



Calyptrogyne (Pholidostachys) dactyloides (H. E. Moore) W. Boer

Photograph by Dr. J. P. Schulz.

VERHANDELINGEN DER KONINKLIJKE NEDERLANDSE
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THE GEONOMOID PALMS

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CONTENTS

| | |
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| INTRODUCTION | 5 |
| Acknowledgments | 8 |
| MORPHOLOGY AND ANATOMY | 9 |
| Stem | 9 |
| Leaf | 15 |
| Dermal appendages | 25 |
| Inflorescence | 26 |
| Flower | 33 |
| Pollen | 36 |
| Fruit | 38 |
| Trends of specialization. | 43 |
| DELIMITATION OF GENERA | 46 |
| DISTRIBUTION, ECOLOGY, AND USES. | 52 |
| REFERENCES | 58 |
| TAXONOMY | 61 |
| Tribus Geonomeae | 61 |
| I Calyptrogyne | 62 |
| II Welfia | 76 |
| III Asterogyne | 79 |
| IV Geonoma | 82 |
| NAMES OF UNCERTAIN APPLICATION | 189 |
| INDEX OF EXSICCATAE | 191 |
| INDEX OF NAMES | 199 |

INTRODUCTION

TOMLINSON has suggested (1961) that the palm-collector is a somewhat quixotic character. This statement is illustrated by a quotation from Bailey: "to procure material of the great palms is like setting forth to collect a windmill except that one does not have the advantage of steps built on the derrick". In general, indeed, palms are unattractive to collect and to handle in the herbarium. The tribe of the Geonomoid palms, however, represents a rather pleasant exception being a group of unarmed and mostly rather small plants with often arundinaceous stems up to a few meters tall. Consequently they are more frequently collected and studied than other palms resulting in a large number of collections and publications.

The first author dealing with these palms was WILLDENOW (1805). He established the genus *Geonoma* with two species based on Bredemeyer collections from Venezuela near Caracas. The next contribution to our knowledge of this group was POTTEAU'S (1822) but he misinterpreted the proterandrous inflorescences as being unisexual. His genus *Gynestum*, including 5 species from French Guiana, was merged by KUNTH (1841) into *Geonoma*. Contemporaneously with Poiteau and unaware of the efforts of the latter MARTIUS (1823) published the results in *Geonoma* of his Brazilian itinerary.

This early work established a sound basis for understanding of the genus, whereafter additional knowledge rapidly increased. Various collectors and authors of the middle and the second half of the 19th century should be mentioned like e.g. d'Orbigny, Blanchet, Weddell, Oersted, Karsten, Spruce, Barbosa Rodrigues, Trail, and Drude. The most important one, Hermann Wendland, merits a separate mention.

He did not, in fact, publish important papers but indirectly contributed much to the taxonomy of the Geonomoid palms. Hermann Wendland (1825-1903) was raised in a tradition of horticulture and botany. Son of H. L. Wendland and grandson of J. C. Wendland he was the third of his family in succession to act as director of the Royal Gardens at Herrenhausen near Hannover. In 1857 he was sent on a botanical expedition to Central America, where he collected many specimens and several plants which he introduced into cultivation. During his trip, as well as before and afterwards, he paid much attention to palms, especially those smaller species suitable for cultivation in European glasshouses. He soon became a recognised authority on palms because of his keen interest in them. Thus he was called: "*le phénicographe le plus distingué depuis Martius*" (ED. ANDRÉ, 1871). Leaving this estimation to André, it must be confirmed that he added much to our knowledge of the Geonomoid palms. He described several species of horticultural interest as new to science and

provided numerous herbarium-specimens with manuscript names, most of which were later published by various authors. More important, however, was his emphasis of variation in flower and fruit structure in members of this group. These differences urged Wendland to separate successively the satellite genera *Calyptrogyne* (1859), *Calyptronoma* (1864), *Welfia* (1869), *Asterogyne* (1883), and *Pholidostachys* (1883). None of these genera was properly published by Wendland himself except *Calyptrogyne*. He communicated names and descriptions to other botanists like e.g. the younger Hooker, who incorporated them into BENTHAM and HOOKER's *Genera Plantarum*. Wendland also wrote a detailed manuscript on the *Geonomeae*, mainly dealing with the Central American species and only describing the other species known at that time by very short notes. This manuscript first went to Dammer and after the latter's death it reached the Botanisches Museum at Berlin where it was destroyed during world-war II. Before being destroyed it was used as a foundation for and incorporated, for the greater part, in BURRET's *Geonomeae Americanae* (1930). The last-named account served in its turn as a basis for the present treatment. Burret separated two additional genera based on floral characteristics. Subsequently Burret published a number of species thought to be new, as did also Bailey, Glassman, León, Moore, and Steyermark. Recently MOORE (1966) established a new genus *Aristeyera* to accommodate a plant with a newly discovered and distinctive type of flower.

As is clear from this historical survey information on the *Geonomeae* has continually increased and this information has been condensed most recently in Burret's revision. In an earlier paper (WESSELS BOER, 1965) I have attempted to evaluate Burret's work and its consequences for palm taxonomy. Burret employed a very narrow species and genus concept based on a typological approach in combination with an obvious lack of appreciation of variability. In this particular case his approach was rooted in the ideas of a horticulturist. Nevertheless the species and genus concept laid down by him in 1930 are still the starting point for present day students of *Geonomeae* who describe new taxa if specimens reveal slight dissimilarities with earlier described specimens. As a result Geonomoid palms are grossly overnamed in the present author's opinion; species have been distinguished on, as will be shown, irrelevant characters and identification is next to impossible. Apart from this, the most important reason for undertaking the present revision was to gain experience in the understanding of problems of classification and distribution in palms in general. The *Geonomeae* are particularly suited for this purpose as they are relatively well-represented in herbaria. Compared with them other palms are extremely poorly collected.

In the above-mentioned paper I have also discussed my own basic views on palm taxonomy and still see no need to change them. It must be taken into consideration, however, that the present approach is quite different from that in 1965. At that time I started with thorough field-

experience and bulky specimens collected by myself. I was much impressed by the plastic response of individual palms to their environment and variation dependent on age and development. Hence similarities were stressed: the approach was primarily *synthetic*. Now the starting point is formed by numerous, sometimes fairly complete specimens, but in the majority fragmentary or insufficient specimens together with a literature in which attention is focussed on dissimilarities. Consequently my main preoccupation has been telling taxa apart. The approach was more or less *analytical*. On the other hand, the field-experience was not forgotten and I think I still have an open eye for variation. Nevertheless taxa previously separated are united only if they fall within a range of variation actually observed, otherwise they are maintained separately even though there may be some doubt about the significance of the differences observed. A number of species are maintained although in future they may prove to represent only variants of a single species and I shall not be surprised if more intense collecting reduces the number of distinguishable taxa rather than increases it. In spite of the variability sometimes observed within a single species no infraspecific taxa are distinguished in the present study since I consider the usually fragmentary herbarium specimens too poor a basis for their establishment.

It is generally claimed, e.g. by DAVIS & HEYWOOD (1963), that in a revision all names should be taken into account. The work of Burret is notable in the number of names produced which are no longer vouchered by type specimens. The names of several other authors are similar. Sometimes these types or at least isotypes are still present but have not been available. These uncertain names frequently can be reduced to synonyms of other species on the basis of their descriptions although this is sometimes more or less arbitrary. These likely but uncertain examples are indicated with a ?. At the end a list of these questionable synonyms has been compiled. Proposed new species should be compared with each of these names as Burret's and my suggestions about supposed relationship or synonymy may be incorrect.

The present study is based on material from the following herbaria:

- B Berlin, Germany: Botanisches Museum.
- BM London, Great Britain: British Museum (Natural History).
- BH Ithaca, New York – U.S.A.: L. H. Bailey Hortorium.
- BR Bruxelles, Belgium: Jardin Botanique de l'Etat.
- C Copenhagen, Denmark: Botanical Museum and Herbarium.
- F Chicago, Illinois – U.S.A.: Chicago Natural History Museum.
- G Genève, Switzerland: Conservatoire et Jardin Botaniques.
- GOET Göttingen, Germany: Systematisch-Geobotanisches Institut, Universität Göttingen.
- HBR Itajaí, S. Catarina – Brazil: Herbário „Barbosa Rodrigues”.
- K Kew, Great Britain: The Herbarium and Library.

- L Leiden, Netherlands: Rijksherbarium.
LE Leningrad, U.S.S.R.: Herbarium of the Komarov Botanical Institute of the Academy of Sciences of the U.S.S.R.
M München, Germany: Botanische Staatssammlung.
MG Belém, Brazil: Museu Paraense Emilio Goeldi.
NY New York, New York – U.S.A.: The New York Botanical Garden.
P Paris, France: Muséum National d'Histoire Naturelle, Laboratoire de Phanérogamie.
R Rio de Janeiro, Brazil: Divisão de Botânica do Museu Nacional.
RB Rio de Janeiro, Brazil: Jardim Botânico.
S Stockholm, Sweden: Botanical Department, Naturhistoriska Riksmuseum.
SP São Paulo, Brazil: Instituto de Botânica.
U Utrecht, Netherlands: Botanical Museum and Herbarium.
UC Berkeley, California – U.S.A.: Herbarium of the University of California.
US Washington, D.C. – U.S.A.: U.S. National Museum (Department of Botany).
VEN Caracas, Venezuela: Instituto Botánico.

Acknowledgments: The author owes a special debt of gratitude to the directors and curators of all these herbaria who made material available to him. The study has been undertaken at the Botanical Museum and Herbarium of the State University at Utrecht, director Prof. Dr. J. Lanjouw. Dr. P. B. Tomlinson (Miami) critically read the general part in manuscript and suggested many corrections and clarifications. He has also provided microscopic sections of dried stem samples of several species. Dr. W. Punt (Utrecht) assisted greatly with the section on palynology. Dr. H. E. Moore (Ithaca) worked with the keys in manuscript and provided several improvements. Dr. K. U. Kramer (Utrecht) critically read the complete manuscript and also contributed the latin diagnosis of the new species. His assistance in numerous other ways has been particularly valuable. Mr. D. K. Ferguson read the manuscript and offered much help with the English text. Finally thanks are due to Dr. A. M. W. Mennega (Utrecht) for patiently correcting the proofs in the author's absence.

MORPHOLOGY AND ANATOMY

Relatively little information on morphology and anatomy of the Geonomoid palms is available. Morphological characters which are impossible to assess from herbarium sheets are often neglected by collectors. Features such as a clustered or solitary habit, the size of the stem, the shape of the crown, the number of leaves, the colour of the inflorescence at anthesis and in fruit, the colour of the fruit at maturity, are rarely adequately recorded on herbarium labels. Yet such features are very important for distinguishing species. The herbarium taxonomist is sometimes unable to appreciate the significance of differences observed in the fragmentary specimens at his disposal because this information is lacking. The opinion, however, that if minute scraps are not quite similar the huge plants that palms are, must be — by extrapolation — extremely different, is not necessarily correct.

The morphological and anatomical information available, in combination with some new observations, is considered here briefly. A wealth of information is accumulated in TOMLINSON's *Anatomy of the Monocotyledons*, vol. 2, *Palmae*. The structures reported in this chapter are partly based on incidental observations. Hence it is not impossible that they are not generally applicable.

Stem

The stem of Geonomoid palms is very variable, in size ranging from a condensed state in species described as being "acaulescent" to columnar, to 20 m tall and $1\frac{1}{2}$ dm in diameter in *Welfia*. Stems are most frequently cane-like, only a few m tall and up to a few cm in diameter. VON MOHL (1831) named this type a *caudex arundinaceus*, i.e. a slender, erect, more or less densely ringed stem; internodes obconical; epidermis smooth, lustrous, permanent; ground parenchyma cells little enlarged; central vascular bundles rather soft, the peripheral vascular bundles rather hard. In *Welfia* and *Calyptronoma* the taller columnar stems do not remain smooth, the epidermis is not permanent, the surface layers are replaced and the nodes become gradually less visible.

"Acaulescent" species do have short subterranean stems with little internodal elongation. These stems are rather soft with numerous more or less obliquely running fibres. The subterranean part of normal canes is of the same structure. Sometimes, in old "acaulescent" plants the "subterranean" stem reaches a height of several dm above the ground, still retaining the congested nodes, a rather soft structure, and obliquely running fibres. Species which normally produce canes, under unfavourable circumstances may develop unextended internodes resulting in stems of the subterranean type. This, for instance, was observed in *Geonoma euspatha*

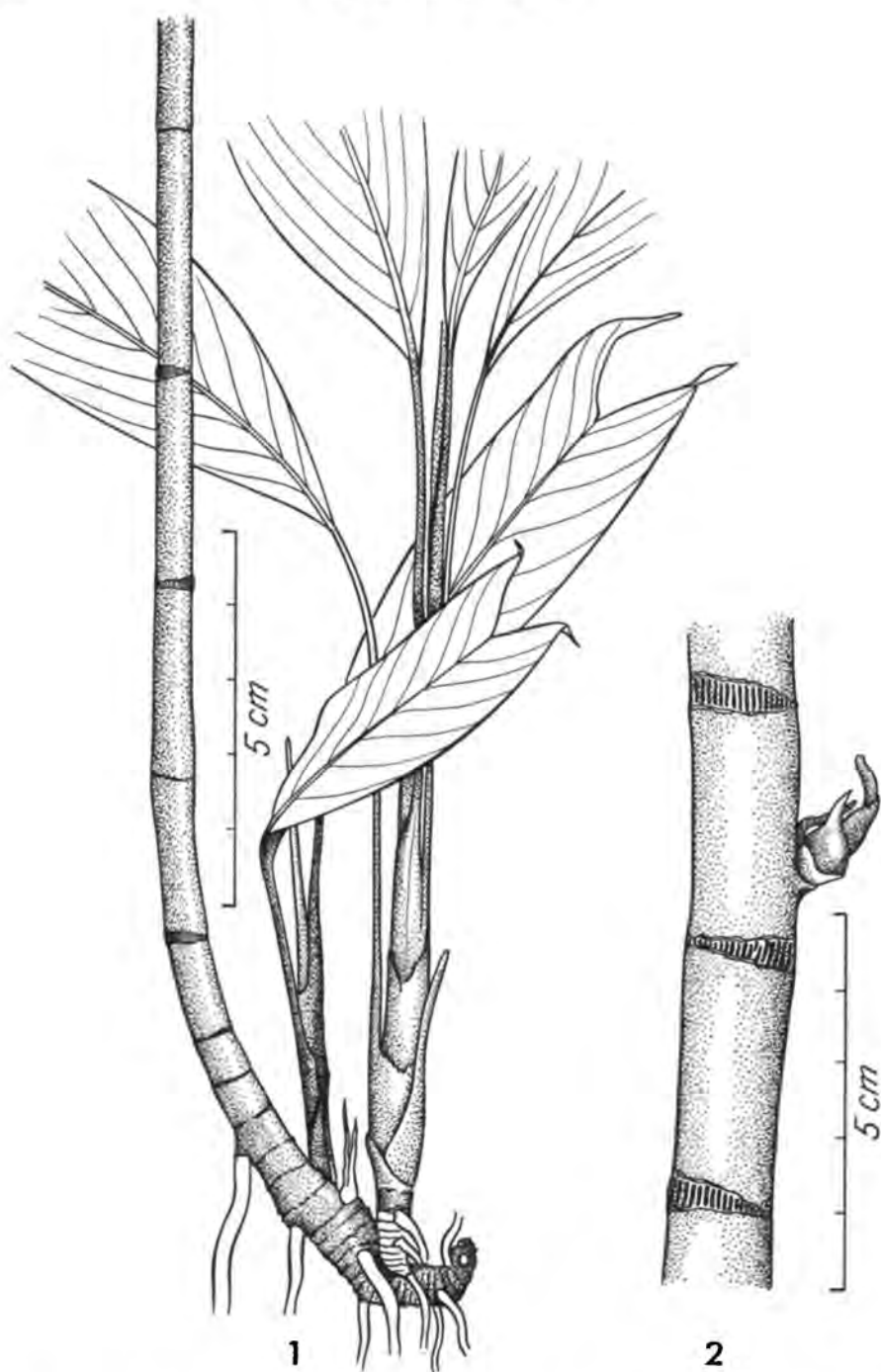


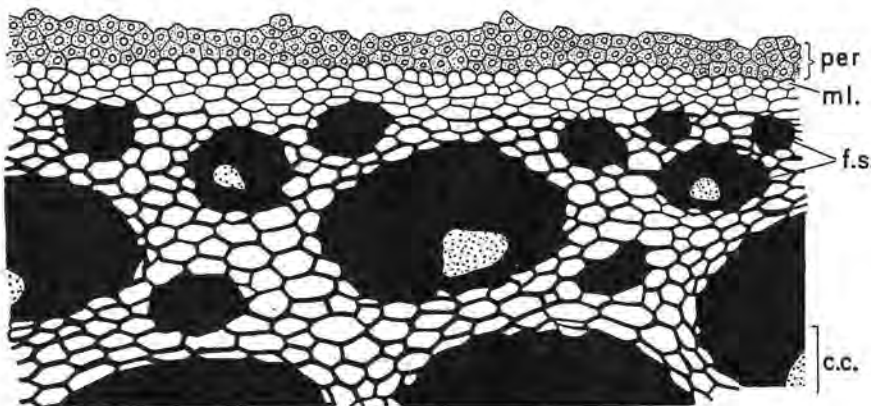
Fig. 1. *Geonoma stricta* (WB 1513), axillary suckers arising from the subterranean part of the parent cane. — Fig. 2. *Geonoma baculifera* (WB 388), part of the stem with a suckerbud on the internode.

in Suriname at low elevations. The longest internodes are produced under optimal conditions. Hence, the length of the internodes is, within certain limits, the result of external conditions.

In many species axillary suckers arise from the subterranean part of the parent cane (fig. 1). Such suckers develop into new canes, giving the plant a clustered appearance. This process, too, is highly influenced by external conditions and characteristic for the species. Certain species always remain solitary. An initial horizontal growth of the suckers as creeping rhizomes such as occurs in colonial palms, e.g., in species of *Bactris* and *Chamaedorea*, has never been recorded in Geonomoid palms.

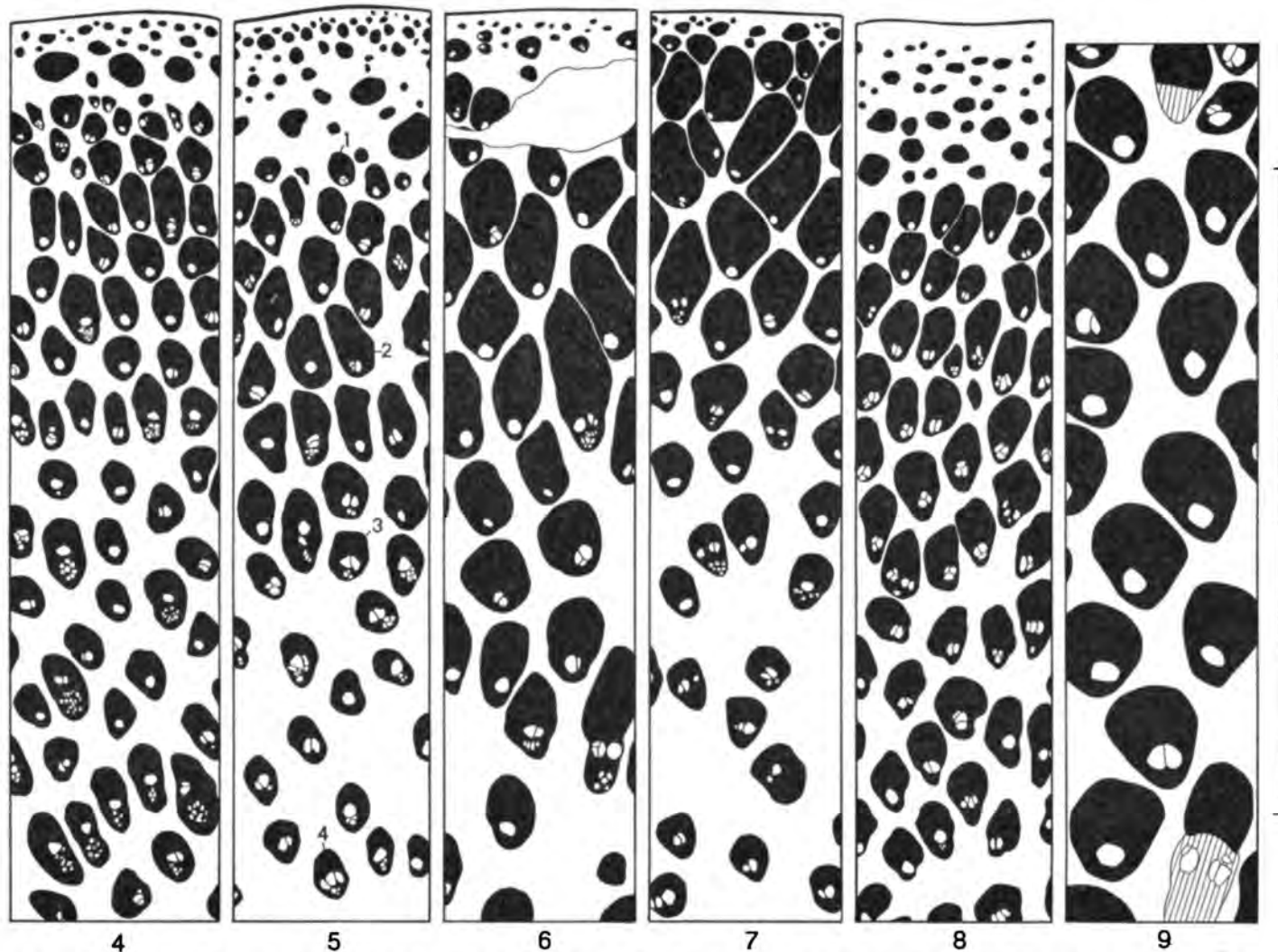
ENGEL (1865) described a *Geonoma* species with a branched stem which he named *Geonoma ramosa*. BURRET (1930) studied Engel's original water-colour of this specimen and thought its branching an abnormality. In Suriname I found occasionally plants of *Geonoma baculifera* with sucker-buds on the internodes and not, as might be supposed, in the axils. What seems to be the same type of branching was recently described by MOORE (1967) for *Aristeyera ramosa* (fig. 2). The anatomy of the stem was studied by VON MOHL (1831) in *Geonoma simplicifrons* and recently by TOMLINSON (1966) in *Aristeyera spicata*. Dr. Tomlinson kindly prepared some microscopic slides from dried stem samples collected by the present author which are also used here.

In the cane-like stem a distinct but rather thin periderm is developed by ligno-suberisation of cortical parenchyma in combination with meristematic activity of a continuous peripheral layer of small regular cells. In dried stems this periderm is frequently scaled off as it is rather hard and does not shrink like the stem. Under these circumstances the meristematic layer becomes the outermost layer and is easily mistaken for an epidermis



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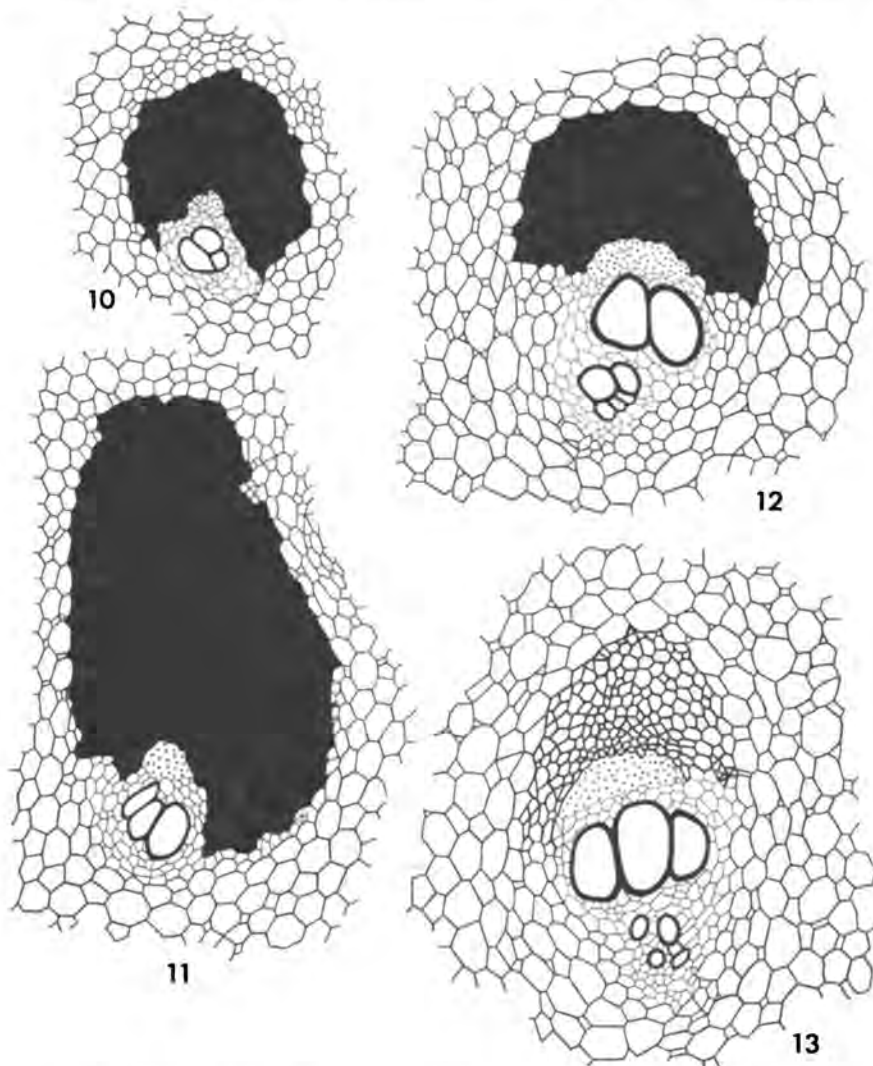
Fig. 3. *Geonoma maxima* (WB 194), cross-section of the cortex of the stem (*per.* periderm, often scaled off in dried stems; *ml.* meristematic layer forming periderm; *f.s.* fibrous strands of variable diameter sometimes with conducting elements; *c.c.* peripheral part of the central cylinder with congested vascular bundles).



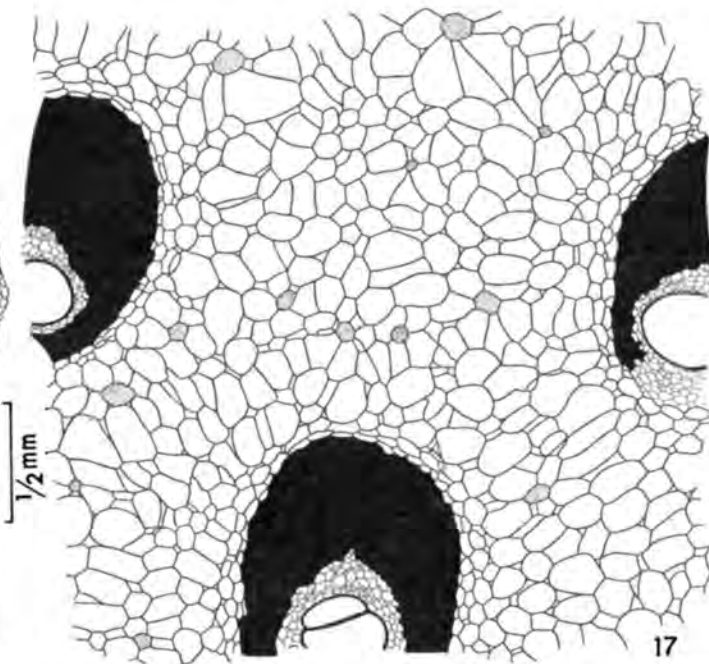
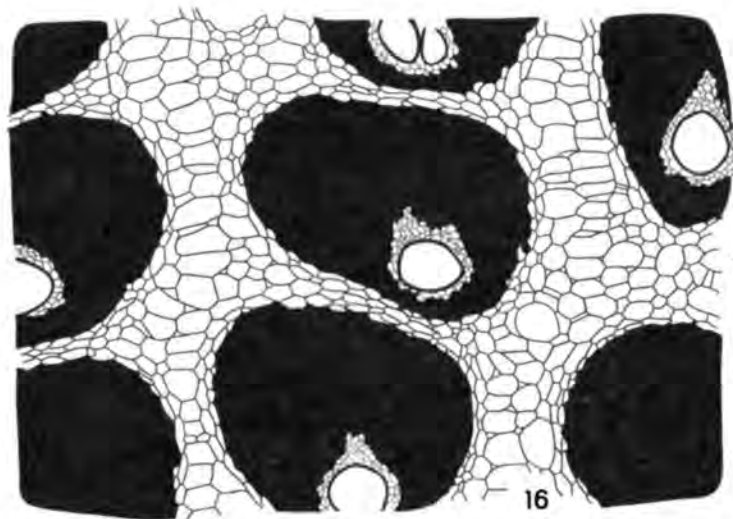
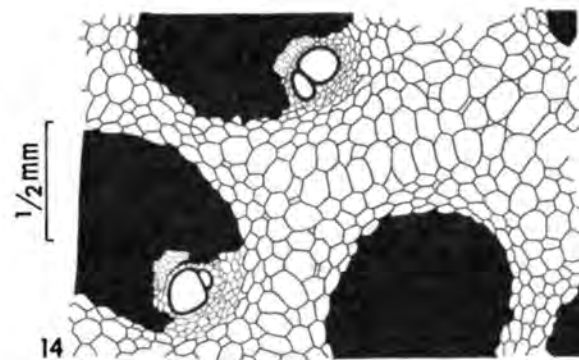
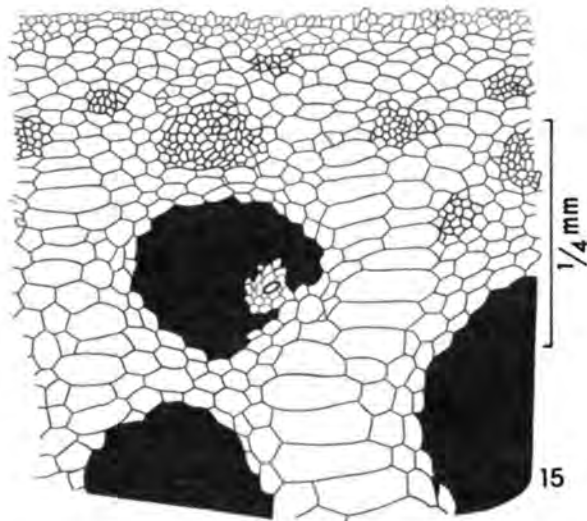
Figs. 4-9. Sectors of cross-sections of the stem at a height of about 6 dm above the ground; xylem elements are indicated in the solid black vascular bundles. - Fig. 4. *Geonoma baculifera* (WB 648). - Fig. 5. *Geonoma baculifera* (WB 1375), note the individual variability. - Fig. 6. *Geonoma pinnatifrons* (WB 1635). - Fig. 7. *Geonoma maxima* (WB 197). - Fig. 8. *Geonoma triglochis* (WB 1501). - Fig. 9. *Calypstrogyne occidentalis* (WB 1662).

(fig. 3). The cortex is narrow, about 1 mm wide with numerous fibrous strands of variable diameter, the largest strands sometimes including xylem and/or phloem elements. The central cylinder is delimited by the congested vascular bundles at its periphery, the vascular bundles are less crowded towards the centre with decreasingly fewer fibres whereas the amount of phloem and xylem, notably protoxylem elements, increases (figs. 4–9). The general stem structure corresponds with that described for *Rhapis* by ZIMMERMANN & TOMLINSON (1965).

The vascular bundles normally have one wide metaxylem vessel; more metaxylem vessels, often in combination with protoxylem, appear in



Figs. 10–13. *Geonoma baculifera* (WB 1375), enlargements of vascular bundles indicated in fig. 5 showing the variation in structure at successive levels. – Fig. 10. vascular bundle 1 of fig. 5. – Fig. 11. vasc. b. 2. – Fig. 12. vasc. b. 3. – Fig. 13. vasc. b. 4.



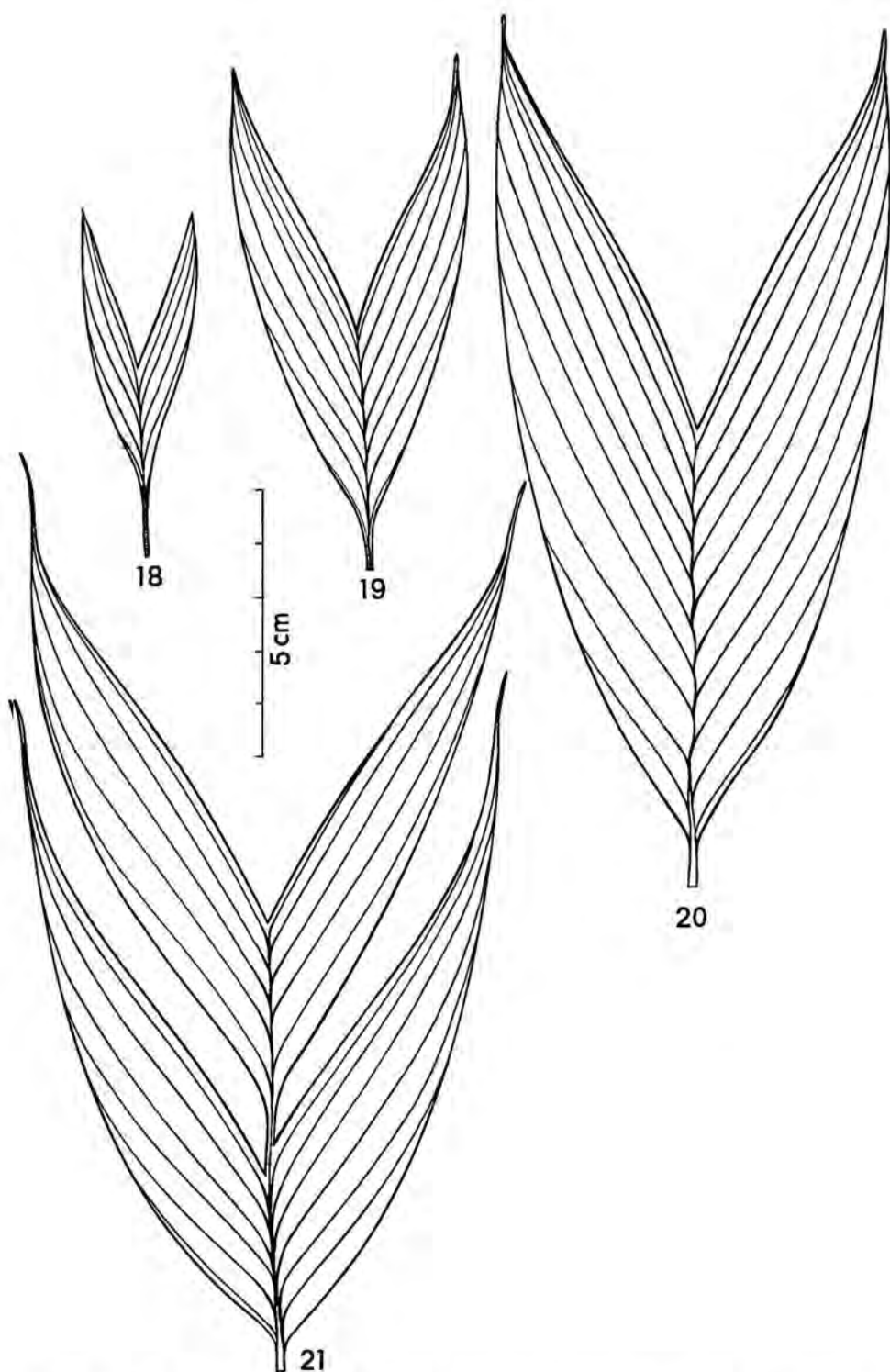
Figs. 14–17. Cross-sections of the stem showing diffuse secondary thickening. – Figs. 14–15. *Geonoma pinnatifrons* (WB 1635); expansion of parenchyma cells radiately around the vascular bundles (fig. 14) and dilatation zones of transversely elongated and dividing cells in the cortex (fig. 15). – Figs. 16–17. *Calypstrogyne occidentalis* (WB 1662); a more pronounced diffuse secondary thickening (fig. 16), ground parenchyma cells at the centre arranged in more or less stellate patterns of a small isodiametric cell and a few radiating, much expanded cells (fig. 17).

bundles closely below their exertion as leaftraces. In species with short internodes, e.g. *Geonoma triglochis*, where the leaves are placed closely together, most bundles in cross-section have 2 or 3 metaxylem vessels. The shape of the vascular bundles is more or less characteristic of the species but varies much from the periphery to the centre (figs. 10-13) and is, moreover, influenced by the age of the stem. In young stems the fibres are thin-walled and these walls become gradually thickened with age. Thickening of fibres is always most advanced in peripheral bundles. Within the fibrous part of a single bundle it starts also in the peripheral part but is rather irregular: thickened fibres occur side by side with thin-walled ones. Wall-thickening is often combined with a slight increase in the diameter of the fibres. The thin-walled young fibres are distributed more or less at random but the fully developed, sclerified fibres form, by mutual pressure, a regular pattern. The few slides studied of *Geonoma baculifera* suggest also a slight increase in number of fibres per sheath with age but this may be a misinterpretation due to individual variability and not correlated with age.

Several Geonomoid species with cane-like stems have no diffuse secondary thickening at all: old stems tend sometimes even to show a reduction in diameter by contraction. The ground parenchyma cells are isodiametrical and remain so in old stems. As SCHOUTE (1912) pointed out, diffuse secondary thickening in palms is largely the result of expansion of parenchyma cells in combination with the formation of intercellular spaces. This was observed to some degree in *Geonoma pinnatifrons*, a relatively tall species with some diffuse secondary thickening. Here expansion of parenchyma cells radiately around the vascular bundles (fig. 14) together with dilatation zones of transversely elongated and dividing cells in the cortex (fig. 15) is found. The tall *Welfia* and *Calyptronoma* species with columnar stems show a much more pronounced diffuse secondary thickening (fig. 16). For instance, in *Calyptronoma occidentalis* ground parenchyma cells at the centre are much more expanded and arranged in more or less stellate patterns composed of units with a small central isodiametric cell (probably a raphide sac) and a few radiating, much expanded cells (fig. 17). Large intercellular spaces are incorporated in this pattern.

Leaf

As is usual in palms leaves in Geonomoid palms are restricted to the terminal part of the stem. In very small species with pencil-thick canes like *Geonoma stricta*, leaves persist along a considerable part of the stem but more frequently they are congested in a distinct crown. Often these crowns are semiglobose to globose but several species are characterized by congested leaves which radiate almost horizontally, giving the palms an umbrella-like habit, as e.g. in *Asterogyne martiana*, *Geonoma spixiana*,



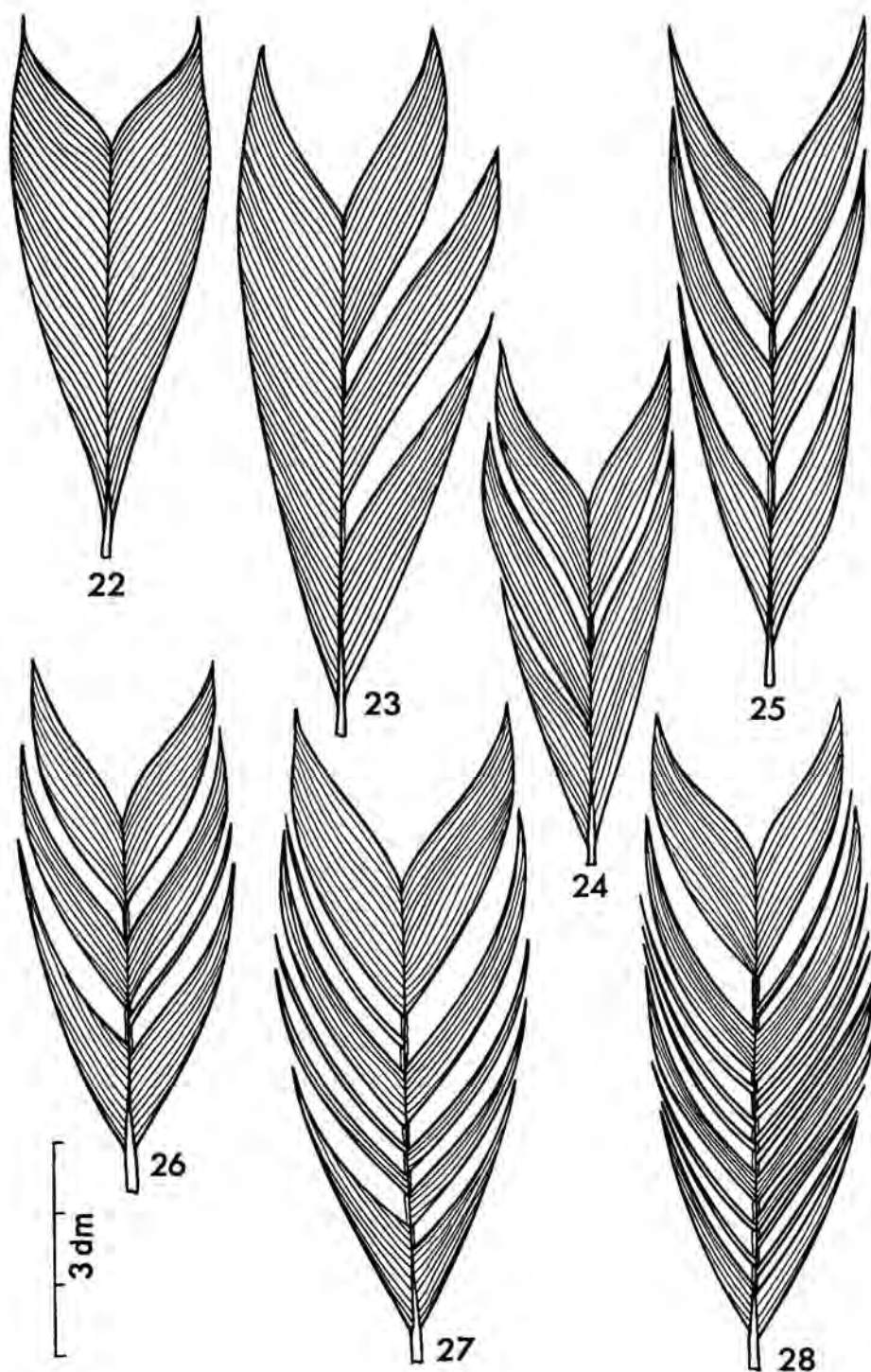
Figs. 18–21. *Geonoma deversa* (WB 176a); a simple, bifid seedling leaf and successively larger stages of a juvenile plant, division of the leaves starting here rather early.

and *Geonoma leptospadix*. The number of leaves retained by each species is rather constant and rarely surpasses 7 on the one hand, 25 on the other, in this group.

The leaf consists of a sheath, a petiole, and a lamina. The sheath is tubular and covers the internode and leafbases of younger leaves. Rarely, in very small plants with pencil-like canes, such tubular sheaths are said to be little modified with age. More usually, however, the tube gives very little resistance to the pressure exerted by the enclosed, developing leafbases, the ventral tissues disorganize and erode almost completely. Only the thickened dorsal part persists without becoming conspicuously fibrous, e.g. in *Geonoma triglochis*, *Calyptronoma occidentalis*. Exceptionally in dead leaves the petiole fractures and the base persists for some time, e.g. in *Geonoma leptospadix*. Normally the entire leaves are deciduous through the development of a separation layer at the node. Since in mature leaves the ventral tissues of the sheaths will have disappeared already, complete release is possible. This accounts for the smooth and ringed cane. This type of leafbase does not agree with any of those distinguished by TOMLINSON (1962) and clearly represents an intermediate kind, a possibility already mentioned by him. A tubular base which changes little reminds one of the *Calamus* type but in the more usual, complete disappearance of ventral tissues leaving a gradually broadened extension of the leaf axis so that petiole and sheath are not sharply separated the type of behaviour agrees better with *Phoenix*. Since the leaves are deciduous and abscise cleanly as a unit they also resemble the *Veitchia* type.

The petiole is rather uniform throughout the tribe, grooved above and, in cross-section, semicircular below.

The lamina has a strong rachis, is pinnateveined, and bifid at the apex. The lamina is reduplicate plicate, i.e. folded back at the primary veins with the secondary veins turned downward. The first seedling leaves are simply bifid (figs. 18–21), a condition retained in several adult Geonomoid palms, otherwise regularly pinnate adult leaves are observed. TOMLINSON (1960) in a most interesting paper on the seedling leaves in palms has drawn attention to this retention of juvenile foliage, usually by palms with a reduced habit. This proved to be correct also for the *Geonomeae*. The genera with the tallest species, *Welfia* and *Calyptronoma*, have regularly paripinnate leaves with linear, unicostate segments only. The other genera with smaller species, *Calyptrogyne*, *Pholidostachys*, *Aristeyera*, *Asterogyne*, *Kalbreycera*, *Geonoma*, and *Taenianthera* have fundamentally simple, bifid leaves which in adult plants are often more or less dissected and thus more or less irregularly pinnate. Sometimes almost regularly pinnate leaves with linear, 1-veined segments are produced but the presence of broader apical and basal segments with several primary veins indicate the simple origin. Long series of transitional leaves with increasing dissection, from the simple juvenile type to the more or less pinnate adult type, can be observed within a single species (figs. 22–28). Apart from



Figs. 22–28. *Geonoma baculifera*; leaves of adult plants forming a series of laminas with increasing dissection from the simple juvenile type to the more or less pinnate adult type. – Fig. 22. (WB 1375). – Fig. 23. (WB 388). – Fig. 24. (WB 942). – Fig. 25. (WB 278). – Fig. 26. (WB 349). – Fig. 27. (WB 648). – Fig. 28. (WB 277).

the age of the plant this leaf division is also highly influenced by external factors, such as light intensity, moisture, soil, etc. Sometimes, as in *Geonoma maxima* in Suriname, no correlation between the extent of division of the leaves and the age of the plant or its ecological conditions could be found. Degree of pinnation proved to be the same in old and young shoots of the same plant but very different in different individuals growing side by side in the same place. Therefore the present author (WESSELS BOER, 1965) has suggested that the differences have a genetic origin and that the different forms interbreed freely in natural populations. The concept of the homologous series, developed by VAVILOV (1922) in other plants, predict that if such a genetically based diversity exists in *Geonoma maxima* it is also likely to exist in other species. Generally speaking, however, leaves are most strongly divided in adult, well-developed plants and tend to be least divided or simple in slender species and young or poorly developed plants. This range of variation is within the limits characteristic for each species. There are species which retain nearly simple leaves even when vigorous and fully adult whereas other species have rather regularly pinnate leaves even if they are still young or poorly developed. Since BURRET (1930) made a considerable use of differences in lamina division for distinguishing and keying out species without allowing for the above-mentioned variation it is very difficult to work with his key. SPRUCE (1869), who certainly distinguished too many species, was well-aware of the variability in leaves as is clear from his general remarks preceeding his treatment of *Geonoma*. He considered the number of primary veins and the angle they form with the rachis of larger diagnostic value. This character was adopted by DRUDE (1882) in *Flora Brasiliensis*. In the present study the number of veins proved to be of little use as it is too variable within the species but too constant in the tribe. Moreover, in the taller species the number of veins is either rarely recorded or shown by herbarium material. The angle between the veins and the rachis is indeed a good diagnostic feature. Usually this angle is sharpest at the base of the lamina and tends to increase gradually towards the apex. Furthermore the veins of simple leaves emerge at a sharper angle than in divided leaves. Measurements at the middle of the leaves are recorded in the descriptions. Another feature which proved to be of diagnostic value is the elevation of the veins both above and below the lamina surface. Sometimes veins are more or less prominent on both surfaces, in other species they are hardly elevated to slightly immersed on one surface and more or less prominent on the other.

The lamina in particular of several representatives of *Geonomeae* has been the subject of anatomical analysis by TOMLINSON (1961, 1966). He carefully studied and described specimens belonging to *Calyptronoma*, *Pholidostachys*, *Calypstrogyne*, *Welfia*, *Aristeyera*, and *Geonoma*. From this information it is clear that several anatomical features are common to these Geonomoid palms. These are: shape of the epidermal cells, structure

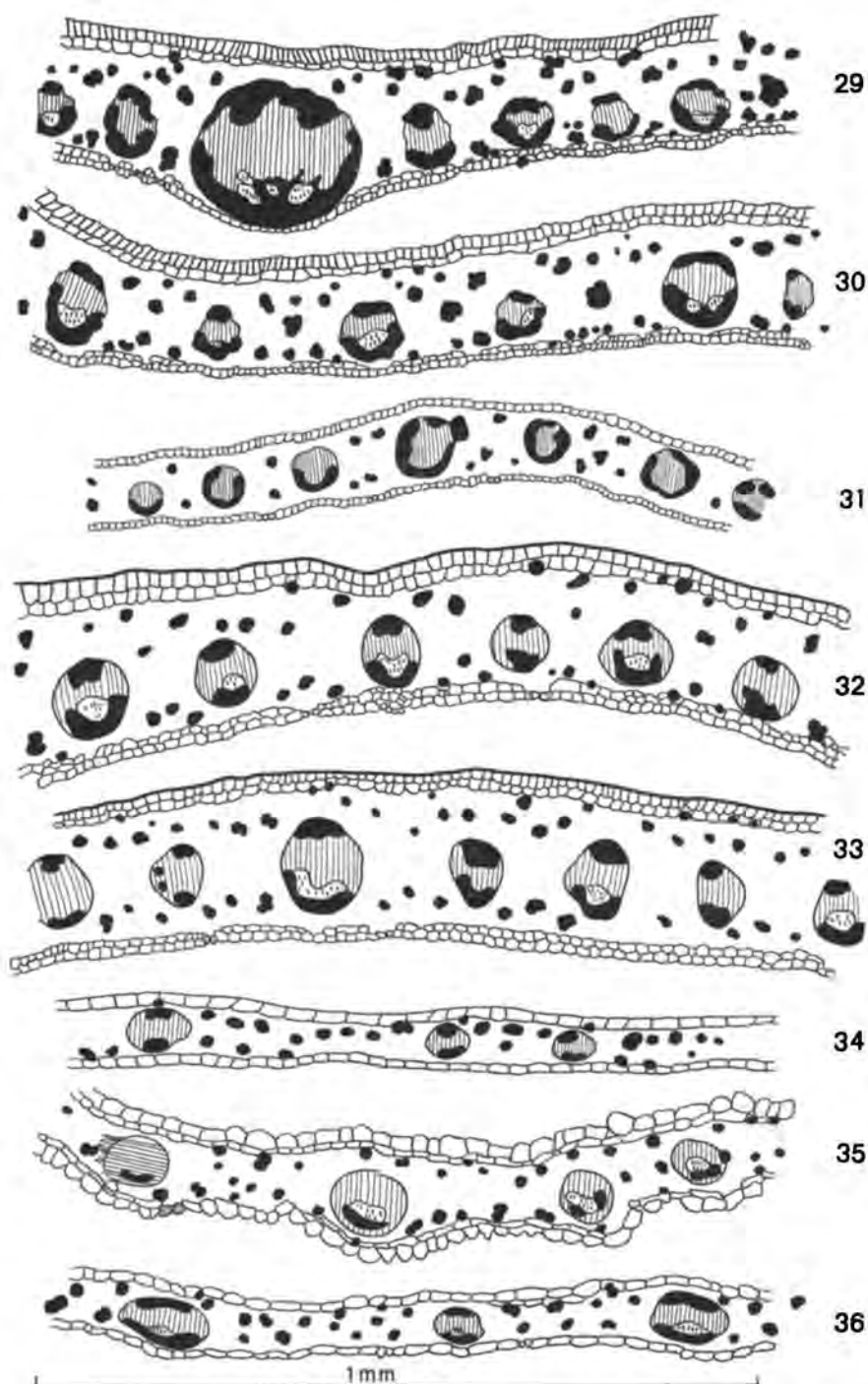
and distribution of the stomata, structure and distribution of stegmata, and structure of assimilating mesophyll.

Epidermal cells are adaxially rather regular, more or less obliquely transversely extended without sinuous walls; the outer wall is sometimes thicker than the remaining walls with a cutinized layer penetrating somewhat between anticlinal walls. The abaxial epidermal cells are usually smaller and more irregular. Stomata are restricted to the abaxial intercostal regions, and never occur in distinct files. The terminal subsidiary cells are usually somewhat shorter than the other epidermal cells; each guard-cell has 2 cutinized ledges. Stegmata are abundant in the lamina in usually slightly discontinuous files adjacent to the fibres. Silica-bodies are more or less spherical or sometimes ellipsoidal; the basal wall of the silica-cells is usually thickened. The assimilating mesophyll is frequently without distinct palisade layers; the adaxial cells are compact; middle and abaxial mesophyll layers are distinctly transversally septate forming a well-developed system of intercellular spaces obvious only in longitudinal sections.

Besides these common features there is an appreciable diversity in lamina anatomy, viz. in the degree of differentiation of hypodermal mesophyll layers as specialized colourless layers, in the distribution of non-vascular fibres and vascular bundles, and in the structure of assimilating mesophyll. In order to reach an opinion about the taxonomic significance of this diversity 24 lamina sections have been drawn on the same scale and in the same way, firstly each epidermal and hypodermal cell was copied precisely. Then in polarized light the very bright fibres were drawn solid black and the less distinctly polarized part of the vascular bundles was hatched. The phloem of the vascular bundles did not polarize at all and was stippled, sometimes large xylem elements were indicated separately (figs. 29-52).

The most complicated lamina anatomy is found in *Welfia* and *Calyptronoma*, both genera with adult paripinnate leaves. A distinct colourless hypodermis is present below each surface. TOMLINSON (1961) found a 2-layered hypodermis below each surface in *Welfia*. The mesophyll has a 2-3-layered palisade, rather distinct in *Welfia* but much less distinct in *Calyptronoma*. Veins are numerous in the abaxial mesophyll. Non-vascular fibres are present in strands scattered throughout the mesophyll. Formation of a hypodermis is perhaps stimulated by high light intensities as it proves to be a more or less variable feature. It is absent in juvenile leaves. The number of fibres or fibrous strands increases with the age of the lamina since they differentiate over a long period of time in one leaf. Otherwise their frequency and distribution is fairly constant and of diagnostic value. In the lamina of mature juvenile leaves fibres are equally numerous. Distinct palisade layers are absent from the laminae of juvenile leaves, mesophyll cells are even somewhat transversely extended.

The other genera, *Calypstrogyne*, *Pholidostachys*, *Aristeyera*, *Asterogyne*,



Figs. 29–52. Cross-sections of laminas, all drawn on the same scale and in the same way. – Fig. 29. *Welfia georgii* (Cook 94). – Fig. 30. *Welfia georgii* (Cook & Doyle 636). – Fig. 31. *Welfia regia*, juvenile leaf (Fassett 25210). – Fig. 32. *Calyptrogyne* (*Calyptronoma*) *dulcis* (Ekman H15685). – Fig. 33. *Calyptrogyne* (*Calyptronoma*) *occidentalis* (WB 1662). – Fig. 34. *Calyptrogyne condensata* (Pittier 16719). – Fig. 35. *Calyptrogyne sarapiquensis* (Standley & Valerio 48979). – Fig. 36. *Calyptrogyne ghiesbreghtiana* (Standley 52653).

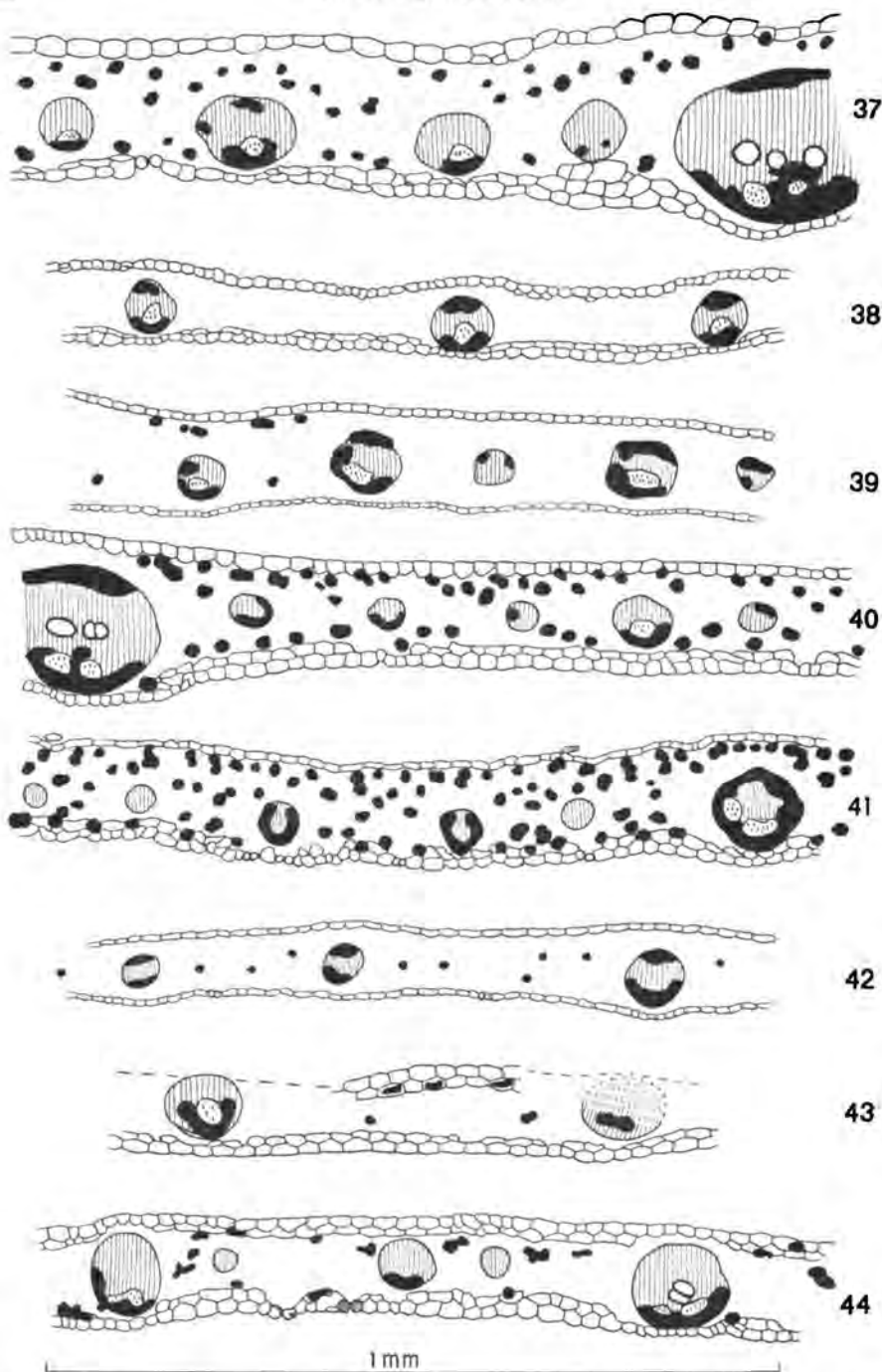


Fig. 37. *Calyptrogyne ghiesbreghtiana* (King 5251).—Fig. 38. *Calyptrogyne* (*Pholidostachys*) *pulchra* (Standley & Valerio 48937).—Fig. 39. *Calyptrogyne* (*Pholidostachys*) *synanthera* (Killip & Smith 15314).—Fig. 40. *Asterogyne spicata* (Tamayo 4177).—Fig. 41. *Asterogyne martiana* (Killip 35293).—Fig. 42. *Geonoma* (*Kalbrejera*) *triandra* (Hodge 7014).—Fig. 43. *Geonoma* (*Taenianthera*) *acaulis* (Killip & Smith 28145).—Fig. 44. *Geonoma* (*Taenianthera*) *poiteauana* (WB 1579).

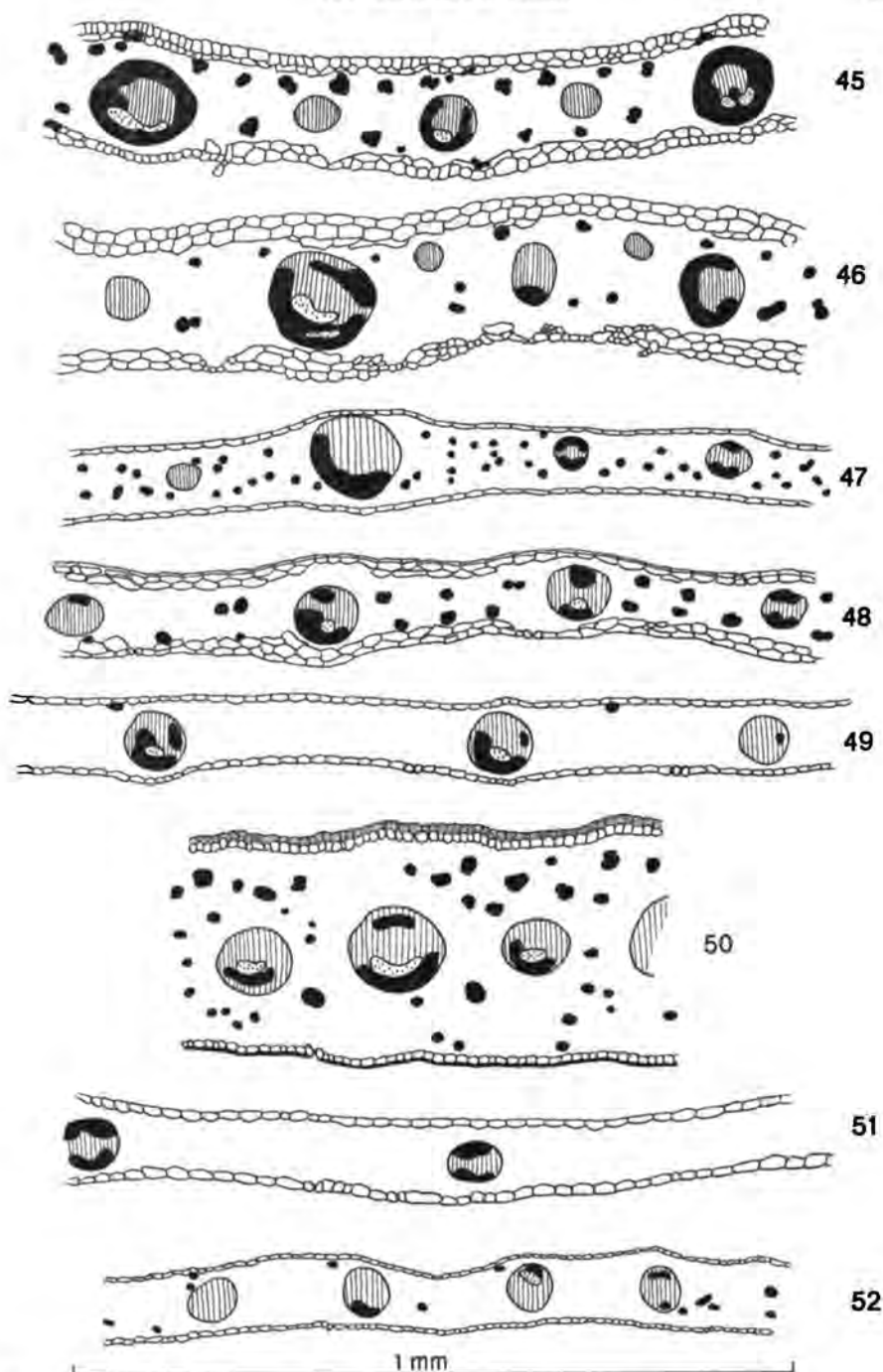


Fig. 45. *Geonoma* (*Taenianthera*) *tamandua* (Leprieur s.n.).—Fig. 46. *Geonoma* (*Taenianthera*) *chococola* (Killip 35290).—Fig. 47. *Geonoma poeppigiana* (Killip & Smith 28026).—Fig. 48. *Geonoma elegans* (Reitz & Klein 6542).—Fig. 49. *Geonoma gamiova* (Reitz & Klein 3159).—Fig. 50. *Geonoma megalospatha* (Weberbauer 6800).—Fig. 51. *Geonoma maxima* (WB 210).—Fig. 52. *Geonoma juruana* (Killip & Smith 26993).

Kalbrejera, *Geonoma*, and *Taenianthera* all have simple to more or less irregularly divided laminae. This juvenile character is also expressed in anatomical characters. A hypodermis is frequently absent or only incompletely developed. The mesophyll is usually without palisade layers but with transversely extended cells. Since these palms grow in the shaded understory of dense forests, the observed differences may be of ecological origin. In this connection the anatomy of *Geonoma megalospatha*, a species from the xerophytic high Andean formations, is instructive. The lamina is very thick and coriaceous with numerous veins in the middle mesophyll. The adaxial cells are very compact and almost isodiametric, with a transition to an indistinct palisade about 3 layers below the epidermis. A distinct colourless hypodermis is absent although the subepidermal layer contains only a few chloroplasts. The epidermis also includes a few chloroplasts and is further characterized by the strongly thickened outer walls with a very thick cutinized layer. Hence under very exposed conditions the formation of a cuticle seems to be promoted rather than a hypodermis. On the other hand, an atypical specimen of *Calypstrogyne ghiesbreghtiana*, aberrant in having a thick, subcoriaceous lamina, proved to have an incomplete abaxial hypodermis, whereas a typical specimen had no hypodermis. Thus the presence or absence of a hypodermis is perhaps on the specific level a more or less inconstant feature, and certainly so on the generic level.

Based on limited observations of available material leaf anatomy characterizes each genus as follows:

Welfia: structurally rather elaborate; adaxial epidermal cells small; hypodermis well-developed below each surface; mesophyll with a distinct palisade; fibres numerous, mostly united into fibrous strands pectinating with the veins; veins numerous.

Calyptronoma: like *Welfia*, but adaxial epidermal cells larger; mesophyll with an indistinct palisade; fibres numerous, often solitary, each with a rather wide lumen, more or less restricted to the abaxial and adaxial part of the mesophyll; veins numerous.

Calypstrogyne: simpler than *Calyptronoma*; hypodermis usually absent or more or less incompletely developed; mesophyll cells transversely extended, no palisade layers; fibres with thin walls; veins less numerous.

Pholidostachys: like *Calypstrogyne*; hypodermis absent or incompletely developed abaxially; fibres absent or infrequent.

Asterogyne: hypodermis present only abaxially; mesophyll without distinct palisade layers, cells somewhat transversely extended; fibres extremely numerous, often solitary, each with a rather wide lumen, scattered throughout the mesophyll but most frequent in the adaxial layer; veins in part very small, not producing a ribbing of the lamina.

Aristeyera: almost identical with *Asterogyne*.

Kalbrejera: epidermal cells in cross-section flattened; hypodermis

absent; mesophyll cells transversely extended, with infrequently scattered solitary fibres, each with a narrow lumen.

Geonoma: like *Kalbreyera*; epidermal cells sometimes with a few chloroplasts; fibres sometimes very rare, but in other species more numerous. *Geonoma elegans*, the only species investigated with a spicate inflorescence, has an incomplete layer below each surface resembling a hypodermis but containing a few chloroplasts like the epidermis. *Geonoma megalospatha* shows adaptations to its extreme environmental conditions. The few species investigated in this large genus show a remarkable diversity.

Taenianthera: like *Geonoma*; a hypodermis-like layer present below each surface, together with the epidermis, usually containing a few chloroplasts; fibres usually infrequent and united into strands, fibres each with a wide lumen.

Dermal appendages

The Geonomoid palms lack spines and other armature. All of them are, however, more or less pubescent. TOMLINSON (1961, 1966) has drawn attention to the diagnostic value of hairs. He found hairs, each consisting of a uniseriate, rarely biseriate, filament of short cells arising from a scarcely sclerotic basal cell, most distinctive for the tribe. Only *Reinhardtia*, *Sclerosperma*, and *Bactris* are recorded with somewhat similar hairs. A more or less thick covering of these hairs is usually seen on young, expanding leaf sheaths and petioles, on the lower surface of the lamina, notably along the secondary veins, and in young bracts. The terminal part of each uniseriate filament consists of thin-walled cells and is not persistent. The length of the filament as well as its size and colour of the cells is of taxonomic value in many species. Accordingly species are described as lepidote when the filaments are short and give the plant a scurfy appearance, or floccose when the filaments are very long and make the plant appear woolly, etc. The basal cell, which produces the filament, is a sometimes inflated, more or less lignified, epidermal cell. In *Calyptronoma* and *Welfia* these basal cells are outstanding by being deeply sunken and enlarged.

Apart from these unique uniseriate filamentous hairs several species have, scattered along the abaxial side of primary veins, membranous scales about 1 cm long. Such scales are not unusual in palms and are very well-developed, for example, in *Mauritia flexuosa* and *Euterpe oleracea*.

UHL (1966) described the peculiar, profusely branched, dendroid trichomes containing tannin and originating from columnar epidermal cells, which densely cover the inflorescence axis of *Aristeiera spicata*. Such hairs also occur in, e.g., *Geonoma interrupta* but a variant of the same trichome type which is unbranched, simple and straight, seems to be more common in Geonomoid inflorescences. Also the uniseriate filaments are frequently found in young inflorescences.

Inflorescence

The inflorescence of the Geonomoid palms is a simple or branched, thickened axis bearing subsessile flowers, completely or partly enveloped by usually 2 conspicuous bracts. Inflorescences are produced interfoliarly and become frequently infrafoliar by subsequent leaf fall. Only one inflorescence occurs at a node. As far as can be seen from examination of single sections, the vascular system to the inflorescence is derived by traces which diverge from major leaf traces as has been demonstrated in *Rhapis exelsa* by ZIMMERMANN and TOMLINSON (1965).

The inflorescences consist of an axis with several bracts, the main axis giving off lateral branches. Both main axis and lateral branches terminate in flower-bearing axes (rachillas). The axis has an enlarged basal bract, together with usually one or sometimes even two other enlarged bracts, inserted at a higher level. Beyond the uppermost of these larger bracts there are several smaller ones, which distally subtend lateral branches; lateral branches in turn may have bracts subtending lateral branches of a higher order. Triads of one female and two male flowers are sunken in pits in the rachillas. The pits are completely covered by bracts in early stages of development (fig. 53).

In the typological terminology of TROLL (1964) the inflorescence represents a *polytelic synflorescence* with spirally arranged *paracladia* or *coflorescences*. The "main inflorescence" is represented by the terminal rachilla and preceded by an "inhibiting zone" from the ultimate bract to the first flowerpit. The main part of the axis and the corresponding parts of the ramifications of the latter giving off the *paracladia* or *coflorescences* of the first, second etc., order, is Troll's "enriching zone". The flower triads are the condensed partial inflorescences. Unfortunately the second volume of Troll's *Infloreszenzen*, containing a treatment of monocotyledonous inflorescences has not yet been published.

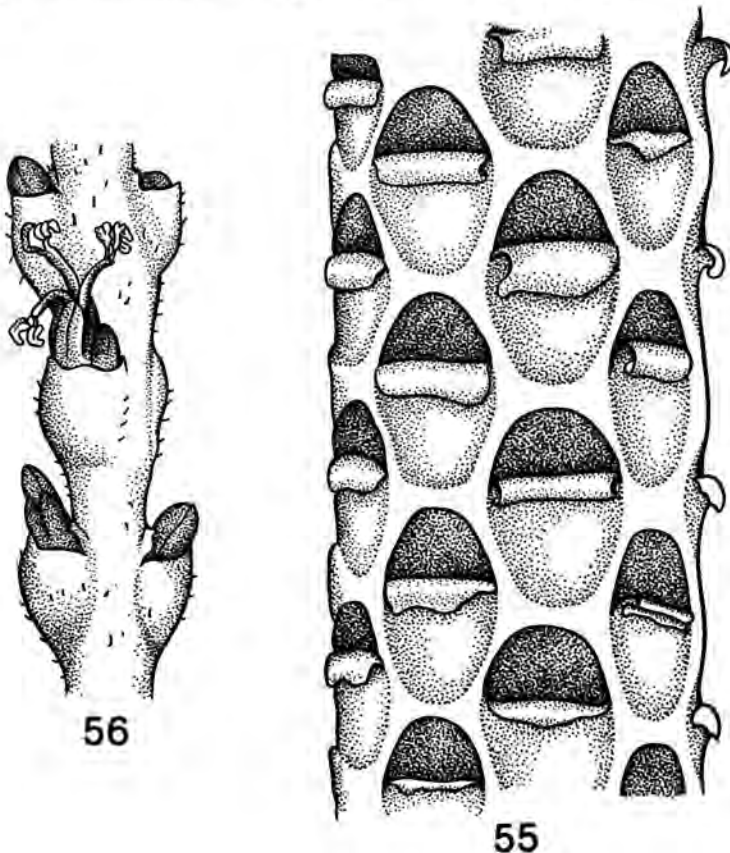
Those general features are common to all *Geonomeae*, but the inflorescences of the different species and genera are rather different by virtue of differences in overall size and relative dimensions of parts. A rather common variant is the simple inflorescence without *paracladia*; the bracts of the enriching zone are still present. Such unbranched inflorescences often have very long axes (fig. 54). Judging from the position of the bracts this elongation can occur uniformly throughout the whole axis, as, for instance, in *Geonoma brongniartii*. In other cases it is restricted to the part of the axis above the second bract, e.g. in *Taenianthera* species, or the part below the second bract e.g., in *Calyptrogyne s.str.* The bracts range in texture from thin and membranaceous to thick and coriaceous and in shape from narrowly tubular to broadly flattened and more or less winged at the margins. Bracts are always more or less flattened because of the pressure of the subtending leaf base but this is only conspicuous in the broad ones. A remarkable developmental difference occurs in *Geonoma* species. Sometimes the unexpanded inflorescence is folded and twisted



Figs. 53–54. Inflorescences (simplified) with the bracts, the axis sometimes with lateral branches, and the rachillas with the flowerpits containing the flower triads. – Fig. 53. A twice branched inflorescence (e.g., of *Geonoma pinnatifrons*). – Fig. 54. A spicate inflorescence (e.g., of *Geonoma* section *Taenianthera*).

within the still closed bracts. Expansion occurs after the complete abscission of the deciduous bracts and a subsequent stretching of the rachillas and other parts, e.g., in *Geonoma deversa*, *Geonoma leptospadix* etc. In other species the small, unexpanded inflorescence remains straight and unfolded within the closed bracts. During expansion it elongates rapidly and emerges through a terminal split in the persistent bracts, e.g., in *Geonoma simplicifrons* and also in *Asterogyne martiana*. The material available proved insufficient for tracing the taxonomic significance of this diversity. It seems, however, to be the same in closely related species.

Another taxonomically valuable character was found in the bracts covering the flowerpits. In *Welfia*, *Calyptronoma*, *Calyptrogyne*, *Pholidostachys*, *Asterogyne*, and *Aristeyera* these bracts are immersed. They more or less recurve and roll back when flowers or fruits are exerted (fig. 55). In *Geonoma*, *Taenianthera*, and *Kalbreycera*, on the contrary, the bracts are elevated and they show a median rupture, so that flowers or fruits push aside each lateral part of the bract (fig. 56). Since successive



Figs. 55–56. Parts of rachillas showing the two types of bracts covering the flowerpits. – Fig. 55. *Welfia georgii*; the bracts are immersed, they recurve and roll back when the flowers are exerted. – Fig. 56. *Geonoma triandra*; the bracts are elevated and may become cleft so that flowers or fruits can push aside the parts.

pits overlap, a single transverse section of the rachillas gives an impression of the internal organization. This was studied in detail for *Aristeiera spicata* by UHL (1966). Slides prepared by myself from several other species of the tribe demonstrate that most of her results are more generally applicable. In transverse section the pit appears to be a depression in the axis closed outside by a modified bract. The limits of these bracts are readily recognized histologically as they consist of somewhat larger parenchyma than the cells of the axis. Differences in the lips as mentioned above are reflected in anatomical structure and by the method of attachment to the axis.

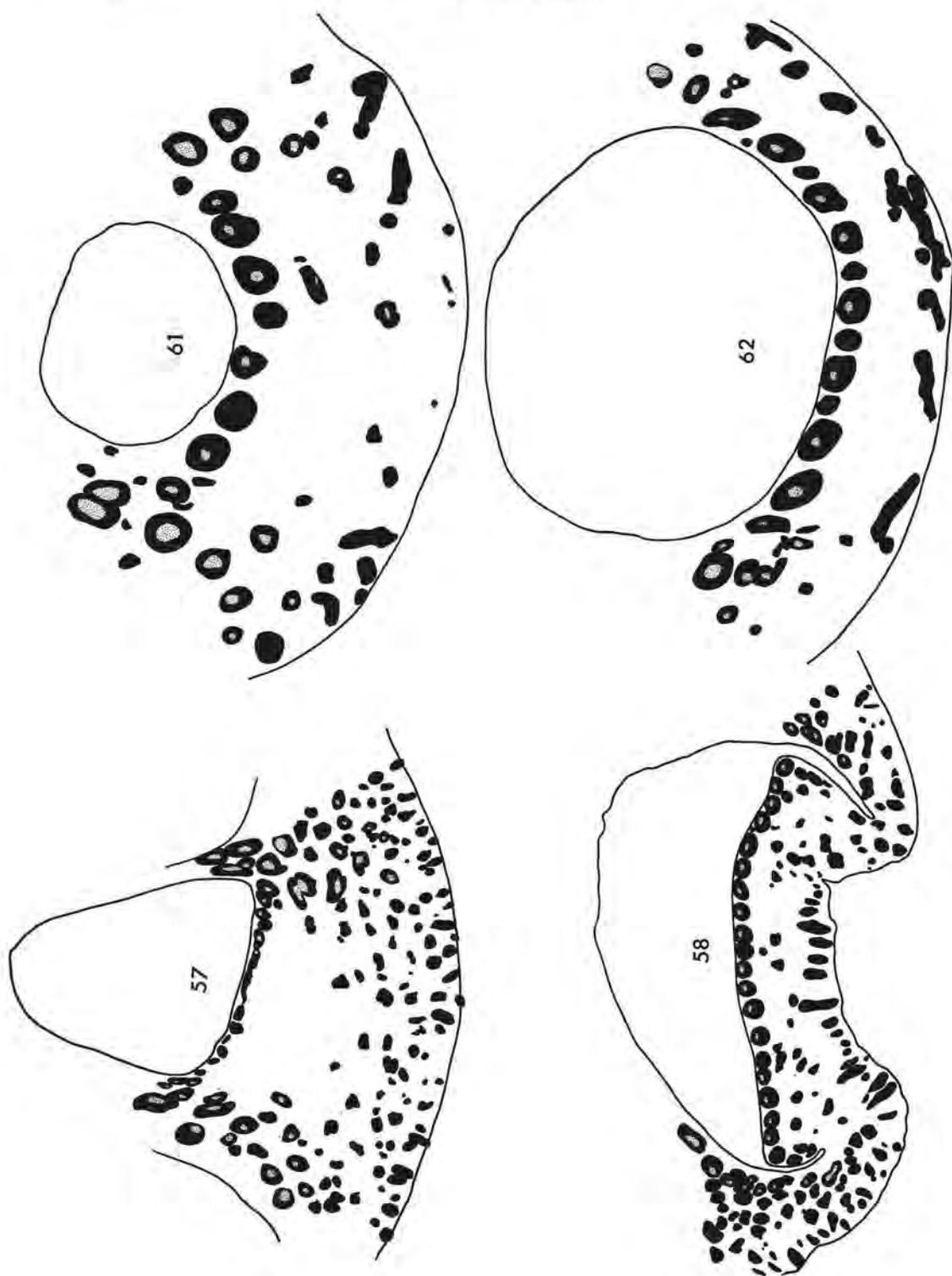
In the immersed, recurving type the bract is adnate to the axis only in its lower half. In the upper half where the bract is free the edge of the axis is involute, the margin of the bract correspondingly revolute so that the inrolled edges of the axis lock the bract in its position. By shrivelling of the locking margin the bract becomes disengaged and recurves outward. This process is facilitated by the distribution of the vascular bundles which run in a single parallel adaxial series (figs. 57-60). The recurving of the bract proved to be a reversible process in dried material of *Calypstrogyne occidentalis*. If soaked again, the bract straightens without becoming locked, recurving again after desiccation, etc.

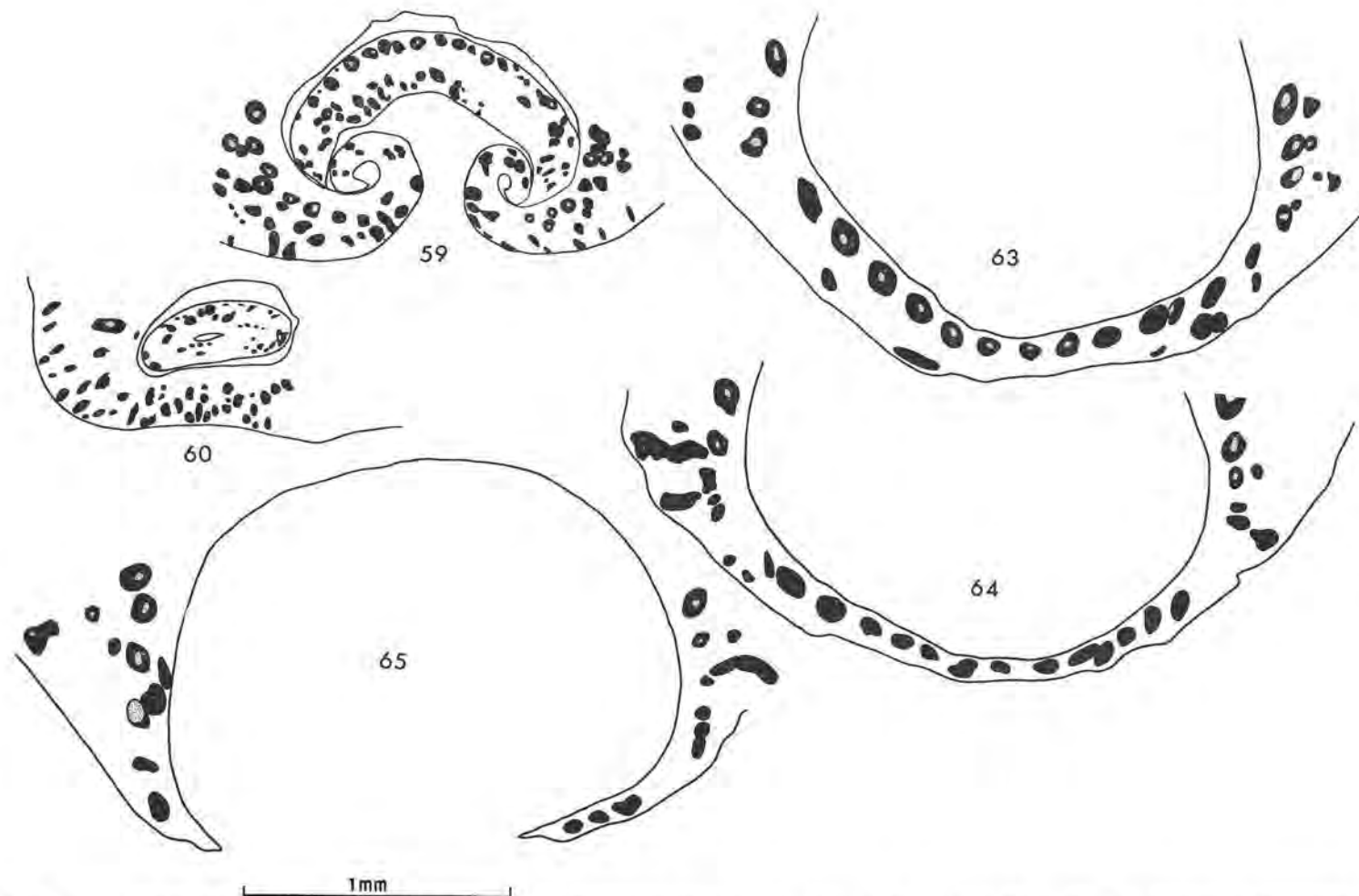
In the elevated and splitting type the margins of bract are adnate to the axis for most of their length. Hence the necessary enlargement of the mouth of the flowerpit to allow exsertion of flowers and fruits is obtained by a median vertical cleavage of the bract along a preformed, very thin part. In these bracts there is not only an adaxial row of parallel bundles but there are also obliquely running abaxial bundles (figs. 61-65). Sometimes in bracts of the first type the free part is rather short and an additional splitting of the bract occurs, not, however, in a strictly median plane. This is found in *Calypstrogyne brachystachys* for example.

The bract bundles originate from bundles of the main axis and may enter the bract directly, or they may divide to form an inner branch to a floral axis and an outer branch to the bract (UHL, 1966).

UHL (1966) regarded the pits as invaginations of the axis, a supposition mainly based on the position of the vascular bundles without a discussion of the development of invaginations. It is perhaps appropriate to mention at this point the results of MEKEL (1933). He studied the origin of pits in the stem of *Matteuccia struthiopteris* and found them to be the result of differential growth. The tissue under the young leaf axils scarcely grows in vertical or peripheral directions. However, the tissues apical, basal, or lateral to the axils do grow. In this way an elevated rim is produced below each leaf primordium on the young stem. These parts grow continually but the leaf axil remains behind and finally lies in a deep pit.

The arrangement of flowerpits in the rachillas is of considerable diagnostic importance. It ranges from rather close-set orthostichies to a more

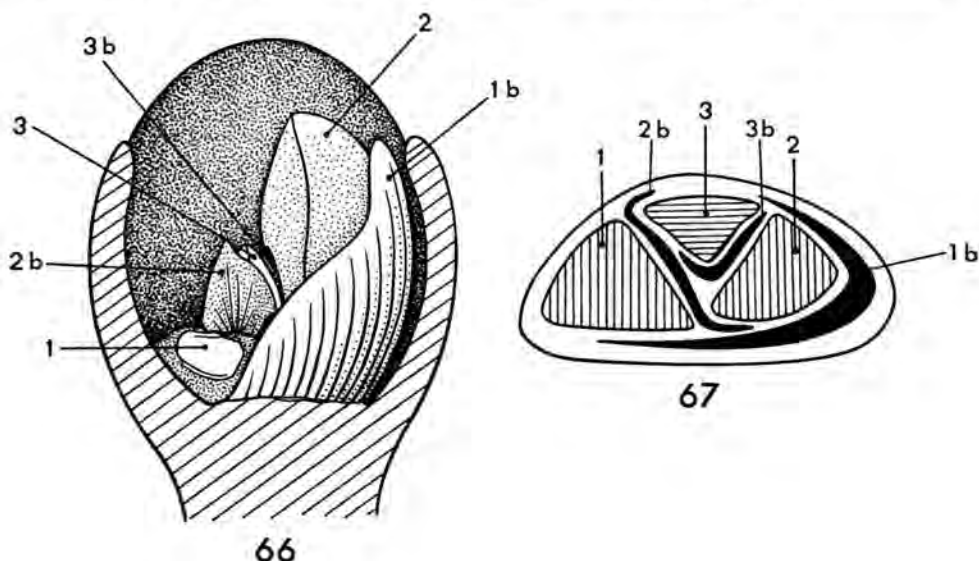




Figs. 57-65. Cross-sections of the bracts covering the flowerpits at successively higher levels. - Figs. 57-60. *Asterogyne martiana*. - Fig. 57. The lower half of the bract adnate to the axis. - Figs. 58-60. The upper free part of the bract locked in its position by the inrolled edges of the axis. - Figs. 61-65. *Geonoma euspatha*; the bract is adnate to the axis for most of its length, a cleavage is formed in the thin median part; obliquely running bundles are seen in the abaxial part of the bract. Drawings by Miss G. Zijlstra.

or less loosely spiral, verticillate or decussate arrangement. There is a tendency for a correlation between orthostichies and immersed lips on the one hand and a spiral, verticillate, or decussate arrangement and elevated lips on the other. Exceptions are observed, however, and the separation of slightly twisted orthostichies from a close-set spiral arrangement is also rather arbitrary. The upper rim of the flowerpit may be smooth or may be extended into a more or less elevated upper lip. It is called upper lip to distinguish it from the bract which is referred to as lower lip. Such bilabiate flowerpits are characteristic for most species of *Geonoma*.

The triads of flowers may each be interpreted as a bostryx composed of a very short axis with terminal on the main branch a male flower (flowering first) and below it, in the axil of a relatively large bract, terminal on a lateral branch a male flower (flowering second) which again, in the axil of its much smaller bract, has a lateral branch with a female flower (flowering last) subtended by a very small bract (figs. 66, 67). These bracts were indicated in *Geonoma* for the first time by MARTIUS (1849) in Hist. Nat. Palm. 1: tab. Z 15 fig. V 1-10 and subsequently found to be generally present in the tribe. UHL (1966) found the triads of *Aristeyera* usually to be arranged as mirror images in successive flowerpits. This proved to be more or less correct for other genera, too. Moreover, she found anatomical evidence for additional, aborted flowers or branches in *Aristeyera* on the branches terminating in each male flower and possibly also on the branch ending with the female flower. This suggests, according



Figs. 66-67. Diagrammatic representation of the triad of flowers in the flowerpit (1 the first flowering male flower; 2 the second flowering male flower; 3 the female flower flowering last; 1 b the relatively large bract subtending flower 1; 2 b the much smaller bract subtending flower 2; 3 b the very small bract subtending flower 3.

to her, that the *Aristeyera* triad has originated from a more ramified type of partial inflorescences.

As mentioned above the monoecious inflorescences are proterandrous: the male flowers open a few days or even weeks before the female flowers which are hidden deeply in the pit. The male flowers fall directly after anthesis or rarely shrivel and persist some time in the pits. With the male flowers at anthesis and the female flowers hidden, or the male flowers fallen and the female flowers at anthesis inflorescences are easily mistaken as unisexual. The genus *Gynestum*, a synonym of *Geonoma*, was the result of such an incorrect description. Another result of such misobservation is the description of "the very curious phenomenon: Alternation of Function" by SPRUCE (1869). He supposed that unisexual male and female inflorescences alternate all the way up the stem. The incorrectness of this observation was already pointed out in the same year by WENDLAND (1869).

Flower

As with other parts, the flowers of the *Geonomeae* share some common features but are quite diverse in several respects. The flowers are slightly asymmetric and trimerous. There are 3 spirally attached sepals, usually keeled, free and imbricate (in bud) in the upper part, basally more or less connate and adnate to the receptacle. The sepals are unequal and progressively smaller. There are 3 petals, connate in a tube to about $\frac{1}{3}$ or more of their length and basally adnate to the receptacle; just above the connate part they are imbricate for a short distance and valvate in the upper part. The petals are almost equal. UHL (1966) found in *Aristeyera* that the vascular traces of the corolla arise from the receptacular bundles in 3 successively higher groups indicating a spiral arrangement of the petals. In each type of flower either the androecium or the gynoecium is reduced. The androecium generally consists of 6 stamens in 2 whorls of 3, rarely more (to 42) or only 3. The filaments are connate for the major part and are in the basal part adnate to the receptacle and the corolla tube. The terminal free parts (if present) usually exceed the petals considerably at anthesis. The anthers show remarkable diversity as is described below. The gynoecium consists of 3 carpels that are spirally arranged, basally connate and adnate to the receptacle. The pistil has a central style which is trilobed in cross-section and terminates in 3 papillose style branches. Each carpel has a single anatropous ovule but only one per pistil matures. The gynoecium also shows some diversity.

The striking variability in floral characteristics has been used for the establishment of genera and consequently received considerable attention from various authors, from Wendland to Burret and most recently Moore. A more detailed description of floral diversity seems thus indicated.

With respect to sepals, petals, and pistillode the male flower is essentially the same in all species. Sepals and petals are as described above. The pistillode consists of a central axis with 3 rudimentary carpels; the styles

are more or less developed, and sometimes a connate style may terminate in 3 free style branches. This pistillode is situated at the end of the receptacle at the bottom of the hollow tube formed by the upper connate part of the filaments. Otherwise male flowers differ only in the androecium; both in number and shape of anthers. The following male flower types can be distinguished in the various genera:

Calyptrogyne type: 6 stamens; the filaments at anthesis connate inside the petals and exceeding these by a few mm long, free linear part; the anthers with united thecae, cordato-sagittate, dorsifixed, erect in bud, becoming deflexed with bases uppermost at anthesis. The same type of male flowers exists in *Calyptronoma* and *Pholidostachys*.

Welfia type: very large flowers, about $1\frac{1}{2}$ cm long, with numerous stamens (30–42); these, inclusive of the free filament lobes, slightly shorter than the petals which are recurved at anthesis; the anthers with united thecae, linear-sagittate, dorsifixed, erect in bud. This type resembles the *Calyptrogyne* type in the united thecae, being, apart from its size, mainly distinguished by the numerous stamens and the mode of exposing them at anthesis.

Geonoma type: 6 stamens; the filaments as in *Calyptrogyne*; stamens each with free, linear lobes, a few mm long; the anthers inflexed in bud, with free thecae on a bifid connective, at anthesis deflexed, with the thecae uppermost but still forming a sharp angle with the filament. This type is also found in *Asterogyne*. However, in *Asterogyne* the filament lobes are apically very slender making the attachment of the connective less rigid than in *Geonoma* species.

Kalbreycera type: 3 stamens; the filaments as in *Calyptrogyne*; stamens each with free, linear lobes, a few mm long; anthers inflexed in bud, with free thecae on a bifid connective, at anthesis deflexed, with the thecae uppermost but still forming a sharp angle with the filament. This type is represented only by a single species and is distinguished from the *Geonoma* type by 3 stamens instead of 6.

Taenianthera type: 6 stamens; the filaments as in *Calyptrogyne*; each stamen with free linear lobes, a few mm long; anthers inflexed in bud, with free thecae on a bifid connective, at anthesis deflexed, with the thecae uppermost and in line with the filament. This type is also very close to the *Geonoma* type but is distinguished by the movable junction between connective and filament which enables the thecae to move into line with the filament.

Aristeyera type: 11–24 stamens; the filaments as in *Calyptrogyne*; each stamen with free, linear lobes, a few mm long; anthers inflexed in bud, with free thecae on a bifid connective and at an angle to almost erect at anthesis. This type resembles the *Geonoma* type in the separate thecae but is distinguished by the many stamens. Also the junction between connective and filament is less rigid than in the *Geonoma* type but on the other hand not so movable as in the *Taenianthera* type.

The thecae are invariably introrse and longitudinally dehiscent although in fact the split is directed towards the axis in terms of the anther's position in bud; by deflection at anthesis the split is turned outward.

Female flowers are less diverse than male flowers. Carpels are reduced to one in *Geonoma*, *Taenianthera*, and *Kalbrejera* but otherwise the diversity is mainly due to differences in the staminodes which parallel those in the fertile androeceum. Sepals and petals agree with the general description given above. A short description of the female flowers corresponding to the above types of male flower follows:

Calyptronoma and *Calyptrygyne*: petals connate basally into a thin membranaceous tube, the terminal lobes coherent, forming a *calyptra* released basally at anthesis; staminodes 6, forming a shortly lobate tube; ovary 3-celled, the style becoming long-exserted after the corolla calyptra has fallen.

Pholidostachys: petals thin, membranaceous, the lobes not coherent but valvate and persistent; staminodes 6, forming a long, digitately lobed-staminodial tube. In *Calyptrygyne*, *Calyptronoma*, and *Pholidostachys* the male flowers are very similar but the female flowers differ in petals and staminodial tube.

Welfia (from bud): petals valvate, persistent; staminodes about 20, connate at base; the free terminal part of the fleshy, anantherous filaments 3-4 mm long; ovary 3-celled.

Geonoma: petals valvate, persistent; staminodes 6, forming a tube about as long as the petals, either truncate to crenulate (*Eu-geonoma*) or digitately lobed (*Astrandroeceum*) at apex. If lobate the lobes are stellate-radiating at anthesis. Ovary at anthesis 1-celled by reduction of 2 carpels but style basifixed, 3-crestate with 3 recurved branches.

Asterogyne: the female flower resembles the digitately lobed type of *Geonoma* (*Astrandroeceum*) but has a 3-celled ovary.

Taenianthera: here the female flowers agree exactly with the *Astrandroeceum* type.

Aristeyera: petals valvate, persistent; staminodes variable in number, usually 7-18, connate at base, at anthesis free, with exserted and spreading anantherous filaments; ovary 3-celled.

Kalbrejera: petals valvate, persistent; staminodes 3, not alternating with the carpels, united into a shortly-crenulate tube; ovary at anthesis 1-celled.

The abortion of 2 carpels in *Geonoma*, *Taenianthera*, and *Kalbrejera* occurs at a rather late stage. In the female flower bud at a time before or sometimes even as late as anthesis of the male flowers in the same triad a straight, 3-fid pistil with an apical style can be observed (figs. 68-75). During the enlargement of the female flower before anthesis, however, only one of the carpels develops, producing a 1-celled ovary with a basifixed style (figs. 76-79). Reduction in the gynoeceum of the *Geonomae* is characteristic for the tribe as a whole as they always produce 1-seeded

fruits. The reduction in the number of carpels just before anthesis is only observed in the three above-mentioned genera. Originally *Kalbreycera* was described as probably having a 3-celled pistil with a terminal style. This proved to be a misinterpretation based on the dissection of a bud of a female flower.

UHL (1966) found in *Aristeyera* that the number of vascular traces in tepals is variable. "In the petal tube of the staminate flowers and in the sepals of the pistillate flowers, some of the traces appear to differentiate over a long period of time and as a result the number of traces increases with the age of the flower. The traces developing later do not become connected to the vascular strands in the floral receptacles". Unconnected lateral traces have also been reported from other palm groups.

The small flowers do not have nectaries and seem, generally speaking, unattractive to insects. In the style glandular epidermal cells can be found sometimes. The exerted stamens and rather long, recurved papillose style branches perhaps may be interpreted as an indication for wind pollination.

Pollen

A palynological survey of the Geonomoid palms has been the subject of a separate paper (PUNT & WESSELS BOER, 1966). Representatives of all genera except *Kalbreycera* were studied and some variation was met with. Based on exine characters and the shape of the pollen grains the species studied could be grouped into 4 types, but the differences were more or less obscured by transitions from one type to another. These types are:

Geonoma type with rather indistinct characters, the exine without a distinct ornamentation.

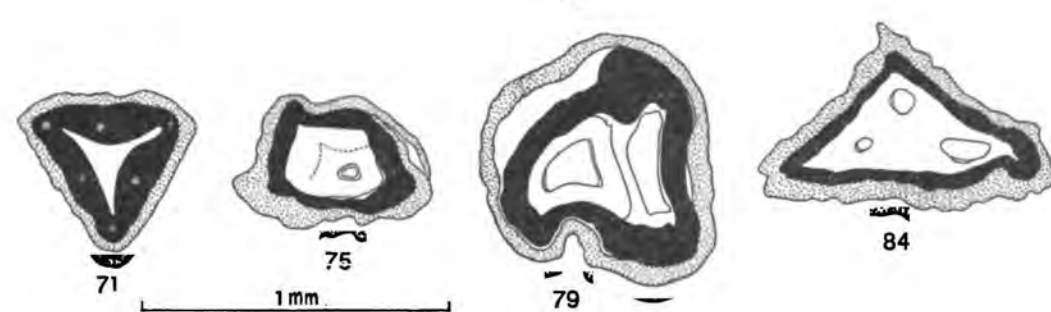
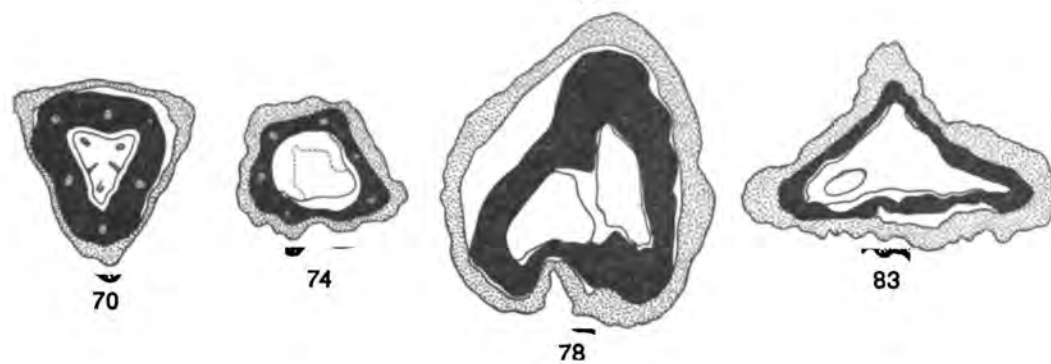
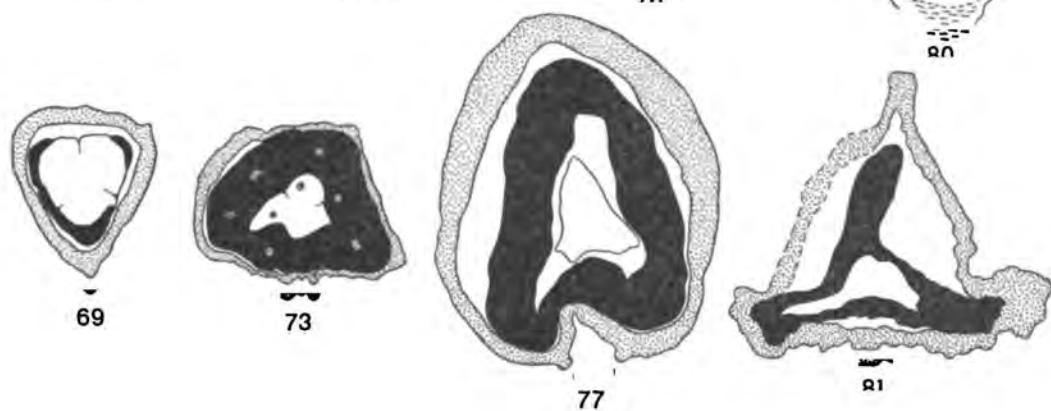
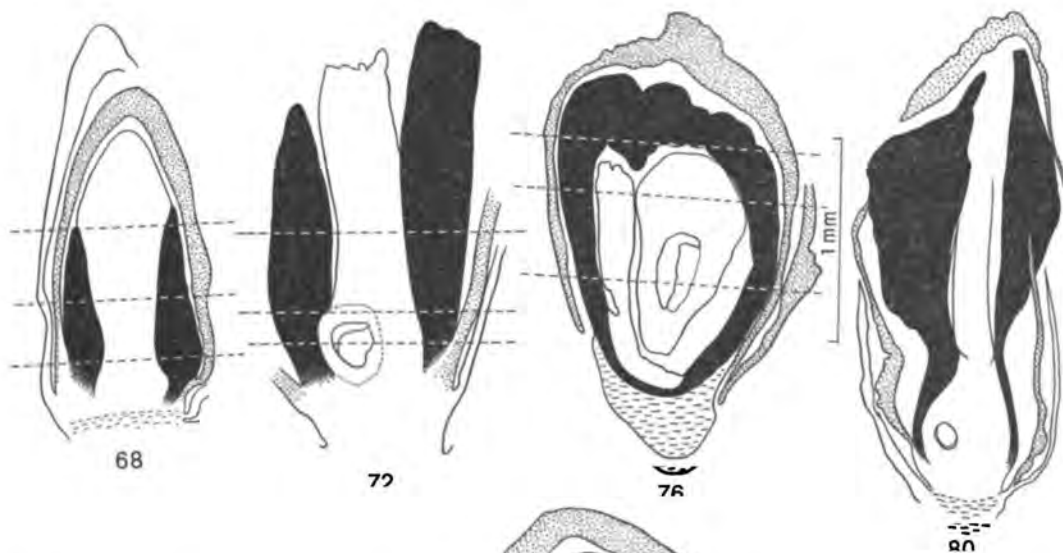
Asterogyne type with a fine but distinct reticulum.

Calyptogyne glauca type with a thick, slightly undulating tectum with perforations inordinately arranged or sometimes in very short chains.

Calyptronoma occidentalis type with a vermiculate ornamentation. Dr. Punt has now kindly contributed a description of the pollen grains of the genus *Kalbreycera*, previously not treated in the study cited:

Kalbreycera triandra Burret [Gaviria, Molina & Barkley 18C752 (US)]. Apertures: Pollen grains monocolpate. Colpus long, nearly as long as the longest axis of the grains.

Figs. 68-84. Longitudinal and transverse sections of expanding female flowers (simplified) showing the development of the pistil (pistil white; staminodial tube black; petals stippled). - Figs. 68-71. *Geonoma euspatha*; very young flower, the ovary still very small, without distinct cells and with a relatively large apical style. - Figs. 72-75. *Geonoma baculifera*; young flower with a distinctly one-celled ovary but still with an apical style. - Figs. 76-79. *Geonoma baculifera*; flower at anthesis, with a one-celled ovary and a basifixed style. - Figs. 80-84. *Calyptogyne occidentalis*; flower just before anthesis, with a three-celled ovary and an apical style (magnification of figs. 76 and 80 less than of the other figs.). Drawings by Miss G. Zijlstra.



Shape: Pollen grains ellipsoidal, slightly irregular, longest axis about $30\ \mu$ (means of ten grains), distinctly longer than the largest width.

Exine: Pollen grains intectate, reticulate. Sexine as thick as nexine.

Columellae low but distinct. Capita laterally fused into a reticulum.

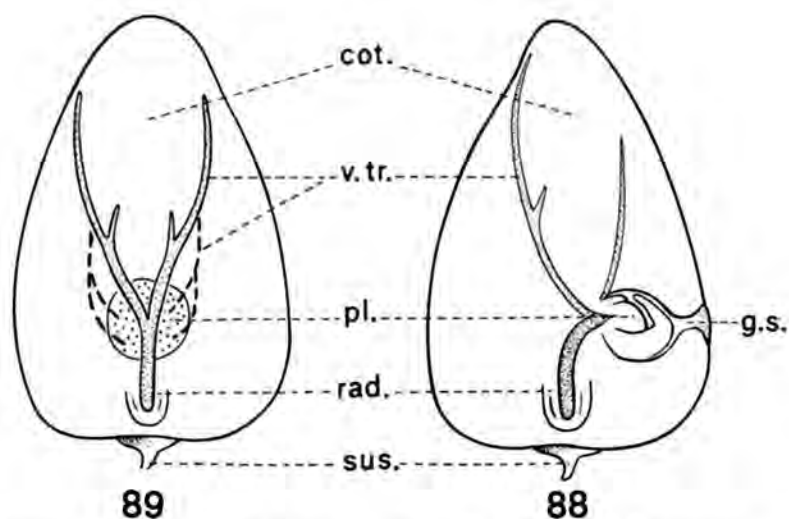
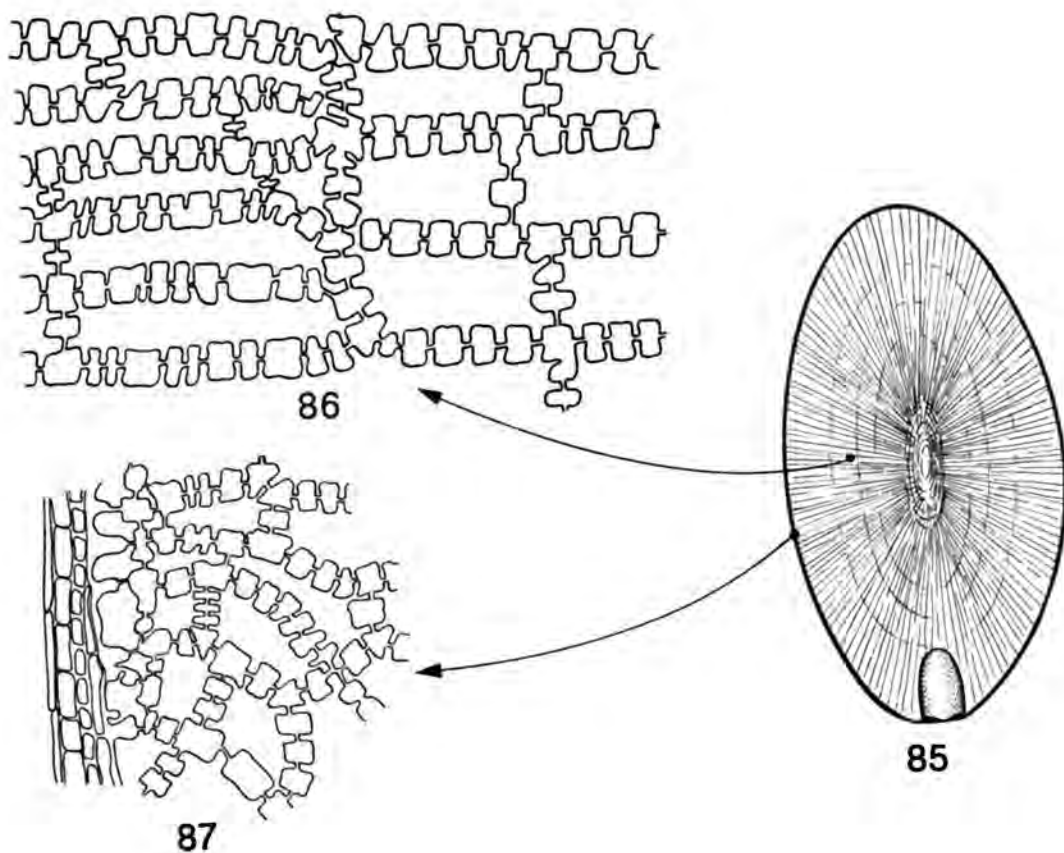
Muri of the reticulum thin, simplibaculate; lumina rather irregular, angular; meshes usually larger than $1\ \mu$, but sometimes smaller, or larger (up to $2.5\ \mu$). Lumina smaller towards the colpus.

The shape of the *Kalbrejera* pollen grains resembles that of the *Geonoma* type but the reticulate structure is in accordance with the *Asterogyne* type.

Pollen morphology shows little or no correlation with floral morphology. The less differentiated pollen of the *Geonoma* type is found in species now referred to *Pholidostachys*, in *Welfia*, *Taenianthera*, and all the *Geonoma* species studied. The reticulate *Asterogyne* type is, except in *Asterogyne martiana*, also found in *Taenianthera* and *Kalbrejera* in a more or less similar state. The *Calyptrogyne glauca* and *Calyptronoma occidentalis* types, which are not very distinct, are also found in most species of *Calyptrogyne*, *Calyptronoma*, and *Pholidostachys*, and also in *Aristeyera spicata*. There is, for instance, a remarkable and very pronounced difference in exine structure between *Calyptronoma occidentalis* from Jamaica and *Calyptronoma* material from Cuba. This provides an argument against the merging of all West Indian *Calyptronomas* into a single species as proposed by BECCARI (1912) and accepted by BURRET (1930).

Fruit

As mentioned under the female flowers, only a single ovule in the normally 3-celled, 3-ovulate ovary matures. This results in a 1-seeded, drupe-like fruit frequently showing the remnants of the style and the other two carpels near its base. According to shape, and especially features of the mesocarp, 4 clearly distinguishable fruit types can be recognized. Otherwise they are sufficiently uniform to make an initial general description possible. The fruits are subglobose to ovoid. The part originally enclosed in the flowerpit of the rachilla is frequently narrowed into a stipitate base. A pointed apex is not to be mistaken for a style rest. The exocarp is thin and smooth, the mesocarp more or less fibrous and frequently rather dry, the endocarp crustaceous, lustrous, usually not adherent to the seed. The seed is globose to ovoid, with a small subbasal hilum. The raphe, a sharply contrasting greyish line on the brownish testa, encircles the seed from the hilum to the basal embryo. The slightly impressed raphe is usually unbranched but sometimes forks or has a few parallel branches. Wendland explicitly stated in his descriptions whether the raphe was branched or not and apparently thought it of taxonomic importance but I fail to understand its significance. A well-developed caruncula is usually present. The endosperm is homogeneous and seems to be very finely radially and transversely striate in longitudinal section (fig. 85). This striated appearance proves on microscopic examination to



Figs. 85–87. *Calyptrigyne dulcis*; endosperm. – Figs. 88–89. *Geonoma poiteauana*; embryo (cot. cotyledon; g.s. germinating split; pl. plumule; rad. radicle; sus. suspensor; v. tr. vascular traces). – Fig. 88. Longitudinal section. – Fig. 89. Diagram.

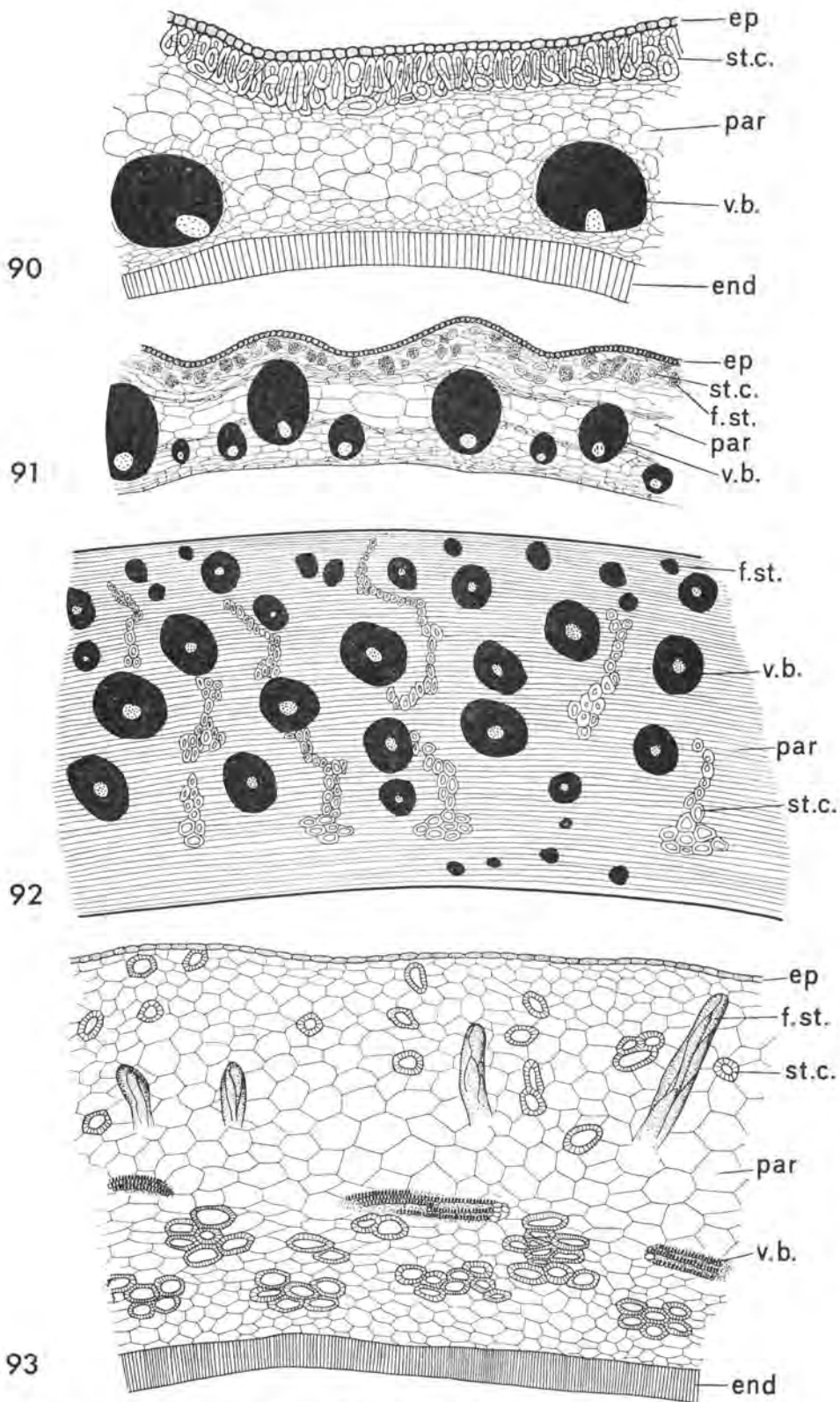
result from large, radially elongated endosperm cells. The walls of these cells are much thickened and pitted (figs. 86, 87).

Embryos turned out to be essentially similar. The impressive contribution to the embryography of *Cyperaceae* by VAN DER VEKEN (1965) raised, in vain, some hope of finding an additional character useful in the delimitation of the Geonomoid genera. The embryos of species of *Welfia*, *Calyptronoma*, *Calyptrogyne*, *Pholidostachys*, *Asterogyne*, *Geonoma*, and *Taenianthera* all agree very well with the description of the embryo of *Archontophoenix cunninghamiana* given by GATIN (1906). Shrunken embryos taken from herbarium material can be revived by immersing them in about 5 % hydrochloric acid. The straight embryo has a basal suspensor. The upper two thirds is the cotyledon which largely remains embedded in the endosperm and functions as a suctorial organ during germination. Near its base the embryo contains the curved plumule with the radicle coinciding with the axis of the embryo and directed towards the base. The plumule is directed laterally towards a germinating split and forms almost a right angle with the radicle. The cotyledon constitutes, as mentioned, the largest part of the embryo and is in direct contact with the endosperm via its epidermis. The plumule is connected dorsally with the cotyledon but is otherwise fully free within a small pit open to the outside through the germinating split. The radicle, on the contrary, is not sharply delimited from the surrounding tissue and is only distinguishable by its longitudinally elongated cells. From the plantlet a few provascular bundles run into the cotyledon and distally branch repeatedly (figs. 88, 89). Large, isodiametric cells, probably raphide-sacs, are observed at the extreme base of the embryo. Germination starts with a limited elongation of the cotyledon extruding the plantlet from the endosperm. The seedling develops next to the seed.

As mentioned above, the fruits differ mainly in shape and mesocarp characters, allowing the recognition of 4 fruit types:

Calyptrogyne type: fruit obovoid, rounded at apex, the stipitate base horizontally flattened and curved. The mesocarp with unequal, partly rather thick, anastomosing fibres, forming a reticulum with a thicker fibre encircling the seed laterally. Microscopically the exocarp is a single layer of cubical, intensely brownish- to blackish-coloured cells. Just below this epidermis a layer of radially elongated stone cells is observed. The fibres, i.e. vascular bundles composed of a thick sclereidal sheath and a slender conductive part, are embedded in a very loose, thin-walled parenchyma which usually becomes disorganized in drying. As in the other fruit types, the endocarp consists of regular, closely packed, radially arranged, cylindrical cells with much thickened and pitted lateral walls (fig. 90). Fruits of *Calyptrogyne*, *Calyptronoma*, and *Pholidostachys* are essentially similar.

Asterogyne type: fruit ellipsoid-ovoid, slightly horizontally flattened and keeled at apex, at least when dry, the stipitate base flattened and



Figs. 90-93. Cross-sections of the fruit walls (*end.* endocarp; *ep.* epidermis; *f.st.* fibrous strands; *par.* parenchyma; *st.c.* stone cells; *v.b.* vascular bundles).—Fig. 90. *Calyptrogyne dulcis* (Balguer 404.788).—Fig. 91. *Asterogyne martiana* (Steysmark 42064).—Fig. 92. *Welfia regia* (Fasett 25210).—Fig. 93. *Geonoma poiteauana* WB 1586).

curved. The mesocarp with rather equal, longitudinal fibres partly fused laterally and distally. Microscopically tannin, which colours the mesocarp, is not restricted to the epidermis but occurs in all parenchyma cells. The subepidermal stone cells do not form a continuous layer, because of intermixed parenchyma cells. The stone cells are also more or less longitudinally, instead of radially elongated and clustered. Small and larger vascular bundles alternate rather regularly, embedded in cubical parenchyma cells. The conducting tissues are situated adaxially in the vascular bundles. The parenchyma cells become flattened, i.e., transversely elongated in cross-section, towards the endocarp (fig. 91). In *Asterogyne martiana* the endocarp is adherent to the seed. Fruits of *Aristeyera spicata* match this type rather well but the arrangement of the vascular bundles in the parenchyma is less regular, bundles of fibres without conductive elements are present in the outer layer and the endocarp is not adherent to the seed.

Welfia type: fruits resemble the *Asterogyne* type rather well but differ in several features. A subepidermal layer of stone cells is lacking but otherwise stone cells form a continuous system between the vascular bundles throughout the mesocarp but especially towards the centre. The vascular bundles, with central conducting tissues, are scattered equally throughout the mesocarp: the widest bundles at the centre but gradually becoming more slender towards each surface (fig. 92). Here also the endocarp is not adherent to the seed as is otherwise normal in Geonomoid palms.

Geonoma type: fruit globose to ovoid, more or less pointed at apex, usually strictly terete in cross-section or sometimes more or less angular by mutual pressure. Mesocarp dry without prominent fibres. Microscopically colour due to tannin is restricted to the epidermal cells. A subepidermal layer of stone cells is lacking but single or clustered stone cells are dispersed throughout the parenchyma with a distinct concentration towards the endocarp. A few more or less transverse and longitudinal vascular bundles without a fibrous sheath are present. Radially or somewhat obliquely running fibrous bundles with usually less than 10 sclereids in cross-section are more numerous but never crowded (fig. 93). These fibrous bundles account for the tuberculate appearance of dry fruits. Raphidesacs were observed occasionally in the outer part of the mesocarp. The endocarp does not adhere to the seed. Fruits of *Geonoma*, *Taenianthera*, and *Kalbreycera* are essentially the same.

Fruits of the *Calyptrogyne* and *Asterogyne* type are rather variable in size. Even fruits of a single collection are frequently seen with a noticeable diversity in dimensions. Consequently, efforts to establish new species on differences in size of the fruits do not seem to be very successful. This was done, for instance, by Burret in *Welfia* and by Brother León in Cuban *Calyptronomas*. On the other hand differences in fruit size can be of diagnostic value if they are sufficiently great. This is so in, e.g., the

separation of West Indian *Calyptronoma* species by Bailey, but this was also supported by other characters.

In the *Geonoma* type the fruit is much more constant within a single species. This variation is quantitatively demonstrated in the table (p. 44).

The examples chosen are closely related species which are difficult to separate. They are perhaps more satisfactorily treated as subspecies of *Geonoma interrupta*. The measurements recorded give an impression of the significance of differences in fruit size used in this paper as a character for keying out *Geonoma* species.

Trends of specialization

Even from the limited information available it is clear that although the Geonomoid palms share common features, making them a natural group, they are quite diverse in several respects. This considerable range of diversity seems to result from certain trends of specialization.

TOMLINSON (1960) pointed out that where simple leaves characterize the adult foliage of palms, they represent a derived and not a primitive condition.

He considers a primitive sequence in this group, one in which the first, bifid eophylls are succeeded by paripinnate adult leaves. This is found in *Welfia* and the West Indian *Calyptronoma* species and coincides with a rather tall habit. These palms are solitary, the columnar stem with distinct diffuse secondary thickening. In most other representatives the adult type of foliage is never produced and this is usually associated with reduced cane-like stems with little diffuse secondary thickening, or even an "acaulescent" habit. The adult type of foliage is anatomically distinguished by the occurrence of a well-developed colourless hypodermis below each surface. In species with permanent juvenile foliage the hypodermis is usually less developed. E.g., *Asterogyne* and *Aristeyera* have only a 1-layered abaxial hypodermis; *Calyptrogyne* and *Geonoma*, but not *Taenianthera*, usually have no hypodermis.

Since closely related, i.e. morphologically comparable, species occupy similar or at least nearby areas, a rather recent, rapid evolution seems likely. This rapid evolution may have been facilitated by the occupation of new ecological niches. Normally palms compete in the canopy, but the Geonomoid palms usually inhabit the less crowded understory of dense forests and are adapted to the conditions of that habitat (cf. CORNER, 1966, p. 71). In this context also the tall *Welfia* and *Calyptronoma* species with paripinnate leaves must be regarded as primitive.

In inflorescences, the immersed flowerpit lip type of *Welfia*, *Calyptronoma*, *Pholidostachys*, *Calyptrogyne*, *Asterogyne* and *Aristeyera* seems less modified and hence more primitive than the elevated lips of *Kalbreycera*, *Geonoma*, and *Taenianthera*. Palm flowers normally have 6 stamens, frequently also more or sometimes only 3. The same range is observed in the *Geonomeae*. Noteworthy is the discrepancy between male and female

| specimen | number | length | diameter | species | number | length | diameter |
|---|--------|---------------|---------------|--------------------------|--------|---------------|---------------|
| Pittier 24393 Venezuela | 12 | $7,6 \pm 0,3$ | $6,6 \pm 0,2$ | } <i>G. pinnatifrons</i> | 36 | $8,1 \pm 0,7$ | $6,4 \pm 0,4$ |
| Ramage s.n. St. Lucia | 12 | $9,0 \pm 0,3$ | $6,7 \pm 0,2$ | | | | |
| Wessels Boer 1635 Trinidad | 12 | $7,8 \pm 0,2$ | $6,0 \pm 0,2$ | | | | |
| Matuda 16384 Mexico | 12 | $5,5 \pm 0,2$ | $4,4 \pm 0,2$ | } <i>G. oxycarpa</i> | 60 | $5,4 \pm 0,4$ | $4,3 \pm 0,3$ |
| Schipp 397 British Honduras | 12 | $5,4 \pm 0,3$ | $4,7 \pm 0,3$ | | | | |
| Cook & Doyle 4 Guatemala | 12 | $5,6 \pm 0,4$ | $4,3 \pm 0,3$ | | | | |
| v. Tuerckheim 8332 Nicaragua | 12 | $5,4 \pm 0,2$ | $4,1 \pm 0,2$ | | | | |
| Purdie s.n. Colombia | 12 | $5,2 \pm 0,3$ | $4,1 \pm 0,2$ | | | | |
| Philipson & Idrobo 1979 Colombia | 12 | $7,1 \pm 0,3$ | $5,5 \pm 0,2$ | } <i>G. euspatha</i> | 48 | $6,9 \pm 0,4$ | $5,8 \pm 0,3$ |
| Steyermark 60789 ¹⁾ Venezuela | 12 | $6,9 \pm 0,5$ | $5,8 \pm 0,2$ | | | | |
| N.Y.B.G. 54437 Suriname | 12 | $6,7 \pm 0,3$ | $6,0 \pm 0,3$ | | | | |
| Wessels Boer 1490 Suriname | 12 | $6,7 \pm 0,4$ | $5,8 \pm 0,3$ | | | | |

¹⁾ Fruits not yet completely mature.

flowers: if there are more than 6 stamens in the male flowers, the female flower also has more than 6 staminodes but fewer than there are stamens in the male flowers. In *Kalbreycera* there are 3 stamens and 3 staminodes as well. In this case, however, the carpels do not alternate with the staminodes, thus indicating the loss of an inner series of 3 staminodes. Therefore it seems likely that 6 stamens represent a primitive condition; a larger or smaller number a specialized condition. The variability of the anthers which range from those with united thecae in sagittate anthers to those with free thecae on a bifid connective probably also represents a series in specialization. Essentially the position of the anthers in, e.g., *Calyptronoma* and *Geonoma* is the same at anthesis. The increasingly free thecae may assist in pollination. The pistil, normally composed of 3 carpels, shows a reduction to one in *Geonoma*, *Taenianthera*, and *Kalbreycera*. The pistillode has invariably 3 reduced carpels. The tendency for the gynoeceum to be reduced is characteristic of the tribe as a whole, since only 1 ovule matures even when there are 3. The conclusion is that *Calyptronoma*, *Calyptrogyne*, and *Pholidostachys* seem to have rather primitive flowers. *Welfia*, *Aristeyera*, and *Kalbreycera* are probably advanced in the number of stamens; *Aristeyera* and *Kalbreycera* also, as well as *Asterogyne*, *Geonoma*, and *Taenianthera*, in the free thecae. *Geonoma*, *Taenianthera*, and *Kalbreycera* are further advanced in having a unilocular ovary. On the other hand the mode of opening of the female flowers and pollen morphology are apparently advanced in *Calyptronoma* and *Calyptrogyne*.

Generally speaking, pollen grains are regarded as primitive if they are:

1) rather small in size; 2) regular in shape; 3) reticulate.

According to these criteria the species of *Calyptrogyne*, *Calyptronoma*, and *Pholidostachys* which were investigated have advanced pollen grains except for *Calyptrogyne dactyloides* and *Calyptrogyne synanthera*, now referable to *Pholidostachys*. The *Geonoma* pollen type is primitive according to criteria 1 & 2, the *Asterogyne* pollen type is primitive according to criterion 3.

The present discussion shows the absence of any correlation between these differing, hypothetical series of specialization. This lack of correlation suggests a polyphyletic origin for several features. Apparently the overall trend of specialization in many features is the same for the tribe as a whole, but the level of specialization within the individual genera is very variable.

DELIMITATION OF GENERA

Since the days of Wendland an increasing number of small genera have been separated from *Geonoma*. These satellite genera are distinguished by striking differences, as was pointed out in the previous chapter. Since, however, these distinguishing features are not all at the same level of separation they have been a controversial matter in the literature. Therefore an account of the main reasons for the present classification is given here. The present investigations in the *Geonomeae* convinced me that the tribe is characterized by a plasticity whereby various organs have become specialized. Consequently the resulting advanced features partly represent parallel evolution with a polyphyletic origin and do not necessarily indicate a close relationship. This, for instance, is readily seen in the case of tall habit and adult foliage versus reduced habit with permanently juvenile foliage. Tall Geonomoid palms with absolutely regular paripinnate leaves are represented by *Calyptronoma* and *Welfia* whereas remarkable differences in size and leaf structure occur within the genus *Geonoma*. For example we may compare *Geonoma stricta*, a very small species, with the specimen described by Burret as *Geonoma dryanderæ*. On the other hand species with a smaller habit and permanently juvenile foliage are referred to *Calyptronoma*, viz. *Calyptronoma synanthera* and *Calyptronoma dactyloides*, species which are both undoubtedly close to *Calyptronoma*. The same specialization is shown in several other non-Geonomoid genera like, e.g., *Bactris* which includes the very tall *Bactris gasipaes* and the extremely small *Bactris simplicifrons*. The anatomy of the lamina corresponds with this reduction so that features like the presence or absence of a hypodermis and the distribution of non-vascular fibres can be used for classifying the genera only with great caution.

Another example of parallel specialization that does not by itself indicate close relationships is the diversity of the androecium. No natural classification can be based solely on the number of stamens or the shape of the anthers. If, for instance, *Aristeyera* is placed close to *Welfia* because both have numerous stamens this position proves to be unsatisfactory with regard to vegetative anatomy (TOMLINSON, 1966), shape of the anthers (MOORE, 1966), pollen morphology (PUNT & WESSELS BOER, 1966), and fruit structure (chapter 2). Likewise the shape of the anthers alone does not justify a satisfactory separation. It brings together *Calyptronoma*, *Calyptrogyne*, *Pholidostachys*, and *Welfia* with sagittate anthers erect in bud and united thecae; *Asterogyne*, one species of *Aristeyera*, *Kalbreycera* and *Geonoma* with free thecae on a bifid connective inflexed in bud and forming a sharp angle with the filament at anthesis. The other species of *Aristeyera* and *Taenianthera* are more or less distinct from the last group by the articulation between the connective and the filament. This

grouping cuts across other resemblances and is clearly useless. A comparable diversity in the sterile and/or fertile androecium is exhibited by several other, unrelated, groups of palms. Since floral features in palms are relatively well-assessed from fragmentary herbarium specimens and notably since they are thought *a priori* by many authors to be of fundamental importance, several single-character genera have been created. In neotropical palms this has been done in the Bactroid (*Bactris-Pyrenoglyphis*, *Astrocaryum-Hexopetion*), Cocoid (*Attalea segregates*) and Iriartoid palms, etc; none of the segregates is generally accepted. The emphasis on two other characters, up to now only little taken into consideration, affords a much more satisfactory grouping. These characters are:

- A. the two types of lip; a. lip immersed, recurving, b. lip elevated, splitting.
- B. the fruit structure; a. the *Calyptrogyne* type, b. the *Welfia* type, c. the *Asterogyne* type, d. the *Geonoma* type.

Of all possible combinations of these characters only a limited number is actually found, namely:

Aa Ba in *Calyptronoma*, *Calyptrogyne*, and *Pholidostachys*

Aa Bb in *Welfia*

Aa Bc in *Asterogyne* and *Aristeyera*

Ab Bd in *Geonoma*, *Taenianthera*, and *Kalbrejera*.

These four groups accord more or less with the distribution of several other features and represent a natural grouping in the present author's opinion. Consequently four genera are accepted within the *Geonomeae*:

1. *Calyptrogyne*, including *Calyptronoma* and *Pholidostachys*
2. *Welfia*
3. *Asterogyne*, including *Aristeyera*
4. *Geonoma*, including *Taenianthera* and *Kalbrejera*.

These genera are discussed in more detail below.

Calyptrogyne is, apart from the immersed lips and its peculiar fruit type, characterized by: male flowers with 6 stamens with sagittate, dorsifixed anthers with united thecae; usually advanced pollen grains (rather large, irregularly shaped with inordinate to more or less vermiculate perforations in the tectum); female flowers with a 3-celled pistil and frequently coherent petals forming a circumcissile cap at anthesis. WENDLAND established the genus in 1860, partly based on a very detailed analysis of the flowers by KOCH (1858). In this description *Calyptrogyne* was defined rather narrowly to accommodate the small Central American species with a spicate inflorescence and a caducous second bract only. Subsequently Wendland persuaded GRISEBACH to establish another new genus, *Calyptronoma* (1864), for the taller West Indian species with a branched inflorescence and a more or less persistent second bract. Apparently Grisebach was not very happy with the segregation and a field-note by C. Wright, who collected

the original material of *Calyptronoma dulcis*, urged him to merge it with *Geonoma* in later writings. Wright's argument, still present (*in schedula*) in GOET, is: "Stam. tube not slender. Style terminal ("excentric terminal"?). Trunk not "very hard" nor "somewhat crooked" unless accidentally nor with a "great swelling at the root". Hence it appears to be not *C. swartzii* and has some of the characters of *Geonoma* & *Calyptronoma*. Dont make two genera pray!! on such slight characters". Clearly Wright and Grisebach missed the essential characters. Also in later literature the genus was rarely maintained. The younger Hooker in Bentham and Hooker united *Calyptronoma* with *Calypetrogyne*, an opinion accepted by BECCARI (1912) and BURRET (1930). In a somewhat popular way BAILEY (1938) advocated the restoration of *Calyptronoma* but he could not convince authors like Brother LEÓN (1944) and BURRET (1953). The story of *Pholidostachys* is somewhat similar. It was proposed in correspondence by Wendland to Hooker fil. who did not accept it for the "*Genera Plantarum*". According to Wendland *Pholidostachys* is distinctive in the reduced inflorescence and the large fruits with thick mesocarpic fibres. It was provisionally accepted by Burret who found the separation so questionable that he provided alternative names to allow for future modification. Recently MOORE (1967) redefined *Pholidostachys* in a very successful way. He stressed differences in the female flowers which hitherto had been completely overlooked. Moore found the petals of the pistillate corolla in *Pholidostachys* to be very briefly connate into a tube about as high as the ovary, the lobes distinct, glumaceous, persistent and not forming a circumscissile cap. In *Calypetrogyne* and *Calyptronoma* he found the petals of the pistillate corolla connate basally into a thin membranaceous tube for more than half their length, the lobes valvate and thicker, not separating but forming a circumscissile conic cap, caducous at anthesis. This feature in combination with the difference in inflorescence gives a natural division of the species between *Calyptronoma*, *Calypetrogyne*, and *Pholidostachys*, supported by several other characters:

Calyptronoma: Tall, stem columnar; leaves regularly paripinnate, lamina thick, epidermis with a thick cuticle, hypodermis well-developed below each surface, mesophyll with numerous veins and scattered fibres solitary or in small strands; inflorescences usually twice branched; female flowers with a deciduous corolla cap; Greater Antilles.

Calypetrogyne: Small, usually acaulescent; lamina thin, subsimple to irregularly divided into broad segments, long-cuneate at base, epidermal cells thin-walled, hypodermis absent or rarely poorly developed, mesophyll with fewer veins and numerous scattered fibres; inflorescence spicate; female flowers with a deciduous corolla cap; Central America.

Pholidostachys: Rather tall, trunk several cm to about 1 dm in diameter; lamina thin, irregularly pinnate, epidermal cells thin-walled, hypodermis absent or locally poorly developed, mesophyll with still fewer veins and almost without fibres (sometimes a few present in old leaves); inflorescence

once branched or the lowest branches further branched; female flowers with persistent valvate petals; north-western South America and adjacent Central America.

These taxa are given the rank of subgenera within the genus *Calypstrogyne*. In this way their resemblance as well as the differences are well reflected by the classification. A generic rank for the three taxa seems inadvisable as I consider differences between them less important than the differences which exist between other genera of the *Geomeae*. Moreover stability in nomenclature is promoted in this way.

Welfia is, apart from the immersed lips and its peculiar fruit type characterized by: large dimensions in every respect; male flowers with numerous stamens with dorsifixed, sagittate anthers with united thecae; very large pollen grains without a distinct structure of the exine; female flowers with a 3-celled pistil. Leaves of the adult type, more or less agreeing in their anatomy with that of *Calypstrogyne* subgenus *Calyptronoma*. The stamens are of the same type as in *Calypstrogyne* but they are more numerous; the pollen grains are quite different. From a pollen morphological point of view it is unimaginable that there is a close relation between *Welfia* and *Calypstrogyne*. In general *Welfia* seems to be rather isolated as was concluded by TOMLINSON (1966) on anatomical evidence.

Asterogyne is, apart from the immersed lips and its peculiar fruit type, characterized by: male flowers with a variable number of stamens (6–24) with free thecae on a bifurcate connective; female flowers with a 3-celled pistil. *Asterogyne* was proposed by WENDLAND (1883) in a letter to Hooker fil. who accepted this new genus for the "*Genera Plantarum*". It remained monotypic because the second species described by Burret must be regarded as conspecific with the type species. Recently MOORE (1966) described a new species and referred it to a new genus, *Aristeyera*. In the original description *Aristeyera* was placed close to *Welfia*, mainly because of the numerous stamens. In other respects it shows less resemblance to *Welfia* but is very close to *Asterogyne martiana* from which it differs in its slightly taller habit, spicate inflorescence with only 2 bracts, a somewhat different junction of connective and filament, its pollen grains, fruit with the endocarp not adherent to the seed, and especially in the numerous stamens, 21–24 instead of 6. A subsequently described second species, *Aristeyera ramosa*, is even closer to *Asterogyne martiana*. The plant is of the same size, has a ramified inflorescence with 3 bracts just as (sometimes) in the latter species, exactly the same anthers, the endocarp probably adherent to the seed (only immature fruit seen). The only differences observed are in the number of stamens (11–12) and the size of the fruit. Otherwise both species are identical and quite indistinguishable in the absence of flowers or fruits. The separation of *Asterogyne* from *Aristeyera* is based now only on the number of stamens. The initial wide gap between the genera, 6 versus 21–24 stamens, is now filled and obscured by the second species. Moreover, generic separations based only on the number

of stamens have proved unsatisfactory in palms on several occasions and have been rejected, for instance, by the present author in *Attalea*, *Iriarteia*, and *Oenocarpus* (WESSELS BOER, 1965). Here also, a union of *Asterogyne* and *Aristeyera*, stressing resemblances in almost every feature, seems to be more natural and satisfactory than a separation based only on the number of stamens.

Geonoma is, apart from the elevated lips and its peculiar fruit type characterized by: male flowers with usually 6, rarely 3 stamens with free thecae on a bifurcate connective; pollen grains usually small and without a distinct structure, sometimes larger and with a reticulate structure; female flowers at anthesis with a 1-celled ovary with a basifixed style by reduction of the 2 other carpels. The plants usually have a reduced, slender habit; the lamina has a simplified anatomy by reduction. The genus is very successful with over 70 known species.

BURRET (1930) described 2 new genera which are considered here to be congeneric with *Geonoma*. The first, *Kalbreycera*, was founded to accommodate an unusual Kalbreyer collection with 3 instead of 6 stamens and a supposedly 3-celled pistil with a terminal style. The original material was lost during the war but several new specimens are now available. Burret dissected female flower buds and found a terminal style on a supposedly 3-celled ovary. The new material demonstrates clearly that during the development of the flower only 1 carpel develops, resulting in a 1-celled ovary with a basifixed style at anthesis just as in *Geonoma*. As *Geonoma* is characterized by reductions in almost every respect, notably in the gynoeceum, a reduction in the androeceum seems likely, especially as *Kalbreycera* is not distinguished in any other feature from *Geonoma*. On the other hand the number of stamens proves invariably to be 6 in *Geonoma* as in most other species of the tribe, and this difference should be regarded as of fundamental importance. Consequently *Kalbreycera* is given the rank of subgenus within *Geonoma*. Burret thought *Kalbreycera* intermediate between *Asterogyne* and *Geonoma*. This position, already assailed by the new interpretation of the pistil, seems to be highly improbable from a phylogenetic viewpoint.

Taenianthera, Burret's second segregate from *Geonoma*, was based on the position of the thecae in line with the filament at anthesis. This character is correlated with a digitately lobed staminodial tube in the female flower and a spicate inflorescence. In the original description also a furcate inflorescence is recorded which is probably an error. In his identifications Burret was not very fortunate in recognizing his new genus; he referred specimens and species to it that do not fit and conversely he excluded species that are referable to it. In his discussion Burret stated *Taenianthera* to be very close to *Geonoma* and the separation of the two genera to be rather questionable. Yet *Taenianthera* seems to represent a natural group although not sharply distinguished from other *Geonoma* species. Moreover, the position of the anthers, in a line with the filament at anthesis, is not

observable in every species. In the present study *Taenianthera* is maintained as a section, characterized by a small, often "acaulescent" habit; lamina anatomically with a hypodermis-like layer below each surface, epidermal cells usually with chloroplasts; inflorescence erect, spicate, flowerpits at anthesis congested, more or less in orthostiches; anthers at anthesis usually in line with the filament; pollen more or less reticulate; female flowers with a digitately lobed staminodial tube.

Most of these features can be observed singly in other *Geonoma* species but not in the same combination. A section *Astrandroeceum*, founded by SPRUCE (1869) on the digitately lobed staminodial tube present in several species, was given the rank of subgenus by Burret. It was, however, rejected by TRAIL (1876) and DRUDE (1882) and also in the present author's opinion it is an unnatural assemblage. At present *Geonoma* species which do not belong to *Kalbrejera* or *Taenianthera* cannot be separated into discernable subgeneric taxa. It is still possible to recognize associations not necessarily separated by marked discontinuities. In order to emphasize these associations the *Geonoma* species are separated into 17 groups of species, some of which are monotypic.

DISTRIBUTION, ECOLOGY, AND USES

The *Geonomeae* are almost exclusively found in the neotropics, a very few *Geonoma* species occur in south-eastern Brazil south of the tropic of Capricorn. The area of the tribe ranges from south-eastern Mexico south of about 18° N and the Greater Antilles, through Central America, most of the Lesser Antilles, and the tropics of South America, to the Brazilian state of Rio Grande do Sul and Bolivia. This area is interrupted by considerable gaps in which no species have been recorded, apparently because ecological conditions are unfavourable.

All genera occur in Central America and the adjacent part of north-western South America. The boundaries of the area occupied by the tribe as a whole is almost completely delimited by *Geonoma* which includes the greatest number of species. In the Greater Antilles the tribe is represented by *Calyptrogyne* subgenus *Calyptronoma* and by one *Geonoma* species in Hispaniola.

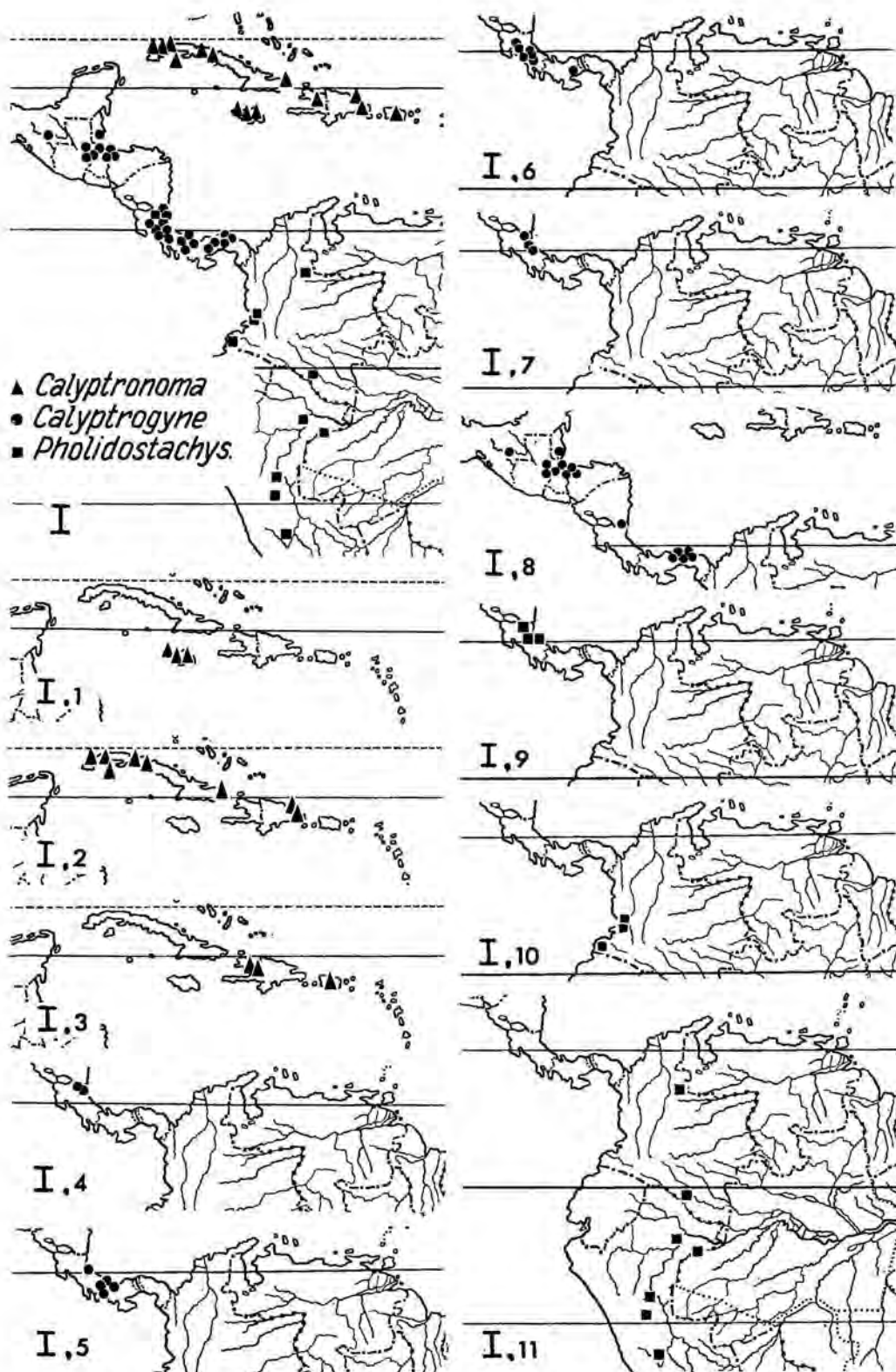
Calyptrogyne has 3 subgenera which scarcely overlap in their distribution; *Calyptronoma* is restricted to the Greater Antilles; *Calyptrogyne* to Central America, ranging from southernmost Mexico to Panama with most species in Costa Rica; and *Pholidostachys* is represented by one species in Central America and the adjacent part of South America and another 3 species in South America from Colombia to Peru. (map I).

Welfia is large and unattractive to collectors so it is only rarely gathered. So far I have seen specimens from Costa Rica and Colombia only. According to the literature the genus has a wider distribution in Central America and is found from Honduras to Colombia (map II).

Asterogyne, until recently considered to be a monotypic genus represented by a species common in an area from British Honduras and Guatemala to western Colombia, is now enlarged by 2 species described from the states of Miranda and Sucre in northern Venezuela. Further collecting will probably fill the gap between these areas (map III).

Geonoma, as mentioned above, has an extensive range (map IV).

The centre of concentration of species for the tribe as a whole is found in western Colombia and adjacent Central America with extensions along the Andes into Venezuela and southward into Ecuador and Peru. In this centre the entire range of diversity observed in the *Geonomeae* can be found. There is not only a maximum concentration of species but all genera and nearly all major subgeneric taxa are present. This concentration probably has to be related to the extreme ecological variability in the Andes and adjacent areas. To interpret it as a centre of origin seems purely hypothetical since no really primitive genus can be designated. In all genera, both primitive and advanced features are found together. The largest number of primitive features seems to be retained in *Calyptronoma*,

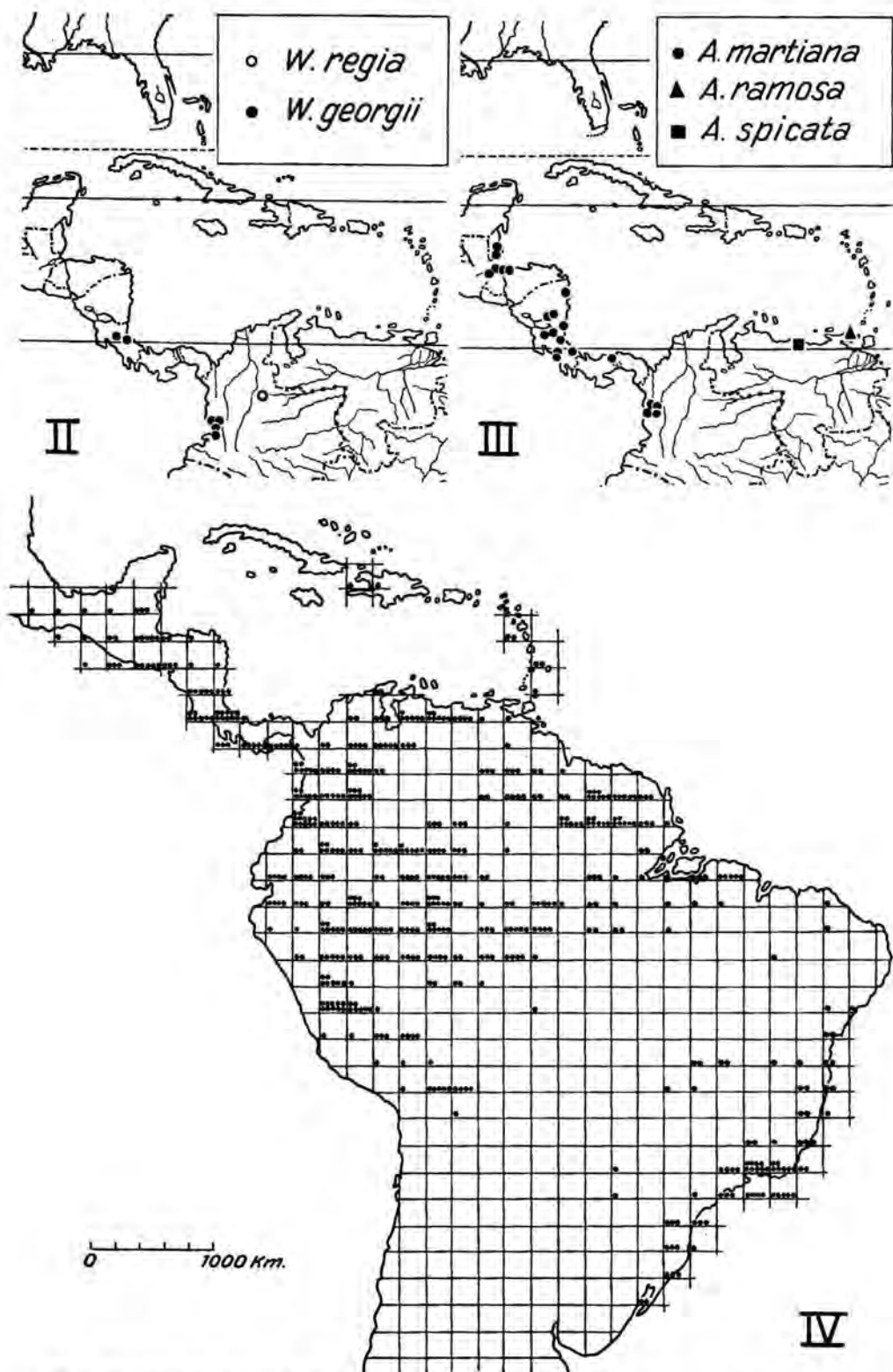


Map I. Distribution of the genus *Calyptrogyne*. I,1 *C. occidentalis*; I,2 *C. dulcis*; I,3 *C. rivalis*; I,4 *C. trichostachys*; I,5 *C. condensata*; I,6 *C. brachystachys*; I,7 *C. sarapiquensis*; I,8 *C. ghiesbreghtiana*; I,9 *C. pulchra*; I,10 *C. dactyloides*; I,11 *C. synanthera*.

a subgenus of *Calyptrogyne*, and this is the only major subgeneric taxon not occurring in the centre. The distribution of the subgenus *Calyptronoma* is very remarkable indeed as it is strictly isolated from other members of the *Geonomeae* except for one *Geonoma* species recorded from Hispaniola.

Distribution maps have been compiled for each genus only from specimens studied, literature records having been excluded. Since the distribution of the taxa in the *Geonomeae* is still far from completely known, the method of dotting actually gathered specimens is preferred to indicating the areas by boundary lines. This was done with *Calyptrogyne*, *Welfia*, and *Asterogyne*. In *Geonoma*, however, this method seemed to be less advisable because of the numerous species and specimens. Here the area was divided into squares of about 40 000 km²; the number of species collected in each square was counted and indicated on the map by as many dots. Since these dots are placed at the bottom of each square they tend to be well to the south of the actual locality of the species. This accounts for many dots in the sea. This technique clearly indicates the centres of concentration of species in the area. Centres of concentration in *Geonoma* are western Colombia and adjacent Central America with extensions into the Andes of Venezuela and Peru, just as in the tribe as a whole. A second concentration is in south-eastern Brazil, in the state of Rio de Janeiro. The second Brazilian centre is exclusive to *Geonoma*: no other Geonomoid palms occur here. Concentration of species in Suriname is perhaps accidental, due to the unusually intense palm collecting in that country. Further collecting is likely to increase the number of dots but probably will not affect the general distribution pattern. Consequently the discontinuity in Central Brazil, as well as the gaps in Venezuela and south of the Guianas, are regarded to be significant. Compared with the distribution of forest types in South America as mapped by HUECK (1966) the occurrence of *Geonoma* is correlated very well with forest types. The large discontinuity in Central and eastern Brazil is frequently met with in plant taxa of tropical South America and clearly coincides with a region of relatively low rainfall. According to Hueck this region is occupied by dry, rather open forests or savanna-like areas, partly referred to as *campos cerrados* and *caatingas*, interrupted by scattered areas covered with semi-humid forests along rivers or near mountains. South-east of this territory an extensive forest landscape is found, called "the territory of east- and south-Brazilian subtropical forests" by Hueck. Along the coast this forest type passes into "the Brazilian coastal rainforest", a tropical rainforest on sea-facing mountain slopes and ancient parts of the coastal plain. The second centre of concentration of *Geonoma* is in these coastal rainforests. Species number declines sharply in the more westerly subtropical and semi-humid forests becoming zero or nearly so in relatively dry Central Brazil. Careful exploration of the scattered semi-humid forests in this part of Brazil will probably reveal the existence of a few additional species.

The two remaining, much smaller gaps are also found in the distribution



Map II. Distribution of the genus *Welfia*. Map III. Distribution of the genus *Asterogyne*. Map IV. Distribution of the genus *Geonoma*.

of many other South American plants but their significance seems to have been generally overlooked in taxonomic revisions. If distributions are indicated by a rather crudely encircling all mapped records they tend to be obscured. Taking into account the artificial southward shifting which results from the dotting technique used, the gaps coincide with the llanos of the Orinoco in Venezuela and the savanna-complex at the boundary of Brazil and the Guianas. Both territories are known to be almost un-forested, herbaceous formations (cf. HUECK, 1966). Here, apparently, the *Geonomeae* are unable to thrive.

From this distribution, strictly dependent on the occurrence of dense, wet forests, preferably tropical and montane rainforests, it becomes obvious that most representatives of the *Geonomeae* require wet and very shady habitats. The conclusion is confirmed by ecological data on labels. The need for moisture by *Geonoma* species is seen also by comparing of the distribution map with a map showing the mean annual precipitation (STONE, 1945). No species are found in regions with an annual precipitation below 1000 mm, few species in regions with an annual precipitation of 1000–2000 mm, whereas areas with a distinct concentration of species usually have a mean annual precipitation of 2000–5000 mm. This information, of course, is very approximate, yet there is a remarkable correlation.

A few *Geonoma* species are adapted to the extreme conditions of the high Andean grass-steppes at an altitude of about 3000 m where erect shrubs are rare. These species, in the absence of the dense forest shade at these heights, show marked xerophytic specialization. *Welfia* and *Calyptronoma*, too, occur in more exposed habitats in what seems to be the original environment for these plants. The high Andean *Geonoma* species, on the contrary, colonize the open habitat by secondary specializations superposed on those specializations needed for life in the understory of dense rainforests. Judging from its numerous species *Geonoma* is a very successful genus. Closely related species occupy similar or comparable and adjacent areas. Hence they are considered to have evolved rather recently and rapidly, probably facilitated by the colonization of a new ecological niche.

The vertical range of the tribe extends from sea-level to about 3000 m; in individual species the range is frequently restricted to about 400 m, but reaches sometimes 1000 m and more. Species are equally numerous in the forests from sea-level up to about 2700 m whereas at higher altitudes only a few specialized, closely related species occur.

Uses

Leaves are put to considerable use by natives for thatching their houses. To procure sufficiently large amounts only the leaves of species that form dense stands can be used. Otherwise the leaves of all species seem to be equally servicable. If dry and warm, the leaves curl and the roofs become thick and airy, thus providing a good protection against the sun's heat. If only slightly moist, the leaves straighten out again, making the roof

absolutely waterproof. If good, mature leaves are used, the roofs will remain in a good condition for more than 10 years. Young leaves of a few tall species (e.g. *Geonoma edulis*) are eaten as palm-cabbage.

The lower part of the cane with radiating rootbases is sometimes used as a whipper by natives (palma molinillo). The canes are reported to be suitable for fabrication of walking-sticks although this is probably incorrect as they tend to split very readily.

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TAXONOMY

Tribus **GEONOMEAE** (Hook. fil.) Drude, in Martius, Flora Bras. 3 (2): 275. 1881.

Basionym: *Palmae*—subtribus *Geonomeae* Hook. fil. in Bentham & Hooker, Genera Plantarum 3(2): 872, 877–878, 913–915. 1883.

Type genus: *Geonoma* Willd.

Medium-sized or more commonly by reduction small arundinaceous to “acaulescent”, unarmed, solitary or clustered palms. Stem smooth, usually distinctly ringed and in smaller species without distinct secondary thickening. Leaves in seedlings simple, bifid at apex, becoming sometimes regularly paripinnate in adult plants, but more usually the juvenile leaf type is more or less persistent which results in adult plants with simple or irregularly pinnate laminas with at least the apical and basal segments broader; pinnae reduplicate; petiole grooved above, semi-cylindrical below; sheath at first tubular, becoming open by breakdown and erosion of the ventral tissues.

Inflorescences at anthesis interfoliar, with (1–)2(–3) enlarged basal bracts persistent or sometimes deciduous at anthesis, with flowers of both sexes, protrandrous; flower-bearing axes with deep pits covered by a modified bract, in these pits 2 male flowers and 1 female flower subtended by successively smaller bracts forming a condensed bostryx. Flowers with 3 imbricate, progressively smaller, carinate sepals that are free except at their very base and with 3, basally united, apically valvate petals. Male flowers with (3)6(–42) stamens, the filaments basally adnate to the petals and receptacle forming a solid stipe, then connate into a tube, terminally excurrent into free lobes, anthers at anthesis deflexed: the part that is lowermost in bud becoming uppermost at anthesis; a small 3-celled pistillode is present at the bottom of the filamental tube at the end of the receptacle. Female flowers with anantherous staminodes united into a truncate to crenulate or digitately lobed tube; ovary 3-celled or reduced and 1-celled, style central or by reduction of 2 cells basifixed with 3 recurved papillose style branches, each cell with 1 anatropous ovule of which only 1 matures. Fruit 1-seeded, drupe-like with at the base remains of the style and 2 aborted carpels; exocarp thin; mesocarp more or less fleshy to rather dry and more or less fibrous; endocarp crustaceous. Seed encircled by a sharply contrasting raphe from the hilum to the basal embryo, endosperm homogeneous with radiately arranged, large endosperm cells, embryo straight with a small, curved, basal plumule.

Key to the genera of *Geonomeae*:

1* The bracts covering flowerpits immersed, later recurved

- and rolled back; female flowers at anthesis with a 3-celled pistil with a central style; fruits with fibrous mesocarp.
- 2" Male flowers with 6 stamens, the anthers with united thecae; fruit rounded at apex; mesocarpic fibres anastomosing I *Calypstrogyne* (62)
- 2' Male flowers with 6-42 stamens, if only 6 the thecae free on a bifurcate connective; fruit keeled at apex (when dry); mesocarpic fibres longitudinal, apically fused.
- 3" Relatively large palms with regularly pinnate leaves; male flowers with about 40 stamens, anthers with united thecae; in dry fruits mesocarpic fibres not prominent outside. II *Welfia* (76)
- 3' Small undergrowth palms with simple to irregularly divided leaves; male flowers with 6-24 stamens, anthers with free thecae on a bifurcate connective; in dry fruits mesocarpic fibres prominent outside. III *Asterogyne* (79)
- 1' The bracts covering flowerpits elevated, later incised and each lateral part pushed aside; female flowers at anthesis with a 1-celled pistil with a basifixed style; mesocarp of the fruit almost without distinct fibres . IV *Geonoma* (82)

I CALYPTROGYNE

Calypstrogyne H. Wendland, Bot. Zeit. 17: 72. 1859; Hook. fil. in Bentham & Hooker, Gen. Pl. 3(2): 914. 1883; Beccari, Pom. Col. J. 2: 356. 1912; Burret, Bot. Jahrb. 63: 131. 1930; León, Contrib. Ocasión. Mus. Hist. Nat. Col. "de la Salle" 3: 1. 1944. *Calyptronoma* Grisebach, Flora Brit. W. Ind. 518. 1864; Bailey, Gent. Herb. 4: 156. 1938.

Pholidostachys Hook. fil. in Bentham & Hooker, Gen. Pl. 3(2): 915. 1883; Burret, Bot. Jahrb. 63: 129. 1930.

Cocops Cook, Bull. Torr. Bot. Cl. 28: 568, t 47 f 2. 1901.

Type species: *Calypstrogyne ghiesbreghtiana* (Linden & H. Wendland) H. Wendland.

Small "acaulescent" to relatively tall palms with simple to regularly pinnate leaves.

Inflorescences spicate to twice branched with 2 enlarged bracts, the basal one persistent, the second one persistent or deciduous; bracts covering the flowerpits immersed. Male flowers with 6 stamens; anthers sagittate, dorsifixed with united thecae. Female flowers with a 3-celled pistil; staminodial tube digitately lobed. Fruit rounded at apex; the mesocarp fleshy with unequal, anastomosing fibres.

11 species belonging to 3 subgenera in the Greater Antilles, Central America, and north-western South America (map I).

Key to the subgenera of *Calypstrogyne*:

- 1 a Rather tall palms with regularly pinnate leaves, all segments with only 1 primary vein (costa), lamina rather thick; Greater Antilles I A *Calyptronoma*

- b Small to rather tall palms with more or less irregularly pinnate or even simple leaves, at least part of the segments with more than 1 primary vein, lamina rather thin; Central & South America 2
- 2 a Small, often "acaulescent" palms; inflorescences spicate with a very long peduncle, second bract inserted just below the spike and caducous; petals of female flowers forming a cap caducous at anthesis; Central America I B *Calypptogyne*
- b Rather tall, caulescent palms; inflorescences branched or if spicate with a short peduncle, second bract inserted below the mouth of the basal bract, both bracts persistent for some time; petals of female flowers valvate, soon becoming fibrous but not caducous I C *Pholidostachys*

Subgenus A **CALYPTRONOMA** (Grisebach) W. Boer, nov. stat.

Basionym: *Calyptronoma* Grisebach, Flora Brit. W. Ind. 518. 1864, as genus.
Type species: *Calypptogyne occidentalis* (Swartz) Gomez Maza.

Rather tall palms with regularly pinnate leaves, lamina anatomically with a well-developed hypodermis below each surface, mesophyll with an indistinct palisade layer and numerous fibres.

Inflorescences once or twice branched, basal bract chartaceous to coriaceous, persistent, second bract membranaceous and decaying with age, inserted below the mouth of the basal one. Female flowers with adherent, not separating petals forming a circumscissile cap caducous at anthesis.

3 species in the Greater Antilles.

Key to the species of *Calypptogyne* subgenus *Calyptronoma*: (the present separations are more or less tentative as the material available was insufficient to reach any definite conclusions)

- 1 a Lips of the flowerpits about as long as the mouth; rachillas about 3 dm long; fruit 10-17 mm long; Jamaica I A, 1. *C. occidentalis*
- b Lips of the flowerpits distinctly shorter than the mouth; rachillas less than 2½ dm long; fruit up to 12 mm long; Greater Antilles except for Jamaica 2
- 2 a Lower lateral branches with 5-8 rachillas usually not longer than 22 cm; fruit subglobose, 8-12 mm long. I A, 2. *C. dulcis*
- b Lower lateral branches with no more than 2-5 rachillas usually slightly shorter than 2½ dm; fruit compressed, 5-6 mm long I A, 3. *C. rivalis*

I A, 1 *Calypptogyne occidentalis* (Swartz) Gomez Maza, Noc. Bot. Sist. 50. 1893 (p.p.); Burret, Bot. Jahrb. 63: 140. 1930 (p.p.); León, Contrib. Ocasión. Mus. Hist. Nat. Col. "de la Salle" 3: 3. 1944.

Basionym: *Elaeis occidentalis* Swartz, Flora Ind. Occ. 1: 619. 1797.

Homotypic synonyms: *Calyptronoma occidentalis* (Swartz) H. E. Moore, Gent. Herb. 9: 252. 1963.

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Calyptrogyne swartzii (Grisebach & H. Wendland) Beccari, Pom. Col. J. 2: 356. 1912 (p.p.).

Type collection: Swartz s.n., Jamaica (not seen).

Heterotypic synonym: *Calyptrogyne victorinii* León, Contrib. Ocasión. Mus. Hist. Nat. Col. "de la Salle" 3: 4, t 1 f 1. 1944.

Type collection: Victorin 20067, Jamaica (not seen).

Solitary, stem up to about 12 m tall and 2 dm in diameter; leafscars becoming obscure; petiole inclusive of sheath 6-8 dm long; rachis 17-22 dm long; lamina with 30-40 pairs of linear pinnae at regular intervals, in the middle 6-10 dm long and 4-6 cm wide; the costa prominent both above and below, more or less densely paleaceous below, 3-5 pairs of unequally strong secondary veins in each segment, inconspicuous above, more or less prominent below.

Inflorescences once branched or the rachillas 2-3 -furcate at base; basal bract flattened, about 4 dm long, chartaceous, the second tubular, about 4 dm long, inserted about $1\frac{1}{2}$ dm above the basal one; peduncle about 5 dm long, compressed, rachis about 1 dm long, with about 20 rachillas simple or 2-3 on a short foot, rachillas about 3 dm long and 7 mm in diameter; inflorescence at first densely covered with a creamy bloom that soon disappears after exposure; flowerpits in 6-8 vertical series, 3-4 mm above each other; lip about as long as the mouth of the flowerpit, strongly rolled back in dry inflorescences. Male flowers about 6 mm long, female flowers much shorter, except for the slender style completely hidden in the pits at anthesis. Fruit ovoid, variable in size, 10-17 mm long and 7-10 mm in diameter, somewhat flattened and 2-edged; seed ovoid, up to 11 mm long.

Only known from Jamaica, occurring both in swamps and in the hills and mountains of the interior, up to an altitude of about 800 m (map I, 1).

Jamaica: Britton 537 (F, US); Fredholm 3254 (US); Harris 9842 (C, F, US); Jenman s.n. (K); Maxon 2327 (US); Underwood 3415 (F); Wessels Boer 1662 (U).

Calyptrogyne occidentalis (often under the name *C. swartzii*) has been the subject of much discussion and speculation in literature. However, by the successive publications of BECCARI (1912), BURRET (1930), BAILEY (1938), and LEÓN (1944), its position gradually became clearer. Beccari and Burret considered it the only West Indian *Calyptrogyne* species occurring on all the Greater Antilles. Bailey collected and studied specimens from the different islands which resulted in the separation of 4 species; one for each island in accordance with Bailey's ideas about distribution and evolution of island populations. León accepted these results but augmented the number of species to 4 for Cuba and 2 for Jamaica, only on the basis of slight differences in size and shape of the fruits.

A study of material available in conjunction with literature makes possible the separation of 3 species: *C. occidentalis* from Jamaica, *C. dulcis* from Cuba and Hispaniola, and *C. rivalis* from Puerto Rico and Hispaniola. *C. occidentalis* is easily recognized by the lips being about as large as the mouth of the flowerpit, further by the hardly doubly branched inflorescence and the relatively large fruits, notably in the extremes. León's separation of the Jamaican population into 2 species is not followed, as it is not supported by Bailey's observations in the field nor by a study of the cited specimens. Plants growing in the swamps tend to be more vigorous than plants from the mountains in the interior. This alone does not warrant a specific separation, even though the Jamaican population is heterogeneous.

Geonoma plumeriana, established by Martius on drawings and notes of Plumier, is sometimes referred to *C. occidentalis* or, as it came from Santo Domingo, to one of the other species in the present circumscription. However, the statement as to its cespitose habit excludes it from *Calyptronoma*. Confusion by Plumier with *Euterpe*, for instance, seems possible. Since it is impossible to elucidate the problem, *Geonoma plumeriana* is not treated further but omitted as a doubtful species.

1 A, 2 *Calyptrogyne dulcis* (Wright ex Grisebach) Gomez Maza, Dicc. Bot. 72. 1889; León, Contrib. Ocasión. Mus. Hist. Nat. Col. "de la Salle" 3: 7, pl. 1 f 3a, 2 f 1. 1944.

Basionym: *Geonoma dulcis* Wright ex Grisebach, Cat. Pl. Cub. 222. 1866.

Homotypic synonym: *Calyptronoma dulcis* (Wright ex Grisebach) Bailey, Gent. Herb. 4: 168. 1938.

Type collection: Wright 265 (a. 1865), Cuba near Hanabana (GOET holotype). Heterotypic synonyms: *Geonoma intermedia* Grisebach & H. Wendland in Sauvalle, Flora Cub. 153. 1873.

Calyptronoma intermedia (Grisebach & H. Wendland) H. Wendland in Kerch., Palm. 238. 1878.

Calyptrogyne intermedia (Grisebach & H. Wendland) Gomez Maza, Noc. Bot. Sist. 50. 1893; León, Contrib. Ocasión. Mus. Hist. Nat. Col. "de la Salle" 3: 8, pl 1 f 3b, 2 f 2. 1944.

Type collection: Wright 3972, Cuba, Sierras del Rangel (GOET holotype, F, P, US).

Calyptrogyne clementis León, Contrib. Ocasión. Mus. Hist. Nat. Col. "de la Salle" 3: 11, pl 1 f 2, 3c, 2 f 4. 1944.

Calyptronoma clementis (León) A. D. Hawkes, Phytologia 3: 145. 1949.

Type collection: Clement (León 17964), Cuba, Oriente (NY).

Calyptrogyne microcarpa León, Contrib. Ocasión. Mus. Hist. Nat. Col. "de la Salle" 3: 10, pl 1 f 3d, 2 f 3. 1944.

Calyptronoma microcarpa (León) A. D. Hawkes, Phytologia 3: 145. 1949.

Type collection: León 18574, Cuba, Trinidad Mountains (NY).

Solitary, stem up to about 8–10 m tall and 2 dm in diameter; leafsheath about 3 dm long; petiole about 5 dm in length; rachis about $2\frac{1}{2}$ m long; lamina with up to about 70 pairs of linear pinnae at regular intervals,

in the middle 7–9 dm long and 3–4 cm wide; the costa prominent both above and below, brown paleaceous below, 2–4 pairs of unequally strong secondary veins in each segment, inconspicuous above and prominent below.

Inflorescences doubly branched, basal bract flattened, coriaceous, up to 4 dm long and 8 cm wide, second bract 5–9 dm long, inserted 1–2 dm above the basal, soon disappearing, leaving only a collar-like remnant; peduncle 5–7 dm long; rachis 4–5 dm long with 30–50 lateral branches, the lower ones branching again into 2–8 rachillas, the uppermost simple, rachillas $\frac{1}{2}$ – $2\frac{1}{2}$ dm long and about 4 mm in diameter; flowerpits arranged in 6 vertical series, 5–7 mm above each other; the lip distinctly shorter than the mouth, more or less rolled back. Male flowers about 6 mm long, female flowers shorter. Fruit obovoid to subglobose, 8–12 mm long and 5–7 mm in diameter, more or less narrowed and flattened at base, rounded at apex; seed up to 6 mm long and $4\frac{1}{2}$ mm in diameter.

Known from Cuba, Isle of Pines, and Hispaniola, in wet forests, swamps, along streams, and in moist ravines of the mountains (map I, 2).

Cuba: Baker & Dinmoch 4882 (F, US); Britton & Britton 5018 (F, US); Dahlgren 51 (F), 47–066 (F); Dahlgren & León 47–026 (F); van Hermann 767A (F, P); Horne 3050 (US); Jack 7580 (US), 7849 (F, US); Killip 13526 (US); León 17964 (NY), 18574 (NY); Maxon 4464 (US); Palmer & Riley 529 (US); Shafer 317 (F); Wright 265 (GOET), 1466 (F, G, P), 3972 (F, GOET, P, US).

Isla de Pinos: Blaim 170 (F); Britton, Britton & Wilson 14761 (F, US); Curtis 485 (F, G, L, LE, M, P, US).

Hispaniola: Abbot 406 (US); Ekman H15685 (US).

Beccari and Burret considered the Cuban material identical with the Jamaican material and consequently *C. dulcis* synonymous with *C. occidentalis*. There is a striking resemblance indeed. A more precise examination, however, demonstrates the existence of several differences. Inflorescences of *C. dulcis* have a longer rachis with more lateral branches; the ramification is almost simple in *C. occidentalis* whereas the lateral branches have up to 8 rachillas in *C. dulcis*. The latter is also distinguished by the relatively short, slender rachillas, the small lips of the flowerpits, and the size of the fruit. An interesting difference was found in their pollen morphology. *C. dulcis* shows an inordinate arrangement of the perforations of the tectum; *C. occidentalis* has a vermiculate ornamentation. This last-mentioned difference can hardly be expected to occur within a single species. For these reasons the separation seems justified, as was done by Bailey and León. A further separation of the Cuban population into 4 species, as proposed by León, seems impossible. The material at my disposal is rather uniform and without appreciable differences. Even León's descriptions suggest a phenotypical variation rather than distinct species. Hence the 4 species are united here. Furthermore some Hispaniolan specimens are attributed to *C. dulcis* in accordance with Bailey's identification (*in schedula*).

I A, 3 *Calyptrogyne rivalis* (O. F. Cook) León, Contrib. Ocasión. Mus. Hist. Nat. Col. "de la Salle" 3: 12. 1944.

Basionym: *Cocops rivalis* O. F. Cook, Bull. Torr. Bot. Cl. 28: 568, t 47 f 2. 1901.

Homotypic synonym: *Calyptronoma rivalis* (O. F. Cook) Bailey, Gent. Herb. 4: 171. 1938.

Type collection: Cook s.n., Puerto Rico (not seen).

Heterotypic synonyms: *Calyptronoma quisqueyana* Bailey, Gent. Herb. 4: 169, f 86, 89, 92, 94. 1938.

Calyptrogyne quisqueyana (Bailey) León, Contrib. Ocasión. Mus. Hist. Nat. Col. "de la Salle" 3: 12. 1944.

Type collection: Bailey 229, Hispaniola, Haiti (BH holotype).

Solitary, stem up to about 10 m tall and 3 dm in diameter; leaves up to about 3 m long, lamina with linear pinnae at regular intervals, in the middle up to about 1 m long and 5–8 cm wide; the costa prominulent above, prominent and paleaceous below, usually 3 pairs of unequal secondary veins in each segment, slightly immersed above and prominent below.

Inflorescences doubly branched; basal bract flattened, 3–4 dm long, about 1 dm wide, coriaceous, second bract inserted about 2 dm above the basal, soon decaying, leaving only a collar-like remnant; peduncle 6 dm long, almost terete, rachis with short lateral branches each with 3–5 rachillas, in the upper part with simple rachillas, rachillas less than $2\frac{1}{2}$ dm long and 5 mm in diameter; flowerpits arranged in 6 vertical series, 4–6 mm above each other; lip distinctly shorter than the mouth. Fruit small, 5–6 mm long and about 4 mm in diameter when mature; seed about 4 mm long and less than 3 mm in diameter.

In Hispaniola and Puerto Rico locally frequent in wet places and along streams (map I, 3).

Hispaniola: Bailey 229 (BH), 229a (BH); Ekman H5498 (US).

Puerto Rico: Britton & Hess 2785 (F).

C. rivalis is distinguished from *C. occidentalis* by the smaller lips of the flowerpits, the more slender rachillas, and the smaller fruits; from *C. dulcis* by the less branched inflorescence, the longer rachillas more densely beset with flowerpits, and also by the smaller fruits. Except in the extremely small fruit, the species is intermediate between *C. occidentalis* and *C. dulcis*. Neither the studied specimens nor the descriptions reveal appreciable differences between *C. rivalis* and *C. quisqueyana* which are consequently united here.

Although the material studied is fragmentary the fruit character, in combination with the other slight differences, appear to be sufficient to maintain *C. rivalis* as a separate species. However, further study is needed in this subgenus.

Subgenus B **CALYPTROGYNE**

Type species: *Calyptrogyne ghiesbreghtiana* (Linden & H. Wendland) H. Wendland.

Small palms, "acaulescent" or with a cane-like stem; leaves simple to irregularly divided, lamina anatomically without hypodermis or incompletely developed, mesophyll cells transversely extended, no palisade layer, and with few fibres.

Inflorescences spicate; second bract inserted at the end of the peduncle far above the mouth of the basal bract, caducous at anthesis, leaving a characteristic scar just below the spike. Female flowers with coherent, not separating petals forming a circumscissile cap caducous at anthesis.

5 species in Central America.

Key to the species of *Calyptrogyne* subgenus *Calyptrogyne*:

- 1 a Part of inflorescence above scar of second bract
densely brown furfuraceous 2
- b Part of inflorescence above scar of second bract
glabrous 3
- 2 a Second bract membranaceous, finely striate when
dry; flowerpits about 2–3 mm apart in the spike I B, 4. *C. trichostachys*
- b Second bract coriaceous, smooth (when dry);
flowerpits densely congested, less than 1 mm apart
in the spike I B, 5. *C. condensata*
- 3 a Leaf rachis less than 4 dm long, leaf segments
strongly contracted at base; flowerpits arranged in
about 5 series; usually growing above 700 m alt. I B, 6. *C. brachystachys*
- b Leaf rachis more than 7 dm long, leaf segments not
narrowed at base; flowerpits arranged in 7 or more
series, not growing above 700 m alt. 4
- 4 a Lamina with numerous, very inconspicuous but
clearly visible cross-veinlets; lower lips of the
flowerpits longer than broad; fruit about 1 cm long,
brownish-green when dry I B, 7. *C. sarapiquensis*
- b Lamina without visible cross-veinlets; lower lips
of the flowerpits broader than long; fruit about
1½ cm long, blackish when dry I B, 8. *C. ghiesbreghtiana*

I B, 4 *Calyptrogyne trichostachys* Burret, Bot. Jahrb. 63: 135. 1930.

Type collection: Koschny s.n., Costa Rica, San Carlos (not seen, destroyed at B).

Stem very short; leafsheath about 1 dm long, fibrous; petiole about 2½ dm long; rachis 5–7 dm long; sheath, petiole, and rachis deciduously brown lepidote; lamina irregularly pinnate, 7–10 dm long, about 5 dm wide, broad segments intermixed with linear ones; 28–31 pairs of primary veins prominent above and below, secondary veins immersed above, prominent and greyish-lepidote below, tertiary veins unequal, a rather strong one on each side of the secondary veins, veins emerging at 35–40° from the rachis.

Inflorescence 10–14 dm long, the basal bract about 2 dm long, the

deciduous second bract 3–4 dm long, membranaceous, finely striate when dry; the spike densely brown furfuraceous, about 3 dm long and 8 mm in diameter; flowerpits spirally arranged, 2–3 mm apart; the lower lip becoming emarginate. Flowers not seen. Fruit ovoid, 10 mm long, 6 mm in diameter; seed 6 mm long, 4 mm in diameter.

Only recorded from the vicinity of San Carlos in Costa Rica (map I, 4).
Costa Rica: Cook & Doyle 43 (US), 53 (US).

C. trichostachys is distinguished from *C. condensata*, the other species with a furfuraceous spike, by the membranaceous, slightly striate, second bract and the rather loose arrangement of the flowerpits. The type was lost during the war but there is no doubt about this species, since the Cook & Doyle specimens agree exactly with the description and are also from the same area. Pittier 16719, provisionally attributed by Burret to this species, is referred more satisfactorily to *C. condensata*.

I B, 5 *Calypstrogyne condensata* (Bailey) W. Boer nov. comb.

Basionym: *Geonoma condensata* Bailey, Gent. Herb. 6: 209, f 106. 1943.

Type collection: von Wedel 2972, Panama, Bocas del Toro (BH holotype).

Plant up to about 1½ m tall; leafsheath about 2 dm long; petiole up to about 3 dm in length; rachis up to 9–10 dm long; lamina irregularly pinnate, up to 13 dm long and 6 dm wide, broad segments often intermixed with linear ones; about 30 pairs of primary veins prominent above and below, secondary veins impressed above, prominulent and greyish-lepidote below, tertiary veins unequal, a rather strong one on each side if the secondary veins, veins emerging at 30–40° from the rachis.

Inflorescence 8–15 dm long, the basal bract 1½–2½ dm long, the deciduous second bract 1½–2½ dm long, coriaceous, smooth and at first densely brown furfuraceous like the whole inflorescence, spike 8–20 cm long and 5–7 mm in diameter; flowerpits spirally arranged and extremely close to each other; lower lip rolled back and entire. Flowers about 5 mm long. Fruit ovoid, 12 mm long and 7 mm in diameter.

Known from Costa Rica and western Panama, at low altitudes (map I, 5).

Costa Rica: Pittier 16719 (US).

Panama: Dunlap 117½ (F); Hart s.n. (K); Stork 117½ (US); von Wedel 2972 (BH).

C. condensata resembles *C. trichostachys* in the brown furfuraceous spike but is at once distinguished by the thicker, smooth second bracts and especially by the congested flowerpits with their never emarginate lower lips. Bailey's illustration, showing the characteristic scar of the second bract just below the spike, demonstrates already by itself that *G. condensata* does not belong to *Geonoma*.

I B, 6 *Calypstrogyne brachystachys* H. Wendland ex Burret, Bot. Jahrb. 63: 132. 1930; Dahlgren, Field Mus. Bot. 14: pl 85. 1959.

Type collection: Wendland 45, Costa Rica, Sarapiquí (not seen).

Heterotypic synonym: *Geonoma allenii* Bailey, Gent. Herb. 6: 204, f 104. 1943.

Type collection: Allen 2947, Panama, Coclé (BH holotype).

Short stem present, 3–6 dm long; leafsheath 2–3 dm long; petiole $1\frac{1}{2}$ –2 dm in length; rachis 2–3 dm in length; sheath, petiole, and rachis dark reddish-brown lepidote; lamina irregularly pinnate, 3–5 dm long and about $2\frac{1}{2}$ dm wide, usually with 3–5 broad segments narrowed at base, the lamina rounded at base; about 20 pairs of primary veins prominent above and very prominent below, secondary veins impressed above, slightly prominent and reddish-brown lepidote below, tertiary veins unequal, a rather strong one on each side of the secondary veins, veins emerging at about 40° from the rachis.

Inflorescence 9–13 dm long; the basal bract $2\frac{1}{2}$ – $3\frac{1}{2}$ dm long, the deciduous second bract 2–4 dm long, membranaceous and finely striate when dry; spike glabrous, 2–3 dm long and 4–5 mm in diameter; flowerpits slightly spirally arranged in usually 5 series; the lower lip semicircular, often becoming emarginate. Flowers about 6 mm long. Fruit ovoid, 12 mm long and 8 mm in diameter; seed $8\frac{1}{2}$ mm long and $6\frac{1}{2}$ mm in diameter.

Costa Rica and the adjacent part of Panama, in moist forests at altitudes of 700–2200 m (map I, 6).

Costa Rica: Brenz 3563 (F), 3796 (F), 4962 (F), 13470 (F), 15666 (F), 20464 (F); León 144 (F); Standley 39909 (US), 39916 (US); Standley & Valerio 44775 (US), 44840 (US), 45986 (US), 46277 (US), 46336 (US); Valerio 1593 (F).

Panama: Allen 2947 (BH).

C. brachystachys is characterized by the reddish-brown lepidote petiole and rachis, the short rachis, the rounded base of the lamina, and the rather slender, glabrous spike with about 5 series of flowerpits. Moreover, it seems to be the only species of this subgenus occurring above 700 m altitude.

The type is no longer extant but a photograph is available, and several Standley & Valerio collections were named by Burret. Hence there is no doubt about the identity of this species. *Geonoma allenii* cannot be separated. Bailey's illustration with the characteristic scar of the second bract excludes it from *Geonoma*.

I B, 7 *Calypstrogyne sarapiquensis* H. Wendland ex Burret, Bot. Jahrb. 63: 134. 1930.

Type collection: Wendland s.n., Costa Rica, Rio Sarapiquí (not seen).

"Acaulescent" or with a short stem, up to 1 m long; leafsheath 2–3 dm long; petiole $\frac{1}{2}$ –2 dm in length; rachis 8–10 dm long; lamina irregularly

pinnate, 10–13 dm long and 4–6 dm wide, long cuneate at base, divided into a few broad segments or into several, partly linear and 1-veined segments; about 30 pairs of primary veins prominent above and to a lesser degree below, secondary veins immersed above, prominent below, tertiary veins unequal, partly prominulent, numerous very inconspicuous but clearly visible cross-veinlets present, veins emerging at about 30° from the rachis.

Inflorescence 13–15 dm long; the basal bract about 3½ dm long, the deciduous second bract about 2½ dm long, membranaceous and finely striate when dry; spike glabrous, about 2½ dm long and 6 mm in diameter; flowerpits somewhat spirally arranged in usually 7 series; the lower lip oblong, entire. Flowers not seen. Fruit ovoid, brownish-green when dry, 11 mm long and 7½ mm in diameter; seed about 7 mm long and 5 mm in diameter.

Only known from the northern coastal plain of Costa Rica at altitudes of up to about 100 m (map I, 7).

Costa Rica: Billee 7400 (BR, F, US); Loomis 1 (US); Standley 36745 (US); Standley & Valerio 48957 (US), 48979 (US); Stevens 571 (US).

C. sarapiquensis is characterized by the cross-veinlets of the leaves, the oblong lower lips of the flowerpits, and the size and colour of the fruits. Wendland compared this species with *C. glauca*. The latter is rather doubtful, being based on an apparently mixed collection. *C. glauca* is treated here as a synonym of *C. ghiesbreghtiana*.

I B, 8 *Calypstrogyne ghiesbreghtiana* (Linden & H. Wendland) H. Wendland, Bot. Zeit. 17: 72. 1859; Burret, Bot. Jahrb. 63: 133. 1930.

Basionym: *Geonoma ghiesbreghtiana* Linden & H. Wendland, Linnæa 28: 343. 1856.

Type collection: Ghiesbreght s.n., Mexico, Chiapas (not seen).

Heterotypic synonyms; *Geonoma glauca* Oersted, Vidensk. Meddel. Kjöeb. 1858: 35. 1859 (p.p.?).

Calypstrogyne glauca (Oersted) H. Wendland, Kerck. Palm. 238. 1878; Burret, Bot. Jahrb. 63: 134. 1930.

Type collection: Oersted 6565, Nicaragua, Río San Juan (C lectotype).

Geonoma spicigera Koch, Wochenschr. f. Gärtn. 244. 1858.

Calypstrogyne spicigera (Koch) H. Wendland, Bot. Zeit. 17: 72. 1859,

Type collection: Warscewicz s.n., Guatemala? (K?).

Geonoma donnell-smithii Dammer, Bot. Jahrb. 36, Beibl. 80: 32. 1905.

Calypstrogyne donnell-smithii (Dammer) Burret, Bot. Jahrb. 63: 133. 1930.

Type collection: Donnell Smith 1833, Guatemala, Río Dulce (not seen).

Geonoma costatifrons Bailey, Gent. Herb. 6: 206, f 105. 1943.

Type collection: Fairchild & Jobbins 2639, Panama, C.Z. (BH).

“Acaulescent” or with a short stem up to about 1 m long; leafsheath 2–3 dm long; petiole about 3–4 dm in length; rachis 6–8 dm long; lamina irregularly pinnate, 8–11 dm long and 2–3 dm wide, cuneate at base,

broad segments intermixed with linear 1-veined ones; 20-30 pairs of primary veins prominent above and below, secondary veins immersed above, prominent below, tertiary veins unequal, a rather strong one on each side of the secondary veins, veins emerging at about 30° from the rachis.

Inflorescences about 1½ m long; the basal bract 4-7 dm long, the deciduous second bract 3-4½ dm long, membranaceous and finely striate when dry; spike glabrous, 2½-4 dm long and 6-11 mm in diameter; flowerpits spirally arranged in 7-11 series; the lower lip rounded, broader than long, entire. Flowers 4-5 mm long. Fruit obovoid, blackish when dry, 15 mm long, 8 mm in diameter, seed 9 mm long and 7 mm in diameter.

Central America from Mexico (Chiapas) to Panama, in dense forests at lower altitudes, from sea-level to about 650 m (map I, 8).

Mexico: Doyle & Collins 235 (US).

Guatemala: Cook & Griggs 749 (US); Johnson 1735 (US); Kellerman 7165 (F); Steyermark 39177 (F), 39195 (F), 39784 (F), 41639 (F); Standley 25105 (US), 73031 (F), 73164 (F); Warscewicz? s.n. (K).

British Honduras: Stevenson 7 (F).

Honduras: Bangham 217 (F); Standley 52653 (F, US), 56849 (F); Williams & Molina 13078 (F); Yuncker 4565 (F).

Nicaragua: Oersted 6565 (C).

Panama: Allen 3435 (BH, BR, G, P); Fairchild & Jobbins 2639 (BH); King 5251 (UC, US); Pittier 4305 (US); Seibert 1531 (US).

C. ghiesbreghtiana is rather close to *C. sarapiquensis*. It is distinguished by its somewhat larger dimensions, the absence of cross-veinlets, the shorter lips of the flowerpits, and the larger fruits. Unfortunately the type, leg. Ghiesbreght, could not be found. A newer collection, Doyle & Collins 235, also originating from the state of Chiapas, Mexico, matches the description very well. Hence it is regarded as representing this species. The Mexican specimen cannot be separated from material from Guatemala to Panama. Specimens from Guatemala and adjacent Honduras are usually referred to *C. donnell-smithii* which is definitely conspecific with *C. ghiesbreghtiana*. A specimen at K, sent by Wendland under the name *C. spicigera* and said to come from Guatemala, was probably collected by Warscewicz and is supposed to be an isotype of *Geonoma spicigera*. This specimen, too, is conspecific with *C. ghiesbreghtiana*. Wendland treated *C. spicigera* as a synonym of *C. glauca* based on *Geonoma glauca*. The latter, however, is a questionable species, described in a little detailed and indistinctive way. Macbride's photograph of the supposed type, Oersted 6567, represents *Geonoma cuneata*. Oersted 6565, also present at C, really represents *Calypstrogyne*. An indication that it is the type of *C. glauca* is wanting but this seems likely. It consists of material belonging to *C. ghiesbreghtiana* intermixed with inflorescences of *C. sarapiquensis*. I choose this material in C, exclusive of the last-mentioned inflorescences, as the lectotype, and *C. glauca* becomes a synonym of *C. ghiesbreghtiana*.

Several of Wendland's remarks on *C. glauca* suggest that part of the material was in fact *C. sarapiquensis*, a consequence of the mixed Oersted collection.

Geonoma costatifrons from Panama is a Calyptrogyne, as shown by the position of the second bract, and also belongs to *C. ghiesbreghtiana*. It is most surprising that *C. ghiesbreghtiana*, known from Mexico to Panama, was never collected in Costa Rica whereas the other four species are only or mainly known from that country.

Subgenus C **PHOLIDOSTACHYS** (Hook. fil.) W. Boer, nov. stat.

Basionym: *Pholidostachys* Hook. fil. in Bentham & Hooker, Gen. Pl. 3(2): 915. 1883, as genus.

Type species: *Calyptrogyne pulchra* (H. Wendland ex Burret) Burret.

Rather tall palms with irregularly divided leaves; lamina anatomically without or with a poorly developed hypodermis, mesophyll cells transversally extended without palisade layer and only with a few fibres.

Inflorescences branched to spicate; 2 enlarged bracts persistent but becoming fibrous with age and finally disappearing, the second bract inserted below the mouth of the basal bract; the bracts covering the flowerpits extremely large. Petals of female flowers with distinctly valvate lobes not caducous at anthesis; style branches scarcely united except at base.

3 species in north-western South America and adjacent Central America.

Key to the species of *Calyptrogyne* subgenus *Pholidostachys*:

1. a. Inflorescence spicate I C, 9. *C. pulchra*
 b. Inflorescence branched 2
2. a. The rachis of the inflorescence up to about 5 cm long
 with less than 15 simple rachillas; lips of the flowerpits
 about 4 mm long and 3 mm wide; fruit subglobose,
 9–15 mm long I C, 10. *C. dactyloides*
 b. The rachis of the inflorescence usually more than
 1 dm long with more than 20, often partly bifurcate
 rachillas; lips of the flowerpits 1½–2 mm long and
 2–3 mm wide; fruit obovoid, 13–19 mm long . . . I C, 11. *C. synanthera*

I C, 9 *Calyptrogyne pulchra* (H. Wendland ex Burret) Burret nomen provis., Bot. Jahrb. 63: 129. 1930.

Basionym: *Pholidostachys pulchra* H. Wendland ex Burret, Bot. Jahrb. 63: 130. 1930; Standley, Field Mus. Bot. 18: 123. 1937.

Type collection: Wendland s.n., Costa Rica, Rio Sarapiquí (K).

Heterotypic synonym: ? *Pholidostachys kalbreyeri* H. Wendland ex Burret Bot. Jahrb. 63: 131. 1930.

Type collection: Kalbreyer 1881, Colombia, Antioquia, Ciénegas (not seen, destroyed at B).

Solitary, stem 2–3 (9) m tall, 3–5 cm in diameter, internodes up to 1 dm long; leafsheath about 2 dm long; fibrous at margin; petiole 5–6 dm in length; rachis $5\frac{1}{2}$ – $6\frac{1}{2}$ dm long; lamina irregularly pinnate, 6–10 pairs of long and narrow, subfalcate segments 4–6 dm long and $3\frac{1}{2}$ –7 cm wide, each with 4–6 primary veins prominent above, not at all elevated below, secondary veins immersed above, prominent below, veins emerging at 30–40° from the rachis.

Inflorescences spicate; enlarged bracts tubular, the basal 1– $1\frac{1}{2}$ dm long, the second $2\frac{1}{2}$ – $3\frac{1}{2}$ dm, inserted 3–4 cm higher than the basal; peduncle about $1\frac{1}{2}$ dm long with 5–7 suborbicular to somewhat acute bracts in the upper part, spike 4–5 dm long and 8 mm in diameter; flowerpits arranged in 10 vertical series, about 1 mm above each other; the lower lip semi-circular, 4 mm in diameter, recurved and rolled back, entire or irregularly crenate. Flowers not seen. Fruit red, blackish-brown when dry, obovoid, up to 28 mm long and 15 mm broad; seed oblong, up to 15 mm long and 9 mm in diameter.

Occurring in all probability from Costa Rica to Colombia, in wet forests at low altitudes (map I, 9).

Costa Rica: Standley & Valerio 48937 (F, US), 48956 (F, US); Wendland s.n. (K).

C. pulchra is readily recognized by the spicate, shortly pedunculate inflorescence and the very large fruits with strong fibres in the mesocarp. Notably on account of the last-named character a generic separation was proposed. A second species, *P. kalbreyeri*, was described on probably fragmentary material. The description is rather little detailed and does not demonstrate appreciable differences from *C. pulchra* except for the somewhat smaller dimensions. In the absence of other Colombian material the problem cannot be solved, but *P. kalbreyeri* is not maintained here as a separate species. Burret's combination *C. kalbreyeri* cannot be used, as this name is preoccupied.

I C, 10 **Calypstrogyne dactyloides** (H. E. Moore) W. Boer nov. comb.
Frontispiece

Basionym: *Pholidostachys dactyloides* H. E. Moore, J. Arn. Arb. 48: 148, f 3, 4. 1967.
Type collection: Cuatrecasas 15892, Colombia, El Valle (BH).

Solitary, stem up to about 4–5 (10) m tall and 9 cm in diameter, densely ringed; leafsheath about 4 dm long, fibrous, deciduously brown furfuraceous; petiole 4–6 dm long; rachis up to $1\frac{1}{2}$ m in length; lamina slightly irregularly pinnate with up to about 12 pairs of somewhat falcate, lanceolate segments up to 8 dm long and 1 dm wide, slightly narrowed at base, acuminate at apex; primary veins strongly prominent above, prominulent and brown sparsely lepidote below, secondary veins immersed above and prominent below, tertiary veins fine, veins emerging at 30–40° from the rachis.

Inflorescences once branched; enlarged bracts subcoriaceous, soon becoming fibrous, flattened, up to about 4 dm long and $1\frac{1}{2}$ dm wide; inserted at the base of the peduncle, second bract inserted about halfway; peduncle $1\frac{1}{2}$ – $3\frac{1}{2}$ dm long, in the upper part with 3–4 about $1\frac{1}{2}$ cm long, acute bracts; rachis short, less than $\frac{1}{2}$ dm long, rachillas 5–8, simple, $2\frac{1}{2}$ –4 dm long and 5–8 mm in diameter; flowerpits arranged in 8–10 vertical series, about 3 mm above each other; lower lip large, ovate, about 4 mm long and 3 mm wide, later rolled back and sometimes cleft; complete inflorescence shortly brown furfuraceous. Flowers about 5 mm long. Fruit ovoid to subglobose, 9–15 mm long and 6–12 mm in diameter; seed subglobose, 6–9 mm long and $5\frac{1}{2}$ –8 mm in diameter.

Known from the Pacific coastal area of Colombia near sea-level, in forests flooded by fresh water during the greater part of the year (map I, 10).

Colombia: Cook 133 (US), 150 (US), 165 (US); Cuatrecasas 15982 (BH); Schulz 486 (U).

C. dactyloides is easily distinguished from its closest relative, *C. synanthera*, by the very short rachis of the inflorescence, the larger lower lips of the flowerpits, and the usual small, more subglobose fruits. Its distribution and ecology are also different.

I C, 11 *Calypstrogyne synanthera* (Martius) Burret, Bot. Jahrb. 63: 137. 1930; Dahlgren, Field Mus. Bot. 14: pl 87. 1959; Macbride, Field Mus. Bot. 13: 334. 1960.

Basionym: *Geonoma synanthera* Martius, Hist. Nat. Palm. 2: 13, t 13. 1823. Homotypic synonym: *Calyptronoma synanthera* (Martius) Bailey, Gent. Herb. 4: 166. 1938.

Type collection: Ruiz & Pavon s.n., Peru, Chicoplaya (F, M holotype).

Heterotypic synonyms: *Calyptronoma robusta* Trail, J. Bot. 14: 330, t 183 f 3. 1876; Drude in Martius, Flora Bras. 3(2): 511. 1882.

Calypstrogyne robusta (Trail) Burret, Bot. Jahrb. 63: 137. 1930.

Type collection: Trail 961 / CLXXXVI, Brazil, Rio Javary (BM, K holotype, P).

Calypstrogyne kalbreyeri Burret, Bot. Jahrb. 63: 137. 1930.

Calyptronoma kalbreyeri (Burret) Bailey, Gent. Herb. 4: 166. 1938.

Type collection: Kalbreyer 1967, Colombia, Antioquia, Uranao (not seen, destroyed at B).

Calypstrogyne weberbaueri Burret, Bot. Jahrb. 63: 139. 1930.

Calyptronoma weberbaueri (Burret) Bailey, Gent. Herb. 4: 166. 1938.

Type collection: Weberbauer 1234, Peru, Puno, Chunchusmayo (not seen, destroyed at B).

Solitary, stem $3\frac{1}{2}$ –7 m tall and up to about 5 cm in diameter; leafsheath about 3 dm long, shortly dark brown furfuraceous; petiole 5–6 dm long; rachis 8–12 dm in length; lamina slightly irregularly pinnate with 5–10 pairs of rather porrect to slightly falcate segments up to 7 dm long and 1 dm wide, slightly narrowed at base, acuminate at apex; veins strongly prominent above, prominulent and paleaceous below, secondary veins

immersed above, prominent below, tertiary veins fine, veins emerging at 30–40° from the rachis.

Inflorescences once branched or sometimes the lower branches bi- or trifurcate; basal bract coriaceous, flattened, about 4 dm long and $\frac{1}{2}$ dm wide, second bract chartaceous, inserted about 1 dm higher than the basal; peduncle up to about 5 dm long, in the upper part with a few bracts, rachis $1\frac{1}{2}$ –5 dm long, with 20–30 and more rachillas 2–3 dm long and about 6 mm in diameter; flowerpits arranged in 8–10 vertical series, 3–4 mm above each other; lower lip semiorbicular, $1\frac{1}{2}$ –2 mm long and 2–3 mm wide, rolling back but not cleft; complete inflorescence creamy-brown furfuraceous. Flowers about 5 mm long. Fruit obovoid, 13–19 mm long and 8–10 mm in diameter; seed ovoid, 8–10 mm long and $4\frac{1}{2}$ – $5\frac{1}{2}$ mm in diameter.

Eastern part of the Andes from Colombia to Peru and the adjacent westernmost part of the Amazon basin, in the forests at altitudes of up to about 1500 m (map I, 11).

Colombia: Killip & Smith 15314 (US); Schultes 3879 (BH).

Peru: Klug 1495 (F, US); Macbride 5674 (F, US); Moore, Salazar & Smith 8343 (BH), 8383 (BH); Ruiz & Pavon s.n. (F, M).

Brazil: Trail 961 / CLXXXVI (BM, K, P).

C. synanthera is characterized by the long rachis of the inflorescence bearing numerous rachillas, the rather small lower lips of the flowerpits, and the large, obovoid fruits. *C. robusta* agrees with the type of *C. synanthera* and the other Peruvian collections very well; the fruit is, however, somewhat larger. Since fruit size proved to be variable in *Calyptrogyne* this feature seems to be insufficient to warrant specific separation. I also fail to understand the significance of Burret's observation that "the flowerpits are less crowded and that the vertical bract enclosed lines of the flowerpits are less marked".

C. kalbreyeri is known from the collection Killip & Smith 15314, a specimen identified by Burret himself. This specimen, however, cannot be distinguished from *C. synanthera* and consequently *C. kalbreyeri* is placed here in synonymy. According to the description *C. weberbaueri* differs only in its white-pruinose instead of brownish tomentose rachillas. In fact young inflorescences of *C. synanthera* have light-tinged creamy-furfuraceous rachillas. Since Burret studied older, fruiting rachillas, it seems not impossible that the tomentum was largely abraded, resulting in a white-pruinose appearance. The recorded brownish tomentose base of the inflorescence in particular makes this supposition highly probable. In consequence the species is not retained as a separate entity in the present treatment.

II WELFIA

Welfia H. Wendland, Regels Gartenflora 18: 242. 1869; Hook. fil. in Bentham & Hooker, Gen. Pl. 3: 915. 1883; Burret, Bot. Jahrb. 63: 125. 1930.

Type species: *Welfia regia* H. Wendland ex André.

Tall, solitary palms with a columnar stem; leaves regularly pinnate with linear, 1-veined pinnae at regular intervals along the rachis, lamina anatomically with a well-developed hypodermis below each surface, mesophyll with a distinct palisade-layer, fibres numerous, mostly united in strands.

Inflorescences once branched; 2 enlarged bracts coriaceous, deciduous; the bracts covering the flowerpits immersed. Male flowers with numerous (30–45) stamens, anthers linear-sagittate, dorsifixed, with united thecae. Female flowers with a 3-celled pistil, staminodes about 18, united in the lower part, the free lobes radiating at anthesis. Fruit horizontally compressed and apically keeled; mesocarp with numerous longitudinal fibres not prominent outside, anatomically the mesocarp with a continuous system of stone cells forming a network in cross-section; seed with a branched raphe (in *W. georgii* at least).

(Probably) 2 species in Central America and Colombia (map II).

Key to the species of *Welfia*:

- 1 a Flowerpits in a vertical series 4–6 mm above each other;
the Andes of eastern Colombia, above 650 m II, 1. *W. regia*
- b Flowerpits in a vertical series about 2 mm above each other;
Honduras to western Colombia, near sea-level II, 2. *W. georgii*

II, 1 *Welfia regia* H. Wendland ex André, Ill. Hort. 18: 93, t 62. 1871; Burret, Bot. Jahrb. 63: 128. 1930.

Type collection: Wallis s.n., Colombia, Cauca valley, 1200 m alt. (not seen).

Stem 15–20 m tall, about 1½ dm in diameter; coma with 20–30 leaves, these 5–7 m long, leaves with 40–60 pairs of pinnae; the habit reminding one of *Cocos nucifera*.

Inflorescences more than 1 m long, erect at anthesis, pendulous in fruit; peduncle very short, about 1 dm long, rachillas about 1 m in length (so far description compiled from literature), 3 cm in diameter, densely beset with flowerpits arranged in 8 vertical series, 4–6 mm above each other; lower lip recurved and rolled back, entire, rachillas deciduously brown tomentose. Flowers not seen. Fruit oblong-elliptical, brownish when dry, almost mature 34 mm long and 16 mm in diameter, more or less keeled at margin and apex, the stipitate base flattened and recurved, the apex obliquely pointed.

Eastern Colombia, mountain slopes above 650 m altitude (map II).
Colombia: Fassett 25210 (US).

W. regia is a very poorly known species. The differences between this species and *W. georgii* as stated by Burret are not very striking and seem to be of little diagnostic value. The fragmentary material now available is insufficient to establish more satisfactory specific differences. Nevertheless both species are kept separate because of their (supposed) ecological

differences. *W. regia* is said to occur not below 650 m altitude whereas *W. georgii* occurs near sea-level. It is expected that with sufficient material more morphological differences will turn up.

II, 2 *Welfia georgii* H. Wendland ex Burret, Bot. Jahrb. 63: 125. 1930; Dahlgren, Field Mus. Bot. 14: pl 410, 411. 1959; McCurrach, Palms of the World 266. 1960.

Type collection: Wendland 74, Costa Rica, Rio Sarapiquí (K).

Heterotypic synonym: ? *Welfia microcarpa* Burret, Bot. Jahrb. 63: 129. 1930.

Type collection: unknown collector s.n., Honduras, without precise locality (not seen, destroyed at B.).

Stem up to 20 m tall, 1–1½ dm in diameter; leafsheath 7–8 dm long, gradually narrowed into a 7–8 dm long petiole; rachis 4–5 m long with 50–90 pairs of pinnae, these linear lanceolate, more or less plicate, strongly narrowed and reduplicate at base, acuminate at apex, in the middle 10–12 dm long and 7–8 cm wide, gradually reduced towards base and apex, costa slightly impressed above, very prominent below, secondary veins several, not elevated above, prominent below.

Inflorescences with the basal bract 7 dm long, thick, woody coriaceous, sulcate, flattened, carinate and crenulate at margin, the second bract slightly shorter, chartaceous, both bracts inserted less than 3 cm apart at the base of the peduncle; peduncle about 1½ dm long and 5 cm in diameter, curved, in the upper part with a few bracts, 5 cm broad and 1½ cm long, rachis very short, with 7–9 pendulous rachillas 6–8 dm long and 2½ cm in diameter (fresh 3–3½ cm); flowerpits arranged in 8 vertical series, about 2 mm above each other; the lower lip very large. Male flowers up to 2 cm long, white, in striking contrast to the deep reddish inflorescence. Female flowers only seen in bud. Fruit oblong-elliptical, dark violet, brownish when dry, 3½–4½ cm long and almost 2 cm in diameter, slightly horizontally compressed, more or less keeled at margin and apex, the apex obliquely pointed; seed oblong, 2½ cm long and 12–14 mm in diameter.

Central America eastward from Honduras or Costa Rica) and in western Colombia, in forests near sea-level up to an altitude of about 100 m (map II).

Costa Rica: Cook & Doyle 636 (US); Wendland 74 (K).

Colombia: Cook 94 (US); Cuatrecasas 13967 (F), 16314 (F), 16932 (F), 17365 (F).

W. georgii was published by Burret from Wendland's manuscript. In the unusually long description the differences with *W. regia* do not become very clear. The two species, however, are said to occur at significantly different altitudes. Hence it does not seem justified to unite them without a study of adequate material which is lacking at present.

W. microcarpa, a species described from fruits from Honduras without further details, is not maintained as a separate entity. The mentioned difference in size seems to be of little value and does not allow a satis-

factory separation. As the type was lost and no type locality is known, it will be very difficult, if at all possible, to obtain more information about it.

III ASTEROGYNE

Asterogyne H. Wendland ex Hook. fil. in Bentham & Hooker, Gen. Pl. 3: 914. 1883; Burret, Bot. Jahrb. 63: 140. 1930.

Aristeiera H. E. Moore, J. Arn. Arb. 47: 3. 1966.

Type species: *Asterogyne martiana* (H. Wendland) H. Wendland ex Hemsley in Godman & Salvin.

Small palms with a cane-like stem; leaves usually simple, lamina anatomically only with an abaxial hypodermis, mesophyll without distinct palisade layer, cells somewhat transversely extended, fibres abundant, veins partly very slender.

Inflorescence spicate or once branched, with 2-3 tubular membranaceous bracts; the bracts covering the flowerpits immersed. Male flowers with 6-24 stamens, filaments tapering into a long slender point, the thecae free on a bifurcate connective rather versatile on the filament. Female flowers with a 3-celled pistil, staminodial tube digitately lobed. Fruit when dry apically keeled; mesocarpic fibres prominent outside, longitudinal and not anastomosing, mesocarp anatomically with a discontinuous subepidermal layer of stone cells, vascular bundles unequal, with a well-developed fibrous sheath and adaxially placed conducting elements; endocarp often adherent to the seed.

3 species in Central America and northern South America (map III).

Key to the species of *Asterogyne*:

- 1 a Inflorescence branched; male flowers with 6-12 stamens;
fruit with the endocarp usually adherent to the seed¹⁾ 2
- b Inflorescence spicate; male flowers with 21-24 stamens;
fruit with the endocarp not adherent to the seed . . . III, 3. *A. spicata*
- 2 a Male flowers with 11-12 stamens; fruit about 15-16 mm
long; northern Venezuela, above 750 m III, 2. *A. ramosa*
- b Male flowers with 6 stamens; fruit up to about 12 mm
long; Central America and adjacent Colombia, from
sea-level up to about 500 m III, 1. *A. martiana*

III, 1 *Asterogyne martiana* (H. Wendland) H. Wendland ex Hemsley in Godman & Salvin, Biol. Centr. Am. Bot. 3: 409. 1885; Burret, Bot. Jahrb. 63: 140. 1930; Dahlgren, Field Mus. Bot. 14: pl 8, 9. 1959.

Basionym: *Geonoma martiana* H. Wendland, Linnaea 28: 342. 1856; Spruce, J. Linn. Soc. 11: 106. 1869.

Type collection: Wendland s.n., ex hort. Herrenhausen, from Central America (not seen).

¹⁾ cf. also *Geonoma oligoclada*.

Heterotypic synonyms: *Geonoma trifurcata* Oersted, Kjoeb. Vidensk. Meddel. 1858: 34. 1859.

Type collection: Oersted s.n., Nicaragua, Rio San Juan (C holotype).

Asterogyne minor Burret, Bot. Jahrb. 63: 143. 1930.

Type collection: Lehmann 708, Colombia, near Barbacoas (not seen, destroyed at B).

Solitary, stem often less than 1 m tall but sometimes up to 2 m and more, 3–5 cm in diameter, internodes about $\frac{1}{2}$ cm long; leafsheath about 2 dm long, fibrous at margin; petiole 1–3 dm long, rachis 5–8 dm in length; sheath, petiole, and rachis at first densely brown lepidote, glabrescent; lamina simple, long cuneate at base, 7–10 dm long and $1\frac{1}{2}$ – $2\frac{1}{2}$ dm wide; 30–40 pairs of primary veins prominent above and below, sparsely brown lepidote below, secondary veins immersed above, prominent below, on each side of the secondary veins one rather prominent tertiary vein, veins emerging at 20–25° from the rachis.

Inflorescences once branched; 2 or sometimes 3 tubular, enlarged bracts, the basal one about 2 dm long, the second up to $3\frac{1}{2}$ dm long, both inserted closely together at the base of the peduncle, the third, if present, inserted much higher; peduncle about 5 dm long at anthesis, elongating to about 10 dm in fruit, densely brown lepidote, in the upper part with a few acute bracts up to 3 cm long, rachillas usually 5 (1–8) emerging closely together at the end of peduncle, $1\frac{1}{2}$ – $2\frac{1}{2}$ dm long, often tapering into a long, slender point, 4–6 (8) mm in diameter, thickening but not elongating in fruit; bilabiate flowerpits arranged in 6–7 vertical series, about 3 mm above each other; the lower lip semicircular. Male flowers 6 mm long, with 6 stamens. Female flowers about 6 mm long, with a 6-lobed staminodial tube. Fruit ellipsoid, purplish-black, brown when dry, 12 mm long and 6 mm in diameter; seed $7\frac{1}{2}$ mm long and $4\frac{1}{2}$ mm in diameter.

Central America from British Honduras and Guatemala to the western part of Colombia, in dense forests in wet and well-drained places at lower altitudes, from sea-level to about 500 m (map III).

British Honduras: Gentle 3743 (F); Schipp 392 (F, G, K).

Guatemala: Standley 25015 (US); Steyermark 39785 (F, US), 42064 (F).

Honduras: Standley 52655 (F, US), 53156 (F, US); Wilson 224 (US); Yunker 5002 (F).

Nicaragua: Englesing 260 (F), 350 (F); Lévy 505 bis (p.p.) (F, G, P); Oersted 6566 (C); Seemann 163 (BM), s.n. (BM).

Costa Rica: Cook & Doyle 61 (US), 544 (US); Dodge 9284 (F); Holm & Iltis 914 (F, US); Pittier 6818 (BR), 16658 (US), 16717 (US), 16922 (US); Tonduz 7559 (BR).

Panama: Pittier 4226 (F, US).

Colombia: Archer 1978 (US); Cook 84 (p.p.) (US); Cuatrecasas & Llano 24195 (US); Killip 35293 (US).

A. martiana is a rather uniform species. It is readily recognized by the floral morphology. Its conspecificity with *G. trifurcata* was already noted by Wendland, a conclusion confirmed by all later authors. Separation of

A. minor, as done by Burret, is clearly not advisable as there are no essential differences. The slightly smaller dimensions can be explained by the relatively high altitude (500 m) at which the specimen was collected which is according to the collector the upper limit of its occurrence. This is in agreement with other records. Only Kalbreyer 1830, examined by Burret, is said to have been collected at 1000 m altitude, but that specimen belongs perhaps to another species, like, for instance, *A. ramosa* which cannot be separated unless flowers or almost mature fruits are seen.

The presence of 3 enlarged bracts on one inflorescence, stressed as a most unusual feature in *A. ramosa* by its author, is found in several specimens of *A. martiana* as well.

III, 2 *Asterogyne ramosa* (H. E. Moore) W. Boer nov. comb.

Basionym: *Aristeyera ramosa* H. E. Moore, J. Arn. Arb. 48: 143-147, f 1-2. 1967.
Type collection: Steyermark & Rabe 96088, Venezuela, Sucre, Peninsula de Paria (BH holotype).

Stem to 3 m tall, 3-8 cm in diameter; leafsheath about $2\frac{1}{2}$ dm long; petiole about $3\frac{1}{2}$ dm in length; rachis about 7 dm long; sheath, petiole, and rachis at first densely brown lepidote, glabrescent; lamina simple, long cuneate at base, about 1 m long and $2\frac{1}{2}$ dm wide; about 40 pairs of primary veins prominent above, prominulent below, secondary veins immersed above, prominent below, a rather strong tertiary vein prominent below on each side of the secondary veins, veins emerging at an angle of about 25° from the rachis.

Inflorescence once branched, with 3 tubular enlarged bracts the basal about 2 dm long, the second up to 5 dm long and the innermost to 7 dm in length, all inserted rather closely together at the base of the peduncle; peduncle about 12 dm at anthesis, elongating to about 17 dm in fruit, rachillas 4-6, emerging closely together at the end of the peduncle, about 2 dm long and 5 mm in diameter, thickening but not elongating in fruit; bilabiate flowerpits arranged in 6-8 vertical series, about 2 mm above each other; lower lip semicircular. Male flowers about 6 mm long, with 11-12 stamens. Female flowers about 7 mm long, with up to 9 staminodes. Fruit ellipsoid, dark purplish, brown when dry, 15-16 mm long and about 5 mm in diameter but not quite mature.

Only known from two recently collected specimens, both from the same locality: Peninsula de Paria, Sucre, Venezuela, in wet forests above 750 m altitude (map III).

Venezuela: Steyermark 94803 (BH); Steyermark & Rabe 96088 (BH).

A. ramosa and *A. martiana* are only separable in flowering or fruiting condition, although there is no reason to confuse both species as they occur at different altitudes and in different areas.

III, 3 *Asterogyna spicata* (H. E. Moore) W. Boer nov. comb.

Basionym: *Aristeiera spicata* H. E. Moore, J. Arn. Arb. 47: 5, f 1-3. 1966.

Type collection: Steyermark 90010, Venezuela, Miranda, Parque Nacional de Guatopo (BH).

Solitary, stem 2-8 m tall, about 4 cm in diameter, internodes very short; leafsheath about $1\frac{1}{2}$ dm long, fibrous at margin; petiole up to 4 dm long; rachis about 7 dm in length; sheath, petiole, and rachis densely brown lepidote, glabrescent; lamina usually simple, cuneate at base, about 10 dm long and $2\frac{1}{2}$ dm wide; about 30 pairs of primary veins inconspicuous above, prominent and sparsely palaceous below, secondary veins immersed above, prominent below, tertiary veins unequal, one on each side of the secondary veins rather prominent, veins emerging at about 25° from the rachis.

Inflorescences spicate, with 2 tubular enlarged bracts the basal $1\frac{1}{2}$ - $2\frac{1}{2}$ dm long, the second 3-4 dm long, bracts inserted about 6 cm apart at the base of the peduncle; peduncle about 5 dm long, spike $2\frac{1}{2}$ -4 dm long and 10-14 mm in diameter, the whole inflorescence inclusive of bracts brown lepidote at first; bilabiate flowerpits arranged in 8 vertical series, about 4 mm above each other; the lips rather large and prominent, the lower lip semicircular. Male flowers 9 mm long, with 21-24 stamens, these unequal and irregular as a result of mutual pressure in bud. Female flowers about 8 mm long, with 15-18 staminodes. Fruit ovoid, said to be dark red, brown when dry, 18 mm long and 7 mm wide; seed 10 mm long and 5 mm wide.

Only known from a few recently collected specimens, all from the same locality: Parque Nacional de Guatopo, Miranda, Venezuela, on steep slopes in shade of wet forest at about 500 m altitude (map III).

Venezuela: Steyermark 90010 (BH); Tamayo 4177 (US).

A. spicata resembles both other *Asterogyne* species in some degree. It can be distinguished by the spicate inflorescence with a 10-14 mm thick spike, and by features of the flowers and fruits. Spicate inflorescences are also observed in *A. martiana* but the spike is less thick in that case. The stamens of *A. spicata* are unequal and irregular as a result of mutual pressure in the bud. In particular the innermost stamens are deformed and the attachment of the connective to the filament is seemingly very unusual for the genus. The outer stamens, however, are well-shaped and show the normal attachment: the filament tapering into a long slender point and forming a distinctly angled but rather movable junction with the bifurcate connective.

IV GEONOMA

Geonoma Willdenow, Spec. Pl. 4(1): 174, 593. 1805; Willdenow, Mém. Acad. Roy. Sci. Berlin 13 (1804): 37. 1807; Martius, Hist. Nat. Palm. 2: 6. 1823; Kunth, Enum.

Pl. 3: 228. 1840; Spruce, J. Linn. Soc. 11: 98. 1869; Trail, J. Bot. 14: 323. 1876; Drude in Martius, Flora Bras. 3(2): 475. 1882; Hook. fil. in Bentham & Hooker, Gen. Pl. 3(2): 913. 1883; Burret, Bot. Jahrb. 63: 144. 1930.

Gynestum Poiteau, Mém. Mus. Hist. Nat. Paris 9: 387. 1822.

Kalbrejera Burret, Bot. Jahrb. 63: 142. 1930.

Taenianthera Burret, Bot. Jahrb. 63: 267. 1930.

Type species: *Geonoma simplicifrons* Willdenow.

Usually rather small, arundinaceous or "acaulescent" palms, with simple to more or less irregularly divided to pinnate leaves; lamina anatomically without a colourless hypodermis, the epidermis often containing chloroplasts, mesophyll without a palisade layer, cells transversely extended, fibres usually infrequent.

Inflorescences spicate to more or less branched, with 1-3 enlarged bracts; the bracts covering the flowerpits elevated. Male flowers with 3 or 6 stamens with free thecae on a bifurcate connective. Female flowers with a basifixed style and a one-celled ovary formed by the reduction of 2 cells just before anthesis, staminodial tube often truncate or shortly crenate at apex, sometimes digitately lobed. Fruit usually pointed at apex, mesocarp rather dry without prominent longitudinal fibres but short, more or less radially arranged, fibrous strands giving the dry fruit a tuberculate appearance.

About 75 species from Central America and the West Indies to south-eastern Brazil and Paraguay in South America, with a definite preference for tropical and montane rainforests (map IV).

Synopsis of the subgenera, sections, and groups of species of *Geonoma*:

- | | group |
|--|-------|
| 1" Male flowers with 3 stamens, inflorescence with only 1 enlarged bract | |
| subgenus A <i>Kalbrejera</i> | 1 |
| 1' Male flowers with 6 stamens, inflorescence usually with 2 enlarged bracts, sometimes 1 or 3 | |
| subgenus B <i>Geonoma</i> ¹⁾ | |
| 2" Inflorescence spicate, with a long peduncle; bracts inserted closely together at the base of the peduncle; flowerpits at anthesis congested, more or less in orthostichies; female flowers with a digitately lobed staminodial tube; "acaulescent" or with a short stem | |
| section a <i>Taenianthera</i> | |
| 3" Male flowers with the anthers at anthesis in line with the filament. | 2 |
| 3' Male flowers with the anthers at anthesis sharply reflexed in relation to the filaments. | 3 |
| 2' Inflorescence branched or, if spicate, female flowers with a crenate or truncate staminodial tube; bracts sometimes rather far apart; flowerpits often uncongested, spirally, decussately or verticillately arranged; often with a stem | |
| section b <i>Geonoma</i> | |
| 4" Inflorescence branched or spicate; female flowers with a truncate or crenate staminodial tube. | |
| 5" Inflorescence spicate, with the peduncle longer than the spike, glabrous to brownish lepidote; flowerpits spirally arranged. | |

¹⁾ For a key to the species see p. 86.

- | | group |
|--|-------|
| 6" Bracts inserted closely together at the base of the peduncle; flowerpits often congested; fruit small, greenish; Central America and coastal Colombia and Ecuador. | 4 |
| 6' Bracts inserted often more or less far apart; flowerpits rather loosely arranged; fruit often larger, blackish; Andean region. | 5 |
| 5' Inflorescence branched or, if spicate, at first densely villose to floccose, glabrescent, and/or with verticillately or decussately arranged flowerpits. | |
| 7" Inflorescence spicate, or once branched with a few rachillas, densely villose to floccose at an early stage. | |
| 8" Tomentum of the inflorescence reddish-brown; 2 enlarged bracts present; south-eastern Brazil. | 6 |
| 8" Tomentum of the inflorescence greyish-brown; 2 enlarged bracts present; only known from the foot of the Peruvian Andes. | 7 |
| 8' Tomentum of the inflorescence yellowish-brown; only 1 enlarged bract present; Amazon basin and adjacent parts of the Guianas. | 8 |
| 7' Inflorescence usually branched, spicate in depauperate plants only. | |
| 9" Bracts often short and swollen, early caducous; rachillas slender, folded and twisted within the bracts; flowerpits often alternately verticillate in trimerous whorls; fruit globose, 6-7 mm in diameter. | 9 |
| 9' Bracts usually long, rarely swollen and often persistent; rachillas slender to rather thick, often straight within the bracts; flowerpits often spirally arranged or decussate; fruit globose to ovoid, often longer than 7 mm. | |
| 10" Flowerpits decussate or sometimes verticillate to somewhat irregularly arranged; south-eastern Brazil and 1 species from Venezuela. | 10 |
| 10' Flowerpits spirally arranged or sometimes more or less verticillate; unknown from south-eastern Brazil. | |
| 11" Flowerpits without upper lips or the upper lip protracted into an inconspicuous ciliate rim; interior of flowerpits pilose in the upper part. | 11 |
| 11' Flowerpits usually with a distinctly protracted upper lip and glabrous inside. | |
| 12" Rachillas often rather slender and short; flowerpits at anthesis rather small, usually less than 2 mm in diameter, the upper lip not very prominent; rarely occurring above 1000 m altitude. | |
| 13" Inflorescence with a short rachis bearing a few simple rachillas; bracts tubular, membranaceous, soon becoming fibrous. | 12 |
| 13' Inflorescence usually with a well-developed rachis bearing ramified lateral branches or simple rachillas; bracts distinctly flattened, (sub)coriaceous, early caducous or persistent. | 13 |
| 12' Rachillas slender to rather thick and frequently relatively long; flowerpits rather | |

- group
- large, more than 2 mm in diameter, with 2 prominent lips; rarely occurring below 1000 m altitude.
- 14" Small palms; inflorescence with persistent, more or less tubular, membranaceous or chartaceous bracts, once or sometimes repeatedly branched. 14
- 14' Relatively tall palms; inflorescence with caducous, coriaceous bracts, usually repeatedly branched, rachillas folded and twisted within the bracts. 15
- 4' Inflorescence branched; female flowers with a digitately lobed staminodial tube.
- 15" Solitary, umbrella-shaped palms; stem densely ringed; lamina with veins emerging at 10–30° from the rachis. 16
- 15' Clustered palms with a globose crown; well-developed stems with internodes of several cm long; lamina with the veins emerging at 30–70° from the rachis. 17

Subgenus A **KALBREYERA** (Burret) W. Boer nov. stat.

Basionym: *Kalbreycera* Burret, Bot. Jahrb. 63: 142. 1930, as genus.

Type species: *Geonoma triandra* (Burret) W. Boer.

Small arundinaceous palms with irregularly divided leaves.

Inflorescences twice branched, with only one enlarged, somewhat striate bract; flowerpits regularly decussate. Male flowers with 3 stamens, anthers sharply reflexed from the filaments. Female flowers with a 1-celled ovary and a basifixed style, staminodial tube crenulate.

One species in Panama and Colombia.

Group 1: species 1.

IV A 1, 1 *Geonoma triandra* (Burret) W. Boer nov. comb. **Plate I.**

Basionym: *Kalbreycera triandra* Burret, Bot. Jahrb. 63: 143. 1930.

Type collection: Kalbreyer 1829, Colombia, Antioquia, Murri (not seen, destroyed at B).

Clustered, stem about 2–3 m tall, less than 1 cm in diameter, internodes about 2 cm long; leafsheath 7–8 cm in length; petiole about 1½ dm long; rachis 2½–3½ dm long; sheath, petiole, and rachis at first densely greyish furfuraceous, glabrescent; lamina irregularly divided into a few broad segments or sometimes simple, 4–5 dm long and 1½–2½ dm wide; 26–33 pairs of primary veins prominent above and below, secondary veins immersed above, prominent and densely greyish lepidote below, veins emerging at 40–55° from the rachis.

Inflorescences twice branched; basal bract 1–1½ dm, flattened, chartaceous, striate, second bract small, up to 5 cm long, usually completely enclosed by the basal one and inserted about 4 cm higher; peduncle 1–2 dm long, rachis 5–10 cm long, with 10–20 lateral branches, these simple in the

terminal part of the rachis but the lower ones branched, with 2–6 rachillas up to about 1 dm long and less than 1 mm in diameter, terminating in a slender point; inflorescence inclusive of bract greyish-brown furfuraeous at first; bilabiate flowerpits regularly decussate, $1\frac{1}{2}$ –2 mm apart, the upper lip inconspicuous, the lower lip rounded to subacute, entire. Flowers about $1\frac{1}{2}$ mm long. Fruit ovoid, probably greenish, 7 mm long and 6 mm in diameter; seed $5\frac{1}{2}$ mm long and 5 mm in diameter.

Apart from the destroyed type and an old, poorly labelled specimen from Panama, only known from 4 gatherings all from the same locality: Colombia, Antioquia, near Villa Arteaga, at 150–200 m altitude, in rainforest (map IV, 1).

Panama: Seemann s.n. (BM).

Colombia: Gaviria, Molina & Barkley 18C752 (BH, US); Hodge 7002 (BH), 7014 (BH), 7074 (BH).

The original material of *G. (Kalbreyera) triandra* was lost during the war, but later collections agree so well with the description that there is no doubt about the identity of this species. The terminal style on a supposedly 3-celled ovary is only observable in young, unexpanded female flowers; a 1-celled ovary with a basifixed style is formed at anthesis by reduction of the two other carpels.

Subgenus B **GEONOMA**

Type species: *Geonoma simplicifrons* Willdenow

“Acaulescent”, arundinaceous, or sometimes relatively tall palms, with simple to irregularly divided or sometimes almost regularly pinnate laminas; epidermis with or without chloroplasts.

Inflorescences spicate to branched, with usually 2, sometimes 1 or 3 enlarged bracts. Male flowers with 6 stamens, anthers at anthesis either in line with or sharply reflexed from the filaments. Female flowers with either a digitately lobed or a crenate to truncate staminodial tube.

About 75 species throughout tropical America, in wet forests.

Key to the species of *Geonoma* subgenus *Geonoma*:

- 1 a Inflorescence spicate 2
- b Inflorescence branched with 2 or more
 rachillas 23
- 2 (1) a Peduncle about equal to or longer than
 the spike 3
- b Peduncle distinctly shorter than the spike 19
- 3 (2) a Flowerpits congested, more or less in
 orthostiches; female flowers with a digi-
 tately lobed staminodial tube 4
- b Flowerpits usually somewhat distant,
 spirally arranged; female flowers with a
 crenulate staminodial tube 10

- 4 (3) a Lamina up to about 1 m long, rather thin to subchartaceous; spike 1-2½ dm long. . . 5
 b Lamina longer than 12 dm, chartaceous to subcoriaceous; spike 2½-5 dm long. . . 9
- 5 (4) a Spike slender, about 2½ mm thick; anthers at anthesis sharply reflexed from the filament IV B, 6 *G. paradoxa*
 b Spike usually thicker; anthers at anthesis in line with the filament 6
- 6 (5) a Veins emerging at 15-35° from the rachis; flowerpits at anthesis more than 2 mm in diameter 7
 b Veins emerging at 45-70° from the rachis; flowerpits at anthesis less than 2 mm in diameter 8
- 7 (6) a Veins emerging at 15-25° from the rachis; flowerpits in 5-6 series, 2-3 mm apart. . IV B, 5 *G. poiteauana*
 b Veins emerging at 20-35° from the rachis; flowerpits in 8 or more series, usually about ½ mm apart IV B, 4 *G. macrostachys*
- 8 (6) a "Acaulescent"; lamina simple to irregularly pinnate with up to 8 pairs of unequal segments; fruit subglobose, about 7 mm in diameter. IV B, 2 *G. acaulis*
 b Stem 1-2 m tall; lamina rarely irregularly, usually regularly divided with 1-veined segments only, with the exception of the apical pair; fruit ovoid, 11-13 mm long and 7-8 mm in diameter IV B, 3 *G. camana*
- 9 (4) a "Acaulescent"; veins emerging at about 10° from the rachis IVB, 7 *G. tamandua*
 b Stem present; veins emerging at about 35° from the rachis IV B, 8 *G. chococola*
- 10 (3) a Peduncle and spike at first reddish-brown densely floccose, glabrescent; coastal area of south-eastern Brazil. IV B, 16 *G. elegans*
 b Peduncle and spike somewhat brown lepidote to glabrous; Central America and the Andean region 11
- 11 (10) a Basal and second bract inserted closely together, usually less than 4 cm apart at the base of the peduncle 12
 b Basal and second bract inserted far apart, usually more than 8 cm 16
- 12 (11) a Cane up to about 2 m tall and 2 cm in diameter; spike 1-1½ dm long, with 5-8 series of flowerpits; Pacific coastal region of Colombia and Ecuador, at low altitudes IV B, 12 *G. sodiroi*
 b Cane usually shorter, almost absent or up to about 1 m tall; plants either with a spike 1½-5 dm long with 7-12 series of flowerpits and occurring below 350 m, or spike 1-2½ dm long with 5-8 series of flowerpits and occurring at altitudes above 550 m 13

- 13 (12) a Spike rather long ($1\frac{1}{2}$ –5 dm); flowerpits arranged in 7–12 slightly coiled series; at altitudes below 350 m 14
- b Spike rather short (1 – $2\frac{1}{2}$ dm); flowerpits more or less spirally arranged in 5–8 series; at altitudes above 550 m 15
- 14 (13) a Lamina simple with up to 7 pairs of unequal segments, long cuneate at base; veins emerging at about 20° from the rachis; second bract slightly longer than basal one; fruit greenish IV B, 9 *G. cuneata*
- b Lamina pinnate; segments falcate, strongly narrowed at base; veins emerging at 50 – 60° from the rachis; second bract about twice as long as basal one; fruit purplish-black IV B, 10 *G. procumbens*
- 15 (13) a Lamina obovate, simple to irregularly pinnate with 2–5 pairs of segments; fruit about 8 mm long; Costa Rica to Panama IV B, 11 *G. gracilis*
- b Lamina lanceolate, irregularly pinnate with 2–9 pairs of segments; fruit about 10 mm long; Andes from Colombia to Bolivia IV B, 13 *G. jussieuana*
- 16 (11) a The flowerpits without a distinct upper lip but the upper rim smooth IV B, 45 *G. dicranospadix*
- b The upper rim of the flowerpits extended into a distinct upper lip 17
- 17 (16) a Second bract exceeding the basal one by only a few cm; fruit globose, about 8 mm long; at lower altitudes, usually 250–500 m IV B, 15 *G. brongniartii*
- b Second bract exceeding the basal one by more than 5 cm; fruit ovoid, about 10 mm long; at higher altitudes, above 700 m. . . 18
- 18 (17) a Spike with less than 16 flowerpits per 2 cm; flowerpits about 2 mm in diameter, with large upper and lower lips IV B, 14 *G. lehmannii*
- b Spike with more than 20 flowerpits per 2 cm; flowerpits smaller and less distinctly lipped IV B, 13 *G. jussieuana*
- 19 (2) a Inflorescence often with only 1 enlarged bract; peduncle and spike more or less villose; fruit ovoid, 8–11 mm long, greenish or bluish 20
- b Inflorescence with 2 or sometimes 3 enlarged bracts; peduncle and spikes sparsely hispidulous; fruit globose, about 6 mm long, black 22
- 20 (19) a Lamina usually entire; peduncle 2–4 cm long 21
- b Lamina simple to almost regularly pinnate, usually trijugate; peduncle 6–8 cm long IV B, 22 *G. piscicauda*
- 21 (20) a Lamina about 2–3 dm long; inflorescence less than 8 cm long; flowerpits irregularly decussate, about 3 mm apart, lower lip triangular IV B, 20 *G. stricta*

- b Lamina about 3-5 dm long; inflorescence more than 10 cm long; flowerpits arranged in close spirals; lower lip rounded . . . IV B, 21 *G. pycnostachys*
- 22 (19) a Lamina usually entire, rarely 2-3-jugate; flowerpits often irregularly arranged; lower lip cleft . . . IV B, 24 *G. arundinacea*
- b Lamina usually 3-jugate, sometimes simple to multijugate; flowerpits usually regularly verticillate in trimerous alternating whorls. IV B, 27 *G. deversa*
- 23 (1) a Enlarged bracts usually short, up to about 7 cm, often more or less swollen, the second completely enclosed by the basal one, early caducous; rachillas slender, up to 3 mm thick, at first much folded and twisted within the bracts; flowerpits usually verticillate in alternating trimerous whorls; fruit globose, 6-7 mm in diameter 24
- b Enlarged bracts usually longer than 7 cm, tubular or flattened, the second often exceeding the basal one, often persistent; rachillas slender to rather thick, often straight within the bracts; flowerpits usually spirally arranged or decussate; fruit globose to ovoid, often longer than 6 mm 28
- 24 (23) a Lamina usually simple, narrowly lanceolate, long cuneate at base; peduncle much longer than bracts; flowerpits often irregularly arranged in intervals of about 1 cm along the rachillas . . . IV B, 25 *G. leptospadix*
- b Lamina often trijugate, if simple ovate; peduncle about as long as bracts; flowerpits usually regularly verticillate. . . . 25
- 25 (24) a Primary veins never elevated below, emerging at about 60° from the rachis; dry rachillas not narrowed between the flowerpits, brownish-hispidulous. . . . IV B, 28 *G. oligoclona*
- b Primary veins more or less prominent below, emerging at 25-40° from the rachis; dry rachillas narrowed between the flowerpits, glabrous to sparsely hispidulous . . 26
- 26 (25) a Lamina usually simple to irregularly 2- or 3-jugate; inflorescence with up to circa 10 rachillas; successive whorls about 5-10 mm apart 27
- b Lamina usually regularly 3-jugate or with with more segments; inflorescence often with numerous rachillas; successive whorls about 1/2-3 mm apart IV B, 27 *G. deversa*
- 27 (26) a Lamina 2-3 dm long, bifurcate for about 1/3 of its length; inflorescence with very few rachillas IV B, 24 *G. arundinacea*
- b Lamina 3-5 dm long, bifurcate for about 1/2 of its length; inflorescence with 5-9 rachillas IV B, 26 *G. laxiflora*

- 28 (23) a Flowerpits without upper lip, or the upper rim protracted into an inconspicuous ciliate rim; interior of flowerpits pilose in the upper part 29
- b Flowerpits usually with a distinctly protracted upper lip and with a glabrous interior 36
- 29 (28) a Rachillas with merely forked or branched to stellate hairs 30
- b Rachillas with simple hairs sometimes intermixed with few forked hairs, or almost glabrous 32
- 30 (29) a Small palms up to about 4 m tall; second bract exceeding the basal one; flowerpits without upper lip 31
- b Relatively large palms up to 8 m tall; second bract enclosed by the basal one; upper rim of the flowerpits somewhat protracted and ciliate IV B, 44 *G. interrupta*
- 31 (30) a Peduncle often more than 4 dm long, sometimes with a third enlarged bract within the second bract; fruit ovoid, about 9 mm long; Andes, at 1400–1900 m . . . IV B, 45 *G. dicranospadix*
- b Peduncle 1–3(4) dm long, without an enlarged bract within the second bract; fruit subglobose, about 7 mm in diameter; moderate altitudes, about 300–1400 m. . . IV B, 42 *G. euspatha*
- 32 (29) a Rachillas densely covered with stiff hairs about 1 mm long IV B, 41 *G. pinnatifrons*
- b Rachillas sparsely covered with simple hairs up to about $\frac{1}{2}$ mm long 33
- 33 (32) a Flowerpits with a somewhat protracted upper rim; fruit dark green, ovoid, about 7 mm long and 5 mm in diameter . . . IV B, 43 *G. pulchra*
- b Flowerpits without an upper lip; fruit black or greenish, subglobose to ovoid, either 8 mm or 5–6 mm long 34
- 34 (33) a Inflorescence once branched, with 2–4 rachillas; rachillas almost glabrous; fruit greenish, globose, 5 mm in diameter . . IV B, 46 *G. simplicifrons*
- b Inflorescence if well-developed twice branched, with numerous rachillas; rachillas more or less hispid; fruit black or when greenish distinctly larger (8 mm), ovoid 35
- 35 (34) a Enlarged bracts, papyraceous, deciduous at an early stage; fruit greenish, ovoid, about 8 mm long and 7 mm in diameter . . . IV B, 39 *G. membranacea*
- b Enlarged bracts flattened, coriaceous, persistent for some time; fruit black, subglobose, about 5 mm in diameter . . . IV B, 40 *G. oxycarpa*
- 36 (28) a Female flowers with a digitately lobed staminodial tube 75
- b Female flowers with a shortly crenate to truncate staminodial tube 37

- 37 (36) a Flowerpits regularly decussate 38
 b Flowerpits verticillate or spirally arranged
 but not decussate 41
- 38 (37) a Basal and second bract inserted far apart,
 the second bract usually not at all enclosed
 by the basal bract IV B, 32 *G. schottiana*
 b Both bracts inserted more or less closely
 together at base of peduncle, second bract
 largely enclosed by the basal one 39
- 39 (38) a Lamina usually strongly divided into
 1-veined linear segments; fruit globose,
 8 mm long IV B, 31 *G. brevispatha*
 b Lamina irregularly pinnate into a few
 broad segments and usually without linear
 1-veined segments; fruit ovoid, more than
 10 mm long 40
- 40 (39) a Enlarged bracts pergamentaceous, caduc-
 ous; peduncle cylindrical, distinctly longer
 than the rachis of the inflorescence . . . IV B, 30 *G. blanchetiana*
 b Enlarged bracts subcoriaceous, permanent;
 peduncle laterally compressed, about as
 long as rachis 65
- 41 (37) a Inflorescence once branched, or sometimes
 with the lowermost rachillas bifurcate,
 rarely even trifurcate 42
 b Inflorescence repeatedly branched, the
 lateral branches bearing at least several
 rachillas except for the terminal ones
 perhaps 60
- 42 (41) a Flowerpits small, at anthesis about 1 mm
 in diameter, closely together, rachillas
 enlarging in fruit 43
 b Flowerpits moderately large, about 2 mm
 in diameter, usually more than 3 mm
 apart 44
- 43 (42) a Inflorescence at first covered with a circa
 2 mm thick, very dense, brownish-grey
 tomentum; peduncle 3 dm and more long;
 fruit ovoid, about 8 mm long IV B, 19 *G. poeppigiana*
 b Inflorescence with a much thinner tomen-
 tum; peduncle about 1 dm long or shorter;
 fruit subglobose, about 6 mm long 61
- 44 (42) a Tomentum of the inflorescence dark
 reddish-brown 45
 b Tomentum of the inflorescence yellowish-
 brown or greyish or almost absent 47
- 45 (44) a Rachis of the inflorescence very short,
 with only 2-4 rachillas; only south-eastern
 Brazil 46
 b Rachis more than 5 cm long, with more
 than 5 rachillas; only northern Venezuela IV B, 60 *G. paraguayensis*
- 46 (45) a Lamina irregularly pinnate; rachillas 3-3½
 dm long; flowerpits spirally arranged . . IV B, 17 *G. rodeiensis*

- b Lamina usually regularly pinnate, with 1-veined linear segments; rachillas $1\frac{1}{2}$ – $2\frac{1}{2}$ dm long; flowerpits verticillate IV B, 18 *G. trinervis*
- 47 (44) a Peduncle short, about 5 cm long, with only 1 enlarged bract; inflorescence villose; fruit said to be red IV B, 23 *G. bartlettii*
- b Peduncle usually longer than 5 cm, with 2 enlarged bracts; inflorescence glabrous, lepidote or floccose; fruit green to blackish but not red 48
- 48 (47) a Rachillas crowded with rather small flowerpits, 30 or more per 2 cm at anthesis 49
- b Rachillas more loosely beset with flowerpits 52
- 49 (48) a Inflorescence thick-set; bracts inserted less than 1 cm apart at base of peduncle; peduncle less than 1 dm long; rachillas up to about $1\frac{1}{2}$ dm long and 6–7 mm in diameter IV B, 50 *G. congesta*
- b Inflorescence more elongated; bracts inserted more than 2 cm apart; peduncle longer than 2 dm; rachillas longer than $1\frac{1}{2}$ dm and usually less than 7 mm in diameter 50
- 50 (49) a Inflorescence at first densely furfuraceous; peduncle more than 3 dm long; relatively tall palm IV B, 49 *G. calyptrogynoides*
- b Inflorescence almost glabrous; peduncle up to about 3 dm long; rather small palms 51
- 51 (50) a Enlarged bracts tubular, membranaceous; rachillas slender, dry about 3 mm thick; Amazon basin and Guianas IV B, 47 *G. baculifera*
- b Enlarged bracts flattened, subcoriaceous to chartaceous; rachillas when dry about 5 mm thick; eastern Brazil IV B, 36 *G. rubescens*
- 52 (48) a Solitary palm; stem 3–10 m tall, 5–10 cm in diameter; petiole about $\frac{1}{2}$ m long, leaf-rachis about 1 m long; Central America, only at higher altitudes IV B, 67 *G. seleri*
- b Usually distinctly smaller, sometimes clustered palms; the leaf-rachis notably shorter; species from South America and Costa Rica 53
- 53 (52) a Inflorescence almost glabrous or lepidote; small palms occurring in eastern Brazil 54
- b Inflorescence at first densely floccose, furfuraceous, or rarely lepidote; Andes and Central America, at greater altitudes . . 55
- 54 (53) a Peduncle less than 1 dm long; 6–8 rachillas less than 2 mm thick; above 1200 m. . IV B, 38 *G. wittigiana*
- b Peduncle more than 2 dm long; 3–5 rachillas more than 3 mm thick; probably at low altitudes IV B, 48 *G. pauciflora*

- 55 (53) a Rachillas very slender, 1-1½ mm in diameter; flowerpits scattered, spirally arranged, up to about 8 per 2 cm . . . IV B, 29 *G. spinescens*
 b Rachillas thicker, 2½ mm and more in diameter; flowerpits usually more congested 56
- 56 (55) a Enlarged bracts flattened, inserted closely together, the basal one subcoriaceous, enclosing the second; peduncle less than twice as long as the rachis IV B, 54 *G. pulcherrima*
 b Enlarged bracts tubular, inserted more than 5 cm apart, chartaceous to membranaceous, the second distinctly exceeding the basal one; peduncle usually more than twice as long as the rachis 57
- 57 (56) a Enlarged bracts chartaceous; rachillas thick, about 6 mm in diameter IV B, 56 *G. pachydicrana*
 b Enlarged bracts membranaceous or rarely subcoriaceous; rachillas 2½-4½ mm in diameter 58
- 58 (57) a Usually a third somewhat enlarged bract present; inflorescence with a brown short tomentum IV B, 57 *G. marggraffia*
 b Only two enlarged bracts present; inflorescence densely greyish floccose, glabrescent 59
- 59 (58) a Lamina membranaceous; veins emerging at 45-55° from the rachis; inflorescence with 2-11 rachillas; Andes IV B, 55 *G. lindeniana*
 b Lamina chartaceous; veins emerging at about 35° from the rachis; inflorescence with 3-6 rachillas; Costa Rica IV B, 59 *G. hoffmanniana*
- 60 (41) a Rachillas slender, with more than 25 flowerpits per 2 cm; flowerpits about 1½ mm in diameter; fruit small, subglobose, less than 5 mm long 61
 b Rachillas thicker, flowerpits less congested; fruit often ovoid, usually about 10 mm or more long 62
- 61 (43, a Lamina about 10 dm long; rachillas rather
 60) long, usually more than 2½ dm, with less than 36 flowerpits per 2 cm; fruit 7 × 6 mm IV B, 52 *G. longeovaginata*
 b Lamina about 7 dm long; rachillas short, usually less than 1½ dm long, with more than 40 flowerpits per 2 cm; fruit about 5 mm in diameter IV B, 51 *G. ferruginea*
- 62 (60) a Slender palm, cane about 1 cm in diameter; enlarged bracts membranaceous, less than 1 dm long; rachillas slender, about 1 mm thick; flowerpits dispersed, 2-8 mm apart, much elevated above the rachillas . . . IV B, 37 *G. gastoniana*
 b Plant taller; enlarged bracts chartaceous to coriaceous; rachillas thicker; flowerpits less elevated and often more crowded . . 63

- 63 (62) a Rachillas densely hispid; flowerpits more or less regularly arranged in trimerous alternating whorls; fruit rather large, 16 mm long and 11 mm in diameter IV B, 35 *G. fiscellaria*
 b Rachillas glabrous or more or less pilose but not hispid; flowerpits often not verticillate; fruit smaller, usually about 1 cm long 64
- 64 (63) a Flowerpits partly more or less decussate but a spiral or verticillate arrangement may often be found in the same inflorescence; south-eastern Brazil 65
 b Flowerpits spirally or verticillately arranged but never decussate; Central America, Andes, and some of the Lesser Antilles 66
- 65 (40, a Flowerpits rather densely arranged, about
 64) $1\frac{1}{2}$ mm apart; fruit 12×10 mm IV B, 33 *G. pohliana*
 b Flowerpits loosely arranged, about 5 mm apart; fruit 11×8 mm IV B, 34 *G. gamiova*
- 66 (64) a Enlarged bracts tubular, chartaceous, inserted about 5 cm or more apart . . IV B, 58 *G. orbigniana*
 b Enlarged bracts flattened, (sub)coriaceous, inserted closely together at base of peduncle 67
- 67 (66) a Lamina lustrous above; inflorescence at first densely greyish floccose; fruit small, about 6 mm long, more or less carinate when dry IV B, 54 *G. pulcherrima*
 b Lamina usually dull above; inflorescence lepidote, glaucous, or sparsely beset with short hairs, but not floccose; fruit about 1 cm long, not carinate 68
- 68 (67) a Lamina membranaceous; inflorescence strongly branched, with slender, about 2 mm thick, short, about 1 dm long rachillas IV B, 53 *G. heinrichsiae*
 b Lamina (sub)chartaceous, rarely membranaceous (*G. seleri*); inflorescence branched, with often thick rachillas, frequently more than 4 mm thick, and longer than $1\frac{1}{2}$ dm (depauperate inflorescences sometimes with rather slender, short rachillas but then poorly branched). 69
- 69 (68) a Rachillas slender, about 3 mm thick, and cylindrical, i.e., not narrowed between the flowerpits 70
 b Rachillas thicker, $(2\frac{1}{2})4-7$ mm, and distinctly narrowed between the flowerpits 71
- 70 (69) a Lamina chartaceous-coriaceous; veins emerging at about 30° from the rachis; rachillas yellowish when dry; Mt. Roraima and other sandstone mountains of Guianas IV B, 61 *G. appuniana*
 b Lamina membranaceous; veins emerging at $40-50^\circ$ from the rachis; rachillas brown when dry; Andes IV B, 62 *G. densa*

- 71 (69) a Flowerpits without upper lip IV B, 66 *G. megalospatha*
 b Flowerpits bilabiate 72
- 72 (71) a Lamina membranaceous; rachillas $2\frac{1}{2}$ – $4\frac{1}{2}$ mm thick, sparsely beset with short simple hairs IV B, 67 *G. seleri*
 b Lamina membranaceous to chartaceous or coriaceous; rachillas 3–7 mm thick, glaucous or more or less furfuraceous but never with stiff hairs; Andes, some of the Lesser Antilles 73
- 73 (72) a Leaves sclerophytic; veins emerging at about 30° from the rachis; rachillas brown when dry, more or less furfuraceous . . IV B, 65 *G. weberbaueri*
 b Leaves not sclerophytic; veins emerging at 40–60° from the rachis; rachillas yellowish when dry, or more or less glaucous 74
- 74 (73) a Rachillas somewhat glaucous; flowerpits 3–5 mm apart IV B, 63 *G. undata*
 b Rachillas yellowish when dry; flowerpits about 7 mm apart IV B, 64 *G. helminthoclada*
- 75 (36) a Very small palm, cane less than 1 cm in diameter; leaf rachis about 2 dm long; veins emerging at 50–70° from the rachis; inflorescence once branched; rachillas 6–12 cm long; fruit 7–8 mm long, greenish . . IV B, 74 *G. aspidiifolia*
 b Palms larger in almost every respect; veins emerging at 10–60° from the rachis; inflorescence once or twice branched; fruit 9 mm or more long 76
- 76 (75) a Solitary, umbrella-shaped palms; petiole $\frac{1}{2}$ –2 dm long; veins emerging at 10–30° from the rachis 77
 b Clustered palms with a globose crown; petiole 3–7 dm long; veins emerging at 30–60° from the rachis 78
- 77 (76) a Veins emerging at 10–15° from the rachis; inflorescence twice branched; enlarged bracts flattened, the second enclosed by the basal one; flowerpits congested . . IV B, 68 *G. spixiana*
 b Veins emerging at about 30° from the rachis; inflorescence once branched, with a few rachillas; enlarged bracts tubular, the second twice as long as the basal one; flowerpits usually less densely arranged IV B, 69 *G. triglochis*
- 78 (76) a Rachillas 4 mm or more thick, densely beset with flowerpits, more than 40 per 2 cm; fruit 13–15 mm long 79
 b Rachillas 2–3 mm thick, usually more loosely beset with flowerpits but sometimes up to about 50 per 2 cm; fruit about 9 mm long 80
- 79 (78) a Lamina often bijugate, segments porrect, up to 8 dm long and less than 1 dm wide;

- inflorescence twice branched; fruit deep purple IV B, 71 *G. juruana*
- b Lamina with 3-4 pairs of broad, rhomboid segments, often intermixed with linear ones; inflorescence once branched; fruit yellowish-green IV B, 70 *G. densiflora*
- 80 (78) a Lamina more or less pinnate, 1-veined segments if present linear; veins emerging at 30-50° from the rachis; fruit yellowish-green IV B, 72 *G. maxima*
- b Lamina usually regularly pinnate, with sigmoid 1-veined segments; veins emerging at 60° from the rachis; fruit blackish . . IV B, 73 *G. multiflora*

Section a **TAENIANTHERA** (Burret) W. Boer nov. stat.

Basionym: *Taenianthera* Burret, Bot. Jahrb. 63: 267. 1930, as genus.

Type species: *Geonoma macrostachys* Martius.

"Acaulescent" or with a short stem, lamina anatomically with a hypodermislike layer below each surface, epidermal cells usually with chloroplasts.

Inflorescence erect, spicate with a very long peduncle; 2 tubular bracts inserted closely together at the base of the peduncle; flowerpits at anthesis congested, more or less in orthostiches. Male flowers with the anthers usually in line with the filament. Female flowers with a digitately lobed staminodial tube.

6 species in the northern part of South America at low altitudes, especially in the Amazon basin.

Group 2: species 2-5.

IV B a 2, 2 *Geonoma acaulis* Martius, Hist. Nat. Palm. 2: 18, t 4, 19. 1823; Drude in Martius, Flora Bras. 3(2): 508, t 121 f 1. 1882.

not *Geonoma acaulis* (Poiteau) Burret, Bot. Jahrb. 63: 162. 1930 (based on: *Gynestum acaule* Poiteau).

Homotypic synonym: *Taenianthera acaulis* (Martius) Burret, Bot. Jahrb. 63: 269. 1930; Dahlgren, Field Mus. Bot. 14: pl 403. 1959; Macbride, Field Mus. Bot. 13: 352. 1960.

Type collection: Martius s.n., boundary of Brazil and Colombia, Rio Japurá near Mount Cupatí (M holotype).

Heterotypic synonyms: *Geonoma tapajotensis* (Trail) Drude in Martius, Flora Bras. 3(2): 508. 1882.

Taenianthera tapajotensis (Trail) Burret, Bot. Jahrb. 63: 269. 1930; Macbride Field Mus. Bot. 13: 354. 1960.

Basionym: *Geonoma acaulis* Martius ssp. *tapajotensis* Trail, J. Bot. 14: 324. 1876.

Type collection: Trail 1017 / IX, Brazil, Aramanahy near R. Tapajoz (K holotype).

Taenianthera gracilis Burret, Notizbl. 11: 14. 1930.

Type collection: Lakó 10, coll. Huebner 142, Brazil, Amazonas, Rio Iça (not seen, destroyed at B).

Taenianthera oligosticha Burret, Notizbl. 11: 201. 1931; Macbride, Field Mus. Bot. 13: 354. 1960.

Type collection: Williams 737, Peru, Loreto, Rio Nanay (F holotype).

Taenianthera minor Burret, Notizbl. 14: 324. 1939.

Type collection: Schultze-Rhonhof 2106, Ecuador, Canelos (not seen, destroyed at B).

"Acaulescent"; leafsheath $1\frac{1}{2}$ –2 dm long; petiole 4–6 dm in length, deciduously furfuraceous; lamina $3\frac{1}{2}$ –7 dm long, 3–5 dm wide, rarely simple, usually with 3–8 pairs of unequal segments, these falcate-lanceolate, narrowed at base and gradually acuminate at apex, apical segments 1–2 dm long; 18–30 pairs of primary veins prominent above and below, secondary veins slightly immersed above, below as prominent as primary veins, brown lepidote, tertiary veins above and below inconspicuous, veins emerging at 50 – 70° from the rachis.

Inflorescence simple, second bract 2 – $3\frac{1}{2}$ dm long, basal bract about $\frac{1}{3}$ as long, bracts densely brown lepidote; peduncle $5\frac{1}{2}$ –15 dm long, without bracts except for just below spike, spike 7–20 cm long, 3–6 mm in diameter, densely beset with rather small, bilabiate flowerpits in 7–12 almost vertical series, usually less than $\frac{1}{2}$ mm apart; upper lip inconspicuous, lower lip about $1\frac{1}{2}$ mm broad, cleft. Male flowers with the anthers in line with the filament. Fruit subglobose, slightly apiculate at apex, about 7 mm long and 6 mm in diameter; seed 4–5 mm in diameter.

The western Amazon basin to the foot of the Andes in dense, flood-free forest, probably in well-drained places at low altitudes, not recorded above 200 m altitude (map IV, 2).

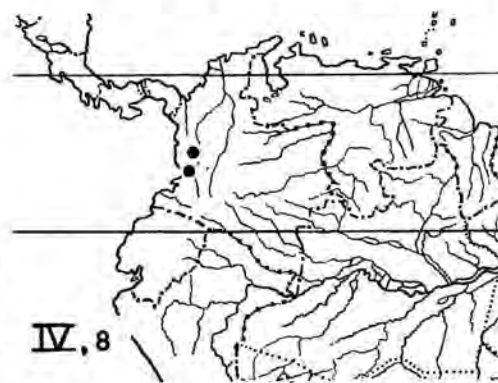
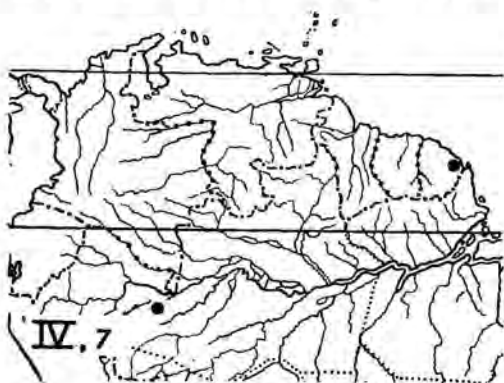
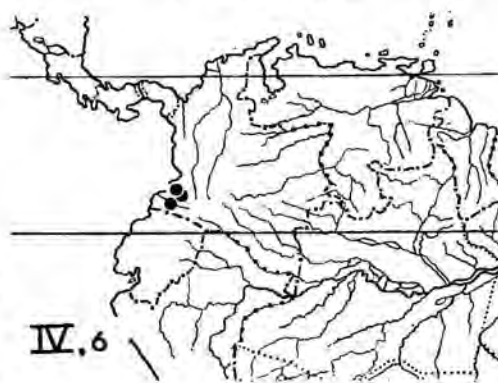
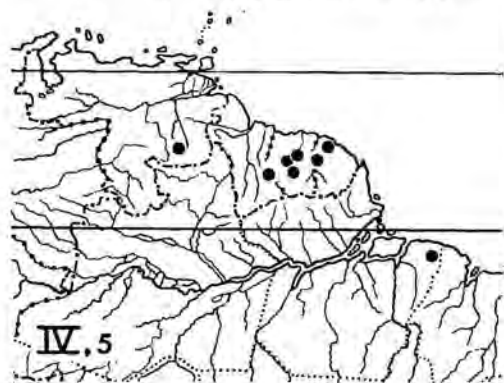
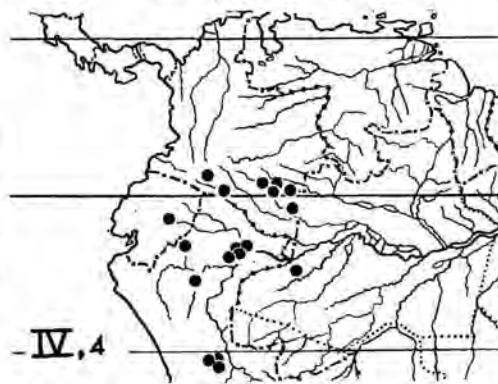
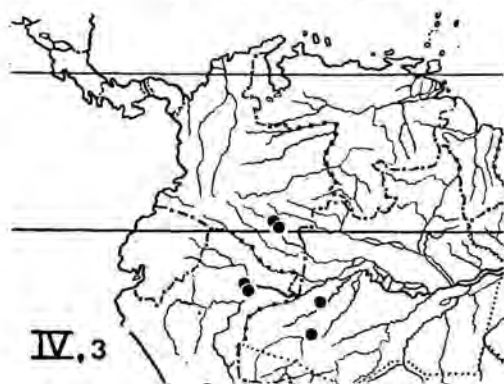
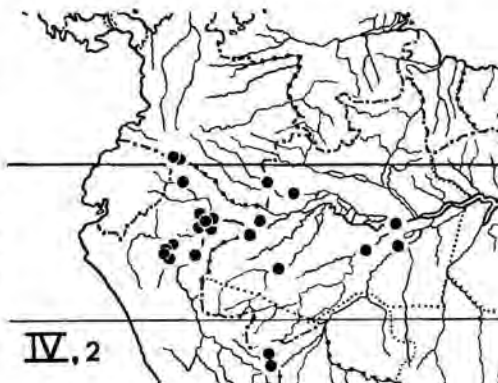
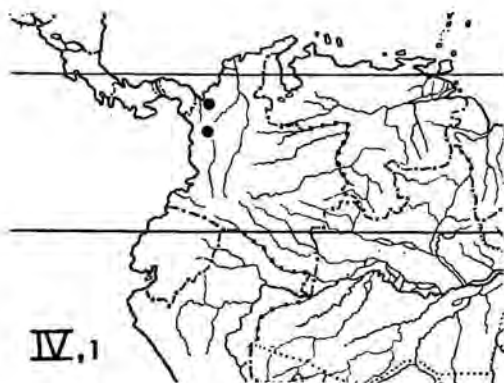
Colombia: Juzepczuk 6260 (LE); Schultes & Black 8339 (BH); Schultes & Cabrera 18967 (BH); 18968 (BH).

Peru: Ducke 7507 (MG); Killip & Smith 27360 (F, US), 28142 (F, US), 28145 (US), 28847 (US), 29373 (US), 29673 (F, US); Klug 448 (F, US); Moore, Salazar & Smith 8433 (BH), 8487 (BH), 8499 (BH), 8502 (BH), 8562 (BH), 8570 (BH), Williams 740 (F), 2991 (F), 3426 (F), 4284 (F), 5100 (F), 5266 (F), 7867 (F).

Brazil: Ducke 6752 (MG), 7431 (MG); Huber 4213 (MG), 4697 (MG), Martius s.n. (M); Trail 1016 / CXXII (K), 1017 / IX (K); Ule 5284 (G, K, L), 5594 (G, L, MG), 6125 (G, L).

G. acaulis is rather variable in size but is otherwise fairly uniform and is characterized by its usually pinnate leaves with more or less sigmoid segments contracted at base, forming a large (50 – 70°) angle with the rachis. The very long pedunculate inflorescence, the spike densely beset with small flowerpits with a deeply cleft lower lip, and the small slightly apiculate fruits are also characteristic.

Martius's original material consists of leaf fragments and 2 inflorescences one of which is twice as long as the other. Drude (*in schedula*) consequently identified the latter as *G. tapajotensis*. No other differences correlated with the difference in size could be traced among the relatively ample gatherings of this species. On the contrary, a continuous series of plants gradually



Maps IV, 1-8. Distribution of *Geonoma* species: IV,1 *G. triandra*; IV,2 *G. acaulis*; IV,3 *G. camana*; IV,4 *G. macrostachys*; IV,5 *G. poiteauana*; IV,6 *G. paradoxa*; IV,7 *G. tamandua*; IV,8 *G. chococola*.

increasing in size from small to rather large was observed. The difference in size seems to be a result of age or environment and does not appear to warrant a separation into a number of species. Therefore *G. tapajotensis* and several of Burret's later segregates are placed in synonymy.

IV B a 2, 3 *Geonoma camana* Trail, J. Bot. 14: 324. 1876; Drude in Martius, Flora Bras. 3(2): 507. 1882.

Homotypic synonym: *Taenianthera camana* (Trail) Burret, Bot. Jahrb. 63: 270. 1930; Dahlgren, Field Mus. Bot. 14: pl 404. 1959; Macbride, Field Mus. Bot. 13: 352. 1960.

Type collection: Trail 977 / CLXXXII, Brazil, Rio Javary (K holotype).

Heterotypic synonyms: *Geonoma lagesiana* Dammer, Verhandl. Bot. Ver. Prov. Brandenb. 48: 121. 1906.

Taenianthera lagesiana (Dammer) Burret, Bot. Jahrb. 63: 270. 1930; Macbride, Field Mus. Bot. 13: 353. 1960.

Type collection: Ule 5745, Brazil, Amazonas, Rio Jurua (G, K, L).

Stem 1–2 m tall, about $2\frac{1}{2}$ cm in diameter, internodes often about 1 cm long; leafsheath more than 2 dm long, gradually narrowed into a 6–10 dm long petiole densely brown lepidote at first, soon becoming glabrous; lamina lustrous above, 6–10 dm long and 3–5 dm wide, irregularly divided and consisting partly of rather broad segments sometimes intermixed with those with 1 vein or regularly pinnate with, except for the apical pair, 1-veined segments only; 25–36 pairs of primary veins prominent above, prominulent below, secondary veins immersed above, below about as prominent as primary veins and brown lepidote, veins emerging at 45–60° from the rachis.

Inflorescence spicate, second bract about 4 dm long, basal bract scarcely half as long; peduncle 7–11 dm long, brown lepidote, spike about $2\frac{1}{2}$ dm long, densely beset with small bilabiate flowerpits, these spirally arranged in more than 10 series; lips rather inconspicuous, lower lip more or less emarginate. Male flowers with the anthers at anthesis in line with the filament. Fruit ovate, black, stipitate, obtuse at apex, often laterally flattened by mutual pressure, 11–13 mm long and 7–8 mm in diameter; seed about 8 mm long and 5 mm in diameter.

Western part of the Amazon basin in low-lying, rather swampy, dense forests (map IV, 3).

Colombia: Juzepczuk 6245 (LE); Schultes & Cabrera 13730 (BH), 16019 (BH). Peru: Killip & Smith 29621 (F, US); Moore, Salazar & Smith 8457 (BH), 8476 (BH).

Brazil: Trail 977 / CLXXXII (K), 979 / CLXXXII B (K), 1013 / CXXVIII (K); Ule 5745 (G, K, L).

G. camana is distinguished by having mature leaves which are lustrous above, and by the relatively large fruits. The type of *G. lagesiana*, Ule 5745, does not have such regularly pinnate leaves as the type of *G. camana*. However, the structure of the leaf and also the inflorescence resemble

the latter so well that there is hardly any doubt as to their conspecificity. Transitions from laminas with a few broad segments to rather regularly pinnate leaves are also observed.

IV B a 2, 4 *Geonoma macrostachys* Martius, Hist. Nat. Palm. 2: 19, t 20. 1823; Martius, Palmet. Orbign. 25, t 11 f 2, 23 B. 1847; Drude in Martius, Flora Bras. 3(2): 504. 1882.

Homotypic synonym: *Taenianthera macrostachys* (Martius) Burret, Bot. Jahrb. 63: 268. 1930; Dahlgren, Field Mus. Bot. 14: pl 405. 1959; Macbride, Field Mus. Bot. 13: 353. 1960.

Type collection: Martius s.n., boundary of Brazil and Colombia, Rio Japurá near Mount Cupatí (M. holotype).

Heterotypic synonym: ? *Geonoma woronowii* Burret, Notizbl. 11: 6. 1930. Type collection: Woronow & Juzepczuk 6119, Colombia, Caquetá, Rio Orteguaza (LE).

"Acaulescent" or with a short stem, leafsheath about $1\frac{1}{2}$ dm long, gradually narrowed into a $3-4\frac{1}{2}$ dm long petiole, deciduously brown furfuraceous; lamina 7-9 dm long and 3-4 dm wide, subsimple or divided into 2-3 pairs of segments, long cuneate at base, broadest above the middle; 20-30 pairs of primary veins prominent above and below, secondary veins immersed above, as prominent as primary veins and slightly brown lepidote below, tertiary veins inconspicuous, veins emerging at 20° (in simple leaves) to 35° (in pinnate leaves) from the rachis.

Inflorescence spicate, second bract about 3 dm long, basal bract about half as long, brown densely lepidote; peduncle 4-8 dm long, laterally compressed, spike 1-2 dm long and 5-8 mm in diameter, with rather large bilabiate flowerpits in about 8 almost vertical series, about $1\frac{1}{2}$ mm apart; upper lip not much protracted, lower lip about 3 mm broad, deeply cleft. Male flowers with the anthers in line with the filament. Fruit subglobose, slightly apiculate at apex, stipitate, 8-9 mm long, 6-7 mm in diameter; seed about 5 mm in diameter.

Western part of the Amazon basin at the foot of the Andes in dense forests. The species prefers apparently slightly higher altitudes than *G. acaulis*, as it is mostly collected from about 100-400 m (map IV, 4).

Colombia: García B. 14974 (BH); Schultes 3406 (BH); Schultes & Cabrera 12812 (BH), 13678 (BH), 15208 (BH), 15447 (BH), 16032 (BH, US), 19789 (BH); Woronow & Juzepczuk 6119 (LE).

Ecuador: Heinrichs 375 (G, M), Mexía 6890 (BH, US).

Peru: Fox 72 (K); Killip & Smith 26455 (US), 26584 (US), 26807 (US), 27295 (F, US), 28895 (US), 29433 (F, US); Moore, Salazar & Smith 8396 (BH), 8426 (BH), 8467 (BH); Poeppig 1509 (L, P); Williams 3769 (F).

Brazil: Martius s.n. (M); Trail 1010 / CCVII (K), 1011 / CLXXXIV (K); Ule 5517 (G).

G. macrostachys is rather close to *G. acaulis* but is distinguished by its often simple leaves with the veins emerging at a more acute angle from the

rachis, and by its inflorescences with relatively slightly shorter peduncles and larger flowerpits. The material studied is more uniform in size than that of *G. acaulis*. The two species also seem to differ in their ecology.

G. woronowii is based on a very poor specimen, Woronow & Juzepczuk 6119, consisting of an unexpanded leaf, a small, probably depauperate inflorescence without flowers or fruits, and some unattached fruit debris. As far as anything can be said about such a poor specimen, it does not militate against a position within *G. macrostachys*.

IV B a 2, 5 *Geonoma poiteauana* Kunth, Enum. Pl. 3: 223. 1841; Wessels Boer, Ind. Palms Sur. 41. 1965.

Based on: *Gynestum acaule* Poiteau, Mém. Mus. Hist. Nat. Paris 9: 391, t 5. 1822. Homotypic synonyms: *Geonoma poiteana* Martius, Palmet. Orbign. 39. 1847; Martius, Hist. Nat. Palm. 3: 317. 1850; (partly) Drude in Martius, Flora Bras. 3(2): 509. 1882.

Geonoma acaulis (Poiteau) Burret, Bot. Jahrb. 63: 162. 1930.

not *Geonoma acaulis* Martius, Hist. Nat. Palm. 2: 18, t 4, 9. 1823.

Type collection: Poiteau s.n., French Guiana (P).

Heterotypic synonyms: ? *Geonoma dammeri* Huber, Bol. Mus. Goeldi 3: 409. 1902; Burret, Bot. Jahrb. 63: 178. 1930.

Type collection: Guedes 2241, Brazil, Pará, Furo Macujubim (not seen).

?*Taenianthera lakoi* Burret, Notizbl. 11: 11. 1930.

Type collection: Lakó, coll. Huebner 128, Brazil, Amazonas, Rio Catrimany (not seen, destroyed at B.).

Geonoma chaunostachys Burret, Bull. Torr. Bot. Cl. 58: 318. 1931.

Type collection: Tate 394, Venezuela, Mt. Duida (NY holotype).

"Acaulescent", up to 1 m tall; petiole including leafsheath 3–4 dm long; lamina simple or divided into a few segments, oblanceolate, long cuneate at base, 6–10 dm long, $1\frac{1}{2}$ (in simple leaves) to $2\frac{1}{2}$ dm (in pinnatisect leaves) wide, segments long caudate-acuminate, lamina strongly plicate, sparsely brown lepidote below; 19–22 pairs of primary veins inconspicuous above, prominent below, secondary veins immersed above, prominent and brown lepidote below, veins emerging at 15–25° from the rachis.

Inflorescence spicate, usually only one per plant; second bract $1\frac{1}{2}$ –3 dm long, basal bract about half as long; peduncle $3\frac{1}{2}$ –7 dm long at anthesis, increasing to 10 dm long in fruit, spike about 1–2 dm long and 5 mm in diameter; bilabiate flowerpits in 5–6 slightly coiled series, 2–3 mm apart; the lower lip cleft. Male flowers with the anthers in line with the filament. Fruit black, ovoid, slightly pointed at apex, 9 mm long and 7 mm in diameter; seed 7 mm long and 5 mm in diameter.

Guiana shield and also collected from the eastern part of the Amazon basin in usually not inundated poorly drained places in (sub)hygrophytic forest. The species seems to be rare (map IV, 5).

Venezuela: Killip 37399 (US, VEN); Tate 394 (NY).

Brazil: Prance & Pennington 1992 (NY).

French Guiana: Leprieur s.n. (P); Poiteau s.n. (P).

Suriname: Boon 1195 (U); Hulk 284 (U); Maguire 24117 (NY, U, US); Stahel 255 b (U); Wessels Boer 1393 (U), 1579 (U), 1586 (U).
British Guiana: Jenman 2071 (K).

G. poiteauana has the typical *Taenianthera* floral morphology and is quite distinct from *G. tamandua*. The latter was incorrectly placed in its synonymy by DRUDE (1882) who did not study material of *G. poiteauana*. *G. dammeri* is only known from its imperfect description. On account of this description it is placed in synonymy here. *G. lakoi*, also without original material available, was considered by its author to be very close to *G. dammeri*. As Burret did not recognize *G. poiteauana* as belonging to *Taenianthera* he did not compare these species with the latter. The description, however, shows their conspecificity. *G. chaunostachys*, based on Tate 394, also belongs here. Because the type has no flowers Burret did not recognize it as a *Taenianthera* species. The specimen is identical with fruiting material of *G. poiteauana* from Suriname and French Guiana.

Group 3: species 6-8.

IV B 3, 6 *Geonoma paradoxa* Burret, Notizbl. 11: 1040. 1934. **Plate II.**

Type collection: Lehmann 8957, Colombia, Rio Timbiqui (K).

Stem short, about $1\frac{1}{2}$ cm in diameter; petiole inclusive of sheath $2\frac{1}{2}$ - $3\frac{1}{2}$ dm long, brown lepidote; rachis 2-3 dm in length; lamina chartaceous, plicate, $2\frac{1}{2}$ -4 dm long and $1\frac{1}{2}$ -2 dm wide, simple to irregularly divided into a few broad segments; 17-30 primary veins prominent above, prominulent below, secondary veins immersed above, prominent and brown lepidote below, tertiary veins prominulent below, veins emerging at 40 - 60° from the rachis.

Inflorescence spicate, erect, about 4 dm long; basal bract $1\frac{1}{2}$ -2 dm long, tubular, second bract much smaller, completely enclosed by the basal one; spike about 10 cm long and $2\frac{1}{2}$ mm in diameter; flowerpits closely together in 6 vertical series, about $1\frac{1}{2}$ mm above each other; lower lip cleft. Male flowers with the anthers reflexed from the filaments. Female flowers with a digitately lobed staminodial tube. Fruit not seen, said to be bright lemon-yellow (Ewan 16871).

Pacific coastal area of Colombia, in rainforests on well-drained places at lower altitudes (map IV, 6).

Colombia: Ewan 16871 (US); Lehmann 8957 (K), BT1118 (K, L).

G. paradoxa was described as having a staminodial tube with long free lobes. As this feature was not shown by the specimens available, the present position is largely based on Burret's observation.

IV B a 3, 7 *Geonoma tamandua* Trail, J. Bot. 14: 323, 1876.

Homotypic synonym: *Taenianthera tamandua* (Trail) Burret, Bot. Jahrb. 63: 268. 1930.

Type collection: Trail 976 / CLXXXIII, Brazil, Amazonas, Rio Javary (K holotype).

"Acaulescent", relatively tall; leafsheath about $1\frac{1}{2}$ dm long; petiole virtually lacking; rachis 10–15 dm long; lamina simple, almost linear, very long cuneate at base, 15–20 dm long and $1\frac{1}{2}$ –2 dm broad, the apical lobes 4–5 dm long; 25–40 pairs of primary veins rather inconspicuous both above and below, secondary veins immersed above, prominent and sparsely brown lepidote below, veins emerging at about 10° from the rachis; lamina strongly plicate, lustrous above, sparsely brown lepidote below.

Inflorescence spicate, basal bract 3–4 dm long, second bract about twice as long; peduncle 4–8 dm long, with a few bracts; bracts and peduncle creamy tomentose, glabrescent; spike 3–5 dm long and 7–10 mm in diameter; flowerpits $1\frac{1}{2}$ mm apart, in 10–11 somewhat oblique, almost vertical series, bilabiate; the upper lip inconspicuous, the lower lip cleft. Male flowers with the anthers sharply reflexed and not in line with the filament. Immature fruit when dry black, rugose, subglobose.

Only known from the type collection and two collections from French Guiana which suggest a rather large area of distribution with a very rare occurrence (map IV, 7).

Brazil: Trail 976 / CLXXXIII (K).

French Guiana: Benoist 1708 (P); Leprieur s.n. (F, G, P).

This relatively tall species with its 2 m long, simple leaves must be very impressive and is certainly very rare as it is so rarely collected. On the other hand, the greatly distant collections in existence suggest a wide distribution. The specimens from French Guiana resemble the type extremely well and there is no doubt about their conspecificity.

The male flowers have stamens with sharply recurved anthers which never come into line with the filament.

IV B a 3, 8 *Geonoma chococola* W. Boer nov. spec. Plate III, IV.

Type collection: Cook 84, Colombia, Buenaventura (US holotype).

Caulis ad ca. 2 m altus, 5 cm crassus. Vagina coriacea. Lamina irregulariter divisa in segmentos aliquot latos, 12–15 dm longa et 3–4 dm lata, supra nidita, modice plicata, nervis primariis ad ca. 50-jugis angulum ca. 30° cum rachide efformantibus.

Spadix spicatus, dense fusco-tomentosus, 9–13 dm longus; fovea verticaliter 11–12-seriatae, labio inferiore valde exserto. Flores masculi post anthesi haud mox decidui; antherae cum filamentis angulum acutum efformantes. Flores feminei tubo staminodiali lobos longos liberos gerente. Fructus ovoideus, 18 mm longus, 14 mm crassus.

Leafsheath about 3 dm long, petiole 3–4 dm long; rachis 9–11 dm long; lamina divided into a few (3) pairs of broad segments, chartaceous;

primary veins prominent above, inconspicuous below, secondary veins slightly immersed above, prominent and densely brown lepidote below, tertiary veins prominent above and below, veins emerging at 30–35° from the rachis.

Inflorescence spicate, densely brown furfuraceous at first, glabrescent; bracts soon becoming fibrous, the basal one $2\frac{1}{2}$ –3 dm long, the second probably only slightly longer; peduncle about 7 dm long at anthesis, elongating in fruit, spike 2– $2\frac{1}{2}$ dm long and about 10 mm in diameter, densely beset with bilabiate flowerpits arranged in 11–12 vertical series; lower lip far protracted, about 3 mm wide and 2 mm long, cleft. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a digitately lobed staminodial tube. Fruit ovoid, 18 mm long and 14 mm in diameter.

Twice recorded from the Pacific coastal area of Colombia, in dense forest (map IV, 8).

Colombia: Cook 84 (US); Killip 35290 (US).

G. chococola is a very characteristic species most closely related to *G. tamandua*. The species is called *chococola* as it seems to be endemic in the Chocó region.

Section b GEONOMA

Type species: *Geonoma simplicifrons* Willdenow.

Small and “acaulescent” to relatively tall with a well-developed stem; lamina anatomically usually with flattened epidermal cells without or sometimes with chloroplasts, hypodermis usually absent, mesophyll cells transversely extended.

Inflorescence spicate to more or less branched with (1–)2(–3) bracts; flowerpits spirally arranged or verticillate or decussate. Male flowers with the anthers sharply reflexed from the filaments. Female flowers usually with a truncate or shortly crenate staminodial tube, sometimes digitately lobed in species with branched inflorescences.

Occurring throughout the area of the genus and with about 65 species.

Group 4: species 9–12.

IV B b 4, 9 *Geonoma cuneata* H. Wendland ex Spruce, J. Linn. Soc. 11: 104. 1869; Burret, Bot. Jahrb. 63: 166. 1930; Standley, Field Mus. Bot. 18: 119. 1937; Dahlgren, Field Mus. Bot. 14: pl. 229. 1959.

Type collection: Wendland s.n., Costa Rica, (K holotype).

Heterotypic synonym: *Geonoma decurrens* H. Wendland ex Burret, Bot. Jahrb. 63: 162. 1930; Bailey, Gent. Herb. 3: 77, f 56–58. 1933; Dahlgren, Field Mus. Bot. 14: pl. 231. 1959.

Type collection: Wendland s.n., Costa Rica, Sarapiquí R. (not seen).

Clustered, cane $\frac{1}{2}$ –2 m tall, 3–4 cm in diameter, internodes $\frac{1}{2}$ –2 $\frac{1}{2}$ cm long; leafsheath about 2 dm long, gradually narrowed into a 1–2 $\frac{1}{2}$ dm long petiole at first brown furfuraceous, soon glabrescent; rachis about 5 dm long; lamina oblong, 7–8 dm long, 2–3 dm wide, simple or divided into 4–7 unequal segments, long cuneate at base; about 30 pairs of primary veins prominent above, prominent below, secondary veins slightly immersed above, prominent and lepidote below, tertiary veins and cross-veinlets evident, veins usually emerging at about 20° from the rachis.

Inflorescence spicate, 2 tubular bracts inserted closely together at the base of the peduncle, basal bract 2–3 dm long, second bract usually about 1 $\frac{1}{2}$ dm longer, bracts densely brown tomentose; peduncle 5–7 dm long, spike 1 $\frac{1}{2}$ –3 dm long, 4–8 mm in diameter, tapering into an up to 2 $\frac{1}{2}$ cm long point; bilabiate flowerpits in 7–10 somewhat oblique series, 1–2 mm apart; upper lip inconspicuous, lower lip semicircular, about 2 mm in diameter, often slightly emarginate. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a truncate staminodial tube. Fruit yellowish-green, ovoid, narrowed at base and slightly apiculate at apex, about 8 mm long and 6 mm in diameter; seed about 5 mm in diameter.

Central America and adjacent north-western South America, from Nicaragua to Colombia, in dense forests at low altitudes, not collected at altitudes above 100 m (map IV, 9).

Nicaragua: Oersted 6567 (C, US).

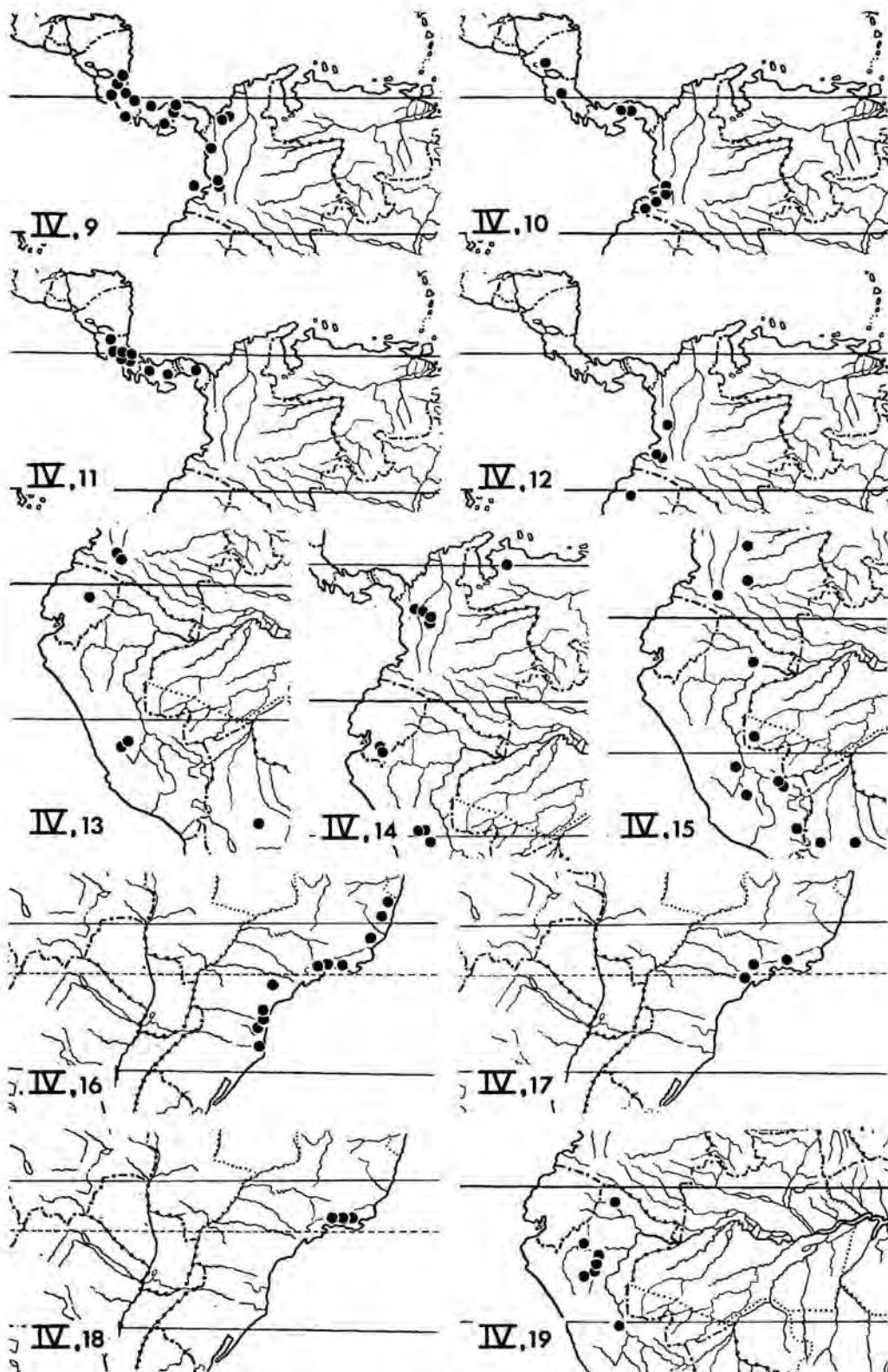
Costa Rica: Cook & Doyle 431 (US), 588 (US), 5476 (US); Dodge & Goerger 9957 (F); Pittier 16712 (US), 16716 (US), 16718 (US); Wendland s.n. (K).

Panama: Allen 1838 (F); Aviles 2 (F), 1001 (F); Bangham 475 (F); Dodge & Allen 17126 (G); Hart 171 (US); Kenoyer 166 (US); Maxon 6897 (US); 6906 (US); Pittier 2284 (US); Shattuck 642 (F), 1001 (US); Standley 27498 (US); 40896 (US); Woodson, Allen & Seiberts 1946 (BM).

Colombia: Fernandez 406 (US); Hodge 6999 (BH); 7011 (BH); Killip & Cuatrecasas 38779 (US); Killip & Garcia 33160 (BM, US), 33287 (BM, US), 33519 (US); Sierra Soto & Barkley 18C631 (BH, US).

The type of *G. decurrens* was lost in the war. As the descriptions of *G. cuneata* and *G. decurrens* are very similar and specimens identified with these species by later botanists cannot be separated, the names are certainly synonyms.

G. cuneata is easily mistaken for several other *Geonoma* species with a long pedunculate spicate inflorescence. Fortunately the species is only sympatric with *G. procumbens* (for differences see the discussion of that species) and *G. sodiroi* which is smaller in all dimensions and has veins issuing at a less acute angle from the rachis, and the second bract of *G. sodiroi* is much longer than the basal one. Other species, like *G. gracilis*, *G. jussieuana*, *G. macrostachys*, *G. lehmannii*, etc. occur at much higher altitudes or are allopatric.



Maps IV,9-19. Distribution of *Geonoma* species; IV,9 *G. cuneata*; IV,10 *G. procumbens*; IV,11 *G. gracilis*; IV,12 *G. sodiroi*; IV,13 *G. jussieuana*; IV,14 *G. lehmannii*; IV,15 *G. brongniartii*; IV,16 *G. elegans*; IV,17 *G. rodeiensis*; IV,18 *G. trinervis*; IV,19 *G. poeppigiana*.

IV B b 4, 10 *Geonoma procumbens* H. Wendland ex Spruce, J. Linn. Soc. 11: 105. 1869; Burret, Bot. Jahrb. 63: 166. 1930; Bailey, Gent. Herb. 3: 75, f 55. 1933; Standley, Field Mus. Bot. 18: 121. 1937.

Type collection: Wendland s.n., Costa Rica, Sarapiquí R. (K holotype).

Clustered or sometimes solitary; cane at first erect, later creeping, up to 2 m long and 3–6 cm in diameter, internodes $\frac{1}{2}$ –1 cm long, rooting at the nodes; leafsheath 3–6 dm long, gradually narrowed into a 6–10 dm long, almost cylindrical petiole; rachis 8–10 dm long; lamina divided into 12–16 pairs of unequal segments 3–5 $\frac{1}{2}$ dm long and 1 $\frac{1}{2}$ –6 cm wide, terminal segments 2–3 dm long and 5–7 cm wide, segments lanceolate, falcate, strongly narrowed at base and long caudate-acuminate at apex; 25–30 pairs of primary veins prominent above and below, secondary veins inconspicuous above and below, veins emerging at 50–60° from the rachis.

Inflorescence spicate, with 2 tubular bracts inserted closely together at the base of the peduncle, basal bract 1–3 dm long, the second one 5–7 dm long, both greyish-lepidote; peduncle 5–10 dm long, spike 2–5 dm long and 5–8 mm in diameter, tapering into a sterile point 1–3 cm long; bilabiate flowerpits arranged in 10–12 almost vertical series and in more or less regularly alternating whorls about 1 mm apart; upper lip inconspicuous, lower lip prominent and slightly emarginate. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit purplish-black, ovoid, about 8 mm long, 5 mm in diameter; seed 5 $\frac{1}{2}$ mm long and 4 mm in diameter.

Central America and adjacent north-western South-America, from Nicaragua to Colombia, in wet forests at low altitudes, not collected above 150 m (map IV, 10).

Nicaragua: Shank & Molina R. 4897 (F).

Costa Rica: Cook & Doyle 62 (US); Wendland s.n. (K).

Panama: Kenoyer 167 (US); Maxon 6870 (US); 6899 (F, US); Pittier 4321 (US); 6846 (US); Standley 41109 (US).

Colombia: Alston 8493 (BM); Doyle 1 (US); Killip 5261 (US).

G. procumbens is closely related to the sympatric *G. cuneata*. The first grows somewhat more robust, the leaves are usually more or less regularly pinnate with falcate, relatively thick segments forming an angle of about 50° with the rachis, the second bract is more than two times as long as the basal one, and the spike is more densely beset with smaller flowerpits.

IV B b 4, 11 *Geonoma gracilis* H. Wendland ex Spruce, J. Linn. Soc. 11: 105. 1869; Burret, Bot. Jahrb. 63: 164. 1930; Standley, Field Mus. Bot. 18: 120. 1937; Dahlgren, Field Mus. Bot. 14: pl 241. 1959.

Type collection: Wendland s.n., Costa Rica, Sarapiquí R., near Pedregal (K holotype).

Heterotypic synonym: *Geonoma obovata* H. Wendland ex Spruce, J. Linn.

Soc. 11: 104. 1869; Burret, Bot. Jahrb. 63: 163. 1930; Standley, Field Mus. Bot. 18: 121. 1937; Dahlgren, Field Mus. Bot. 14: pl 261. 1959.

Type collection: Wendland s.n., Costa Rica, Sarapiquí R. near Pedregal (K holotype).

Solitary, cane $\frac{1}{2}$ –1 m tall, 1–2 cm in diameter, internodes up to about 1 cm long; leafsheath 1–1 $\frac{1}{2}$ dm long; petiole 2 $\frac{1}{2}$ –5 $\frac{1}{2}$ dm long, brown lepidote at first, soon glabrescent; lamina obovate, cuneate at base, 3–4 $\frac{1}{2}$ dm long, 2–3 dm wide, simple to irregularly divided into 2–5 segments, apical segments 1 $\frac{1}{2}$ –2 $\frac{1}{2}$ dm long; 16–25(30) pairs of primary veins, prominent above, very inconspicuous or even slightly immersed below, secondary veins immersed above and prominent below, veins emerging at about 40° from the rachis.

Inflorescences spicate, with 2 tubular bracts inserted closely together at the base of the peduncle, basal bract 12–15 cm long, the second one about 1 $\frac{1}{2}$ times as long; spike 11–22 cm long, 3–4 mm in diameter, tapering into a sterile point about 1 cm long; bilabiate flowerpits spirally arranged in 5–8 series, about 2 mm apart; lower lip at anthesis slightly emarginate. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit greenish, ovoid, pointed at base and apex, about 8 mm long and 6 mm in diameter; seed subglobose, about 5 mm in diameter.

Costa Rica and Panama, in dense and wet forests on mountain slopes, at 600–2000 m (map IV, 11).

Costa Rica: Brenz 4473 (F); 13588 (F); Austin Smith H774 (F); Standley & Valerio 45643 (US), 46303 (US), 46340 (US); Tonduz 7972 (BR), 11263 (US); Valerio 20 (US); Wendland s.n. (K).

Panama: Davidson 331 (F); Goldman 1970 (US); Woodson & Schery 173 (BM).

G. gracilis and *G. obovata* are very similar and the two are certainly conspecific. Wendland collected both types on the same date in the same locality, namely: "anfangs August 1857 bei Pedregal im unteren Sarapiquí-Tal des nördlichen Costarica" cf. BURRET (1930). STANDLEY (1937), however, reported *G. gracilis* as occurring at 1100 m altitude and *G. obovata* on the Atlantic coast. This is probably an error, as the specimens studied all came from 600 m or higher. *G. gracilis* is closely related to *G. cuneata* and *G. procumbens*. The latter species are distinguished by a more robust habit and are not collected from elevations above 200 m.

IV B b 4, 12 *Geonoma sodiroi* Dammer ex Burret, Bot. Jahrb. 63: 165. 1930.

Type collection: Sodiro 187/1, Ecuador, Santo Domingo (P).

Heterotypic synonyms: ? *Geonoma linearis* Burret, Notizbl. 11: 861. 1933.

Type collection: Lehmann 51, Colombia, Barbacoas, Río Telembí (not seen, destroyed at B).

Geonoma gibbosa Burret, Notizbl. 13: 342. 1936.

Type collection: Schultze-Rhonhof 2021, Ecuador, San Carlos de los Colorados (not seen, destroyed at B).

Stem up to about 2 m tall and 2 cm in diameter; leafsheath about 1 dm long, brown tomentose; petiole $2\frac{1}{2}$ – $3\frac{1}{2}$ dm long, at first densely brown furfuraceous, glabrescent; lamina sometimes simple, obovate, cuneate at base, $2\frac{1}{2}$ – $5\frac{1}{2}$ dm long and $1\frac{1}{2}$ – $2\frac{1}{2}$ dm wide, often larger up to 6 dm long and 3 dm wide and more or less divided into a few segments or even into a large number of linear, 1-veined, slightly falcate segments; 23–30 pairs of primary veins prominent above and prominent below, secondary veins immersed above, prominent and brownish lepidote below, tertiary veins prominent below, veins emerging from the rachis at 25° (in simple leaves) to 60° (in pinnate leaves).

Inflorescence spicate, 2 tubular bracts inserted at the base of the peduncle, basal bract $\frac{1}{2}$ –1 dm long, second one $1\frac{1}{2}$ – $2\frac{1}{2}$ dm long; peduncle 3–5 dm in length, spike 1 – $1\frac{1}{2}$ dm long and $3\frac{1}{2}$ –5 mm in diameter; bilabiate flowerpits spirally arranged in 4–7 series, 2–3 mm apart; upper lip inconspicuous, lower lip prominent, emarginate. Male flowers with the anthers reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit not seen.

Pacific coastal areas of Colombia and Ecuador, in rainforests at low altitudes, not collected above 150 m (map IV, 12).

Colombia: Cook 143 (BH, US); Cuatrecasas 15753 (BH), 16042 (BH); Foster & Foster 2315 (BH); Killip 35375 (BM, US); Killip & García 33419 (US).

Ecuador: Sodiro 187/1 (P).

G. sodiroi in the present circumscription proves to have rather variable leaves. On the basis of this variability the synonymous names have been described. The type of *G. linearis* is apparently lost, but Killip 35375, a specimen without inflorescence, matches the description so well that it seems to be almost identical with the original specimen. As it also resembles the type of *G. sodiroi* rather well, the two are thought to be conspecific. Furthermore the description of *G. gibbosa* closely resembles that of *G. sodiroi* and even Burret himself regarded them as very similar. The number of segments and series of flowerpits are rather unreliable characters. Moreover, transitions are found.

Group 5: species 13–15.

IV B b 5, 13 *Geonoma jussieuana* Martius, Palmet. Orbign. 24, t 12 f 1, 23 A f 1. 1847; Burret, Bot. Jahrb. 63: 172, 1930; Dahlgren, Field Mus. Bot. 14: pl 247. 1959.

Type collection: d'Orbigny 45, Bolivia, Cochabamba (P).

Heterotypic synonyms: ? *Geonoma adscendens* Burret, Bot. Jahrb. 63: 175. 1930.

Type collection: Weberbauer 5033, Peru, Cuzco, Sta Ana (not seen, destroyed at B).

Geonoma cuneatoidea Burret, Bot. Jahrb. 63: 167. 1930.

Type collection: Kalbreyer 1828, Colombia, Antioquia, Murri (not seen, destroyed at B).

Geonoma gracillima Burret, Bot. Jahrb. 63: 165. 1930.

Type collection: Kalbreyer 1824, Colombia, Antioquia, Murri (not seen, destroyed at B).

? *Geonoma grandifrons* Burret, Bot. Jahrb. 63: 163. 1930.

Type collection: Kalbreyer 1885, Colombia, Antioquia, Cienegatas (not seen, destroyed at B).

Geonoma pleioneura Burret, Notizbl. 11: 234. 1931.

Type collection: Hopp 1040, Ecuador, Archidona (B, scrap only).

? *Geonoma brachystachys* Burret, Notizbl. 15: 23. 1940.

Type collection: Schultze-Rhonhof 2788, Ecuador, Mera, Pastaza (not seen, destroyed at B).

? *Geonoma campylostachys* Burret, Notizbl. 15: 24. 1940.

Type collection: Schultze-Rhonhof 2785, Ecuador, Mera, Pastaza (not seen, destroyed at B).

? *Geonoma cernua* Burret, Notizbl. 15: 24. 1940.

Type collection: Schultze-Rhonhof 2888, Ecuador, Mera, Pastaza (not seen, destroyed at B).

Taenianthera multisecta Burret, Notizbl. 11: 13. 1930.

Geonoma multisecta (Burret) Burret, Notizbl. 12: 155. 1934; Macbride, Field Mus. Bot. 13: 346. 1960.

Type collection: Woronow & Juzepczuk 5862, Colombia, Caquetá, Sucre (LE).

Taenianthera weberbaueri Burret, Bot. Jahrb. 63: 269. 1930; Burret, Notizbl. 12: 155. 1934.

Type collection: Weberbauer 3450, Peru, Huánuco, Mousón (not seen, destroyed at B).

Cane lacking or up to 1 m tall, about 2 cm in diameter, densely ringed; leafsheath about 2 dm long petiole 4–5 dm in length, densely brown furfuraceous, glabrescent; lamina 5–8 dm long and 2–4 dm wide, with a few to several (2–9) pairs of segments, apical segments up to 2½ dm long; 25–33 pairs of primary veins prominulent above and below, secondary veins inconspicuous above, prominulent and brown lepidote below, veins emerging at about 35° from the rachis.

Inflorescences spicate, with 2 tubular bracts, second bract about 3 dm long, basal bract shorter; peduncle up to 10 dm long, brown lepidote, glabrescent, spike 13–22 cm long and about 5 mm in diameter, somewhat sparsely covered with spirally arranged, bilabiate flowerpits, in about 7 rows, and about 2 mm apart; upper lip inconspicuous, lower lip rather far protracted and deeply cleft. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit (immature) green on a reddish peduncle, shortly pointed at apex, about 10 mm long and 6 mm in diameter.

Andes from Colombia to Bolivia, in dense forests on mountain slopes at altitudes of 700–1700 m (map IV, 13).

Colombia: Uribe P. 1130 (US); Woronow & Juzepczuk 5862 (LE).

Ecuador: Heinrichs 375 (G, M).

Peru: Killip & Smith 23860 (US), 24702 (US); Vargas C. 15406 (BH).

Bolivia: d'Orbigny 45 (P).

This poorly collected and consequently poorly known species was misunderstood by Burret who did not study d'Orbigny's original collection. This may be the reason why he described several, slightly different specimens collected at a later date as new species. Moreover Burret expected *Geonoma* specimens with long pedunculate, spicate inflorescences to have flowers of the *Taenianthera* type. Therefore two such specimens described as new *Taenianthera* species (*T. multisecta* and *T. weberbaueri*) turned out to be *Geonoma* (BURRET, 1934).

Since the base of the peduncle could not be studied in the material available there is no information about the insertion of the bracts. In consequence *G. jussieuana* has been entered twice in the key.

The position of *G. adscendens* is very uncertain and it is placed here rather arbitrarily. Furthermore the status of *G. brachystachys*, *G. campylostachys*, and *G. cernua* remain rather uncertain as there is no original material available and the descriptions do not reveal appreciable differences.

IV B b 5, 14 *Geonoma lehmannii* Burret, Bot. Jahrb. 63: 180. 1930.

Type collection: Lehmann 4630, Colombia, Antioquia (K).

Heterotypic synonyms: ? *Geonoma acutangula* Burret, Bot. Jahrb. 63: 177. 1930.

Type collection: Kalbreyer 1570, Colombia, Antioquia (not seen, destroyed at B).

Geonoma helminthostachys Burret, Bot. Jahrb. 63: 176. 1930.

Type collection: Lehmann 7223, Colombia, Antioquia (F, K).

Geonoma parvifrons Burret, Bot. Jahrb. 63: 178. 1930.

Type collection: Lehmann 5288, Ecuador, Loja to Zamora (K).

? *Geonoma amoena* Burret, Notizbl. 11: 862. 1933.

Type collection: Lehmann 2266, Colombia, Tolima (not seen, destroyed at B).

Cane up to 3 m tall, about $2\frac{1}{2}$ cm in diameter; leafsheath about 2 dm long; petiole $3-5\frac{1}{2}$ dm long, at first brown lepidote; lamina $3-6$ dm long and $1\frac{1}{2}-4$ dm wide, irregularly pinnate or sometimes simple, usually with 3-8 unequal segments, often more or less contracted at base, subcoriaceous, more or less plicate; 15-26 pairs of primary veins prominent above and below, secondary veins immersed above, prominent and brown lepidote below, veins emerging at $30-40^\circ$ from the rachis.

Inflorescences spicate, 2 tubular bracts inserted far apart, basal bract 2-3 dm long, inserted 1-3 cm above base of peduncle, second bract $2\frac{1}{2}-3\frac{1}{2}$ dm long and inserted $1-3\frac{1}{2}$ dm higher; peduncle $3\frac{1}{2}-5$ dm long, spike 2-3 dm long and 4-6 mm in diameter, sparsely covered with large, bilabiate flowerpits spirally arranged in about 5 series, 3-4 mm apart; lips conspicuous, lower lip at first entire, later cleft. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit black, immature about 1 cm long and 7 mm in diameter, apiculate at apex.

Panama and South America from Venezuela to Peru on mountain slopes of the Andes, in dense forests, at 1500-2500 m (map IV, 14).

Panama: Pittier 3171 (US).

Venezuela: Foldats 2446 (VEN); Steyermark & Rabe 97402 (BH); Tamayo 2529 (US, VEN).

Colombia: Archer 1370 (US); Bro. Daniel 569 (US), 4167 (US); Gutierrez V. & Rueda R. 26 (F); Lehmann 4630 (K); 7223 (F, K).

Ecuador: Lehmann 5288 (K); Steyermark 53629 (F); 53632 (F).

Peru: Killip & Smith 25821 (F, US); Mexia 7763 (F, K, UC, US), 7764 (US).

G. lehmannii is distinctive among the other species with a spicate inflorescence occurring at high altitudes by its inflorescences in which the second bract is sometimes partly enclosed by the basal one but the bracts are inserted far apart, and further by the large, bilabiate flowerpits with an at first entire but later cleft lower lip.

Burret described other specimens as separate species and these are placed here in the synonymy. All these specimens agree fairly well in the above-mentioned important characters and seem to differ mainly in size and in the division of the leaves. Unfortunately the present opinion is largely based on descriptions, as the original material, except for *G. helminthostachys* and *G. parvifrons*, was destroyed in the war.

IV B b 5, 15 *Geonoma brongniartii* Martius, Palmet. Orbign. 24, t 12, 23 C f 1. 1847; Burret, Bot. Jahrb. 63: 174. 1930; Dahlgren, Field Mus. Bot. 4: pl 225. 1959; Macbride, Field Mus. Bot. 13: 339. 1960.

Type collection: d'Orbigny 39, Bolivia, Yuracare (F, P).

Heterotypic synonyms: *Geonoma metensis* Karsten, Linnaea 28: 409. 1856; Burret, Bot. Jahrb. 63: 173. 1930; Dahlgren, Field Mus. Bot. 14: pl 257. 1959.

Type collection: Karsten s.n., Colombia, Villavicencio (LE).

Geonoma werdermannii Burret, Bot. Jahrb. 63: 173. 1930.

Type collection: Werdermann 2183, Bolivia, El Beni, Mission Todos Santos (not seen, destroyed at B).

Geonoma cuneifolia Burret, Notizbl. 11: 199. 1931; Macbride, Field Mus. Bot. 13: 341. 1960.

Type collection: Tessmann 3317, Peru, Río Ucayali (B, scrap only).

Subcaulescent, stem varying from almost absent to 8 dm tall; leafsheath about 1 dm long; petiole 3–5 dm in length, brown densely leprose at first; lamina 5–8 dm long and 3–4 dm wide, variably pinnatisect or rarely simple; 28–36 pairs of primary veins prominent above and prominent below, secondary veins immersed above, prominent below, veins emerging at about 45° from the rachis but at a more acute angle in simple leaves.

Inflorescence spicate, bracts tubular, membranaceous, basal bract 2½–3½ dm long, second one 8–14 cm higher inserted, exceeding the basal by a few cm, peduncle 4–5 dm long, with a few small bracts, spike 2–3½ dm long and 3–5 mm in diameter, tapering into a very slender point 2–5 cm long; flowerpits spirally arranged, inconspicuously bilabiate, lower lip at first entire, soon emarginate; inflorescence at first brown lepidote, later glabrescent. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Mature fruit

black, globose, about 8 mm in diameter, more or less rugose when dry.

Mainly known from the eastern slopes of the Andes, from Colombia to Bolivia, at rather low altitudes, usually 250–550 m. There are also a few collections from sandstone mountains east of the Andes in Colombia (map IV, 15).

Colombia: Karsten s.n. (LE); Philipson, Idrobo & Fernandes 1544 (BM); Sprague 349 (K, US); Triana 724 (P).

Peru: Hodge 6079 (BH, US); Huber 1381 (MG); Killip & Smith 22899 (US), 23006 (F, US), 26722 (F, US); Moore, Salazar & Smith 8468 (BH), 8577 (BH), 8592 (BH); Vargas C. 15405 (BH).

Bolivia: Krukoff 10808 (F, US), 10836 (F; d'Orbigny 38 (P), 39 (F, P).

Brazil: Ule 5593 (G, GOET, K, L, MG).

This subcaulescent species is characterized by a spicate, long caudate inflorescence with the second bract hardly exceeding the basal one in length but inserted about 1 dm higher. The species shows some variation in size and division of the leaves, supposedly correlated with the age of the plant. The simple leaves, rather long cuneate at base, are connected by a series of intermediates to more or less regularly pinnate leaves in which the veins emerge from the rachis at a less acute angle. The listed synonyms fall within this range of variability. In all probability Karsten did not compare his species with *G. brongniartii* because he overlooked it. Burret placed his two new species in very close relationship to *G. brongniartii*. The differences used by him to distinguish them are very subtle and proved to be unsatisfactory and not worthwhile.

Group 6: species 16–18.

IV B b 6, 16 *Geonoma elegans* Martius, Hist. Nat. Palm. 2: 144, t 18 A. 1826; Spruce, J. Linn. Soc. 11: 104. 1869; Drude in Martius, Flora Bras. 3(2): 505, t 121. 1882; Burret, Bot. Jahrb. 63: 178. 1930; Dahlgren, Field Mus. Bot. 14: pl 236. 1959.

Type collection: Schott s.n., Brazil, Rio de Janeiro (not seen, not found in M or R).

Heterotypic synonyms: *Geonoma elegans* Martius var. *robusta* Drude in Martius, Flora Bras. 3(2): 506, t 121. 1882; Burret, Bot. Jahrb. 63: 178. 1930; Dahlgren, Field Mus. Bot. 14: pl 237. 1959.

Type collection: Glaziou 9018, Brazil, Rio de Janeiro (C, LE, P).

Geonoma bifurca Drude & H. Wendland in Martius, Flora Bras. 3(2): 504, t 120. 1882; Burret, Bot. Jahrb. 63: 163. 1930; Dahlgren, Field Mus. Bot. 14: pl 222. 1959.

Type collection: Riedel 732, Brazil, Rio de Janeiro (C, F, GOET, LE, M, P)..

Geonoma olfersiana Klotzsch ex Drude in Martius, Flora Bras. 3(2): 506, t 119. 1882; Burret, Bot. Jahrb. 63: 173. 1930.

Type collection: Sellow s.n., Brazil, Rio de Janeiro (not seen, not found in S).

Clustered, 2–3 m tall, cane 7–14 mm in diameter, internodes $\frac{1}{2}$ –2 cm long; leafsheath about 1 dm long; petiole 1–2 dm in length; rachis 2–3 dm long; lamina lanceolate, 4–5 $\frac{1}{2}$ dm long and 12–20 cm wide, irregularly

pinnatisect, often trijugate, intermixed with a few 1-veined segments; 20–25 pairs of primary veins prominent above, subprominent and glabrous below, secondary veins slightly immersed above, prominent and brown lepidote below, veins emerging at about 35° from the rachis.

Inflorescence spicate, interfoliar; 2 tubular bracts membranaceous, basal bract about $1\frac{1}{2}$ – $2\frac{1}{2}$ dm long, inserted sometimes up to 3 cm above the base of the peduncle, second bract exceeding the basal by about $1\frac{1}{2}$ dm and inserted about 1 dm higher; peduncle $2\frac{1}{2}$ –5 dm long, with a few acute bracts, spike $1\frac{1}{2}$ –3 dm long and 3–5 mm in diameter, at first densely reddish-brown floccose, later glabrescent; flowerpits bilabiate, spirally arranged, 2–3 mm apart; lower lip cleft. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit black, ovoid, slightly apiculate, 9 mm long and $7\frac{1}{2}$ mm in diameter; seed almost globular, $5\frac{1}{2}$ mm in diameter.

Coastal area of south-eastern Brazil from sea-level up to 700 m altitude, in wet but well-drained forests on hillsides and mountain slopes (map IV, 16).

Brazil: Blanchet s.n. (G); Brade 18126 (RB), 18427 (RB), 18454 (RB); Duarte 3615 (RB); Glaziou 1177 (P), 9018 (C, LE, P), 10114 (C, P), 10114 a (P); Hatschbach 7794 (L); Kuhlmann 126 (RB), 06425 (RB); Lhotsky s.n. (G); Luetzelburg 20118 (BH, M), 20120 (BH, M), 24027 (M); Occhioni 100 (RB); Reitz 2008 (HBR, US), 3814 (HBR), 4402 (HBR), C 1703 (HBR); Reitz & Klein 1530 (HBR, US), 1684 (HBR), 2036 (HBR), 2921 (HBR), 4476 (HBR), 6542 (HBR); Riedel 732 (C, F; GOET, LE, M, P), 733 (C, F, GOET, LE, M, P, US); Riedel & Luschnath 4 (LE) Smith & Reitz 5712 (US); Ule 865 (US); Weddell 361 (P), 773 (P, US).

G. elegans extends very far south and is rather uniform except in size. The separation of a variety *robusta* was already doubted by Burret and is not tenable. Riedel 732, a robust specimen with simple leaves, agrees so well in other respects that its conspecificity can hardly be doubted. The differences are satisfactorily explained by a supposedly young age. The type of *G. olfersiana* was not available for the present study but the description and also the collecting locality are in favour of uniting it with *G. elegans*.

G. elegans var. *amazonica* Trail does not belong here but represents a separate species, *G. piscicauda*.

IV B b 6, 17 *Geonoma rodeiensis* Barbosa Rodrigues, Les Palm. 42. 1882; Barbosa Rodrigues, Sert. Palm 1: 22, t 11, 32 A. 1903; Burret, Bot. Jahrb. 63: 207. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 11. 1903.

Clustered, up to 4 m tall, cane about $1\frac{1}{2}$ cm in diameter, with short internodes; leafsheath about $1\frac{1}{2}$ dm long; petiole to 8 dm long; rachis $2\frac{1}{2}$ –3 dm in length; sheath, rachis, and petiole at first brown tomentose, soon glabrescent; lamina ovoid, about 4– $5\frac{1}{2}$ dm long, $3\frac{1}{2}$ –5 dm wide, usually with 3 pairs of broad segments intermixed with one or more pairs

of 1-veined linear segments, these slightly falcate, notably the basal pairs which are contracted at the base; 18-20 pairs of primary veins prominent above and below, secondary veins slightly immersed above, prominent below, veins emerging at about 45° from the rachis.

Inflorescences once branched; 2 enlarged bracts, pergamentaceous, flattened, about equally long at apex, inserted about 2 cm apart at the base of the peduncle, basal bract about 2 dm long and 2 cm wide; peduncle enclosed by the enlarged bracts, rachis very short to almost lacking, with 2-4 rachillas $3-3\frac{1}{2}$ dm long and 4-6 mm in diameter; bilabiate flowerpits arranged in 5 spiral series, 2-4 mm apart; lower lip cleft; inflorescence at first very densely reddish-brown floccose. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit purplish-black, ovoid, shortly pointed at apex, 10 mm long and 8 mm in diameter; seed subglobose, 6 mm in diameter.

Only known from the mountains of São Paulo and Rio de Janeiro, not far from the coast, in dense forests (map IV, 17).

Brazil: Bowie & Cunningham s.n. (BM); St. Hilaire D-813 (P); de Saldanha 8607 (R).

G. rodeiensis is a very characteristic species, closely related to *G. elegans* and *G. trinervis*. It is distinguished from *G. elegans* by the branched inflorescence, from *G. trinervis* by the leaves and the more elongate inflorescence.

IV B b 6, 18 *Geonoma trinervis* Drude & H. Wendland in Martius, Flora Bras. 3(2): 492, t 112. 1882; Burret. Bot. Jahrb. 63: 194, 1930; Dahlgren, Field Mus. Bot. 14: pl 294. 1959.

Type collection: Riedel 734, Brazil, Rio de Janeiro, Serra dos Orgãos (F, K, LE, P).

Slender, up to 2-3 m tall, cane about $1\frac{1}{2}$ cm in diameter with apparently short internodes; leafsheath about 1 dm long, fibrous; petiole $2\frac{1}{2}$ -3 dm in length; rachis $2\frac{1}{2}$ -4 dm long; lamina lanceolate, $3\frac{1}{2}$ -5 dm long and $1\frac{1}{2}$ -2½ dm wide, regularly divided into 15-21 pairs of slightly falcate segments with 1 primary vein (midvein) prominent above, scaly and prominent below, secondary veins inconspicuous above, prominent below, usually 2 per segment, veins emerging at about 40° from the rachis.

Inflorescence once branched; 2 enlarged bracts coriaceous, flattened, about equally long, inserted about 1 cm apart at the base of the peduncle, $1-1\frac{1}{2}$ dm long and $2-2\frac{1}{2}$ cm wide; peduncle enclosed by the enlarged bracts and 3 small bracts of which the lowermost is often rather large, rachis only a few cm long, with 3-5 rachillas $1\frac{1}{2}$ -2½ dm long and about 5 mm in diameter; bilabiate flowerpits verticillate in 3- or 4-fid whorls 2-3 mm apart; lower lip at first entire; inflorescence at first brown floccose,

later glabrescent and then rugose. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit purplish-black, ovoid, shortly pointed at apex, about 10 mm long and 8 mm in diameter.

Only known from the mountains of Rio de Janeiro, in dense forests (map IV, 18).

Brazil: "Admiralitat s.n. (M); Glazion 2754 (P); Riedel 734 (F, K, LE, P); de Saldanha 7090 (R).

G. trinervis is distinguished from its closest relatives by the regularly pinnate leaves and the thick-set inflorescences with verticillate flowerpits.

Group 7: species 19.

IV B b 7, 19 *Geonoma poeppigiana* Martius, Palmet. Orbign. 35. 1847; Burret, Bot. Jahrb. 63: 263. 1930; Burret, Notizbl. 11: 321. 1931; Macbride, Field Mus. Bot. 13: 347. 1960.

Type collection: Poeppig 2295 / 2326 B, Peru, Yurimaguas (LE, M holotype).

Solitary, stem lacking or up to 4 m tall; leafsheath 1–3 dm long; petiole 4–8 dm in length, at first densely reddish-brown tomentose, glabrescent; lamina about 8–12 dm long and 3–5 dm wide, usually irregularly divided into unequal segments or rarely simple, segments lanceolate, 3–5 dm long and 2–7 cm wide, sometimes intermixed with linear pinnae; lamina brownish-grey below; primary veins prominent above and below, secondary veins slightly immersed above, prominent and brown lepidote below, veins emerging from the rachis at 20° (in simple leaves) to 45° (in divided leaves).

Inflorescences variable in size, once branched; 2 enlarged bracts about equally long, chartaceous, the basal one 1½–4 dm long and 2–4 cm wide, the second inserted about 1½ cm higher and in small inflorescences somewhat larger than the basal bract but in large inflorescences in contrast slightly shorter; peduncle 3–6 dm long, rachis ½–1½ dm wide, with 4–9 simple rachillas 1½–5 dm long and 3–6 mm in diameter, tapering into a slender, sterile point; flowerpits usually congested in up to 10 spiral series, flowerpits often less than 1 mm in diameter but sometimes up to 2 mm, with inconspicuous lips; peduncle and rachillas at first covered with a brownish-grey very dense tomentum, glabrescent. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit blackish, ovoid, about 8 mm long and 6 mm in diameter.

Only known from Peru in dense forests, on mountain slopes, at moderate altitudes (100–1000 m) (map IV, 19).

Peru: Killip & Smith 26247 (US), 28026 (F, US), 28541 (US), 28729 (US); Mexia 6135 (F, K, UC); Moore, Salazar & Smith 8450 (BH), 8503 (BH), 8530 (BH); Poeppig 2295 / 2326 B (LE, M).

Material studied by Martius and labelled *G. poeppigiana* was found to be a mixture. Martius's description, however, was apparently based on the Poeppig specimen from Peru, Yurimaguas, as noted by Wendland (*in schedula*) and BURRET (1930). More recent collections by Killip & Smith and Moore, Salazar & Smith, partly from the type locality, agree very well with the type. Therefore there is now no doubt about this species.

G. poeppigiana is very distinctive notably in its inflorescences with a very particular tomentum at first, the congested, rather small flowerpits with inconspicuous lips, and the very long peduncle. The species is apparently rather isolated.

Group 8: species 20–23.

IV B b 8, 20 *Geonoma stricta* (Poiteau) Kunth, Enum. Pl. 3: 232. 1841; Martius, Hist. Nat. Palm. 3: 317. 1850; Drude in Martius, Flora Bras. 3(2): 503. 1882; Burret, Bot. Jahrb. 63: 182. 1930; Dahlgren, Field Mus. Bot. 14: pl 291. 1959; Wessels Boer, Ind. Palms Sur. 33. 1965.

Basionym: *Gynestum strictum* Poiteau, Mém. Mus. Hist. Nat. Paris 9: 391, t 19. 1922.

Type collection: Poiteau s.n., French Guiana (P).

Heterotypic synonym: *Geonoma maguirei* Bailey, Bull. Torr. Bot. Cl. 75: 102, f 5. 1948.

Type collection: Maguire 24166, Suriname, Upper Coppename R. (NY holotype).

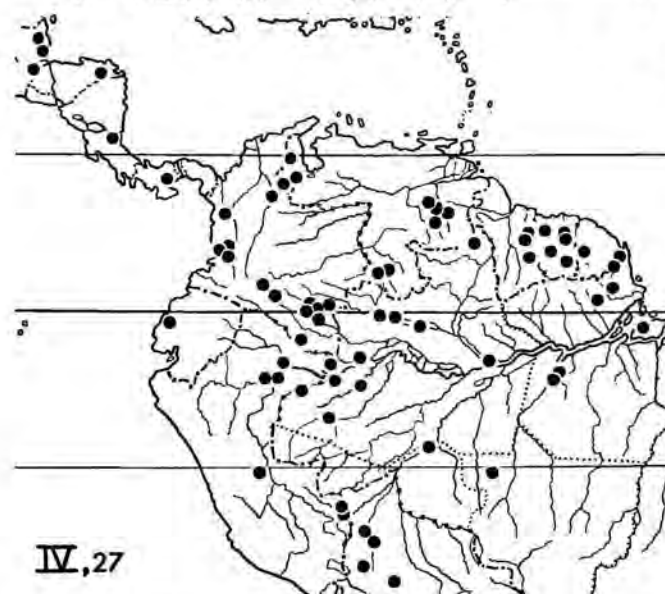
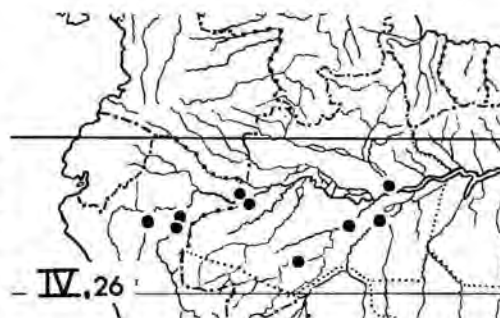
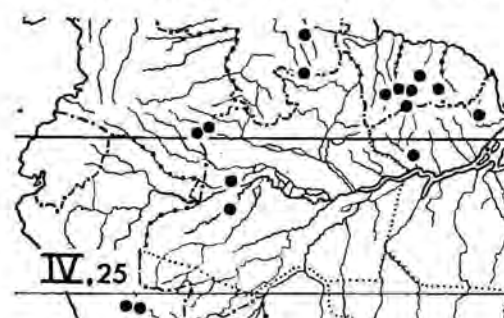
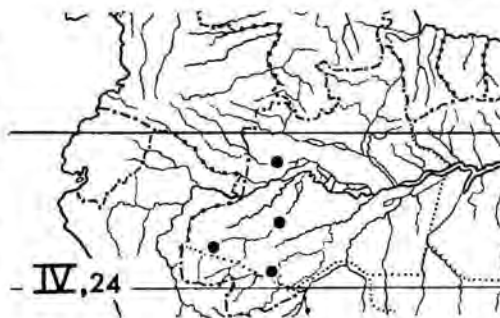
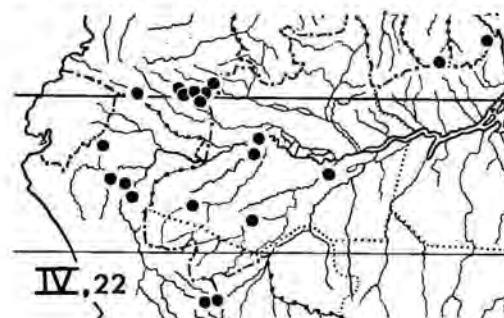
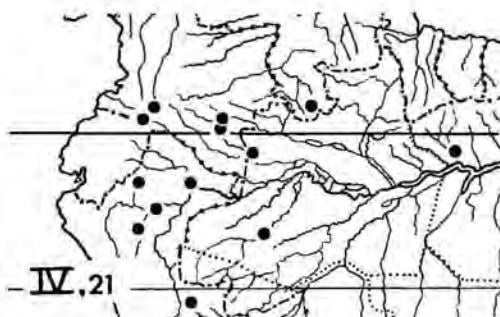
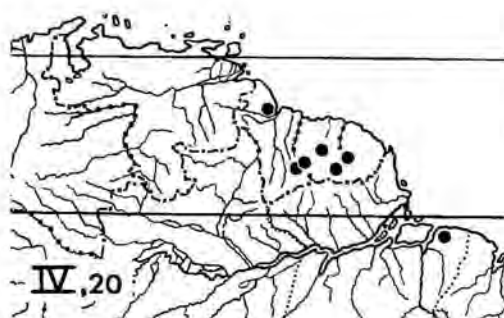
Very small, often solitary, up to about 1 m tall, cane about 5 mm in diameter, internodes 3–4½ cm long; leafsheath 4–5 cm in length; petiole 10–12 cm long; lamina simple, lanceolate, 22–27 cm long and 6–9 cm wide, apical lobes 3–5 cm long; 19–25 pairs of primary veins inconspicuous above, prominent below, secondary veins invisible above, prominent and slightly lepidote below, veins emerging at 30–35° from the rachis.

Inflorescences several per plant, erect in the leafaxils, spicate with one enlarged, membranaceous bract about 3½ cm long, soon decaying, at the base of the circa 2 cm long peduncle; peduncle with 2–3 small acute bracts the lowermost sometimes rather large, spike 3–4 cm long; flowerpits irregularly decussate, about 3 mm apart; upper lip lacking, lower lip entire, triangular, fimbriate; inflorescence villose. Male flowers persistent after anthesis, anthers sharply reflexed from the filaments. Female flowers with a crenate staminodial tube. Fruit greyish-blue, ovoid, short-pointed at apex, about 1 cm long and 6 mm in diameter; seed 7 mm long and 5 mm in diameter.

Guianas; one collection from eastern Pará; in very wet but usually uninundated places in dense forests, apparently rare (map IV, 20).

Brazil: Huber 1805 (MG).

French Guiana: Leprieur s.n. (G, P); Mélinon 424 (P); Perrottet s.n. (P); Poiteau s.n. (G, P).



Maps IV,20-28. Distribution of *Geonoma* species: IV,20 *G. stricta*; IV,21 *G. pycnostachys*; IV,22 *G. piscicauda*; IV,24 *G. arundinacea*; IV,25 *G. leptospadix*; IV,26 *G. laxiflora*; IV,27 *G. deversa*; IV,28 *G. oligoclona*.

Suriname: Forest. Dept. 720 (U), 6508 (U); Maguire 24166 (NY); Stahel Wilh. Geb. Exp. 67 (U); Wessels Boer 1017 (U), 1064 (U), 1513 (U), 1558 (U), 1598 (U). British Guiana: Forest. Dept. B.G. 6368 (BH).

G. stricta is closely related to *G. pycnostachys* but can be distinguished, apart from its smaller dimensions, by the inflorescences. These are much smaller with relatively widely spaced flowerpits, and the small bracts along the peduncle and the lower lips are more or less acute instead of rounded.

IV B b 8, 21 **Geonoma pycnostachys** Martius, Hist. Nat. Palm. 2: 16, t 17, 21 f 1. 1823; Martius, Palmet. Orbign. 38. 1847; Drude in Martius, Flora Bras. 3(2): 503. 1882; Burret, Bot. Jahrb. 63: 181. 1930; Dahlgren, Field Mus. Bot. 14: pl. 280. 1959; Macbride, Field Mus. Bot. 13 (1): 348. 1960.

Type collection: Martius s.n., Brazil, Amazonas, Rio Japurá (M holotype).

Small, often solitary, up to about 2 m tall, cane 5–8 (12) mm in diameter, internodes 2–6 cm long; leafsheath 1–1½ dm long; petiole 1–1½ dm in length; lamina simple, elliptic, 3–5 (6) dm long and 12–20 cm wide, apical lobes 8–11 cm long; 26–31 pairs of primary veins prominent above, prominent below, secondary veins slightly immersed above, prominent and brown lepidote below, veins emerging at 35–40° from the rachis.

Inflorescences several per plant, erect in the leafaxils, spicate with one enlarged, membranaceous bract 5–8 cm long, soon disappearing, at the base of the 2½–4 cm long peduncle; peduncle with 3 small obtuse bracts, spike 8–14 (20) cm long, densely covered with regular spirally-arranged bilabiate flowerpits; the lower lip entire, rounded; inflorescence villose. Male flowers persistent after anthesis, the anthers sharply reflexed from the filaments. Female flowers with a crenate staminodial tube. Fruit ovoid, shortly pointed at apex, 11 mm long and 6 mm in diameter.

Western part of the Amazon, at moderate altitudes (400–1000 m), in dense wet forests (map IV, 21).

Venezuela: Cardona 1358 (US, VEN).

Colombia: Perez Arbeláez 704 (US); García B. 15003 (BH); Schultes 3547 (BH); Schultes & Cabrera 12807 (BH), 13672 (BH).

Peru: Killip & Smith 26190 (F, US); Moore, Salazar & Smith 8377 (BH), 8380 (BH), 8495 (BH), 8528 (BH); Pearce s.n. (K).

Brazil: Martius s.n. (M); Trail 1025 / XVI (K), 1027 / CLXII A (K).

G. pycnostachys resembles *G. piscicauda* but is distinguished by the shorter peduncle and the more thick-set inflorescence; for the differences with *G. stricta*, see the discussion on that species.

IV B b 8, 22 **Geonoma piscicauda** Dammer, Verh. Bot. Ver. Brandenb. 48: 124. 1906; Burret, Bot. Jahrb. 63: 182. 1930; Dahlgren, Field Mus. Bot. 14: pl 273. 1959; Wessels Boer, Ind. Palms Sur. 31. 1965.

Type collection: Ule 5520, Brazil, Amazonas, Rio Juruá (F, G, K, L).

Heterotypic synonyms: *Geonoma trauniana* Dammer, Verh. Bot. Ver. Brandenb. 48: 124. 1906; Burret, Bot. Jahrb. 63: 183. 1930; Dahlgren, Field Mus. Bot. 14: pl 293. 1959.

Type collection: Ule 5946, Brazil, Amazonas, Rio Juruá (G, L, MG).

Geonoma witiana Dammer, Verh. Bot. Ver. Brandenb. 48: 124. 1906; Burret, Bot. Jahrb. 63: 182. 1930; Burret, Notizbl. 11: 235. 1931.

Type collection: Ule 5884 (inflorescence only), Brazil, Amazonas, Rio Juruá (G).

Geonoma raimondii Burret, Bot. Jahrb. 63: 182. 1930.

Type collection: Raimondi 978, Peru, Amazonas (not seen, destroyed at B).

Geonoma trailii Burret, Bot. Jahrb. 63: 183. 1930.

based on: *Geonoma elegans* Martius var. *amazonica* Trail, J. Bot. 14: 324. 1876; Drude in Martius, Flora Bras. 3(2): 506. 1882.

Type collection: Trail 1032 / CXXXIII, Brazil, Amazonas, Rio Purus (K holotype).

? *Geonoma lanceolata* Burret, Notizbl. 11: 7. 1930.

Type collection: Lakó 18, coll. Huebner 146, Brazil, Amazonas, Rio Iça (B holotype).

Geonoma bella Burret, Notizbl. 12: 304. 1935.

Type collection: Krukoff 4543, Brazil, Amazonas, Paranagua (F, K, M, U, US).

? *Geonoma herthae* Burret, Notizbl. 14: 325. 1939.

Type collection: Schultze-Rhonhof 2394, Ecuador, Pacayacu (not seen, destroyed at B).

Small, often solitary, up to 2–3 m tall, cane about 8 mm in diameter, internodes 2–7 cm long; leafsheath 8–9 cm in length; petiole about 2 dm long, densely brown furfuraceous; lamina ovate, 3–5 dm long and $1\frac{1}{2}$ – $2\frac{1}{2}$ dm wide, variably pinnatisect, often trijugate but sometimes simple to regularly pinnate with 1-veined segments and with all possible intermediates between these extremes, apical lobes about $1\frac{1}{2}$ dm long; 21–27 pairs of primary veins prominent above, inconspicuous below, secondary veins slightly immersed above, prominent and lepidote below, veins emerging at about 50° from the rachis.

Inflorescences infrafoliar, erect, spicate with only one enlarged bract about 10 cm long, later caducous; peduncle 6–8 cm long, with 3 small acute bracts the lowermost rather large, spike $1\frac{1}{2}$ – $2\frac{1}{2}$ dm long; bilabiate flowerpits more or less regularly alternating, verticillate in whorls of 3–4 about 2 mm apart; lower lip acute triangulate, entire; young inflorescence villose, later glabrescent. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a crenate staminodial tube. Fruit probably greenish, ovoid, slightly pointed at apex, 8 mm long and 6 mm in diameter; seed subglobose, about $5\frac{1}{2}$ mm long.

Apparently rather widespread in the Amazon basin, in dense wet forests, usually collected from altitudes up to about 300 m, but one collection said to be from an altitude of 4500 ft. (map IV, 22).

Colombia: Foster & Foster 2245 (BH); Schultes & Cabrera 12797 (BH), 13095 (BH), 13105 (BH, US), 13665 (BH), 14108 (BH, US), 15321 (BH), 17088 (BH), 17328 (BH, US), 17388 (BH), 17418 (BH), 17659 (BH, US), 20021 (BH, US); Woronow & Juzepczuk 6124 (LE).

Peru: Killip & Smith 27812 (US); Moore, Salazar & Smith 8368 (BH), 8374 (BH), 8378 (BH), 8566 (BH), 8586 (BH); Williams 2544 (F), 5209 (F).

Brazil: Krukoff 4543 (F, K, M, U, US); Lakó 18 (B); Trail 1031 / CLXI (K), 1032-1034 / CXXXIII (BM, K); Ule 5520 (F, G, K, L), 5884 (spadix only) (G), 5946 (G, L, MG).

French Guiana: Leprieur s.n. (P).

Suriname: Rombouts 880 a (U).

The synonymy of *G. piscicauda* has already been discussed in a previous paper (WESSELS BOER, 1965). The type of *G. wittiana*, Ule 5884 (G), showed the correctness of BURRET's (1931) statement that it was mixed up with a *Hyospathe* leaf.

Further *G. lanceolata* seems to belong here. Unfortunately the type at B is very poor, consisting of a bunch of leaves only without any inflorescence. *G. herthae* was originally placed elsewhere but the present position seems to be more satisfactory; the very small spicate inflorescences are rather characteristic, especially in combination with the relatively long apical lobes of the leaves. In fact, the lamina of Woronow & Juzepczuk 6119 which is said to match the lamina of *G. herthae* very well is almost identical with the (rarely occurring) simple leaves of *G. piscicauda*, as present, e.g., in the type.

IV B b 8, 23 *Geonoma bartlettii* Dammer ex Burret, Bot. Jahrb. 63: 183. 1930. Plate V.

Type collection: Bartlett 8195, British Guiana, Conawaruk R. (not seen, destroyed at B, not present at K).

Heterotypic synonyms: ? *Geonoma tessmannii* Burret, Bot. Jahrb. 63: 181. 1930.

Type collection: Tessmann 4225, Peru, Rio Marañon (not seen, destroyed at B).

? *Geonoma hoppii* Burret, Notizbl. 11: 235. 1931.

Type collection: Hopp 1039, Ecuador, Archidona (not seen, destroyed at B).

Stem arundinaceous, up to about 8 mm in diameter, internodes 3-5 cm long; leafsheath about 8 cm in length; petiole $1\frac{1}{2}$ -2 dm long; sheath and petiole at first brown tomentose, glabrescent, rachis $2\frac{1}{2}$ -3 dm long; lamina trijugate, about $3\frac{1}{2}$ dm long and $1\frac{1}{2}$ dm wide, somewhat lustrous above; about 25 pairs of primary veins prominulent above and below, secondary veins slightly immersed above, prominent and brown lepidote below, tertiary veins prominulent both above and below, veins emerging at about 35° from the rachis.

Inflorescences infrafoliar, bifurcate; enlarged bracts soon disappearing, basal bract about 4 cm long, membranaceous, second bract smaller and completely enclosed by the basal one, inserted about 5 cm higher; peduncle about 5 cm long, 2 rachillas about 1 dm long and $2\frac{1}{2}$ mm in diameter, brownish villose; bilabiate flowerpits spirally to more or less verticillately arranged and about 2 mm apart; lower lip semicircular, entire. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a crenate staminodial tube. Fruit not seen, recorded as being red.

Only a single specimen available from French Guiana without precise locality.

French Guiana: Leprieur s.n. (P).

A Leprieur specimen at P matches the description of *G. bartlettii* rather well and is considered to represent that species. *G. bartlettii* resembles *G. piscicauda* but is distinguished by the branched inflorescences.

G. tessmannii and *G. hoppii* cannot be separated by their descriptions and are placed here in synonymy, although, it is true, in the absence of material. In particular the red fruits recorded for both *G. bartlettii* and *G. hoppii* are very remarkable; as far as I know red-coloured fruits are never observed in any other *Geonoma* species. The variability in leafshape and the large area indicated by the two presumed synonyms is comparable to that found in *G. piscicauda*.

Group 9: species 24–28.

IV B b 9, 24 *Geonoma arundinacea* Martius, Hist. Nat. Palm. 2: 17, t 18. 1823; Martius, Palmet. Orbign. 37. 1847; Drude in Martius, Flora Bras. 3(2): 502. 1882; Burret, Bot. Jahrb. 63: 180. 1930; Dahlgren, Field Mus. Bot. 14: pl 218. 1959.

Type collection: Martius s.n., Brazil, Amazonas, Rio Japurá (M lectotype). Heterotypic synonym: *Geonoma uleana* Dammer, Verh. Bot. Ver. Brandenb. 48: 122. 1907; Dahlgren, Field Mus. Bot. 14: pl 295. 1959.

Type collection: Ule 5521, Brazil, Amazonas, Upper Rio Juruá (G).

Clustered, $\frac{1}{2}$ –2 m tall, canes about 5 mm in diameter, internodes $1\frac{1}{2}$ –5 cm long; petiole including leafsheath $1\frac{1}{2}$ –2 dm long, gradually broadened towards the base; lamina lustrous above, simple or 2–3 jugate, oblong, round attenuate at base, 2–3 dm long and 8 (in simple) to 17 cm (in pinnate leaves) wide, apical lobes 5–8 cm long; 17–23 pairs of primary veins prominent above and below, secondary veins prominulent above, prominent and slightly lepidote below, tertiary veins inconspicuous, veins emerging at 35–40° from the rachis.

Inflorescences spicate or sometimes bifurcate; enlarged bracts 4–6 cm long, membranaceous, fibrous decaying, the basal one enclosing the second and inserted about $\frac{1}{2}$ cm apart; peduncle 5–6 cm long with 2 small bracts, spike 1–2 $\frac{1}{2}$ dm long and about 2 mm in diameter; flowerpits more or less irregularly spirally arranged to almost regularly verticillate, whorls about 5 mm apart; flowerpits bilabiate; lower lip cleft. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Immature fruit globose, pointed at apex, about 6 mm in diameter.

Western Amazon basin in Brazil (map IV, 24).

Brazil: Huber 4346 (MG); Martius s.n. (L, M, P); Trail 1030 / CXLIX (K); Ule 5521 (G).

Comparison of original Martius material with Ule 5521 demonstrates that *G. uleana* is similar to *G. arundinacea*. The species is probably closely related to *G. deversa* and atypical specimens can hardly be separated, except perhaps by the fruit. Unfortunately mature fruits of *G. arundinacea* are lacking in the specimens. The species also resembles *G. stricta* in general appearance but it is easily distinguished by its inflorescence. The Ule 6879 specimen from Peru, dept. Loreto, Iquitos, cited by Dammer and Burret, was not available for the present study.

IV B b 9, 25 *Geonoma leptospadix* Trail, J. Bot. 14: 327, t 183 f 2. 1876; Drude in Martius, Flora Bras. 3(2): 495. 1882; Burret, Bot. Jahrb. 63: 230. 1930; Wessels Boer, Ind. Palms Sur. 34. 1965.

Type collection: Trail 962-963 / CLXXII, Brazil, Amazonas, Rio Tocantins (F, K holotype).

Heterotypic synonym: *Geonoma saramaccana* Bailey, Bull. Torr. Bot. Cl. 75: 104, f 6. 1948.

Type collection: Maguire 24095, Suriname, Upper Saramacca R. (NY holotype).

Solitary, cane erect, 4-10 dm tall, 8-12 mm in diameter, internodes 1-2½ cm long; leaves closely together and almost horizontally radiating; leafsheath 8-12 cm long, gradually narrowing into the petiole, 4-8 cm long; rachis 2½-4½ dm long; lamina lustrous above, narrowly lanceolate, long cuneate at base, 3½-6 dm long and 8-14 cm wide, simple or rarely divided into a few segments, apical lobes 10-15 cm long; 21-26 pairs of primary veins prominent both above and below, secondary veins immersed above, prominent and brown lepidote below, veins emerging from the rachis at about 30°.

Inflorescences several per plant, usually in different stages of development; 2 enlarged bracts rather short, more or less swollen, inserted about 1 cm apart at base of peduncle, basal bract chartaceous, 5-10 cm long, second one smaller; inflorescence in bud strongly folded and twisted within the closed bracts, at anthesis with a 1½-2 dm long peduncle slightly elongating in fruit, rachis about 5 cm long with 3-5 usually simple, sometimes bifid, rachillas about 1-2 dm long and 1-2 mm in diameter; flowerpits scattered along the rachis, spaced about 1 cm apart, rarely decussate or verticillate, bilabiate; the lower lip entire. Male flowers with the anthers sharply reflexed from the filaments. Female flowers about 2½ mm long with a crenulate staminodial tube. Fruit globose, black, slightly tuberculate, 6-7 mm in diameter; seed 5-6 mm in diameter.

Rather widespread in northern South America, apparently occasional and not frequent in the undergrowth of mesophytic forest, in relatively dry, uninundated places; in the mountains up to altitudes of about 750 m (map IV, 25).

Venezuela: Killip 37398 (US, VEN); Steyermark 90666 (BH).

Colombia: Schultes & Cabrera 13968 (BH), 17353 (BH, US).

Peru: Killip & Smith 26170 (F, US), 26414 (F, US).
 Brazil: Ducke 11467 (MG); Pires, Rodrigues & Irvine 50759 (MG); Trail 963 / CLXXII (F, K); Ule 5516 (G, L, K).
 Suriname: Daniels & Jonker 839 (U); Florschütz & Maas 3041 (U), 3133 (U); Hulk 249 (U); Maguire 24095 (NY); N.Y.B.G. Wilh. Geb. Exp. 54365 (U); Stahel Wilh. Geb. Exp. 275 (U); Wessels Boer 912 (U), 949 (U), 1488 (U), 1502 (U), 1603 (U).
 British Guiana: Forest. Dept. B.G. 7234 (BH), 7700 (BH); Jenman 2072 (K).

G. leptospadix is a characteristic species, at once distinguished from its relatives by the umbrella-like habit and the long, slender, pendulous inflorescences.

IV B b 9, 26 *Geonoma laxiflora* Martius, Hist. Nat. Palm. 2: 12, t 11. 1823; Martius, Palmet. Orbign. 37. 1847; Trail, J. Bot. 14: 325. 1876; Drude in Martius, Flora Bras. 3(2): 495. 1882; Burret, Bot. Jahrb. 63: 239. 1930; Dahlgren, Field Mus. Bot. 14: pl 248. 1959.

Type collection: Martius s.n., Brazil, Rio Negro (M lectotype).

Heterotypic synonyms: *Geonoma laxiflora* Martius var. *depauperata* Trail, J. Bot. 14: 326. 1876.

Type collection: Trail CXVI, Brazil, Amazonas (K holotype).

Geonoma beccariana Barbosa Rodrigues, Vellozia 1 (ed. 1): 33. 1888; Barbosa Rodrigues, Sert. Palm. 1: 26, t 17. 1903.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 17. 1903.

Clustered, up to 2–5 m tall; canes erect, often more or less flexuose, 6–12 mm in diameter, internodes 1–3 cm long; leafsheath $\frac{1}{2}$ –1 dm in length; petiole 1–1 $\frac{1}{2}$ dm long; lamina membranaceous, usually simple, sometimes 2-jugate, broadly elliptical, deeply bifurcate at apex, cuneate at base, 3–5 dm long and 1 $\frac{1}{2}$ –2 $\frac{1}{2}$ dm wide, apical lobes 17–27 cm long; 15–20 pairs of primary veins prominent above, prominulent below, secondary veins prominulent above, prominent and lepidote below, tertiary veins inconspicuous, veins emerging from the rachis at about 25°.

Inflorescences infrafoliar, once branched; enlarged bracts broad and short, slightly swollen, caducous before anthesis, 3–4 cm long and about 2 cm wide, inserted about $\frac{1}{2}$ cm apart at the base of the peduncle; peduncle 3–5 cm long with about 3 very small bracts, rachis usually less than 3 cm long with 5–9 rachillas, simple or sometimes the lowermost bifurcate, 2–3 dm long and 1–2 mm in diameter; flowerpits, especially in the upper part, in trimerous whorls about 7 mm apart, bilabiate; the lower lip entire. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit globose, black on an orange inflorescence, about 7 mm in diameter; seed about 5 mm in diameter.

Brazil, Colombia, and Peru, western Amazon basin, frequent in swamps along rivers in the shade of forests (map IV, 26).

Colombia: Schultes 6656 (BH); Schultes & Black 8290 (BH), 46. 315 (BH).
 Peru: Killip & Smith 27654 (F, US); Moore, Salazar & Smith 8497 (BH); Williams 2537 (F), 4483 (F).

Brazil: Goeldi 3894 (MG); Huber 4353 (MG), 4430 (MG); Huebner 48 (B), 53 (B), 105 (B), 132 (B); Jobert & Schwacke 567 p.p. (P, R); Martius s.n. (M); Trail 1022 / LIX (K), CXVI (K).

The separation of slightly smaller specimens as a distinct variety, as done by Trail, seems not worth while. The division of the leaves is without taxonomic significance.

The poorly described *G. beccariana* has, according to Barbosa Rodrigues's plate the deeply bifurcate leaf and the short-pedunculate inflorescence of *G. laxiflora*. Therefore it is treated as a synonym.

IV B b 9, 27 ***Geonoma deversa*** (Poiteau) Kunth, Enum. Pl. 3: 231. 1841; Martius, Palmet. Orbign. 37. 1847; Burret, Bot. Jahrb. 63: 239. 1930; Dahlgren, Field Mus. Bot. 14: pl 234. 1959; Wessels Boer, Ind. Palms Sur. 29. 1965.

Basionym: *Gymestum deversum* Poiteau, Mém. Mus. Hist. Nat. Paris 9: 390, t 18. 1822.

Type collection: Poiteau s.n., French Guiana (P).

Heterotypic synonyms: *Geonoma paniculigera* Martius, Hist. Nat. Palm. 2: 11, t 10. 1823; Martius, Palmet. Orbign. 33: 1847; Spruce J. Linn. Soc. 11: 114. 1869; Drude in Martius, Flora Bras. 3(2): 484. 1882; Burret, Bot. Jahrb. 63: 238. 1930; Dahlgren, Field Mus. Bot. 14: pl 267-269. 1959.

Type collection: Martius s.n., Brazil, without precise locality (M lectotype).

? *Geonoma desmarestii* Martius, Palmet. Orbign. 23, t 11, 22 B f 3. 1847; Burret, Bot. Jahrb. 63: 263. 1930; Dahlgren, Field Mus. Bot. 14: pl 233. 1959.

Type collection: d'Orbigny 50, Bolivia, Cochabamba (P).

Geonoma longepetiolata Oersted, Vidensk. Meddel. Kjoeb. 1858: 36. 1859; Burret, Bot. Jahrb. 63: 236. 1930.

Type collection: Oersted s.n., Nicaragua, Rio San Juan (not seen, apparently missing in C).

Geonoma flaccida H. Wendland ex Spruce, J. Linn. Soc. 11: 108. 1869; Burret, Bot. Jahrb. 63: 236. 1930.

Type collection: Wendland s.n., Costa Rica, Rio Sarapiquí (K holotype).

Geonoma microspatha Spruce, J. Linn. Soc. 11: 108. 1869; Burret, Bot. Jahrb. 63: 238. 1930; Dahlgren, Field Mus. Bot. 14: pl 258. 1959.

Geonoma paniculigera Martius var. *microspatha* (Spruce) Trail, J. Bot. 14: 327. 1876.

Type collection: Spruce 28, Brazil, Amazonas, Rio Negro (K holotype).

Geonoma trijugata Barbosa Rodrigues, Enum. Palm. Nov. 12, t 1 f 1. 1875; Barbosa Rodrigues, Sert. Palm. 1: 24, t 9 B, 14. 1903; Burret, Bot. Jahrb. 63: 238. 1930. Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 14. 1903.

Geonoma yauaperyensis Barbosa Rodrigues, Contrib. Jard. Bot. R.d.J. 3: 88. 1902; Barbosa Rodrigues, Sert. Palm. 1: 29, t 30. 1903; Burret, Bot. Jahrb. 63: 238. 1930. Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 30. 1903.

Geonoma myriantha Dammer, Verh. Bot. Ver. Brandenb. 48: 120. 1906; Burret, Bot. Jahrb. 63: 236. 1930.

Type collection: Ule 5882, Brazil, Amazonas, Juruá Miry (G, K, L).

Geonoma leptostachys Burret, Notizbl. 10: 1014. 1930; Dahlgren, Field Mus. Bot. 14: pl 250. 1959.

Type collection: Luetzelburg 23072, Brazil, Rio Negro, Camanáos (M, R).

Geonoma macropoda Burret, Notizbl. 10: 1015. 1930; Dahlgren, Field Mus. Bot. 14: pl 254. 1959.

Type collection: Luetzelburg 22089, Brazil, Amazonas, Manáus (M, R).

Geonoma major Burret, Notizbl. 10: 1016. 1930; Dahlgren, Field Mus. Bot. 14: pl 255. 1959.

Type collection: Luetzelburg 22273, Brazil, Rio Negro, Cucuhy (M).

Geonoma killipii Burret, Notizbl. 11: 320. 1932; Macbride, Field Mus. Bot. 13: 344. 1960.

Type collection: Killip & Smith 26594, Peru, Junín, Puerto Bermudez (F, US).

Solitary or clustered, canes varying from a few dm up to 2–4 m tall, $\frac{1}{2}$ –2 cm in diameter, internodes 2–3 cm long; leafsheath about 1–1 $\frac{1}{2}$ dm in length; petiole 2–4 dm long; rachis 2–5 dm long; lamina usually trijugate or sometimes intermixed with linear 1-veined segments and rarely irregularly pinnate, varying from an almost simple leaf to one composed of numerous narrow segments; dry leaves grey, lustrous above and brownish tinged below (not so in expanding leaves); about 25–35 pairs of primary veins more or less prominent above and below, secondary veins immersed above, prominent below, veins emerging at 30–40° from the rachis.

Inflorescences once or twice branched; enlarged bracts short, early deciduous, often more or less swollen, about 4–10 cm long, usually 3 enlarged bracts gradually decreasing in size or sometimes exceeding the basal one, inserted closely together at the base of the peduncle; peduncle $\frac{1}{2}$ –1 $\frac{1}{2}$ dm long, rachis $\frac{1}{2}$ –1 $\frac{1}{2}$ dm long with 5–12 lateral branches, simple or the lowest branching again into 2–6 rachillas; on juvenile or depauperate plants simple spicate inflorescences rarely occur; rachillas 1–2 $\frac{1}{2}$ dm long and 1 $\frac{1}{2}$ –2 $\frac{1}{2}$ mm in diameter, sparsely hispid; bilabiate flowerpits alternately verticillate in trimerous whorls $\frac{1}{2}$ –3 mm apart, dry rachillas narrowed between the whorls; a more or less irregular arrangement: whorls of 4 flowerpits, or decussate flowerpits is infrequently observed. Male flowers 3 mm long, anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit black, globose, 6 mm in diameter, rounded at apex and base; seed 5 mm in diameter.

Widespread from Central America to French Guiana, the Amazon basin, Bolivia, and Peru in South America, at lower altitudes from sea-level up to about 600 m, in well-drained places in dense forests (map IV, 27).

Guatemala: Standley 72791 (F).

British Honduras: Kinloch 55 (F); Peck 605 (K); Schipp 94 (BM, F, G, K, US).

Honduras: Hagen & Hagen 1321 (F).

Costa Rica: Cook & Doyle 587 (US); Wendland s.n. (K).

Panama: Pittier 4411 (F, US).

Venezuela: Agostini 239 (BH); Cardona 796 (US, VEN); Killip 37302 (US, VEN), 37316 (BH, F, US, VEN), 37488 (US, VEN); Pittier 10977 (US, VEN); Spruce 41 (K); Steyermark & Rabe 96677 (BH); Wurdack & Adderley 43188 (BH).

Colombia: Archer 2162 (US); Cook 166 (US); Cuatrecasas 16270 (F); Foster & Foster 1673 (BH), 1741 (BH); García B. 13632 (US), 14395 (US), 14628 (BH); Killip & García 33413 (BH, US); Killip & Smith 14866 (US); Schultes 3886 (BH), 6749 (BH); Schultes & Black 8328 (BH); Schultes & Cabrera 12733 (BH), 12781 (BH), 13667 (BH), 16258 (BH), 17854 (BH); Woronow 6059 (LE).

Ecuador: Heinrichs 501 (G, M).

Peru: Killip & Smith 26532 (US), 26594 (F, US); Klug 1497 (F, US); Moore, Salazar & Smith 8469 (BH), 8565 (BH), 8568 (BH), 8569 (BH); Williams 875 (F).
 Bolivia: Cardena 1981 (US); Haenke s.n. (M); Krukoff 10983 (F); d'Orbigny 50 (P); White 1094 (K, US).
 Brazil: Baker 111 (MG); Egler & Irwin 46691 (BH); Froés 26013 (BH); Hoehne 5106 (R), 5107 (R); Huber 554 (MG), 1827 (MG), 2032 (BH, MG); Irwin, Egler & Westra 47351 (BH); Luetzelburg 22089 (M, R), 22273 (M, R), 23072 (M, R); Martius s.n. (M, P); Snethlage 10119 (MG); Spruce 28 (K), 32 (K); Trail 943 / CXCI (K), 944 / XLIX (K), 946 / LXX (K), 947 / LXXI (K), 948 / LXXIII (K), 952 / CC (K), 953 / CLIII (K), 955 (K), 957 / CLXXVII (K), 958 / CLXXXVII (K), 959 / CLXXXVII (K), 960 / CLXIII (K); Ule 5882 (G, K, L).
 French Guiana: Geay 871 (P); Leprieur s.n. (G, P); Poiteau s.n. (G, P).
 Suriname: Forest. Dept. Sur. 963 (U), 2998 (U); Lindeman 3616 (U), 5172 (U), Tulleken 447 p.p. (L); Wessels Boer 181 (U), 320 (U), 336 (U), 460 (U), 948 (U).
 British Guiana: Jenman 522 (K); im Thurn IX (K).

G. deversa is a very characteristic species, distinguished by the usually trijugate, greyish-lustrous leaves without very prominent veins above, the relatively short bracts early shedding, the flowerpits usually alternately verticillate in triads, and the globose black fruits 6 mm in diameter.

The species occurs over an unusually large area for *Geonoma* species. In fact it has the largest area of all *Geonoma* species and it follows that it can not only stand more or less diverse ecological conditions but also that it can successfully compete under various circumstances. It must, therefore, have facilities for adaptation which often result in morphological variation. However, the variation encountered in this species is small rather than unusually large. There is a direct and readily detectable relation between dimensions and water-supply and soil. Plants on relatively dry, poor soil tend to be depauperate with small dimensions and a poorly branched to even simple, spicate inflorescence. On well-drained and yet very wet, rich soil they grow more vigorously and may have large, twice branched inflorescences. The leafshape, most frequently regularly trijugate, shows some variation, ranging from almost simple to more or less regularly pinnate with numerous linear segments. A more impressive difference is observed in the bracts; Suriname plants as well as specimens from the Amazon basin and Central America have small, swollen bracts, the second one completely enclosed by the basal but sometimes the inner bracts are longer than the basal one.

As it is characteristic for the species that the bracts are deciduous at an early stage, most specimens lack bracts. Hence bract-length escaped close examination and could not be correlated with other characters. The few specimens with bracts seem to indicate that plants from the Amazon basin usually have the tubular form. Trail, who possibly studied both forms in the field, separated besides *G. paniculigera* a variety *microspatha* to which he attributed, among other things, original material of *G. deversa* at P. This position, although nomenclaturally incorrect, seems acceptable from a taxonomical viewpoint. Such a separation is avoided here only because of the mentioned lack of bracts that makes it a useless

separation for herbarium specimens. The characters used by Burret to separate the species placed here in synonymy proved to be without diagnostic value. Identifications, making use of his key, proved to be well-nigh impossible and did not lead to any degree of separation into more homogeneous groups. Some of the characters mentioned are not even present in the types most of which were available for study.

G. desmarestii, based on a sterile specimen still kept in P and a drawing by d'Orbigny belong in all probability to *G. deversa* as far as can be observed in the type. In which case d'Orbigny's ecological note, stating that the species occurs in exactly the same conditions as *G. orbigniana*, seems incorrect.

IV B b 9, 28 *Geonoma oligoclona* Trail, J. Bot. 14: 325, t 183 f 1. 1876; Drude in Martius, Flora Bras. 3(2): 497. 1882; Burret, Bot. Jahrb. 63: 236. 1930; Dahlgren, Field Mus. Bot. 14: pl 262. 1959.

Type collection: 1019 / CCI, Brazil, Amazonas, Rio Jutahi (K lectotype).

Cane 1–2½ m tall, about 1½ cm in diameter, internodes about 2½ cm long; leafsheath about 1 dm long; petiole 2–3½ dm in length, brown deciduously lepidote; lamina regularly trijugate, 3½–5 dm long and 3–4 dm wide, segments sigmoid, strongly narrowed at base, the middle pair of segments closer to the basal pair than to the apical pair; 20–28 pairs of primary veins prominent above but not at all prominent below, secondary veins immersed above, prominent below, veins emerging from the rachis at about 60°.

Inflorescences once branched; enlarged bracts short, apparently more or less persistent, the basal one 6–7 cm long and 3 cm broad, the second one smaller; peduncle 5–6 cm long enclosed by the bracts, rachis about 1 cm long, with 3–5 simple, cylindrical rachillas 1½–3 dm long and about 3 mm in diameter, sparsely brownish hispidulous; bilabiate flowerpits alternating verticillate in trimerous whorls ½–1 mm apart; rachillas not narrowed between the whorls; lips small, lower lip entire. Male flowers 3 mm long, the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit unknown.

Western part of the Amazon basin in Brazil, in dense forests, apparently in rather well-drained places (map IV, 28).

Brazil: Krukoff 7158 (F, K, US); Trail 1019 / CCI (K), 1020 / CLXXI (BM, K).

G. oligoclona is a characteristic species, close to *G. deversa*, distinguished by the primary veins of the leaves being not at all prominent below, the short pedunculate, once branched inflorescences with 2 broad, flattened bracts, and the long, cylindrical rachillas, i.e. not narrowed between the flowerpit-whorls. Furthermore the leafshape may prove to be characteristic but probably will turn out to be more variable when more material is available for examination. In general leafshape is an unreliable character.

Group 10: species 29–38.

IV B b 10, 29 *Geonoma spinescens* H. Wendland ex Burret, Bot. Jahrb. 63: 230. 1930; Dahlgren, Field Mus. Bot. 14: pl 286. 1959.

Type collection: Schlim s.n., "Nle Grenade" (not seen).

Heterotypic synonyms: ? *Geonoma concinna* Burret, Bot. Jahrb. 63: 229. 1930.

Type collection: Kalbreyer 1367, Colombia, Antioquia, Tabor (not seen, destroyed at B).

Geonoma tenuis Burret, Notizbl. 13: 478. 1937.

Type collection: Pittier 13840, Venezuela, Aragua, Rancho Grande (F).

Clustered, 1–2 m tall; leafsheath about 2 dm in length; petiole about 4 dm long; lamina simple or irregularly divided, ovate, cuneate at base, 6–8 dm long and $2\frac{1}{2}$ – $3\frac{1}{2}$ dm wide, apical lobes $2\frac{1}{2}$ dm long; about 23 pairs of primary veins prominent both above and below, secondary veins inconspicuous above, prominulent and lepidote below, veins emerging at 25–35° from the rachis.

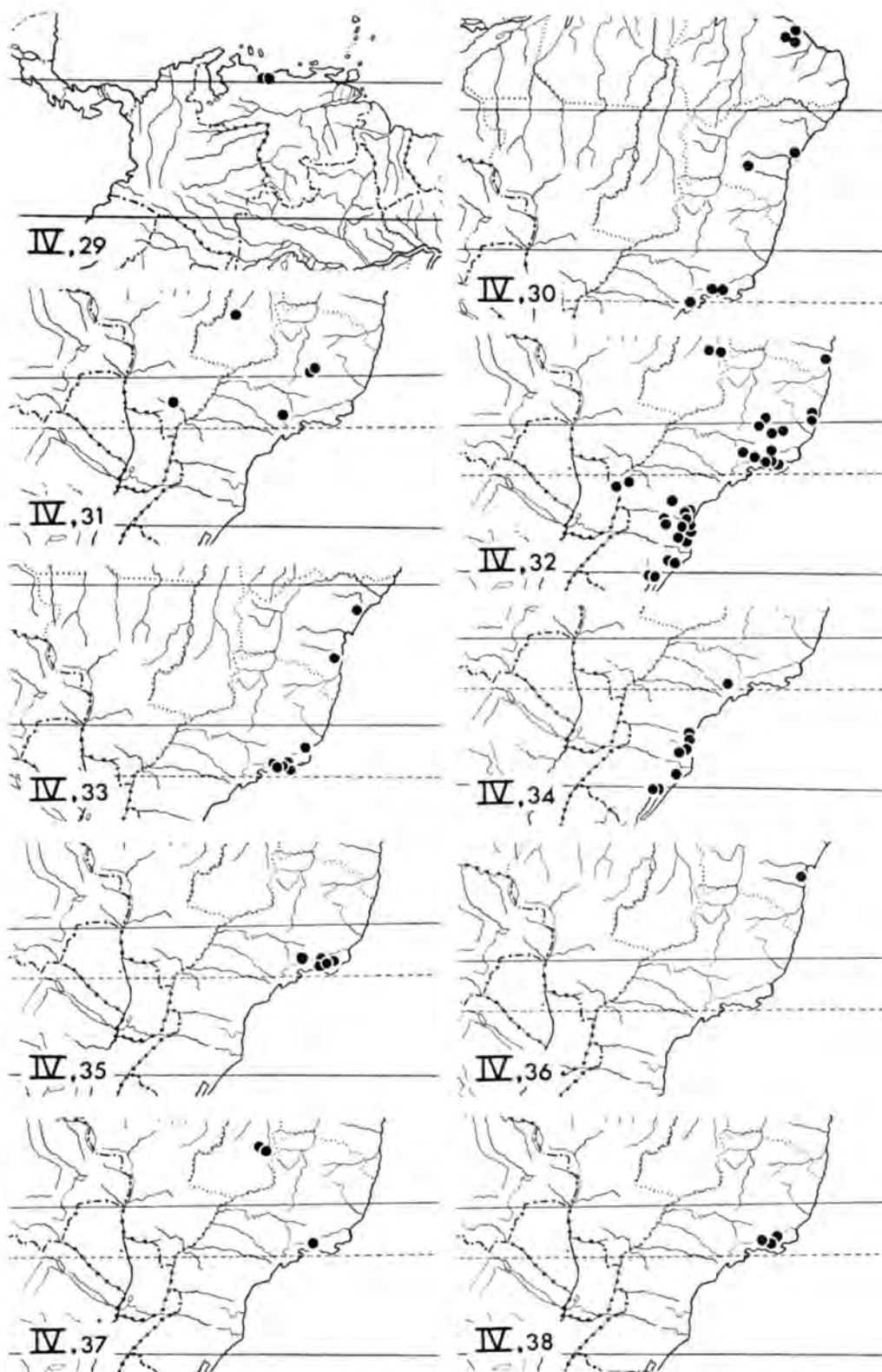
Inflorescences twice branched; fibrously decaying bracts subequal, about 1 dm long, inserted closely together at the base of the peduncle; peduncle $2\frac{1}{2}$ – $3\frac{1}{2}$ dm long, rachis 1– $1\frac{1}{2}$ dm long with about 10 or more lateral branches, the lower ones branched again into 3–10 rachillas, the upper ones simple, up to about 10 cm long and 1– $1\frac{1}{2}$ mm in diameter, brown tomentose, later glabrescent; bilabiate flowerpits loosely spirally arranged, 4–6 mm apart; the lower lip semicircular, becoming emarginate. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Immature fruit elliptic, olive green on a salmon red inflorescence (Steyermark), 6–7 mm long and 4–5 mm broad.

Only twice collected in Venezuela, states Aragua and Caraboba, in dense wet forests at an altitude of about 1000 m (map IV, 29).

Venezuela: Pittier 13840 (F); Steyermark & Steyermark 95360 (BH).

G. spinescens is poorly known, the type being destroyed in the war. Fortunately a photograph is still available; it was published by DAHLGREN (1959). A slightly different specimen, Pittier 13840, was described by Burret as a new species, mainly on the basis of the absence of the brown tomentum on the rachillas, but otherwise the two specimens resemble each other very closely. Even Burret himself felt doubt about the separation, as is shown by his discussion.

G. elegans, *G. rodeiensis*, and *G. poeppigiana*, all species with a very thick tomentum on the inflorescence, demonstrate how easily such a tomentum completely disappears. As the bracts in Pittier 13840 had lost their structure the inflorescence must have been exposed to external influences and consequently had a good chance to lose the tomentum. Moreover, more or less enclosed parts at the base of the peduncle still have the remnants of a tomentum. Hence the absence of a tomentum cannot be used as a reason for separation on a specific level.



Maps IV,29–38. Distribution of *Geonoma* species: IV,29 *G. spinescens*; IV,30 *G. blanchetiana*; IV,31 *G. brevispatha*; IV,32 *G. schottiana*; IV,33 *G. pohliana*; IV,34 *G. gamiova*; IV,35 *G. fascellaria*; IV,36 *G. rubescens*; IV,37 *G. gastoniana*; IV,38 *G. wittigiana*.

G. concinna, based on a Kalbreyer specimen gathered in Colombia at about 2000 m, matches in its description *G. spinescens* rather well and is placed here. *G. spinescens* shows a striking resemblance to *G. blanchetiana* from the east coast of Brazil and is distinguished by the long peduncle and the spirally arranged flowerpits.

IV B b 10, 30 *Geonoma blanchetiana* H. Wendland ex Drude in Martius, Flora Bras. 3(2): 494. 1882; Burret, Bot. Jahrb. 63: 236. 1930.

Type collection: Blanchet s.n., Brazil, Bahia (BR holotype).

Heterotypic synonyms: *Geonoma luetzelburgii* Burret, Bot. Jahrb. 63: 235. 1930; Dahlgren, Field Mus. Bot. 14: pl 253. 1959.

Type collection: Luetzelburg 6073, Brazil, Rio de Janeiro, Serra da Estrela (M).

? *Geonoma decussata* Burret, Fedde Rep. 32: 103. 1932.

Type collection: Werdermann 3454, Brazil, Bahia, near Caetete (not seen, destroyed at B).

Cane 2–3 m tall; leafsheath 2–3 dm long; petiole 3–6 dm in length; lamina pergamentaceous, 4–8 dm long and 3–5 dm wide, irregularly pinnate with a few broad segments acuminate at apex; primary veins prominent above and below, secondary veins inconspicuous above, below slightly less prominent than primary veins, tertiary veins inconspicuous, veins emerging at about 40° from the rachis.

Inflorescences twice branched with 2 pergamentaceous, caducous bracts, the second one inserted 3–4 cm above the basal bract; peduncle 18–25 cm, almost cylindrical, rachis 1–2 dm long with 12–17 lateral branches, the lowermost again branched into 2–5 rachillas, the upper ones simple, rachillas 15–25 cm long and 1–1½ m in diameter, with almost regularly decussate bilabiate flowerpits 2–3 mm apart; the lower lip entire. Male flowers about 3 mm long with the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit ovoid, stipitate, rounded at apex, 12 mm long and 10 mm in diameter seed 9 mm long and 7 mm in diameter.

Eastern Brazil, from the coastal zone to rather far inland at moderate altitudes (300 to 1400 m) (map IV, 30).

Brazil: Blanchet s.n. (BR); Bolland 20 (K); Ducke 1556 (MG); Glaziov 2759 (P), 3138 (P); Luetzelburg 6073 (M), 20119 (M); Mosén 4394 (P); Ule 9129 (G, K).

G. blanchetiana is very close to *G. pohliana* and its relatives, notably to *G. brevispatha*, and may be distinguished by the less divided, pergamentaceous lamina, the 2 caducous pergamentaceous bracts at the base of the rather long cylindrical peduncle, the slender rachillas with decussate flowerpits, and the ovoid, rather large fruit.

The type, Blanchet s.n. (BR), consists of an inflorescence only. The added leafscraps belong, at least partly, to *Bactris*, as already noted by Wendland (*in schedula*). This inflorescence resembles the type of *G. luetzelburgii*, also a single inflorescence, rather well. The flowerpits tend, however,

to be verticillate instead of decussate. However, at the end of several rachillas a regular decussate arrangement is observed. *G. decussata* is placed here on the basis of its description only, the type being no longer available.

IV B b 10, 31 *Geonoma brevispatha* Barbosa Rodrigues, Prot. App. 41: 1879; Barbosa Rodrigues, Sert. Palm. 1: 28, t 22, 31 B. 1903; Burret, Bot. Jahrb. 63: 234. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 22. 1903.

Heterotypic synonyms: *Geonoma aricanga* Barbosa Rodrigues, Prot. App. 40. 1879; Barbosa Rodrigues, Les Palm. 37, t 4 f 5, 6. 1882; Barbosa Rodrigues, Sert. Palm. 1: 31, t 25. 1903; Burret, Bot. Jahrb. 63: 232. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 25. 1903.

Geonoma weddelliana H. Wendland ex Drude in Martius, Flora Bras. 3(2): 494, t 114. 1882; Burret, Bot. Jahrb. 63: 234. 1930; Dahlgren, Field Mus. Bot. 14: pl 298. 1959.

Type collection: Weddell 2983, Brazil, between Goiás and Cuyabá (P).

Geonoma calophyta Barbosa Rodrigues, Les Palm. 48. 1882; Barbosa Rodrigues, Sert. Palm. 1: 36, t 32 B. 1903; Burret, Bot. Jahrb. 63: 206. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 32 B. 1903.

Geonoma rupestris Barbosa Rodrigues, Les Palm. 47. 1882; Barbosa Rodrigues, Sert. Palm. 1: 34, t 31 A. 1903; Burret, Bot. Jahrb. 63: 235. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 31 A. 1903.

? *Geonoma caudulata* Loesener, Bot. Jahrb. 21: 423. 1896; Burret, Bot. Jahrb. 63: 234. 1930; Dahlgren, Field Mus. Bot. 14: pl 227. 1959.

Type collection: Ule 3150; (? 226), Brazil, Goiás, Serra dos Viadinhos (P).

Geonoma altissima Barbosa Rodrigues, Palm. Matto Gross. 6, t 2. 1898; Barbosa Rodrigues, Sert. Palm. 1: 23, t 12 B, 13 B. 1903; Burret, Bot. Jahrb. 63: 235. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 12 B, 13 B. 1903.

Geonoma chapadensis Barbosa Rodrigues, Palm. Matto Gross. 4, t 1. 1898; Barbosa Rodrigues, Sert. Palm. 1: 23, t 12 A, 13 A. 1903; Burret, Bot. Jahrb. 63: 235. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 12 A, 13 A. 1903.

Geonoma stenochista Burret, Bot. Jahrb. 63: 232. 1930.

Type collection: Glaziou 20030, Brazil, Minas Gerais, Rio Parauna, Serra do Cipó (P).

Geonoma plurinervia Burret, Notizbl. 15: 99. 1940.

Type collection: Archer & Gehrt 74 (herb. no. 36431), Brazil, Matto Grosso, Campo Grande (BH, US).

Geonoma warmingii A. D. Hawkes, Arch. Bot. Est. S. Paulo n. ser. 2: 189. 1952.

Based on: *Geonoma schottiana* Martius var. *palustris* Warming ex Drude in Martius, Flora Bras. 3(2): 493. 1882.

Type collection: Warming 1843, Brazil, Minas Gerais, Lagoa Santa (C).

Densely clustered, cane 1–4 m tall, up to 4 cm in diameter; leafsheath 2–3 dm long, more or less fibrous; petiole 2–4 dm in length; lamina subcoriaceous, 5–7 dm long and 3–5 dm wide, more or less regularly pinnate, segments unequal, often several 1-veined and linear, more or less plicate at base; 22–28 pairs of primary veins prominent above and below, secondary veins immersed above, prominent and greyish lepidote below, tertiary veins fine, veins emerging at 20–40° from the rachis.

Inflorescence twice branched; 2 subcoriaceous bracts, subequal long, the second one inserted 1–3 cm above the basal which is 11–15 cm long; peduncle 1–1½ dm long, rachis 7–15 cm in length, with 7–15 rachillas, in the upper part of the rachis simple and in the basal part often further branched, rachillas 1–2 dm long and 1½ mm in diameter; bilabiate flowerpits regularly decussate, about 2 mm apart; lower lip at first entire, becoming often more or less cleft. Male flowers at anthesis 2½ mm long, anthers sharply reflexed from the filaments. Female flowers with a shortly dentate staminodial tube. Fruit subglobose, black on a reddish inflorescence, about 8 mm in diameter; seed globose, 5 mm in diameter.

South-eastern part of Central Brazil and Paraguay, on rather wet and poorly drained places (map IV, 31).

Brazil: Archer & Gehrt 74 (BH, US); Duarte 2619 (RB); Eiten & de la Sota 2122 (BH); Glaziov 20030 (P), 22274 (BR, P); Ule 226 (P, R); Warming 1843 (C); Weddell 2527 (P), 2983 (F, P).

Paraguay: Hassler 4715 (G, K, P, UC).

G. brevispatha is very close to *G. pohliana* and its relatives but may be distinguished by the rather strongly pinnate, subcoriaceous, slightly plicate leafblades, the 2 persistent, subcoriaceous bracts enclosing the peduncle and inserted closely together, the slender rachillas with decussate, elevated flowerpits with rather small flowers, the globose, relatively small fruits.

Barbosa Rodrigues described several species, but they all agree so well in their descriptions and in the plates in Sert. Palm., vol 1, that I am unable to distinguish them. The other names reduced to synonymy here are based on specimens which could actually be studied. They show some variation in minor characters but match each other so well in leafstructure, inflorescences, flowers, and fruits that one is justified in regarding them conspecific.

The type of *G. caudulata*, Ule 3150 (= 226) is mixed up with a small inflorescence with scattered flowerpits. This inflorescence seems to represent *G. gastoniana* rather than a depauperate inflorescence of *G. brevispatha*.

IV B b 10, 32 *Geonoma schottiana* Martius, Hist. Nat. Palm. 2: 143, t 11 A. 1826; Martius, Palmet. Orbign. 32. 1847; Spruce, J. Linn. Soc. 11: 108. 1869; Drude in Martius, Flora Bras. 3(2): 492, t 113. 1882; Burret, Bot. Jahrb. 63: 232. 1930; Dahlgren, Field Mus. Bot. 14: pl 282–284. 1959.

Type collection: Schott 4111, Brazil, Rio de Janeiro (M).

Heterotypic synonyms: *Geonoma schottiana* Martius var. *angustifolia* Drude in Martius, Flora Bras. 3(2): 492. 1882.

Type collection: not designated.

Geonoma schottiana Martius var. *latifolia* Drude in Martius, Flora Bras. 3(2): 492. 1882.

Type collection: not designated.

not *Geonoma schottiana* Martius var. *palustris* Warming ex Drude, l.c. *Geonoma erythrosapadice* Barbosa Rodrigues, Prot. App. 41. 1879; Barbosa Rodrigues, Les Palm. 36, t 4 f 3, 4. 1882; Barbosa Rodrigues, Sert. Palm. 1: 30, t 24. 1903; Burret, Bot. Jahrb. 63: 232. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 24. 1903.

Geonoma hoehnei Burret, Bot. Jahrb. 63: 231. 1930.

Type collection: Hoehne & Gehrt, herb. Mus. S. Paulo 17391, Brazil, São Paulo, Japuhya (SP holotype).

Clustered, canes 1–3 m tall; leafsheath about 2 dm long; petiole 4–6 dm in length; lamina regularly pinnate, 6–10 dm long and 3–5 dm wide, segments linear, 1-veined, slightly falcate, caudate-acuminate at apex, usually about 1–2 cm wide and 3–4½ dm long, decreasing in length towards apex, the apical pair with a few primary veins; lamina with 25–40 pairs of primary veins prominent above, prominulent and with large brown scales below, each segment with 2 lateral secondary veins prominent above and below, tertiary veins fine, veins emerging at 45–55° from the rachis.

Inflorescences twice branched, with 2 long, tubular, subcoriaceous, persistent bracts, the basal one inserted at the base of the peduncle, the second bract usually inserted above the mouth of the basal one and not enclosed at all; peduncle 3–6 dm long, rachis 1–2 dm long with 8–16 rachillas branched, or simple at the upper part of the rachis, 1–2 mm in diameter with regularly decussate flowerpits; lower lip entire becoming emarginate; pairs of flowerpits 3–6 mm apart. Male flowers about 3 mm long, anthers sharply reflexed from the filaments. Female flowers with a shortly dentate staminodial tube. Fruit ovoid, black, slightly stipitate, obtuse at apex, 10 mm long, 8 mm in diameter; seed ovoid, 6 mm long and 5 mm broad.

Rather widespread in south-eastern Brazil, from sea-level up to an altitude of 1000 m (map IV, 32).

Brazil: Blanchet s.n. (M); Brade 16590 (RB), 17137 (RB), 18318 (RB), 18359 (RB), 18852 (RB); Burret 9 (RB); Castellanos 23161 (R); Dusén 12136 (F, S, US), 15540 (F); Dutra 398 (R); Gaudichaud 114 (P), 389 (F, P); Glaziov 1178 (P, US), 8493 (C, F, P), 9011 (C, G, K, P, R), 15681 (C, P), 16476 (C, F, G, P), 22273 (C, P); Góes & Alves 92 (RB); Hatschbach 2975 (US), 8066 (US); Hoehne & Gehrt 17391 (SP); Klein 1862 (HBR); Luschath 69 (LE); Luetzelburg 20045 (BH, M); Mexia 4664 (UC, US); Occhioni 101 (RB), 102 (RB); Rambo 42217 (P, US); Regnell I 448 (C, US); Reitz 1828 (HBR), 1900 (HBR), 3183 (HBR), 3535 (HBR), 5023 (HBR), C 1040 (HBR); Reitz & Klein 1281 (HBR), 1715 (HBR), 2305 (HBR), 2306 (HBR), 2307 (HBR), 2309 (HBR), 2426 (HBR), 2669 (HBR), 3208 (HBR), 3591 (HBR), 4402 (HBR), 4410 (HBR), 5818 (HBR), 8800 (HBR), 8838 (HBR), 8906 (HBR), 9005 (HBR), 9053 (HBR), 9249 (HBR), 9655 (HBR), 10523 (HBR), 11398 (HBR), 11399 (HBR), 11412 (HBR); de Saldanha 5292 (R), 6730 (R); Schott 4111 (M); Schwacke 2514 (R), II-87 (R), IV-73 (R); Vidal 1985 (R); Warming 1844 (C), 1847 (C); Weddell 774 (G, P), 1020 (P); Wulle s.n. (RB).

G. schottiana is close to *G. pohliana* and its relatives. It can be distinguished by the regularly pinnate leaves, the regularly decussate flowerpits, but above all by the bracts inserted far apart on the very long peduncle.

Already BURRET (1930) correctly stated that the varieties described by Drude cannot be maintained as separate taxa. Furthermore the reduction of *G. erythrospadice* to a synonym of *G. schottiana* is justified. *G. hoehnei* is also considered as a synonym of *G. schottiana*.

IV B b 10, 33 *Geonoma pohliana* Martius, Hist. Nat. Palm. 2: 142, t 6 A, 1826; Martius, Palmet. Orbign. 31. 1847; Drude in Martius, Flora Bras. 3(2): 487. 1882; Burret, Bot. Jahrb. 63: 208. 1930; Dahlgren, Field Mus. Bot. 14: pl 275, 277. 1959.

Type collection: Schott s.n., Brazil, Rio de Janeiro (not seen).

Heterotypic synonyms: *Geonoma macroclona* Drude & H. Wendland in Martius, Flora Bras. 3(2): 486. 1882; Burret, Bot. Jahrb. 63: 210. 1930.

Type collection: Lhotzky s.n., Brazil, Bahia, near Ilheos (BR holotype, G). *Geonoma trigonostyla* Barbosa Rodrigues, Les Palm. 46. 1882; Barbosa Rodrigues, Sert. Palm. 1: 27, t 20, 21. 1903; Burret, Bot. Jahrb. 63: 210. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 20, 21. 1903.

Geonoma latifolia Burret, Fedde Rep. 32: 102. 1933.

Type collection: Werdermann 3065, Brazil, Sergipe, Serra do Itabaiana (B). ? *Geonoma kuhlmannii* Burret, Notizbl. 14: 261. 1938.

Type collection: Kuhlmann 141, Brazil, Rio de Janeiro, Nova Friburgo (not seen).

Clustered, with a few canes up to 3 m tall, 2–3 cm in diameter; leaf-sheath about 2 dm long; petiole 4–8 dm in length; lamina irregularly pinnate, 6–10 dm long and 3–5 dm wide, segments unequal, linear to rather broad, porrect, apical pair $2\frac{1}{2}$ –4 dm long; about 30 pairs of primary veins prominent above and prominulent below, secondary veins inconspicuous above, prominent and greyish lepidote below, tertiary veins fine, veins emerging at 35–45° from the rachis.

Inflorescences once or twice branched, with 2 subcoriaceous, persistent, fibrous decaying bracts, inserted 1–2 cm apart at the base of the peduncle, subequal, the basal bract $1\frac{1}{2}$ –2 dm long, enclosing the peduncle almost completely; rachis 1–3 dm long with 8–14 lateral branches simple, or sometimes the lower ones further branched into 2–7 rachillas, rachillas $1\frac{1}{2}$ –4 dm long and 2–3 mm in diameter; bilabiate flowerpits usually rather densely, spirally arranged although sometimes alternating trimerous verticillate or decussate, about $1\frac{1}{2}$ mm apart; lips conspicuous, lower lip at first entire, later on cleft. Male flowers $3\frac{1}{2}$ mm long, anthers sharply reflexed from the filaments. Female flowers with a shortly dentate staminal tube. Fruit ovoid, slightly apiculate, 12 mm long and 10 mm in diameter.

Eastern Brazil, in the coastal zone from low altitudes up to 1800 m (map IV, 33).

Brazil: Blanchet s.n. (BR, G); Brade 16477 (RB); Burret & Brade 1 (RB); Glaziou 9007 (C, K, LE, P), 9017 (F, K, M, P), 15557 (C, K, P); Lhotzky s.n. (BR, G); Luetzelburg 12501 (M); Pohl s.n. (M); de Saldanha 6727 (R); Werdermann 3065 (B); Wulle s.n. (RB).

G. pohliana was the first species described from a group of very close relatives: *G. blanchetiana*, *G. brevispatha*, and *G. gamiova*. Among these species *G. pohliana* is distinguished by having spirally arranged to alternating verticillate flowerpits whereas the other species tend to have more or less regularly decussate flowerpits although sometimes in *G. pohliana* they are decussate too. The species is separated from *G. blanchetiana* by the porrect leafsegments, the persistent, subcoriaceous bracts, and the thicker rachillas with relatively large flowerpits and flowers. It is separated from *G. brevispatha* by the porrect leafsegments and the larger, less fleshy fruits. It differs from *G. gamiova* by the shorter distances between the flowerpits. Moreover *G. gamiova* occurs south of the Tropic of Capricorn, the other species being confined to regions north of the Tropic of Capricorn.

As already noted by Burret, *G. macroclona* is almost identical with *G. trigonostyla*. It also agrees rather well with *G. pohliana* and must be considered conspecific. Werdermann 3065, the type of *G. latifolia* could not be separated and is placed in synonymy here. Unfortunately the last-mentioned collection has been reduced to a few very poor scraps of lamina and peduncle, in combination with unattached rachillas and fruits. *G. kuhlmannii* is placed here in synonymy on account of its description only, no type material being available.

IV B b 10, 34 *Geonoma gamiova* Barbosa Rodrigues, Contrib. Jard. Bot. R. d. J. 6: 13, t 37. 1907; Burret, Bot. Jahrb. 63: 205. 1930.

Type collection: Barbosa Rodrigues s.n., Brazil, Santa Catarina, Blumenau (not seen).

Clustered, canes 2–4 m tall; leafsheath about 2 dm in length; petiole 3–5 dm long; lamina irregularly pinnate, 5–8 dm long and 3–4½ dm wide, segments unequal, linear to rather broad, falcate, long caudate-acuminate at apex, apical pair of segments 2–2½ dm long; 25–40 pairs of primary veins prominent above and prominulent below, secondary veins inconspicuous above, prominent and brownish lepidote below, tertiary veins fine, veins emerging at about 40° from the rachis.

Inflorescence once or twice branched, with 2 subcoriaceous, persistent bracts inserted about 3 dm apart at the base of the peduncle, subequal, the basal bract 1½–2 dm long, enclosing the peduncle or sometimes slightly shorter; rachis 10–15 cm long with 8–13 lateral branches simples, or sometimes the lower ones are further branched, rachillas 2–3 dm long and 2–3 mm in diameter; bilabiate flowerpits scattered to more or less regularly decussate, about 5 mm apart; lips prominent, lower lip entire for a long time. Male flowers about 4 mm long, the anthers sharply reflexed from the filaments. Female flowers with a shortly dentate staminodial tube. Fruit ovoid, slightly stipitate, and pointed at apex, 11 mm long and 8 mm in diameter; seed subglobose, about 7 mm in diameter.

South-eastern Brazil south of the Tropic of Capricorn, in the coastal area in dense forests, at altitudes up to 800 m (map IV, 34).

Brazil: Dutra 303 (R), 712 (R); Eiten, Eiten & de la Sota 2056 (BH); Rambo 47141 (F); Reitz C 446 (HBR, RB), 3551 (HBR); Reitz & Klein 1128 (HBR), 1980 (HBR), 2308 (HBR), 2338 (HBR), 2344 (HBR), 2349 (HBR), 2351 (HBR), 2358 (HBR), 2562 (HBR), 2589 (HBR), 2593 (HBR), 3157 (HBR), 3159 (HBR), 3603 (HBR), 4298 (HBR), 4396 (HBR), 4486 (HBR), 6884 (HBR), 7001 (HBR); Ule 864 (US); Schwacke IV-72 (R).

G. gamiova, published in a little accessible paper by Barbosa Rodrigues, is the southernmost species of the genus, sympatric with *G. schottiana* only (although the latter has a much larger area). *G. gamiova* is mainly known from the numerous Reitz & Klein collections from Sta. Catarina. The species is distinguishable from *G. pohliana*, its closest relative, by the relatively widely spaced flowerpits and in characteristics of the leaves which are, however, very difficult to put into words.

IV B b 10, 35 *Geonoma fiscellaria* Martius ex Drude in Martius, Flora Bras. 3(2): 486, t 110. 1882; Burret, Bot. Jahrb. 63: 207. 1930; Dahlgren, Field Mus. Bot. 14: pl 239. 1959.

Type collection: Glaziov 1180, Brazil, Rio de Janeiro (BR holotype, P).

Heterotypic synonyms: *Geonoma barbiger* Barbosa Rodrigues, Les Palm. 45. 1882; Barbosa Rodrigues, Sert. Palm. 1: 32, t 26 B. 1903; Burret, Bot. Jahrb. 63: 208. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 26 B. 1903.

Geonoma pilosa Barbosa Rodrigues, Les Palm. 43. 1882; Barbosa Rodrigues, Sert. Palm. 1: 29, t 23. 1903; Burret, Bot. Jahrb. 63: 207. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 23. 1903.

Geonoma tomentosa Barbosa Rodrigues, Les Palm. 44. 1882; Barbosa Rodrigues, Sert. Palm. 1: 31, t 26 A. 1903; Burret, Bot. Jahrb. 63: 207. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 26 A. 1903.

Geonoma barbosiana Burret, Notizbl. 14: 255. 1938.

Type collection: Brade & Burret 25, Brazil, Rio de Janeiro (not seen).

Clustered, canes 2–4 m tall, 4–7 cm in diameter, internodes rather long; leafsheath about 3 dm long; petiole 6–9 dm in length; greyish-lepidote; rachis 5–8 dm long; lamina irregularly pinnate with few to numerous unequal segments about 4–6 dm long, falcate-lanceolate, long caudate-acuminate at apex; primary veins prominent above, prominulent below, secondary veins prominulent above, prominent and sparsely greyish lepidote below, tertiary veins fine, veins emerging at about 40° from the rachis.

Inflorescence twice branched, with 2 flattened bracts inserted about 2–3 cm apart at the base of the peduncle, basal bract $2\frac{1}{2}$ –3 dm long, enclosing the second one; peduncle slightly shorter than the enlarged bracts with a few acute, small bracts in the upper half, rachis up to $2\frac{1}{2}$ dm long, the lateral branches of the lower part with up to 8 rachillas, in the upper part simple rachillas only, 2– $2\frac{1}{2}$ dm long and 3–5 mm in diameter; in-

florescence densely hispid; bilabiate flowerpits occurring more or less regularly in trimerous alternating whorls about 2–3 mm apart; lips conspicuous, the lower lip at first entire, later on becoming emarginate. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit ovoid, rounded at apex, slightly stipitate, 16 mm long and 11 mm in diameter.

Only collected from the mountain forests in the state Rio de Janeiro at altitudes of up to 1250 m (map IV, 35).

Brazil: Blanchet 27 (P); Brade 16591 (R), 18830 (RB); Glaziou 1180 (BR, P), 9012 (C, G, K, LE, P, R); Luetzelburg 20121 (M); de Saldanha 6728 (R); Weddell 815 (G, P).

G. fiscellaria is a relatively tall species, readily distinguished by its large, hispid inflorescences. Barbosa Rodrigues, unfamiliar with *G. fiscellaria*, described 3 new species, all from the same locality, which resemble each other and the latter species very well, as shown by his excellent drawings. Consequently there cannot be any doubt about their conspecificity. Burret also described a new species which is slightly smaller. His type was not available, but a specimen collected by Brade (18830) at the type locality and named *G. barbosiana* by Brade, was sent on loan from RB. This specimen matches Burret's description exactly and is in the present writer's opinion conspecific with *G. fiscellaria*. The smaller dimensions and the less divided leaf may be due to the greater altitudes where it was found: plants referred to *G. barbosiana* were collected at 900–1250 m whereas the typical plants were taken between 400 and 700 m.

IV B b 10, 36 *Geonoma rubescens* H. Wendland ex Drude in Martius, Flora Bras. 3(2): 491, t 111. 1882; Burret, Bot. Jahrb. 63: 205. 1930; Dahlgren, Field Mus. Bot. 14: pl 281. 1959.

Type collection: Blanchet s.n., Brazil, Bahia, Ilheus (BR holotype, P).

Heterotypic synonym: *Geonoma platycaula* Drude & Trail in Martius, Flora Bras. 3(2): 490. 1882 (p.p.?); Burret, Bot. Jahrb. 63: 205. 1930; Dahlgren, Field Mus. Bot. 14: pl 276. 1959 (p.p.).

Type collection: Martius s.n., Brazil, Bahia (M).

Up to 3 m tall, cane erect, $1\frac{1}{2}$ –4 cm in diameter; leafsheath and petiole not seen; rachis 6–7 dm long; lamina ovate lanceolate, about 9 dm long and 5 dm wide, simple or divided into a few broad segments, apical lobes $2\frac{1}{2}$ –3 dm long; about 40 pairs of primary veins prominent above and prominent below, secondary veins very inconspicuous above, prominent below, veins emerging at about 40° from the rachis.

Inflorescences with 2 almost equally long bracts $1\frac{1}{2}$ –2 dm long and 2 cm wide, inserted 2–4 cm apart at the base of the peduncle; peduncle $1\frac{1}{2}$ –2 dm long with 3–4 small bracts, rachis less than 5 cm long with 4–7 stiff rachillas $1\frac{1}{2}$ –2 dm long and about 5 mm in diameter; flowerpits in 6 longitudinal

or somewhat spiral series, inconspicuously lipped, lower lip entire, flowerpits 1–2 mm apart. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with the staminodial tube crenulate. Immature fruit 13 mm long and 9 mm in diameter, acute at apex.

Only known from a few old poorly labelled collections from Brazil, Bahia, near Ilheos (map IV, 36).

Brazil: Blanchet s.n. (BR, P); Martius s.n. (M).

The type, well-reproduced on plate 111 of *Flora Bras.*, is still present at BR. This specimen, however, is not numbered whereas the type of *G. macroclona* is a Blanchet collection bearing the number 2461 in pencil which was apparently added later.

That Martius had an incorrect conception of *G. simplicifrons* emerges from his description and illustrations in *Hist. Nat. Palm.* 2: 14, t 8 f 1, 14. 1823, where a very heterogeneous mixture is placed under this name. One of these aberrant inflorescences, t 14 f 1, was named *G. rubescens* by Wendland in *schedula*. On the same inflorescence and a few unattached leaves Drude based his species *G. platycaula*. A second specimen which seems to be lost now, and said to have been collected by Kegel in Suriname, was also referred to this species. This, and the fact that there is no proof that the inflorescence and the leaves belong together, render it necessary to designate a lectotype. Hence Martius's inflorescence is chosen as type of *G. platycaula*. Wendland had already identified this inflorescence as *G. rubescens* to which species it certainly belongs.

IV B b 10, 37 *Geonoma gastoniana* Glaziou ex Drude, *Flora Bras.* 3(2): 496, t 116. 1882; Burret, *Bot. Jahrb.* 63: 230. 1930; Dahlgren, *Field Mus. Bot.* 14: pl 240. 1959.

Type collection: Glaziou 9019, Brazil, Rio de Janeiro, Tingua (C, G, K, LE, P holotype).

Slender, up to 2 m tall, cane about 1 cm in diameter, smooth, internodes $\frac{1}{2}$ –1 $\frac{1}{2}$ cm long; leafsheath about 8 cm long; petiole about 2 dm in length; lamina ovate, about 4 dm long and 2 $\frac{1}{2}$ –3 dm wide, divided into broad segments intermixed with those having but 1 vein, or sometimes composed of 1-veined segments only, apical lobes 2–2 $\frac{1}{2}$ dm long; 15–20 pairs of primary veins prominent above, prominent and with a few scattered scales below, secondary veins immersed above, prominent and brown lepidote below, tertiary veins inconspicuous, veins emerging at 35–40° from the rachis.

Inflorescence infrafoliar, twice branched, rather variable in size with 2 tubular membranaceous bracts, the basal one up to 9 cm long, enclosing the second which is 1–2 cm higher inserted; peduncle about 1 dm long, rachis about as long and with an apparently varying number of slender rachillas 2–2 $\frac{1}{2}$ dm long, between the flowerpits about 1 mm in diameter,

including flowerpits about 2 mm in diameter; rachillas sparsely puberulent; bilabiate flowerpits spirally arranged, 2–8 mm apart; rachillas tapering into a slender, curved point. Male flowers with the anthers sharply reflexed from the filaments. Female flowers about 3 mm long, staminodial tube shortly crenulate. Fruit unknown.

Twice collected in Goiás and once in Rio de Janeiro, in mountain forest along creeks up to an altitude of about 1300 m (map IV, 37).

Brazil: Glaziou 9019 (C, G, K, LE, P), 22275 (P); Ule 3150 p.p. (P, R).

G. gastoniana is easily distinguished by its small inflorescences with their scattered flowerpits far apart on the slender rachillas. In other respects it calls to mind *G. brevispatha* and its relatives. Ule 3150 (P), the type of *G. caudulata*, is mixed up with a small inflorescence that probably belongs here.

IV B b 10, 38 *Geonoma wittigiana* Glaziou ex Drude, Flora Bras. 3(2): 499, t 115. 1882; Burret, Bot. Jahrb. 63: 229. 1930; Dahlgren, Field Mus. Bot. 14: pl 229. 1959.

Type collection: Glaziou 6458, Brazil, Rio de Janeiro, Serra dos Orgãos (C, K, P holotype, R).

Small, clustered, up to $1\frac{1}{2}$ m tall, cane slender, 6–10 mm in diameter, internodes about 1 cm long; leafsheath about 6 cm long; petiole 12–15 cm in length; rachis 15–21 cm long; lamina ovate, 22–28 cm long, 11–15 cm wide, usually trijugate or sometimes with several 1-veined segments, apical segments about 12 cm long; 18–20 pairs of primary veins prominent above and below, paleaceous below, secondary veins immersed above, prominent and brown lepidote below, veins emerging at about 50° from the rachis.

Inflorescences infrafoliar with 2 membranaceous, tubular bracts, the basal bract about 5 cm long, narrowed into a short point at apex, enclosing the second bract which is inserted 1–2 cm higher up; peduncle 6–10 cm long, rachis 3–4 cm long with 6–8 simple rachillas about 8 cm long and $1\frac{1}{2}$ mm in diameter; bilabiate flowerpits more or less spirally arranged or sometimes almost decussate, 1–3 mm apart. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit unknown.

Only known from the Serra dos Orgãos, Rio de Janeiro, at an altitude of 1200–1500 m.

Brazil: Brade 16345 (R), 16442 (R), 16476 (R); Glaziou 6458 (C, K, P, R); Lietze s.n. (LE); Ule 4147 (R).

G. wittigiana is only known from a single locality, all specimens studied are quite uniform (map IV, 38).

Group 11: species 39–46.

IV B b 11, 39 *Geonoma membranacea* H. Wendland ex Spruce, J. Linn. Soc. 11: 106. 1869; Burret, Bot. Jahrb. 63: 243. 1930; Dahlgren, Field Mus. Bot. 14: pl 256. 1959.

Type collection: Wendland s.n., Guatemala, Volcan de Fuego (K holotype). Heterotypic synonym: *Geonoma leptoclada* Burret, Notizbl. 11: 863. 1933. Type collection: Lehmann 1613, Guatemala, Volcan de Santa Maria (not seen, destroyed at B).

Solitary, stem 2–4 m tall, $1\frac{1}{2}$ –5 cm in diameter, internodes 3–5 cm long; leafsheath 1– $1\frac{1}{2}$ dm in length; petiole 4–5 dm long; lamina irregularly pinnate, lanceolate, 6–8 dm long and 3–4 dm wide, with 5–12 pairs of unequal segments, broad and 1-veined ones intermixed, segments sigmoid and more or less contracted at base; 30–40 pairs of primary veins prominent above and below, secondary veins immersed above, prominent and brown lepidote below, veins emerging at 40–55° from the rachis.

Inflorescences twice branched, with 2 tubular, papyraceous bracts later shed, 1– $1\frac{1}{2}$ dm long, subequal, inserted about 3 cm apart at the base of the peduncle, the second slightly longer than the basal one; peduncle $1\frac{1}{2}$ – $2\frac{1}{2}$ dm long, rachis 7–15 cm long with 5–8 lateral branches, the lower ones branched again into 2–3 rachillas, the upper ones simple, 7–17 cm long and $1\frac{1}{2}$ – $2\frac{1}{2}$ mm thick, hispid with about $\frac{1}{2}$ mm long, simple hairs; flowerpits spirally arranged about 4–9 mm apart; upper lip lacking, lower lip entire; flowerpits inside densely pilose; flowering inflorescence brown-purple turning to brick-red and finally orange in fruit. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit greenish, ovoid, 8 mm long and 7 mm in diameter, rounded at apex; seed globose, 6 mm in diameter.

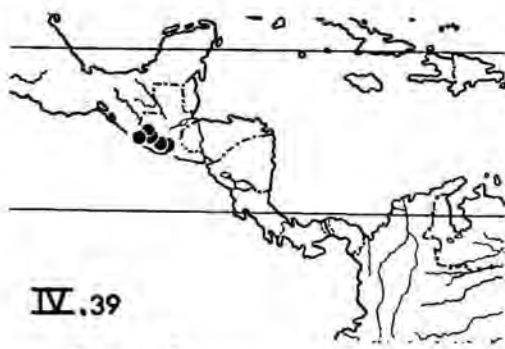
Only known from southern Guatemala, in dense forests, on south-facing volcano slopes at 1000–1500 m (map IV, 39).

Guatemala: Heyde & Lux, ed. Donnell Smith 4656 (F, K, US); Standley 86906 (F), 86970 (F); Steyermark 33339 (F), 37091 (F), 47919 (F); Wendland s.n. (K).

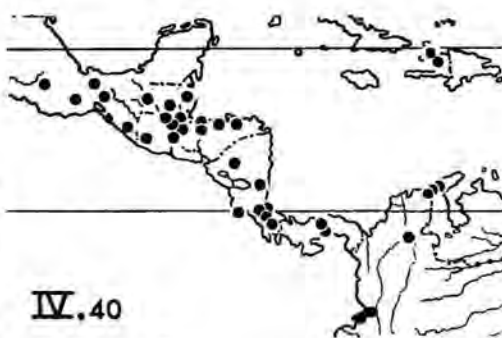
G. membranacea is readily distinguished from its closest relatives by the rather large, greenish fruits. *G. leptoclada* agrees in its description extremely well, and even in the absence of type material I feel no doubt about its position. The species which has been collected several times, always in the same habitat, has apparently a narrow ecological amplitude and a limited distribution.

IV B b 11, 40 *Geonoma oxycarpa* Martius, Palmet. Orbign. 30. 1847; Urban, Symb. Ant. 8: 76. 1920; Burret, Sv. Vet. Akad. Handl. ser. 3, 6, 7: 23. 1929; Burret, Bot. Jahrb. 63: 244. 1930.

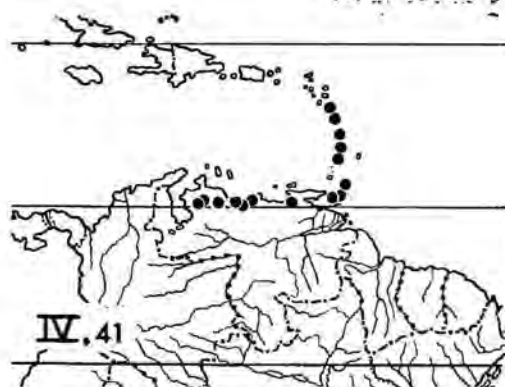
Type collection: Plumier s.n., Haiti, Port de Paix (not seen).



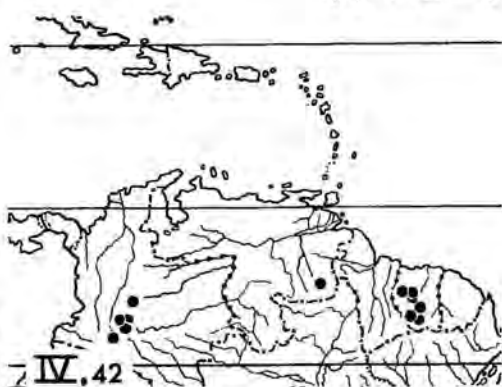
IV.39



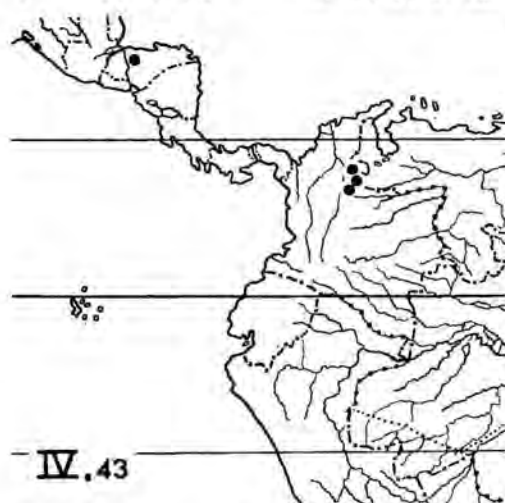
IV.40



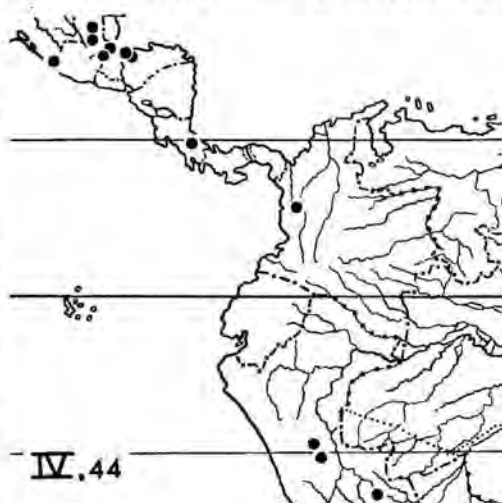
IV.41



IV.42



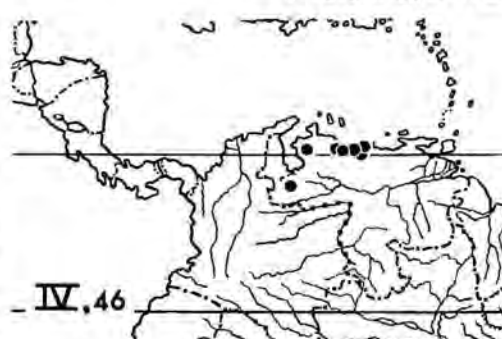
IV.43



IV.44



IV.45



IV.46

Maps IV,39-46. Distribution of *Geonoma* species: IV,39 *G. membranacea*; IV,40 *G. oxycarpa*; IV,41 *G. pinnatifrons*; IV,42 *G. euspatha*; IV,43 *G. pulchra*; IV,44 *G. interrupta*; IV,45 *G. dicranospadix*; IV,46 *G. simplicifrons*.

Heterotypic synonyms: *Geonoma mazicana* Liebmann in Martius, Hist. Nat. Palm. 3: 316. 1850; Spruce, J. Linn. Soc. 11: 109. 1869; Burret, Bot. Jahrb. 63: 244. 1930; Dahlgren, Field Mus. Bot. 14: pl 264-266. 1959.

Type collection: Liebmann 10804, Mexico, Oaxaca (C holotype, K, P, UC, US). *Geonoma magnifica* Linden & H. Wendland, Linnaea 28: 335. 1856; Burret, Bot. Jahrb. 63: 247. 1930.

Type collection: Ghiesbreght s.n., Mexico, Tabasco (not seen).

Geonoma purdieana Spruce, J. Linn. Soc. 11: 109, 1869; Burret, Bot. Jahrb. 63: 247. 1930.

Type collection: Purdie 259, Colombia, Río de la Hacha (K holotype).

Geonoma binervia Oersted, Vidensk. Meddel. Kjöeb. 1858: 33. 1859; Burret, Bot. Jahrb. 63: 247. 1930; Bailey, Gent. Herb. 3: 78, f 59-61. 1933.

Type collection: Oersted 6564, Nicaragua, San Juan (C holotype).

Geonoma megaloptila Burret, Bot. Jahrb. 63: 247. 1930.

Type collection: Kalbreyer 1968, Colombia, Santander (not seen, destroyed at B).

Geonoma platybothros Burret, Notizbl. 11: 200. 1931.

Type collection: H. H. Smith 2340, Colombia, Santa Marta (F, K, P, US).

Geonoma preussii Burret, Bot. Jahrb. 63: 242. 1930.

Type collection: Preuss 1415, Mexico, Tehuantepec (not seen, destroyed at B).

? *Geonoma ramosissima* Burret, Bot. Jahrb. 63: 249. 1930.

Type collection: Kalbreyer 1892, Colombia, Antioquia, Cinegetas (not seen, destroyed at B).

? *Geonoma rivalis* Kalbreyer ex Burret, Bot. Jahrb. 63: 241. 1930.

Type collection: Kalbreyer 1427, Colombia, Antioquia, Coco (not seen, destroyed at B).

Very variable in size, 2-7 m tall, stem 2-12 cm in diameter, internodes 1-4 cm long; leafsheath about 3-4 dm in length, densely brown furfuraceous; petiole 5-10 dm long; rachis 5-17 dm long, produced at apex into a slender thread; lamina irregularly pinnate, usually broad segments intermixed with linear ones but sometimes with a few pairs of broad segments only or almost regularly pinnate with all segments linear; segments falcate; 30-80 pairs of primary veins prominent above and inconspicuous below, secondary veins slightly immersed above, prominent and sparsely brown lepidote below, veins emerging at about 40° from the rachis.

Inflorescences repeatedly branched, with 2 coriaceous, flattened bracts, the basal one 1-2 dm long, enclosing the second, bracts inserted 3-5 cm apart at the base of the peduncle; peduncle up to about 3 dm long, rachis 1½-4½ dm long, lateral branches 1-3 times branched again, rachillas ½-2½ dm long and 2-3 mm wide with straight simple hairs about ½ mm long or sometimes a few forked hairs; flowerpits spirally arranged in 5 series, about 3-6 mm apart; upper lip lacking, lower lip rounded, entire; interior of flowerpits pilose. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a slightly crenulate staminodial tube. Fruit black on red rachillas, subglobose to slightly ovoid, 5½ mm long and 4½ mm in diameter, slightly pointed at apex, stipitate; seed subglobose, about 3½ mm in diameter.

Central America, western Colombia, and Haiti in wet, apparently poorly

drained forests near sea-level, and in the mountains up to an altitude of 1000 m or more (map IV, 40).

Mexico: Cook 822 (F, US); Doyle & Collins 6 (US), 10 (US); Galeotti 4985 (BR, P), 4989 (BR, F, P); Liebmann 10804 (C, K, P, UC, US); Matuda 3477 (F), 16384 (F); Mell 653 (US); Williams 8954 (F).

Guatemala: Cook & Doyle 4 (US), 35 (F, US); Cook & Griggs 128 (US); Goll 228 (F, US); Steyermark 38757 (F), 44387 (F), 45442 (F, US); Tuerckheim 8332 (F, US); Watson 158² (F, US).

British Honduras: Peck 604 (K); Schipp 397 (BM, F, G, K, UC, US).

Honduras: Molina R. 2974 (F); Standley 52928 (F, US), 54689 (F, US); Wilson 407 (US); Yuncker, Koepper & Wagner 8473 (F, G).

Nicaragua: Oersted 6564 (C); Williams, Molina R. & Williams 23876 (F).

Costa Rica: Brenz 21848 (F); Cook & Doyle 727 (US), 728 (US); Hatch 162; Loomis 11 (US); Pittier 6613 (BR), 6614 (BR); Valerio 1056 (F).

Panama: Aviles 94 (F); Kenoyer 173 (US); Maxon, Harvey & Valentine 6825 (F, US); Pittier 4330 (US); Shattuck 396 (F); Steyermark 17220 (G, US).

Hispaniola: Ekman H 3781 (K, US); Fennell & Loomis 138964 (US).

Colombia: Cook 164 (BH, US); Cuatrecasas 16981 (BH); Curran 166 (US); Killip 34845 (US); Linden s.n. (L); Purdie 259 (K); Seifrizz 173 (US); H. H. Smith 2340 (F, K, P, US).

G. oxycarpa in the present circumscription shows a remarkable variability in size. Rather small plants with trijugate leaves and small, twice branched inflorescences belong here as do robust plants with stems up to 7 m tall and 1 dm or more in diameter with leaves to 3 m long and inflorescences branched four times. Intermediates are found between these extremes all sharing several distinctive characters: the strongly flattened basal bract that completely encloses the second, the rachillas sparsely beset with about $\frac{1}{2}$ mm long hairs, the flowerpits without an upper lip, and the very small, black fruits.

Burret already noted the occurrence of *G. oxycarpa* in Central America; he reduced *G. mexicana* to a synonym of the latter while noting the close resemblance to *G. binervia*. In practice he found it impossible to assign intermediate specimens to one of the two species and named them "*G. binervia* Oerst. *cfr. etiam oxycarpa* Mart." etc. Since no appreciable gaps can be found it seems more satisfactory to treat them as one species. This is also done in the present treatment with several other names based on hardly distinct specimens from Central America and western Colombia. Unfortunately several of the types, notably of Burret's species, are no longer available, but some idea about them can be gained from specimens at US to which Burret applied the same name. Only *G. rivalis*, represented by Curran 166 from Colombia, does not fit very well into the variation spectrum. The specimen is smaller than is usual in this species. On the other hand it shows all the mentioned characteristics and is therefore, in the absence of more material, not maintained here as a separate species.

IV B b 11, 41 *Geonoma pinnatifrons* Willdenow, Spec. Pl. 4(1): 593. 1805; Willdenow, Mém. Acad. Sci. Berlin 13: 38. 1807; Burret, Bot. Jahrb. 63: 245. 1930; Dahlgren, Field Mus. Bot. 14: pl 272 (p.p.?). 1959.

Type collection: Bredemeyer 21, Venezuela, Caracas (B holotype, M).

Heterotypic synonyms: *Geonoma martinicensis* Martius, Palmet. Orbign. 28. 1847; Urban, Fedde Rep. Beih. 5: 141. 1920; Burret, Bot. Jahrb. 63: 246. 1930. Type collection: Plumier s.n., Martinique (not seen, not found at BR, M, or P). *Geonoma pleeana* Martius, Palmet. Orbign. 33. 1847; Burret, Bot. Jahrb. 63: 264. 1930.

Type collection: Plée s.n., Venezuela, Maracaibo (not seen).

Geonoma vaga Grisebach, Flora Brit. W. Ind. 517. 1864; Bailey, Gent. Herb. 7: 433, f 201. 1947.

Geonoma pinnatifrons Willdenow var. *vaga* (Grisebach) Burret, Bot. Jahrb. 63: 246. 1930.

Type collection: Imray s.n., Dominica (K).

Geonoma dominicana Bailey, Gent. Herb. 4: 232, f 147. 1939; Hodge, Lloydia 17: 153. 1954.

Type collection: Hodge 307, Dominica (not seen).

Clustered, with sometimes 10 and more canes together, canes 2–6 m tall and 3–5 cm in diameter, internodes 5–10 cm long; leafsheath about 3–4 dm long; petiole 2–6 dm in length; rachis 7–15 dm long; lamina irregularly pinnate, broad segments intermixed with linear ones, segments slightly falcate; primary veins prominent above and below but above about two times stronger than below, secondary veins inconspicuous above, below about as thick as primary veins, glabrous except for a few scattered scales, veins emerging at 35–50° from the rachis.

Inflorescences twice branched, with 2 flattened, soon decaying and early caducous bracts 1–3 dm long, inserted about 1–4 cm apart at the base of the peduncle, the second more or less exceeding the basal one; peduncle 2–6 dm long, becoming arching with drooping rachillas 1–2½ dm long and about 3 mm thick, covered with about 1 mm long stiff, straight hairs, glabrescent; inflorescence pinkish-brown at anthesis turning orange-red in fruit; flowerpits spirally arranged in about 5 series, about 2 mm apart; upper lip lacking, lower lip rounded, entire; flowerpits pilose inside, and often with a ciliate upper rim. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a slightly crenulate staminodial tube. Fruit black, ovoid, 8 mm long and 7 mm in diameter, slightly pointed at apex, stipitate; seed subglobose, 5 mm in diameter.

Lesser Antilles and northern Venezuela north of 10° N lat., in dense forests on mountain sides at moderate altitudes (300–1500 m) (map IV, 41).

Guadeloupe: l'Herminier s.n. (P); Questel s.n. (P).

Dominica: Imray 192 (K); Ramage s.n. (K).

Martinique: Hahn 419 (G, P), 1309 (BR, G, P, US).

St. Lucia: Ramage s.n. (K).

St. Vincent: H. H. & G. W. Smith 1433 (K).

Tobago: Broadway 4073 (F, G); Eggers 5825 (L, P, US).

Trinidad: Britton, Britton & Hazen 1933 (US); Britton, Freeman & Bailey 2278 (G, US); Britton, Hazen & Mendelson 1805 (US); Broadway 2701 (BR, F, G), 5676 (F), 5928 (F, P); Crueger s.n. (GOET, K); Fendler 728 (P); Purdie 23 (GOET, K); A. C. Smith 10010 (US); Wessels Boer 1635 (U).

Venezuela: Aristeguieta & Pannier 1876 (VEN); Bredemeyer 21 (B, M); Pittier 13915 (F, VEN), 13943 (F, VEN); Pittier & Nakichenowich 15399 (US, VEN); Schlim 1723 (LE); Steyermark 61056 (F, VEN), 91633 (BH), 95100 (BH); Steyermark & Steyermark 95308 (BH); Tamayo 2548 (US, VEN), 2549 (US, VEN).

G. pinnatifrons is very close to *G. interrupta*, and at one time I believed they were conspecific. Working over the material again it became clear that a separation is indeed possible. If the caducous, unequal bracts, the second exceeding the basal one, the often rather long rachillas at first covered with about 1 mm long straight hairs, and, last but not least, the relatively large fruits (8 × 7 mm) are emphasized, the species seems to be rather well delimited. Burret discussed the resemblances of *G. pinnatifrons*, *G. martinicensis*, and *G. vaga*, reducing the latter to a variety of the first. The differences mentioned by Burret are not as closely related to the distribution as he believed. For instance, Martius named a specimen from Venezuela *G. pleeana* linking *G. pinnatifrons* and *G. martinicensis*. Grisebach in his original description of *G. vaga* cited material from both Trinidad and Dominica. Burret chose the Imray specimen from Dominica as lectotype, excluding other material from the taxon. Consequently Bailey's new species *G. dominicana*, described to accommodate the plants from Dominica, is also synonymous.

IV B b 11, 42 *Geonoma euspatha* Burret, Notizbl. 11: 10. 1930.

Type collection: Woronow & Juzepczuk 5885, Colombia, Caquetá, Sucre (LE). Heterotypic synonym: *Geonoma karuaiana* Steyermark, Field. Bot. 28(1): 88. 1951.

Type collection: Steyermark 60789, Venezuela, Bolívar, Rio Caruai (F holotype). Misapplied name: *Geonoma interrupta* auct. non Martius; Wessels Boer, Ind. Palms Sur. 27. 1965.

Variable in habit, stem almost lacking to well-developed and up to 6 in a cluster, 2–3 m tall and about 1 cm in diameter, internodes up to about 6 cm long; leafsheath $1\frac{1}{2}$ –2 dm long; petiole 5–7 dm in length; lamina 8–10 dm long and $3\text{--}4\frac{1}{2}$ dm wide, irregularly pinnate with a few pairs of unequal segments sometimes intermixed with linear, 1-veined ones; 30–35 pairs of primary veins prominent above, prominulent and glabrous below, secondary veins slightly immersed above, prominent and brown lepidote below, veins emerging at about 35° from the rachis.

Inflorescences once or twice branched, with 2 flattened, tubular bracts inserted closely together at the base of the peduncle, the basal one 1–3 dm long, the second exceeding the basal by 1–10 cm; peduncle 1–4 dm long, rachillas variable in ramification and size, 6–20 cm long and about 3 cm in diameter, green at anthesis, turning purple and finally bright red in

fruit, sparsely beset with about 0.2 mm long, often forked, stiff hairs; flowerpits spirally arranged, about 3–5 mm apart; upper lip lacking, lower lip entire; flowerpits densely pilose inside. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a slightly crenulate staminodial tube. Fruit black, subglobose, 7 mm long and 6 mm in diameter, slightly pointed at apex; seed globose, 5 mm in diameter.

From north-western South America to Bolivia in mountains, at moderate altitudes (300–1400 m), but not in the Andes (map IV, 42).

Venezuela: Steyermark 60789 (F).

Colombia: Killip 34274 (US); Philipson 2327 (BM); Philipson & Idrobo 1962 (BM), 1979 (BM); Philipson, Idrobo & Fernandez 1464 (BM); Woronow & Juzepczuk 5885 (LE).

Bolivia: Krukoff 10982 (F).

Suriname: Florschütz & Maas 3052 (U); Forest. Dept. 5736 (U); N.Y.B.G. Wilh. Geb. Exp. 54392 (BH, NY, U), 54437 (BH, NY, U), 54762 (NY, U); Wessels Boer 1489 (U), 1490 (U), 1552 (U).

G. euspatha is very close to *G. interrupta* and I originally regarded them as conspecific (WESSELS BOER, 1965). However, the species seem sufficiently different to maintain them separately. *G. euspatha* is characterized by the less branched inflorescences, the rather long bracts the second exceeding the basal by 1–10 cm, the relatively thick and sparsely hairy rachillas, and the 7 mm long fruits. The habit of the plant and the shape and size of the inflorescence are apparently much influenced by the altitude at which it occurs. At low altitudes the plants develop a rather thick and short to very short stem with close-set internodes and often rather slender inflorescences with very long bracts. Plants from higher altitudes have slender canes with long internodes and more thick-set inflorescences with shorter bracts and rachillas. This correlation of habit and altitude (a phenotypic response?) was observed by the author in Suriname and is also shown by the four gatherings of Philipson c.s. collected at different altitudes in the Macarena Range in Colombia. Woronow & Juzepczuk 5885 represents a lowland form, whereas Steyermark 60789, collected at 1220 m altitude has the typical features of that elevation.

IV B b 11, 43 *Geonoma pulchra* Engel, Linnaea 33: 686. 1865; Burret, Bot. Jahrb. 63: 243. 1930.

Type collection: Engel s.n., Colombia, between Magdalena and Catatumbo (LE).

Stem 3–6 m tall, 5–10 cm in diameter, internodes short; leafsheath probably about 5 dm long; petiole short to almost lacking; lamina irregularly pinnatisect, up to $1\frac{1}{2}$ –2 m long and 8 dm wide, broad segments intermixed with 1-veined linear ones, segments slightly falcate, plicate at base; up to 40 or more pairs of primary veins prominent above, prominent and with a few scales below, secondary veins slightly immersed above,

prominent and glabrous below, tertiary veins fine, veins emerging at about 45° from the rachis.

Inflorescences repeatedly branched; only unattached branches seen; rachillas up to 2 dm long and about 2 mm in diameter, sparsely beset with simple stiff hairs 0.3–0.5 mm long; bilabiate flowerpits spirally arranged in 4 series, 2–4 mm apart; flowerpits shortly pilose inside; upper lip inconspicuous but distinct, densely ciliate, lower lip rounded, entire. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit dark green, ovoid, 7 mm long and 5 mm in diameter, slightly pointed at apex and base; seed ovoid, 5 mm long and 4 mm broad.

Once collected in Honduras, without precise locality, and three collections from a limited area in the Cordillera Oriental of the Andes in Colombia, in very wet and dense forests, at 1500–2000 m (map IV, 43).

Honduras: Wilson 405 (US).

Colombia: Engel s.n. (LE); Kalbreyer 698 (K); Killip & Smith 15336 (US).

G. pulchra is characterized by the simple, straight hairs on the rachillas, the bilabiate, inside pilose flowerpits, and the ovoid, 7 mm long, dark green fruits. The species is closest to *G. pinnatifrons* from which it is distinguished by the shorter and less crowded hairs on the rachillas, the bilabiate flowerpits, the smaller, apparently green instead of black fruits, and its more westerly distribution at higher altitudes. It is separated from *G. interrupta* by the longer simple hairs on the rachillas, the flowerpits with a dense tomentum inside, and the ovoid instead of subglobose fruits.

The type of *G. pulchra* consists of leaf fragments only and is not very distinctive. The present circumscription is entirely based on the interpretation of Burret who placed Kalbreyer 698 in this species.

IV B b 11, 44 *Geonoma interrupta* (Ruiz & Pavón) Martius, Hist. Nat. Palm. 2: 8, t 7. 1823; Martius, Palmet. Orbign. 27. 1847; Burret, Bot. Jahrb. 63: 249. 1930; Dahlgren, Field Mus. Bot. 14: 246. 1959.

Basionym: *Martinezia interrupta* Ruiz & Pavón, Syst. Veg. 296. 1798.

Type collection: Ruiz & Pavón s.n., Peru, between Pozuzu and Cuchero (F, K, M holotype).

Heterotypic synonyms: *Geonoma edulis* H. Wendland ex Spruce, J. Linn. Soc. 11: 106. 1869; Burret, Bot. Jahrb. 63: 209. 1930; Dahlgren, Field Mus. Bot. 14: pl 235. 1959.

Type collection: Wendland s.n., Costa Rica, Turialba (K holotype).

Geonoma dryanderæ Burret, Notizbl. 12: 615. 1935.

Type collection: Dryander 30, Colombia, Valle, Rio Tulua (not seen, destroyed at B).

? *Geonoma polyclada* Burret, Notizbl. 15: 26. 1940.

Type collection: Schultze-Rhonhof 2790, Ecuador, Mera, Pastaza (not seen, destroyed at B).

Stem solitary, up to about 7 m tall, 5–12 cm in diameter; leafsheath

gradually narrowed into petiole; petiole $\frac{1}{2}$ – $1\frac{1}{2}$ dm long, at first brown furfuraceous; rachis up to 12 dm long; lamina irregularly pinnate, up to about 14 dm long and 6 dm wide, broad segments intermixed with narrower ones, slightly falcate, more or less plicate at base; 40–70 pairs of primary veins prominent above, prominent and glabrous below, secondary veins slightly immersed above, prominent and sparsely brown lepidote below, veins emerging at 40–50° from the rachis.

Inflorescences repeatedly branched, with 2 flattened, fibrously decaying bracts, the basal one about 3 dm long and 8 cm wide, completely enclosing the second, bracts inserted about 4 cm apart at the base of the peduncle; peduncle $1\frac{1}{2}$ – $2\frac{1}{2}$ dm long, rachis about 5–6 dm long, the lower lateral branches with lateral branches of the second order which bear 2–3 rachillas 2–3 dm long and $2\frac{1}{2}$ – $3\frac{1}{2}$ mm in diameter, not very densely beset with about 0.2 mm long, forked or stellate hairs; bilabiate flowerpits spirally arranged in 4–5 series, about 2–4 mm apart; upper lip small but distinct, finely ciliate, lower lip rounded, entire; flowerpits almost glabrous inside, empty flowerpits longitudinally elongated. Male flowers about 3 mm long, anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit pale olive-green and shining (Steyermark), globose, about 6 mm in diameter, stipitate.

Central America (Mexico, Guatemala, Honduras, Costa Rica), in dense forests, on hillsides at 50–1000 m altitude and in the Andes (Colombia, Peru) at an altitude of about 1000 m (map IV, 44).

Mexico: Matuda 16820 (F).

Guatemala: Kellerman 7130 (F); Steyermark 41603 (F); 45378 (F), 46079 (F)

Honduras: Bangham 204 (F, US); Hagen & Hagen 1023 (F); Yuncker 5004 (F)

Costa Rica: Wendland s.n. (K).

Colombia: Dryander 3000 (49) (US).

Peru: Moore, Salazar & Smith 8390 (BH), 8588 (BH); Ruiz & Pavon s.n. (F, K, M).

Several Central American *Geonoma* collections named "*G. binervia*" proved to be distinct from that species in easily overlooked characters which turned out to be of diagnostic value. These characters are the forked or stellate hairs on the rachillas, the bilabiate, inside almost glabrous flowerpits longitudinally elongated when empty, and the globose fruits. The Central American plants agree rather well with the type of *G. interrupta* from Peru and are treated as conspecific. The gap between these localities is linked by a Dryander collection from Colombia which also matches the other specimens rather well. An earlier Dryander specimen from almost the same locality and, according to the description, identical with the present gathering, has been used to establish a new species, *G. dryanderiae*. This is therefore reduced to synonymy. *G. polyclada* is somewhat doubtfully placed here on account of its description only.

In a previous treatment (WESSELS BOER, 1965) *G. interrupta* was given a somewhat wider circumscription. This resulted in a large, rather widespread, but still fairly homogeneous species with a very extensive synonymy

only incompletely established on that occasion. The emphasis on slight but clearly detectable differences in bracts, pubescence of the rachillas, lips, pubescence of the flowerpits, and last but not least, on shape, size and colour of the fruits permits a further separation. This separation proves to be natural as it coincides with geography and, as far as can be seen from the labels, with ecology. Since fruit characters are most reliable in *Geonoma* and since there exists a good correlation with geography and ecology, the variation is not interpreted as infraspecific and the segregates are assigned the rank of species. On the other hand these species are very closely related, and their delimitation is seriously obscured by a large variation in size of the individual plants. Depauperate plants of different species resemble each other more in habit and general appearance than a depauperate and a vigorous one of the same species. Consequently identification of specimens without inflorescences and fruits often meets with difficulties and is often impossible when the origin of the plant is not known.

IV B b 11, 45 *Geonoma dicranospadix* Burret, Bot. Jahrb. 63: 169. 1930.

Type collection: Kalbreyer s.n., Colombia, without precise locality (not seen, destroyed at B).

Heterotypic synonyms: *Geonoma frontinensis* Burret, Bot. Jahrb. 63: 170. 1930.

Type collection: Lehmann 7323, Colombia, Antioquía (K).

? *Geonoma granditrijuga* Burret, Bot. Jahrb. 63: 171. 1930.

Type collection: Weberbauer 3672, Peru, Huánuco (not seen, destroyed at B).

Geonoma kalbreyeri Burret, Bot. Jahrb. 63: 168. 1930.

Type collection: Kalbreyer 1642, Colombia, Antioquía (not seen, destroyed at B).

Geonoma mucronata Burret, Bot. Jahrb. 63: 171. 1930.

Type collection: Kalbreyer 1334, Colombia, Antioquía (not seen, destroyed at B).

Geonoma longepedunculata Burret, Notizbl. 11: 8. 1930.

Type collection: Woronow & Juzepczuk 6157, Colombia, Caquetá, Rio Ortégua (LE).

Leafsheath $1\frac{1}{2}$ –2 dm long; petiole 5–7 dm in length, densely brown furfuraceous; lamina with 3–7 unequal, lanceolate, rather straight segments, 5–8 dm long and 3–5 dm wide, apical segments 2–2 $\frac{1}{2}$ dm long; 23–27 pairs of primary veins prominent above, rather inconspicuous with a few scales below, secondary veins slightly immersed above, prominent and brown lepidote below, tertiary veins inconspicuous, veins emerging at 30–40° from the rachis.

Inflorescences spicate or bi- or tri-furcate; above the 2 tubular bracts sometimes a small but distinctly enlarged third one present, inserted just within the mouth of the second bract, basal and second bract far apart, the second at least 2 dm long, densely greyish-brown villose; peduncle more than 4 dm long, spike or rachillas $1\frac{1}{2}$ –2 dm long and about 4 dm in diameter, somewhat sparsely beset with flowerpits almost regularly arranged in alternating, trimerous whorls forming 6 spiral series; flowerpits about 2 $\frac{1}{2}$ mm apart; upper lip lacking, lower lip inconspicuous, at anthesis

entire. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit fleshy, black, ovoid, apiculate at apex, stipitate, 9 mm long and 6 mm in diameter; seed 6 mm long and 4 mm in diameter.

Only known from the Colombian Andes, at higher altitudes (1400–1900 m) (map IV, 45).

Colombia: Engel s.n. (LE); Killip & Hazen 8787 (US); Lehmann 7323 (K); Pennell 9057 (US); Pennell & Killip 8787 (US); Woronow & Juzepczuk 6157 (LE).

The type, an unlabelled Kalbreyer collection, was not available, but fortunately three specimens at US that had been studied by Burret and named *G. dicranospadix*. These specimens have been used as a standard for the species. The type of *G. frontinensis* is somewhat smaller but agrees so well with the other specimens that it is regarded as conspecific. The type of *G. longepedunculata* also agrees very well.

G. kalbreyeri and *G. mucronata* are based on collections from the same localities and, according to the descriptions, hardly differ. Even Burret himself thought *G. kalbreyeri* to be very closely related to *G. dicranospadix* and failed to separate the species satisfactorily in his key. They are consequently reduced to synonyms in the present treatment. Dammer provided Weberbauer 4557 (not seen) with the never properly published name *G. gracilipes*. This species was not accepted by Burret, but he, nevertheless, provided a formal latin description for it (Bot. Jahrb. 63: 173. 1930). Burret assigned the specimen to *G. jussieuana* but as he misinterpreted that species a position within *G. dicranospadix* seems more likely.

IV B b 11, 46 *Geonoma simplicifrons* Willdenow, Spec. Pl. 4(1): 594. 1805; Willdenow, Mém. Acad. Sci. Berlin 13: 37. 1807; Martius, Hist. Nat. Palm. 2: t 8 f 1. 1823; Klotzsch, Linnaea 20: 450. 1847; Burret, Bot. Jahrb. 63: 240. 1930.

Plate IV.

Type collection: Bredemeyer 20, Venezuela, Caracas (B holotype).

Heterotypic synonyms: *Geonoma willdenowii* Klotzsch, Bot. Zeit. 4: 112. 1846; Klotzsch, Linnaea 20: 450. 1847.

Type collection: Karsten s.n., Venezuela, Puerto Cabellas (BM, G).

Geonoma fendleriana Spruce, J. Linn. Soc. 11: 108. 1869; Burret, Bot. Jahrb. 63: 240. 1930.

Type collection: Fendler 2467, Venezuela, Colonia Tovar (GOET, K holotype).

Small, clustered, up to 3 m tall, cane about 12 mm in diameter, at base subtended by a dense cone of aerial roots, internodes about 2–3 cm long; leafsheath 11–17 cm in length; petiole about 3–5 dm long; sheath, petiole, and rachis densely brown lepidote, glabrescent; lamina oblong, attenuate at base, 4–7 dm long and $1\frac{1}{2}$ –3 dm wide, 2–4-jugate or rarely simple, the apical lobes $1\frac{1}{2}$ – $2\frac{1}{2}$ dm long; primary veins prominent both above and below, secondary veins slightly immersed above, prominent and brown lepidote below, emerging at about 40° from the rachis.

Inflorescences once branched, with 2 depressed, tubular bracts about equally long, 2–2½ dm in length, the second inserted 1 cm higher than the basal one and slightly shorter, fibrously decaying; peduncle 2–3 dm long with 2 small bracts, branching into 2–4 rachillas 13–23 cm long and 3 mm thick, sparsely pilose; flowerpits arranged in 5 spiral series, 1½–2 mm apart; upper lip lacking, lower lip short, at first entire, later incised; flowerpits pilose inside. Male flowers with the anthers sharply reflexed from the filaments. Female flowers 3½ mm long with a slightly crenulate staminodial tube. Fruit greenish (mature?), globose, 5 mm in diameter, shortly pointed at apex; seed 3½ mm in diameter.

North-western Venezuela, in cloud forest on mountain slopes, from 400–1400 m; in Venezuela said to be locally frequent; never recorded from the Colombian Andes (map IV, 46).

Venezuela: Agostini & Fariñas 89 (U, VEN); Bredemeyer 20 (B); Fendler 2467 (GOET, K); Karsten s.n. (BM, G); Killip & Lasser 37802 (US, VEN); Pittier 8030 (US), 9109 (US), 11371 (US, VEN), 13838 (F, VEN), 13989 (VEN), 14122 (VEN), 15313 (VEN); Steyermark 91859 (BH), 91991 (BH), 94299 (BH), 95204 (BH); Tamayo 2207 (G, VEN); Vogl 458 (M); Williams 10350 (F), 13496 (F, K, US, VEN); Woronow 7170 (LE), 7505 (LE).

The synonymy of this species was already established by Burret.

Group 12: species 47–49.

IV B b 12, 47 *Geonoma baculifera* (Poiteau) Kunth, Enum. Pl. 3: 233. 1841; Spruce, J. Linn. Soc. 11: 113. 1869; Drude in Martius, Flora Bras. 3(2): 489. 1882; Burret, Bot. Jahrb. 63: 240. 1930; Wessels Boer, Ind. Palms Sur. 25. 1965.

Basionym: *Gynestum baculiferum* Poiteau, Mém. Mus. Hist. Nat. Paris 9: 389, t 17. 1822.

Type collection: Poiteau s.n., French Guiana (P).

Heterotypic synonyms: *Geonoma acutiflora* Martius, Hist. Nat. Palm. 2: 10, t 9. 1823; Martius, Palmet. Orbign. 36. 1847; Drude in Martius, Flora Bras. 3(2): 489. 1882.

Type collection: Martius s.n., Brazil, Pará (M lectotype).

Geonoma macrospatha Spruce, J. Linn. Soc. 11: 105, 114. 1869.

Geonoma baculifera (Poiteau) Kunth var. *macrospatha* (Spruce) Drude in Martius, Flora Bras. 3(2): 490. 1882; Burret, Bot. Jahrb. 63: 240. 1930.

Type collection: Spruce 42, Venezuela, Rio Casiquiare (K holotype, P).

? *Geonoma estevaniana* Burret, Notizbl. 14: 256. 1938.

Type collection: Burret 208, Brazil, Pará, Utinga (not seen, destroyed at B).

Small, cane up to 2 m long, about 1½ cm in diameter, often creeping at base and rooting at the nodes, with basal and lateral shoots, internodes 4–9 cm long; leafsheath 1½–2 dm in length; petiole about 2 dm long; leafsheath and petiole at first densely creamy lepidote, glabrescent; lamina lanceolate, long cuneate at base, 7–9 dm long and 2–3 dm wide, simple or irregularly pinnatisect with a few broad segments often intermixed with 1-veined ones, the apical segments 2–3 dm long; 35–40 pairs

of primary veins prominent above, inconspicuous below, secondary veins slightly immersed above, prominent and brown lepidote below, veins emerging at about 25° from the rachis.

Inflorescence with 2 depressed tubular bracts $2\frac{1}{2}$ –3 dm long and 1–2 cm wide, the second 2–4 cm higher inserted than the basal one and about 3 cm longer; peduncle $2\frac{1}{2}$ – $3\frac{1}{2}$ dm long, with 3–5 small bracts, rachis 3–7 cm long, with 4–7 rachillas 12–20 cm long, sparsely pilose when young, at anthesis green, in fruit orange; flowerpits spirally arranged in 5–7 series, about 2 mm apart, bilabiate; lips entire. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with an almost truncate staminodial tube. Fruit black at maturity, ovoid, about 1 cm long and 8 mm in diameter; seed 7 mm long and 6 mm in diameter.

Guianas, eastern part of Venezuela, and Amazon valley, often forming an almost closed understory in swampy areas, e.g., along rivers and creeks, always in dense shade and at low altitudes, the highest collection being from 525 m (map IV, 47).

Venezuela: Cardona 922 (US, VEN); Killip 37437 (US); Luetzelburg 22368 (M, R); Spruce 42 (K, P); Steyermark 90576 (VEN); Williams 11307 (VEN), 15198 (F, US, VEN).

Brazil: Bailey 327 (BH); Dahlgren & Sella 12 (F); Ducke 10573 (MG); Fröes & Black 24526 (BH); Huber 7802 (MG); Irwin & Westra 47714 (BH); Krukoff 6082 (F); Luetzelburg 22368 (M, R), 22892 (M, R); Martius s.n. (M); Prance & Pennington 1675 (NY); Prance, Pennington & Silva 1598 (NY); Spruce 72 (K); Trail 970 / CLXXX (K).

French Guiana: Benoist 1673 (P); Mélinon s.n. (P); Perrottet s.n. (G, P); Poiteau s.n. (P).

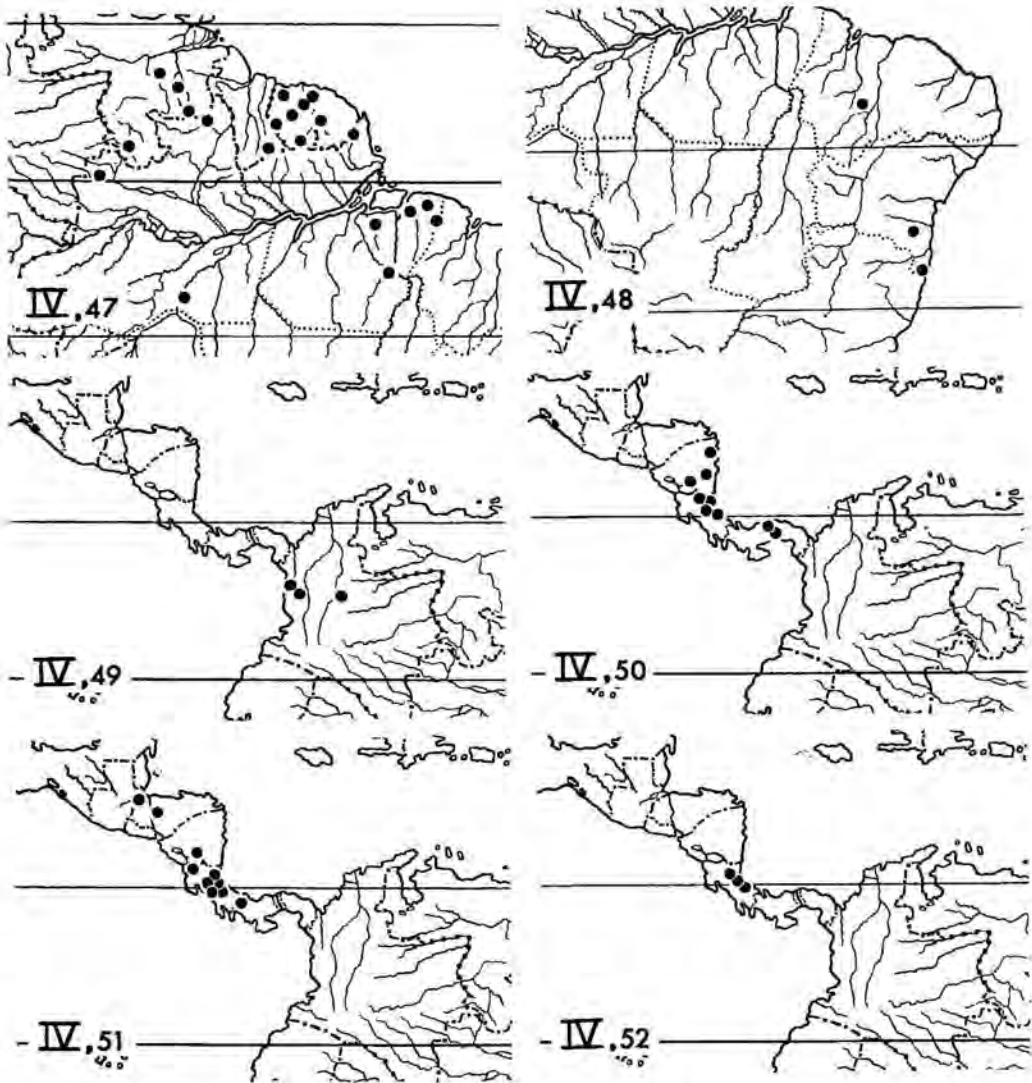
Suriname: Daniels & Jonker 1299 (U); Florschütz & Maas 2326 (U); Lindeman 4184 (U), 4613 (U); Maguire 24094 (NY, US), 24154 (NY, US); Mennega 517 (U); N.Y.B.G. Wilh. Geb. Exp. 55587 (NY, U); Pulle 517 (U); Rombouts 70 (U), 880 (U), 881 (U); Splitgerber 926 (L); Tresling 263 (U); Tulleken 447 p.p. (L), 479 (L); Wessels Boer 158 (U), 176 (U), 277 (U), 278 (U), 325 (U), 335 (U), 349 (U), 367 (U), 369 (U), 388 (U), 648 (U), 942 (U), 1375 (U); Wulschlägel 1649 (BR), 1942 (GOET).

British Guiana: Forest. Dept. B.G. 7558 (BH); A. C. Smith 2770 (F, K, US).

Martius described *G. acutiflora* because he was not aware of Poiteau's publication. Soon afterwards the name was reduced to synonymy. The type of *G. macrospatha* is somewhat more robust than the type of *G. baculifera*, but does not differ on the specific level. *G. estevaniana* would seem to have been based on a rather poor specimen of *G. baculifera*. Unfortunately the type was destroyed in the war. The description and discussion would suggest that *G. estevaniana* is also a synonym of *G. baculifera*.

IV B b 12, 48 *Geonoma pauciflora* Martius, Hist. Nat. Palm. 2: 12, t 12. 1823; Martius, Palmet. Orbign. 37. 1847; Burret, Bot. Jahrb. 63: 188. 1930; Dahlgren, Field Mus. Bot. 14: pl 271. 1959.

Type collection: Martius s.n., Brazil, Maranhão or Piauí (M holotype).



Maps IV,47-52. Distribution of *Geonoma* species: IV,47 *G. baculifera*; IV,48 *G. pauciflora*; IV,49 *G. calyptrigynoides*; IV,50 *G. congesta*; IV,51 *G. ferruginea*; IV,52 *G. longevaginata*.

Heterotypic synonyms: *Geonoma portiana* H. Wendland, *Linnaea* 28: 340. 1856; Spruce, *J. Linn. Soc.* 11: 106. 1869; Drude in Martius, *Flora Bras.* 3(2): 501, t 118. 1882.

Type collection: Wendland s.n., cult. Hort. Herrenhausen (K).

Geonoma caespitosa H. Wendland ex Drude in Martius, *Flora Bras.* 3(2): 500, t 117. 1882; Burret, *Bot. Jahrb.* 63: 186. 1930; Dahlgren, *Field Mus. Bot.* 14: pl 226. 1959. Type collection: Wendland s.n., Cult. Hort. Herrenhausen (not seen).

Clustered, rather slender, cane about 1 cm in diameter, internodes 1–3 cm long; leafsheath about 8 cm in length; petiole $1\frac{1}{2}$ –2 dm long, brown lepidote, glabrescent; lamina oblong, long cuneate at base, $2\frac{1}{2}$ –4 dm long and $1\frac{1}{2}$ –2 dm wide, simple or irregularly divided into a few broad segments sometimes intermixed with 1-veined ones, apical lobes 1– $1\frac{1}{2}$ dm long; 17–21 pairs of primary veins prominent above and below, secondary veins immersed above, prominent and brown lepidote below, tertiary veins prominent, veins emerging at about 40° from the rachis; lamina lustrous above.

Inflorescences relatively large, at first brown densely lepidote, with 2 pergamentaceous, tubular bracts, the basal one $1\frac{1}{2}$ –2 dm long and about 1 cm wide, the second exceeding the basal one by 2–3 cm and inserted 4–9 cm higher; peduncle $2\frac{1}{2}$ –4 dm long with a few small, acute bracts, rachis 2–8 cm long with 2–5 simple rachillas 1– $1\frac{1}{2}$ dm long and 3–6 mm in diameter; bilabiate flowerpits rather large, spirally arranged to more or less verticillate, about 5 mm apart; lower lip cleft. Male flowers with the anthers sharply reflexed from the filaments. Female flowers about 4 mm long, staminodial tube shortly dentate. Fruit subglobose, slightly pointed at apex, greenish, about 8 mm in diameter; seed 6 mm in diameter.

The species is mainly known from old, extremely poorly labelled collections. According to Martius it occurs in the interior of Piauí and Maranhão, in moist forests. Other specimens are from Bahia (map IV, 48).

Brazil: Blanchet 25 p.p. (G, P); Curran 22 (US), 239 (US), Martius s.n. (M); Riedel 488 (LE); Wendland s.n., cult. Hort. Herrenhausen (K).

G. pauciflora is only poorly known. However, the position of the names placed here in synonymy is shown by the original material, Wendland s.n. cult. and Riedel 488, as well as by Drude's excellent plates in *Flora Brasiliensis*.

IV B b 12, 49 *Geonoma calyptrogynoidea* Burret, *Bot. Jahrb.* 63: 223. 1930. Plate VII.

Type collection: Kalbreyer 1398, Colombia, La Mesa (not seen, destroyed at B).

Relatively tall, usually solitary, cane up to 7 m high, about 5 (–10) cm in diameter; petiole about 3 dm long; lamina 10–17 dm long and to 5 dm wide, irregularly divided into 3 or more unequal segments, the apical lobes about 5 dm long; 50–60 pairs of primary veins strongly prominent

above, inconspicuous below, secondary veins slightly immersed above, prominent and greyish lepidote below, tertiary veins prominent both above and below, veins emerging at about 30° from the rachis.

Inflorescences with 2 long tubular, chartaceous bracts; peduncle more than 3 dm long, depressed with a few adpressed bracts, rachis short, with 3-9 simple, stout rachillas; peduncle, rachis, and rachillas densely brown furfuraceous, glabrescent; flowerpits congested, almost regularly arranged in alternating whorls consisting of 5 flowerpits; upper lip inconspicuous, lower lip incised. Male flowers about 5 mm long, anthers sharply reflexed from the filaments. Female flowers with a slightly crenulate staminodial tube. Fruit unknown.

Only known from a limited area in western Colombia, at lower altitudes (below 400 m?) (map IV, 49).

Colombia: Archer 1980 (US); Haught 1850 (US); Killip & García 33623 (US).

The Kalbreyer specimen was destroyed at B, but Burret himself named Haught 1850, a rather complete specimen, and Archer 1980, a single leaf. There is consequently no doubt about the identity of the species.

Group 13: species 50-52.

IV B b 13, 50 *Geonoma congesta* H. Wendland ex Spruce, J. Linn. Soc. 11: 112. 1869; Burret, Bot. Jahrb. 63: 224. 1930; Standley, Field Mus. Bot. 18: 119. 1937.

Type collection: s.n., Costa Rica, R. Sarapiquí (K holotype).

Densely clustered in clumps of 10-20, canes 3-4 m high, 2-3 cm in diameter, internodes 3-6 cm long; leafsheath 2½-3 dm in length; petiole short, less than 1 dm long; rachis 6-9 dm long; lamina lanceolate, cuneate at base, about 10 dm long and 4 dm wide, irregularly pinnate or rarely simple, broad segments often intermixed with 1-veined ones; about 50 pairs of primary veins highly prominent above, inconspicuous below, secondary veins slightly immersed above, prominent and glabrescent below, veins emerging at 30-40° from the rachis; lamina lustrous above with inconspicuous transverse commissures.

Inflorescences with 2 flattened bracts inserted about 1 cm apart at the base of the peduncle, the second enclosed by the basal one, 5-6 cm broad; peduncle 6-10 cm long, slightly depressed, with 2 small bracts, rachis 3-10 cm long, with 6-13 simple rachillas 13-17 cm long and 6-7 mm in diameter; flowerpits congested, spirally arranged in 6-8 series. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a slightly crenulate staminodial tube. Fruit obovoid, at base more or less flattened by mutual pressure, 15 mm long and 11 mm in diameter; seed 8 mm long and 7 mm broad.

Nicaragua, Costa Rica, and Panama, usually collected on the Atlantic

side of the mountains, on well-drained hillsides, at low to moderate altitudes (up to 600 m) (map IV, 50).

Nicaragua: Englesing 199 (F); Molina R. 1957 (F); Levy 1445 (P).

Costa Rica: Cook & Doyle 5477 (US); Loomis 3 (US); Pittier 16920 (BM, US); Seibert 1597 (US); Standley & Valerio 48954 (US), 48976 (US), 49004 (US); Tonduz 7558 (BR); Wendland s.n. (K).

Panama: Maxon 6903 (US); Pittier 2659 (US); Standley 27594 (US).

G. congesta is a very uniform and characteristic species with a rather limited distribution, easily recognized by the vigorous, densely clustered growth, the once branched, thick-set inflorescences with short, thick rachillas, and the large, obovoid fruits.

IV B b 13, 51 *Geonoma ferruginea* H. Wendland ex Spruce, J. Linn. Soc. 11: 110. 1869; Burret, Bot. Jahrb. 63: 227. 1930; Standley, Field Mus. Bot. 18: 119. 1937; Dahlgren, Field Mus. Bot. 14: pl 238. 1959.

Type collection: Wendland s.n., Costa Rica, Sarapiquí Valley (K holotype). Heterotypic synonyms: *Geonoma microspadix* H. Wendland ex Spruce, J. Linn. Soc. 11: 110. 1869; Burret, Bot. Jahrb. 63: 263. 1930; Standley, Field Mus. Bot. 18: 120. 1937.

Type collection: Wendland s.n., Costa Rica, Sarapiquí Valley (K holotype). *Geonoma versiformis* H. Wendland ex Spruce, J. Linn. Soc. 11: 109. 1869; Burret, Bot. Jahrb. 63: 226. 1930; Dahlgren, Field Mus. Bot. 14: pl 297. 1959.

Type collection: Wendland s.n., Costa Rica, near Turialba (K holotype). *Geonoma microstachys* H. Wendland ex Burret, Bot. Jahrb. 63: 228. 1930.

Type collection: Wendland s.n., Costa Rica, Sarapiquí Valley (not seen).

Small, forming rather large clusters, up to 4 m tall, canes 2½ cm in diameter, internodes 3–10 cm long; leafsheath about 1½ dm in length; petiole 1–3½ dm long; rachis 2–4 dm long; sheath, petiole, and rachis greyish-brown tomentose; lamina ovate, usually regularly trijugate sometimes intermixed with 1-veined segments, 3–6 dm long and 2–4 cm wide, segments falcate, more or less contracted at base, apical segments 1½–2½ dm long; 22–32 pairs of primary veins prominent above, prominent and glabrous below, secondary veins immersed above, prominent and greyish lepidote below, veins emerging at about 45° from the rachis.

Inflorescences several nodes below the leaves, with flattened bracts inserted 3–4 mm apart at the base of the peduncle, caducous before anthesis, the basal bract about 1 dm long, enclosing the second one; peduncle 5–9 cm long with 2 small bracts, rachis slightly longer than peduncle, 7–10 cm long with lateral branches simple or branched again, rachillas 10 (–18) cm long, in little-branched inflorescences 4–13 branches 5–7 cm long, and in much-branched inflorescences with up to 35 branches and with all possible intermediates between these extremes, rachillas 2 (rarely up to 3½) mm in diameter, densely beset with bilabiate flowerpits spirally arranged and about 1 mm apart; lower lip entire to slightly emarginate; inflorescence reddish-brown tomentose. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with the

staminodial tube shortly crenulate. Fruit subglobose, purple-black, when immature oblong, about 6 mm long; seed about 4 mm in diameter.

Central America, from Guatemala to Panama, in moist forests at moderate altitudes (250–1350 m) (map IV, 51).

Guatemala: Steyermark 41873 (F).

Honduras: L. O. & R. P. Williams 18756 (F).

Nicaragua: Tate 259 (K).

Costa Rica: Cook & Doyle 135 (US), 153 (US); Austin Smith H 1220 (F); Donnell Smith 6845 (K, US); Standley 37328 (US); Standley & Valerio 44778 (F, US), 44784 (US); Tonduz 12979 (F, US); Wendland s.n. (K).

Panama: Cooper 493 (F).

G. microspadix and *G. microstachys* are probably based on duplicates of the same Wendland collection. There is absolutely no difference between the type of *G. microspadix* at K and specimens named *G. microstachys* by Burret. Unfortunately the specimen at Herrenhausen was destroyed in the war. Presumably Wendland accidentally wrote the manuscript-name *G. microspadix* on the Kew duplicate instead of *G. microstachys*. In addition *G. ferruginea* and *G. microspadix* cannot be separated. Burret used in his key the ramification of the inflorescence, the former once branched, the latter twice branched. However, the type at K has a twice branched inflorescence, like Standley & Valerio 44778 (named *G. ferruginea* by Burret) and Standley & Valerio 44784 (named "*G. cfr. ferruginea et cfr. microstachys intermedia*" by Burret), both Standley & Valerio specimens being almost identical. Furthermore, *G. versiformis*, separated because of the more divided lamina and the somewhat more robust inflorescence, is insufficiently distinct to be maintained as a separate species.

IV B b 13, 52 *Geonoma longevaginata* H. Wendland ex Spruce, J. Linn. Soc. 11: 109. 1869; Burret, Bot. Jahrb. 63: 208. 1930.

Type collection: Wendland s.n., Costa Rica, Sarapiquí R. (K holotype).

Clustered, 3–5 m tall, cane about 3 cm in diameter, internodes 1–1½ dm long; leafsheath 2½–3½ dm in length; petiole up to 7 dm long, reddish-brown lepidote, glabrescent; lamina irregularly pinnate, more than 1 m long and about 7 dm wide, segments unequal, slightly falcate; about 50 pairs of primary veins prominent above and below, secondary veins slightly immersed above, prominent and brownish lepidote below, tertiary veins fine, veins emerging at about 50° from the rachis.

Inflorescences once branched, or the lowermost lateral branches furcate, with 2 early caducous bracts about 1 dm long, inserted closely together at the base of the peduncle; peduncle about as long as the bracts, rachis ½–2 dm long with 5–11 lateral branches, the lower bearing 2–4 rachillas, the rest simple, rachillas 2–3½ dm long and 2½–3½ mm in diameter, sparsely covered with short simple hairs; flowerpits spirally arranged in 6–8

series, 3–5 mm apart; upper lip inconspicuous, lower lip rounded, deeply emarginate. Male flowers $2\frac{1}{2}$ mm long, the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit subglobose, 7 mm long and 6 mm in diameter, slightly pointed at apex and narrowed at base, finely tuberculate; seed almost globose, $4\frac{1}{2}$ mm in diameter.

Only known from Costa Rica, without ecological data (map IV, 52).
Costa Rica: Loomis 10 (US); Standley & Valerio 48974 (US); Wendland s.n. (K).

G. longevaginata resembles *G. ferruginea* but is larger in all dimensions, the rachillas for example being longer whereas the inflorescence is less branched than is usual in the latter. The leaves are also more regularly pinnate and do not tend to be trijugate.

Group 14: species 53–60.

IV B b 14, 53 *Geonoma heinrichsiae* Burret, Notizbl. 12: 43. 1934; Dahlgren, Field Mus. Bot. 14: pl 243. 1959.

Type collection: Heinrichs 225, Ecuador, Ambato (F, leafscrap only).

Slender, 3–10 m tall, cane a few cm in diameter; leafsheath not seen; petiole about 4 dm long; lamina about 5–7 dm long, irregularly pinnate, segments 3–5 dm long and 1–8 cm wide, slightly sigmoid; 25–35 pairs of primary veins prominent above, slightly prominent below, secondary veins immersed above, prominent and glabrescent below, tertiary veins very fine, veins emerging at about 45° from the rachis.

Inflorescences twice branched, peduncle and bracts not seen, according to the author the basal bract about $2\frac{1}{2}$ dm long, firm, flattened, completely enclosing the slightly smaller second one; peduncle about $2\frac{1}{2}$ dm long, rachis $1\frac{1}{2}$ –2 dm long with 9–15 lateral branches, the lower bearing 2–4 rachillas, the rest simple, rachillas about 1 dm long and 2–3 mm in diameter, sparsely beset with short, simple hairs; bilabiate flowerpits rather loosely spirally arranged, about 6 mm apart; upper lip slightly protracted, lower lip large, rounded, at first entire becoming emarginate. Male flower 3 mm long, anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Immature fruit ovate, 9 mm long.

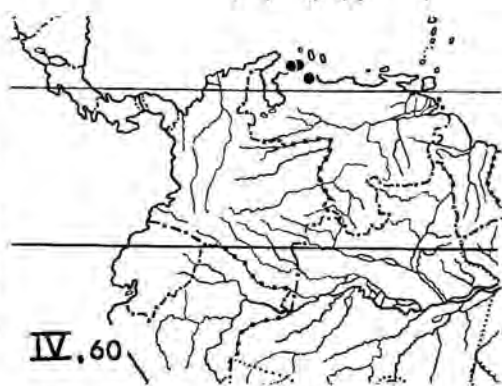
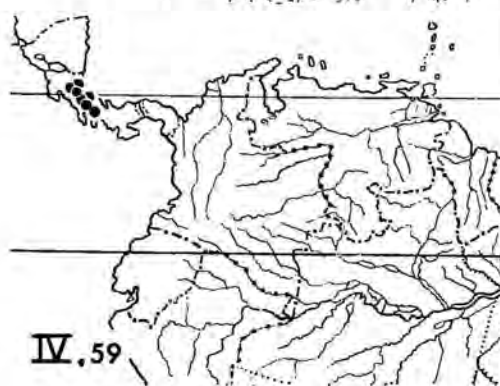
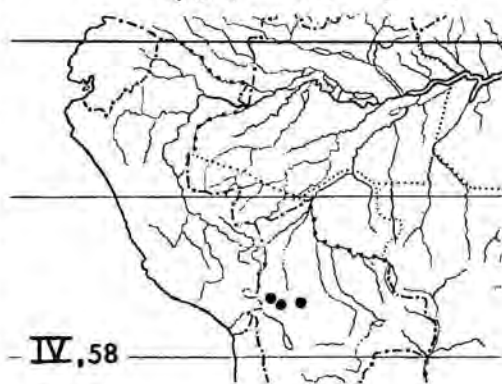
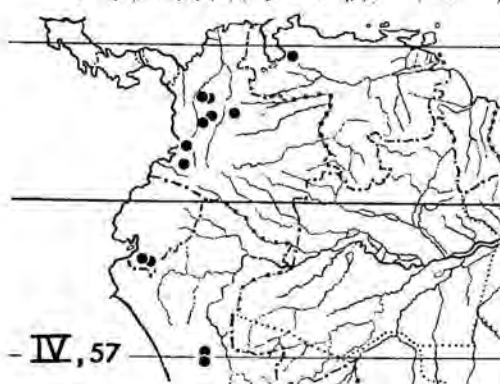
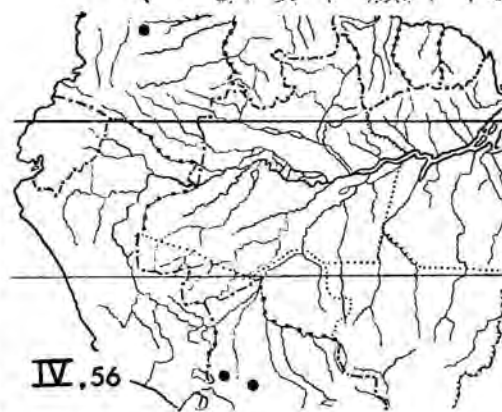
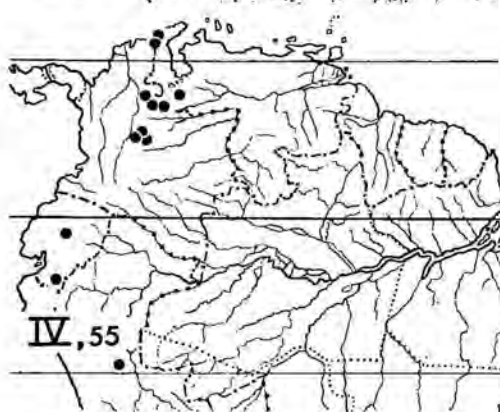
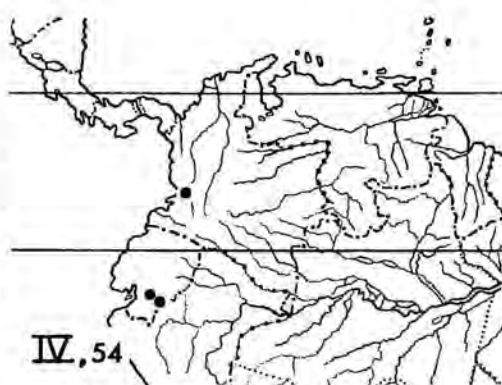
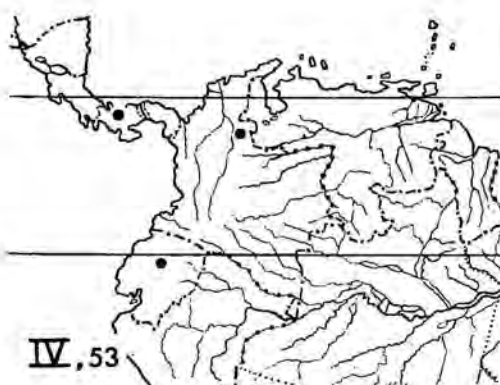
Only known from 3 fragmentary collections from Panama, Colombia, and Ecuador, respectively, at high altitudes (all ca. 2000 m), in rainforest (map IV, 53).

Panama: Davidson 377 (F).

Colombia: Schlim 1171 (G, P).

Ecuador: Heinrichs 225 (F).

G. heinrichsiae was placed by Burret in relationship to *G. deversa*, etc., but in the present author's opinion it is better connected with *G. orbigniana*



Maps IV,53-60. Distribution of *Geonoma* species: IV,53 *G. heinrichsiae*; IV,54 *G. pulcherrima*; IV,55 *G. lindeniana*; IV,56 *G. pachydicrana*; IV,57 *G. marggraffia*; IV,58 *G. orbigniana*; IV,59 *G. hoffmanniana*; IV,60 *G. paraguayensis*.

and allied species. The species is close to *G. densa* from which it is separated by the smaller inflorescences with shorter rachillas.

IV B b 14, 54 *Geonoma pulcherrima* Burret, Bot. Jahrb. 63: 195. 1930.

Type collection: Lehmann 5289, Ecuador, at confluence of Rio Bomboiza and Rio Zamora (K).

Heterotypic synonyms: ? *Geonoma euterpoidea* Burret, Bot. Jahrb. 63: 196. 1930.

Type collection: Kalbreyer 1477, Colombia, Antioquia, Alto Guatapé (not seen, destroyed at B).

Geonoma iodolepis Burret, Bot. Jahrb. 63: 198. 1930.

Type collection: Kalbreyer 1668, Colombia, Antioquia, Amalfi (not seen, destroyed at B).

? *Geonoma iodoneura* Burret, Bot. Jahrb. 63: 210. 1930.

Type collection: Kalbreyer 1965, Colombia, Santander, Teorama (not seen, destroyed at B).

? *Geonoma stenothyrsa* Burret, Bot. Jahrb. 63: 197. 1930.

Type collection: Kalbreyer 1372, Colombia, Antioquia, San Carlos (not seen, destroyed at B).

Solitary, cane $2\frac{1}{2}$ –7 m tall, 3–5 cm in diameter; leafsheath about $2\frac{1}{2}$ dm long, petiole short, 2–3 dm in length; rachis 4–6 dm long; deciduously brownish lepidote; lamina irregularly pinnate, chartaceous, 5–6 dm long and about 3 dm wide, broader segments intermixed with linear 1-veined ones or almost regularly pinnate with linear segments only; 25–30 pairs of primary veins prominent above, prominulent and sparsely brown lepidote below, secondary veins immersed above, prominent and greyish lepidote below, veins emerging at about 40° from the rachis.

Inflorescences twice branched or only once in depauperate specimens, with 2 flattened, relatively broad, subcoriaceous bracts, the basal one 1–2 dm long and 3–5 cm wide, the second slightly smaller, enclosed by the basal one, about 4 cm higher inserted; peduncle 2–3 dm long, rachis up to about 2 dm long in well-developed specimens, with 8–15 lateral branches, the lower branching again in 3–8 rachillas, the rest simple, rachillas 8–16 cm long and $2\frac{1}{2}$ mm in diameter; inflorescence at first greyish floccose, soon glabrescent; bilabiate flowerpits densely spirally arranged, 2–3 mm apart; upper lip small, lower lip circular, deeply cleft. Male flowers 3 mm long, anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit subglobose, blackish-purple, when slightly immature about 6 mm in diameter.

North-western South America in the Andes, at high altitudes (800–2600 m), in forest. In the type locality the species is recorded as being abundant in periodically flooded places along rivers (map IV, 54).

Colombia: Killip & Hazen 11137 (US).

Ecuador: Lehmann 5289 (F, K, L), 6538 (K).

Compared with its relatives *G. pulcherrima* is a rather tall palm,

characterized by the usually twice branched inflorescence densely greyish floccose, the subcoriaceous, rather short bracts inserted less than $\frac{1}{2}$ dm apart at the base of the peduncle, the congested flowerpits, and the small flowers and fruits. An isotype of *G. pulcherrima* is available from F, K, and L. Another specimen, Killip & Hazen 11137, was identified as *G. iodolepis* by Burret. As both specimens and also the descriptions agree rather well *G. iodolepis* is placed in synonymy. It should be mentioned, however, that a second specimen named *G. iodolepis* by Burret (Pennell 9314) does not belong here and is referred to *G. marggraffia*. The other names are placed here in synonymy on account of the descriptions only.

IV B b 14, 55 *Geonoma lindeniana* H. Wendland, Linnaea 28: 337. 1856; Spruce, J. Linn. Soc. 11: 106. 1869; Burret, Bot. Jahrb. 63: 198. 1930; Dahlgren, Field Mus. Bot. 14: pl 251. 1959.

Type collection: Funck & Schlim s.n., Venezuela, Capacho (L).

Heterotypic synonyms: *Geonoma pumila* Linden & H. Wendland, Linnaea 28: 338. 1856; Spruce, J. Linn. Soc. 11: 110. 1869; Burret, Bot. Jahrb. 63: 187. 1930; Dahlgren, Field Mus. Bot. 14: pl 279. 1959.

Type collection: Schlim s.n., Colombia, Sta Marta (K).

Geonoma linearifolia Karsten, Linnaea 28: 411. 1856; Burret, Bot. Jahrb. 63: 194. 1930; Dahlgren, Field Mus. Bot. 14: pl 252. 1959.

Type collection: Karsten, s.n. Colombia, Bogotá (LE).

Geonoma ramosa Engel, Linnaea 33: 684. 1865; Burret, Bot. Jahrb. 63: 194. 1930.

Type collection: Engel s.n., Venezuela, Tachira, S. Cristóbal (LE).

? *Geonoma andina* Burret, Bot. Jahrb. 63: 188. 1930; Macbride, Field Mus. Bot. 13: 339. 1960.

Type collection: Raimondi s.n., Peru, Cajamarca, Cutervo (not seen, destroyed at B).

? *Geonoma campyloclada* Burret, Bot. Jahrb. 63: 189. 1930.

Type collection: Kalbreyer 2045, Colombia, Arizal (not seen, destroyed at B).

? *Geonoma floccosa* Burret, Bot. Jahrb. 63: 203. 1930.

Type collection: Weberbauer 2277, Peru, Junín, Huacapistana (not seen, destroyed at B).

? *Geonoma leucotricha* Burret, Bot. Jahrb. 63: 204. 1930.

Type collection: Kalbreyer 2035, Colombia, Tibajes (not seen, destroyed at B).

? *Geonoma macroura* Burret, Bot. Jahrb. 63: 202. 1930.

Type collection: Kalbreyer 1788, Colombia, Antioquia, Tambu (not seen, destroyed at B).

? *Geonoma anomoclada* Burret, Notizbl. 12: 615. 1935.

Type collection: Dryander 29, Colombia, El Valle, Bitaco (not seen, destroyed at B).

? *Geonoma molinillo* Burret, Notizbl. 13: 491. 1937.

Type collection: Duque 537, Colombia, El Valle, Rio Nima (not seen, destroyed at B).

? *Geonoma tenuifolia* Burret, Notizbl. 15: 25. 1940.

Type collection: Schultze-Rhonhof 2990, Ecuador, Mera, Pastaza (not seen, destroyed at B).

Canes 1–5 m tall, $1\frac{1}{2}$ –3 cm in diameter; leafsheath $1\frac{1}{2}$ –2 dm long; petiole 3–4 $\frac{1}{2}$ dm in length; lamina membranaceous, $4\frac{1}{2}$ –6 dm long and

about $3\frac{1}{2}$ dm wide, irregularly pinnate with a few broad segments intermixed with linear ones or sometimes regularly pinnate with linear 1-veined segments only; 20–26 pairs of primary veins prominent above, prominent and reddish-brown lepidote below, secondary veins immersed above, prominent and more or less lepidote below, tertiary veins prominent, veins emerging at $45\text{--}55^\circ$ from the rachis.

Inflorescences once branched or with the lowest branches bi- or trifurcate, with usually 2 tubular, membranaceous bracts very rarely a third tubular bract developed, the basal one about $2\frac{1}{2}$ dm long, the second 5–8 cm higher inserted and usually a few cm longer than the basal one; peduncle enclosed by the bracts or sometimes longer, rachis usually 5–12 cm long with 4–11 rachillas but sometimes only 2 or 3 rachillas on a proportionately shorter rachis, rachillas about $1\frac{1}{2}$ dm long and $3\frac{1}{2}$ –4 mm in diameter; bilabiate flowerpits spirally arranged, about 2–4 mm apart; upper lip small, lower lip broadly rounded, entire to more or less emarginate; peduncle and rachillas deciduously densely floccose. Male flowers $3\frac{1}{2}$ mm long, the anthers sharply reflexed from the filaments. Female flowers with a slightly crenulate staminodial tube. Fruit greenish, slightly ovoid, $8\frac{1}{2}$ mm long and 6 mm in diameter, slightly pointed at apex, stipitate; seed subglobose, 5 mm in diameter.

North-western South America, at high altitudes (1700–2600 m) on forested mountain slopes (map IV, 55).

Venezuela: Engel s.n. (LE); Funck & Schlim s.n. (K, L); Steyermark 56391 (F, VEN); Steyermark & Rabe 97253 (BH); Vareschi 6476 (VEN).

Colombia: Dawe 363 (K); Engel s.n. (LE); Foster, Foster & Smith 1421 (BH); Funck s.n. (K); Juzepczuk 6565 (LE); Karsten s.n. (LE); Linden s.n. (L); Schlim 955 (G), 1656 (LE); Triana 720 (US), 723 (BM, P).

Ecuador: Espinosa 661 (BH); Mexia 7027 (BH, UC, US); Poortman 145 (P). Peru: Moore, Salazar & Smith 8355 (BH).

G. lindeniana is distinguished from its relatives by the rather thin membranaceous leaves, the greyish floccose inflorescences with long tubular bracts inserted 5–8 cm apart and usually completely enclosing the peduncle; the flowerpits rather closely together with an at first entire, but later on cleft lower lip, and the small green fruits.

G. pumila is based on a collection with very small leaves, but as no differences in the inflorescences could be observed this name is reduced to synonymy. A recently collected specimen, Foster, Foster & Smith 1421, is identical with the type of *G. pumila*.

G. linearifolia was studied from a Karsten specimen at LE, an inflorescence together with *Hyospathe* material. As can be seen from the photograph in Dahlgren's Index the original material at W was not a mixture. The inflorescence at LE cannot be separated from *G. lindeniana* and it is therefore regarded as conspecific. The Engel specimen representing *G. ramosa*, still preserved at LE, fits well in *G. lindeniana* and is consequently placed there. The types of Burret's new species are all

lost and no later collections of these species with Burret's identification were met with. The descriptions, however, do not reveal any essential difference from *G. lindeniana* in the present circumscription. They are consequently placed here in synonymy.

IV B b 14, 56 *Geonoma pachydicrana* Burret, Bot. Jahrb. 63: 206. 1930

Type collection: Miguel Bang 877 p.p., Bolivia, Cochabamba (F, G, K, L, M, US).

Solitary, cane up to about 3 m tall and 3 cm in diameter, internodes about 2 cm long; leafsheath about 3 dm in length; petiole about 7 dm long; rachis about 6 dm long; lamina irregularly pinnate, subcoriaceous, 4–5 dm wide, broader segments intermixed with linear 1-veined ones, the broader segments also often rather narrow with 2–3 primary veins only; about 36 pairs of primary veins prominent above and below, paleaceous below, secondary veins immersed above, prominulent and brown lepidote below, tertiary veins prominulent, veins emerging at 50–60° from the rachis.

Inflorescences once branched, with 2 long, tubular, chartaceous bracts, the basal one enclosing the second, inserted 3–12 cm apart; peduncle 2–4½ dm long, rachis 4–5 cm long with 4 simple rachillas about 2 dm long and 6 mm in diameter; inflorescence deciduously brown furfuraceous; bilabiate flowerpits densely spirally arranged in 6 series, about 3 mm apart; upper lip short, lower lip broadly rounded, entire to more or less cleft. Male flowers 4 mm long, the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit ovoid, 11 mm long inclusive of the 1½ mm long stipitate base, 8 mm in diameter, slightly pointed at apex.

Three collections seen, one from Colombia in forest at 2325 m, the other two from Bolivia near Cochabamba and Tipuani (map IV, 56).

Colombia: Grant 9177 (US).

Bolivia: Miguel Bang 877 p.p. (F, G, K, L, M, US); Buchtien 5338 (US).

G. pachydicrana is a characteristic species with subchartaceous leaves, a long-pedunculate, little-branched inflorescence with long bracts and with thick rachillas densely beset with flowerpits. The Colombian collection resembles the type fairly well and is provisionally treated as being conspecific.

IV B b 14, 57 *Geonoma marggraffia* Engel, Linnaea 33: 685. 1865; Burret, Bot. Jahrb. 63: 194. 1930.

Type collection: Engel s.n., Venezuela, Trujillo, Villa Boconó (LE).

Heterotypic synonyms: *Geonoma microclada* Burret, Bot. Jahrb. 63: 190. 1930.

Type collection: Lehmann 7322, Colombia, Montaña del Oro, Supia (K).

? *Geonoma goniocarpa* Burret, Bot. Jahrb. 63: 185. 1930.

Type collection: Kalbreyer s.n., Colombia, Murri (not seen, destroyed at B).

Geonoma lepidota Burret, Bot. Jahrb. 63: 191. 1930.

Type collection: Lehmann 7321, Colombia, Antioquia, Rio Dolores (K).

? *Geonoma paleacea* Burret, Bot. Jahrb. 63: 199. 1930.

Type collection: Kalbreyer 1478, Colombia, Antioquia, Rio Guatapé (not seen, destroyed at B).

? *Geonoma wendlandiana* Burret, Bot. Jahrb. 63: 192. 1930.

Type collection: Kalbreyer 1514, Colombia, Antioquia, Concordia (not seen, destroyed at B).

Geonoma rhytidocarpa Burret, Bot. Jahrb. 63: 189. 1930.

Type collection: Kalbreyer 1115, Colombia, Santander, Sisabita (not seen, destroyed at B).

Stem 1–3 m tall and $2\frac{1}{2}$ –6 cm in diameter; leafsheath about 3 dm long; petiole $2\frac{1}{2}$ –5 dm long; sheath and petiole deciduously brown lepidote; rachis 3– $4\frac{1}{2}$ dm in length; lamina chartaceous, more or less plicate, irregularly plicate to simple, usually with a few pairs of broad segments sometimes intermixed with linear 1-veined ones; about 20 pairs of primary veins prominent above, prominent and paleaceous below, secondary veins immersed above, prominent and brown lepidote below, veins emerging at about 20° from the rachis in simple leaves and at an angle of about 35° in pinnate leaves.

Inflorescences once branched or rarely with the lowest branches bifurcate; usually 3 tubular, subchartaceous bracts, the basal one 2–3 dm long, the second $1\frac{1}{2}$ –2 dm long, inserted 11–13 cm higher than the basal one, the third more or less enlarged; peduncle 3–4 dm long, rachis 2–8 cm long with 3–10 rachillas 12–20 cm long and $2\frac{1}{2}$ – $3\frac{1}{2}$ mm in diameter; peduncle and rachillas at first densely brown furfuraceous becoming glabrous and dirty grey with age; bilabiate flowerpits rather densely spirally arranged, 3–4 mm apart; upper lip small, lower lip rounded, almost entire to more or less emarginate. Male flowers $3\frac{1}{2}$ mm long, anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit subglobose to slightly ovoid, 1 cm long and 9 mm in diameter, rounded at apex, seed globose, 8 mm in diameter.

Andes, from Venezuela to Peru, in dense forests, at high altitudes (1400–2800 m) (map IV, 57).

Venezuela: Engel s.n. (LE).

Colombia: Doyle 15 (US), 21 (US); Goudot s.n. (P); Killip & Smith 16044 (US); Koeie 4585 (C); Lehmann 7321 (K), 7322 (K), s.n. (K); Linden 896 (BM, L, P); Pennell 7642 (US), 9314 (US).

Ecuador: Steyermark 53638 (F), 54537 (F).

Peru: Macbride 4775 (F); Moore, Salazar & Smith 8328 (BH).

G. marggraffia is distinguished from its relatives by the brown scales on the primary veins at the abaxial side of the chartaceous, plicate lamina, the presence of a third enlarged bract, and the rather dense arrangement of the flowerpits on the cylindrical rachillas.

Lehmann's two types at K are almost identical and are certainly conspecific with *G. marggraffia*. The recorded difference in size, not reflected

by the herbarium specimens, may be credited to the different altitudes at which they were growing. The Kalbreyer types are no longer available and the names based on them are reduced to synonymy on account of the descriptions only. This position, however, seems to be fairly satisfactory. Only in the case of *G. rhytidocarpa* can this position be confirmed for Killip & Smith 16044, a specimen named *G. rhytidocarpa* by Burret himself.

IV B b 14, 58 *Geonoma orbigniana* Martius, Palmet. Orbign. 22, t 11 f 1, 22 A f 1-5. 1847; Burret, Bot. Jahrb. 63: 201. 1930; Dahlgren, Field Mus. Bot. 14: pl 263. 1959.

Type collection: d'Orbigny 44, Bolivia, Cochabamba (P).

Cane usually about 1 m tall and $2\frac{1}{2}$ cm in diameter, internodes less than 1 cm long; leafsheath about 2 dm long; petiole about 3 dm long; rachis $2\frac{1}{2}$ - $4\frac{1}{2}$ dm long; lamina membranaceous, 4-6 dm long and 3-4 dm wide, irregularly pinnate, 3-5 broad segments often intermixed with linear 1-veined ones; 25-35 pairs of primary veins prominent above, inconspicuous below, secondary veins slightly immersed above, prominent below, tertiary veins fine, veins emerging at 40-50° from the rachis.

Inflorescences twice branched, with 2 tubular bracts, the basal one chartaceous, about $2\frac{1}{2}$ dm long, the second about 2 dm long and 5 cm higher inserted; peduncle $3-4\frac{1}{2}$ dm long, rachis 1-2 dm long with about 12 lateral branches the lowest branching again into 2-7 rachillas $1\frac{1}{2}$ -2 dm long and $2\frac{1}{2}$ -3 mm in diameter; peduncle and rachillas deciduously brown villose; bilabiate flowerpits widely spirally arranged, 6-8 mm apart; upper lip relatively small, lower lip rounded, entire to more or less emarginate. Male flowers $3\frac{1}{2}$ mm long, the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit not seen, recorded as being black.

Only known from 3 collections from Bolivia in subtropical very wet forest on the mountain slopes at about 1000 m altitude (map IV, 58).

Bolivia: Miguel Bang 877 p.p. (F, G, K, L, LE, M, US); Buchtien 3670 (US); d'Orbigny 44 (P).

G. orbigniana is distinguished by the membranaceous lamina, the twice branched inflorescence with chartaceous tubular bracts inserted about 5 cm apart, the slender rachillas with loosely arranged flowerpits, and the fruits. At present it is only known from Bolivia.

IV B b 14, 59 *Geonoma hoffmanniana* H. Wendland ex Spruce, J. Linn. Soc. 11: 106. 1869; Burret, Bot. Jahrb. 63: 201. 1930; Dahlgren, Field Mus. Bot. 14: pl 245. 1959.

Type collection: Wendland s.n., Costa Rica, Volcán de Barba (K holotype).

Stem about 1 m tall, probably solitary; leafsheath $1\frac{1}{2}$ -2 dm long;

petiole 2–4½ dm long; sheath, petiole, and rachis deciduously brown lepidote; lamina chartaceous, 7–8 dm long and 4–5 dm wide, irregularly pinnate with 3–5 broad segments sometimes intermixed with linear 1-veined ones; 18–25 pairs of primary veins prominent above and below, secondary veins slightly immersed above and prominent below, tertiary veins fine, veins emerging at an angle of about 35° from the rachis.

Inflorescences once branched, with 2 membranaceous, tubular bracts, the basal one 1½–2½ dm long, the second 2½–3½ dm long, far exceeding the basal one being inserted 7–17 cm higher; peduncle 3–6½ dm long, rachis 2–6 cm long with 3–6 rachillas 1½–2 dm long and 3–4 mm in diameter; peduncle and rachillas reddish-brown villose; bilabiate flowerpits spirally arranged in 5 series, 4–7 mm apart; upper lip short, lower lip rounded, emarginate at an early stage. Male flowers 4 mm long, the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit green on a dull red inflorescence, ovoid, pointed at apex, stipitate, 10 mm long and 8 mm in diameter, slightly laterally depressed; seed globose, 7 mm in diameter.

Only known from Costa Rica, in wet forests at 1800–3000 m altitude (map IV, 59).

Costa Rica: Kupper 1204 (M); Pittier 368 (BR); Standley 42046 (F, US), 42159 (F, US), 42172 (US), 42692 (US); Standley & Valerio 43988 (US), 51430 (US); Valerio 1023 (F), 1596 (F); Wendland s.n. (K).

IV B b 14, 60 *Geonoma paraguayensis* Karsten, *Linnaea* 28: 410. 1856; Burret, *Bot. Jahrb.* 63: 263. 1930.

Type collection: Karsten s.n., Venezuela, peninsula Paraguaná, Mt. Sta. Ana (not seen).

Dwarfed under extreme conditions, in this case only reaching a length of 2–3 dm, well developed:

cane erect or more or less prostrate with adventitious roots, up to 3 m tall, about 2½ cm in diameter; leafsheath about 2 dm long; petiole short, about 1 dm long; rachis about 6–9 dm long; lamina subcoriaceous, rather regularly pinnate with linear stiff 1-veined segments sometimes intermixed with broader segments with more than 1 vein; primary veins prominent above, prominulent and brown paleaceous below, secondary veins immersed above, prominent and glabrous below, veins emerging at about 35° from the rachis.

Inflorescence once branched or sometimes with the lowest rachillas bi- or even tri-furcate; enlarged bracts flattened, the basal one enclosing the second, inserted 2–5 cm apart at the base of the peduncle; peduncle about 2–3 dm long with a reddish-brown deciduous tomentum, rachis to about 12 cm long, with about 12 rachillas circa 1 dm long and 2½–3½ mm in diameter; large bilabiate flowerpits spirally arranged, 2–4 mm apart; lips conspicuous, the lower lip emarginate. Male flowers up to 5 mm long,

anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit not seen, according to Karsten black, globose, $6\frac{1}{2}$ mm in diameter.

Known from the north-western coastal area of Venezuela on rocks more or less exposed to the wind. The species can stand rather rough conditions which results in depauperate plants; on the most exposed ridges of the Cerro Sta Ana, Paraguaná for instance, the plants do not grow more than 20–30 cm tall (map IV, 60).

Venezuela: Curran & Haman 694 (BH, US); Lasser & Aristeguieta 3417 (VEN); Steyermark & Braun 94660 (BH); Tamayo 871 (US, VEN), 1130 (US, VEN).

G. paraguanensis is somewhat similar to *G. densa*; it is distinguished by the brown tomentum on the usually once branched inflorescence, the more congested rachillas, and in its ecological conditions. It seems to be restricted to a very limited area. The original material of Karsten was lost but as there are several collections from the type locality there is no doubt about the species.

Group 15: species 61–67.

IV B b 15, 61 *Geonoma appuniana* Spruce, J. Linn. Soc. 11: 106. 1869; Dahlgren, Field Mus. Bot. 14: pl 221. 1959.

Type collection: Appun 1411, British Guiana, Mt. Roraima (K holotype). Heterotypic synonym: *Geonoma roraimae* Dammer, Notizbl. 6: 261. 1913. Type collection: Ule 8805, Guiana, Mt. Roraima (G, K, L, MG, US).

Stem 5–10 m tall, 5–8 cm in diameter; leafsheath up to 5 dm long; petiole 1–4 dm long; rachis 5–11 dm in length; lamina stiff chartaceous-coriaceous, plicate, up to 16 dm long and 7 dm wide, irregularly divided into a few broad, porrect segments or sometimes into more numerous, narrower segments; about 45 pairs of primary veins prominent above, prominulent and densely greyish leprose below, secondary veins immersed above, prominent and greyish leprose below, veins emerging at about 30° from the rachis.

Inflorescences repeatedly branched with 2 coriaceous, subequal, swollen bracts early caducous, the basal about 2 dm long, enclosing the slightly higher inserted second one; peduncle about 2 dm long with a few small bracts, rachis not completely seen, probably more than 5 dm long with numerous lateral branches the lowest 4–5 dm long, with up to 15 lateral branches of the second order partly branching again into up to 8 rachillas, rachillas $1\frac{1}{2}$ –2 dm long and $2\frac{1}{2}$ –3 mm in diameter, cylindrical, brownish-yellow when dry, "salmon-brick" (Steyermark) in fruit when fresh; bilabiate flowerpits loosely spirally arranged, 5–10 mm apart; lips conspicuous. Male flowers about 4 mm long, the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial

tube. Immature fruit green, shining, globose, about 10 mm in diameter, small pointed at apex.

Known from Mt. Roraima and from other sandstone mountains in the state of Bolivar, Venezuela, at higher altitudes (1800–2300 m) in forest up to the limit of bluffs and on the bluffs themselves (map IV, 61).

Venezuela: Pinkus 140 (BH, F, G, US); Steyermark 58667 (F), 59805 (F).

Brazil: Luetzelburg 21606 (M); Ule 8805 (G, K, L, MG, US).

British Guiana: Appun 1141 (K); im Thurn 382 (K).

Burret united *G. appuniana* with *G. barthia* after examining rather poor material. The recent ample gatherings of Steyermark, however, reveal several differences that justify the restoration of the species. Apart from differences in area and ecology, *G. appuniana* apparently preferring much more exposed places, there are also morphological differences, such as a thicker lamina, a larger, more branched inflorescence with smaller bracts, and more loosely arranged flowerpits. Furthermore the rachillas of *G. appuniana* are brownish-yellow when dry, those of *G. densa* (*G. barthia*) are dark brown.

IV B b 15, 62 *Geonoma densa* Linden & H. Wendland, *Linnaea* 28: 333. 1856; Spruce, *J. Linn. Soc.* 11: 107. 1869; Burret, *Bot. Jahrb.* 63: 197. 1930; Dahlgren, *Field Mus. Bot.* 14: pl 232. 1959.

Type collection: Funck & Schlim s.n., Colombia, Cachiri (K, L).

Heterotypic synonyms: *Geonoma barthia* Eng., *Linnaea* 33: 688. 1865; Burret, *Bot. Jahrb.* 63: 212. 1930.

Type collection: Engel s.n., Venezuela, Mérida (LE).

? *Geonoma aulacophylla* Burret, *Bot. Jahrb.* 63: 216. 1930.

Type collection: Kalbreyer 1607, Colombia, Antioquia, Alto San José (not seen, destroyed at B).

? *Geonoma plicata* Burret, *Bot. Jahrb.* 63: 217. 1930.

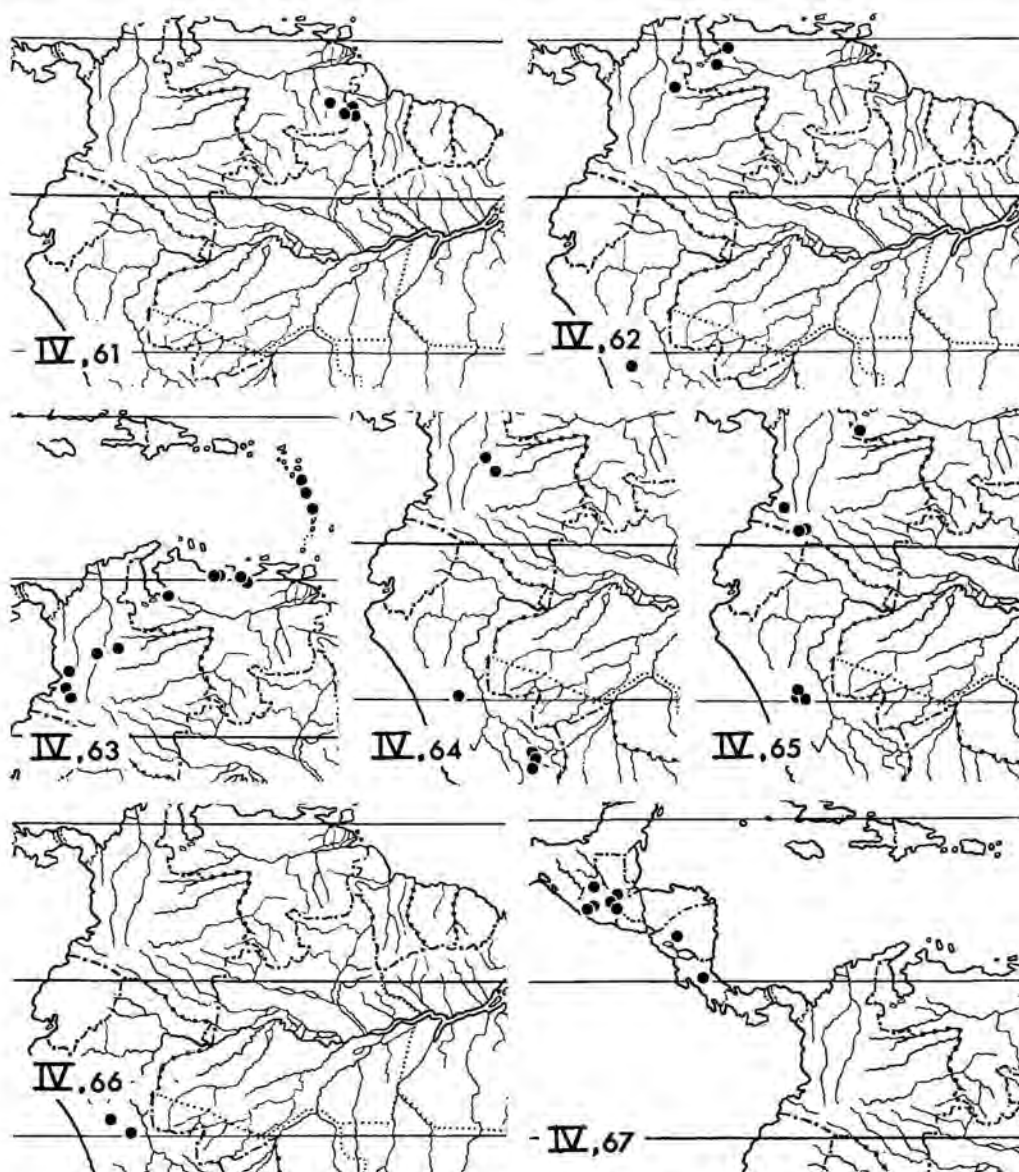
Type collection: Kalbreyer 1607 b, Colombia, Antioquia, Alto San José (not seen, destroyed at B).

? *Geonoma uncibracteata* Burret, *Bot. Jahrb.* 63: 215. 1930.

Type collection: Stuebel 367 a, Colombia, Cuchilla de Patascoy near Pasto (not seen, destroyed at B).

Slender, cane 5–8 m tall, $2\frac{1}{2}$ –5 cm in diameter, internodes short; leaf-sheath up to about 3 dm long; petiole 6–9 dm long; rachis about 1 m long; lamina membranaceous, up to about 14 dm long and 7 dm wide, more or less regularly pinnatisect, linear 1-veined segments intermixed with broader ones, slightly falcate; about 35–40 pairs of primary veins prominent above, prominulent and paleaceous below, secondary veins slightly immersed above, prominent and glabrous below, veins emerging at 40–50° from the rachis.

Inflorescences twice branched; 2 coriaceous, subequal, swollen bracts early caducous, the basal bract up to $2\frac{1}{2}$ dm long, completely enclosing the second one inserted about 1 cm higher up; peduncle about $2\frac{1}{2}$ dm



Maps IV,61-67. Distribution of *Geonoma* species; IV,61 *G. appuniana*; IV,62 *G. densa*; IV,63 *G. undata*; IV,64 *G. helminthoclada*; IV,65 *G. weberbaueri*; IV,66 *G. megalospatha*; IV,67 *G. seleri*.

long, with a few small acute bracts, rachis $3\frac{1}{2}$ dm long with about 15 lateral branches the lower branching again into 3–15 simple or rarely bifurcate rachillas, the terminal ones simple, rachillas 1–2 dm long and about 3 mm thick, cylindrical; bilabiate flowerpits spirally arranged, about 5 mm apart; lips conspicuous, lower lip deeply cleft. Male flowers about 5 mm long, the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. Fruit not seen.

Andes from Venezuela to Peru, at high altitudes (1800–2500 m), on densely forested mountainsides (map IV, 62).

Venezuela: Engle s.n. (LE); Karsten s.n. (LE); Steyermark 55305 (F).

Colombia: Funck & Schlim s.n. (K, L).

Peru: Killip & Smith 24700 (F, US).

G. densa resembles *G. undata* very much; it is distinguished by the inflorescences with slender cylindrical rachillas (i.e., not narrowed between the flowerpits) which are brown instead of greyish-glaucous, and by the more widely spaced flowerpits. The species also resembles *G. paraguayensis* which is much smaller and differs in several other features. The types of *G. densa* and *G. barthia* agree very well and are certainly conspecific. Burret considered *G. appuniana* conspecific with *G. barthia* but that position is unacceptable in the present author's opinion in spite of obviously very close affinity.

The position of *G. aulacophylla*, *G. plicata*, and *G. uncibracteate* remains very doubtful in the absence of original material, and the names are only placed here tentatively.

IV B b 15, 63 *Geonoma undata* Klotzsch, Linnaea 20: 452. 1847; Spruce, J. Linn. Soc. 11: 107. 1869; Burret, Bot. Jahrb. 63: 213. 1930; Dahlgren, Field Mus. Bot. 14: pl 296. 1959.

Type collection: Karsten 26, Venezuela, Tovar (BM).

Heterotypic synonyms: *Geonoma margaritoides* Engel, Linnaea 33: 682. 1865.

Type collection: Engel s.n., Venezuela, Tachira (LE).

Geonoma dussiana Beccari, Fedde Rep. 16: 436. 1920.

Type collection: Duss 4198, Guadeloupe (F, LE, US).

? *Geonoma macrosiphon* Burret, Bot. Jahrb. 63: 214. 1930.

Type collection: Sodiro s.n., Ecuador, Nauegol (not seen, destroyed at B).

Geonoma hodgeorum Bailey, Caribbean Forester 3: 108, t 6. 1942; Hodge, Lloydia 17: 153. 1954.

Type collection: Hodge 1430, Dominica (BH holotype, NY).

Solitary, stem 5–10 m tall, up to 1 dm in diameter; leafsheath up to 6 dm long; petiole to about 5 dm long; rachis up to about 13 dm long, tapering into a slender thread; lamina membranaceous irregularly pinnate, broadest at base, segments broad to linear and 1-veined, porrect, about 9 dm long at base, decreasing to 4 dm at apex, segments closely together along rachis; primary veins prominent above, prominulent below, secon-

dary veins immersed above, prominent and sparsely brown lepidote below, tertiary veins unequal, veins emerging at 40–60° from the rachis.

Inflorescence twice branched, with 2 coriaceous, swollen bracts, the basal one 3–4 dm long and about 1 dm wide, the second inserted 2–3 cm higher, completely enclosed by the basal one; peduncle $1\frac{1}{2}$ – $2\frac{1}{2}$ dm long with 13–21 lateral branches the lower branching again into 2–14 simple or sometimes bi- or tri-furcate rachillas, the upper simple, rachillas $2\frac{1}{2}$ – $4\frac{1}{2}$ dm long and 3–6 mm in diameter, at first creamy shortly furfuraceous, glabrescent, with a glaucous appearance; bilabiate flowerpits regularly alternating verticillate forming 6 vertical series, 3–5 mm apart; lips conspicuous, upper lip often crenate, lower lip large, deeply cleft. Male flowers about 4 mm long, the anthers sharply reflexed from the filaments. Female flowers with a short crenulate staminodial tube. Slightly immature fruit ovoid, about 9 mm long exclusive of the about $2\frac{1}{2}$ mm long stipitate base, and 7 mm in diameter, sharply pointed at apex.

Lesser Antilles, and Andes from northern Venezuela to Colombia, at high altitudes (1400–2250 m), in moss-clad montane forests (map IV, 63).

Guadeloupe: Duss 3313 (LE), 4198 (F, LE, US); Questel 614 (P).

Dominica: Hodge & Hodge 1430 (BH, NY), 2835 (NY).

Martinique: Duss 22 (F, LE, US).

Venezuela: Engel s.n. (LE); Fendler 2461 (G, GOET, K, US); Funck & Schlim 499 (G, P); Karsten 26 (BM); Moritz 3 (BM); Pittier 10012 (US, VEN); Steyermark 9167 (BH); Steyermark & Rabe 97389 (BH); Tamayo 1239 (F, US, VEN), 1558 (US, VEN).

Colombia: Cuatrecasas 15495 (BH); Doyle 27 (US); Killip & García 33942 (BM, US); Linden 1091 (BM), 1092 (BM, G, P).

G. undata is characterized by the membranaceous leaves, the rachillas at first shortly creamy furfuraceous, when glabrescent having a somewhat glaucous appearance, and the bilabiate flowerpits. The species is very close to *G. helminthoclada*, *G. weberbaueri*, and *G. megalospatha* which tend to occur at higher altitudes and do not show the glaucous appearance of the rachillas. Burret already partly established the synonymy. As the occurrence of *G. undata* on Guadeloupe has been established it is not surprising to find other specimens from Dominica and Martinique. *G. hodgeorum* belongs here and was incorrectly placed in affinity with *G. pinnatifrons*. *G. macrosiphon* is somewhat doubtfully placed here in the absence of material; the recorded differences (pointed rachillas and long staminodial tubes) do not seem to warrant a separation.

IV B b 15, 64 *Geonoma helminthoclada* Burret, Bot. Jahrb. 63: 222. 1930; Macbride, Field Mus. Bot. 13: 343. 1960.

Type collection: Raimondi 509, Peru, Amazonas, Chachapoyas (not seen, destroyed at B).

Heterotypic synonym: ? *Geonoma pachyclada* Burret, Bot. Jahrb. 63: 214. 1930.

Type collection: Kalbreyer 417, Colombia, Santander, S. Pedro (not seen, destroyed at B).

Relatively tall; leafsheath about 5 dm long, petiole not seen; lamina membranaceous, rather regularly divided into narrow 1-3-veined segments up to about 8 dm long and 5 cm wide, apical pair about $2\frac{1}{2}$ dm long; primary veins prominent above, prominulent below, secondary veins immersed above, prominent and greyish leprose below, veins emerging at $40-50^\circ$ from the rachis.

Inflorescences twice branched, with 2 coriaceous, swollen bracts early caducous, the basal one about 3 dm long and 1 dm wide, completely enclosing the slightly smaller second one, inserted about 2 cm higher; peduncle short, about 1 dm long, rachis up to about 3 dm long with about 15 lateral branches the lower branching again into 2-8 simple rachillas, the upper simple, rachillas $2\frac{1}{2}-3\frac{1}{2}$ dm long and 5-6 mm in diameter, very sparsely brown lepidote to glabrous, yellowish when dry; bilabiate flowerpits $3\frac{1}{2}$ mm and more in diameter, loosely spirally arranged in 6 series, about 7 mm apart; lips conspicuous, upper lip crenate, lower lip deeply cleft. Male flowers about 6 mm long, the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Fruit not seen.

Peruvian and Colombian Andes, at high altitudes (1600-2800 m) (map IV, 64).

Colombia: Triana 56 (P), 722 (BM, P).

Peru: Cook & Gilbert 1092 (US), 1108 (US), 1187 (US), 1454 (US); Moore, Salazar & Smith 8350 (BH).

G. helminthoclada is distinguished from *G. undata* by the thicker rachillas with widely spaced flowerpits, yellowish when dry instead of having the glaucous appearance of *G. undata*. *G. weberbaueri* and *G. megalospatha* tend to occur at higher altitudes and have thick, coriaceous leaves and furthermore the inflorescences show differences. The type of *G. helminthoclada* was not available but both Cook & Gilbert collections were identified by Burret as belonging to this species. There is hence no doubt about the species. The position of *G. pachyclada* is less certain as it is placed here on account of the description only.

IV B b 15, 65 *Geonoma weberbaueri* Dammer ex Burret, Bot. Jahrb. 63: 221. 1930; Macbride, Field Mus. Bot. 13: 350. 1960.

Type collection: Weberbauer 3552, Peru, Huánuco, s.w. of Manzón (B).

Heterotypic synonyms: ?*Geonoma macroclada* Burret, Bot. Jahrb. 63: 220. 1930.

Type collection: Kalbreyer 1501, Colombia, Antioquia, Titiribi (not seen, destroyed at B).

Geonoma stuebelii Burret, Bot. Jahrb. 63: 220. 1930.

Type collection: Stuebel 321 E, Colombia, Popayan, Cerro Munchique (not seen, destroyed at B).

Solitary, 4–8 m tall, stem 5–12 cm in diameter, internodes about $\frac{1}{2}$ dm long; leafsheath about 4 dm long; petiole 1–3 dm long; rachis 5–8 dm long; petiole and rachis red in living plants; lamina subcoriaceous, 8–10 dm long and about 6 dm wide, more or less regularly pinnate into linear (1-veined) or broader (up to 9-veined) segments; 25–40 pairs of primary veins prominent above, inconspicuous and brown lepidote below, secondary veins immersed above, prominent below, tertiary veins fine, veins emerging at about 30° from the rachis.

Inflorescences twice branched with 2 coriaceous bracts persistent for some time, the basal one $3\text{--}4\frac{1}{2}$ dm long, completely enclosing the second one inserted about 2 cm higher up; peduncle $1\frac{1}{2}\text{--}2\frac{1}{2}$ dm long, rachis 3–6 dm long with 15–20 and more lateral branches the lower branching again into 3–9 simple or rarely bifurcate rachillas, the terminal ones simple, rachillas about 2–3 dm long and 5–8 mm in diameter; inflorescence at first densely brown furfuraceous, glabrescent; bilabiate flowerpits rather closely spirally arranged into 6–8 series, 2–4 mm apart; upper lip crenate, lower lip deeply cleft. Male flowers about 5 mm long, the anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Immature fruit subglobose, pointed at apex and base, 15 mm long and 10 mm in diameter, dry blackish, fresh bronze green.

Andes, from Venezuela to Peru, at high altitudes (2500–3200 m) (map IV, 65).

Venezuela: Steyermark 57351 (F).

Colombia: Yepes Agredo 432 (F); Bristol 800 (BH); Foster & Foster 2070 (BH).
Peru: Hutchinson, Wright & Straw 5942 (BH, UC); Moore, Salazar & Smith 8327 (BH); Weberbauer 3552 (B).

G. weberbaueri resembles *G. megalospatha* but is distinguished by the presence of the upper lip of the flowerpits, and the probably larger and differently coloured fruits. Both species occur at very high altitudes in the Andes and have sclerophytic leaves. *G. weberbaueri* can be separated by the brownish instead of yellowish (dry) rachillas with more densely arranged flowerpits. Weberbauer 3552 is one of the very few holotypes in *Geonoma* still present in B. It consists of a complete inflorescence with very young fruits stored in the fruit collection. *G. macroclada* is placed here on the basis of the description only. Agredo 432 originates from the type locality of *G. stuebelii* and matches the description of that species very well and makes the position of that name sufficiently certain.

IV B b 15, 66 *Geonoma megalospatha* Burret, Bot. Jahrb. 63: 218. 1930;
Macbride, Field Mus. 13: 345. 1960. Plate VIII.

Type collection: Weberbauer 6800, Peru, Huánuco, Valle Río Pozuzo (F).
Heterotypic synonym: ? *Geonoma andicola* Burret, Bot. Jahrb. 63: 218. 1930;
Macbride, Field Mus. Bot. 13: 338. 1960.

Type collection: Weberbauer 1345, Peru, Puno, Chunchusmayo (not seen, destroyed at B).

Plant 4–6 m tall; petioles probably short; rachis about 6 dm long; lamina irregularly pinnate, coriaceous, segments unequal, 4–5 dm long at base, gradually decreasing to about 2 dm in the apical segments, strongly plicate; primary veins hardly prominent on the very thick and hard lamina, brown lepidote below, secondary veins marginal in linear pinnae or in broader segments on the top of the induplicate folds, rather conspicuous below, tertiary veins unequal, the larger minutely lepidote, veins emerging at about 25° from the rachis.

Inflorescences twice branched, with 2 flattened, subequal coriaceous bracts fibrous decaying, $2\frac{1}{2}$ – $3\frac{1}{2}$ dm long, inserted about 5 cm apart at the base of the peduncle; peduncle enclosed by the bracts, rachis 1– $2\frac{1}{2}$ dm long with 8–13 lateral branches, the lower branching again into 2–3 rachillas, the upper simple, rachillas $1\frac{1}{2}$ –2 dm long and 5–7 mm in diameter, at first furfuraceous; flowerpits spirally arranged in 6 series, 4–7 mm apart; upper lip lacking, lower lip large, rounded, deeply cleft. Female flowers about 5 mm long, staminodial tube slightly crenulate. Immature fruit ovoid, pointed at apex, stipitate, 1 cm long and 6 mm in diameter, when dry orange.

Peruvian Andes, at 2500–3000 m altitude, in sclerophytic shrub vegetations: "grows with *Ceroxylum crispum* Burret at the altitudinal boundary for Peruvian species of palms" (Macbride) (map IV, 66).

Peru: Macbride 4867 (F); Weberbauer 6800 (F, US).

G. megalospatha resembles in its inflorescence *G. undata*, *G. helminthoclada*, and *G. weberbaueri*, but is at once distinguished by the absence of an upper lip of the flowerpits. *G. andicola*, being slightly smaller in all dimensions, cannot be separated for that reason only and, in the absence of original material, is placed in synonymy on account of its description.

IV B b 15, 67 *Geonoma seleri* Burret, Bot. Jahrb. 63: 211. 1930.

Type collection: Seler 2757, Guatemala, Huehuetenango, Yalambohoch (not seen, destroyed at B).

Heterotypic synonyms: *Geonoma polyneura* Burret, Notizbl. 11: 500. 1932. Type collection: Cook & Griggs 36, Guatemala, Alta Vera Paz, Sepacuite (US holotype).

Geonoma molinae Glassman, Field Mus. Bot. 31: 7, f 2. 1964.

Type collection: Williams, Molina R. & Williams 23507, Nicaragua, Matagalpa, Santa María de Ostuma (F holotype).

Solitary, stem 3–10 m tall, 5–10 cm in diameter, internodes 2–3 cm long; leafsheath 3–4 dm long; petiole about $\frac{1}{2}$ m in length; sheath and petiole deciduously brown lepidote; rachis about 1 m long; lamina unequally pinnate, segments up to 7 dm long and 2–12 cm wide, rather porrect to slightly falcate in the upper part, apical segments $3\frac{1}{2}$ dm long; primary veins prominent above, inconspicuous below, secondary

veins slightly immersed above, prominent below, tertiary veins unequal, partly prominent below, veins emerging at 40–50° from the rachis.

Inflorescences twice or rarely once branched, with flattened, chartaceous bracts, basal one $1\frac{1}{2}$ – $2\frac{1}{2}$ (– $3\frac{1}{2}$) dm long and 3–4 (–6) cm wide, completely enclosing the slightly smaller second one, both deciduous, inserted 2–3 (–8) cm apart at the base of the peduncle; peduncle about as long as or slightly longer than bracts, rachis usually about 2 dm long (7 cm–4 dm) usually with 10–15 lateral branches the upper simple and the lower usually bearing 2–6 rachillas $1\frac{1}{2}$ – $2\frac{1}{2}$ dm long and $2\frac{1}{2}$ – $4\frac{1}{2}$ mm in diameter, sparsely beset with short simple hairs; bilabiate flowerpits spirally arranged in 6 series, about 4–6 mm apart; lips rather prominent, lower lip emarginate. Male flowers about 4 mm long, anthers sharply reflexed from the filaments. Female flowers with a crenulate staminodial tube. Immature fruit ovoid, 12 mm long inclusive of the 2 mm long stipitate base and 9 mm in diameter, slightly pointed at apex.

Central America, recorded so far from Guatemala, Nicaragua and Costa Rica only; at higher altitudes (1300–2500 m) on forested mountain slopes (map IV, 67).

Guatemala: Cook & Doyle 128 (US), 327 (F, US); Cook & Griggs 36 (F, US), 40 (US); Steyermark 29890 (F), 34340 (F), 37305 (F), 42858 (F), 48742 (F).

Nicaragua: Williams, Molina R. & Williams 23507 (F).

Costa Rica: Austin Smith NY 1346 (F).

G. seleri is a Central American species showing some resemblance to *G. undata* and its allies. It is notably distinguished by the relatively slender inflorescences sparsely covered with short simple hairs. The inflorescences show considerable variation in size: beside the normal 4–5 dm long ones larger as well as smaller and less branched specimens have been collected. Cook & Doyle 327 has a simple branched one with 8 rachillas. The two inflorescences of that number were identified by Burret himself as *G. seleri*. This collection agrees very well with the type of *G. molinae* which is consequently placed here. Cook & Griggs 36, the type of *G. polyneura*, consists of abundant vegetative material, photographs of the fresh inflorescence, and an inflorescence at anthesis. The vegetative material cannot be distinguished from *G. seleri*. The very slender inflorescence, however, seems to be diminutive and atypical, also in comparison with the photographs. Furthermore, apart from its size, it agrees very well with *G. seleri*. Consequently *G. polyneura* is treated as conspecific with *G. seleri*. The afore mentioned variability of the inflorescences which is considerable makes it extremely difficult to key out this species in a satisfactory way.

Group 16: species 68–69.

IV B b 16, 68 *Geonoma spixiana* Martius, Hist. Nat. Palm. 2: 15, t 15, 16, 21 f 3. 1823; Martius, Palmet. Orbign. 33. 1847; Drude in Martius, Flora

Bras. 3(2); 488. 1882; Burret, Bot. Jahrb. 63: 263. 1930; Dahlgren, Field Mus. Bot. 14: pl 287, 288. 1959.

Type collection: Martius s.n., Brazil, Amazonas, Rio Japurá (M holotype). Heterotypic synonym: *Geonoma grandisecta* Burret, Bot. Jahrb. 63: 258. 1930; Burret, Notizbl. 12: 614. 1935; Dahlgren, Field Mus. Bot. 14: pl 242. 1959. Type collection: Huebner 106, Brazil, Campos Salles near Manaus. (B).

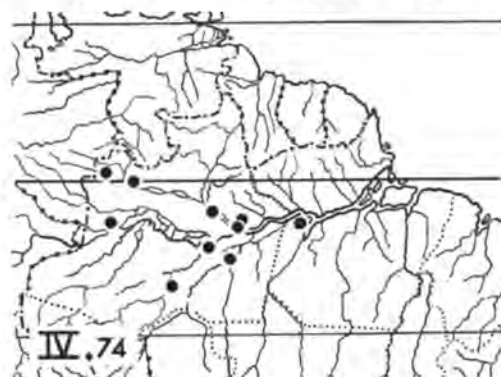
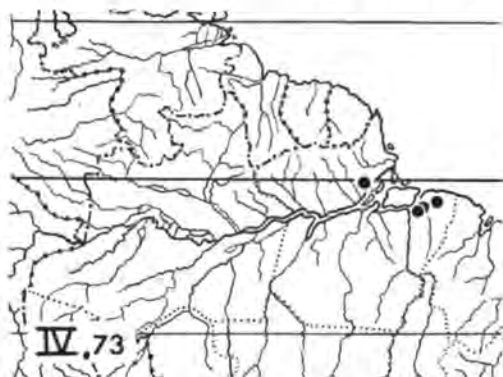
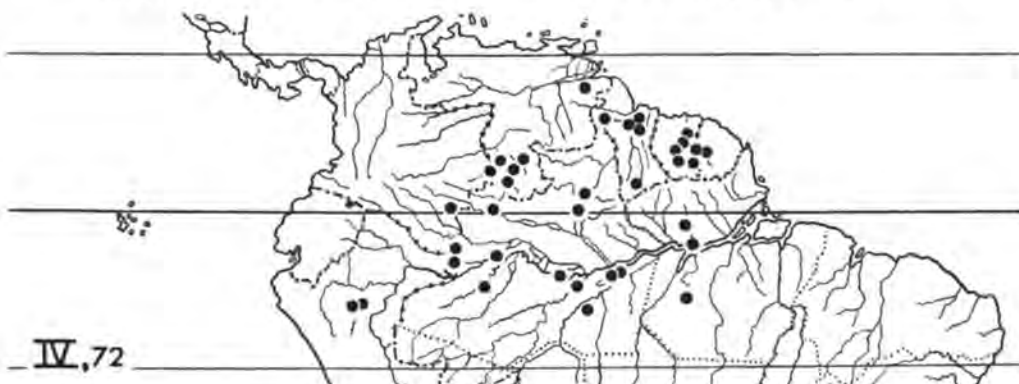
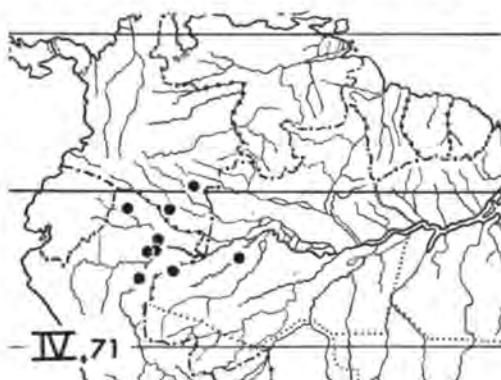
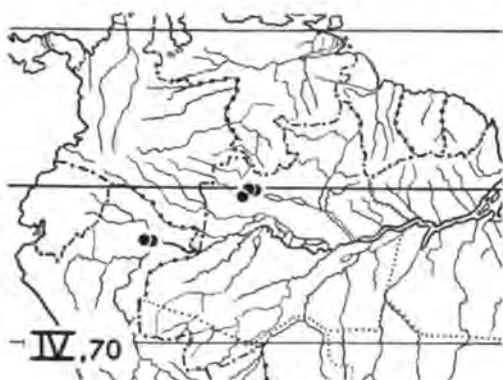
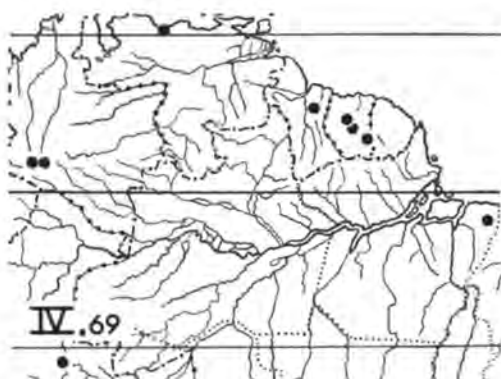
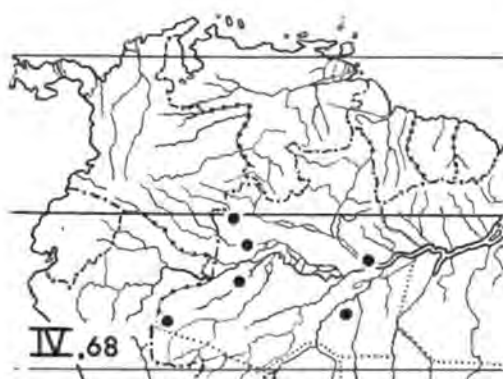
Solitary, cane erect, up to 5 (-10) m tall, 2-3 cm in diameter, internodes 3-7 cm long; leaves horizontally radiating; leafsheath about $1\frac{1}{2}$ dm long; petiole 1-2 dm long; rachis 5-10 dm long; sheath, petiole, and rachis at first densely brown leprose, glabrescent; lamina strongly plicate, irregularly pinnatisect with a few broad segments, lanceolate, long cuneate at base, 10-20 dm long and $2\frac{1}{2}$ -4 dm wide, apical lobes 4-6 dm long; about 24 pairs of primary veins prominent above, slightly immersed below, secondary veins immersed above, prominent and leprose below, tertiary veins prominent both above and below, veins emerging at $10-15^\circ$ from the rachis.

Inflorescences twice branched, with 2 flattened bracts inserted about 2 cm apart at the base of the peduncle, the basal one $1\frac{1}{2}$ -2 dm long and about 5 cm wide, completely enclosing the smaller second one; peduncle $1\frac{1}{2}$ -2 dm long with about 5 small bracts, rachis 5-15 cm long, with 8-13 rachillas, the lower bi- or tri-furcate, the upper ones simple, 3-6 mm in diameter, densely covered with bilabiate flowerpits arranged in 5-6 spiral series, about 1 mm apart; upper lip inconspicuous, lower lip cleft. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a digitately lobed staminodial tube, the lobes radiating star-like at anthesis. Fruit not seen.

Brazil, western Amazon basin, said to be frequent on well-drained, sandy soil, in dense shade of forest (map IV, 68).

Brazil: Hopp 1151 (B), 1333 (B); Huebner 106 (B); Krukoff 7157 (BH, BM, F, K, US); Luetzelburg 22026 (M, R); Martius s.n. (M); Trail 972 / CVII (K), 973 / CXXXV (K), 975 (K).

Martius (1847) referred Blanchet specimens from Bahia, still kept in BR and labelled in his handwriting "*G. spixiana* M?", to *G. spixiana* but in fact these specimens do not belong here. This heterogeneous material was separated by Drude into 3 species: *G. rubescens*, *G. pauciflora*, and *G. macroclona*. Krukoff 7157 and Luetzelburg 22026, identified by Burret as *G. grandisecta*, and also the scrap of the type at B agree very well with the Martius and Trail collections. According to Burret's key the only difference is in the division of the lamina. As this character proved to be most unreliable the two names are considered to represent a single species.



Maps IV,68–74. Distribution of *Geonoma* species: IV,68 *G. spixiana*; IV,69 *G. triglochin*; IV,70 *G. densiflora*; IV,71 *G. juruana*; IV,72 *G. maxima*; IV,73 *G. multiflora*; IV,74 *G. aspidiifolia*.

IV B b 16, 69 *Geonoma trigloch* Burret, Notizbl. 11: 8. 1930.

Plate IX, X.

Type collection: Woronow & Juzepczuk 5858, Colombia, Sucre, Caquetá (LE).
Heterotypic synonym: *Geonoma umbraculiformis* W. Boer, Ind. Palms Sur. 37, f 2. 1965.

Type collection: Versteeg 322, Suriname, Lawa R. (U holotype).

Solitary, cane erect, about 2 m tall, 3–4 cm in diameter, internode; 1–1½ cm long; leaves closely together and almost horizontally radiating; leafsheath 1½–2 dm long; petiole about 5 dm long; lamina lanceolate, cuneate at base, 8–11 dm long and about 2½ dm wide, simple or irregularly divided into 2–3 pairs of broad segments, apical lobes 2–2½ dm long; 32–40 pairs of primary veins prominent both above and below, secondary veins immersed above, prominent and densely brown tomentose below, tertiary veins inconspicuous, veins emerging at about 25° from the rachis; lamina lustrous above, sparsely lepidote and when dry brownish below.

Inflorescences once branched, with 2 tubular membranaceous bracts fibrously decaying, the basal one 1–1½ dm long, the second 2–3 dm long and inserted 3–5 dm higher up; peduncle 3–4 dm long with in the upper part a few small bracts, 2–6 rachillas 1–2 dm long and 3–9 mm in diameter; bilabiate flowerpits spirally arranged in 5–10 series, 2–3 mm apart; lower lip cleft. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a digitately lobed staminodial tube radiating star-like at anthesis. Mature fruit green on an orange inflorescence, ovoid, 10–12 mm long and 8–10 mm in diameter; seed 9 mm in diameter.

Known from several collections scattered throughout the northern part of South America, usually on well-drained mountain slopes at moderate altitudes (250–750 m), in dense forest (map IV, 69).

Venezuela: Vogl 462 (M).

Colombia: Sprague 348 (K); Woronow & Juzepczuk 5858 (LE).

Peru: Killip & Smith 26431 (F, US).

Brazil: Prance & Pennington 1831 (NY, U).

French Guiana: Leprieur s.n. (P).

Suriname: Daniëls & Jonker 823 (U); Versteeg 322 (U); Wessels Boer 1501 (U), 1553 (U).

British Guiana: Forest. Dept. 6335 (BH).

The isolated collections indicate a wide distribution and within this area a rare occurrence. Specimens from Suriname were once thought to represent an undescribed species. More material, however, revealed that the species can be more robust and produce inflorescences with up to 6 rachillas. Killip & Smith 26431 was named *G. cfr. spixiana* by Burret, a species clearly different in the shape and structure of the leaves, the inflorescences, and the bracts, and also in the fruits. Killip & Smith 26431 and Sprague 348 are intermediate between the type of *G. trigloch* with thick rachillas with many series of flowerpits and the Suriname

material with slender rachillas with few series of flowerpits. In every other respect all collections resemble each other very well. There cannot be any doubt as to their conspecificity as leaves, fruits and stems are almost identical. Furthermore the inflorescences, apart from the thickness of the rachillas, agree very well in bracts, length-ratio of the different parts, and structure.

Group 17: species 70–74.

IV B b 17, 70 *Geonoma densiflora* Spruce, J. Linn. Soc. 11: 112. 1869; Drude in Martius, Flora Bras. 3(2): 489. 1882; Burret, Bot. Jahrb. 63: 263. 1930.

Type collection: Spruce 30, Brazil, Rio Negro, São Gabriel (K holotype).

Heterotypic synonyms: *Geonoma densiflora* Spruce var. *monticola* Spruce, J. Linn. Soc. 11: 118. 1869.

Type collection: Spruce 33, Brazil, Rio Negro, São Gabriel (K holotype).

Geonoma personata Spruce, J. Linn. Soc. 11: 112. 1869.

Type collection: Spruce 34, Brazil, Rio Negro, São Gabriel (K holotype).

Clustered, cane 2–4 m tall, 1–2 cm in diameter, internodes 2–10 cm long; leafsheath 1–2 dm long; petiole 3–6 dm long; lamina irregularly pinnate, 4–7 dm long and 3–5 dm wide, with 3–4 pairs of broad segments rhomboid-falcate, often intermixed with a few linear 1-veined segments; 25–30 pairs of primary veins prominent above, prominulent below, secondary veins prominulent above, prominent below, veins emerging at about 40° from the rachis.

Inflorescences once branched, with 2 subcoriaceous, subequal bracts 12–17 cm long and inserted about 1 cm apart at the base of the peduncle; peduncle completely enclosed by bracts, 10–13 cm long, rachis 2–5 cm long, with 3–7 simple rachillas 10–12 cm long and 5–6 mm in diameter; bilabiate flowerpits densely spirally arranged in 8 series, less than 1 mm apart; upper lip inconspicuous, lower lip semicircular, emarginate. Male flowers about 4 mm long, anthers sharply reflexed from the filaments. Female flowers with a digitately lobed staminodial tube radiating star-like at anthesis. Fruit ovoid, probably yellowish-green at maturity, 15 mm long and 11 mm in diameter, stipitate, rounded at apex; seed ovoid, 11 mm long and 8 mm in diameter.

Only known from the Spruce collections from the Rio Negro, Brazil, and two collections from Loreto near Iquitos, Peru (map IV, 70).

Peru: Le Fiehl 4 (BH); Moore, Salazar & Smith 8428 (BH).

Brazil: Spruce 30 (K), 33 (K), 34 (K).

G. densiflora is distinguished by the once branched inflorescences with thick rachillas densely covered with flowerpits, and the large fruits. The Peruvian and Brazilian specimens are almost identical and the species seems to be very constant. Furthermore the three Spruce specimens are very similar and their treatment as a single species is not open to doubt.

IV B b 17, 71 *Geonoma juruana* Dammer, Verh. Bot. Ver. Brandenb. 48: 119. 1906; Burret, Bot. Jahrb. 63: 256. 1930.

Type collection: Ule 5744, Brazil, Rio Jurua (F, scrap only).

Heterotypic synonym: *Geonoma longisecta* Burret, Bot. Jahrb. 63: 257. 1930.

Macbride, Field Mus. Bot. 13: 345. 1960.

Type collection: Tessmann 5087, Peru, Iquitos (NY).

Clustered, canes 2–3 m tall and about $1\frac{1}{2}$ cm in diameter, internodes at least 2 cm long; leafsheath about $1\frac{1}{2}$ dm long; petiole 3–5 dm long, first brown lepidote, glabrescent; lamina often bijugate, 5–6 dm long and 4–5 dm wide, segments 2–5 cm apart, porrect, up to 8 dm long and 5–9 cm wide, rarely 1-veined linear segments present or the lamina simple; about 20 pairs of primary veins prominent above, inconspicuous below; secondary veins inconspicuous above, prominent and brown lepidote below, tertiary veins fine, veins emerging at about 30° from the rachis.

Inflorescences twice branched, with subequal, rapidly decaying, deciduous bracts about 12 cm long and inserted about 1 cm apart at the base of the peduncle; peduncle and rachis each up to about 1 dm long, the lower lateral branches with 4–8 rachillas, the upper part of the rachis with simple rachillas $1-1\frac{1}{2}$ dm long and 4 mm in diameter; bilabiate flowerpits arranged in about 7 subvertical series, about $1\frac{1}{2}$ mm apart; lower lip prominent and more or less entire, upper lip inconspicuous. Male flowers about $3\frac{1}{2}$ mm long, the anthers sharply reflexed from the filaments. Female flowers with a digitately lobed staminodial tube radiating star-like at anthesis. Fruit deep purple on red rachillas, ovoid to subglobose, 13 mm long and 11 mm in diameter, rounded at base and apex, flattened by mutual pressure; seed ovoid, 9 mm long and 8 mm in diameter.

North-western Peru and adjacent parts of Brazil and Colombia, in dense forest (map IV, 71).

Colombia: García B. 14324 (US); Schultes 3884 (BH); Schultes & Cabrera 16011 (BH).

Peru: Killip & Smith 26987 (F, US), 26993 (US), 27977 (F, US), 29951 (US); Klug 537 (F, US), 1496 (F, US); Moore, Salazar & Smith 8424 (BH), 8431 (BH), 8509 (BH); Tessmann 5087 (NY); Williams 8019 (F).

Brazil: Jobert & Schwacke 516 (P, R); Trail 1009 / CLXXVI A (K); Ule 5744 (F).

G. juruana is distinguished by the leafshape, the often entire lower lips of the flowerpits, and the large blackish-purple fruits on red rachillas. Burret reduced *G. juruana* to a synonym of *G. spruceana*. In effect Trail circumscribed his new species very broadly, including *G. juruana*. However, since the type (lectotype Trail XXIV) belongs to *G. maxima*, *G. juruana* and *G. spruceana* cannot be treated as synonyms. The position of *G. longisecta* is sufficiently clear, as Burret himself applied this name to several later collections.

G. rectifolia Wallace, Palm Trees Amazon 67, t 25. 1853 may belong

here, too. Wallace referred the species, apparently incorrectly, as related to *G. paniculigera*; the fruit is too large and nothing is shown of a verticillate arrangement of the flowerpits on the plate. The poor description and illustration agree rather well with *G. juruana* but also with e.g., *G. baculifera*, and a definite interpretation is impossible.

IV B b 17, 72 *Geonoma maxima* (Poiteau) Kunth, Enum. Pl. 3: 229. 1841; Drude in Martius, Flora Bras. 3(2): 483. 1882; Burret, Jahrb. 63: 260. 1930.

Basionym: *Gynestum maximum* Poiteau, Mém. Mus. Hist. Nat. Paris 9: 388, t 1. 1822.

Type collection: Poiteau s.n., French Guiana (P).

Heterotypic synonyms: *Geonoma ambigua* Spruce, J. Linn. Soc. 11: 111. 1869; Burret, Bot. Jahrb. 63: 263. 1930.

Type collection: Appun 566, British Guiana (K holotype).

Geonoma discolor Spruce, J. Linn. Soc. 11: 110. 1869; Burret, Bot. Jahrb. 63: 262. 1930.

Type collection: Spruce 36, Brazil, Amazon R. near mouth of Rio Tapajoz (K holotype).

Geonoma hexasticha Spruce, J. Linn. Soc. 11: 110. 1869; Burret, Bot. Jahrb. 63: 262. 1930.

Type collection: Spruce 29, Brazil, Rio Negro (K holotype).

Geonoma negrensis Spruce, J. Linn. Soc. 11: 113. 1869.

Type collection: Spruce 70, Venezuela, Rio Negro, near confluence with Rio Casiquiare (K holotype).

Geonoma schomburgkiana Spruce, J. Linn. Soc. 11: 111. 1869 (excluding leaf).

Type collection: Schomburgk 705, British Guiana (inflorescence only) (K holotype).

Geonoma bijugata Barbosa Rodrigues, Enum. Palm. Nov. 10. 1875; Barbosa Rodrigues, Sert. Palm. 1: 25, t 16. 1903; Burret, Bot. Jahrb. 63: 251. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 16. 1903.

Geonoma brachyfoliata Barbosa Rodrigues, Enum. Palm. Nov. 10. 1875; Barbosa Rodrigues, Sert. Palm. 1: 35, t 33. 1903; Burret, Bot. Jahrb. 63: 257. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 33. 1903.

Geonoma capanemae Barbosa Rodrigues, Enum. Palm. Nov. 9. 1875; Barbosa Rodrigues, Sert. Palm. 1: 33, t 10 A, 29. 1903; Burret, Bot. Jahrb. 63: 256. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 29. 1903.

? *Geonoma falcata* Barbosa Rodrigues, Enum. Palm. Nov. 10. 1875; Barbosa Rodrigues, Sert. Palm. 1: 27, t 9 C, 19. 1903; Burret, Bot. Jahrb. 63: 257. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 19. 1903.

Geonoma speciosa Barbosa Rodrigues, Enum. Palm. Nov. 9. 1875; Barbosa Rodrigues, Sert. Palm. 1: 26, t 10 B, 18. 1903; Burret, Bot. Jahrb. 63: 255. 1930.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 18. 1903.

Geonoma spruceana Trail, J. Bot. 14: 328. 1876 (partly); Drude in Martius, Flora Bras. 3(2): 497. 1882; Burret, Bot. Jahrb. 63: 256. 1930.

Type collection: Trail XXIV, Brazil, Lago Juruty (K lectotype).

Geonoma huebneri Burret, Bot. Jahrb. 63: 254. 1930.

Type collection: Huebner 43, Brazil, Serra de Jupaty (B holotype).

Geonoma latisecta Burret, Bot. Jahrb. 63: 255. 1930.

Type collection: Huebner 30, Brazil, near Manaus (B holotype).

Geonoma robusta Burret, Bot. Jahrb. 63: 259. 1930.

Type collection: Bartlett 6/8189, British Guiana, Conawaruk R. (not seen, destroyed at B).

Geonoma camptoneura Burret, Notizbl. 11: 201. 1931.

Type collection: Williams 7836, Peru, Rio Huallaga, Yurimaguas (F).

? *Geonoma insignis* Burret, Notizbl. 15: 28. 1940.

Type collection: Schultze-Rhonhof 2892, Ecuador, Mera, Pastaza (not seen, destroyed at B).

Clustered, cane solitary, with small basal shoots or few to several canes together, up to 5 m tall, $1\frac{1}{2}$ – $2\frac{1}{2}$ cm in diameter, internodes 6–18 cm long; leafsheath 1 – $1\frac{1}{2}$ dm long; petiole 4–7 dm long; lamina variably pinnate, 7–10 dm long and 5–6 dm wide, with 2–22 pairs of unequal segments broadly rhomboid-lanceolate with several primary veins to linear and 1-veined, in leaves with more than 10 segments usually all segments 1-veined except for the apical and basal one each with a few veins; 15–30 pairs of primary veins prominent above, prominulent below, secondary veins inconspicuous above, prominent and brown lepidote below, tertiary veins fine, veins emerging at 35 – 50° from the rachis.

Inflorescences twice or rarely once branched, with 2 subcoriaceous, subequal bracts 1 – $1\frac{1}{2}$ dm long and inserted about 1 cm apart at the base of the peduncle; peduncle 8–16 cm long, rachis 10–16 cm long, with simple rachillas in the upper part, the lower lateral branches usually branching again into 3–9 rachillas 7–15 cm long and about $2\frac{1}{2}$ mm in diameter; bilabiate flowerpits more or less distantly spirally arranged in 5–6 series; lower lip emarginate. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a digitately lobed staminodial tube radiating star-like at anthesis. Fruit subglobose to slightly ovoid, yellowish-green on orange rachillas, about 9 mm in diameter; seed globose, 6 mm in diameter.

Wide-spread in the Guianas and the Amazon basin, in rather well-drained places in dense forest, often on hillsides (map IV, 72).

Venezuela: Spruce 70 (K); Steyermark 58093 (F), 87274 (VEN), 89119 (VEN); Vareschi 7796 (VEN); Williams 14014 (F, VEN), 14193 (US, VEN), 14738 (F), 14808 (F, US, VEN), 15091 (F).

Colombia: García B. 15005 (BH); Schultes, Baker & Cabrera 17948 (BH), 18038 (BH); Schultes & Cabrera 14455 (BH).

Ecuador: Schultes 3467 (BH).

Peru: Moore, Salazar & Smith 8520 (BH); Williams 7836 (F).

Brazil: Archer 7810 (US); Dahlgren & Sella 11 (F); Ducke 8551 (MG), 11267 (MG); Fróes 28707 (BH); Huebner 30 (B), 43 (B); Luetzelburg 23044 (M, R); Martius s.n. (M); Sneath 10098 (MG); Spruce 29 (K), 36 (K), 70 (K); Trail 983 / LIV (K), 984 / CXLIV (K), 991 / CLXX (K), 995 / CXXXVIII (K), 996 / CXXXVIII (K), 997 / LXXXIV (K), 999 / CLXXIV (K), 1000 / CXXV (K), 1001 / CLXIV (K), 1003 / XLI (K), 1005 / XLIII (K), 1007 / XCIII (K); Ule 6126 (G, L).

French Guiana: Leprieur s.n. (P); Poiteau s.n. (G, P).

Suriname: Boon 1128 (U); van Donselaar 1051 (U); Florschütz & Maas 2945 (U); Gonggrijp & Stahel 174 (U); Lanjouw 793 (U); Lindeman 4037 (U), 6128 (U);

N.Y.B.G. Wilh. Geb. Exp. 54009 (NY, U), 54010 (NY, U), 54263 (NY, U), 54363 (NY, U), 54366 (NY, U); Splitgerber 954 (L); Wessels Boer 194 (U), 199 (U), 206 (U), 210 (U), 254 (U), 256 (U), 281 (U), 646 (U), 1280 (U), 1407 (U), 1472 (U), 1497 (U), 1614 (U), 1617 (U).

British Guiana: Appun 566 (K); de la Cruz 4234 (F, US); Forest. Dept. 7339 (BH); Jenman 1700 (K), 2102 (K), 2103 (K), 4160 (K); Persaud 49 (F); Sandwith 176 (K); Smith 2556 (F, G, K, US).

G. maxima in the present concept is distinguished among the species with a digitately lobed staminodial tube by the usually twice branched inflorescence orange in fruit and bearing rather small (about 9 mm in diameter), subglobose, yellowish-green fruits. The division of the leaves proves to be very variable, ranging from regularly pinnate leaves with 1-veined linear segments only to 2-jugate leaves with only two pairs of broader segments. Furthermore the inflorescences vary to some extent, namely in the density of the flowerpits and the length of the apical appendices of the rachillas. These variants cannot be separated into distinguishable taxa as they constitute a continuous series, but they have served as the basis for a number of new species, and contrariwise, as an argument for an excessively broad species concept. Martius based his *G. multiflora* on plants representing *G. maxima*, but his original material at M consists of an additional two species. Due to the choice of a lectotype by Burret *G. multiflora* must be considered as a separate species and not as a synonym of *G. maxima*.

G. spruceana belongs to the typical form without any doubt but Trail, impressed as he was by the large variability, enlarged it with several subspecies or varieties which in part represent *G. juruana* and *G. aspidiifolia*. Altogether Trail's treatment of *G. spruceana* is not very satisfactory and his subspecific taxa do not seem to be natural; Burret's emendations are not a great improvement, either. As the infraspecific names are not typified and based on series of specimens, their taxonomic position depends largely on the choice of lectotypes. This has been avoided here.

In the present treatment the closely related and very similar species of the *Astrandroeceum* group are in the first place separated by fruit characters. This seems to be a natural division as it proved to be correlated with less pronounced differences in leaves, inflorescences, etc. Although *G. maxima* has yellowish-green fruits, several of the Barbosa Rodrigues specimens described as having purplish-black fruits are placed here as synonyms. This was done as the specimens agree very well with *G. maxima* in other respects, whereas the description of the colour of the fruits is supposed to be a misobservation. Misobservations of this kind are not rare in the work of Barbosa Rodrigues. The yellowish-green fruits would appear to represent an immature stage as in numerous other *Geonoma* species the greenish colour turns to the final purplish-black shade when they mature. Even a keen observer like Trail described *G. spruceana*: "*fructibus . . . viridibus (nigricantibus?)*" apparently considering that

they do, in fact, turn black. In this connection I think it particularly significant, too, that the illustrations of cross-sections of completely mature fruits show in both cases a green exocarp.

IV B b 17, 73 *Geonoma multiflora* Martius, Hist. Nat. Palm. 2: 7, t 6. 1823 (partly); Martius, Palmet. Orbign. 33. 1847; Trail, J. Bot. 15: 130. 1877; Drude in Martius, Flora Bras. 3(2): 484. 1882; Burret, Bot. Jahrb. 63: 261. 1930.

Type collection: Martius s.n., Brazil, Pará (M lectotype).

Heterotypic synonym: *Geonoma paraensis* Spruce, J. Linn. Soc. 11: 112. 1869.

Type collection: Spruce 69, Brazil, Pará (K holotype).

Probably about 2 m tall, cane about 2 cm in diameter, internodes at least 2–3 cm long; leafsheath about 2 dm long; petiole about 5 dm long; rachis about 6 dm in length; lamina about 10 dm long and 6 dm wide, regularly pinnate with 11–17 pairs of 1-veined, falcate-lanceolate segments rather strongly reduplicate and narrowed at base, long caudate-acuminate at apex, the apical pair sometimes broader and with several primary veins; primary veins prominent above, inconspicuous below, lateral of each primary vein 2–3 secondary veins about equally strong, veins emerging at about 60° from the rachis.

Inflorescence twice branched, with 2 subcoriaceous, subequal, flattened bracts 1–1½ dm long and inserted about ½ cm apart at the base of the peduncle; peduncle 5–10 cm long, rachis 15–20 cm long, the lower lateral branches bearing 2–12 rachillas, the upper simple, rachillas 11–18 cm long and 2 mm in diameter; bilabiate flowerpits spirally arranged, 2–3 mm apart; lips slightly prominent, lower lip emarginate. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a digitately lobed staminodial tube radiating star-like at anthesis. Fruit black, ovoid, 9 mm long and 7 mm in diameter, rounded at apex; seed subglobose, about 6 mm in diameter.

Only known from the forest near the Amazon delta in Pará, Brazil (map IV, 73).

Brazil: Cavalcante 1000 (MG); Huber 142 (MG), 1809 (MG); Ledoux 29056 (MG); Martius s.n. (M); Spruce 69 (K); Trail 942 / CCXXIII (K).

G. multiflora in the present circumscription is very homogeneous. It is distinguished by the regularly pinnate leaves with falcate segments reduplicate at base, the rather shortly pedunculate, strongly branched inflorescence, the digitately lobed staminodial tube and in particular the small, black fruits. Martius's original concept of the species was much broader. He based the species on specimens frequently observed in "*sylvis umbrosis Provinciarum Maragnaniensis, Paraensis et Fluminis nigri*". Splitgerber 954 from Suriname was also included in *G. multiflora*.

Martius's herbarium material at M is still more confused. As *G. multiflora* in the sense of Martius completely covers *G. maxima*, and as Martius himself named Suriname material of *G. maxima* "*G. multiflora*" the latter was treated in the Flora of Suriname as a synonym. This, however, is incorrect because Burret chose the leaf fragment, illustrated on plate 6 of the Hist Nat. Palm., vol. 2, as the lectotype. Since this lectotype belongs to the species later described by Spruce as *G. paraensis* this name is a synonym of *G. multiflora* as treated by Burret.

IV B b 17, 74 *Geonoma aspidiifolia* Spruce, J. Linn. Soc. 11: 112. 1869; Drude in Martius, Flora Bras. 3(2): 499. 1882; Burret, Bot. Jahrb. 63: 262. 1930.

Type collection: Spruce 75, Brazil, Amazonas, Rio Tamura (K holotype).
Heterotypic synonyms: *Geonoma chelidonura* Spruce, J. Linn. Soc. 11: 111. 1869; Drude in Martius, Flora Bras. 3(2): 502. 1882; Burret, Bot. Jahrb. 63: 250. 1930.

Type collection: Spruce 73, Brazil, Rio Uaupés (K holotype).
Geonoma tuberculata Spruce, J. Linn. Soc. 11: 112. 1869; Trail, J. Bot. 14: 329. 1876; Drude in Martius, Flora Bras. 3(2): 500. 1882; Burret, Bot. Jahrb. 63: 252. 1930.

Type collection: Spruce 18, Brazil, near mouth of Rio Negro (K holotype).
Geonoma furcifolia Barbosa Rodrigues, Enum. Palm. Nov. 11. 1875; Barbosa Rodrigues, Sert. Palm. 1: 25, t 10 D, 15. 1903; Burret, Bot. Jahrb. 63: 251. 1930.
Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 15. 1903.

Geonoma palustris Barbosa Rodrigues, Enum. Palm. Nov. 11. 1875; Barbosa Rodrigues, Sert. Palm. 1: 33, t 27. 1903; Burret, Bot. Jahrb. 63: 252. 1930.

Not *Geonoma palustris* auct. non Barbosa Rodrigues, Warming ex Drude in Martius, Flora Bras. 3(2): 493. 1882.

Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 27. 1903.

Geonoma uliginosa Barbosa Rodrigues, Enum. Palm. Nov. 11. 1875; Barbosa Rodrigues, Sert. Palm. 1: 33, t 10 C, 28. 1903; Burret, Bot. Jahrb. 63: 253. 1930.
Lectotype: Barbosa Rodrigues, Sert. Palm. 1: t 28. 1903.

Geonoma dasystachys Burret, Bot. Jahrb. 63: 251. 1930.

Type collection: Trail 981 / XC, Brazil, Rio Tarumá (K holotype).

? *Geonoma lakoi* Burret, Bot. Jahrb. 63: 253. 1930.

Type collection: Lakó, coll. Huebner 116, Brazil, Rio Manacapuru (not seen, destroyed at B).

Geonoma parvisecta Burret, Notizbl. 10: 1018. 1930.

Type collection: Luetzelburg 22278, Brazil, Rio Negro (M).

Slender, clustered, usually about 1 m tall, cane arundinaceous, less than 1 cm in diameter, internodes 2–5 cm long; leafsheath 5–8 cm long; petiole 1–2 dm long; rachis $1\frac{1}{2}$ –2 dm long; lamina 3–5 dm long and $2\frac{1}{2}$ –4 dm wide, variably pinnate with a few unequal, broad segments to regularly pinnate, with equal, linear 1-veined segments; 13–20 pairs of primary veins prominent above, very inconspicuous below, secondary veins inconspicuous or even slightly immersed above, prominent and brownish lepidote below, veins emerging at 50–70° from the rachis.

Inflorescences once branched, with 2 papyraceous, almost tubular

bracts inserted about 1 cm apart at the base of the peduncle, the basal one enclosing the second bract as well as the peduncle; peduncle 5–10 cm long, rachis 1–6 cm long, with 3–11 simple rachillas 6–12 cm long and 3 mm in diameter; bilabiate flowerpits rather closely spirally arranged, 1–2 mm apart; lower lip at first entire, upper lip inconspicuous. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a digitately lobed staminodial tube radiating star-like at anthesis. Fruit greenish, ovoid, rounded at apex, 7–8 mm long and about 6 mm in diameter; seed ovoid, about 6 mm long and 5 mm in diameter.

Brazil, the Central part of the Amazon basin, in dense forests (map IV, 74).

Brazil: Ducke 11766 (MG); Fróes 24994 (BH); Luetzelburg 22278 (M); Spruce 16 (K), 18 (K), 73 (K), 75 (K); Trail 964 / CVIII (K), 980 / XCVII (K), 981 / XC (K), 982 / CXLIII (K), 985 / XXIX (K), 986 / XXV (K), 988 / LVI (K), 992 / CXVIII (K), 993 / LXXXIX (K); Ule 8987 (K, MG).

G. aspidiifolia resembles *G. maxima* very much but is smaller in almost every respect. However, the leaves with veins emerging at a larger angle from the rachis and the once branched inflorescences with slightly thicker rachillas are characteristic. Like *G. maxima* this species shows a considerable variability in division of the leaves; simple bifurcate leaves, pinnate leaves with few unequal, broad segments, and pinnate leaves with only linear, 1-veined segments forming a continuous series with all possible intermediates. As a result of this variability in leafshape several new species have been described which cannot be separated and are here reduced to synonyms. Even the separation of *G. aspidiifolia* and *G. maxima* is sometimes very difficult. Tall specimens of *G. aspidiifolia* and depauperate specimens of *G. maxima* are easily mistaken for each other. In consequence Trail placed most of his collections as different subspecies or varieties under *G. spruceana*, which resulted in a very heterogeneous species. The present emphasis on fruit and inflorescence characters permits a separation of smaller, more homogeneous species. The fruit and inflorescence characters run more or less parallel with characters of the leaves, habit, etc., that are difficult to put into words. Nevertheless leaves of plants in both species show a large range of variability and further research with more and better material may lead to a refinement of their classification.

An imperfectly known species.

?, 75 *Geonoma oligoclada* Burret, Notizbl. 11: 9. 1930.

Type collection: Lakó 7, coll. Huebner 138, Brazil, Amazonas, Rio Içá.

Solitary, cane about 7 dm tall, 2 cm in diameter, internodes short, about 1 cm long; petiole inclusive of sheath about 6 dm long; rachis $7\frac{1}{2}$ dm long; lamina simple, obovate-lanceolate, 12 mm long and 3 dm

wide, apical lobes $4\frac{1}{2}$ dm long; 34 pairs of primary veins, secondary veins much more elevated below than primary veins, tertiary veins fine, veins emerging at 25° from the rachis.

Inflorescences once branched, with 2 subequal, chartaceous, flattened, brown furfuraceous bracts about 3 dm long and 2 cm wide, the basal one enclosing the second and inserted closely together at the base of the peduncle; peduncle about 9 dm long, with in the upper part 3 small bracts, rachis 5 cm long with 4 simple rachillas 2-3 dm long and 5 mm in diameter, more or less pointed at apex; bilabiate flowerpits rather regularly arranged in 8 vertical series; lips conspicuous, lower lip entire. Male flowers with the anthers sharply reflexed from the filaments. Female flowers with a shortly crenulate staminodial tube. (Description after Burret).

Known from the type collection only.

Brazil: Lakó 7, coll. Huebner 138 B.

The type was badly damaged in the last war and was reduced to the stem with petioles and peduncles with bracts. These remnants remind one of the genus *Asterogyne* rather than of *Geonoma*. However, it seems rather unlikely that Burret, with the complete material at hand, should have made such a misidentification, although he may have been misled by the young, unexpanded flowers. *G. oligoclada*, questionable with respect to the genus, definitely represents a good species distinct from every other species in the tribe.

NAMES OF UNCERTAIN APPLICATION

- Geonoma acutangula* Burret, Bot. Jahrb. 63: 177. 1930. cf. *G. lehmannii*.
Geonoma adscendens Dammer ex Burret, Bot. Jahrb. 63: 175. 1930. cf. *G. jussieuana*.
Geonoma amoena Burret, Notizbl. 11: 862. 1933. cf. *G. lehmannii*.
Geonoma andicola Dammer ex Burret, Bot. Jahrb. 63: 218. 1930. cf. *G. megalospatha*.
Geonoma andina Burret, Bot. Jahrb. 63: 188. 1930. cf. *G. lindeniana*.
Geonoma anomoclada Burret, Notizbl. 12: 615. 1935. cf. *G. lindeniana*.
Geonoma aulacophylla Burret, Bot. Jahrb. 63: 216. 1930. cf. *G. densa*.
Geonoma brachystachys Burret, Notizbl. 15: 23. 1940. cf. *G. jussieuana*.
Geonoma campyloclada Burret, Bot. Jahrb. 63: 189. 1930. cf. *G. lindeniana*.
Geonoma campylostachys Burret, Notizbl. 15: 24. 1940. cf. *G. jussieuana*.
Geonoma caudulata Loesener, Bot. Jahrb. 21: 423. 1896. cf. *G. brevispatha*.
Geonoma cernua Burret, Notizbl. 15: 24. 1940. cf. *G. jussieuana*.
Geonoma concinna Burret, Bot. Jahrb. 63: 229. 1930. cf. *G. spinescens*.
Geonoma congestissima Burret, Bot. Jahrb. 63: 224. 1930. The author was unable to recognize any plant from the original description.
Geonoma dammeri Huber, Bol. Mus. Goeldi 3: 409. 1902. cf. *G. poiteauana*.
Geonoma decussata Burret, Fedde Rep. 32: 103. 1932. cf. *G. blanchetiana*.
Geonoma desmarestii Martius, Palmet. Orbign. 23, t 11, 22 B f 3. 1847. cf. *G. deversa*.
Geonoma estevaniana Burret, Notizbl. 14: 256. 1938. cf. *G. baculifera*.
Geonoma euterpoidea Burret, Bot. Jahrb. 63: 196. 1930. cf. *G. pulcherrima*.
Geonoma falcata Barbosa Rodrigues, Enum. Palm. Nov. 10. 1875. cf. *G. maxima*.
Geonoma floccosa Dammer ex Burret, Bot. Jahrb. 63: 203. 1930. cf. *G. lindeniana*.
Geonoma goniocarpa Burret, Bot. Jahrb. 63: 185. 1930. cf. *G. marggraffia*.
Geonoma grandifrons Burret, Bot. Jahrb. 63: 163. 1930. cf. *G. jussieuana*.
Geonoma granditrijuga Burret, Bot. Jahrb. 63: 171. 1930. cf. *G. dicranospadix*.
Geonoma herthae Burret, Notizbl. 14: 325. 1939. cf. *G. piscicauda*.
Geonoma hoppii Burret, Notizbl. 11: 235. 1931. cf. *G. bartlettii*.
Geonoma insignis Burret, Notizbl. 15: 28. 1940. cf. *G. maxima*.
Geonoma iodoneura Burret, Bot. Jahrb. 63: 210. 1930. cf. *G. pulcherrima*.
Geonoma kuhlmannii Burret, Notizbl. 14: 261. 1938. cf. *G. pohliana*.
Geonoma lacerata Hort. ex Floral Mag. 8: t 446. 1869. The illustration shows a seedling with acute instead of bifid leaves. Consequently it does not belong to the Geonomoid palms.
Geonoma lakoi Burret, Bot. Jahrb. 63: 253. 1930. cf. *G. aspidiifolia*.
Geonoma lanceolata Burret, Notizbl. 11: 7. 1930. cf. *G. lanceolata*.
Geonoma leucotricha Burret, Bot. Jahrb. 63: 204. 1930. cf. *G. lindeniana*.
Geonoma linearis Burret, Notizbl. 11: 861. 1933. cf. *G. sodiroi*.
Geonoma macroclada Burret, Bot. Jahrb. 63: 220. 1930. cf. *G. weberbaueri*.
Geonoma macrophylla Burret, Notizbl. 15: 27. 1940. The author was unable to recognize any plant from the original description.
Geonoma macrosiphon Burret, Bot. Jahrb. 63: 214. 1930. cf. *G. undata*.
Geonoma macroua Burret, Bot. Jahrb. 63: 202. 1930. cf. *G. lindeniana*.
Geonoma molinillo Burret, Notizbl. 13: 491. 1937. cf. *G. lindeniana*.
Geonoma pachyclada Burret, Bot. Jahrb. 63: 214. 1930. cf. *G. helminthoclada*.
Geonoma paleacea Burret, Bot. Jahrb. 63: 199. 1930. cf. *G. marggraffia*.
Geonoma plicata Burret, Bot. Jahrb. 63: 217. 1930. cf. *G. densa*.
Geonoma plumeriana Martius, Palmet. Orbign. 34. 1847. cf. *C. occidentalis*.
Geonoma polyclada Burret, Notizbl. 15: 26. 1940. cf. *G. interrupta*.
Geonoma ramosissima Burret, Bot. Jahrb. 63: 249. 1930. cf. *G. oxycarpa*.

- Geonoma rectifolia* Wallace, Palm Trees Amazon 67, t 25. 1853. cf. *G. juruana*.
Geonoma rivalis Kalbreyer ex Burret, Bot. Jahrb. 63: 241. 1930. cf. *G. oxycarpa*.
Geonoma seemannii Hort. ex Floral Mag. 8: t 428. 1869. The author was unable to recognize any plant from the poor illustration and description.
Geonoma solitaria (Engel) Jahn, Palm. Fl. Venez. 67. 1908. See *Roebelia solitaria*.
Geonoma stenothyrsa Burret, Bot. Jahrb. 63: 197. 1930. cf. *G. pulcherrima*.
Geonoma tenuifolia Burret, Notizbl. 15: 25. 1940. cf. *G. lindeniana*.
Geonoma tessmannii Burret, Bot. Jahrb. 63: 181. 1930. cf. *G. bartlettii*.
Geonoma trichostachys Burret, Notizbl. 11: 862. 1933. The author was unable to recognize the species from the original description.
Geonoma uncibracteata Burret, Bot. Jahrb. 63: 215. 1930. cf. *G. densa*.
Geonoma ventricosa Engel, Linnaea 33: 688. 1865. The author was unable to recognize the species from the original description.
Geonoma wendlandiana Burret, Bot. Jahrb. 63: 192. 1930. cf. *G. marggraffia*.
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Pholidostachys kalbreyeri H. Wendland ex Burret, Bot. Jahrb. 63: 131. 1930. cf. *C. pulchra*.
Roebelia solitaria Engel, Linnaea 33: 680, t 3 f 5. 1865. cf. Burret, Bot. Jahrb. 63: 265. 1930. The present author was unable to recognize any plant from the original description.
Taenianthera lakoi Burret, Notizbl. 11: 11. 1930. cf. *G. poiteauana*.
Welfia microcarpa Burret, Bot. Jahrb. 63: 129. 1930. cf. *W. georgii*.

INDEX OF EXSICCATAE

The parenthetical numerals behind the collectors numbers refer to the species

- Abbot, W. L. 406 (I, 2).
 Agostini, G. 239 (IV, 27).
 Agostini, G. & M. Feriñas 89 (IV, 46).
 Agredo, S. Y. 432 (IV, 65).
 Alleizette, Ch. d' 7642 (IV, 41).
 Allen, P. H. 1838 (IV, 9); 2947 (I, 6); 3435 (I, 8).
 Appun, C. F. 566 (IV, 72); 1141 (IV, 61).
 Arbelaez, E. P. 704 (IV, 21).
 Archer, W. A. 1370 (IV, 14); 1978 (III, 1); 1980 (IV, 49); 2162 (IV, 27); 7810 (IV, 72).
 Archer, W. A. & A. Gehrt 74 (IV, 31).
 Aristiguieta, L. & F. Pannier 1876 (IV, 41).
 Aviles, S. 2 (IV, 9); 94 (IV, 40); 1001 (IV, 9).
 Bailey, L. H. 229 (I, 3); 327 (IV, 47).
 Baker, B. O. 111 (IV, 27).
 Baker, B. O. & Dinmoch 4882 (I, 2).
 Bang, A. M. 877 (IV, 56 & 58).
 Bangham, W. N. 204 (IV, 44); 217 (I, 8); 475 (IV, 9).
 Benoist, R. 1673 (IV, 47); 1708 (IV, 7).
 Biolley, P. 7400 (I, 7).
 Blain, J. 170 (I, 2).
 Blanchet, J. S. 25 p.p. (IV, 48); 27 (IV, 33); 1431 (IV, 16); 2461, II 195 (IV, 33).
 Bolland, G. 20 (IV, 30).
 Boon, H. 1128 (IV, 72); 1195 (IV, 5).
 Brade, A. C. 16345, 16442, 16476 (IV, 38); 16477 (IV, 33); 16590 (IV, 32); 16591 (IV, 35); 17137 (IV, 32); 18126 (IV, 16); 18318, 18359 (IV, 32); 18427, 18454 (IV, 16); 18830 (IV, 35); 18852 (IV, 32).
 Bredemeyer, F. 20 (IV, 46); 21 (IV, 41).
 Brenez, A. M. 3563, 3796 (I, 6); 4473 (IV, 11); 4962, 13470 (I, 6); 13588 (IV, 11); 15666, 20464 (I, 6); 21848 (IV, 40).
 Bristol, M. L. 800 (IV, 65).
 Britton, N. L. 537 (I, 1).
 Britton, N. L. & E. G. Britton 5018 (I, 2).
 Britton, N. L., E. G. Britton & T. E. Hazen 1933 (IV, 41).
 Britton, N. L., E. G. Britton & P. Wilson 14761 (I, 2).
 Britton, N. L., W. G. Freeman & L. H. Bailey 2278 (IV, 41).
 Britton, N. L., T. E. Hazen & W. Mendelson 1805 (IV, 41).
 Britton, N. L. & W. E. Hess 2785 (I, 3).
 Broadway, W. E. 2701, 4073, 5676, 5928 (IV, 41).
 Buchtien, O. 3670 (IV, 58); 5338 (IV, 56).
 Burret, M. & A. C. Brade 1 (IV, 33); 9 (IV, 32).
 Cardena, M. 1981 (IV, 27).
 Cardona, F. 796 (IV, 27); 922 (IV, 47); 1358 (IV, 21).
 Castellanos, A. 23161 (IV, 32).
 Cavalcante, P. 1000 (IV, 73).
 Collins, G. N. 10 (IV, 40).
 Comm. Geog. & G. S. Paulo 1605 (IV, 16).
 Cook, O. F. 84 p.p. (IV, 8); 94 (II, 2); 133 (I, 10); 143 (IV, 12); 150 (I, 10); 164 (IV, 40); 165 (I, 10); 166 (IV, 27); 822, 836 (IV, 40).

- Cook, O. F. & C. B. Doyle 4, 35 (IV, 40); 43, 53 (I, 4); 61 (III, 1); 62 (IV, 10); 128 (IV, 67); 135, 153 (IV, 51); 174 (IV, 11); 327 (IV, 67); 431 (IV, 9); 544 (III, 1); 587 (IV, 27); 588 (IV, 9); 636 (II, 2); 727, 728 (IV, 40).
- Cook, O. F. & G. B. Gilbert 1092, 1108, 1187, 1454 (IV, 64).
- Cook, O. F. & R. F. Griggs 36, 40 (IV, 67); 128 (IV, 40); 749 (I, 8).
- Cruz, J. S. de la 4234 (IV, 72).
- Cuatrecasas, J. 13967 (II, 2); 15497 (IV, 63); 15753 (IV, 12); 15982 (I, 10); 16042 (IV, 12); 16270 (IV, 27); 16314, 16932 (II, 2); 16981 (IV, 40); 17365 (II, 2).
- Cuatrecasas, J. & M. Llano 24195 (III, 1).
- Curran, H. M. 22 (IV, 48); 166 (IV, 40); 239 (IV, 48).
- Curran, H. M. & M. Haman 694 (IV, 60).
- Curtiss, A. H. 485 (I, 2).
- Dahlgren, B. E. 51, 47.066 (I, 2); 610741 (IV, 47).
- Dahlgren, B. E. & Bro. León 47.026 (I, 2).
- Dahlgren, B. E. & E. Sella 11 (IV, 72); 12 (IV, 47).
- Daniel, Bro. 569, 4167 (IV, 14).
- Daniels, A. G. H. & F. P. Jonker 823 (IV, 69); 839 (IV, 25); 1299 (IV, 47).
- Davidson, M. E. 331 (IV, 11).
- Dawe, M. T. 363 (IV, 55).
- Dodge, C. H. 9284 (III, 1).
- Dodge, C. W. & P. H. Allen 17126 (IV, 9).
- Dodge, C. W. & V. F. Goerger 9957 (IV, 9).
- Donselaar, J. van 1051 (IV, 72).
- Doyle, C. B. 1 (IV, 10); 15, 21 (IV, 57); 27 (IV, 63).
- Doyle, C. B. & G. N. Collins 6, 10 (IV, 40); 235 (I, 8).
- Dryander, E. 3000 (IV, 44).
- Duarte, A. 2619 (IV, 31); 3615 (IV, 16).
- Ducke, A. 1556 (IV, 30); 6752, 7431, 7507 (IV, 2); 8551 (IV, 72); 10573 (IV, 47); 11267 (IV, 72); 11467 (IV, 25); 11766 (IV, 74).
- Dunlap, V. C. 117½ (I, 5).
- Dusén, P. 6937, 12031 (IV, 16); 12136, 15540 (IV, 32).
- Duss, Père 22, 3313, 4198 (IV, 63).
- Dutra, J. 303 (IV, 34); 398 (IV, 32); 712 (IV, 34).
- Eggers, H. F. A. von 5825 (IV, 41).
- Egler, W. A. & H. S. Irwin 46691 (IV, 27).
- Eiten, G., L. T. Eiten & E. de la Sota 2056 (IV, 34); 2122 (IV, 31).
- Ekman, E. L. H3781 (IV, 40); H5498 (I, 3); H15685 (I, 2).
- Englesing, F. C. 199 (IV, 50); 260, 350 (III, 1).
- Espinosa, R. 661 (IV, 55).
- Ewan, J. A. 16871 (IV, 6).
- Fairchild, A. G. B. & D. Jobbins 2639 (I, 8).
- Fassett, N. C. 25210 (II, 1).
- Fendler, A. 728 (IV, 41); 2461 (IV, 63); 2467 (IV, 46).
- Fennel, T. A. & H. F. Loomis 138964 (IV, 40).
- Fernandez, A. 406 (IV, 9).
- Florschütz, P. A. & P. J. M. Maas 2326 (IV, 47); 2945 (IV, 72); 3041 (IV, 25); 3052 (IV, 42); 3133 (IV, 25).
- Foldats, E. 2446 (IV, 14).
- Forest. Dept. B. G. 6335 (IV, 69); 6368 (IV, 20); 7234 (IV, 25); 7339 (IV, 72); 7558 (IV, 47); 7700 (IV, 25).
- Forest. Dept. Sur. 720 (IV, 20); 963, 2998 (IV, 27); 5736 (IV, 42); 6508 (IV, 20).
- Foster, M. B. & R. Foster 1673 (IV, 27); 2070 (IV, 65); 2245 (IV, 22); 2315 (IV, 12).
- Foster, M. B., R. Foster & E. Smith 1421 (IV, 55).
- Fox, M. 72 (IV, 4).

- Fredholm, A. 3254 (I, 1).
 Fróes, R. L. 24994 (IV, 74); 26013 (IV, 27); 28707 (IV, 72).
 Fróes, R. L. & G. A. Black 24526 (IV, 47).
 Funck, H. C. & L. Schlim 499 (IV, 63).
 Galeotti, H. G. 4985, 4989 (IV, 40).
 García-Barriga, H. 13632 (IV, 27); 14324 (IV, 71); 14395, 14628 (IV, 27); 14974 (IV, 4); 15003 (IV, 21); 15005 (IV, 72).
 Gaudichaud-Beaupré, C. 114, 389 (IV, 32).
 Gaviria, O. L., J. A. Molina & F. A. Barkley 18C752 (IV, 1).
 Geay, F. 871 (IV, 27).
 Gentle, P. H. 3743 (III, 1).
 Glaziou, M. A. 1177 (IV, 16); 1178 (IV, 32); 1180 (IV, 35); 2754 (IV, 18); 2759, 3138 (IV, 30); 6458 (IV, 38); 8493 (IV, 32); 9007 (IV, 33); 9011 (IV, 32); 9012 (IV, 35); 9017 (IV, 33); 9018 (IV, 16); 9019 (IV, 37); 10114 p.p. (IV, 16); 10118 (IV, 22 & 26); 15557 (IV, 33); 15681, 16476 (IV, 32); 20030 (IV, 31); 22273 (IV, 32); 22274 (IV, 31); 22275 (IV, 37).
 Goeldi, A. 3894 (IV, 26); 3927 (IV, 71).
 Góes, O. C. & O. Alves 92 (IV, 32).
 Goldman, E. A. 1970 (IV, 11).
 Goll, G. P. 228 (IV, 40).
 Grant, M. L. 9177 (IV, 56).
 Gutiérrez V. & J. Rueda R. 26 (IV, 14).
 Hagen, Chr. von & W. von Hagen 1023 (IV, 44); 1321 (IV, 27).
 Hahn, L. 419, 1309 (IV, 41).
 Harris, W. 9842 (I, 1).
 Hart, J. 171 (IV, 9).
 Hassler, E. 4715 (IV, 32).
 Hatch, W. R. 162 (IV, 51).
 Hatschbach, G. 2975 (IV, 32); 7794 (IV, 16); 8066 (IV, 32).
 Haught, O. 1850 (IV, 49).
 Heinrichs, E. 225 (IV, 53); 375 (IV, 4); 501 (IV, 27).
 Hermann, H. A. van 767A (I, 2).
 Heyde & Lux, ed. J. Donnell Smith 4656 (IV, 39).
 Hilaire, A. de St. D813 (IV, 17).
 Hodge, W. H. 1430, 2835 (IV, 63); 6079 (IV, 15); 6999 (IV, 9); 7002 (IV, 1); 7011 (IV, 9); 7014, 7074 (IV, 1).
 Hoehne, F. C. 5106, 5107 (IV, 27).
 Hoehne, F. C. & A. Gehrt 17391 (IV, 32).
 Holm, R. W. & H. H. Iltis 914 (III, 1).
 Horne, W. T. 3050 (I, 2).
 Huber, J. 142 (IV, 73); 554 (IV, 27); 1381 (IV, 15); 1805 (IV, 20); 1809 (IV, 73); 1827, 2032 (IV, 27); 4213 (IV, 2); 4346 (IV, 24); 4353, 4430 (IV, 26); 4697 (IV, 2); 7802 (IV, 47).
 Huebner, G. 30, 43 (IV, 72); 138 (IV, 75); 146 (IV, 22).
 Hulk, J. F. 249 (IV, 25); 284 (IV, 5).
 Hutchinson, P. C., J. K. Wright & R. M. Straw 5942 (IV, 65).
 Irwin, H. S., W. A. Egler & L. Y. Th. Westra 47351 (IV, 27).
 Irwin, H. S. & L. Y. Th. Westra 47714 (IV, 47).
 Jack, J. B. 7018, 7580, 7849 (I, 2).
 Jenman, G. S. 522 (IV, 27); 1700 (IV, 72); 2071 (IV, 5); 2072 (IV, 25); 2102, 2103, 4160 (IV, 72).
 Jobert & C. A. Schwacke 516 (IV, 71); 567 (IV, 21 & 26).
 Johnson, H. 1735 (I, 8).
 Juzepczuk, S. 6245 (IV, 3); 6260 (IV, 2); 6565 (IV, 55).

- Kalbreyer, W. 698 (IV, 43).
 Karsten, W. 26 (IV, 63).
 Kellerman 7130 (IV, 44); 7165 (I, 8).
 Kenoyer, L. A. 166 (IV, 9); 167 (IV, 10); 173 (IV, 40).
 Killip, E. P. 5261 (IV, 10); 13526 (I, 2); 34274 (IV, 42); 34845 (IV, 40); 35290 (IV, 8); 35293 (III, 1); 35375 (IV, 12); 37302, 37316 (IV, 27); 37398 (IV, 25); 37399 (IV, 5); 37437 (IV, 47); 37488 (IV, 27).
 Killip, E. P. & J. Cuatrecasas 38779 (IV, 9).
 Killip, E. P. & H. García 33160, 33287 (IV, 9); 33413 (IV, 27); 33419 (IV, 12); 33519 (IV, 9); 33623 (IV, 49); 33942 (IV, 63).
 Killip, E. P. & T. E. Hazen 8787 (IV, 45); 11137 (IV, 54).
 Killip, E. P. & T. Lasser 37802 (IV, 46).
 Killip, E. P. & A. C. Smith 14866 (IV, 27); 15314 (I, 11); 15336 (IV, 43); 16044 (IV, 57); 22899, 23006 (IV, 15); 23860 (IV, 13); 24700 (IV, 62); 24702 (IV, 13); 25821 (IV, 14); 26170 (IV, 25); 26190 (IV, 21); 26247 (IV, 19); 26414 (IV, 25); 26431 (IV, 69); 26455 (IV, 4); 26532 (IV, 27); 26584 (IV, 4); 26594 (IV, 27); 26722 (IV, 15); 26807 (IV, 4); 26987, 26993 (IV, 71); 27295 (IV, 4); 27360 (IV, 2); 27654 (IV, 26); 27812 (IV, 22); 27977 (IV, 71); 28026 (IV, 19); 28142, 28145 (IV, 2); 28541, 28729 (IV, 19); 28847 (IV, 2); 28895 (IV, 4); 29373 (IV, 2); 29433 (IV, 4); 29621 (IV, 3); 29673 (IV, 2); 29951 (IV, 71).
 King, R. M. 5251 (I, 8).
 Kinloch, J. B. 55 (IV, 27).
 Klein, R. 1862 (IV, 32).
 Klug, G. 448 (IV, 2); 537 (IV, 71); 1495 (I, 11); 1496 (IV, 71); 1497 (IV, 27).
 Kœie, M. 4585 (IV, 57).
 Krukoff, B. A. 4543 (IV, 22); 6082 (IV, 47); 7157 (IV, 68); 7158 (IV, 28); 10808, 10836 (IV, 15); 10982 (IV, 42); 10983 (IV, 27).
 Kuhlmann, J. G. 126, 06425 (IV, 16).
 Kupper, W. 1204 (IV, 59).
 Lanjouw, J. 793 (IV, 72).
 Lasser, T. & L. Aristeguieta 3417 (IV, 60).
 Ledoux, P. 29056 (IV, 73).
 LeFiell, C. F. 4 (IV, 70).
 Lehmann, F. C. 4630, 5288 (IV, 14); 5289, 6538 (IV, 54); 7233 (IV, 14); 7321, 7322 (IV, 57); 7323 (IV, 45); 8957, BT1118 (IV, 6).
 Léon, Bro. 17964, 18574 (I, 2).
 Léon, J. 144 (I, 6).
 Lévy, P. 505 bis (III, 1); 1445 (IV, 50).
 Liebman, F. M. 10804 (IV, 40).
 Lindeman, J. C. 3616 (IV, 27); 4037 (IV, 72); 4184, 4613 (IV, 47); 5172 (IV, 27); 6128 (72).
 Linden, J. 896 (IV, 57); 1091, 1092 (IV, 63).
 Loomis, H. F. 1 (I, 7); 3 (IV, 50); 10 (IV, 52); 11 (IV, 40).
 Luetzelburg, Ph. von 6073 (IV, 30); 12501 (IV, 33); 20045 (IV, 32); 20118 (IV, 16); 20119 (IV, 30); 20120 (IV, 16); 20121 (IV, 35); 21606 (IV, 61); 22026 (IV, 68); 22089, 22273 (IV, 27); 22278 (IV, 74); 22368, 22892 (IV, 47); 23044 (IV, 72); 23072 (IV, 27); 24027 (IV, 16).
 Luschnath, B. 69 (IV, 32).
 Macbride, J. F. 4775 (IV, 57); 4867 (IV, 66); 5674 (I, 11).
 Maguire, B. 24094 (IV, 47); 24095 (IV, 25); 24117 (IV, 5); 24154 (IV, 47).
 Matuda, E. 3477, 16384 (IV, 40); 16820 (IV, 44).
 Maxon, W. R. 1769, 2327 (I, 1); 4464 (I, 2); 6870 (IV, 10); 6897 (IV, 9); 6899 (IV, 10); 6903 (IV, 50); 6906 (IV, 9).
 Maxon, W. R., A. D. Harvey & A. T. Valentine 6825 (IV, 40).

- Mélinon, M. 424 (IV, 20).
 Mell, C. D. 653 (IV, 40).
 Mennega, A. M. W. 517 (IV, 47).
 Mexia, Y. 4664 (IV, 32); 6135 (IV, 19); 6890 (IV, 4); 7027 (IV, 55); 7763, 7764 (IV, 14).
 Molina R., A. 1957 (IV, 50); 2974 (IV, 40).
 Moore, H. E., A. Salazar C. & E. E. Smith 8327 (IV, 65); 8328 (IV, 57); 8343 (I, 11); 8350 (IV, 64); 8355 (IV, 55); 8368, 8374 (IV, 22); 8377 (IV, 21); 8378 (IV, 22); 8380 (IV, 21); 8383 (I, 11); 8390 (IV, 44); 8396 (IV, 4); 8424 (IV, 71); 8426 (IV, 4); 8428 (IV, 70); 8431 (IV, 71); 8433 (IV, 2); 8450 (IV, 19); 8457 (IV, 3); 8467 (IV, 4); 8468 (IV, 15); 8469 (IV, 27); 8476 (IV, 3); 8487 (IV, 2); 8495 (IV, 21); 8497 (IV, 26); 8499, 8502 (IV, 2); 8503 (IV, 19); 8509 (IV, 71); 8520 (IV, 72); 8528 (IV, 21); 8530 (IV, 19); 8562 (IV, 2); 8565 (IV, 27); 8566 (IV, 22); 8568, 8569 (IV, 27); 8570 (IV, 2); 8577 (IV, 15); 8586 (IV, 22); 8588 (IV, 44); 8592 (IV, 15).
 Moritz, J. W. K. 1787 (IV, 63).
 Mosen, Hj. 4394 (IV, 30).
 Occhioni, P. 100 (IV, 16); 101, 102 (IV, 32).
 Oersted, S. A. 6564 (IV, 40); 6565 (I, 7 & 8) 6566 (III, 1); 6567 (IV, 9).
 Orbigny, A. d' 38, 39 (IV, 15); 44 (IV, 58); 45 (IV, 13); 50 (IV, 27).
 Palmer, W. & J. H. Riley 529 (I, 2).
 Peck, M. E. 604 (IV, 40); 605 (IV, 27).
 Pennell, F. W. 7642 (IV, 57); 9057 (IV, 45); 9314 (IV, 57).
 Pennell, F. W. & E. P. Killip 8787 (IV, 45).
 Persaud, A. C. 49 (IV, 72).
 Philipson, W. R. 2327 (IV, 42).
 Philipson, W. R. & J. M. Idrobo 1962, 1979 (IV, 42).
 Philipson, W. R., J. M. Idrobo & A. Fernandez 1464 (IV, 42); 1544 (IV, 15).
 Pinkus, A. S. 140 (IV, 61).
 Pires, J. M., W. Rodrigues & G. C. Irvine 50759, 51645 (IV, 25).
 Pittier, H. 368 (IV, 59); 2284 (IV, 9); 2659 (IV, 50); 3171 (IV, 14); 4226 (III, 1); 4305 (I, 8); 4321 (IV, 10); 4330 (IV, 40); 4411 (IV, 27); 6613, 6614 (IV, 40); 6818 (III, 1); 6846 (IV, 10); 8030, 9109 (IV, 46); 10012 (IV, 63); 10977 (IV, 27); 11371, 13838 (IV, 46); 13840 (IV, 29); 13915, 13943 (IV, 41); 13989, 14122, 15313 (IV, 46); 16658 (III, 1); 16712, 16716 (IV, 9); 16717 (III, 1); 16718 (IV, 9); 16719 (I, 5); 16920 (IV, 50); 16922 (III, 1).
 Pittier, H. & M. Nakichenowich 15399 (IV, 41).
 Poeppig, E. 1509 (IV, 2, 4 & 19); 2295, 2326B (IV, 19).
 Poortman 145 (IV, 55).
 Prance, G. T. & T. D. Pennington 1675 (IV, 47); 1831 (IV, 69); 1992 (IV, 5).
 Prance, G. T., T. D. Pennington & N. T. Silva 1598 (IV, 47).
 Prance, G. T., N. T. Silva & J. M. Pires 59110 (IV, 31).
 Pulle, A. A. 517 (IV, 47).
 Purdie, W. 23 (IV, 41); 259 (IV, 40).
 Questel, A. 614 (IV, 63).
 Raben, F. C. 322 (IV, 16).
 Rambo, B. 42217 (IV, 32); 42332, 47141 (IV, 34).
 Regnell, A. F. I-448 (IV, 32).
 Reitz, P. R. 1703 (IV, 16); 1828, 1900 (IV, 32); 2008 (IV, 16); 3183, 3535 (IV, 32); 3551 (IV, 34); 3814, 4402 (IV, 16); 5023 (IV, 32); C446 (IV, 34); C1040 (IV, 32); C1703 (IV, 16).
 Reitz, P. R. & R. Klein 1128 (IV, 34); 1281 (IV, 32); 1530, 1684 (IV, 16); 1715 (IV, 32); 1980 (IV, 34); 2036 (IV, 16); 2305, 2306, 2307 (IV, 32); 2308 (IV, 34); 2309 (IV, 32); 2338, 2344, 2349, 2351, 2358 (IV, 34); 2426 (IV, 32); 2562, 2589,

- 2593 (IV, 34); 2669 (IV, 32); 2921 (IV, 16); 3157, 3159 (IV, 34); 3208, 3591 (IV, 32); 3603, 4298, 4396 (IV, 34); 4402, 4410 (IV, 32); 4476 (IV, 16); 4486 (IV, 34); 5818 (IV, 32); 6542 (IV, 16); 6884, 7001 (IV, 34); 8800, 8838, 8906, 9005, 9053, 9249, 9655, 10523, 11398, 11399, 11412 (IV, 32).
- Riedel, L. 488 (IV, 48); 732, 733 (IV, 16); 734 (IV, 18).
- Riedel, L. & B. Luschnath 4 (IV, 16).
- Rodriguez, L. 4552 (IV, 41).
- Rombouts, H. E. 70, 880 (IV, 47); 880a (IV, 22); 881 (IV, 47).
- Sagot, P. 815 (IV, 47).
- Saldanha, J. de 5292 (IV, 32); 6726 (IV, 35); 6727 (IV, 33); 6728 (IV, 35); 6730 (IV, 32); 7090 (IV, 18); 8607 (IV, 17).
- Sandwith, N. Y. 176 (IV, 72).
- Schipp, W. A. 94 (IV, 27); 392 (III, 1); 397 (IV, 40).
- Sohlim, L. 955 (IV, 55); 1171 (IV, 53); 1656 (IV, 55); 1723 (IV, 41).
- Schomburgk, R. 705 p.p. (IV, 72).
- Schott, H. W. 4111 (IV, 32).
- Schultes, R. E. 3406 (IV, 4); 3467 (IV, 72); 3547 (IV, 21); 3879 (I, 11); 3884 (IV, 71); 3886 (IV, 27); 6656 (IV, 26); 6749 (IV, 27).
- Schultes, R. E., R. E. D. Baker & I. Cabrera 17948, 18038 (IV, 72).
- Schultes, R. E. & G. A. Black 8290 (IV, 26); 8339 (IV, 2); 46-315 (IV, 26).
- Schultes, R. E. & I. Cabrera 8328, 12733, 12781 (IV, 27); 12797 (IV, 22); 12807 (IV, 21); 12812 (IV, 4); 13095, 13105, 13665 (IV, 22); 13667 (IV, 27); 13672 (IV, 21); 13678 (IV, 4); 13730 (IV, 3); 13968 (IV, 25); 14108 (IV, 22); 14455 (IV, 72); 15208 (IV, 4); 15321 (IV, 22); 15447 (IV, 4); 16011 (IV, 71); 16019 (IV, 3); 16032 (IV, 4); 16258 (IV, 27); 17088, 17328 (IV, 22); 17353 (IV, 25); 17388, 17418, 17659 (IV, 22); 17854 (IV, 27); 18967, 18968 (IV, 2); 19789 (IV, 4); 20021 (IV, 22).
- Schulz, J. P. 486 (I, 10).
- Schwacke, C. A. 2514, II-87 (IV, 32); IV-70 (IV, 16); IV-72 (IV, 34); IV-73 (IV, 32).
- Seeman, B. C. 163 (III, 1).
- Seibert, R. J. 1531 (I, 8); 1597 (IV, 50).
- Seifriz, W. 173 (IV, 40).
- Shafer, J. A. 317 (I, 2).
- Shank, P. J. & A. Molina R. 4897 (IV, 10).
- Shattuck, O. 396 (IV, 40); 642, 1001 (IV, 9).
- Smith, Austin H774 (IV, 11); H1220 (IV, 51); NY1346 (IV, 67).
- Smith, A. C. 2556 (IV, 72); 2770 (IV, 47); 10010 (IV, 41).
- Smith, H. H. 2340 (IV, 40).
- Smith, H. H. & G. W. Smith 1433 (IV, 41).
- Smith, J. Donnell 6845 (IV, 51).
- Smith, L. B. & P. R. Reitz 5712 (IV, 16).
- Snethlage, E. 10098 (IV, 72); 10119 (IV, 27).
- Sodiro, A. 187/1 (IV, 12).
- Soto, F. Sierra & F. A. Barkley 18C631 (IV, 9).
- Splitgerber, F. L. 926 (IV, 47); 954 (IV, 72).
- Sprague, T. A. 348 (IV, 69); 349 (IV, 15).
- Spruce, R. 16, 18 (IV, 74); 28 (IV, 27); 29 (IV, 72); 30 (IV, 70); 32 (IV, 27); 33, 34 (IV, 70); 41 (IV, 27); 42 (IV, 47); 69 (IV, 73); 70 (IV, 72); 72 (IV, 47); 73, 75 (IV, 74).
- Stahel, G. 67 (IV, 20); 275 (IV, 25).
- Standley, P. C. 25015 (III, 1); 25105 (I, 8); 27498 (IV, 9); 27594 (IV, 50); 36745 (I, 7); 37328 (IV, 51); 39909, 39916 (I, 6); 40896 (IV, 9); 41109 (IV, 10); 42046, 42159, 42172, 42692 (IV, 59); 52653 (I, 8); 52655 (III, 1); 52928 (IV, 40); 53156

- (III, 1); 54689 (IV, 40); 56849 (I, 8); 72791 (IV, 27); 73031, 73164 (I, 8); 86906, 86970, (IV, 39).
- Standley, P. C. & J. Valerio 43988 (IV, 59); 44775 (I, 6); 44778, 44784 (IV, 51); 44840 (I, 6); 45643 (IV, 11); 45986, 46277 (I, 6); 46303 (IV, 11); 46336 (I, 6); 46340 (IV, 11); 48937 (I, 9); 48954 (IV, 50); 48956 (I, 9); 48957 (I, 7); 48974 (IV, 52); 48976 (IV, 50); 48979 (I, 7); 49004 (IV, 50); 51430 (IV, 59).
- Stevens, F. L. 571 (I, 7).
- Stevenson, N. S. 7 (I, 8).
- Steyermark, J. A. 17220 (IV, 40); 29890 (IV, 67); 33339 (IV, 39); 34340 (IV, 67); 37091 (IV, 39); 37305 (IV, 67); 38757 (IV, 40); 39177, 39195, 39784 (I, 8); 39785 (III, 1); 41603 (IV, 44); 41639 (I, 8); 41873 (IV, 51); 42064 (III, 1); 42858 (IV, 67); 44387 (IV, 40); 45378 (IV, 44); 45442 (IV, 40); 46079 (IV, 44); 47919 (IV, 39); 48742 (IV, 67); 53629, 53632 (IV, 14); 53638, 54537 (IV, 57); 55305 (IV, 62); 56391 (IV, 55); 57351 (IV, 65); 58093 (IV, 72); 58667, 59805 (IV, 61); 60789 (IV, 42); 61056 (IV, 41); 87274, 89119 (IV, 72); 90010 (III, 3); 90575, 90576 (IV, 47); 90666 (IV, 25); 91607 (IV, 63); 91633 (IV, 41); 91859, 91991, 94299 (IV, 46); 94803 (III, 2); 95100 (IV, 41); 95204 (IV, 46).
- Steyermark, J. A. & A. Braun 94660 (IV, 60).
- Steyermark, J. A. & M. Rabe 96088 (III, 2); 96677 (IV, 27); 97253 (IV, 55); 97389 (IV, 63); 97402 (IV, 14).
- Steyermark, J. A. & C. Steyermark 95308 (IV, 41); 95360 (IV, 29).
- Stork, H. E. 117½ (I, 5).
- Tamayo, F. 871, 1130 (IV, 60); 1239, 1558 (IV, 63); 2207 (IV, 46); 2529 (IV, 14); 2548, 2549 (IV, 41); 4177 (III, 3).
- Tate, G. H. H. 394 (IV, 5).
- Tate, R. 259 (IV, 51).
- Tessmann, G. 5087 (IV, 71).
- Thieme, C., ed. J. Donnell Smith 5124 (IV, 40).
- Thurn, E. F. im 382 (IV, 61); IX (IV, 27).
- Tonduz, Ad. 7558 (IV, 50); 7559 (III, 1); 7972, 11263 (IV, 11); 12979 (IV, 51).
- Trail, J. W. H. 696 / CLXXX (IV, 47); 942 / CCXXXIII (IV, 73); 943 / CXCHII, 964 / LXX, 947 / LXXI, 952 / CC, 953 / CLIII, 955, 957 / CLXXVII, 958 / CLXXVII, 959 / CLXXXVII, 960 / CLXIII (IV, 27); 961 / CLXXXVI (I, 11); 963 / CLXXII^A (IV, 25); 964 / CVIII (IV, 74); 972 / CVII, 973 / CXXXV, 975 (IV, 68); 976 / CLXXXIII (IV, 7); 977 / CLXXXII, 979 / CLXXXII^B (IV, 3); 980 / XCVII, 981 / XC, 982 / CXLIII (IV, 74); 983 / LIV, 984 / CXLIV (IV, 72); 985 / XXIX, 986 / XXV (IV, 74); 991 / CLXX (IV, 72); 992 / CXVIII, 993 / LXXXIX (IV, 74); 995 / CXXXVIII, 996 / CXXXVIII, 997 / LXXXIV, 1000 / CXXV, 1001 / CXXIV, 1003 / XLI, 1005 / XLIII, 1006 / CXI (IV, 72); 1009 / CLXXVI^A (IV, 71); 1010 / CCVII, 1011 / CLXXXIV (IV, 4); 1013 / CXXIII (IV, 3); 1016 / CXXII, 1017 / IX (IV, 2); 1019 / CCL, 1020 / CLXXI (IV, 28); 1022 / LIX (IV, 26); 1025 / XVI, 1027 / CLXII^A (IV, 21); 1030 / CXLIX (IV, 24); 1031 / CLXI, 1032 / CXXXIII, 1033 / CXXXIII^A, 1034 / CXXXIII^B (IV, 22); CXXII (IV, 2).
- Tresling, J. 263 (IV, 47).
- Triana, J. J. 56 (IV, 64); 720 (IV, 55); 722 (IV, 64); 723 (IV, 55); 724 (IV, 15).
- Tuerckheim, H. von 8332, II-478 (IV, 40).
- Tulleken, J. E. 447 (IV, 27 & 47); 479 (IV, 47).
- Ule, E. 226 (IV, 31); 864 (IV, 34); 865 (IV, 16); 4147 (IV, 38); 5284 (IV, 2); 5516 (IV, 25); 5517 (IV, 4); 5520 (IV, 24); 5521 (IV, 24); 5593 (IV, 15); 5594 (IV, 2); 5744 (IV, 71); 5745 (IV, 3); 5882 (IV, 27); 5884, 5946 (IV, 22); 6125 (IV, 2); 6126 (IV, 72); 8805 (IV, 61); 8987 (IV, 74); 9129 (IV, 30).
- Underwood, L. M. 3415 (I, 1).
- Uribe P., C. 1130 (IV, 13).

- Valerio, J. 20 (IV, 11).
Valerio, M. 1023, 1056 (IV, 59); 1593 (I, 6).
Vareschi, V. 6476 (IV, 55); 7796 (IV, 72).
Vargas C., C. 15405 (IV, 15); 15406 (IV, 13).
Versteeg, G. M. 322 (IV, 69).
Vidal, J. 1985 (IV, 32).
Vogl, C. 458 (IV, 46).
Warming, E. 1843 (IV, 31); 1844, 1847 (IV, 32).
Watson, S. 158² (IV, 40).
Weberbauer, A. 3552 (IV, 65); 6800 (IV, 66).
Weddell, H. A. 361, 773 (IV, 16); 774 (IV, 32); 815 (IV, 35); 1020 (IV, 32); 2527, 2983 (IV, 31).
Wedel, H. von 2972 (I, 5).
Wendland, H. 74 (II, 2).
Werdermann, E. 3065 (IV, 33).
Wessels Boer, J. G. 158, 176 (IV, 47); 181 (IV, 27); 194, 199, 206, 210, 254, 256 (IV, 72); 277, 278 (IV, 47); 281 (IV, 72); 320 (IV, 27); 325, 335 (IV, 47); 336 (IV, 27); 349, 367, 369, 388 (IV, 47); 460 (IV, 27); 646 (IV, 72); 648 (IV, 47); 912 (IV, 25); 942 (IV, 47); 948 (IV, 27); 949 (IV, 25); 1017, 1064 (IV, 20); 1280 (IV, 72); 1375 (IV, 47); 1393 (IV, 5); 1407, 1472 (IV, 72); 1488 (IV, 25); 1489, 1490 (IV, 42); 1497 (IV, 72); 1501 (IV, 69); 1502 (IV, 25); 1513 (IV, 20); 1542 (IV, 25); 1552 (IV, 42); 1553 (IV, 69); 1558 (IV, 20); 1579, 1586 (IV, 5); 1598 (IV, 20); 1603 (IV, 25); 1614, 1617 (IV, 72); 1635 (IV, 41); 1662 (I, 1).
White, O. E. 1094 (IV, 27).
Williams, L. 740 (IV, 2); 875 (IV, 27); 2537 (IV, 26); 2544 (IV, 22); 2991, 3426 (IV, 2); 3769 (IV, 4); 4284 (IV, 2); 4483 (IV, 26); 5100 (IV, 2); 5209 (IV, 22); 5266 (IV, 2); 7836 (IV, 72); 7867 (IV, 2); 8019 (IV, 71); 8954 (IV, 40); 10350 (IV, 46); 11307 (IV, 47); 13496 (IV, 46); 14014, 14193, 14738, 14808, 15091 (IV, 72); 15198 (IV, 47).
Williams, L. O. & A. Molina R. 13078 (I, 8).
Williams, L. O., A. Molina R. & T. P. Williams 23507 (IV, 67); 23876 (IV, 40).
Williams, L. O. & T. P. Williams 18756 (IV, 51).
Wilson, P. 224 (III, 1); 405 (IV, 43); 407 (IV, 40).
Woodson, R. E., P. H. Allen & R. J. Seibert 1946 (IV, 9).
Woodson, R. E. & R. W. Schery 173 (IV, 11).
Woronow, G. 6059 (IV, 27); 7170, 7505 (IV, 46).
Woronow, G. & S. Juzepczuk 5858 (IV, 69); 5862 (IV, 13); 5885 (IV, 42); 6119 (IV, 4); 6124 (IV, 22); 6157 (IV, 45).
Wright, C. 265, 1466, 3972 (I, 2).
Wulle, s.n. (IV, 33).
Wulfschlägel, H. R. 1942 (IV, 47).
Wurdack, J. & L. S. Adderley 43188 (IV, 27).
Yuncker, T. G. 4565 (I, 8); 5002 (III, 1); 5004 (IV, 44).
Yuncker, T. G., J. M. Koepper & K. A. Wagner 8473 (IV, 40).

INDEX OF NAMES

The names accepted in the present study are in **bold face**, synonyms in *italics*, and names of uncertain application in normal print. The roman numerals refer to the genera treated in this paper, the arabic numerals to the species.

| | | | |
|------------------------|--------|---------------------------|--------|
| <i>Aristeyera</i> | III | <i>rivalis</i> | I, 3 |
| <i>ramosa</i> | III, 2 | <i>robusta</i> | I, 11 |
| <i>spicata</i> | III, 3 | <i>swartzii</i> | I, 1 |
| | | <i>synanthera</i> | I, 11 |
| | | <i>weberbaueri</i> | I, 11 |
| Asterogyne | III | | |
| <i>martiana</i> | III, 1 | <i>Cocops</i> | I |
| <i>minor</i> | III, 1 | <i>rivalis</i> | I, 3 |
| <i>ramosa</i> | III, 2 | | |
| <i>spicata</i> | III, 3 | <i>Elais occidentalis</i> | I, 1 |
| Calyptrogyne | I | | |
| <i>brachystachys</i> | I, 6 | Geonoma | IV |
| <i>clementis</i> | I, 2 | <i>acaulis</i> | IV, 2 |
| <i>condensata</i> | I, 5 | <i>acutangula</i> | ? |
| <i>dactyloides</i> | I, 10 | <i>acutiflora</i> | IV, 47 |
| <i>donnell-smithii</i> | I, 8 | <i>adscendens</i> | ? |
| <i>dulcis</i> | I, 2 | <i>allenii</i> | I, 6 |
| <i>ghiesbreghtiana</i> | I, 8 | <i>altissima</i> | IV, 31 |
| <i>glauca</i> | I, 8 | <i>ambigua</i> | IV, 72 |
| <i>intermedia</i> | I, 2 | <i>amoena</i> | ? |
| <i>kalbreyeri</i> | I, 11 | <i>andicola</i> | ? |
| <i>microcarpa</i> | I, 2 | <i>andina</i> | ? |
| <i>occidentalis</i> | I, 1 | <i>anomoclada</i> | ? |
| <i>pulchra</i> | I, 9 | <i>appuniana</i> | IV, 61 |
| <i>quisqueyana</i> | I, 3 | <i>aricanga</i> | IV, 31 |
| <i>rivalis</i> | I, 3 | <i>arundinacea</i> | IV, 24 |
| <i>robusta</i> | I, 11 | <i>aspidiifolia</i> | IV, 74 |
| <i>sarapiquensis</i> | I, 7 | <i>aulacophylla</i> | ? |
| <i>spicigera</i> | I, 8 | <i>baculifera</i> | IV, 47 |
| <i>swartzii</i> | I, 1 | <i>barbigera</i> | IV, 35 |
| <i>synanthera</i> | I, 11 | <i>barbosiana</i> | IV, 35 |
| <i>trichostachys</i> | I, 4 | <i>barthia</i> | IV, 62 |
| <i>victorinii</i> | I, 1 | <i>bartlettii</i> | IV, 23 |
| <i>weberbaueri</i> | I, 11 | <i>beccariana</i> | IV, 26 |
| | | <i>bella</i> | IV, 22 |
| Calyptonoma | I | <i>bifurca</i> | IV, 16 |
| <i>clementis</i> | I, 2 | <i>bijugata</i> | IV, 72 |
| <i>dulcis</i> | I, 2 | <i>binervia</i> | IV, 40 |
| <i>intermedia</i> | I, 2 | <i>blanchetiana</i> | IV, 30 |
| <i>kalbreyeri</i> | I, 11 | <i>brachyfoliata</i> | IV, 72 |
| <i>occidentalis</i> | I, 1 | <i>brachystachys</i> | ? |
| <i>microcarpa</i> | I, 2 | <i>brevispatha</i> | IV, 31 |
| <i>quisqueyana</i> | I, 3 | <i>brongniartii</i> | IV, 15 |
| | | <i>caespitosa</i> | IV, 48 |

| | | | |
|-------------------------|--------|-------------------------|--------|
| <i>calophyta</i> | IV, 31 | <i>glauca</i> | I, 8 |
| <i>calyptrogynoides</i> | IV, 49 | <i>goniocarpa</i> | ? |
| <i>camana</i> | IV, 3 | <i>gracilis</i> | IV, 11 |
| <i>camptoneura</i> | IV, 72 | <i>gracillima</i> | IV, 13 |
| <i>campyloclada</i> | ? | <i>grandifrons</i> | ? |
| <i>campylostachys</i> | ? | <i>grandisecta</i> | IV, 68 |
| <i>capanemae</i> | IV, 72 | <i>granditrijuga</i> | ? |
| <i>caudulata</i> | ? | <i>heinrichsiae</i> | IV, 53 |
| <i>cernua</i> | ? | <i>helminthoclada</i> | IV, 64 |
| <i>chapadensis</i> | IV, 31 | <i>helminthostachys</i> | IV, 14 |
| <i>charnostachys</i> | IV, 5 | <i>herthae</i> | ? |
| <i>chelidomura</i> | IV, 74 | <i>hexasticha</i> | IV, 72 |
| <i>chococola</i> | IV, 8 | <i>hodgeorum</i> | IV, 63 |
| <i>concinna</i> | ? | <i>hoehnei</i> | IV, 32 |
| <i>condensata</i> | I, 5 | <i>hoffmanniana</i> | IV, 59 |
| <i>congesta</i> | IV, 50 | <i>hoppii</i> | ? |
| <i>congestissima</i> | ? | <i>huebneri</i> | IV, 72 |
| <i>costatifrons</i> | I, 8 | <i>insignis</i> | ? |
| <i>cuneata</i> | IV, 9 | <i>intermedia</i> | I, 2 |
| <i>cuneatoidea</i> | IV, 13 | <i>interrupta</i> | IV, 44 |
| <i>cuneifolia</i> | IV, 15 | <i>iodolepis</i> | IV, 54 |
| <i>dammeri</i> | ? | <i>iodoneura</i> | ? |
| <i>dasytachys</i> | IV, 74 | <i>jurua</i> | IV, 71 |
| <i>decurrens</i> | IV, 9 | <i>jussieuana</i> | IV, 13 |
| <i>decussata</i> | ? | <i>kalbreyeri</i> | IV, 45 |
| <i>densa</i> | IV, 62 | <i>karuaiana</i> | IV, 42 |
| <i>densiflora</i> | IV, 70 | <i>killipii</i> | IV, 27 |
| <i>desmarestii</i> | ? | <i>kuhlmannii</i> | ? |
| <i>deversa</i> | IV, 27 | <i>lacerata</i> | ? |
| <i>dicranospadix</i> | IV, 45 | <i>lagesiana</i> | IV, 3 |
| <i>discolor</i> | IV, 72 | <i>lakoi</i> | ? |
| <i>dominicana</i> | IV, 41 | <i>lanceolata</i> | ? |
| <i>donnell-smithii</i> | I, 8 | <i>latifolia</i> | IV, 33 |
| <i>dryanderæ</i> | IV, 44 | <i>latisecta</i> | IV, 72 |
| <i>dulcis</i> | I, 2 | <i>laxiflora</i> | IV, 26 |
| <i>dussiana</i> | IV, 63 | <i>lehmannii</i> | IV, 14 |
| <i>edulis</i> | IV, 44 | <i>lepidota</i> | IV, 57 |
| <i>elegans</i> | IV, 16 | <i>leptoclada</i> | IV, 39 |
| <i>erytrospadice</i> | IV, 32 | <i>leptospadix</i> | IV, 25 |
| <i>estevaniana</i> | ? | <i>leptostachys</i> | IV, 27 |
| <i>euspatha</i> | IV, 42 | <i>leucotricha</i> | ? |
| <i>euterpoidea</i> | ? | <i>lindeniana</i> | IV, 55 |
| <i>falcata</i> | ? | <i>linearifolia</i> | IV, 55 |
| <i>fendleriana</i> | IV, 46 | <i>linearis</i> | ? |
| <i>ferruginea</i> | IV, 51 | <i>longepedunculata</i> | IV, 45 |
| <i>fiscellaria</i> | IV, 35 | <i>longepetiolata</i> | IV, 27 |
| <i>flaccida</i> | IV, 27 | <i>longevaginata</i> | IV, 52 |
| <i>floccosa</i> | ? | <i>longisecta</i> | IV, 71 |
| <i>frontinensis</i> | IV, 45 | <i>luetzelburgii</i> | IV, 30 |
| <i>furcifolia</i> | IV, 74 | <i>macroclada</i> | ? |
| <i>gamiova</i> | IV, 34 | <i>macroclona</i> | IV, 33 |
| <i>gastoniana</i> | IV, 37 | <i>macrophylla</i> | ? |
| <i>ghiesbreghtiana</i> | I, 8 | <i>macropoda</i> | IV, 27 |
| <i>gibbosa</i> | IV, 12 | <i>macrosiphon</i> | ? |

| | | | |
|----------------------|--------|-----------------------|--------|
| <i>macrospatha</i> | IV, 47 | <i>plurinervia</i> | IV, 31 |
| <i>macrostachys</i> | IV, 4 | <i>poeppigiana</i> | IV, 19 |
| <i>macroura</i> | ? | <i>pohliana</i> | IV, 33 |
| <i>magnifica</i> | IV, 40 | <i>poiteana</i> | IV, 5 |
| <i>maguirei</i> | IV, 20 | <i>poiteauana</i> | IV, 5 |
| <i>major</i> | IV, 27 | <i>polyclada</i> | ? |
| <i>margaritoides</i> | IV, 63 | <i>polyneura</i> | IV, 67 |
| <i>marggraffia</i> | IV, 57 | <i>portiana</i> | IV, 48 |
| <i>martiana</i> | III, 1 | <i>preussii</i> | IV, 40 |
| <i>martinicensis</i> | IV, 41 | <i>procumbens</i> | IV, 10 |
| <i>maxima</i> | IV, 72 | <i>pulcherrima</i> | IV, 54 |
| <i>megaloptila</i> | IV, 40 | <i>pulchra</i> | IV, 43 |
| <i>megalospatha</i> | IV, 66 | <i>pumila</i> | IV, 55 |
| <i>membranacea</i> | IV, 39 | <i>purdiana</i> | IV, 40 |
| <i>metensis</i> | IV, 15 | <i>pycnostachys</i> | IV, 21 |
| <i>mexicana</i> | IV, 40 | <i>raimondii</i> | IV, 22 |
| <i>microclada</i> | IV, 57 | <i>ramosa</i> | IV, 55 |
| <i>microspadix</i> | IV, 51 | <i>ramosissima</i> | ? |
| <i>microspatha</i> | IV, 27 | <i>rectifolia</i> | ? |
| <i>microstachys</i> | IV, 51 | <i>rhytidocarpa</i> | IV, 57 |
| <i>molinae</i> | IV, 67 | <i>rivalis</i> | ? |
| <i>molinillo</i> | ? | <i>robusta</i> | IV, 72 |
| <i>mucronata</i> | IV, 45 | <i>rodeiensis</i> | IV, 17 |
| <i>multiflora</i> | IV, 73 | <i>roraimae</i> | IV, 61 |
| <i>multisecta</i> | IV, 13 | <i>rubescens</i> | IV, 36 |
| <i>myriantha</i> | IV, 27 | <i>rupestris</i> | IV, 31 |
| <i>negrensis</i> | IV, 72 | <i>saramaccana</i> | IV, 25 |
| <i>obovata</i> | IV, 11 | <i>schomburgkiana</i> | IV, 72 |
| <i>olfersiana</i> | IV, 16 | <i>schottiana</i> | IV, 32 |
| <i>oligoclada</i> | ?, 75 | <i>seemannii</i> | ? |
| <i>oligoclona</i> | IV, 28 | <i>seleri</i> | IV, 67 |
| <i>orbigniana</i> | IV, 58 | <i>simplicifrons</i> | IV, 46 |
| <i>oxycarpa</i> | IV, 40 | <i>sodiroi</i> | IV, 12 |
| <i>pachyclada</i> | ? | <i>solitaria</i> | ? |
| <i>pachydicrana</i> | IV, 56 | <i>speciosa</i> | IV, 72 |
| <i>paleacea</i> | ? | <i>spicigera</i> | I, 8 |
| <i>palustris</i> | IV, 74 | <i>spinescens</i> | IV, 29 |
| <i>paniculigera</i> | IV, 27 | <i>spixiana</i> | IV, 68 |
| <i>paradoxa</i> | IV, 6 | <i>spruceana</i> | IV, 72 |
| <i>paraensis</i> | IV, 73 | <i>stenoschista</i> | IV, 31 |
| <i>paraguanensis</i> | IV, 60 | <i>stenothyrsa</i> | ? |
| <i>parvifrons</i> | IV, 14 | <i>stricta</i> | IV, 20 |
| <i>parvisecta</i> | IV, 74 | <i>stuebelii</i> | IV, 65 |
| <i>pauciflora</i> | IV, 48 | <i>swartzii</i> | I, 1 |
| <i>personata</i> | IV, 70 | <i>synanthera</i> | I, 11 |
| <i>pilosa</i> | IV, 35 | <i>tamandua</i> | IV, 7 |
| <i>pinnatifrons</i> | IV, 41 | <i>tapajotensis</i> | IV, 2 |
| <i>piscicauda</i> | IV, 22 | <i>tenuifolia</i> | ? |
| <i>platybothros</i> | IV, 40 | <i>tenuis</i> | IV, 29 |
| <i>platycaula</i> | IV, 36 | <i>tessmannii</i> | ? |
| <i>pleeana</i> | IV, 41 | <i>tomentosa</i> | IV, 35 |
| <i>pleioneura</i> | IV, 13 | <i>trailii</i> | IV, 22 |
| <i>plicata</i> | ? | <i>trauniana</i> | IV, 22 |
| <i>plumeriana</i> | ? | <i>triandra</i> | IV, 1 |

| | | | |
|------------------------|--------|------------------------------|--------|
| <i>trichostachys</i> | ? | <i>Kalbreyera</i> | IV |
| <i>trifurcata</i> | III, 1 | <i>triandra</i> | IV, 1 |
| <i>triglochis</i> | IV, 69 | | |
| <i>trigonostyla</i> | IV, 33 | <i>Martinezia interrupta</i> | IV, 44 |
| <i>trijugata</i> | IV, 27 | | |
| <i>trinervis</i> | IV, 18 | <i>Pholidostachys</i> | I |
| <i>tuberculata</i> | IV, 74 | <i>dactyloides</i> | I, 10 |
| <i>uleana</i> | IV, 24 | <i>kalbreyeri</i> | ? |
| <i>uliginosa</i> | IV, 74 | <i>pulchra</i> | I, 9 |
| <i>umbraculiformis</i> | IV, 69 | | |
| <i>uncibracteata</i> | ? | <i>Roebelia</i> | ? |
| <i>undata</i> | IV, 63 | <i>solitaria</i> | ? |
| <i>vaga</i> | IV, 41 | | |
| <i>ventricosa</i> | ? | <i>Taenianthera</i> | IV |
| <i>versiformis</i> | IV, 51 | <i>acaulis</i> | IV, 2 |
| <i>warmingii</i> | IV, 31 | <i>camana</i> | IV, 3 |
| <i>weberbaueri</i> | IV, 65 | <i>gracilis</i> | IV, 2 |
| <i>weddelliana</i> | IV, 31 | <i>lagesiana</i> | IV, 3 |
| <i>wendlandiana</i> | ? | <i>lakoi</i> | ? |
| <i>werdermannii</i> | IV, 15 | <i>macrostachys</i> | IV, 4 |
| <i>willdenowii</i> | IV, 46 | <i>minor</i> | IV, 2 |
| <i>wittiana</i> | IV, 22 | <i>multisecta</i> | IV, 13 |
| <i>wittigiana</i> | IV, 38 | <i>oligosticha</i> | IV, 2 |
| <i>woronowii</i> | ? | <i>tamandua</i> | IV, 7 |
| <i>yauaperyensis</i> | IV, 27 | <i>tapajotensis</i> | IV, 2 |
| | | <i>weberbaueri</i> | IV, 13 |
| <i>Gynestum</i> | IV | | |
| <i>acaule</i> | IV, 5 | <i>Welfia</i> | II |
| <i>baculiferum</i> | IV, 47 | <i>georgii</i> | II, 2 |
| <i>deversum</i> | IV, 27 | <i>microcarpa</i> | ? |
| <i>maximum</i> | IV, 72 | <i>regia</i> | II, 1 |
| <i>strictum</i> | IV, 20 | | |

PLATES

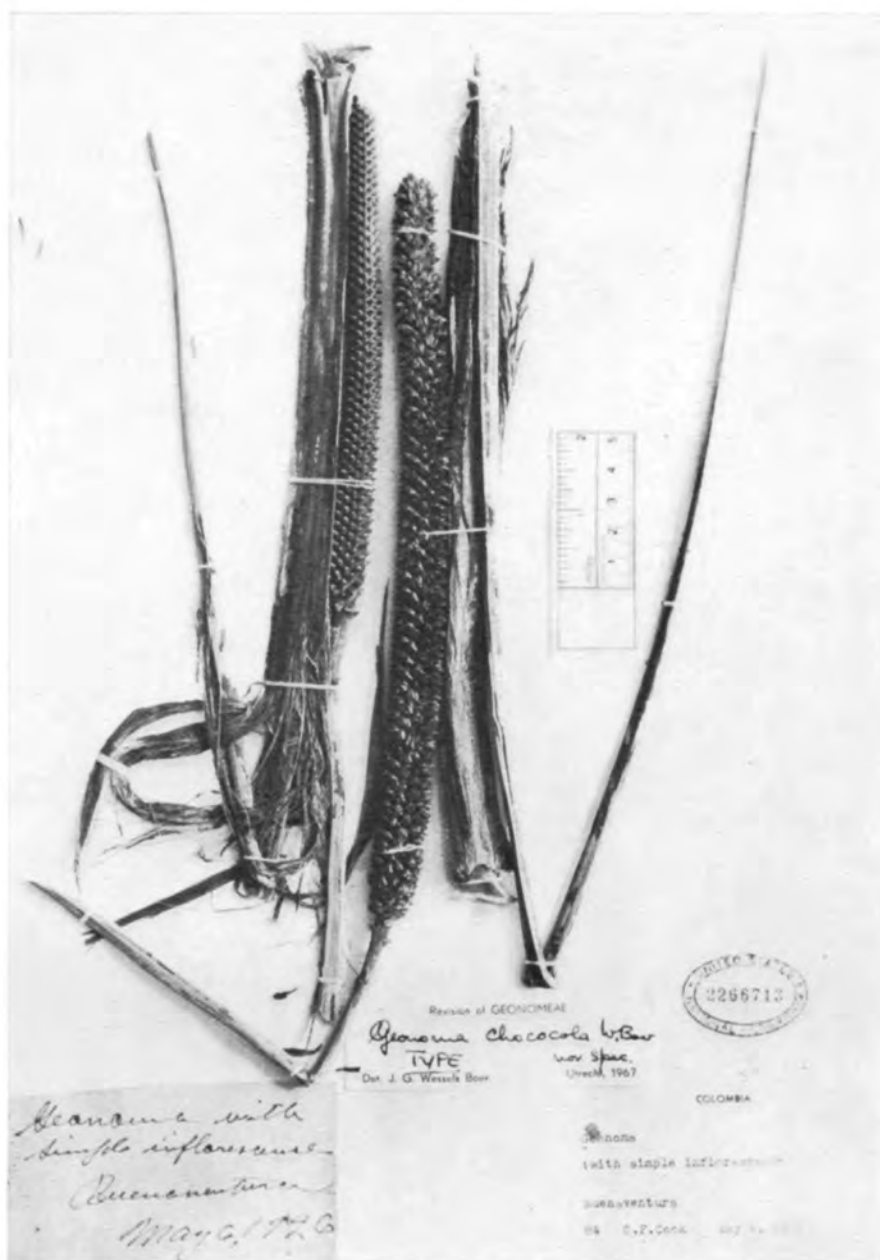


Geonoma (Kalbreyera) triandra (Burret) W. Boer
Colombia, Antioquía, Hodge 7074 (BH).

PLATE II



Geonoma paradoxa Burret
Colombia, Rio Timbiquí, Lehmann 8957 (K).



Geonoma chococola W. Boer
Colombia, Buenaventura, Cook 84 (US).

PLATE IV



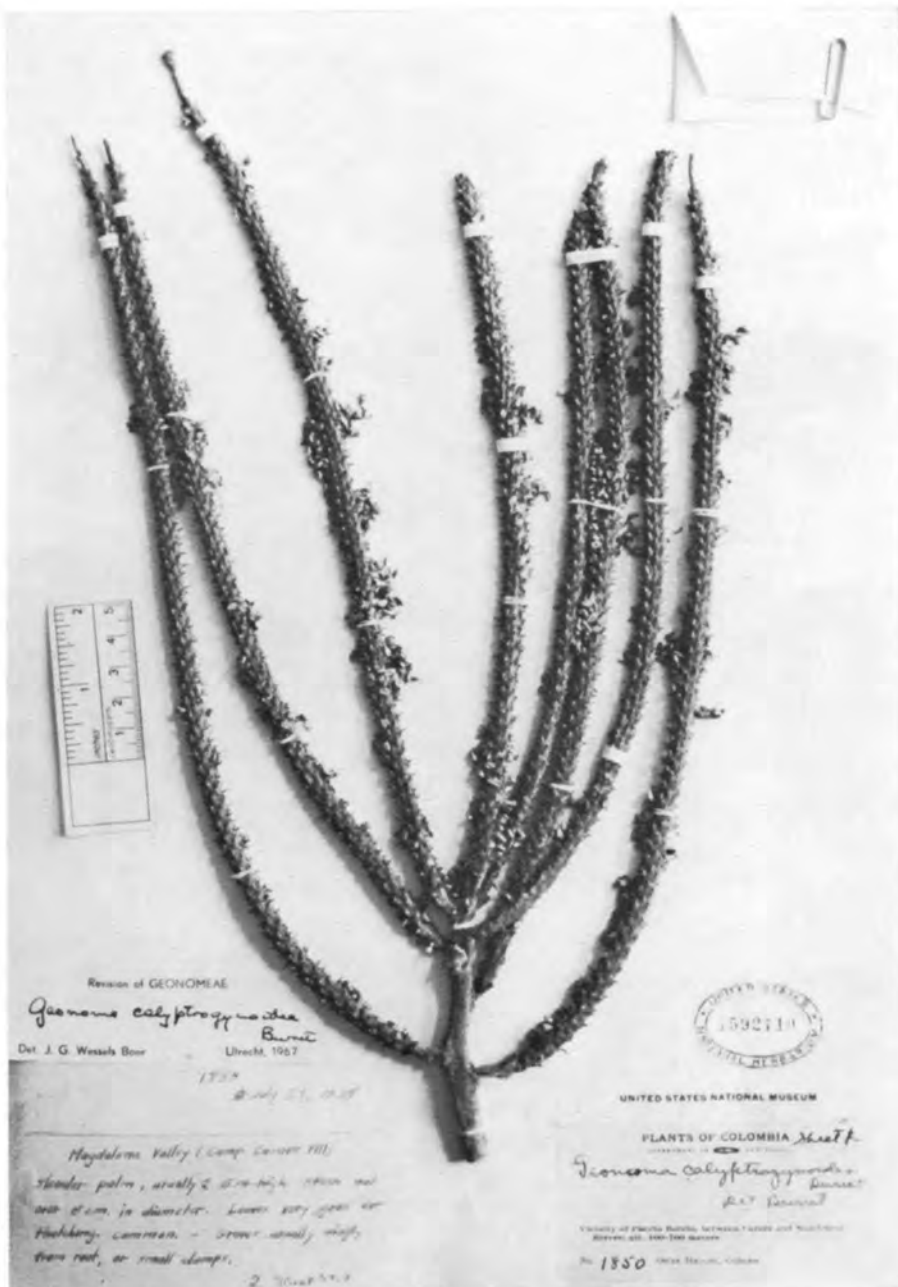
Geonoma chococola W. Boer
Colombia, Buenaventura, Cook 84 (US).



Geonoma bartlettii Dammer ex Burret
French Guiana, Leprieur s.n. (P).



Geonoma simplicifrons Willdenow
 Venezuela, Caracas, Bredemeyer 20 (B, ex herb. Willdenow).



Geonoma calyptrogynoides Burret
 Colombia, Santander, Haught 1850 (US).

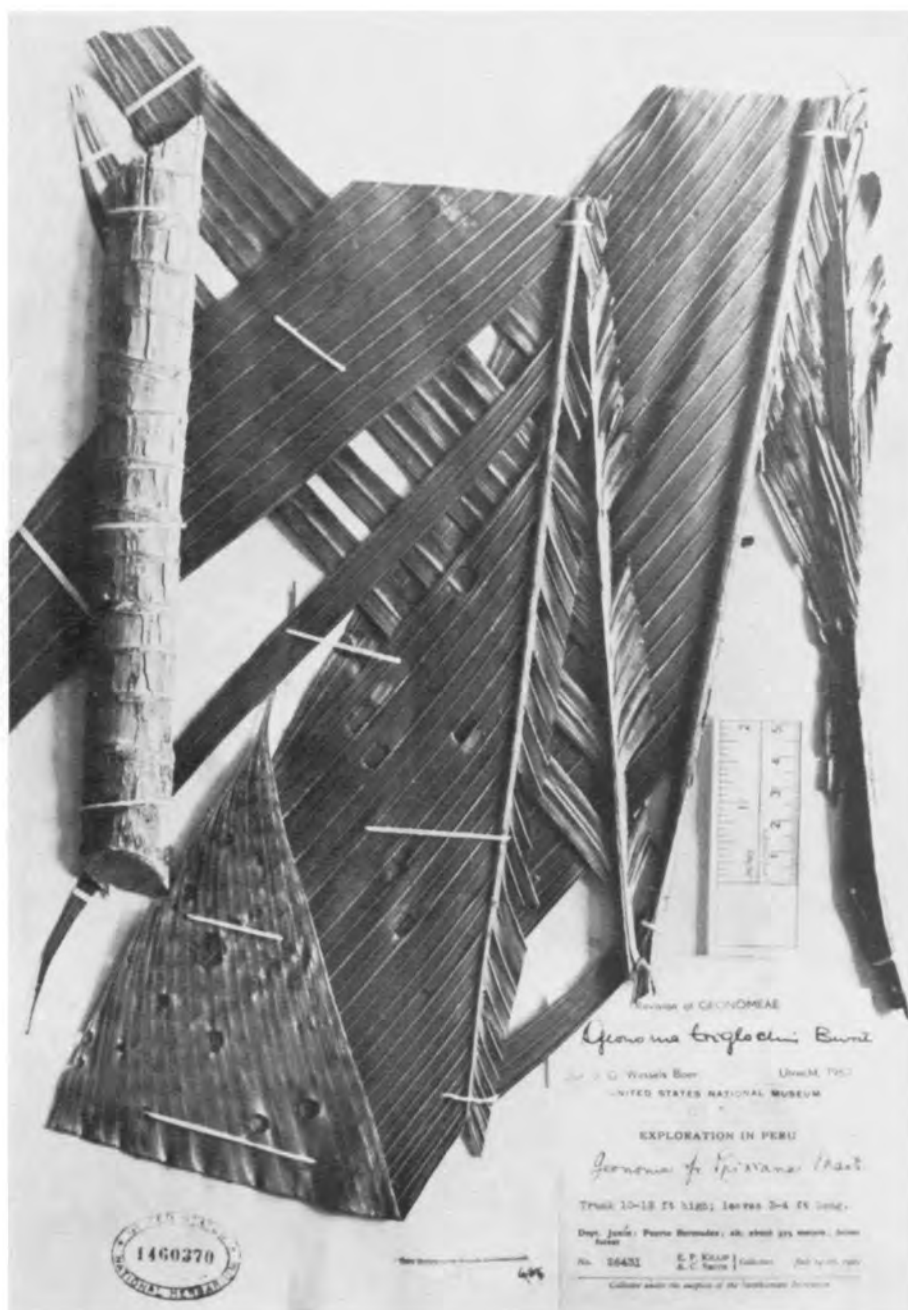
PLATE VIII



Geonoma megalospatha Burret
Peru, Rio Pozuzo, Weberbauer 6800 (US).



Geonoma triglochis Burret
 Peru, Junín, Killip & Smith 26431 (US).



Geonoma triglochis Burret
Peru, Junín, Killip & Smith 26431 (US).