen

v.d. Brink (1931) mentioned that this species grew wild in the surrounding of Pelabuhan Ratu, Sukabumi. Nowadays it is still possible to find this species growing wild in Sukabumi district up to 600 m above sea level. The people there say that they never plant this bamboo because except for its young shoots this species is quite useless. Kurz (1876) reported that this species grew widely in East Java, Bali and Eastern Indonesia, and it was also found up to 1400 m above sea level. It was also reported to grow in Sumatra and Sumbawa.

VERNACULAR NAMES

JAVA : awi ular (Banten according to Kurz 1876), awi Iengka (Sundanese). BALI : tiying tabah.

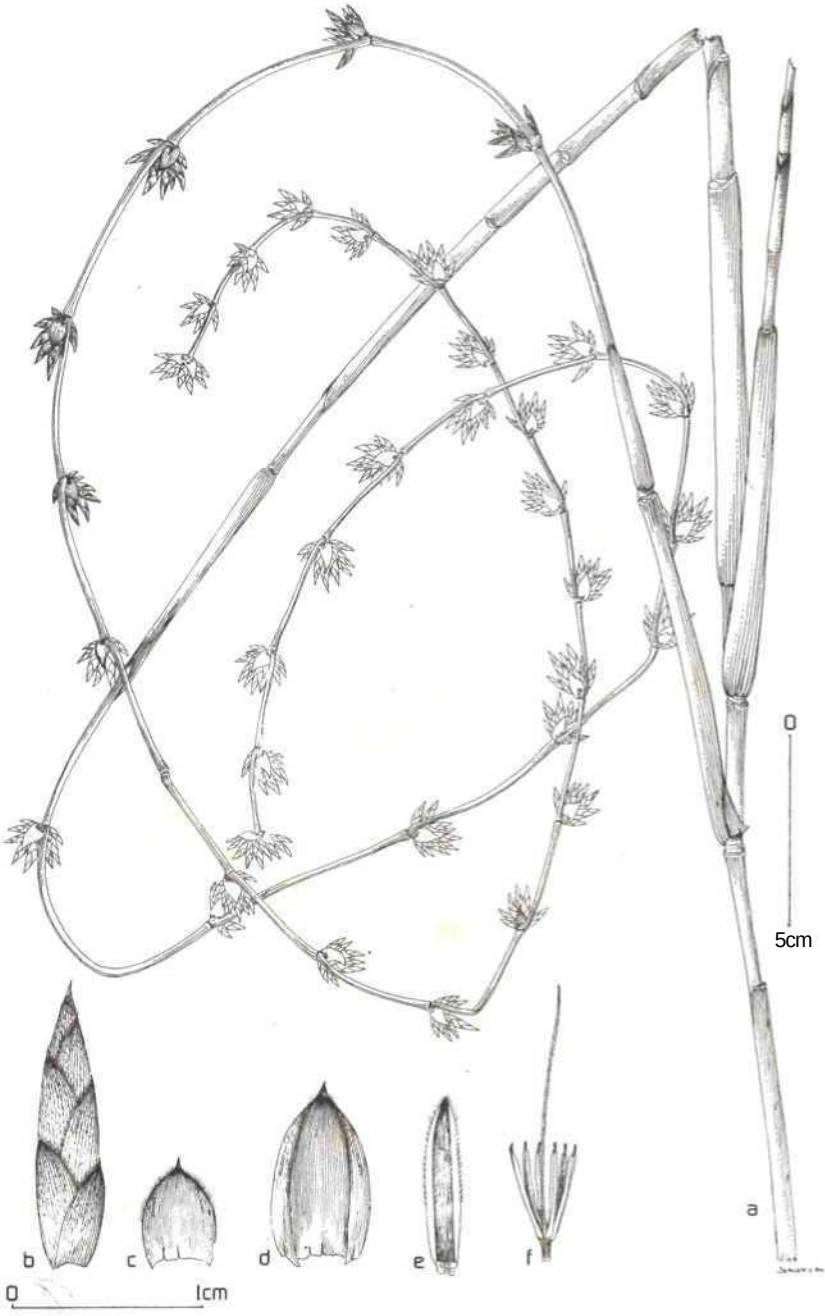
USES

The young shoots of this bamboo are well known and utilized as a raw vegetable in the Sundanese diet.

NOTES

As already stated by Kurz (1870), Munro (1868) confounded more than 3 species under *Oxytenanthera nigrociliata.* Only the Javanese specimens cited by him represent *G. nigrociliata.* The lemmas of specimen *Wallich 5033* from Chapadong, Amherst also have dark brown cilia like the Javanese specimen, but the spikelets are longer and slenderer so that it is more likely to belong to either *G. rostrata* or *G. macrostachya* sensu Gamble (p.p.). Another specimen cited by Munro *(Kurz s.n.* from Andaman Islands) is *Bambusa andamanica* (Kurz 1870). None of the specimens which I studied from India is referable to G. *nigrociUata* and most of them resemble *Wailich 5033.*

Kurz's (1876) description did not mention the curved sheaths extension of the auricles on G. *nigrociliata* as illustrated later by Ochse & Bakhuizen v.d. Brink (1931) and as also described by Backer (1928) and Monod de Froideville (1968). While treating G. *nigrociliata* incompletely, Kurz (1876) also described a new species, *Schizostachyum serpentinum* Kurz, based only on the leaf and the culm sheath. The type specimen of this species has this characteristic curved sheath extension of the auricle so ftiat it is reduced here to the synonymy of G. *nigrociliata.* Flowering grove of *G. nigrociliata* has been observed in South Sukabumi area in February 1985.



Fig, 14. *Gigantochloa nigrociliata* (Buse) Kurz: a. inflorescence; b. spike let; c. glume; d. lemma; e. palea; f. anthers. From *Junghuhn s.n.*

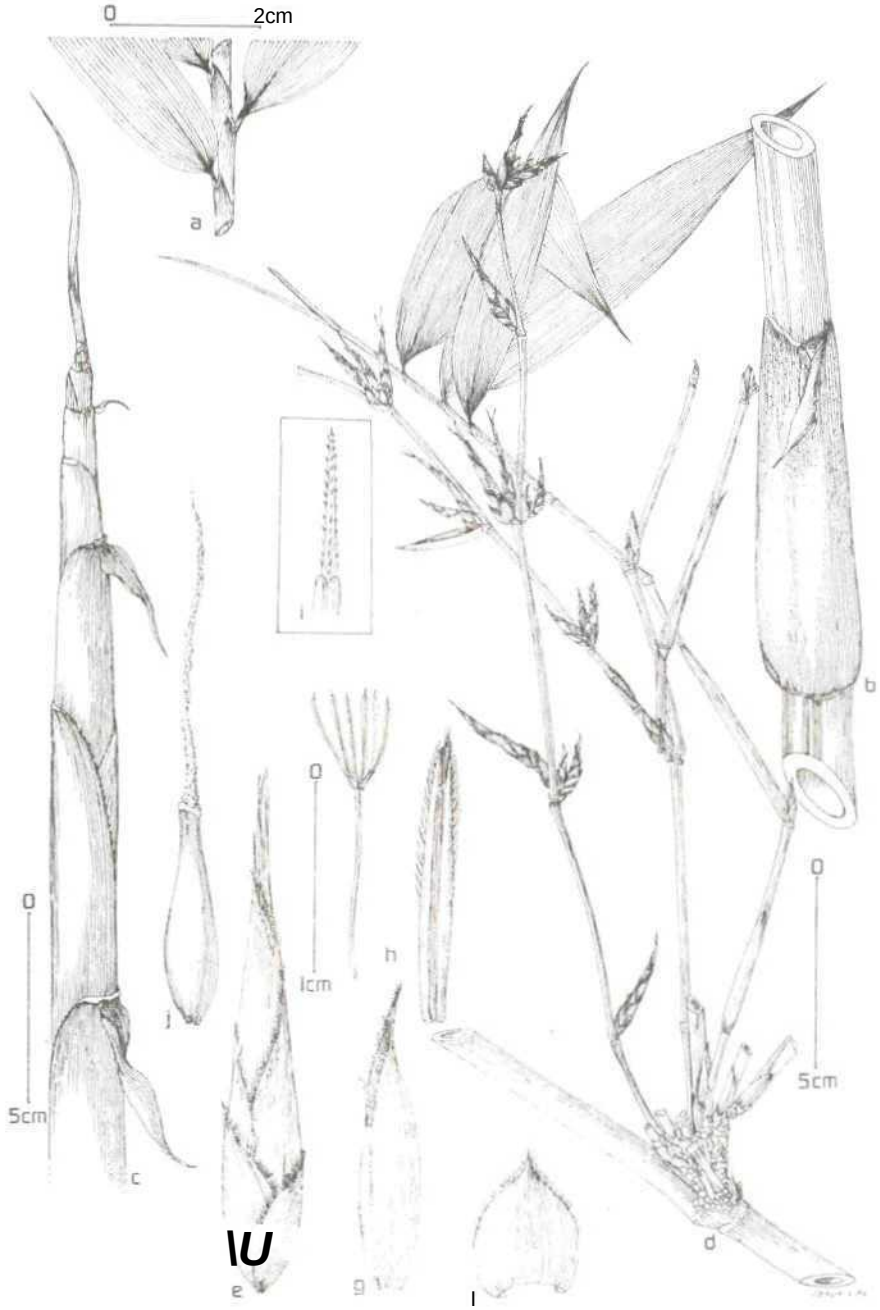


Fig. 15. *Gigantochloa roatrata* Wong: a. inflorescence; b. spikeiet; c. glume; d. lemma; e. palea; f. anthers; g. leaf skeaih; h. young culm sheath; i. young shoot. From *Wong FRI 28981.*

6. GlGANTOCHLOA ROSTRATA Wong — Fig. 15

Gigantochloa rostrata Wong *in* Mai. For. 45 (3) : 349 — 353. 1982 — TYPE : *Wong, FRI 28981* (KEP — Hototype, K — Isotype), Malay Peninsula, Kepong, Forest Research Institute, 15 Oct. 1980, Fl.

Gigantochloa maxima Kurz var. *minor* Holttum in Gard. Bull. Sing. 16 : 116. 1958. — TYPE: *Holttum s.n.* (SING — Holotype), Forest Research Institute, Kepong, Selangor, Sept. 1953. Steril.

Clump loosely tufted.

Young shoots yellowish-green, covered with dark hairs.

Culms up to 8 m tall, slightly drooping, diameter up to 35 cm, the longest internodes about 30 cm long, dark green with yellowish stripes near the culm bases, non waxy, covered with scattered dark hairs and pale hairs on upper part of the internode.

Culm sheaths deciduous, up to 10 cm long, 5.5 cm wide, green with yellowish stripes, with dark hairs appressed on the back ; auricles low, glabrous, dark brown rim 0.5 — 1.5 mm high ; ligules irregularly toothed, 1—1.5 mm high ; blades leaf-like, spreading to reflexed, 8 cm long, 0.5 cm wide.

Leaf blades up to 21 cm long, 2 — iS cm wide, linely hairy, on pseudopetioles 4 mm long ; auricles an inconspicuous rim, glabrous ; ligules 3—8 mm high ; callus scale-like, triangular, 1—2 mm wide.

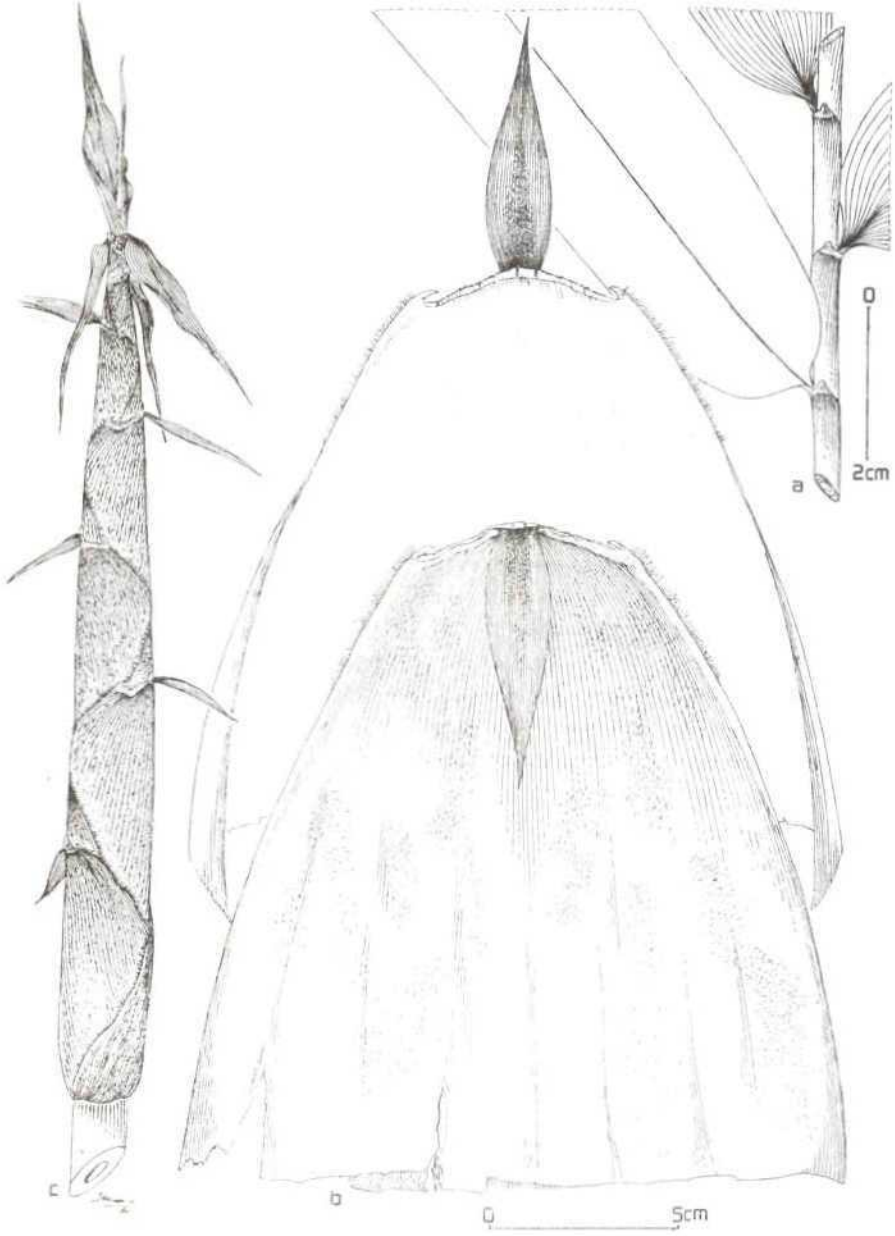
Spikelet slender, 26 — 31 mm long, 2—3 mm wide, consisting of 3 perfect florets with 3 glumes, 6 — 11 mm long, narrowly ovate, apiculate at the apex ; lemmas 15 — 30 mm long, with long pointed and rostraieapex, pale hairy on the back and fringed by dark brown hairs, its apical marginal zone is also covered with dark brown hairs, upper lemmas inroll ; paleas 10 — 22 mm long, notched to bifid, 5 veins between keels, 2 veins between keel and margin ; anthers 6, maroon to dark magenta, 6—10 mm long, with rostrate and hairy apex, 0.5 — 1 mm long. Caryopsis cylindrical, grooved along the dorsal side, 10 — 14 mm long, pale brown.

DISTRIBUTION AND BIOLOGY

This species is known only from the plants cultivated at the Forest Research Institute, Kepong. Some specimens from Tndia originally identified as *G. macrostachya* belong to this species.

NOTES

This species was first described by Holttum (1958) based on its vegetative characters as *G, maxima* var. *minor.* When flowering specimens became available it was redescribed because it was very different from *G. maxima.* The spikelets of this species in some cases resemble the specimen *Wallich 5033* collected from Chappadong, Amherst, identified by Munro (1868) as *Oxytenanthera nigrociliata.*



Fig, 16. *Gigantochloa* ***hassksrliana*** (Kurz) Backer: a. leal' sheath; b. culm sheath. From *Widjaja 1776;* c. Young shoot; d. From *Widjaja* ***1460.***

Several Indian specimens *(Ogilvie s.n., Parkinson 5084, Bape 12818, Parker 2268)* in Dehra Dhoon, which were identified as *G. macrostachya* sensu Gamble (1896) are found referable to *G. rostrata.* Gamble perhaps confounded two different species in his descriptions and illustrations of *G. macrostachya,* since he used Kurz's illustration for the culm sheath and leaf, and Brandis's specimen for the inflorescences. It should be pointed out further that the leaf and the culm sheath of *G. rostrata* resembles *Bambusa affinis* sensu Gamble {1896, pi. 36) which was drawn from a specimen at Calcutta Botanical Gardens. Since the specimens of *G. macrostachya* and *B. affinis* treated by Gamble came mostly from Burma, further study and more collections from this area are needed to ascertain the existence of *G. rostrata* in Burma.

7. GIGANTOCHLOA HASSKARLIANA **(Kurz) Backer — Fig. 16 & 17.**

Gigantochloa hasskarliana (Kurz) Backer in Heyne, Nutt. PI. Ned. Ind. 1 : 299. 1927; Backer, Handb. Fl, Jav. 2 : 277. 1928; Holttum *in* Gard. Bull. Sing. 26 : 118. 1958; Monod de Froideville in Backer & Bakhuizen v.d. Brink, f, Fl. Jav. 3 : 637. 1968, — *Schizostachyum liasskarimnum* Kurz *in* Ind. For. 1 : 352. 1876. (ut *Schizostachyum ? hasskarlianum).* — TYPE : *Kurz s.n.* (L—Lectotype), Java. Fl.

Clump densely tufted, green, of noticeably small sized culms with short intemodes, slightly raised above the ground in the middle of the clump.

Young shoots very slender, grey green with dark brown hairs appressed on the sheath backs; blades of the leaf sheaths initially erect then spreading to deflexed.

Culms green, up to 10 m high, 3 — 6 cm in diameter, the culm wall 8 — 10 mm thick ; the longest intemodes 27 — 51 cm, dark brown hairs on the upper part of the intemodes when young and glabrous afterwards.

Culm sheaths deciduous, covered on the outside with appressed blackish brown hairs, 10 — 27 cm long, triangular ; auricles firm, rim-like, up to 3 mm high, the end usually somewhat raised, edge of culm sheath extends beyond auricles, glabrous ; ligules to 3 mm high, irregularly toothed, ending in fine hairs ; blades lanceolate with a narrow base and acute apex, 2 — 14 cm long by 5 — 15 mm wide at the base, mostly deflexed but sometimes those at the base of the culm may be erect.

Leaf blades lanceolate, 8 — 35 cm long by 1 — 5 cm wide, lower .surface glabrous with 3 — 7 (10) mm pseudopetiole ; leaf sheath with dark brown hairs along the margin ; auricles glabrous, small, rounded up to 1 mm high and 1 mm in lateral extent ; ligules to 2 mm high, toothed, each tooth ending in fine hair.

Spikelet-groups containing up to 20 spikelets in a cluster ; spikelets narrowly ovate, slender, slightly flattened near the base, 8 — 22 cm long by 2 — 3 mm wide ; glumes widely ovate, 3 — 9 mm long by 4 —6 mm wide, fringed with brown hairs up to 1 mm long, apex acuminate ; lemmas 13 — 20 mm by 2 — 7 mm wide, fringed with dark brown cilia, cuspidate with

stiff point at the apex ; paleas 10 — 18 mm long, 1—2 mm wide apex slightly notched and ending in white cilia about 0.5 — 1 mm long, 5—6 veins between keels, 1 — 2 veins between each keel and margin ; anthers 6, maroon to dark magenta, 6 — 7 mm long, apex pointed to about 0.7 — 1 mm long ; fruit narrow, hairy at the apex.

ANATOMY. Macrohairs of leaf lamina none ; microhairs few, with distal cells (36 — 43/Um). Prickle-hairs few, 26 — 50yum long. Papillae, 4 long and 3 — 4 short papillae, overarching the individual stomata. Stomata in 2 — 3 files, outlines obscured by overarching long papillae. Long cells in 4 — 6 files on intercostal zone, sinuous walls.

In transverse section of leaf lamina it can be seen that the fusoid-cells are 100 — 105 /*am* in horizontal diameter, 20 — 25/iim vertical diameter. Six small vascular bundles between successive large vascular bundles. Bulliform cells 3—4 cells together, elongated, about 30 — 35 um by 35 — 43Aim.

Epidermis of culm : Short cells mostly trapezoid, some rectangular, 15 ^im, in pairs with rectangular and narrow silica bodies. Papillae none. Stomata 45 /um long by 25 /um wide. Long cells 125 — 180 Aim long, rectangular, slightly wavy walls.

DISTRIBUTION AND ECOLOGY

This species is known from the Western Indonesia (Sumatra, Kalimantan, Java, Bali). Outside Indonesia it is cultivated in the Botanical Gardens of Singapore and Lae (Papua New Guinea). This bamboo usually grows in the lowland, but it is found growing in the highland up to 1500 m above sea level at Bah'.

VERNACULAR NAMES

JAVA : awi lengka tali, awi tela (Sundanese), pring jajang kapur, pring jajang kertas (Javanese). BALI : Tiying putih (Balinese). SUMATRA : Buloh mayan (S. Sumatra), buluh sorik (Tapanuli), buluh lekukai (Lampung), buluh didi (Aceh). KALIMANTAN : bulok busi (Dayak Kenyah). INDONESIA : Bambu lengka tali.

USES

As far as is known, besides being planted as hedges, this bamboo is used only for making baskets by the local people in East Kalimantan (Dayak Kenyah tribe).

NOTES

Kurz (1876) in his original description pointed out that the culms of this bamboo have very thick walls, 2.5 — 3.75 cm in thickness. During the course of this study no culm of this species as thick as that reported by

Fig. 17. *Gigantochloa kasskarliana* (Kurz) Backer: a. inflorescence; b. spikelet;c. glume; d. lemma; e.palea; f. anther. From *Widjaja 1776.*

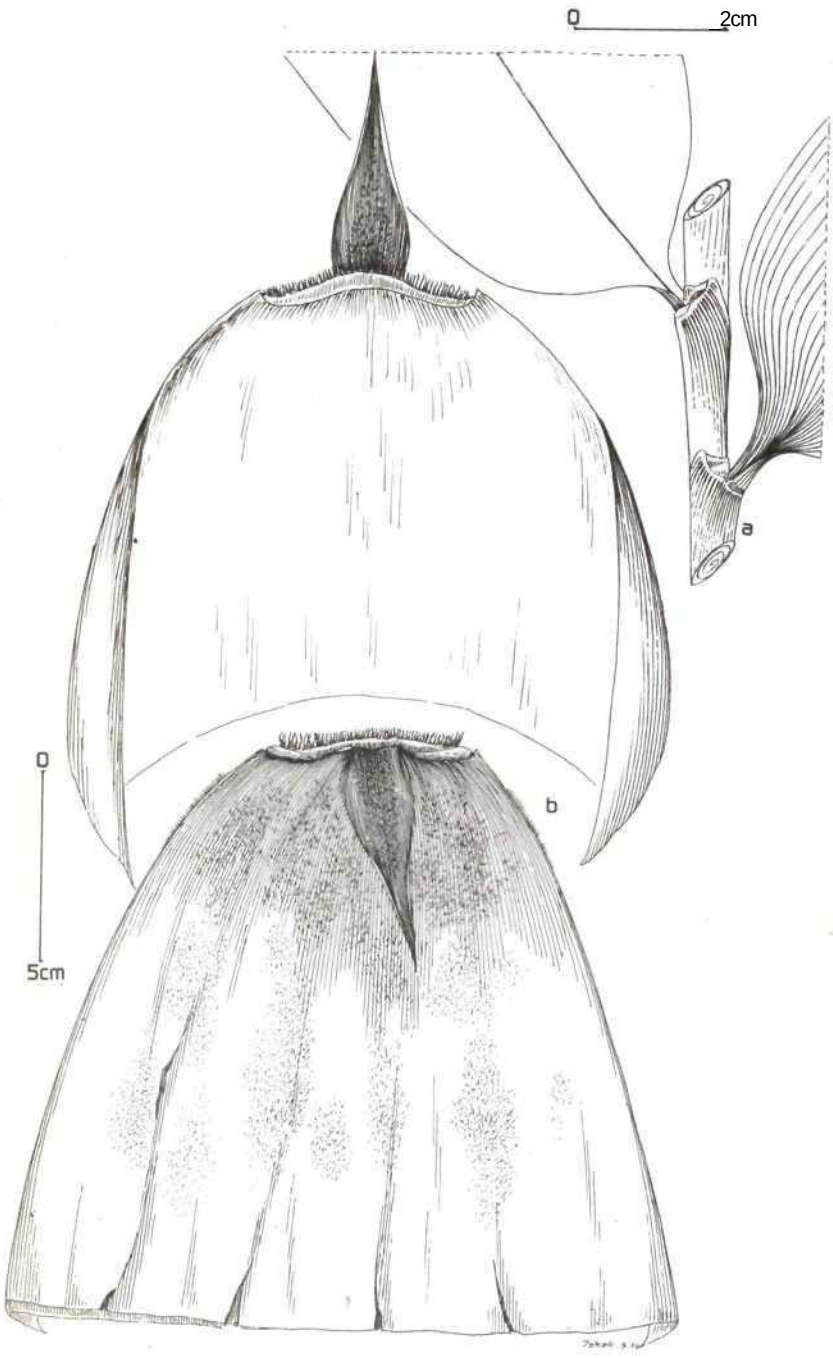


Fig. 18. *Gigantochloa wrayi* Gamble: a. leaf sheath; b. culm sheath. From *Dumas 1504.*

Kurz has been seen. Backer (1928) accommodated this species under the genus *Gigantochloa* and this correct disposition has commonly been adopted by most people.

I have seen specimen collected by Kurz from Java deposited in L (specimens 909.65.106 and 909.65.107) which were probably used in describing this species. The description presented above is supplemented from observation made on specimen *E.A. Widjaja 1774,* Java, Banyuwangi, Suaka Margasatwa Blambangan.

Holttum (1958) mentioned that part of *Oxytenanthera nigrociiiata* sensu Munro was a synonym of *G. hasskariiana,* but none of the specimens used by Munro is identical with *G. hasskariiana.* Holttum (1958) stated that the *Wallich 5033* specimen from Burma was identical with the Singapore plants of *G. hasskariiana.* Actually, the specimen *Wallich 5033* differs from G. *hasskariiana* in having dark brown cilia on the lemma and more slender spikelets. The spikelets of *Wallich 5033* resemble those of *G. rostrata* Wong.

Holttum (1958) also pointed out that the blade of the culm sheaths in the lower culm of *G. hasskariiana* in the Singapore plant was erect. I have seen the living material of Singapore as well as the Penang plants and can substantiate the observation made by Holttum. However, I have not seen any *G. hasskariiana* growing in Indonesia having the same character, so that perhaps this is only a geographic variant.

8. GIGANTOCHLOA WRAYI Gamble — Fig. 18 & 19

Gigantochloa wrayi Gamble fn Ann. R. Bot. Gard. Calc. 7 : 64. 1896 ; Hook, f., Fl. Brit. Ind. 7 : 199. 1896 ; Ridley, Fl. Mai. Pen. 5 : 261. 1925 ; Holttum *in* Gai-d. Bull. Sing. 16 : 124. 1958 ; Lin *in* Spec;. Bull. Taiwan For. Res. Inst. 6 : 39. 1968. - TYPE : *Wray Jr. 1895 (K* — Holotype, BM — Isotype),Perak, Bukit gantang. May 1888. p.p. Fl.

Gigantochloa maxima Kurz. var. ***viridis*** Holttum. - TYPE : *Holttum SFN 4020*! (SING — Holotype, KEP., L — Isotype), Kotatinggi, Johore. 1 Nov. 1963. Fl.

Culms up to 10 m tall, 3 — 7 cm diameter, walls of about 10 mm thick, dark green with dark brown scattered hairs in upper parts of the internode.

Culm sheaths 14.5 — 26 cm Long, when young covered with dark hairs; auricles low, firm, raised at the ends, 4 mm high, and bearing few bristles 5 — 16 mm long ; ligules up to 10 mm high, dentate to deeply incised, with long bristles ; blades reflexed, narrow at the base, 6 — 9.5 cm long.

Leaf blades 18 — 37.5 cm long by 1.5 — 5.5 cm wide with fine hairs on the lower surface, pseudopetioles up to 8 mm long ; auricles rounded, small, often with bristles, up to 2 mm high ; ligule denticulate 2 mm high.

Spikelets 11 — 20 mm long, 3 mm wide, flattened, slender, dark brown hairs on glumes and lemmas ; fertile florets 3 ; glumes 5 — 11 mm long, mucronate ; lemmas 9 — 19 mm long cuspidate with stiff pointed apex ; paleas 12 — 19 mm long, bifid, 3 — 4 veins between keels, 1—2 veins between keel and edge ; anthers 6, up to 8 mm long, long apiculate tips with

Fig. 19. *Gigantochloa wrayi* Gamble: a. inflorescence; b. spikelet; c. glume; d. lemma e. palea; f. anthers. From *Dumas 1504.*

short hairs, maroon to dark magenta; ovary hairy at the apex. Caryopsis about 10 mm long.

DISTRIBUTION AND ECOLOGY

According to Holttum (1958) this bamboo grows wild in north Malaya where it is probably native. It has not been reported from Indonesia before, because the specimen *Dumas 1504* from Sumatra was previously misidentified as *G. verticillata.*

VERNACULAR NAMES

MALAY PENINSULA : buloh beti, buloh mata rusa, buloh manis, buloh semantan, buloh minyak (Malay). SUMATRA : buloh dabo.

USES

In Malaya, this bamboo is used for making baskets.

NOTES

The species concept adopted above is that formulated by Holttum (1958) ; Gamble's type specimens are mixed with *Schizostachyum brachycladum.*

9. GIGANTOCHLOA scoRTECHINII Gamble — Fig. 20, 21 & 22

Gigantochloa scortechinii Gamble in Ann. R. Bot. Gard. Calc. 7 : 62. 1896; Ridley, Fl. **Mai.** Pen. 5 : 261. 1925; Holttum in Gard. Bull. Sing. 16 : 122. 1958. - TYPE: *Father Scortechini s.n.* (K - Holotype, CAL — Isotype), Malay Peninsula, Perak. Fl.

Clumps densely tufted, appear somewhat whitish because of the waxy powder on the young culms.

Young shoots light orange with light green blades covered with appressed dark hairs.

Culms up to 20 m high, diameter up to 12 cm, internodesup to 40 cm long, green with whitish wax when young, when old bright green.

Culm sheaths not easily deciduous, 15 — 25 cm long, light orange, at the apex with light green blade, covered with appressed black hairs;:auricle a low, dark green rim along the sheaths apex, sometimes ended by a few bristles; ligules dentate or deeply incised up to 9 mm long including bristles. Blades spreading to reflexed and leaf like, light green, 9 — 13 cm long by 1 — 3 cm wide.

Leaf blades 20 — 30 cm long by 2 — 3 cm wide, hairy on the lower surface on about 5 mm long pseudopetioles; leaf sheath auricles small, 1 mm

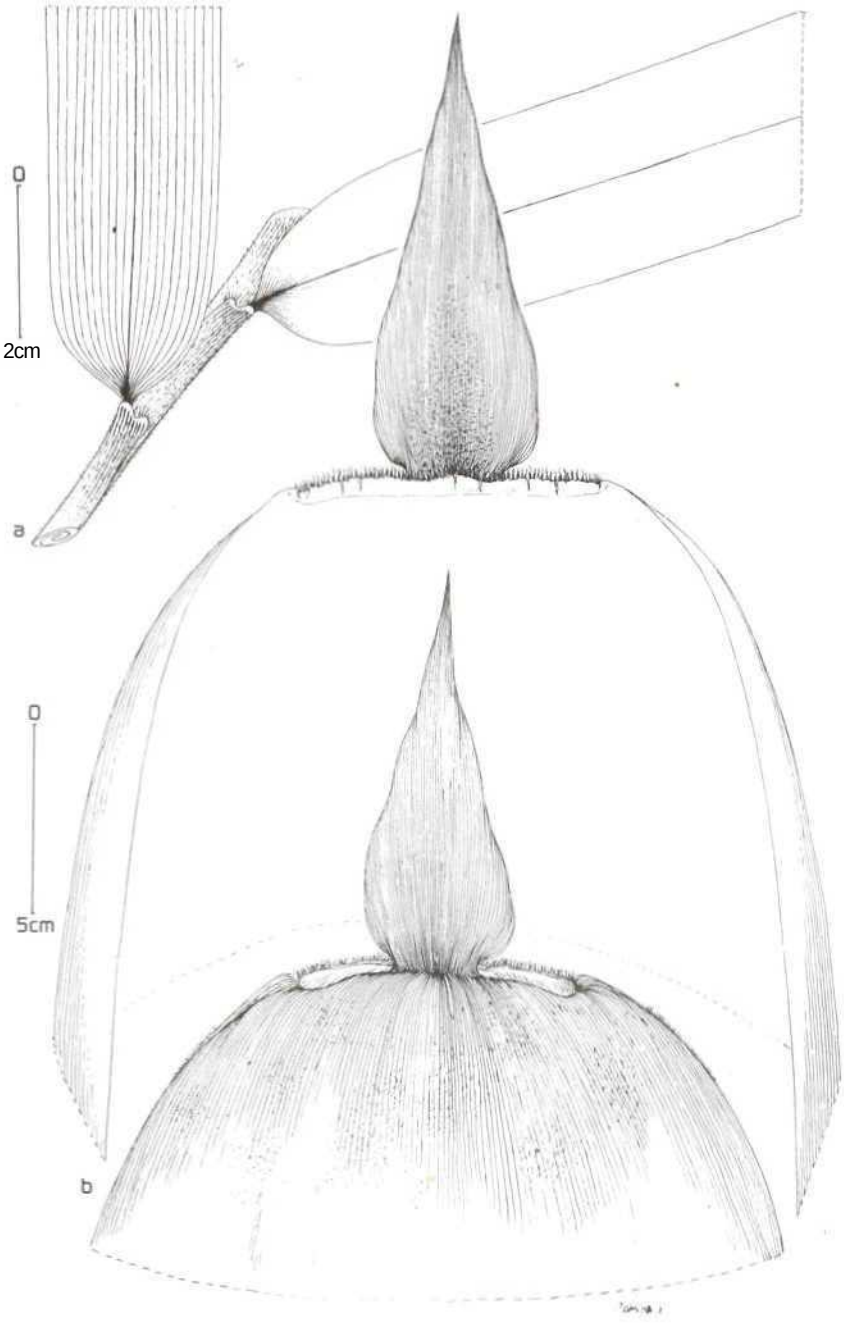


Fig. 20. *Giganiochloa scortechinii* Gamble: a. leaf sheath; b. culm sheath. From *EAW-WKM 1.*

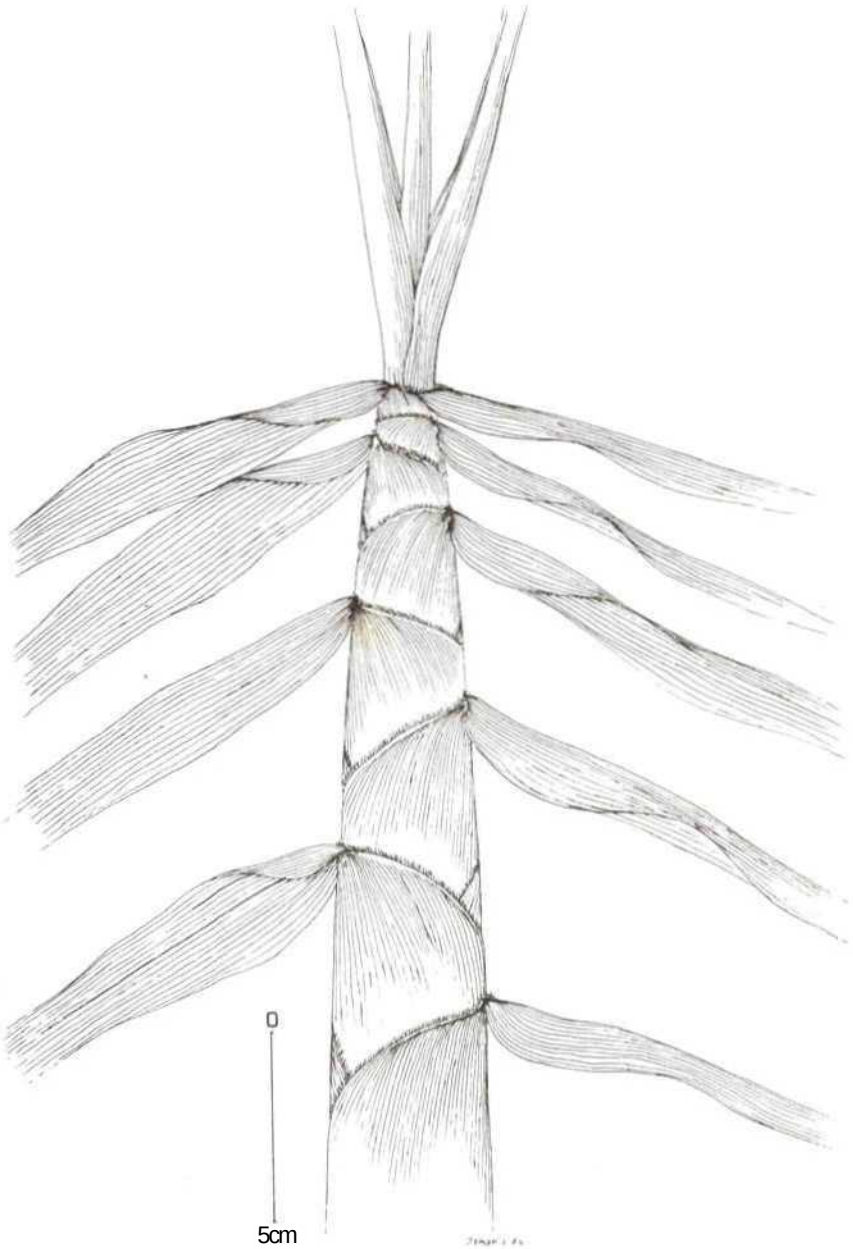


Fig. 21. *Gigantochioa scortechinii* Gamble: young shoot. From *EAW-WKM 1.*

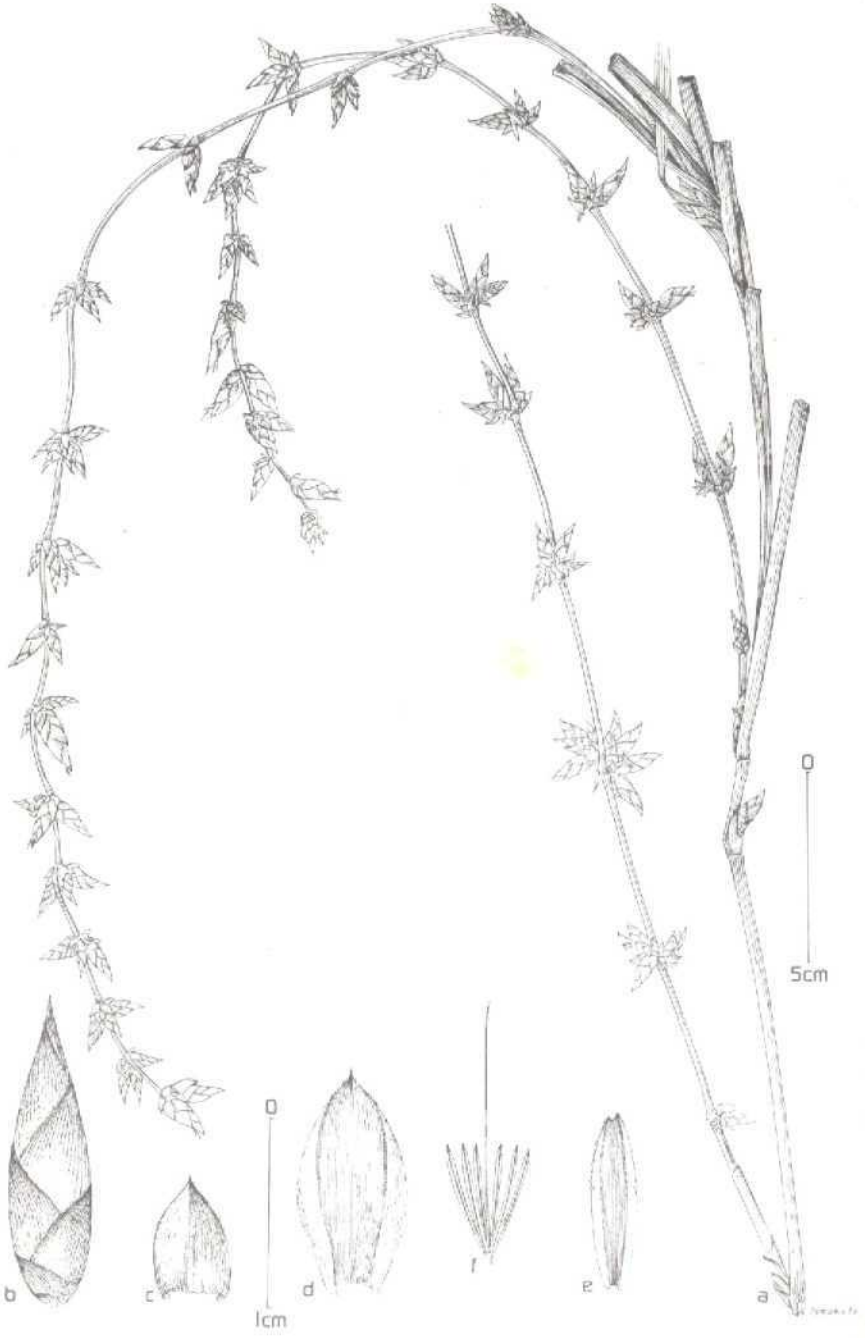


Fig. 22. *Gigantochloa scortechinii* Gamble: a. inflorescence, b. spikelet; c. glume; d. lemma; e. palea; f. anthers. From *EAW-WKM 1.*

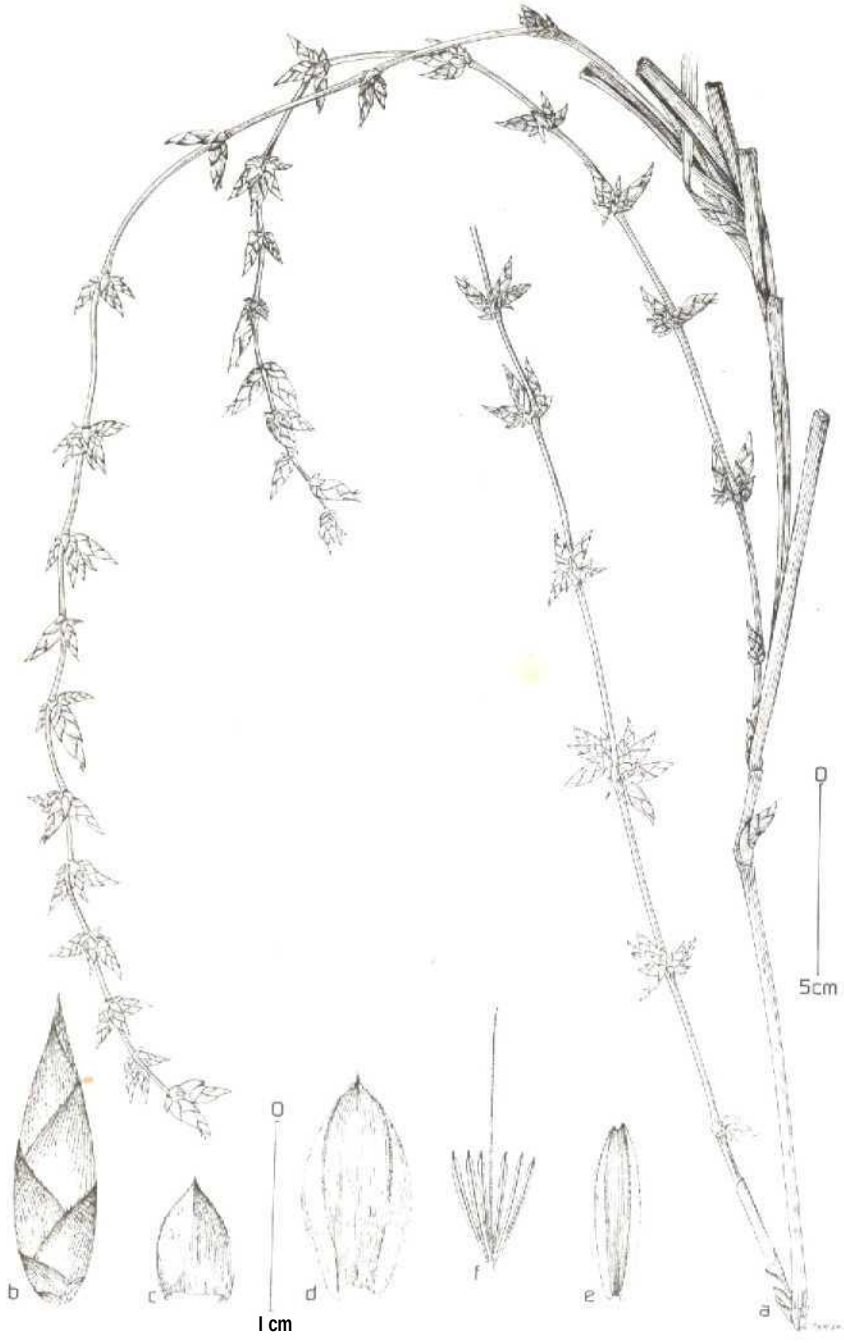


Fig. 22. *Gigantochloa scortechinii* Gamble: a. inflorescence, b. spikelet; c. glume; d. lemma; e. palea; f. anthers. From *EAW-WKM 1.*

high with a few bristles up to 6 mm long; ligules short, 2 mm high sometimes bearing bristles.

Spikelets ovate oblong, densely hairy on the surface, 18 — 20 mm long, flat, 5 — 6 mm wide; glumes 5 — 7 mm long, acuminate with pointed apex fringed with dark brown hairs; lemmas 11 — 14 mm long, cuspidate with short pointed apex also, fringed with dark brown hairs; paleas 10 — 12 mm long, acuminate, bifid; brownishly fringed on keels, 5—6 veins between keels, anthers 6, yellow, up to 9 mm long.

DISTRIBUTION AND ECOLOGY

This bamboo grows wild in the foot hills of Malaya. It is grown in the villages, but natural stands from the forest edge are enough for supplying most basket makers and handicrafts.

VERNACULAR NAMES

MALAY PENINSULA: Buloh semantan, buloh telor, buloh rayah, buloh paao, buloh gala (Malay); buloh seremai (for var. *albovestita* — see below).

USES

This is me most useful bamboo in Malaya for making baskets and any other handicrafts; it is as good as *G. apus* of Java.

NOTES

In the sterile condition this bamboo is rather similar to *G. wrayi* but the orange-greenish colour of the young shoots separates them immediately. The specific characters of *G. scortechinii* are its spikelets, which are covered all over with hairs, and its yellowish anthers. *G. scortechinii* can be separated into two varieties as follows:

a. Culm sheath covered with blackish-brown hairs, auricles bristly.....var. *scortechinii*
b. Culm sheath covered with white-hairs, auricles glabrous.....var. *albovestita*

a. GIGANTOCHLOA scoRTECHnsin Gamble var. SCORTECHINII

b. GIGANTOCHLOA scoRTECHiNn Gamble var. ALBOVESTITA Holttum

Gigantochloa scortechtnii Gamble var. *albovestita* Holttum in Gard. Bull. Sing. 16: 124. 1958. - TYPE: *Holttum K 11* (K - Holotype, SING - Isotype), Kedah, 9th mile from Alor Star to Pokok Sena. Dec. 1963. Steril.

This variety (locally called buloh seremai) is separated from *G. scortechinii* var. *scortechinii* in having white hairy sheaths, and not having bristle on auricles of the culm sheaths.

10. GIGANTOCHLOA RIDLEYI Holttum — Fie. 23

Gigantochloa ridleyi Holttum in Gard. Bull. Sing. 15 : 275. 1956 — TYPE : *Pettana* *•«. (SING — Holotype, K — Isotype) Singapore, Hortus Botanicus Singaporiensis, 4 October 1933. Steril.

Clump densely tufted, raised above the ground in the centre, looks dirty because of persistent culm sheaths.

Culms up to 16 m tall and 10 cm diameter, the longest internodes up to 47 cm, green, not waxy, with scattered dark brown hairs on the upper part of the internodes.

Culm sheaths long persistent, up to 25 cm long in the Singapore plant but reaching 36 cm in Balinese specimens *(Widjaja 1761),* covered with brownish black appressed hairs on the back ; auricles low, rigid, up to 4 mm high, extended along the culm sheath apex to the blade bearing short bristles up to 2 mm long ; ligules to 3 mm high, slightly denticulate, no visible external line of separated blades ; blades appressed to the young culm but otherwise remain erect, not deciduous, triangular, line of junction with the sheath upcurved (with very variable size in curvature) ; blades up to 10 cm long by 6 cm wide (in Balinese specimen *Widjaja 1761,* up to "20 cm long).

Leaf blades up to 40 cm long and 6 cm wide, glabrous on the lower surface ; pseudopetioles 4 — 5 mm long ; leaf sheaths hairy when young, auricles small rounded, 1 mm high glabrous ; ligules 2 mm high, irregularly and indistinctly denticulate.

Spikelets not seen.

DISTRIBUTION AND ECOLOGY

As has been pointed out by Holttum (1958) the type specimen was taken from a living collection planted in Singapore Botanical Gardens and was originally brought in by Ridley from a cultivated specimen growing in Prov. of Wellesley. Recently it was found also in cultivation in Bali. Although Holttum suggested that this species probably comes from further north, no specimen has been seen from the northern part of the Malay Peninsula.

VERNACULAR NAMES

BALI: tiying kaas, tiying jajang, tiying jajang batu, tiying aya (Balinese).

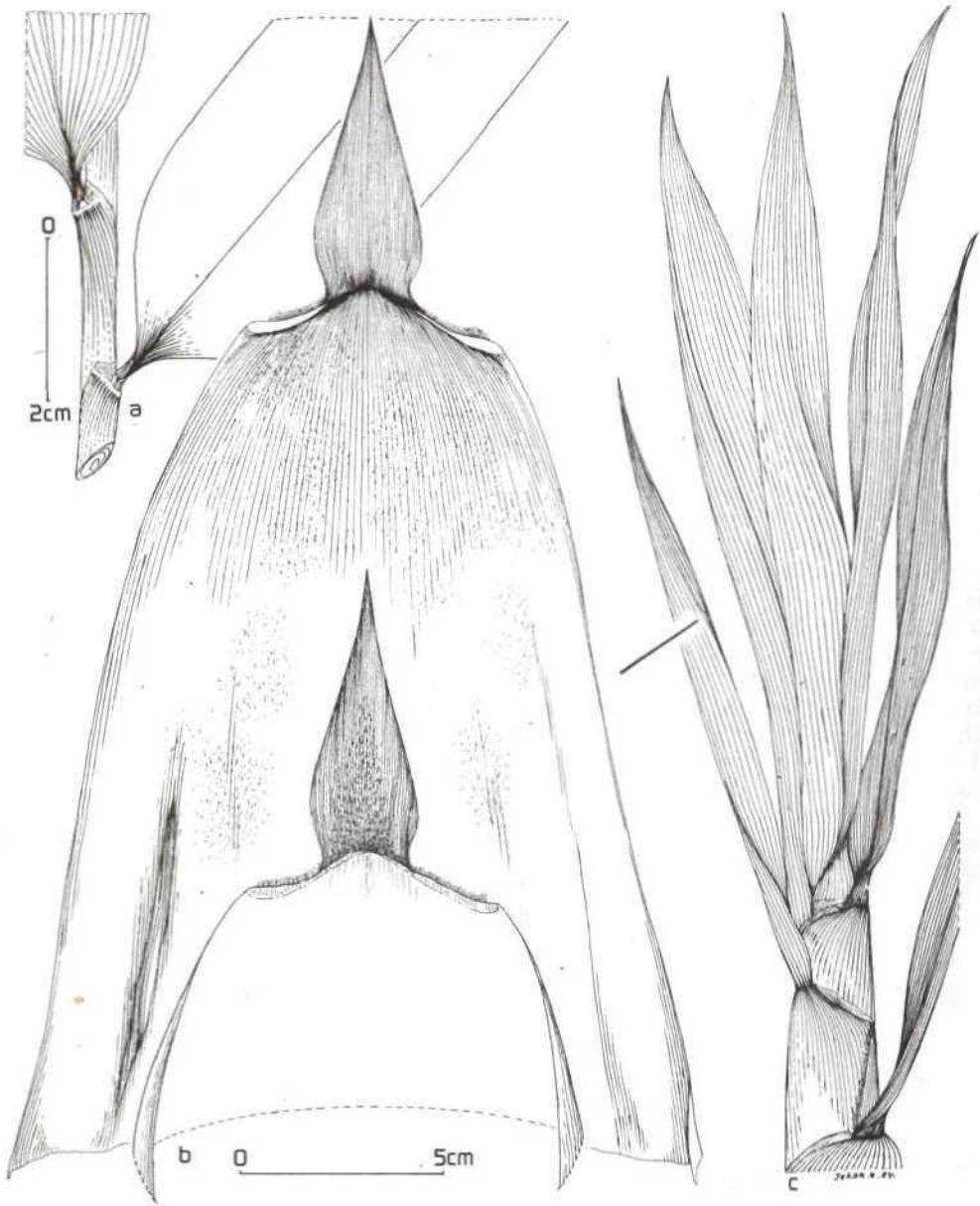


Fig. 24. *Gigantochioa apus* (Schmt. & Schuit.) Kurz: a. leaf sheath; b. culm sheath; c. **young shoot.** From *Widjaja 1729.*

USES

The Balinese said that this bamboo could be used for roofing, but was not suitable for producing good quality string. Holttum reported that the young shoots are astringent and not good to eat.

NOTES

The long persistent culm sheaths and their auricles and ligules are very similar to those of *G. apus,* whereas Holttum (1958) saw its close similarity to G, *maxima (G. pseudoarundinacea* of the present paper). The distinctive feature of the present species is the persistent triangular and erect culm sheath blades, and also a rim-like auricles of the culm sheaths, which differ from other known species of *Gigantochloa.*

11. GIGANTOCHLOA APUS (Schult. & Schult.) Kurz - Fig. 24 & 25.

Gigantochloa apus (Schult. & Schult.) Kurz ill Nat. Tijdschr. Ned. Ind. 27 : 226. 1864; Munro in Trans. Linn. Soc. 26 ; 126. 1868; Kurz *in* Ind. For. 1 : 226. 1876; Backer, Handb. Fl. Jav, 2 : 275.1928; Parker *in* Ind. For. 57 (3) : 108. 1931; Holttum *in* Gard. Bull. Sing, 26 : 118. 1958; Monad de Proideville *in* Backer & Bakh. v.d. Brink f.,Fl. Jav. 3 : 635. 1968. — *Schizostachyum apus* (Schult. & Schult.) Steud., Syn. PI. Glum. 1 : 332. 1855. —*Bambusa apus* Schult. & Schult., Syst. Veg. 7 (2) : 1353. 1830. — TYPE : *Blume a.n.* (M — Holotype; L — Isotype), Java, G. Salak. Steril.

Gigantochloa kurzii Gamble in Ann. R. Bot. Gard. Calc. 7 : 65. 1896 (p.p., quod typus); Hook, f., Fl. Brit. Ind. 7 : 339. 1897; Camus, Les Bambustfes. 141. l913;Kidley, Fl. Mai. Pen. 5 : 187. 1925 (excl. specimen); Brandis, Ind. Trees. 673. 1906. — TYPE: *Kurz s.n.* (K — Lectotype), Burma, Kobala. January — February 1878. Fl.

Clump densely tufted, the middle part usually irregularly raised above the ground. On the whole appears characteristically greyish green, conspicuously dirty because of the appressed and long persistent yellowish brown dried culm sheaths.

Young shoots slender with appressed blackish brown hair, light green to grey green, the blades spreading to deflexed, tinged yellowish.

Culm 8 — 22 m tall, 4 — 13 cm diameter, the wall up to 15 mm thick at the base, internodes 20 — 60 cm long (in Burmese plants the longest internodes may be up to 75 cm as is shown by specimen *Parker 3090),* nodes a little swollen on the outside, node septums concave ; when young the upper part of the internodes are covered with white wax so that the culms appear greyish green becoming bright, green to yellowish green when older.

Culm sheaths persistent, when fresh greenish brown covered by appressed blackish brown hairs, hairs fall off when older so that the culm sheaths become glabrous and appear yellowish brown ; sheaths 7 — 35 cm long, 8 —

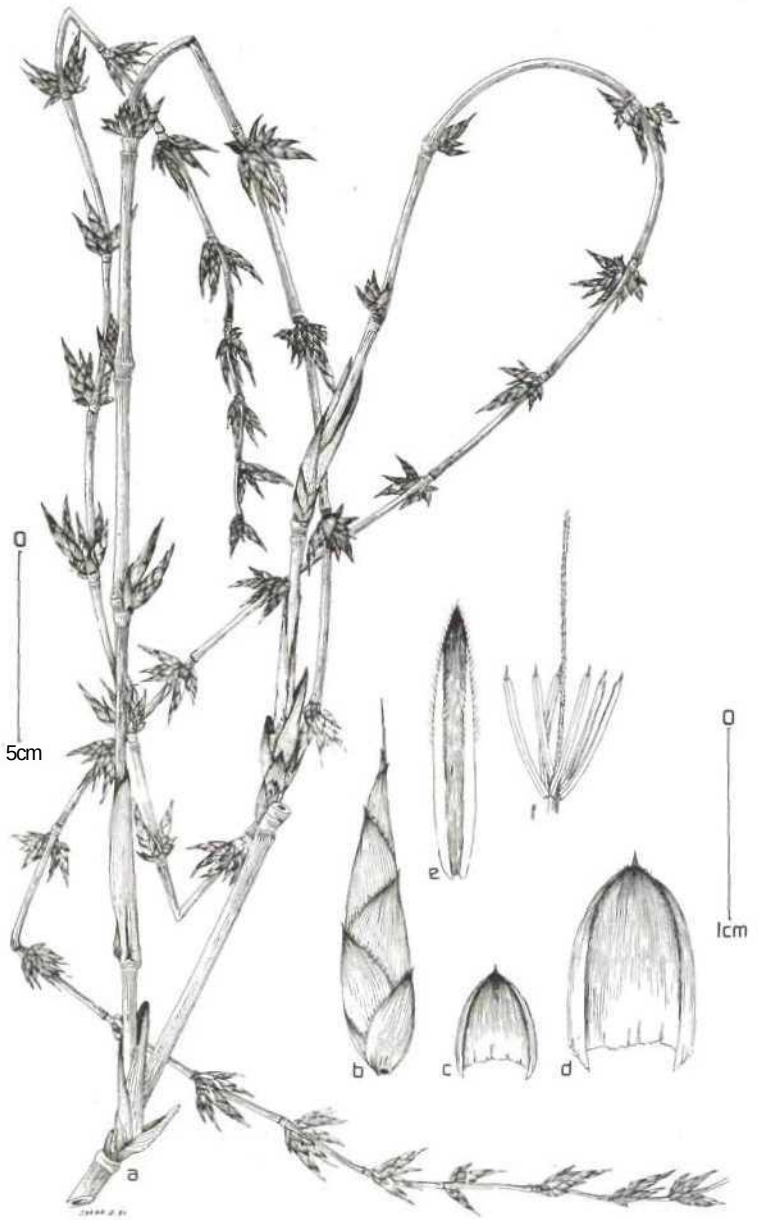


Fig. 25. *Gigantochloa apus* (Schult. & Schuit.) Kurz: a. inflorescence; b. spikelet; c.. Glume; ii. lamma; e. palea; f. anthers. From *W'djaja 1729.*

26 cm wide, narrowly trapezoid with apex almost truncate, bordered on either side of the blades by narrow but firm auricles which are raised toward the outer end, 4 — 8 mm in lateral extent, 1—3 mm high ; the auricles sometimes with scattered bristles up to 7 mm long ; ligules 2—4 mm high irregularly toothed ; blades spreading to deflexed when the culms elongate, ultimately deciduous, ovate triangular, acuminate at the apex, 3"—10 (—18) cm long, 2 — 5 cm wide covered with dark brown appressed but deciduous hairs on both sides.

Leaf blades lanceolate, 13 — 49 cm long, 2 — 9 cm wide, slightly hairy beneath when young and glabrous afterwards, pseudopetioles 4 — 11 mm. Leaf sheaths dark brownly hairy along the margin ; auricles firm, small, rounded, blackish brown, glabrous, 1 — 3 mm at lateral extent, 1—2 mm high; ligules 2 — 4 mm high, finely hairy, with collar-like callus.

Spikelet-groups whorled, up to 30 spikelets in a cluster ; spikelets narrowly ovate, slender, 13 — 22 mm by 2 — 3 mm ; perfect florets 3 ;glumes 2 — 3, ovate, acute and mucronate at the apex, with dark brown cilia at the apex margin, 5 — 13 mm long, 3 — 6 mm wide ; lemmas 3, acute with stiff pointed apex, with dark brown cilia at the apex margin and paler on the base, 13 — 20 mm long, 4 -- 8 mm wide, paleas acute with 4—5 veins between the brown ciliated keels, 1—3 veins between keel and margin, 5 — 18 mm long, 1 — 1.5 mm wide ; anthers 6, maroon to dark magenta, 9 — 11 mm, connective prolonged into hairy acute tips 0.5 — 0.8 mm long, the full length of the filaments form a staminal tube ; ovary oblong, densely hairy at the apex, glabrous below ; caryopsis glabrous, up to 12 mm long, 2 mm wide, longitudinally furrowed on one side, lanceolate with truncate apex, crowned by hairy style base.

ANATOMY. Macrohairs of leaf lamina none; microhairs few, distal cell (36 — 43 um). Prickle-hairs numerous, 23 — 60 um long. Four to eight long and 2—6 short papillae overarching the individual stoma. Stomata in 2 — 3 files, outlines obscured by overarching long papillae. Long cells in 5 — 7 files on intercostal zone, sinuous walls.

In transverse section of leaf lamina it can be observed that there are four smaller vascular bundles on the adaxial side and four on abaxial side of the large vascular bundle in the middle of the midrib. Fusoid cells 82 —115 um horizontal diameter, 36 — 45 /im vertical diameter. Six to seven small vascular bundles between successive large vascular bundles. Bulliform cells 3 — 4 cells together, isodiametric, 65 — 75 um.

Epidermis of culm : Short cells mostly rectangular to trepezoid, 20 um long, in pairs with narrow and rectangular silica bodies. Papillae none. s»tomata 50 um by 25 um wide. Long cells 170 — 290 ^um long, rectangular, sometimes with tapering ends, slightly wavy walls.

DISTRIBUTION ANL* ECOLOGY

Holttum (1958) mentioned that this bamboo was probably native in Tenasserim Burma and introduced a long time ago in Java during prehistorical human migrations, and now is widely planted there. Recent field observations show that wild or naturalized populations of this species occur on Mount Salak (West Java) above Cibitung village. This species has also been found

widely at the Blambangan Nature Reserve (East Java) apparently growing **wild,** but probably escaped from previous cultivation. This bamboo species was introduced into Central Celebes by Javanese and Balinese transmigrants in 1970. In 1970 a forester team from Bbgor Agricultural Institute tried to plant this species in a transmigration area at Riau. Also, it has been reported that this species has been introduced to Central Kalimantan probably by Javanese. No recorder data are available from other areas and the report of Kurz (1864) from Bangka could not be verified during the present study. In 1982 *G. apus* was introduced to South Africa from Java, originating from seeds collected in Cibinong, Bogor.

Gigantochloaapus grows easily either on sandy soil or clay soil. It grows well in the lowland along rivers or on hill slopes up to 1500 m above sea level. This bamboo likes open areas or disturbed forests.

This species was also planted in some Botanical Gardens or Experimental Stations around the world such as in East Africa, South Africa, South and Central America and Great Britain.

VERNACULAR NAMES

JAVA : pring tali, pring apus (Javanese), awi tali (Sundanese), perrenf tale (Madurese). BALI : tiying tali (Balinese). INDONESIA : bambu tali bambu apus.

USES

Gigantochloa apus is the most important bamboo in Java, especially in. **the** handicraft and furniture industries. Moreover it is used extensively for building materials such as for roofings, scaffoldings, bridges, walls etc. Some students from Bogor Agricultural Institute experimented with this species for making ply bamboo ; their results show that this bamboo is better than *G. pseudoarundinacea, D. asper* and *D. giganteus.*

This species is not used for musical instruments, probably because the concavity of the nodal septum gives an unpleasant resonance.

This bamboo is called "bambu tali" by most Indonesian because it is the best bamboo to be used for making string.

NOTES

In describing *Gigantochloa kurzii,* Gamble (1896) confounded two distinct species i.e. G. *apus* and *G. wrayi.* The specimen collected in Mala; belongs to *G. wrayi* whereas Kurz's specimen collected at Tenasserim, which is the lectotype of G. *kurzii,* is identical with G. *apus.* This conclusion wa partially reached also by Holttum (1958). Parker (1931) confused G. *nigrc*

ciliata with the present species since he identified a specimen of the former *(Zoiinger 3934)* as *G. apus. G. apus* can be separated easily from *G. nigro-ciliata* by its rounded and small auricle on the leaf sheath, short ligule, and by the non ciliated spikelets. Moreover *G. apus* is the only species whose culm sheaths are not easily deciduous.

Blume's original specimen from Mt. Salak near Bogor, Java, which was used by Schultes & Schultes (1830) as the type specimen of this species is in MUnchen (M) ; however I did not see any flowering material in the Isotype which is deposited at Leiden.

Small flies fprobably *Trigona sp.* and *Apis sp.)* were seen to visit the spikelets of *G. apus.*

12. GIGANTOCHLOA LEVIS (Blanco) Mere. — Fig. 26 & 27.

Gigantochloa levis (Blanco) Merr. *in* Amer. J. Bot. 3 : 61. 1916 ; Merril, Sp. BL 76. 1918 ; Merrill, Enum. Phil. PL 1 : 96. 1923 ; Holttum *in* Gard. Bull. Sing. 16 : **119.** 1958. - *Bambusa levis* Blanco, PI. Filipp. 1 : 272. 1837 ; Steud., Syn. PI. Glum. 1 : **331.** 1854 ; Miquel, Fl. Ind. Bat. 3 : 421. 1857 ; Munro in Trans. Linn. Soc. 26 : 121. **1868** ; Merril in Phil. J. Sci. Bot. 1 (Suppl.) : 38S. 1906 ; Camus, Les Bambusées 134. 1913.— TYPE : *Species Blanconae 310* (K — Holotype, L, BM, BO - Isotype), Philippines, **Taya**bas, Luzon. Recollected in March 1914. Fl.

Gigantochloa scribneriana Merr. *in* Phil. J. Sci. Bot. 1 { Suppl.) : 390. **1906;** Gamble *in* Phil. J. Sci. Bot. 5 : 270. 1910 ; Gamble *in* Phil. J. Sci. Bot. 8 : 204. 1913 ; Camus, Les Bambusees 143. 1913. - TYPE : *F. Lamson-Scribner 14.* (PNH — Holotype + ; Isotype not seen), Philippines, Cuyo.

Dendrocalamus curranii Gamble *in* Phil. J. Sci. Bot. 5 : 271. 1910 ; Robinson *in* Phil. J. Sci. Bot. 6 : 194. 1911 ; Camus, Les Bambusées 158. 1913 ; Brown & Fisher in Bull. Phil. Bur. For. 22 : 261. 1920. - TYPE : *H.M. Curran BF 10177* (K - Holotype, BO - Isotype), Philippines, Luzon, Tayabas, Sampaloe. March 1908. Ft.

Clumps densely tufted, the middle part usually irregularly raised above the ground, with light green culms.

Young shoots slightly triangular, covered with dark brown hairs, brownish green to green, with green tips.

Culms up to 15 mm tall, about 10 cm diameter ; the longest internodes about 45 cm long, when young pale from the presence of a waxy covering as well as from scattered and appressed detaching brown hairs on upper part ol internodes or just below the nodes, becoming smooth with age; aerial roots present on the lower part of the culm and sometimes also coming out from the lower lateral branches.

Culm sheaths deciduous, 19 — 34 cm long, narrowly triangular, covered with dense spreading detaching dark hairs ; auricles well developed, rounded, 5 — 7 mm high along the sheath apex and continued to the base of **the** blades, with long marginal bristles 7 — 15 mm long : ligules laciniate 9 — 13 mm high including its bristle-like extension blades reflexed, dark purple when young turning green as the culms elongate, very narrowed at the base.

Leaf blades 21- 37 cm long, 2.5 — 6.5 cm wide, with fine hairs on lower surface ; leaf sheath auricles 2—3 mm high with few bristles to 4 mm

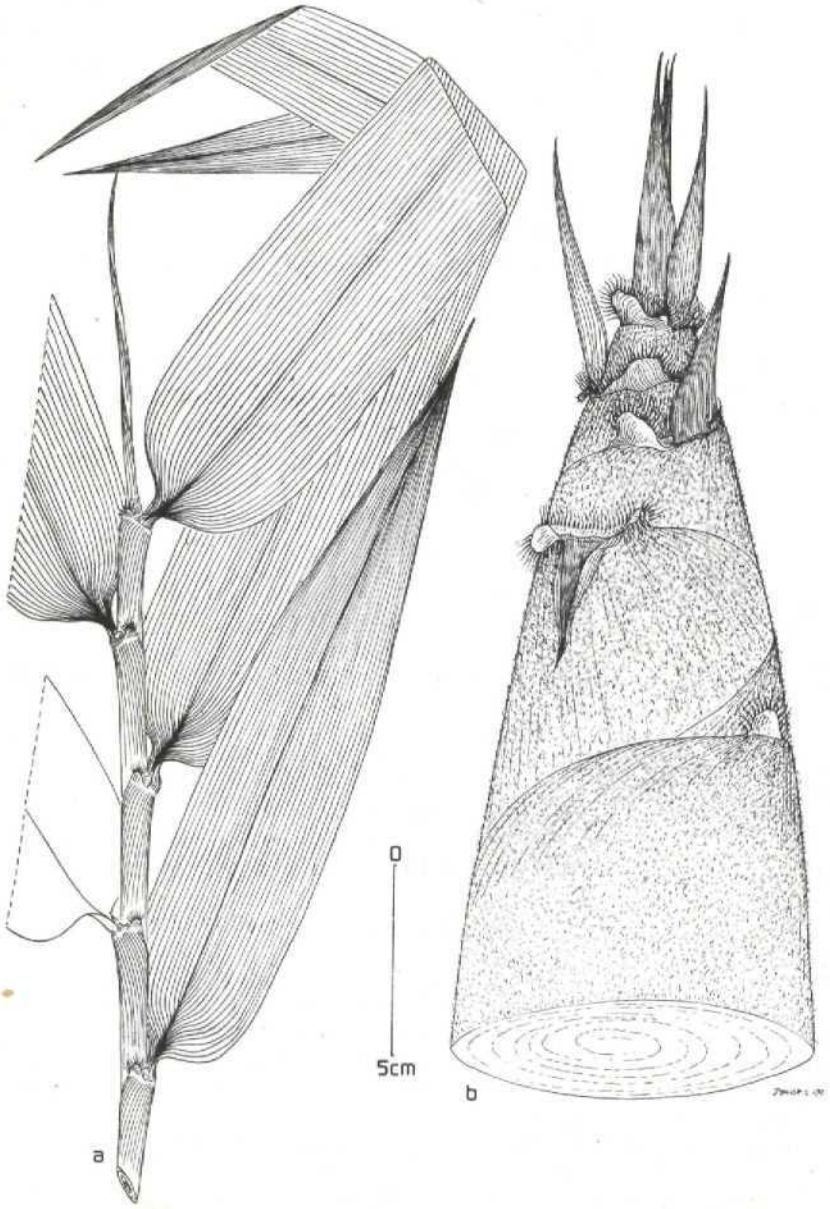


Fig. 26. *Gigantochloa levis* (Blanco) Merr.: a. leaf; b. young shoot. From *Wong FRI 28982.*

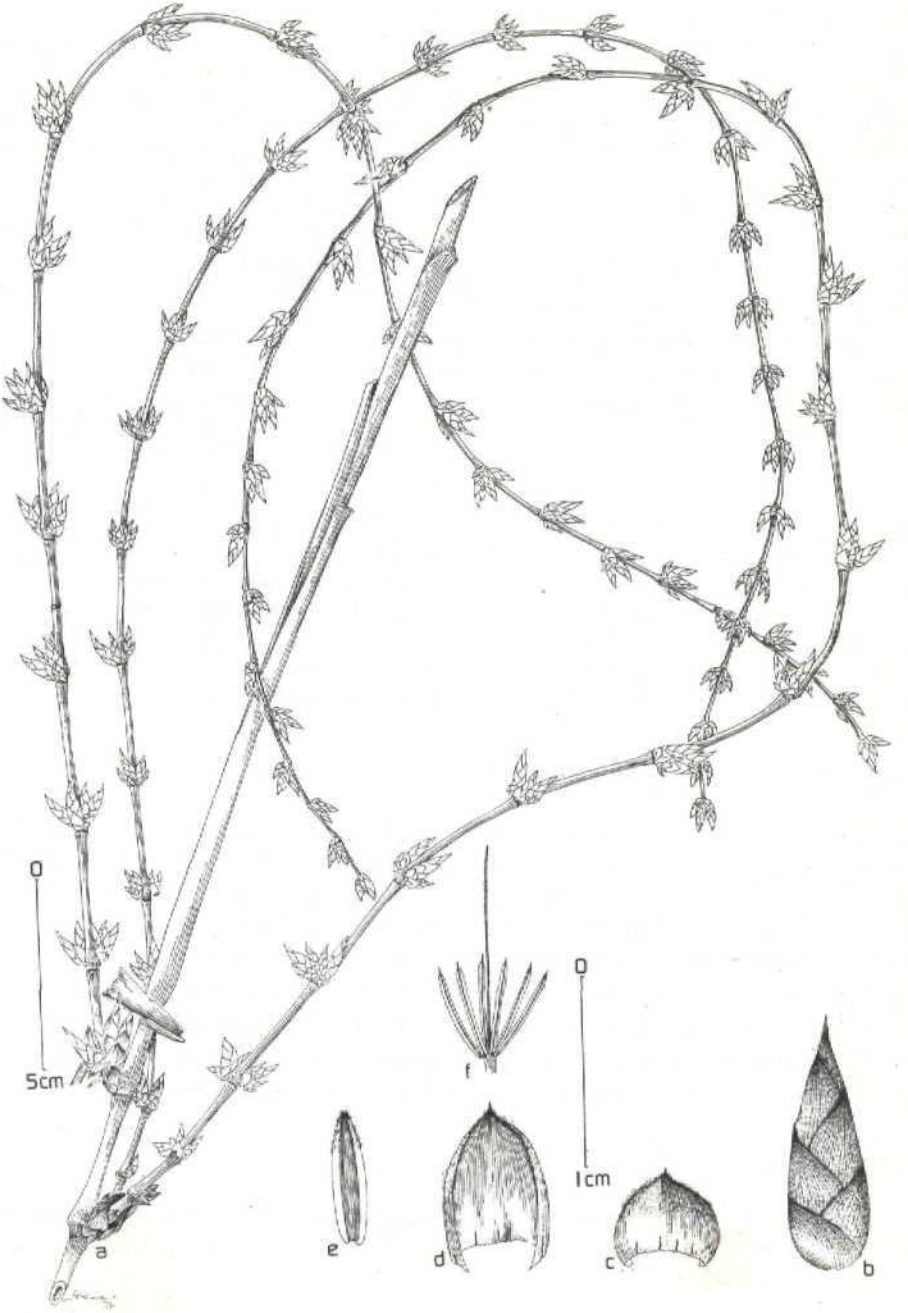


Fig. 27. *Gigantochloa levis* (Blanco) Merr.: a. inflorescence; b. spikelet; c. glume; d. lemma; e. palea; f. anthers. From *Wong FRI 28982.*

long ; ligules denticulate, up to 2 mm with 3 mm bristles.

Spikelets groups with up to 75 spikelets in a cluster, spikelets ovate, finely hairy at the acute apex, 11 — 12 mm long, 4 mm wide, perfect florets 4 ; basal glumes 2 — 3 in number, widely ovate, broadly acute and mucronate at the apex with brownish cilia at the apex margin, 4 — 7 mm long ; lemmas ovate, shortly cuspidate and finely hairy at the apex, edges with long pale cilia, 6 — 11 m long ; paleas narrow, slightly notched at the apex, keels long ciliate, finely hairy on edges and back, 2—4 veins between keels, 1—2 veins between each keel and the edge, 5 — 10 mm long ; anthers 6, yellowish white, 4 — 7 mm long, slightly pointed and hairy at the tips, filaments 3/4 joined to form a staminal tube, style hairy ; caryopsis oblong, 5 mm long and 1 mm wide.

ANATOMY. Macrohairs of leaf lamina few, up to 450µm long ; microhairs with distal cell (24 — 27 µm) slightly longer than basal cells (16 — 25 urn). Prickle-hairs very few. 15 — 20 um long. Four long and 5 short papillae overarching each stoma. Stomata in 2 — 4 files, outlines obscured by overarching long papillae. Long cells in 6 — 7 files on inter coastal zone, with sinuous walls.

In transverse section of leaf lamina it can be seen that the fusoid cells have 100 — 125 µm horizontal diameter by 40 — 50µm vertical diameter. Five to six small vascular bundles between successive large vascular bundle. Bulliform cells elongated, 40 — 50 µm by 70 — 75 um.

Epidermis of culm : Short cells mostly rectangular, some trapezoid, 15 — 20 jam long, in pairs with rectangular, narrow silica bodies. Papillae surrounding stomata, not obscuring the pores. Stomata 25 µm long by 20 jum wide. Long cells 85 — 165µm long with wavy walls.

DISTRIBUTION AND ECOLOGY

This species was originally described from the Philippines but Holttum (1958) said that probably it was not native to that area. This species is also planted in Borneo and I have seen this bamboo grow in the northern part of East Kalimantan. This may have been brought by the Dayaks when they migrated from North Kalimantan (Iwan River). According to Camus (1913) this bamboo was also planted in Indo-China. hi Malaya, I saw this bamboo grown in the villages and its produces excellent edible shoots, as Holttum (1958) has already pointed out. This bamboo was reported also from Sumatra, Sulawesi and Moluccas, but more data from these area are still needed.

VERNACULAR NAMES

BORNEO : Buluh suluk (N. Borneo), buluh poring, buluh pering (Sandakan), buluh tup (Dayak kenyah). PHILIPPINES : Anoh (Luzon).

USES

Young shoots produce excellent edible shoots and are much sought after in Malaya, Borneo and also northern East Kalimantan. Its culms can be used as building material as well and the strength of the culms equals that of *Dendrocalamus asper.*

NOTES

This bamboo neither grows wild nor is planted in Java. Therefore there is nothing to substantiate Merrill's (1916) contention that this species was possibly identical with *G. robusta* which grows in Java. Superficially herbarium specimens of this species resemble *G. robusta,* but it can be differentiated by its broad pointed paleas and lemmas and shorter anther tips. Moreover the present species has waxy culms and the young shoots are characteristically brownish-green with green tips.

13. GlGANTOCHLOA HOLTTUMIANA Wong

Gigantochloa hoittumiana Wong *in* Mai. For. 45 (3) : 346-349. 1982. - **TYPE** : *Wong, FRI 32245* (KEP — Holotype), Malaya **Peninsula,** Pahang, Fraser's Hill. Fl.

Clump tufted.

Culms up to 15 m tall, 3 — 5.5 cm diameter with walls 3—5 mm thick ; the longest intemodes 50 — 60 cm long, plain green but occasionally yellow-streaked at the base, non waxy, with a zone of fine hairs mixed with coarse appressed pale brown hairs just below the nodes.

Culm sheaths orange-flushed at the top ; auricles a low rim about 0.5 mm high raised at the ends to 1.5 — 2.5 mm high, purplish ; ligules with pale bristles 10 — 25 mm (mostly 20 mm) long, even on small sized shoots ; blades lanceolate, green spreading to reflexed.

Leaves pale hairy below, 15 — 30 cm long by 2.5 — 3.5 cm wide ; leaf sheath with pale brown hairs ; auricles purplish, triangular to rounded, about 1.5 mm tall, with yellowish brown spreading bristles 5 — 12 mm long ; ligules a low conspicuous rim with fine brown bristles, 4 — 8 mm high.

Spikelets 12 — 18 mm long, and 3 — 5 mm wide, slightly flattened ; 2 — 3 glumes ; lemmas 11 — 12 mm long, acute with short-pointed tips, minutely pale hairy all over, fringed with white short hairs; paleas as long as or slightly longer than lemmas, apex acuminate to blunt, 5 veins between keels, 2 veins between each keel and margin ; lodicules ovate, long-ciliate on the margin, translucent, with 4 — 5 brown veins, 1.5 — 2 mm long, the posterior lodicule slightly smaller than the two anterior lodicules ; anthers 6, yellow, 7 — 8 mm long, with a short-toothed cusp on the anther apex ; ovary with hairy tips.

DISTRIBUTION AND ECOLOGY

This species was found only on Fraser's Hill, Pahang, West Malaysia at 1100 - 1200 in above sea level.

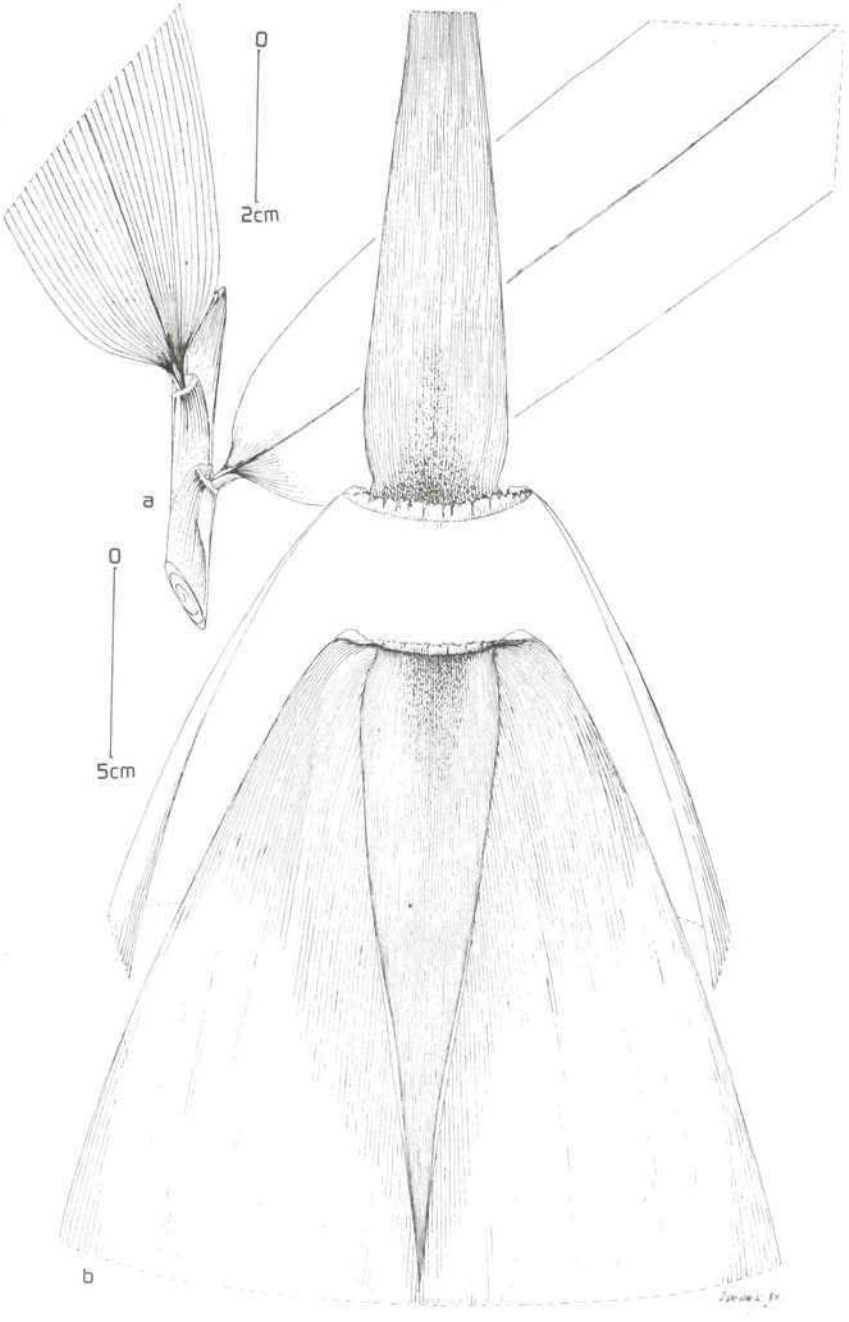


Fig. 28. *Gigantochloa latifolia* Ridl.: a. leaf sheath; b. culm sheath. From *Holttum s.n.*

NOTES

Holttum (1958) noted that lodicules were absent from the species of *Gigantoehioa* in the Malay Peninsula. However, Wong (1982) found 3 lodicules in the Malayan *G. holttumiana.* During the course of the present study lodicules have been found in the Javanese *G. pseudoarundinacea,* and the Sumatran *G. pruriens* and *G. achmadii* newly described in the present contribution.

14. GIGANTOCHLOA LATIFOLIA **Ridl.** — Fig. 28 & 29

Gigantoehioa latifolia Ridl., Fl. Mai. Pen. 5 : 262. 1925; Holttum *in* Gard. Bull. Sing. 16 : 132. 1958. - TYPE : *E. Seimund 368 (K* - Holotype), Maiaya, Pahane, KualaTeku. Febr. 1921.FI.

Clumps densely tufted.

Culms up to 15 mm tall, 4 — 8 cm diameter, walls 14 mm thick, internodes 30 — 40 cm tong, with scattered dark hairs all over their length and white hairs on upper part of internode.

Culm sheaths 14 — 24 cm long, triangular, slightly persistent; auricle a firm, smoothTlow rim, sometimes with extension sheaths beyond the auricles, 1 — 3 mm high and 1.5 — 2.5 cm in lateral extent; ligules of culm sheath 5 mm high, dentate with 8 mm bristle, ligule margin is longer than the middle; blades erect, 5.5 — 11.3 cm long, deltoid.

Leaf blades 24 — 28 cm long and 3.5 — 5 cm wide, slightly hairy to glabrous, with 3 mm long pseudopetioles; auricles of leaf sheaths low, 1 mm high and 3 mm in lateral extent, bristles on the edge up to 5 mm long; ligules 3 mm high membranous, sometimes also with fine bristles.

Spikelet-groups consisting of 11 — 13 spikelets in a cluster, 11 — 13 mm long by 4 mm wide, ovate, with 2 perfect florets; glumes up to 7 mm long and 4 mm wide acuminate, mucronate at the apex; lemmas with brownish cilia, up to 8 mm long, 4 mm wide, cuspidate; paleas slightly longer or as long as lemmas, bifid, and covered with brownish cilia; anthers 6, yellow, pointed at the apex, slightly hairy, 4 — 5 mm long,

DISTRIBUTION AND ECOLOGY

Holttum (1958) pointed out that this species was found in the northern part of the Malay Peninsula but it was not known from Southern Thailand. This species grows both in the lowlands as well as in the highlands and I found a few clumps growing along the road to the Cameron highlands when I visited that area in 1983.

NOTES

According to Holttum (1958) this species is very closely related to G *ligulata.* The differences are only in the wider culm sheath, and in the

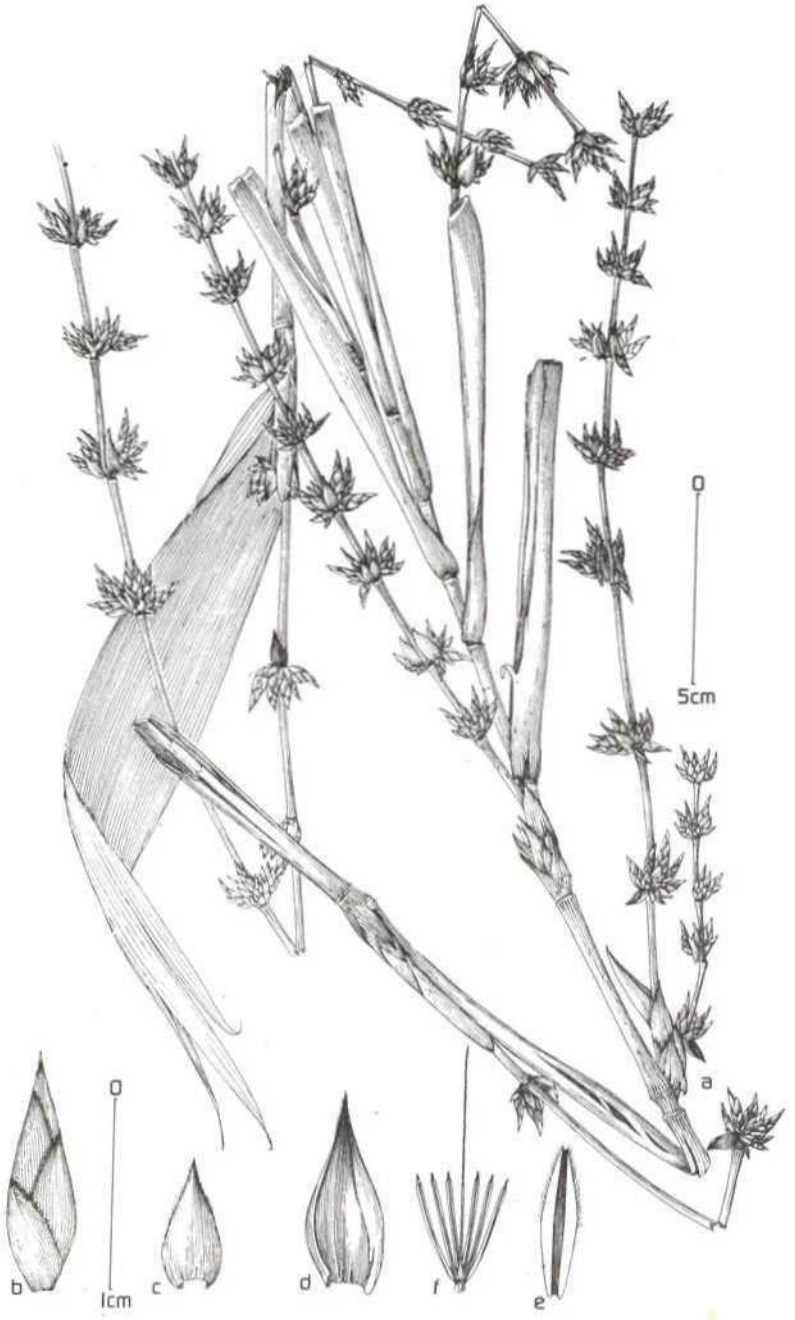


Fig. 29. *Gigantochloa latifolia* Ridl.: a. inflorescence; b. spikelet; c. glume; d. lemma. e. paJea; f. anthers. From *Holttum s.n.*

ligules of the culm sheaths not being higher at the ends than in the middle.

Three varieties have been recognized within *G. ligulata* which can keyed out as follows:

1. a. Culm sheaths with sparsely black hair; upper part of the internode with blackish brown hairs 2
   b. Culm sheath with sparsely white hair; upper paH of the internode with white hairs ..... var. *alba*
2. a. Leaves glabrous, lemmas fimbriate ..... var. *latifoUa*
   b. Leaves hairy, lemmas non-fimbriate ..... var. *efimbriata*

a. GIGANTOCHLOA LATIFOLIA Ridl. var. LATIFOLIA

b. GIGANTOCHLOA LATIFOLIA Ridl. var. EFIMBRIATA Holttum

Gigantochloa latifoiia Rid!, var. *efimbriata* Holttum *in* Oard. Bull. Sing. 16: 133. 1958. - TYPE : *Ridley 12198 p.p.* (SING - Holotype, K - Isotype), Singapore. 1905. PI.

This variety differs from *G, latifoiia* var. *alba* and var. *latifoiia* in having non-fimbriate lemmas and hairy leaves.

C. GIGANTOCHLOA LATIFOLIA Ridl. var. ALBA Holttum

Gigantochtoa laiifolia Ridl. var. *alba* Holttum in Gard. Bull. Sing, 16 : 133. 1958. - TYPE : *Holttum K 12* (K - Holotype), Kedah, Langgar, Dec. 1953. Steril.

Distinguished from *G. latifoiia* var. *latifoiia* and var. *efimbriata* by its white hairs on the culm sheaths and the upper part of young culm. Culm sheath auricles with low firm rims, 0.5 — 2 mm high, up to 15 mm in lateral extent, ligules comb-like, 4 mm high with pale stiff bristles up to 10 mm, throughout sheaths blade junction upcurved. Leaf blade auricles small, lobes up to 1 mm high, ligules 3 - 5 mm high, subentire to lacerate, pseudopetioles 5 mm long with pale bristles on the abaxial edge; callus developed, scale-like, 2 — 3 mm high.

15. GIGANTOCHLOA LIGULATA Gamble — Fig. 30 & 31

Gigantochloa ligulata Gamble *in* Ann. R. Bot. Gard. Calc. 7 : 67. 1896; Hook, f, Fl. Brit. Ind. 7 : 400. 1897; Ridley, Fl. Mai. Pen. 5 : 262. 1925; Holttum *in* Gard. Bull. Sing. 16 : 129. 1958; Lin *in* Spec. Bull. Taiwan For. Res. Ins. 6 : 37. 1968, — TYPE : *J. Wray Jr. 845* (K - Holotype, CAL, L - Isotype), Malaya, Perak, Kuala Wok. Fl.

Clumps densely tufted, culm sheaths not easily deciduous so that they give a temporary dirty appearance to the whole clump.

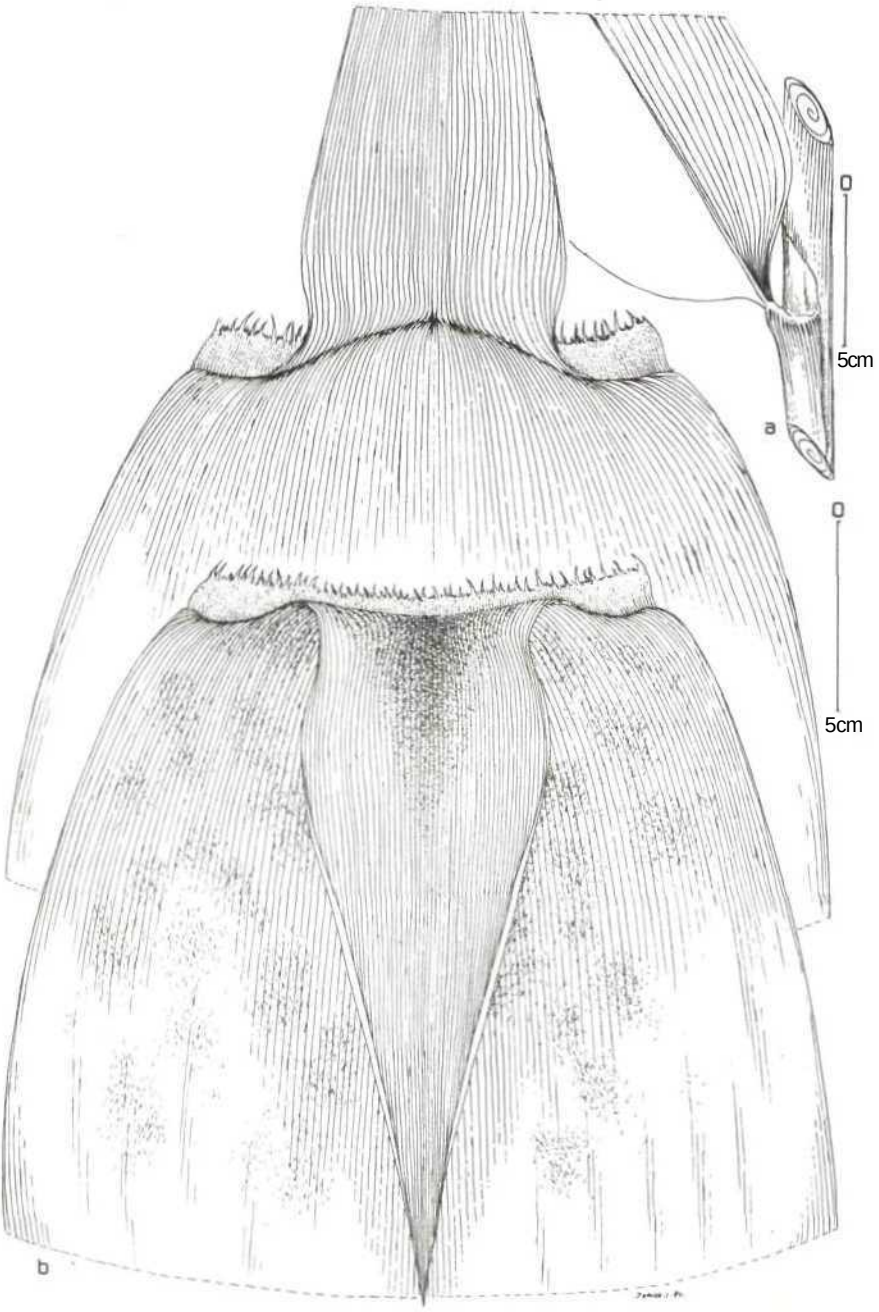


Fig. 30. *Gigantochloa ligulata* Gamble: a. leaf sheath; b. culm sheath. From *Holttum 38417*.

Culms up to 9 m tall, 2 — 4 cm diameter, walls 10 mm thick, the longest internodes 20 — 40 cm long, pale green, sometimes with yellow stripes covered by scattered dark brown stiff hairs on upper parts of ttie internodes and also very fine, much shorter, white hairs.

Culm sheaths slightly persistent, narrowly triangular, rather thin, with dark brown detaching hairs, 14 — 29 cm long; auricles with a low smooth, but firm, rim and down-curved from the edges of the sheath to the base of blades, 1 mm high, 15 — 25 mm in lateral extent, bristles few and long, if any; ligules long, membranous, higher in the margin than in the middle, 17 — 20 mm high at the ends, incised 4/5 of its width; blades erect, not deciduous, so the lines between blades and sheaths are not clearly marked externally, 3 — 6 cm wide, 22 — 28 cm long on the upper sheaths.

Leaf blades large, oblong-lanceolate, pale green and slightly and finely hairy, 30 — 42 cm long, 4 — 7 cm wide with 3 — 7 mm pseudopetioles; leaf sheath auricles conspicuous, appear only as a raised line, and meet the ligules; ligules thin, distinctively long and obvious, 11 — 30 mm long, longer in the distal leaves, deeply bilobed; callus on the upper surface developed into thin scale-like, 3 — 15 mm long.

Spikelet groups in a cluster of up to 60 spikelets, spikelets ovate-lanceolate, 12 — 16 mm long, 4 mm wide, 4 perfect florets and 1 sterile floret: glumes 3—4, ovate, acuminate with short pointed apex, 4 — 8 mm long; lemmas narrowly ovate, cuspidate at the apex, 9 — 12 mm long with dark cilia; paleas narrow and bifid at the apex, fringed on the keel with dark cilia, 8 — 10 mm long, 2—5 veins between keels, 1—2 veins between keel and edge; anthers yellow, 6 — 8 mm long, pointed at the long hairy tips; caryopsis 9 mm long, 2 mm wide, hairy on the apex.

DISTRIBUTION AND ECOLOGY

So far this bamboo is known only from the northern part of Malaya (Holttum 1958) and Thailand (Lin 1968).

VERNACULAR NAMES

MALAY PENINSULA: buluh tikus, buluh tilan (Pahang), buluh rnelian (Alor Siam).

USES

According to Holttum (1953) the young shoots, though small, are of a good edible quality. Lin (1968) reported that this bamboo is also used for rural construction, agricultural implements and paper making.

NOTES

As has been suggested by Holttum (1958) this is a very variable species. There are two groups of varieties i.e. a smaller variety which is a smallish, thick walled bamboo and a larger variety with the culm sheath ligule higher at ends, lacerate to deeply lacerate. However, the latter character is

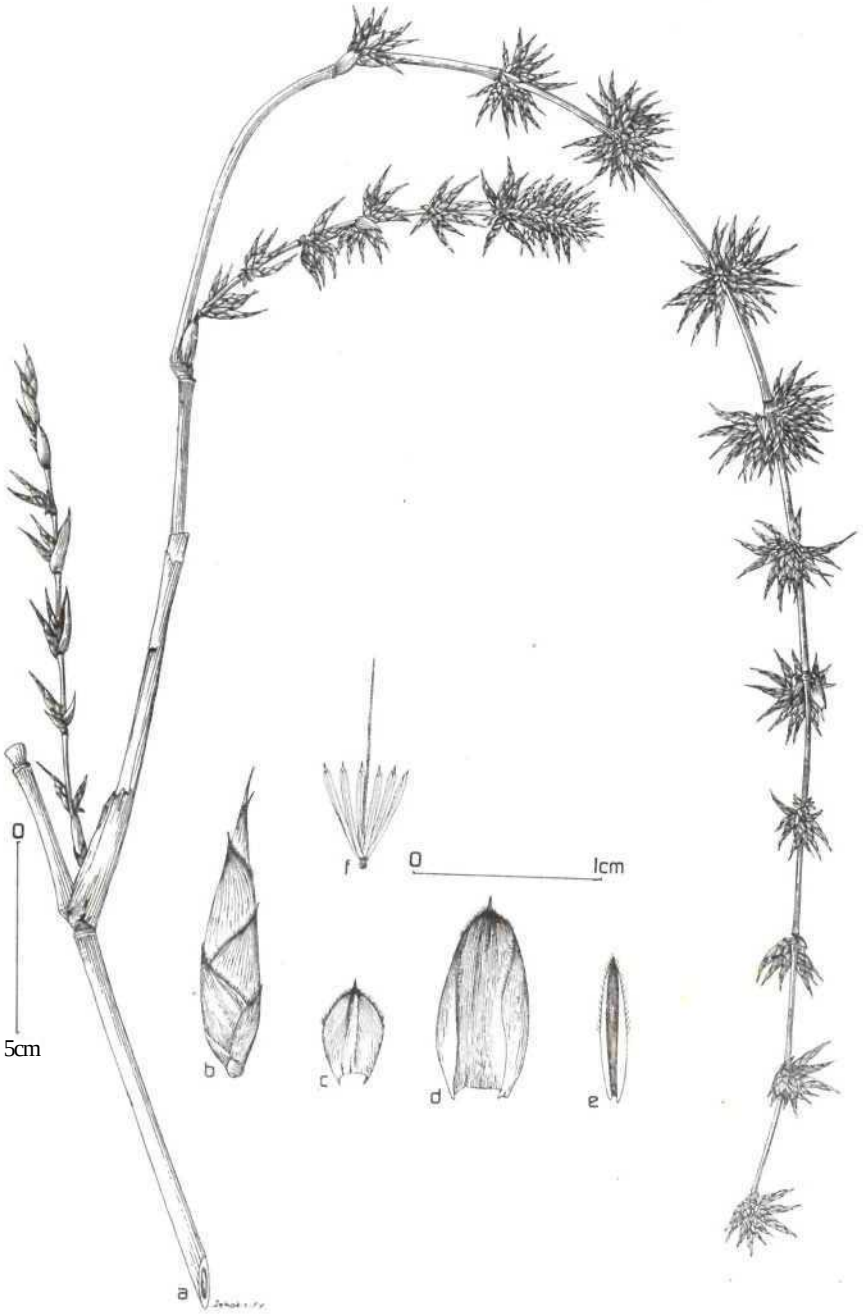


Fig. 31. *Gigantockloa ligulata* Gamble: a. inflorescence; b. spikelet; c. glume; d. lemma; e.palea; f. anthers. From *Md Iluniff & Md Nur 3887.*

variable on the same plant. Beside the vegetative variation, the smaller plants have only two perfect florets whereas the larger ones have 3 — 4 perfect florets.

Holttum (1958) also mentioned the difficulty in separating *G. tigulata* and *G. latifolia,* because in both species there is much variation even on the same clump. He thought that this complex represents inter-breeding taxa. More extensive field studies are required to clear up the taxonomic status of alt these forms.

16. Gigantochloa manggong Widjaja, srj. *nov.* — Fig. 32 & 33

Auriculae vaginarum culmorum firmae brevesque, margine extemo elevato, atrofuscae vel purpurascentes, sine setis ; ligulae 5 mm longa, irregularitei dentata ; lamina foliorum erecta. Spiculae ovato-lanceolatae, gracile ; glume ovatae, mucronatae ; lemmata valde involuta, ovata, cuspidata ; paleae angustae, bifidae ; antherae maroninae vel atromagenteae, usque 6 mm longae, ad apicem cuspidatae et sparse pilosae. — TYPUS : *E.A. Widjaja 1793* (BO — Holotype, K, L — Isotype), Java, Banyuwangi, Suaka Margasatwa Meru Betiri. 25 Nov. 1982. FL

Clumps densely tufted, the centre only slightly raised from the ground, with green to yellowish culms bearing slightly persistent culm sheaths.

Culms up to 15 m tall 5 — 7 cm diameter, the wall up to 10 mm thick at the middle ot the culms,the longest intemode 31 — 35 cm long, smooth, green but afterwards yellowish.

Culm sheaths appressed, dull yellow, 30 — 33 cm long, trapezoid with the apex almost truncate but slightly raised in the middle at the attachment of the sheath blades, covered with appressed dark brown hairs, the hairs fall off when older so that the culm sheaths become glabrous ; auricles a firm rim which is raised towards the end, jointed at the blades, up to 4 mm high, dark brown to purplish brown, without bristles ; ligules 5 mm high, irregularly dentate ; blades erect, narrowly triangular, 18 — 25 cm by 9 — 11 cm wide, deciduous when old, sheath blade junctions inconspicuous.

Leaf blades lanceolate, 27 — 29 cm long, by 3 — 4 cm wide, glabrous, thick, pseudopetiole yellowish, 3 — 4 mm long ;leaf sheaths yellowish with purphsn margin, when young covered with detaching dark brown hairs and becoming glabrous afterwards ; auricles rounded, raised, and joined to ligules at the end, small, up to 1 mm high, purplish ; ligules irregularly toothed, 1 mm high.

Spikelet-groups of up to 35 spikelets in a cluster; spikelets ovate-lanceolate, slender and narrowed at the apex, 7 — 15 mm long, and 2 — 3 mm wide, perfect florets 3 ; glumes 2 in each spikelet, 5—6 mm long, ovate acute and mucronate at the apex, glabrous except for dark cilia 0.5 — 1 mm long around their margin ; lemmas strongly inrolled, ovate narrow and acuminate, 10 — 14 mm long ; paleas bifid at the acute apex, almost as long as lemmas on the mature florets, 9 — 12 mm long by 0.5 — 1 mm wide

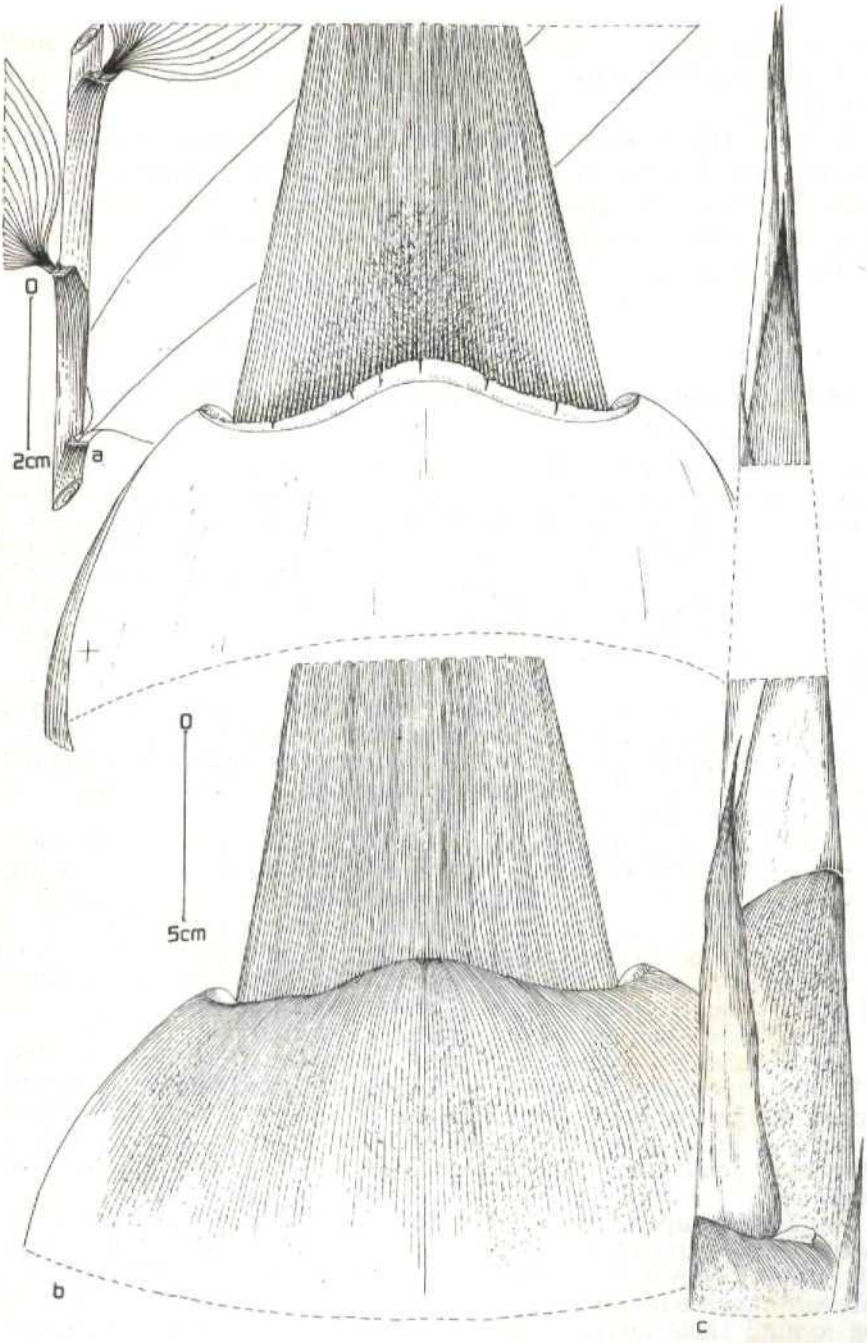
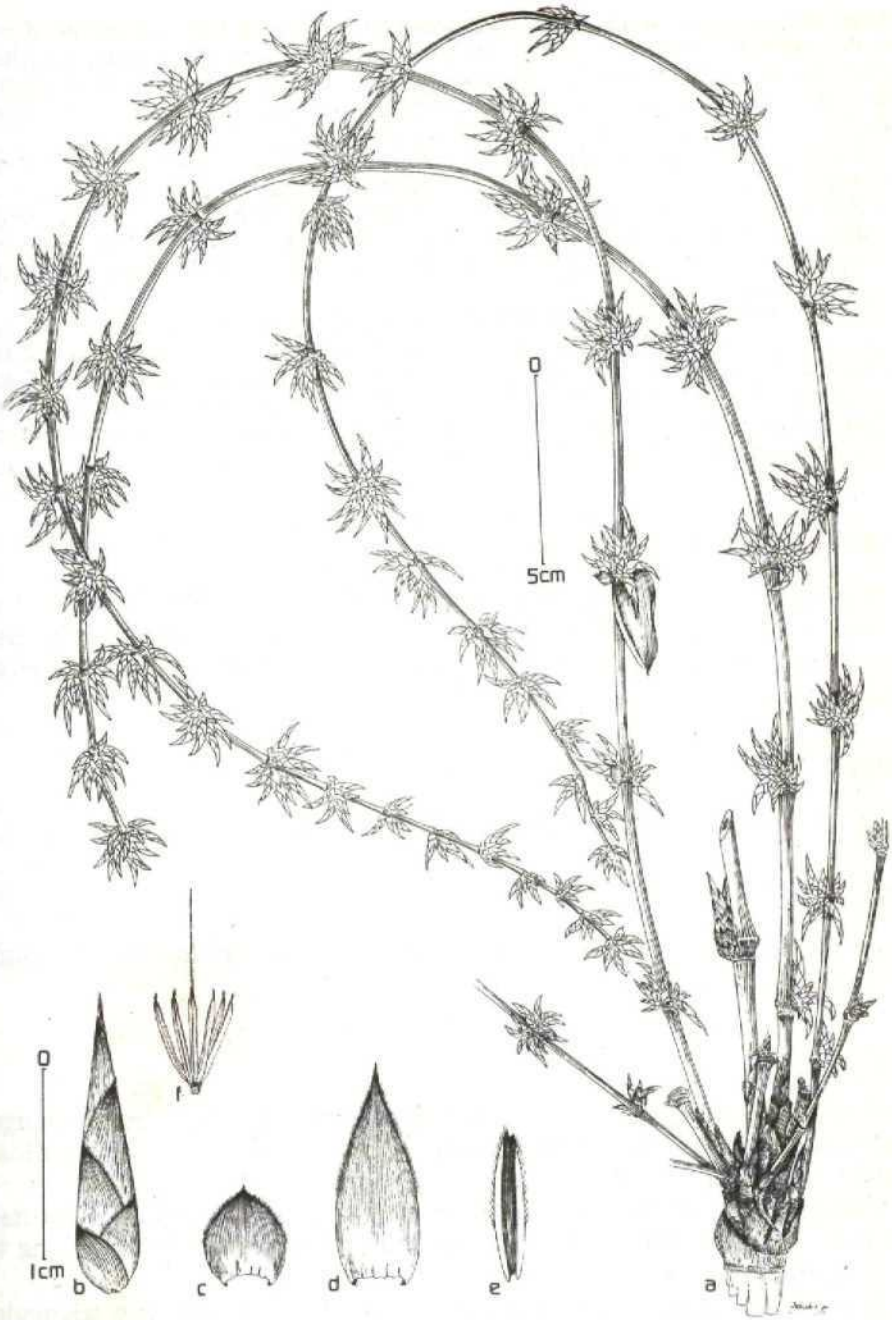


Fig. 32. *Gigantochloa manggong* Widjaja:a. leaf sheath; b. culm sheath; c. young shoot. From *Widjaja 1792.*



Fig, 33. *Gigantoctiloa manggong* Widjaja: a. inflorescence; b. spikelet; c. glume; d. lemma; e. palea; f. anthers. From *Widjaja 1792.*

between keels, keels with short brownish to white fringed or none, 3 — 5 veins between keels and 1—2 veins between keels and the margin ; anthers 6, maroon to dark magenta, up to 6 mm long, with slender and slightly hairy tips, tips up to 0.8 mm long ; ovary ovate, slightly hairy at the apex, style glabrous but hairy at the tips ; caryopsis unknown.

ANATOMY. Macrohairs of leaf lamina few, 90 — 100 µm long; microhairs with distal cells (33 — 43 µm), more less equal to basal cells (34 — 39 Aim). Prickle hairs relatively few, 26 — 43µm long. Three to four long and 3 — 4 short papillae overarching each stoma. Stomata in 3 — 5 files, outlines obscured by overarching long papillae. Long cells in 4 — 6 files on intercostal zone, with sinuous walls.

In transverse section of leaf lamina it can be observed that there are one smaller vascular bundle on the adaxial side and 5 on the abaxial side of the large vascular bundle in the middle of the midrib. Fusoid cells 62 — 73 µm in horizontal diameter ; vertical diameter 29 — 34 um. Seven small vascular bundles between successive large vascular bundle. Bulliform cells 3 cells together, isodiametric, about 47 — 54 µm.

DISTRIBUTION AND ECOLOGY

This species was found growing wild at Meru Betiri Nature Reserve in East Java (50 m alt.) and also along the dry river bed at Candikuning, Bali (about 1500 m alt.). *Parkinson 5101* from Amherst (India) is also referable to this species.

VERNACULAR NAMES

JAVA : pring manggong {Javanese). BALI : tiying Jahe (Balinese).

USES

In Bali people use this bamboo species for building construction although it is not as good as *G. apus.*

NOTES

The Balinese called this species "tiying jahe" (literally means ginger bam boo) on account of the ginger like yellow coloration of the pseudopetiole and the leaf sheath.

The specimen *Parkinson 5101* from Amherst, was originally identified as *G. apus* by R.M. Parker but it has nothing to suggest it being belong to that distinctive species.

The present species can be recognized by its erect narrowly triangular culm sheath blade, characteristic coloration of the pseudopetiole and leaf sheath, and bifid palea.

17. Gigantochloa pruriens Widjaja, *sp, nov.* — Fig. 34, 35 & 36

Vaginae culmorum pilis longis atrofuscis vestitae; auriculae secus verticem vaginae usque ad basim laminae bene evolutae, 6 mm altae, 13 ram latae; ligulae 2 mm longae, dentatae. Spiculae ovato-oblongae, 12 — 14 mm longae, 4 mm latae; glumae ovatae, apiculatae; lemmata ovata, apiculata; paleae acutae, bifidae; antherae 6 — 8 mm longae, apiculatae; lodiculae membranaceae, 1.5 - 3 mm longae. — TYPUS : *E.A. Widjaja 1710* (BO - Holotype, K, L — Isotype), Sumatra, Kotacane, Ketambe, **Pugar.** 8 June 1982. Fl.

Clumps densely tufted, the centre is not raised from the ground.

Young shoots greenish orange-brown, covered with long and dark brown hairs.

Culms erect, dark to faintly-bluish green, up to 15 m high, 6 —12 cm in diameter, wall medium thickness (up to 10 mm on the middle culm), the longest internodes 40 — 60 cm long, green with scattered long and dark hairs on the upper part of the internode.

Culms sheaths up to 30 cm long, deciduous, covered with long and dark brown hairs (up to 3 mm long); auricles well developed along the truncated apex of the sheath adjacent to the narrow base of the blades, 6 mm high, 13 mm in lateral extent; ligules slightly thin, 2 mm high, with dentate margins; blades reflexed about 11 cm long by 2.5 cm wide.

Leaf blades 24.5 — 38 cm long, hairy on the lower surface, on 3 — 4 mm long pseudopetioles; leaf sheaths with brownish hairs when young; auricles inconspicuous along the leaf sheath; ligules irregularly denticulate, 2 mm high; callus well developed sometimes hairy.

Spikelet-groups of up to 5 spikelets in a cluster, spikelets ovate-oblong 12 — 14 mm long, 4 mm wide, perfect florets 4; glumes 2 — 3 in number, ovate acute at the mucronate apex, 4 — 7 mm long; lemmas ovate, narrow and acuminate at the apex with short pointed tips, 8 — 14 mm long with brownish hairs; paleas acute at the notched apex, 7 — 12 mm long with brownish hairs on the keels, 3—4 veins between keels, 1 — 2 veins between keels and margin covered with very fine hairs; anthers 6, yellowish, 6 — 8 mm long, pointed at the tip to about 0.5 mm and hairy; lodicules oblong, ciliate at the tip very thin, 1.5 — 3 mm long.

DISTRIBUTION AND ECOLOGY

The first collection of this species was made by **Lörzing** from North Sumatra and I also found it is growing in the South East Aceh. Lörzing further reported that this plant was abundant in the villages and very rarely found wild. This bamboo grows in the lowland 15 — 400 m above sea level.

VERNACULAR NAMES

SUMATRA : Buluh regen (Batak Karo, Alas), buluh belangke (Melayu), **buluh yakyak** (Gayo).

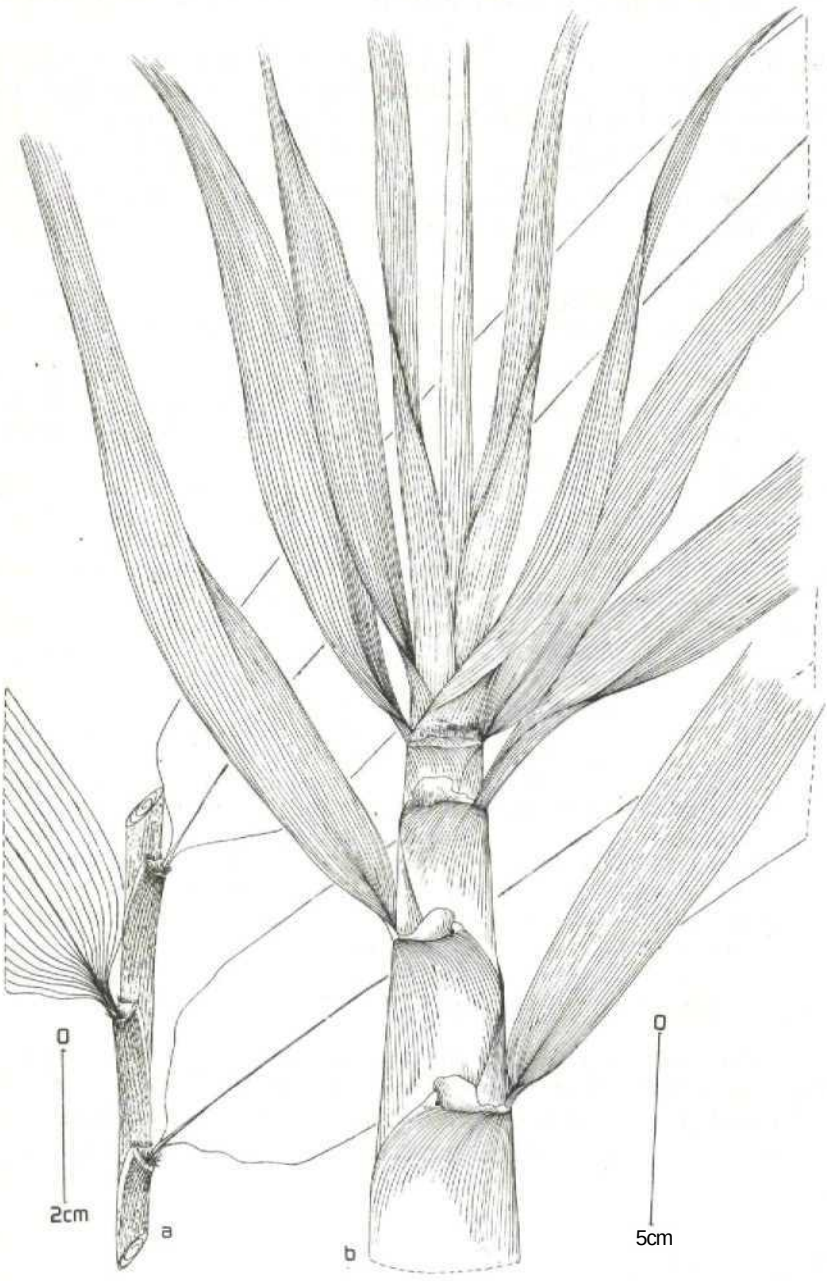


Fig. 34. *Gigantochloa pruriens* Widjaja: a. leaf sheath; b. young shoot. From *Widjaja 1710.*

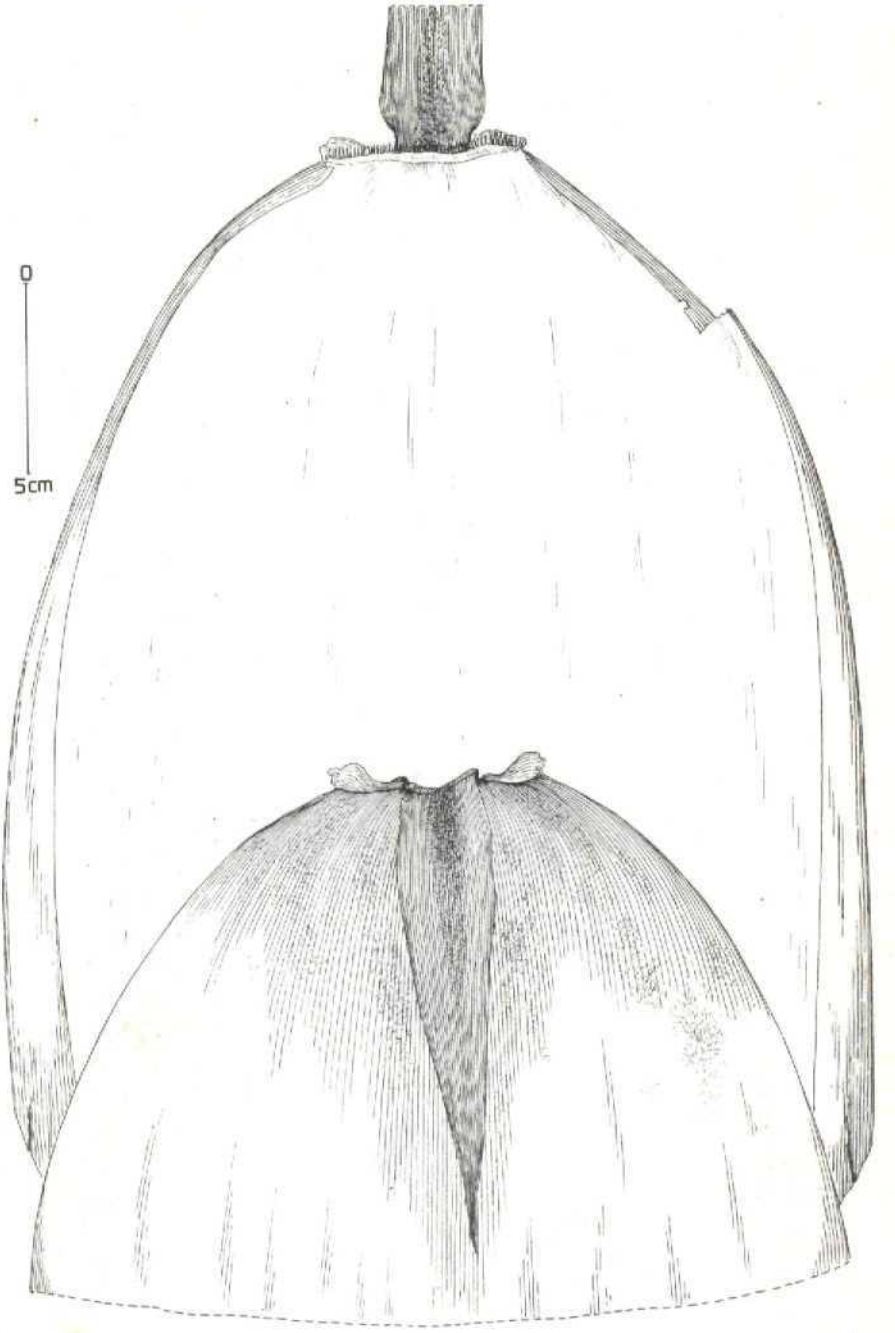


Fig. 35. *Gigantochloa pruriens* Widjaja: culm sheath. From *Widjaja 1710.*

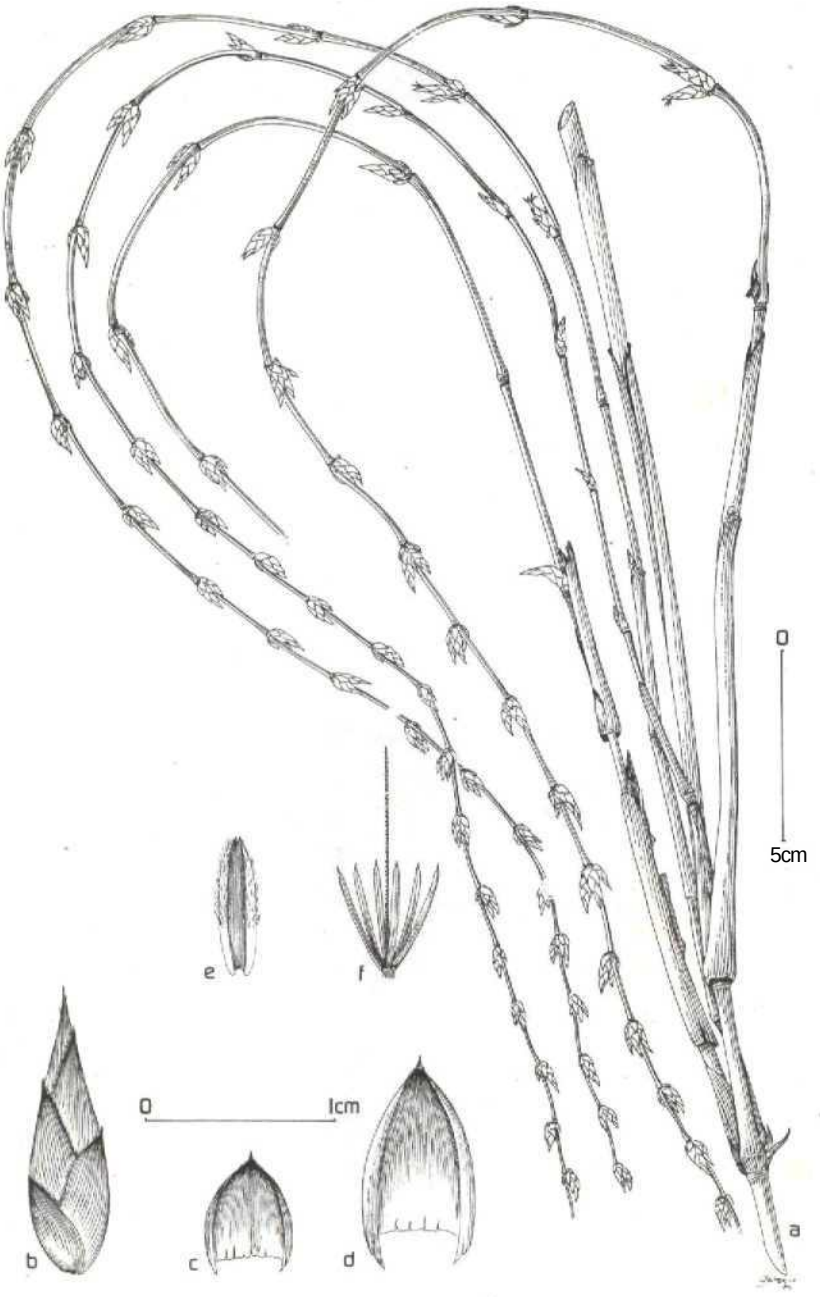


Fig. 36. *Gigantochloa pruriens* Widjaja: a. inflorescence; b. spikelet; c. glume; d. lemma; e.palea; f. anthers; g. lodicule. From *Widjaja 1710.*

USES

This bamboo produces excellent young shoots. The culm is also used for building materials such as pillars, walls and roofing. In some places people take the young culm for making "lemang" (specially cooked rice prepared for the use on a long journey) although this is not the most commonly used bamboo for that purpose. The Batak people reported that this bamboo was also used for making "parhalaan", the typical calendar of Batak people. It is reported that this bamboo much used for harvesting oil palm in North Sumatra.

NOTES

This species can be easily recognized by its long and dense hairy covering of the culm sheaths as well as by the erect culms.

18. Gigantochloa achmadii Widjaja, sp. *nov.* — Fig. 37 & 38.

Auriculae vaginae culmorum rotundae, margine extemo elevatae ad extremas partes exteriores, 6 mm altae, 7 mm lata, aetis usque 4 mm longis praeditae; ligulae 2 — 3 mm longae, dentatae, dentibus setosis; laminae foliorum ovatae, basi angustatae, reflexae, 7 — 9 cm longae, 1 — 2 cm latae. Spiculae ovato-lanceolatae; flosculi perfecti 4; glumae cuspidatae; lemmata latevovata, apiculata; palea acuminata, apiculata; antherae 6 — 8 mm longae, luteae, apiculatae; lodiculae membranaceae, translucidae, 2 — 3 mm longae, ciliatae. - TYPUS : *Achmad &54* (BO - Holotype, K. L - Isotype), Sumatra, Simalur. 16 JP - 1919. Fl.

Culms up to 20 m tall, up to 9 cm diameter, internodes 25 — 35 cm long, yellowish green with whitish hairs on the upper parts of the internodes.

Culm sheaths deciduous, covered with dark brown hairs, 25 — 27 cm long, narrowly triangular; auricles rounded, raised towards the outer ends and .slightly curved outwards, 6 mm high by 7 mm lateral extent with bristles up to 4 mm long; ligules 2 — 3 mm high, dentate, with the teeth ending in long bristles; blades ovate with narrowed base, reflexed, 7—9 cm long by 1 — 2-cm wide.

Spikelet-groups with up to 5 spikelets in a cluster, spikelets ovate-lanceolate with 4 perfect florets; glumes 2, ovate, acuminate, pointed at the apex, brownish cilia along the margin, 14 — 15 mm long, 3—4 mm wide; lemmas widely ovate and cuspidate with pointed apex, with brownish white cilia at the apex margin, 10 — 12 mm long; paleas pointed at the acute apex, white fringed, 8 — 11 mm long, 6 veins between the keels, 2 veins between each keel and the edge; anthers 6, yellow, 6 — 8 mm long, pointed apex 1 mm, hairy; lodicules very thin, translucent, 2 — 3 mm long, with long cilia.

DISTRIBUTION AND ECOLOGY

Known so far only from the herbarium specimens collected from North and West Sumatra (Simalur Island and Secincin, Kayu Tanam) in disturbed forest..It grows usually in heavy clay soil covered by humus.

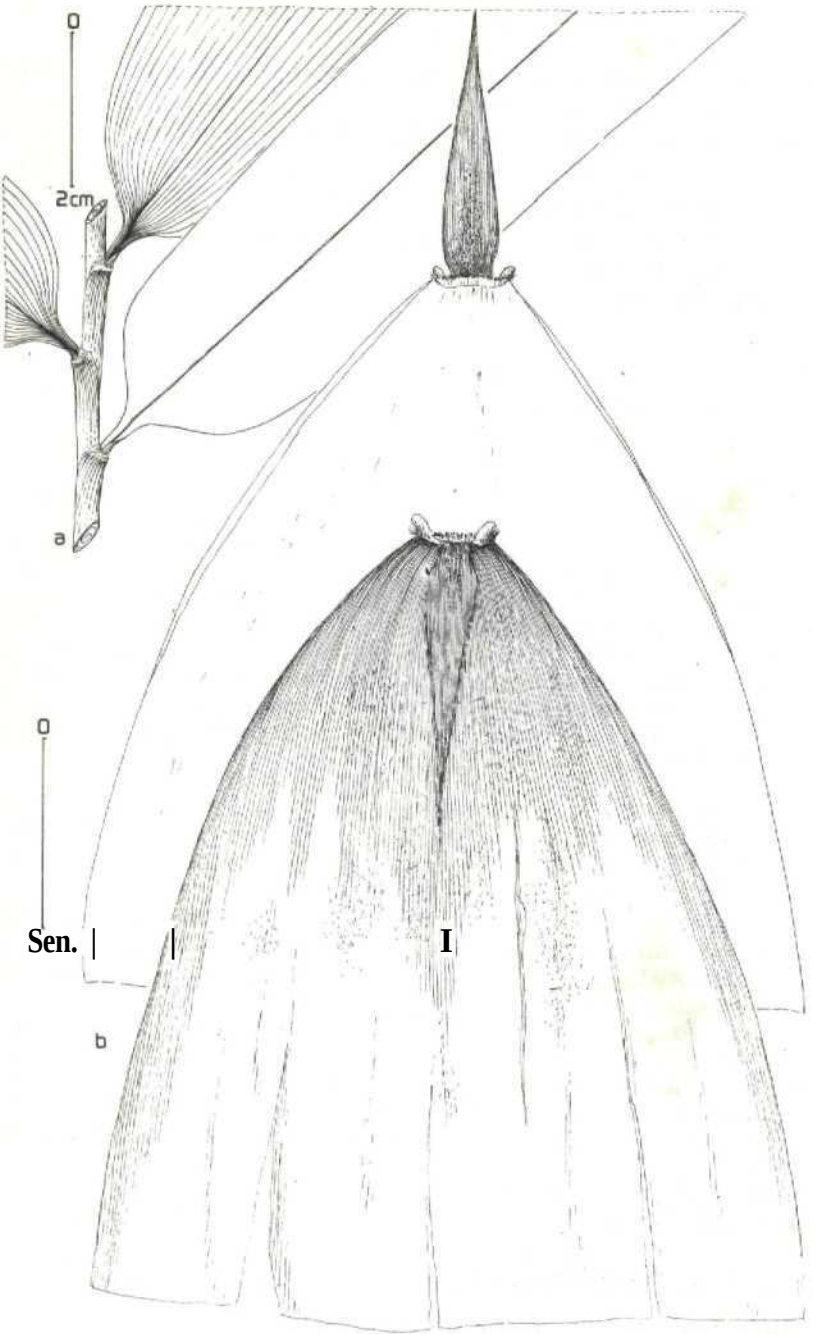


Fig. 37. *Gigantochloa achmadii* Widjaja; a. leaf sheath; b. innerside of culm sheath; c. outer of culm sheath. From *Achmad 854.*

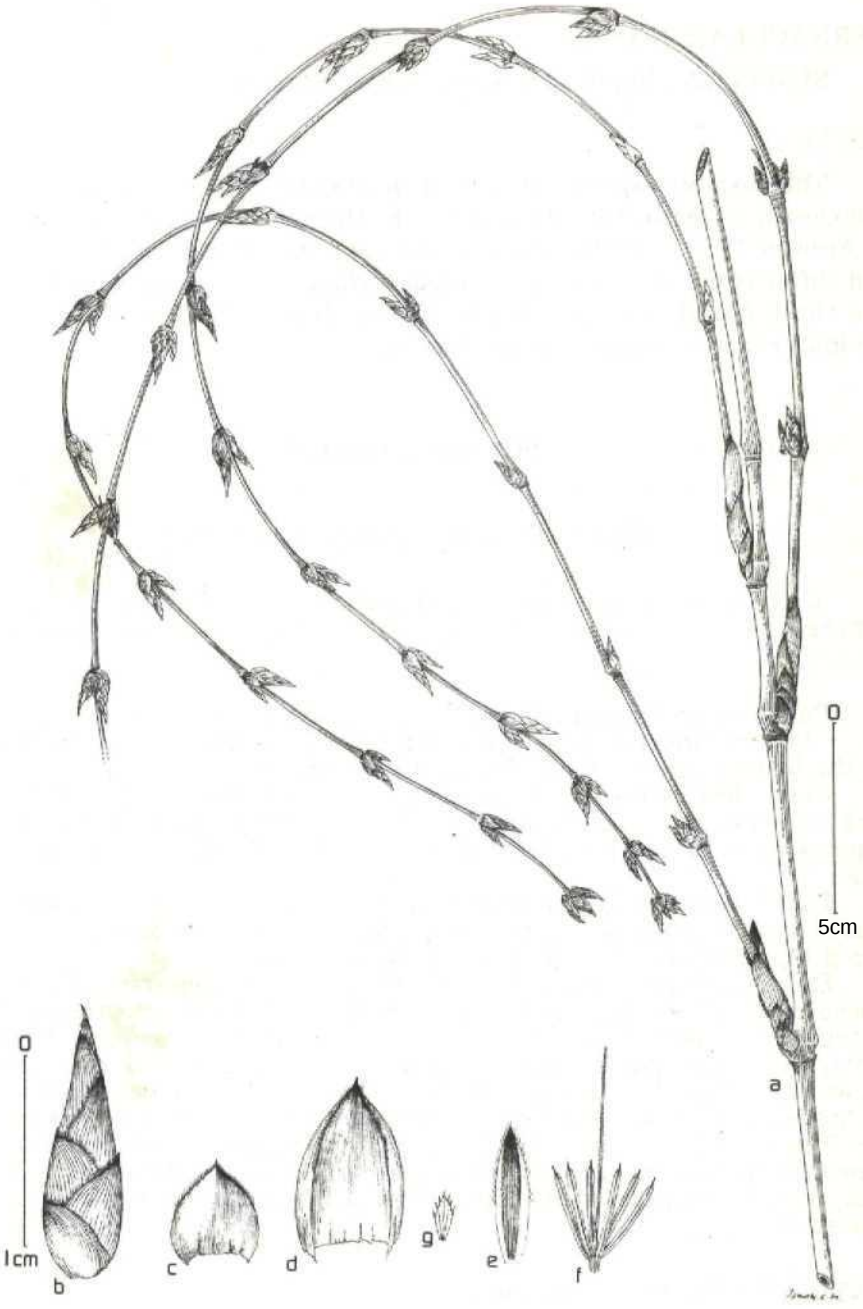


Fig. 38. *Gigantochloa achmadii* **Widjaja:** a. **Inflorescence; b. Spikelet; c. glume; d. lemma; e. palea; f. anthers; g. lodicule. From *Achmad 854.***

VERNACULAR NAMES

SUMATRA : Buluh apo (Simalur, West Sumatra).

NOTES

This bamboo species is named in honour of Mr. Achmad, an active Indonesian collector who assisted Dr. K. Heyne in the botanical exploration in Aceh in 1917 — 1920. The peculiar culm sheath auricles are very distinct and differ from other species of *Gigantochloa.* The spikelets have lodicules like those found in *G. pseudoarundinacea,* but in this species the lodicules are longer than in *G. pseudoarundinacea.*

DOUBTFUL SPECIES

GIGANTOCHLOA IIETEROCLADA Stapf

Gigantochloa keteroclada Stapf apud Gibbs *in* J. Linn. Soc. Bot. 42 : 190. 1914. — TYPE : *L.S. Gibbs 3093* (K — Holotype, BM — lsotype), Sabah near Mensango. Febr. 1910. Fl.

Culms up to 15 mm tall and 3 — 15 cm diameter, the longest internode 30 — 60 cm, green or green with light yellow stripes, aerial roots appear on the lower culms up to 30 cm above the ground.

Culm sheaths up to 30 cm long, trapezoid, green with light brown to dark brown hairs ; auricle 5 mm high ; ligules short, up to 15 mm high, membranous with 13 mm long bristles ; blades reflexed, 12 cm long, 10 — 12 cm wide.

Leaf blades widely lanceolate, 31 — 36 cm long, 2 — 5 cm wide, glabrous pseudopetioles 5 — 7 mm long ; leaf sheaths with firm auricles up to 1 mm high ; ligules up to 2 mm high with fine hairs.

Spikelet-groups containing up to 45 spikelets in a cluster, spikelet ovate lanceolate, acute at the slightly hairy tip, 11 — 14 mm long, 4 mm wide, consisting of 3 perfect florets (2—3 florets according to Gibbs) ; glumes 2 — 3, ovate, 4 — 6 mm long ; lemmas acuminate at the apex, 8 — 11 mm long, with brownish cilia ; paleas pointed at the apex, 5 — 10 mm long, brownish hairs on the edge, 4 veins between keels and 1—2 veins between keels and edge, 5 — 7 mm long, apiculate, slightly hairy at the tips, filament free (3/4 length joined to form staminal tube according to Gibbs) ; lodicules 1 — 12 mm high, thin, ovary hairy at the tips, styles 2, no imperfect floret on the type specimen.

DISTRIBUTION AND ECOLOGY

This species thus far is known only from a specimen collected in North Borneo.

NOTES

I have never seen any flowering *Gigantochloa* which arises from the leafy clumps as Gibbs (1914) described. According to her, this species was close to *G. levis or G. robusta* in having spikelets similarly slightly hairy at the tips. However, this species differed from other *Gigantochloa* species in having free filaments and no imperfect florets. More collections are needed to clarify the taxonomic status of this species.

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APPENDIX
IDENTIFICATION LIST OF GIGANTOCHLOA SPECIMENS

ach	=i *G. achmadii*	man	= G. *manggong*
apu	= *G. apus*	nig	= *G. nigrociliata*
atr	• G. *atroviolacea*	pru	= *G. pruriens*
att	- *G. atter*	pse	= *G. pseudoarundinacea*
has	= *G. hasskarliana*	rid	= *G. ridleyi*
het	= *G. heteroclada*	rob	• *G, robusta*
hol	• *G, holttumiana*	ros	= *G. rostrata*
lat	= *G. latifolia*	sco	= G. *tcortechinii*
lat, var. efi	• G. *latifolia* var. *efimbriata*	sco. var.alb.	= G. *tcortechinii* var. *dlbovestita*
lev	= *G. levis*		
lig	- G. *ligulata*	wra	• G. *wrayi*

Achmad 854 : **ach** — *Alisati s.n.* (Sept. 1934) : apu.

Backer 9528, 24413 : **pse** — *Bakhuizen van den Brink 96, 486, 1413* : **nig** ;*2123* : **att** ;*5131* : **apu** ; *6314. 631 7* : **pse** ; *7391* : **atr** ; *7504 t* **rob** ;*7616* : **nig** — *van Balgooy 2121* : **sco** — *Bandoin s.n.* : **att** — *Bape 12818* : **ros** —*Barnard s.n.* : **wra** — *Beguin 69, 635, 1255* : **att** — *Binnendijk 104* : rob — *Blume sn* (Java) : apu — *Burgess FRI 9389* : **sco** — *Burkill 13118, 13920* : **wra** — *Burkm & Haniff 12479* : **sco** ; *13311* : **lat** ; *13319* **r lig J** *13452* : **wra** ; *16865* : **sco** — *Buyung 11005* : **sco** — *Buwalda 4405* : **rob** ; *6933* : **has.**

Cheang SFN 37941 : **wra** — *Conklin 923* : **lev** — *Conklin & Buwaya* **79570** : **lev**— *Curran 10177* : *\ev - Curtie 3180* : lig ; 3746, *10849* : sco.

Dakkus 297 : **has** — *Danimihardja 2265* : **has** ; *2324* : **rob** ; *2339* : **pse** — *Dolman 21544* : **lig** — *Dransfield 71 7* : **lat** — *Duldulao 25418* : **lev** — *Dumas 1504* : **wra.**

Forest Department A 1103 : **lev.**

Gadrenab s.n. (6 Sept. 1982) : has — *Gamble 21105 - 65* : has ; 27890 : att — *Gibbs 3039 I* **het** — *Gusdorf 265* : **has** ; *9018* : **att.**

Haines 6420 : **wra** — *Hamid 8252* : **sco.** var **.alb.** ; *8253* : sco ; *8254* : wra ;*8256* : **lig** — *Haniff 14238* : **sco** ; *14921* : **wra** — *Haniff & Nur 10206* : **sco** — *Hassan A 31111* : **lev** — *Henderson 22999* : **lig J** *29704* : sco ;*s.n.* (Sept. 1933) : has — *Heyne 1,2* : **apu** ; **7** : **att** ; *14, 53, 54* : **apu** — *Holttum K 1, K 2, K 3* : **lig** *\K 4, K* 5 : lat ; *K 7, K 9* : **lig** ; *K 11* : sco.var.

alb. ; *K 12 :* lat.var.alb. ; *SFN. 19819 :* wra ;*SFN 21163* : has ; *SFN 38415* : sco ; *SFN 38417 :* lig ; *SFN 38420 :* wra ; *SFN 38422 :* lig ; *SFN 38423* : wra ; *SFN 38430 :* lig ; *SFN 38431 :* wra ; *SFN 39640* : sco ; *SFN 40201, 41023-* wra ; s.n. {9 Dec. 1934) : lev ; s.n. (21 Oct. 1946) : apu ; s.n. (26 Oct. 1946) : lat; *s.n.* (26 Oct. 1946) : lig ; s.n. (Sept . 1953) : ros — *Horsfield s.n.* (Java) : att — *Hort.Bog. XI.T-18* : apu ;*X11C8 :* att ; *XII K 1, XIII C 3 :* has ; *XIII C 5:* pse ; *XIV B 1* : rob ; *XIV B 3 :* att ; XIV B 4 : pse ; *XIV B 9* : apu ; *XIV B 20, XIV B 26:* ro,b ; *XIV B 32 :* has ; *XIV C 5 :* att — *HorLPur. VID10* : rob.

Ismail 99946 : sco.

Jagor SFN 37932 : lev —Jaeger s.n. (27 Febr. 1980) : apu — *Jeswiet s.n.* (1920) : pse — *JossC 01211* ratr — *Junghuhn ineditae 118, s.n.* (Java), s.n. (Java, Tjibeureum) : nig.

Kalshoven 1674 : has — *Keith CF 3681 : tev—Kiah s.n.* (4 July 1926) : lev — *Kinsay s.n.* (Malay Peninsula) : sco — *Koorders 1815* : apu ; *1957 :* att ; *8951, 15747 :* pse ; *2071 7 :* apu ; 20840 : att ; *2091 7 :* apu ; *21764 :* pse ; *22309, '34479:* nig ; *35343 :* att ; *36351 :* apu ; *37240 :* rob ; *37246, 37944, 38584 :* apu ; *38585:* rob ; *38588 :* apu ; *38597 :* att ; *38599* ; apu ; *39382* :apu ; *43676* . apu ; 43679 .* att ; *43680 :* apu *43681 :* att ,*43686* , *43687, 43690, 44237 :* apu — *Kunstler 8572 :* sco — *Kurz s.n.* (Java) : has ;*s.n.* (Java) : nig ;s.n. (Burma) : apu ;*s.n.* (Java *ex* Herb. *Clarke 8/88)* : att.

Lopez 40148 : lev ; *Lorzing 11009, 11137. 11198, 13212 :* pru.

McGregor 10414, 10417 : lev — *Maingay 1730 :* lev — *Meiyer 1819* - apu ; *4752a :* rob ; *4759 :* pse ; *SAN 19872 i* lev — *Merrill & Robinson 36916* ! lev— *Mikil SAN 30300 :* lev —*Miller 2517 :* apu ; *3084 :* pse — *Mudjiono 13 :* att ; *s.n.* (26 Oct. 1982) : apu — *Murata, Kato & Mogea B 4321 :* has.

Nurs.n. (5 Oct. 1926) : rid.

Ogilvie s.n. : ros — *ortega 10836 :* lev - *Ottensa.n,* (5 Oct. 1919) : apu ;*s.n.* (Bogor) : atr ;*s.n.* (10 Jan. 1929) : nig ;*s.n.* (Kedung Badak, Bogor) , *s.n.* (19 April 1929) : pse.

Panggabean 53 : ach —*Parker2268* : ros ; *3090 :* apu —*Parkinson 5101 :* man ; *5084 :* ros — *Pestana P 52 : sco ; P78.* apu ; *P82 :* wra j *54 :* rid ;*s.n.* (26 Aug. 1937} : lev ; *s.n.* (4 Oct. 1933) : rid ; *s.n.* (April 1934) : sco ; s.n. (9 Sept. 1937): wra— *Ploem s.n.* (Sumbawa) : nig.

Rahayu 63 : apu — *Kamlanto s.n.* (1983) : atr. — *Ramlanto & Widjaja s.n.* (16 Aug. 1983) :pse ;*s.n.* (16 Aug. 1983): rob — *Ramos' 14696* :lev —Ramos & *Edano 44372 : lev —Ridley 3114 :* wra ; *6682 :* has ; *6999 :* wra ; *7786 :* sco , *8087:* has. *Y8170, 8481, 8483 :* sco ; *12198pp. :* lat.var.efi ; *12198 p.p. :* has; *12501 :* wra ; *14034 :* lig ; *14834 :* lat ; *f4383 :* sco ; *148 3 7* .Jig ; *s.n.* (Prov. Wellesley) : rid ;*s.n.* (1 Jan. 1921) : sco ; «.n. (1906) : wra — *Rifai s.n. :* att — *Robinson 6313, 9642, B.S. 11838 :* lev.

Santos 4738 : lev — *Scortechinis.n. :* sco ~ *Seimund 368 :* lat — *Soderstorm & Calderon 2566 :* rob — *Somerville 10488. 10490 :* sco — *Stone 6105, 6109 :* sco; *6122 :* lev — *Stone & Sidik 12599* . sco — *Strugnell 10549:* sco — *Sulit 5724, 27363:* lev — *Symington 46968, 56959 :* lig.

Talcon 33959 : lev - *Thunberg s.n.* (Java) : pse — *Topping 310 :* lev.

Wardoyo s.n. (22 Oct. 1982) : apu — *Weber 1527 :* lev— *Widjaja 12 :* apu ; *33 :* att ; *38, 39, 50, 51 :* atr; *53 :* apu ; 63: atr ; *303 :* att ; *1436, 1440, 1447 :* pru; *1450 :* has ; *1453 :* apu ; *1456 :* rob ; *1460* : has ; *1462 :* apu ; *1521* . has; *1710 :* pru ; *1715 :* att ; *171 7 :* pse ; *1 729, 1731 :* apu ; *1733 :* pse ; *1741 :* man ; *1749 :* apu ; *1750, 1759* : rid ; *1760 :* apu ; *1761, 1762 :* rid ; *1 763 :* apu ; *1764:* rid ; *1766 :* rob ; *1767 :* att ; *1 768 :* rid ; *1771, 1774, 1776 :* has ;*1779:* apu; *1783 :* att ; *1792, 1793 :* man ; *1804:* apu; *1808 :* rob ; f£M : has ; *1932 :* rob ; *s.n.* (Sept. 1977) ; rob -*WongFRI 28982 :* lev ; *FRI 32145 :* lat.var.alb.; *FRI 32237 :* hoi ;*FRI 32245* . hoi ; *FRI 28981, 32239, 32334 : ros — Wray Jr 134 :* wra ; 845 : lig ; *1895 :* wra ; *3433 :* sco.

Yoshi SAN 81249 : lev.

Zollinger 3479 : pse.

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