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THE FAMILIES OF FLOWERING PLANTS

VOLUME II

MONOCOTYLEDONS

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GLASGOW NEW YORK TORONTO MELBOURNE WELLINGTON
BOMBAY CALCUTTA MADRAS KARACHI KUALA LUMPUR
CAPE TOWN IBADAN NAIROBI ACCRA

TO

AGNES ARBER

OF CAMBRIDGE

IN RECOGNITION OF

HER CLASSICAL

RESEARCHES ON

MONOCOTYLEDONS

PREFACE TO FIRST EDITION

VOLUME II

THE second volume of my *Families of Flowering Plants*, dealing with the Monocotyledons, is somewhat overdue. Since the publication of the Dicotyledons in 1926, I have made two botanical expeditions to Africa, one in South Africa during 1928–9, and lasting nine months, and a second in Rhodesia and the Belgian Congo in 1930, lasting five months. These journeys, undertaken during the preparation of the *Flora of West Tropical Africa*, naturally took up a large amount of my leisure time, during which these studies have been carried out. In addition to this I had, at the beginning of my researches, only a cursory knowledge of the Monocotyledons as compared with that of the Dicotyledons. Up to that time the Monocotyledons had been dealt with at Kew only by a few specialists, J. G. Baker and C. H. Wright (petaloid families), C. B. Clarke (*Cyperaceae*), R. A. Rolfe (*Orchidaceae*), and Otto Stapf (*Gramineae*). Apart from these botanists, no one at Kew had worked much with Monocotyledons, and I had naturally 'to plough the sands' to prepare this new classification.

Although somewhat drastic alterations are proposed, it should be understood that the work is not monographic, but represents only the beginning of an endeavour to establish a phylogenetic system for the Monocotyledons. As emphasized in the first volume, the ultimate aim of taxonomic botany should be a phylogenetic system of classification. It is not by any means all speculation, as some are so fond of declaring; as to the starting-point, it may be; but even in regard to that, reasonable and logical deductions may be made from a comparative examination of living and preserved specimens of the present flora of the world. There is no other road to a knowledge of phylogeny, and it is surprising, when this is done, how many 'missing links' are brought to light.

The principal object of the book is to provide the student with descriptions of the families of Monocotyledons arranged in as logical a sequence as may be possible according to their probable phylogeny, starting with the most primitive and ending with the most advanced types. Some alterations in the status of a few of the families are proposed here for the first time, especially that of the *Amaryllidaceae* and of the *Liliaceae*.

Owing to the small number of families as compared with Dicotyledons, I have attempted to make this second volume more useful than the first by including keys to the genera of the families, with the exception of the *Orchidaceae* and *Gramineae*. The *Gramineae*, no less than the *Orchidaceae*, need life-long study; and I am much indebted to my colleague Mr. C. E. Hubbard for preparing a tentative key to the tribes of the former family. This, together with a reference to Dr. Bews' recent book dealing with the *World's Grasses*, which contains a key to all the genera, is as much as I can ask the publishers to include. For the Orchids Mr. V. S. Summerhayes has kindly helped me with the description, and references are given to the more important taxonomic works.

The perusal of the keys to genera and their use with living and dried material should give the student some idea of classification and of the value of generic characters in each family. It says something for the ingenuity of botanists in the past that out of the *Liliaceae* with the simple floral formula 'Perianth 3+3, petaloid; stamens 3+3, hypogynous; ovary superior, of 3 united carpels' no less than 230 or so genera have been recognized. The same might be said of the *Araceae*, but there, whilst the flowers have become reduced, new organs have appeared adding new characters, the spathe and spadix, and often the segregation of the sexes. Probably too many genera have been proposed for both the *Liliaceae* and the *Araceae*.

To save space a type of key has been used which may not be familiar to British students. Letters of the alphabet indicate the contrasting characters, and as these letters are printed in clarendon type, they should be easily followed. If the plant sought for should not agree with the character or characters attributed to **A**, then **AA**, and rarely **AAA** should be consulted, and then be followed with **B** and **BB**, &c., in a similar manner. Should none of these be applicable, then the student may suspect that he has arrived at the wrong tribe or even family. Particularly will this be likely to happen in the case of the tribes of the family *Liliaceae*, which tend to overlap.

The drawings have been selected mainly with the object of providing the student with a picture, not necessarily of a plant typical of the family (which may be found in every textbook), but rather of one which exhibits some point of special phylogenetic interest.

I am much indebted to Mr. J. E. Dandy, of the Botanical Department, Natural History Museum, for the key to the tribes and genera of *Hydrocharitaceae*, of which he has been preparing a revision; and also to my daughters Violet and Joan, the one having assisted here and there with the drawings, the other for the whole of the typescript.

Finally it gives me great pleasure to inscribe the book to Dr. Agnes Arber of Cambridge, whose researches have added so much to our knowledge of the morphology and anatomy of the Monocotyledons, and who has so worthily carried on the work begun at Cambridge by her late husband, E. A. Newell Arber, and by J. Parkin, whose joint researches stimulated the present writer's interest in phylogeny.

EXCEPT for the addition of one new family, *Cartonemataceae* Pichon, and a number of genera described since the original publication, little alteration has been made to this second volume dealing with Monocotyledons.

Kew
1959

CONTENTS

VOLUME II

SIGNS AND ABBREVIATIONS x

INTRODUCTION
- Classification of Monocotyledons 511
- Bentham and Hooker's *Genera Plantarum* 511
- The system of Engler and Prantl 512
- The New Phylogenetic System here proposed 513
- Monocotyledons monophyletic or polyphyletic? 513
- Lotsy's classification of Monocotyledons 514
- Bessey's classification of Monocotyledons 515
- Separate calyx and corolla 515
- Phylogenetic diagram for Monocotyledons 517

INDEX TO FAMILIES OF MONOCOTYLEDONES FOR READY REFERENCE (also included in General Index) 519

SEQUENCE OF ORDERS AND FAMILIES IN THE NEW SYSTEM 520

KEY TO ARTIFICIAL GROUPS AND TO FAMILIES OF MONOCOTYLEDONES 527

DESCRIPTIONS OF ORDERS AND FAMILIES, WITH KEYS TO GENERA OF SMALLER FAMILIES 536

GLOSSARY 742

INDEX 743

SIGNS AND ABBREVIATIONS

♂ = male flower.
♀ = female flower.
⚥ = bisexual flower.
B.H. = Bentham and Hooker, *Genera Plantarum.*
E.P. = Engler and Prantl, *Die natürlichen Pflanzenfamilien.*
Rendle = Rendle, *Classification of Flowering Plants*, vol. i (1904).

INTRODUCTION

(TO FIRST EDITION, VOL. II)

CLASSIFICATION OF MONOCOTYLEDONS[1]

FOR a history of classification of the families of Monocotyledons the reader is referred to Dr. Rendle's *Classification of Flowering Plants*, vol. i (1904). And for the student interested in the evolution of Monocotyledons there is Dr. N. Bancroft's review of the literature up to 1914, published in the *New Phytologist*, **13**, 285–308 (1914), including a comprehensive bibliography. There is therefore no need to cover the same ground. For general morphology there is Dr. A. Arber's *Monocotyledons: a Morphological Study* (Cambridge, 1925).

Amongst the systems preceding Bentham and Hooker's *Genera Plantarum*, that of Lindley is one of the most outstanding. Indeed, had Lindley followed Darwin he would probably have given us a first-rate phylogenetic system. For the purpose of this work, however, the only systems that need to be considered are those of Bentham and Hooker and of Engler and Prantl.

BENTHAM AND HOOKER'S *GENERA PLANTARUM*

The families are arranged in seven series, none of which is very homogeneous according to modern standards. For example the *Hydrocharitaceae* appear along with the *Burmanniaceae* and *Orchidaceae* in the 'Microspermae', the *Flagellariaceae*, *Juncaceae*, and *Palmae* together make up the 'Calycinae', whilst the 'Glumaceae' contain *Eriocaulaceae*, *Centrolepidaceae*, *Restiaceae*, *Cyperaceae*, and *Gramineae*. Having regard to the association of really related families, I consider the arrangement in the *Genera Plantarum* to be inferior to that of Lindley. From the phylogenetic standpoint, fortunately, it ends with the *Gramineae*, but unfortunately it starts with a series containing the highly advanced *Orchidaceae*. Here is the arrangement of Bentham and Hooker:

Series I. **Microspermae.**—Hydrocharitaceae, Burmanniaceae, Orchidaceae.
Series II. **Epigynae.**—Scitamineae, Bromeliaceae, Haemodoraceae, Iridaceae, Amaryllidaceae, Taccaceae, Dioscoreaceae.
Series III. **Coronarieae.**—Roxburghiaceae, Liliaceae, Pontederiaceae, Philydraceae, Xyridaceae, Mayacaceae, Commelinaceae, Rapateaceae.
Series IV. **Calycinae.**—Flagellariaceae, Juncaceae, Palmae.
Series V. **Nudiflorae.**—Pandanaceae, Cyclanthaceae, Typhaceae, Araceae, Lemnaceae.
Series VI. **Apocarpae.**—Triuridaceae, Alismataceae, Najadaceae.
Series VII. **Glumaceae.**—Eriocaulaceae, Centrolepidaceae, Restiaceae, Cyperaceae, Gramineae.

[1] Additional notes on the system for Monocotyledons used in this book are given in vol. I, p. 29.

THE SYSTEM OF ENGLER AND PRANTL

Engler and Prantl begin their arrangement as they do in the Dicotyledons, with those families devoid of or with a very imperfect perianth. It commences with the **Pandanales**, after which follow the **Helobiae** (Alismataceae, &c.), and after them the **Gramineae** and **Cyperaceae**, followed by the Palms, Aroids, '**Farinosae**', **Liliiflorae**, **Scitamineae**, and **Microspermae**. Of the early groups the *Helobiae* are undoubtedly primitive according to views now generally accepted, but they are placed between such very advanced groups as *Pandanales* and *Glumiflorae* with which they seem to have very little near relationship. Further the *Araceae* are inserted a long way before the *Liliaceae*, from which they have been undoubtedly derived (and not vice versa), and between which there is scarcely a dividing line (see p. 592). From the *Liliiflorae* onwards, however, the Engler and Prantl system is sufficiently phylogenetic according to modern views.

For the convenience of the student I give below the arrangement of Engler and Prantl:

1. Reihe: **Pandanales.**—Typhaceae, Pandanaceae, Sparganiaceae.
2. Reihe: **Helobiae:**
   1. Unterr.: *Potamogetonineae.*—Potamogetonaceae, Najadaceae, Aponogetonaceae, Scheuchzeriaceae.
   2. Unterr.: *Alismatineae.*—Alismataceae.
   3. Unterr. *Butomineae.*—Butomaceae, Hydrocharitaceae.
3. Reihe: **Triuridales.**—Triuridaceae.
4. Reihe: **Glumiflorae.**—Gramineae, Cyperaceae.
5. Reihe: **Principes.**—Palmae.
6. Reihe: **Synanthae.**—Cyclanthaceae.
7. Reihe: **Spathiflorae.**—Araceae, Lemnaceae.
8. Reihe: **Farinosae.**
   1. Unterr.: *Flagellariineae.*—Flagellariaceae.
   2. Unterr.: *Enantioblastae.*—Restionaceae, Centrolepidaceae, Mayacaceae, Xyridaceae, Eriocaulaceae.
   3. Unterr.: *Bromeliineae.*—Thurniaceae, Rapateaceae, Bromeliaceae.
   4. Unterr.: *Commelinineae.*—Commelinaceae.
   5. Unterr.: *Pontederiineae.*—Pontederiaceae, Cyanastraceae.
   6. Unter.: *Philydrineae.*—Philydraceae.
9. Reihe: **Liliiflorae.**
   1. Unterr.: *Juncineae.*—Juncaceae.
   2. Unterr.: *Liliineae.*—Stemonaceae, Liliaceae, Haemodoraceae, Amaryllidaceae, Velloziaceae, Taccaceae, Dioscoreaceae.
   3. Unterr.: *Iridineae.*—Iridaceae.
10. Reihe: **Scitamineae.**—Musaceae, Zingiberaceae, Cannaceae, Marantaceae.
11. Reihe: **Microspermae.**
    1. Unterr.: *Burmanniineae.*—Burmanniaceae.
    2. Unterr.: *Gynandrae.*—Orchidaceae.

THE NEW PHYLOGENETIC SYSTEM HERE PROPOSED

In my volume on the Dicotyledons (p. 6) I gave paragraphs dealing with (1) Considerations for the Delimitation of Groups of Families, (2) Considerations for the Delimitation of Families, and (3) General Principles adopted for the Classification of Flowering Plants. These apply equally well to the Monocotyledons except that in this case it seems evident that herbaceous forms are primitive, whilst woody forms have been derived from them; examples, Palms from the mainly herbaceous family *Liliaceae*; whilst woody climbing Aroids are more advanced in their floral structure, the more primitive groups being all herbaceous.

MONOCOTYLEDONS MONOPHYLETIC OR POLYPHYLETIC?

The question has often arisen as to whether Monocotyledons are monophyletic or polyphyletic. In my comparative table of the systems of Bentham and Hooker, and of Engler and Prantl (vol. i, p. 5), I stated that the Monocotyledons in this new system should be 'placed after the Dicotyledons, from which they were derived at an early stage, the point of origin being the Ranales, *and perhaps other groups*'. The italics are new here, because I have found nothing to support the possibility indicated by them. The statement was inserted as a safeguard because of the confident views of Hallier, followed by Lotsy, who considered Monocotyledons to be diphyletic. After examining the whole group, as represented in the dried and living collections at Kew, and combined with my previous review of the Dicotyledons, I consider the group to be *monophyletic*, and to show a close relationship with the Dicotyledons at one point only, i.e. in the two orders placed at the beginning of the system here proposed, the *Butomales* and *Alismatales*. These share with the *Ranales* an apocarpous gynoecium, and they often possess numerous stamens; moreover, as indicated under those families, the *Butomaceae* correspond very closely with the follicular-carpelled *Helleboroideae*, whilst the *Alismataceae* resemble the achenial *Ranunculoideae* of the family *Ranunculaceae*.[1]

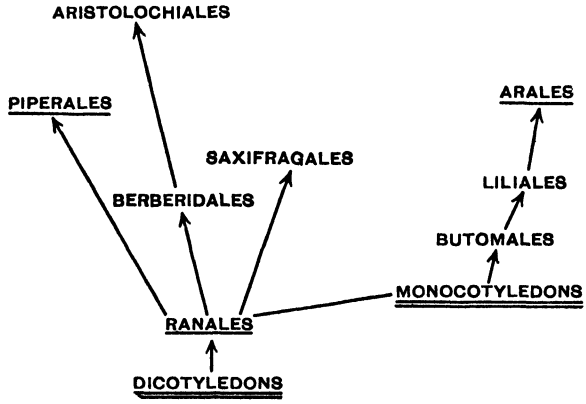
As is well known, the *Ranunculaceae* have without exception abundant endosperm in the seeds, with a very small embryo. Now the seeds of nearly all Monocotyledons are also provided with abundant endosperm, the *Alismatales* and allied families and the Orchids being almost the only exceptions. There is thus a considerable gap between the more primitive Dicotyledons and what appear to be the most primitive Monocotyledons due to the absence of endosperm from the seeds of the latter.

But having regard to the general structure of the gynoecium, the *Butomales* and *Alismatales* may be considered the most primitive group of Monocotyledons, which have probably lost their endosperm owing to the adoption of an aquatic habit. Endosperm supplies nourishment during the germination of the embryo and growth of the seedling, and is regarded as the homologue of the prothallium characteristic of lower groups of plants in which there is an alternation of generations. Endosperm is thus, *ceteris paribus*, to be regarded as a primitive feature in the seed, although it may still be retained in very highly evolved families, for example in *Rubiaceae*.

[1] In this second edition these two groups are treated as separate families (see vol. 1, 399).

Lotsy (*Vorträge über botanische Stammesgeschichte*, **3**, 863 (1911), gives a phylogenetic diagram in which, following Hallier, he shows that Monocotyledons have a diphyletic origin, the *Spadiciflorae* (*Araceae*, *Lemnaceae*, *Cyclanthaceae*, *Palmaceae*, *Pandanaceae*, *Sparganiaceae*, and *Typhaceae*) from the *Piperales* in the Dicotyledons, and the remainder of the Monocotyledons from the hypothetical *Proranales*.

I consider this view of the separate origin of the *Araceae*, &c., from the *Piperales* to be highly improbable. As I have endeavoured to show in this book, the Aroids are directly connected with the *Liliaceae* through the tribe *Aspidistreae* (see p. 604 and Figs. 375 and 388); indeed, there is scarcely a dividing line, and the similarity of these families with *Piperaceae*, &c., if there be any at all, is superficial and due to parallel development in the two groups of flowering plants. I may show this by the reproduction of a part of the phylogenetic diagram given in my first volume and part of that prepared for the present work (see p. 517).



Lotsy's classification of those Monocotyledons which he considered to have been derived from the *Proranales* is as follows:

Helobiae

Alismataceae, Butomaceae, Hydrocharitaceae, Scheuchzeriaceae, Zosteraceae, Posidoniaceae, Aponogetonaceae, Potamogetonaceae, Najadaceae, Altheniaceae, Cymodoceaceae, Triuridaceae.

Enantioblastae

Commelinaceae, Mayacaceae, Xyridaceae, Eriocaulaceae, Centrolepidaceae, Restionaceae, Pontederiaceae.

Liliiflorae

Melanthiaceae, Asphodelaceae, Aloinaceae, Eriospermaceae, Johnsoniaceae, Agapanthaceae, Alliaceae, Gilliesiaceae, Tulipaceae, Scillaceae, Asparagaceae, Dracaenaceae, Smilacaceae, Luzuriagaceae, Ophiopogonaceae, Lomandraceae, Dasypogonaceae, Calectasiaceae, Juncaceae, Flagellariaceae, Stemonaceae, Cyanastraceae, Iridaceae, Haemodoraceae, Hypoxidaceae,

Velloziaceae, Agavaceae, Amaryllidaceae, Bromeliaceae, Dioscoreaceae, Taccaceae, Burmanniaceae.

Scitamineae

Musaceae, Cannaceae, Zingiberaceae, Marantaceae, Orchidaceae.

Glumiflorae

Cyperaceae, Graminaceae.

Bessey (*Ann. Missouri Bot. Gard.*, 2, pp. 119–26 (1915)) arranges the Monocotyledons into two artificial subclasses: the *Strobiloideae* with superior ovary, and the *Cotyloideae* with inferior ovary.

The first group is subdivided into orders in the following sequence: *Alismatales, Liliales, Arales, Palmales, Graminales,* and the second into *Hydrales, Iridales,* and *Orchidales.*

The subject of parallel development in the two great groups of flowering plants is of considerable interest, and I give below a list of families showing analogous characteristics.

Table showing parallel developments in the Dicotyledons and Monocotyledons

Dicotyledons	*Monocotyledons*	*In regard to the following characters*
Ranunculaceae	*Alismataceae*	Apocarpous gynoecium
Cabombaceae	*Butomaceae*	Placentation of ovules
Ceratophyllaceae	*Najadaceae*	Aquatic habitat
Menispermaceae	*Dioscoreaceae*	Climbing habit: similar floral structure
Aristolochiaceae	*Araceae*	Superficial resemblance of perianth and spathe respectively
Hydnoraceae	*Thismiaceae*	Parasitic and saprophytic habit respectively
Hydrostachyaceae	*Potamogetonaceae*	Aquatic habitat and spicate inflorescence
Balsaminaceae	*Orchidaceae*	Zygomorphic flowers
Umbelliferae	*Amaryllidaceae*	Umbelliform inflorescence with usually inferior ovary
Asclepiadaceae	*Orchidaceae*	Androecium: waxy pollen
Compositae	*Eriocaulaceae*	Capitate inflorescence

SEPARATE CALYX AND COROLLA

In the group determined to be the most ancient of the Monocotyledons, there is found in addition to an apocarpous gynoecium an associated character of very great importance. This is the presence of a biseriate perianth, the outer of free often *green sepals*, the inner of free variously *coloured* (often white) *petals*. I fancy the significance of this has not hitherto been recognized. In fact a distinct line of descent may be traced in which the sepals and petals have remained in separate whorls, and the two whorls, whilst their separate parts may coalesce amongst themselves, rarely fuse together as they do in the higher petaloid groups such as the *Liliaceae, Amaryllidaceae,* and *Iridaceae.* In my new classification, therefore, I have regarded this character as being the

basic feature of a whole line of descent, beginning with the *Butomales* and *Alismatales* and persisting in one direction through the *Commelinales*, *Bromeliales* as far as the *Zingiberales*. And I regard the *Zingiberales*, with their reduction to one stamen and large petaloid staminodes, *not as potential orchids*, but as a *parallel development* to the *Orchidaceae*. I can find no better term for the group representing this line of descent than the **Calyciferae** (calyx-bearers). In addition the rootstock in this group is always a rhizome and there are some annuals, but none with bulbs or corms.

Very early in this series, almost from the very outset, reduction and sexual differentiation set in and produced a separate, almost wholly aquatic, branch beginning with the *Juncaginales*, its climax being the *Najadales*, with some of its final branches actually adapting themselves to brackish or marine conditions. And it is perhaps a point of interest that the majority of the parallel group, represented by the *Commelinales*, *Xyridales*, *Eriocaulales*, and *Bromeliales*, favour damp conditions and are found mostly in the moist parts of the tropics and subtropics. Many of the *Bromeliaceae*, like Orchids, are epiphytic.

Somewhere from the stock of this line of development there was evolved a more terrestrial race of Monocotyledons, such as the more primitive of the existing *Liliaceae*, and from that stock most of the remainder of the group has been developed. Just where that point was it is not easy to determine, and probably most of the intermediate experimental stages have disappeared. Perhaps the genus *Scheuchzeria* is the nearest living representative of such a stock. Like the *Alismataceae* its carpels are free, and its perianth-segments have become more uniform and petaloid, with the carpels reduced to three. Moreover *Scheuchzeria* is undoubtedly allied to the most primitive tribe of the *Liliaceae*, the *Narthecieae*, in which the carpels are often only loosely united and the styles free, besides sharing a similar habitat, acid swamps of the Northern Hemisphere.

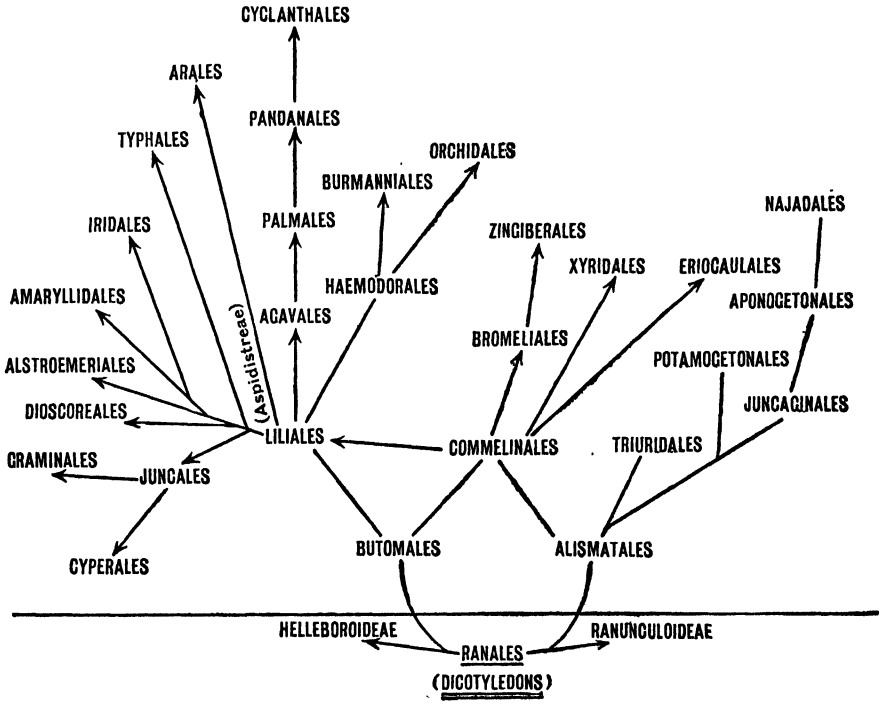
From the Liliaceous stock very prolific evolution has taken place, most of it purely terrestrial or epiphytic, with very few aquatics. And in the family *Liliaceae* the evolution of a more advanced type of root system may be clearly traced, its culmination being the bulb, so characteristic a feature of *Amaryllidaceae*, and the corm of the *Iridaceae*. The evolution of this bulbous habit has enabled these plants to grow in some of the most arid regions of the world, such as parts of Southern Africa where most of the petaloid Monocotyledons are cormous or bulbous rooted. *The corm and bulb seem to have developed hand in hand with the attractive uniseriate perianth.* They are not found for example in the *Araceae*, wherein the perianth has become greatly or entirely reduced, its function being performed by a *bract* (spathe).

This secondary line of descent of Monocotyledons, often called 'Petaloid Monocotyledons', I propose to designate the **Corolliferae** (corolla-bearers), because of the resemblance of the combined whorls of the perianth to the corolla of the Dicotyledons. As stated above, it begins with the large family *Liliaceae*, and branches in several directions, ending in the climax families *Ruscaceae*, *Araceae* and *Lemnaceae*, *Typhaceae*, *Iridaceae*, *Dioscoreaceae*, *Palmae* and *Cyclanthaceae*, the *Burmanniales* and *Orchidaceae*.

A third and much reduced climax group, which has branched off independently from the Liliaceous stock and has been developed on somewhat

parallel lines is the **Glumiflorae.** Its families begin with the *Juncales* (*Juncaceae* and *Restionaceae*), and it includes the *Cyperales* (*Cyperaceae*) and the *Glumales* (*Gramineae*). In the *Juncales* the perianth is much reduced and glumaceous, in the *Cyperales* it is much reduced and modified into scales or 'hypogynous setae' or is entirely absent, whilst in *Glumales* it is represented by lodicules, or, as in *Cyperaceae*, absent.

The ideas put forward in these notes may be shown more clearly in the following diagram:



In the classification proposed here for the first time, I have given *ordinal* rank to several single families which appear to represent the *complete climax* of separate lines of descent. For example, *Araceae* terminate a certain evolutionary line from the Liliaceous stock, through the tribe *Aspidistreae*, and the *Amaryllidaceae* are a similar group but arising from a different source out of the same basal stock. The names used for these orders (or 'cohorts' as they were formerly termed, the 'Reihe' of the Germans) are those of the principal family and that more or less typical of the group. To apply the International Rules of priority to the names of these groups would result in the resuscitation of many names no longer applicable to the groups concerned, and quite meaningless from a phylogenetic standpoint. For example Engler's eighth 'Reihe', termed *Farinosae*, indicates the seeds as having mealy endo-sperm, a character not regarded in this work as of primary phylogenetic importance.

During the course of these studies of the families and genera of Monocotyledons it has been necessary to put aside prejudices and ideas which have largely up to the present been accepted as botanical gospel. For example, nearly all plants with an actinomorphic, petaloid perianth, 6 stamens, and a *superior* ovary, have hitherto been assigned to the family *Liliaceae*; and all those with similar characters, but with an *inferior* ovary, to the *Amaryllidaceae*. In tracing out the relationships of Monocotyledons amongst themselves I have come to the conclusion that the character of the *superior* or *inferior* ovary has often been stressed too much and has led to artificial classification. With this character regarded as of less importance, therefore, I have proposed new conceptions for these families, based, I think, on other and better characters, and resulting, I hope, in a more natural grouping. As a result the size of the *Liliaceae* has been reduced considerably (it was already far too big) by separating such distinctive groups as the *Trilliaceae*, *Smilacaceae*, *Ruscaceae*, *Xanthorrhoeaceae*, and *Agavaceae*, and I have transferred to the family *Amaryllidaceae* the tribes *Agapantheae*, *Allieae*, and *Gilliesieae*, all with a *superior* ovary, *but with an umbellate inflorescence subtended by an involucre of one or more spathaceous bracts*. To my mind the type of inflorescence is of much more importance than the superior or inferior ovary, and the result is a nearer approximation of allied genera. With the removal from the *Amaryllidaceae* as separate families of the *Hypoxidaceae*, the *Alstroemeriaceae*, the *Agavaceae* (to which are added the *Dracaeneae*, &c., from *Liliaceae*), and the *Velloziaceae*, I have recast the *Amaryllidaceae* into a very homogeneous and natural group, the most distinctive and constant feature of which is the *umbellate, scapose inflorescence* (see Figs. 393–5). The *Liliaceae* as thus reduced have never a truly umbellate inflorescence. One might with reason be even more drastic and transfer the *Alstroemerieae* into the *Liliaceae*, for the Alstroemerias, at any rate, are little more than lilies or fritillarias with inferior ovaries, allowing for the difference in their root systems.

INDEX TO FAMILIES OF MONOCOTYLEDONES FOR READY REFERENCE

(Also included in general index at end of volume)

Agavaceae, 662.
Alismataceae, 542.
Alstroemeriaceae, 623.
Amaryllidaceae, 639.
Aponogetonaceae, 552.
Apostasiaceae, 680.
Araceae, 627.

Bromeliaceae, 576.
Burmanniaceae, 685.
Butomaceae, 536.

Cannaceae, 587.
Cartonemataceae, 566.
Centrolepidaceae, 699.
Commelinaceae, 561.
Corsiaceae, 689.
Cyclanthaceae, 672.
Cyperaceae, 704.

Dioscoreaceae, 658.

Eriocaulaceae, 574.

Flagellariaceae, 568.

amineae, 710.

Haemodoraceae, 674.
Heterostylaceae see Tilaeaceae 549
Hydrocharitaceae, 538.
Hypoxidaceae, 678.

Iridaceae, 647.

Juncaceae, 697.
Juncaginaceae, 548.

Lemnaceae, 635.
Lilaeaceae, 549.
Liliaceae, 591.
Lowiaceae, 582.

Marantaceae, 588.
Mayacaceae, 568.
Musaceae, 581.

Najadaceae, 561.

Orchidaceae, 691.

Palmae, 665.
Pandanaceae, 670.
Petermanniaceae, 623.
Petrosaviaceae, 546.
Philesiaceae, 625.
Philydraceae, 683.
Pontederiaceae, 616.
Posidoniaceae, 552.
Potamogetonaceae, 556.

Rapateaceae, 572.
Restionaceae, 700.
Roxburghiaceae, 656.
Ruppiaceae, 558.
Ruscaceae, 619.

Scheuchzeriaceae, 544.
Smilacaceae, 618.
Sparganiaceae, 637.
Stenomeridaceae, 654.
Strelitziaceae, 582.

Taccaceae, 683.
Tecophilaeaceae, 613.
Thismiaceae, 687.
Thurniaceae, 699.
Trichopodaceae, 654.
Trilliaceae, 615.
Triuridaceae, 547.
Typhaceae, 637.

Velloziaceae, 678.

Xanthorrhoeaceae, 660.
Xyridaceae, 570.

Zannichelliaceae, 559.
Zingiberaceae, 584.
Zosteraceae, 554.

SEQUENCE OF ORDERS AND FAMILIES

SUBPHYLUM MONOCOTYLEDONES

DIVISION I. **Calyciferae** (see p. 536)

Notes on affinity (origin and further development)	*Sequence of orders (Cohorts) and families. A cross-line indicates the climax of a group, asterisks a local climax*	*General characters and tendencies of orders*
	83. BUTOMALES	
An ancient group closely allied to the *Helleboraceae* and *Ranunculaceae*; parallel to *Cabombaceae* in placentation of ovules.—Temperate and Tropical Regions.	343. Butomaceae, p. 536. 344. Hydrocharitaceae, p. 538.	Aquatics; apocarpous or syncarpous; ovary superior or inferior; ovules numerous, scattered over the walls of the carpels; no endosperm.
	84. ALISMATALES	
An ancient group, parallel to the preceding, corresponding to the family *Ranunculaceae*; ovules confined to a placenta; great resemblance to some *Ranunculaceae*. — Mostly Temperate Regions.	345. Alismataceae, p. 542. 346. Scheuchzeriaceae, p. 544. 347. Petrosaviaceae, p. 546.	Marsh or aquatic plants, or rarely saprophytes; apocarpous, superior; ovules on a placenta, sometimes reduced to 1; fruits achene-like; no endosperm.
	85. TRIURIDALES	
Probably advanced degraded types of preceding families; flowers very small.—Tropics only.	348. Triuridaceae, p. 547.	Saprophytes; leaves reduced, colourless; perianth-segments 1-seriate, valvate; apocarpous; ovule 1, basal; no endosperm.
	* * * * *	
	86. JUNCAGINALES	
In its early stages an ancient group, then showing transition to the following reduced almost entirely aquatic families (nos. 352–7); the absence of bracts a striking feature.	349. Juncaginaceae, p. 548. 350. Lilaeaceae, p. 549. (Heterostylaceae) 351. Posidoniaceae, p. 552.	Marsh or marine herbs; leaves sheathing at the base; flowers bisexual to unisexual; no bracts; apocarpous to syncarpous or 1 carpel; ovule 1.
	* * * * *	

Notes on affinity (origin and further development)	*Sequence of orders (cohorts) and families. A cross-line indicates the climax of a group, asterisks a local climax*	*General characters and tendencies of orders*
	87. APONOGETONALES	
	352. Aponogetonaceae, p. 552.	Similar to preceding but wholly aquatic, and flowers very much reduced; represented by one fresh-water and one marine family.
	353. Zosteraceae, p. 554.	
	* * * * *	
Advanced aquatic types derived from the preceding; the absence of bracts is compensated for by the reduction of the perianth to single bract-like segments which are marginal on unilateral spadix-like inflorescences, or perianth entirely reduced.	88. POTAMOGETONALES	
	354. Potamogetonaceae, p. 556.	A group parallel to the preceding, and, like it, with one fresh-water and one marine family.
	355. Ruppiaceae, p. 558.	
	89. NAJADALES	
	356. Zannichelliaceae, p. 559.	As in preceding groups but extremely reduced and completely submerged aquatics; some annuals.
	357. Najadaceae, p. 561.	
	* * * * *	
	90. COMMELINALES	
Families derived from the *Butomales* and *Alismatales*, but ovary superior and syncarpous; calyx and corolla remaining distinct; seeds peculiar.	358. Commelinaceae, p. 561.	Terrestrial but usually favouring damp conditions; leaves sheathing at the base; sheath nearly always closed; perianth of free parts, calyx green, corolla coloured; seeds with endosperm, marked with a 'stopper'; strong tendency to reduction in number of stamens.
	359. Cartonemataceae, p. 566.	
	360. Flagellariaceae, p. 568.	
	361. Mayacaceae, p. 568.	
	91. XYRIDALES	
Reduced advanced types of the *Commelinales* with the flowers in heads subtended by bracts; the 'Compositae' of the Monocotyledons; something of a parallel development with the *Glumiflorae*, but much less reduced, and of course not directly related.	362. Xyridaceae, p. 570.	Inner perianth-segments united; perianth becoming dry and chaffy; flowers small, capitate; ovules many to few or 1.
	363. Rapateaceae, p. 572.	
	92. ERIOCAULALES	
	364. Eriocaulaceae, p. 574.	Habit and characters much as in preceding but flowers unisexual, and ovule solitary.

Notes on affinity (origin and further development)	*Sequence of orders (cohorts) and families. A cross-line indicates the climax of a group, asterisks a local climax*	*General characters and tendencies of orders*
	93. BROMELIALES	
Related to *Commelinales*, but more advanced; many epiphytes; leaves and bracts often coloured, with spinulose margins; some strongly xerophytic. — Entirely Tropical.	365. Bromeliaceae, p. 576.	Inflorescence terminal; stamens 6, no staminodes; ovary superior to inferior; fruit usually fleshy; seeds with endosperm, often with long plumose tails.
	94. ZINGIBERALES	
A very advanced group representing the climax of one line of development of the division in which the calyx and corolla have remained in separate whorls; often regarded as *prototypes of Orchids*, but here considered to be *a parallel group*, with a similar reduction to 1 stamen, a very different stamen from that of the orchids. In addition the leaf-sheaths of Orchids are *never ligulate*.	366. Musaceae, p. 581. 367. Strelitziaceae, p. 582. 368. Lowiaceae, p. 582. 369. Zingiberaceae, p. 584. 370. Cannaceae, p. 587. 371. Marantaceae, p. 588.	Herbs with rhizomes; leaf-sheath usually open and with a ligule; calyx and corolla in separate whorls; stamens 6–5, or often only 1, the remainder staminodes and petaloid; ovary inferior; seeds with endosperm, often arillate.

DIVISION II. **Corolliferae** (see p. 591)

	95. LILIALES	
A large group with very ancient types; representing a general basal stock whence prolific evolution has taken place; from this stock have been derived five main orders, (1) *Arales*, (2) *Palmales*, (3) *Amaryllidales* and *Iridales*, (4) *Haemodorales* and *Orchidales*, and (5) the much reduced *Juncales*, *Cyperales*, and *Graminales*.— World-wide distribution.	372. Liliaceae, p. 591. 373. Tecophilaeaceae, p. 613. 374. Trilliaceae, p. 615. 375. Pontederiaceae, p. 616. 376. Smilacaceae, p. 618. 377. Ruscaceae, p. 619. * * * * *	Herbs with rhizomes, corms, or bulbs, rarely climbing; corolla-like perianth a dominant feature, the two series similar and often fusing together into one tube; stamens often 6; ovary superior or rarely semi-inferior; capsule or berry; seeds with copious endosperm.

Notes on affinity (origin and further development)	*Sequence of orders (cohorts) and families. A cross-line indicates the climax of a group, asterisks a local climax*	*General characters and tendencies of orders*
	96. ALSTROEMERIALES	
Directly derived from various groups of the *Liliaceae*; the *Alstroemeriaceae* perhaps just inferior-ovaried *Liliaceae*. —Pronounced austral distribution.	378. Alstroemeriaceae, p. 623. 379. Petermanniaceae, p. 623. 380. Philesiaceae, p. 625.	Rootstock a rhizome or roots tuberous; stem leafy, erect or climbing; flowers in a terminal cluster or raceme; perianth mostly very showy; slight zygomorphism; ovary usually inferior; copious endosperm.
	* * * *	
	97. ARALES	
Herbs or climbers, ending in a few aquatics; the latter may be regarded as parallelisms to the *Najadales*, &c., in the first division. *Araceae* directly derived from *Liliaceae*, through tribe *Aspidistreae* (*Tupistra*, *Rohdea*, *Gonioscypha*, &c.); development parallel with the Palms but on quite different lines. Lotsy considered these to be derived independently from the Dicotyledons through the *Piperales*.	381. Araceae, p. 627. 382. Lemnaceae, p. 635.	Flowers much reduced and arranged on a thickened spike (spadix) subtended by a large often coloured bract (spathe); bisexual to unisexual; perianth very small or entirely reduced; ovary superior; fruit a berry; copious endosperm.
	* * * * *	
	98. TYPHALES	
A highly reduced series, which have taken to the water; perhaps best regarded as a parallel to the *Araceae*, from the *Liliaceae*. A small climax group, generally distributed.	383. Sparganiaceae, p. 637. 384. Typhaceae, p. 637.	Aquatic or marsh herbs with rhizomes; leaves sheathing at the base; flowers unisexual, anemophilous, minute, crowded into clusters or dense spikes; perianth much modified and reduced.
	99. AMARYLLIDALES	
Superior- or inferior-ovaried *Liliaceae* with special type of inflorescence; perhaps also partly recruited from *Butomales*. Climax group, widely distributed.	385. Amaryllidaceae, p. 639.	Scapigerous herbs with radical leaves and bulbous rootstock; flowers showy, in 1–many flowered umbels subtended by 1 or more spathaceous bracts; corona often present; stamens 6; ovary superior or inferior; endosperm present.
	* * * * *	

Notes on affinity (origin and further development)	*Sequence of orders (cohorts) and families. A cross-line indicates the climax of a group, asterisks a local climax*	*General characters and tendencies of orders*
	100. IRIDALES	
Similar to the preceding but evolved separately from the *Liliaceae* and on different lines; rootstock usually a corm; inflorescence not umbelliform; some zygomorphy in the perianth.—General distribution, very numerous in S. Africa and S. America.	386. Iridaceae, p. 647.	Rhizomes or corms, rarely bulbs; perianth becoming zygomorphic; ovary inferior; stamens reduced to 3; style-arms sometimes petaloid; abundant endosperm.
	101. DIOSCOREALES	
Derived from the *Liliaceae*; habit often climbing; mostly broad 'Dicotyledonous' leaves with prominent nerves and reticulate venation.	387. Stenomeridaceae, p. 654. 388. Trichopodaceae, p. 654. 389. Roxburghiaceae, p. 656.	Herbs or climbers from rhizomes or tubers; stem leafy; flowers small, becoming unisexual; ovary superior to inferior; seeds often winged.
Something of a parallel group to the *Menispermaceae* in the Dicotyledons, with similar habit and flower-structure. — Mainly Tropical and Warm Temperate Regions.	390. Dioscoreaceae, p. 658.	
	* * * * *	
	102. AGAVALES	
Intermediate between the *Liliaceae* proper and the Palms although not exactly the path between them; habit becoming woody and xerophytic; leaves often fibrous; remarkable inflorescences with smallish flowers becoming unisexual. —Mostly in warm often arid regions.	391. Xanthorrhoeaceae, p. 660. 392. Agavaceae, p. 662.	Perennials with often woody stock or stem, reaching tree form; flowers becoming dioecious, numerous, and small; perianth becoming dry and often glumaceous.
	* * * * *	
	103. PALMALES	
Derived from the Liliaceous stock, perhaps through part of the *Agavales* (cf. *Dracaena, Yucca, Cordyline,* &c.).—A large climax group nearly confined to the Tropics; very abundant in Indo-Malaya.	393. Palmae, p. 665.	Stem herbaceous to climbing, or tall tree forms and woody; leaves often large, fibrous; flowers small, in panicles, becoming dioecious, subtended by large spathe-like bracts; ovary superior; ovule solitary; berry or drupe; seeds with endosperm.

Notes on affinity (origin and further development)	*Sequence of orders (cohorts) and families. A cross-line indicates the climax of a group, asterisks a local climax*	*General characters and tendencies of orders*
	104. PANDANALES	
Regarded by Engler and Rendle (p. 512) as the most primitive form of Monocotyledons, but here placed as a very advanced reduced group, more or less parallel with the Palms. The coalescence of the fruits into a syncarp is a very advanced character and recalls similar infructescences in *Artocarpaceae*.	394. Pandanaceae, p. 670.	Stems often with aerial roots; leaves often spirally arranged, crowded, mostly spinulose; flowers dioecious, paniculate or densely crowded into spikes enclosed by large spathe-like bracts; perianth rudimentary or absent; ovaries sometimes connate into bundles, in fruit forming a syncarp, the carpels drupaceous or baccate.
	105. CYCLANTHALES	
A very advanced climax group; in this separate line of development equivalent to the *Araceae*.	395. Cyclanthaceae, p. 672.	Flowers monoecious, crowded on a spadix, embraced by deciduous spathe-like bracts; perianth much reduced or absent.
	106. HAEMODORALES	
An advanced group, probably showing the evolution of the *Orchidaceae*, through *Curculigo* (*Hypoxidaceae*) and probably also of *Burmanniaceae* (see p. 674).—Tropics and Subtropics, mainly in the S. Hemisphere.	396. Haemodoraceae, p. 674. 397. Hypoxidaceae, p. 678. 398. Velloziaceae, p. 678. 399. Apostasiaceae, p. 680. 400. Taccaceae, p. 683. 401. Philydraceae, p. 683.	Rootstock a rhizome or rarely a corm; perianth-segments becoming valvate; stamens numerous to 6, free or in bundles; ovary superior to inferior, 3-locular with axile, or 1-locular with parietal placentas; seeds mostly numerous.
	107. BURMANNIALES	
Difficult to place, but probably developed from the preceding stock on parallel lines with the *Orchidaceae*, having similar seeds; connected with the *Apostasiaceae* through *Apostasia* and *Campylosiphon*.	402. Burmanniaceae, p. 685. 403. Thismiaceae, p. 687. 404. Corsiaceae, p. 689.	Mostly saprophytes; leaves usually reduced; perianth tubular, outer lobes valvate; stamens 6 or 3; ovary inferior; seeds minute, very numerous.
	* * * * *	

Notes on affinity (origin and further development)	*Sequence of orders (cohorts) and families. A cross-line indicates the climax of a group, asterisks a local climax*	*General characters and tendencies of orders*
	108. ORCHIDALES	
As stated above, derived through the *Haemodorales* from the *Liliaceous* stock; the climax group of the petaloid Monocotyledons, and as noted under that group somewhat of a parallel with the *Zingiberales*.—World-wide distribution.	405. Orchidaceae, p. 691.	Terrestrial or epiphytic or saprophytic; flowers strongly zygomorphic; perianth segments in 2 whorls, usually petaloid, variously modified; stamens 2 or 1; pollen from granular to waxy and in masses; ovary inferior; seeds very numerous and minute, without endosperm.

DIVISION III. **Glumiflorae** (see p. 695)

	109. JUNCALES	
Reduced and becoming unisexual, from the *Liliaceous* stock.—Very numerous in the S. Hemisphere.	406. Juncaceae, p. 697. 407. Thurniaceae, p. 699. 408. Centrolepidaceae, p. 699. 409. Restionaceae, p. 700.	Herbs, rarely sub-shrubby; leaves linear, grass-like, sheathing at the base, blade often quite reduced; flowers anemophilous, becoming unisexual; perianth present and glumaceous or absent; stamens 6–1; fruit usually a capsule; seeds with endosperm.
	110. CYPERALES	
Derived through *Juncaceous* stock; a climax group with world-wide distribution and developed parallel with the grasses, representing that group in moist and swampy areas.	410. Cyperaceae, p. 704.	Similar to preceding but perianth reduced to scales or setae or absent; fruit an indehiscent 'nutlet'; stems rarely hollow.
	* * * * *	
	111. GRAMINALES	
A large climax group and the most generally successful and enduring of all types of vegetation; not easily traced back to its origin, but perhaps developed parallel with the *Cyperaceae* through the *Juncaceous* stock from the *Liliales*.	411. Gramineae, p. 710.	Similar to *Cyperaceae* but flower subtended by 2 bracts (lemma and palea); perianth usually represented by lodicules; fruit a caryopsis, rarely a nut, berry, or utricle; stems mostly hollow between the nodes.

KEY TO THE ARTIFICIAL GROUPS OF MONOCOTYLEDONES

A. Ovary completely superior:

B. Perianth present, or if small or very reduced or modified, or absent, then flowers not accompanied by glumaceous bracts or bracteoles (glumes):

C. Carpels free or only slightly united at the base, or gynoecium reduced to 1 carpel with 1 stigma; mostly aquatic, sometimes marine plants Group 1 (p. 527)

CC. Carpels more or less completely united, with usually more than 1 stigma; rarely aquatic:

D. Perianth composed of separate calyx and corolla, the former often green, the latter usually petaloid, sometimes both series dry and hyaline but never united into one tube Group 2 (p. 529)

DD. Perianth composed of similar or subsimilar segments in two or one series, usually very conspicuous and petaloid, if united then connate in the lower part into a single tube, sometimes (when inflorescence a spadix) very small and inconspicuous Group 3 (p. 530)

DDD. Perianth sepaloid or dry and glumaceous, usually very small or 0; flowers mostly small and inconspicuous, and arranged in spadices or panicles and often subtended by large spathaceous bracts; or plants grass-like or sedge-like with very small flowers Group 4 (p. 531)

BB. Perianth absent or represented by 'hypogynous setae' or 'scales' or lodicules, with the flowers minute, arranged in spikelets and in the axils of scaly bracts (glumes) Group 5 (p. 532)

AA. Ovary semi-inferior Group 6 (p. 532)

AAA. Ovary completely inferior:

E. Perianth composed of separate calyx and corolla, remaining in two distinct series, the calyx often green or different from the inner petaloid series Group 7 (p. 533)

EE. Perianth-segments more or less all alike and usually petaloid, mostly 6, sometimes 3, free or often united at the base into a single tube Group 8 (p. 534)

GROUP 1

Ovary completely superior; perianth present, or if small or very reduced or modified or absent, then flowers not accompanied by glumaceous bracts or bracteoles (glumes); carpels free or only 1 carpel with 1 stigma

Flowers bracteate:

Ovules spread all over the inner surface of the carpels or intruding septa; carpels dehiscent; flowers often in umbels or solitary, usually involucrate with spathaceous bracts *Butomaceae*

Ovules inserted on a placenta or at the base or apex of the carpels:
Herbs with green leaves, not saprophytic; mostly aquatic or semi-aquatic;
Leaves not ligulate, often pellucid-punctate or lined; carpels usually numerous (more than 3), in an irregular bunch or more rarely in a whorl; petals often clawed, usually very different from the sepals, the latter mostly green *Alismataceae*
Leaves ligulate, subterete; carpels 3 (–6), divaricate in fruit; perianth-segments subsimilar; stamens 6; anthers basifixed, extrorse; stigmas sessile *Scheuchzeriaceae*
Saprophytic herbs with very reduced scale-like colourless leaves:
Carpels 3, divaricate in fruit; perianth imbricate; flowers bisexual *Petrosaviaceae*
Carpels numerous, crowded; perianth valvate; flowers unisexual or polygamous *Triuridaceae*
Tall palms; leaves plicate in bud; flowers in panicles with spathaceous bracts *Palmae*
Flowers without bracts (sometimes the single perianth-segment somewhat bract-like):
Styles heteromorphous; flowers unisexual and bisexual, in the latter the style absent and the flowers in spikes *Lilaeaceae*
Styles homomorphous or absent:
Terrestrial herbs with spike-like racemes or spikes of small flowers; carpels 6 or 4 *Juncaginaceae*
Freshwater aquatics:
Flowers in racemes or spikes:
Flowers usually arranged on one side of the inflorescence; stamens 6 or more, on fairly long filaments; perianth-segments 3–1 or absent, sometimes bract-like *Aponogetonaceae*
Flowers all around the axis of the inflorescence:
Flowers bisexual; stamens 4, inserted on the claws of the perianth-segments; anthers subsessile; carpels 4 *Potamogetonaceae*
Flowers unisexual, in very dense cylindrical spikes *Typhaceae*
Flowers in globose clusters *Sparganiaceae*
Flowers axillary, solitary or in small cymes; stamens often solitary:
Carpels 2 or more; ovule pendulous *Zannichelliaceae*
Carpel solitary; ovule basal *Najadaceae*
Flowers minute, 1–3 in a minute membranous spathe; floating plants, with minute cellular green frond-like plant body *Lemnaceae*
Marine or salt marsh plants:
Flowers spicate:
Flowers bisexual, all around the axis:
Carpels 4 or more *Ruppiaceae*
Carpel solitary *Posidoniaceae*
Flowers monoecious or dioecious; flowers on one side of a flattened axis *Zosteraceae*
Flowers axillary or cymose *Zannichelliaceae*

GROUP 2

Ovary completely superior, syncarpous; perianth of separate calyx and corolla, the former often green, the latter usually petaloid, sometimes both series dry and hyaline but not united into one tube

Branches modified into cladodes and bearing the flowers on their surface or margins; leaves reduced to scales *Ruscaceae*

Branches and leaves not as above:

Flowers usually in cymes, panicles, racemes, or spikes, or rarely solitary, but not capitate and without an involucre of bracts, sometimes enclosed by large leafy boat-shaped bracts or coloured leaves; leaf-sheath usually closed; seeds mostly with a distinct pore-like 'stopper' (embryostega):

Leaves plicate in bud; usually tall palms with large panicles of small flowers with large spathaceous bracts *Palmae*

Leaves not plicate:

Ovary 3–2-locular, with the ovules on axile or basal placentas; leaf-sheaths closed:

Flowers ebracteate; small herbs with spike-like racemes of small flowers *Juncaginaceae*

Flowers bracteate:

Perianth of (usually green) calyx and petaloid corolla:

Ovules few to 1; leaves never cirrhose at the tip; fruit usually a capsule; seeds with a small 'stopper' (embryostega):

Glandular hairs absent; flowers cymose or solitary *Commelinaceae*

Glandular hairs present; flowers spicate *Cartonemataceae*

Ovules numerous; fruit usually fleshy and indehiscent; anthers often versatile; seeds without a 'stopper' but often appendaged *Bromeliaceae*

Perianth dry or somewhat petaloid, small; ovule solitary; stems erect or climbing:

Fruit indehiscent; leaves often cirrhose at the tips *Flagellariaceae*

Fruit dehiscent; leaves never cirrhose *Xanthorrhoeaceae*

Ovary 1-locular, with 3 parietal placentas:

Herbs:

Leaves very narrow, crowded, linear or thread-like, not sheathing, bidentate at the apex; stamens 3; style simple *Mayacaceae*

Leaves broad and green, opposite or whorled; stamens 6; style branches 3 *Trilliaceae*

Woody climbers or shrubs *Philesiaceae*

Flowers in heads and very small, often surrounded by two or more involucral bracts or unilaterally spicate within a spathe; perianth often more or less hyaline:

Flowers bisexual; ovules parietal or ascending from the base:

Stamens 6, without staminodes; anthers opening by a pore; sepals equal; involucral bracts (when present) foliaceous and often two, or flowers unilaterally spicate and within a folded spathe *Rapateaceae*

Stamens 3, often with 3 staminodes; anthers opening by slits; sepals unequal, one larger than the others and forming a hood over the corolla *Xyridaceae*

Flowers unisexual, monoecious, crowded into small heads; inner perianth-segments often united; ovule solitary, pendulous; perennials or rarely annuals *Eriocaulaceae*

GROUP 3

Ovary completely (mostly) superior, syncarpous; perianth of similar or subsimilar segments in two or one series, usually very conspicuous and petaloid, if united then connate in the lower part into a single tube, sometimes (when inflorescence a spadix) very small and inconspicuous

Flowers arranged in a scapose umbel subtended by more or less membranous spathaceous bracts; rootstock usually a bulb; leaves radical and mostly linear *Amaryllidaceae*

Flowers not in umbels, or if rarely subumbellate or rarely in heads then bracts not spathaceous:

Flowers in a spadix subtended by or enclosed in a spathe, very small and inconspicuous and often unisexual *Araceae*

Flowers not in a spadix and without a spathe:

Branches modified and leaf-like (cladodes) and bearing the flowers on their margins or surface, the true leaves reduced to scales; woody plants; filaments connate into a column; fruit a berry *Ruscaceae*

Branches not modified or if so (*Asparagus*) then not bearing the flowers:

Aquatic herbs; inflorescence subtended by a spathe-like leaf-sheath; seeds ribbed; floral bracts absent or very small; stems or branches bearing only 1 leaf *Pontederiaceae*

Terrestrial or marsh plants; inflorescence not subtended by a spathe-like leaf-sheath; floral bracts rarely absent:

Stamens more than 1; flowers actinomorphic:

Anthers usually 2-locular; flowers mostly bisexual; leaves mostly with parallel nerves and veins:

Leaves alternate, or the lower alternate and the upper in a pseudo-whorl at the top below the flowers:

Woody climbers or shrubs with reticulate leaves:

Stamens 6:

Ovules numerous *Philesiaceae*

Ovules solitary in each loculus *Xanthorrhoeaceae*

Stamens 4; ovules 2 to many *Roxburghiaceae*

Herbs or herbaceous climbers, usually with parallel-veined or nerved leaves; or if woody or tree-like then leaves in dense tufts at the base or apex of the stems:

Anthers opening by slits or very rarely by pores; ovary completely superior; rootstock a rhizome or bulb, rarely a corm:

Ovary composed of 6 carpels; flowers ebracteate; inner perianth-segments inserted higher than the outer *Juncaginaceae*

Ovary composed of 3 carpels; flowers usually bracteate; fruit a capsule or berry:
Perianth not dry and not very small:
Plants not or only slightly xerophytic; leaves not fibrous; style usually divided *Liliaceae*
Plants usually very xerophytic; leaves mostly fibrous, in a dense tuft either at the base or apex of the stem; flowers mostly in large panicles *Agavaceae*
Perianth dry and small; plants usually markedly xerophytic; style simple *Xanthorrhoeaceae*
Ovary as above; flowers mostly ebracteate; fruit drupaceous *Flagellariaceae*
Anthers opening by pores; ovary partly inferior; rootstock a corm or flattened tuber *Tecophilaeaceae*
Leaves opposite, or all whorled in the middle or at the top of the stem and then subtending the flower or flowers; flowers terminal, solitary or several and subumbellate or paniculate:
Small herbs with soft herbaceous leaves and few flowers *Trilliaceae*
Large and often woody plants with fibrous leaves and usually large panicles of flowers *Agavaceae*
Anthers 1-locular by confluence of the loculi; flowers small, mostly dioecious; stem climbing or straggling, often prickly; leaves 3–5-nerved, with reticulate venation *Smilacaceae*
Stamen 1, at the base of the anticous segment; flowers very zygomorphic *Philydraceae*

GROUP 4

Ovary completely superior, syncarpous; perianth sepaloid or dry and glumaceous, usually very small and inconspicuous or rarely absent; flowers often arranged in spadices or panicles or heads, usually subtended by large spathaceous or leafy bracts; or plants grass-like or sedge-like

Leaves plicate in bud, with strong parallel nerves, often pinnately or flabellately divided or nerved:
Perianth-segments 6, in two distinct series; mostly tall plants with simple or little-branched stems; flowers small, in panicles or spikes *Palmae*
Perianth-segments 4 or many, or absent; dwarf plants with often deeply bilobed leaves; flowers in dense spikes *Cyclanthaceae*
Leaves not plicate in bud:
Inflorescence without spathaceous but sometimes with glumaceous leaf-like bracts; leaves linear, often tufted at the base of the stem:
Anthers dorsifixed, versatile; style simple or nearly so *Xanthorrhoeaceae*
Anthers basifixed, erect:
Flowers bisexual:
Perianth-segments, when present, in whorls:
Stamens 3 or more; ovules numerous or few; leaf-blade usually well developed; perianth present; ovules, when solitary, erect *Juncaceae*

Stamens 1 or rarely 2; leaves small; perianth absent; ovule solitary, pendulous *Centrolepidaceae*
Perianth-segments irregularly arranged; flowers in globose or oblong heads subtended by long foliaceous bracts *Thurniaceae*
Flowers dioecious; leaves mostly reduced to sheaths; mainly Southern Hemisphere *Restionaceae*
Inflorescence subtended by a spathaceous bract, or with spathaceous bracts:
Flowers bisexual, or if unisexual then monoecious, though sometimes separated on the spadix and often accompanied by neuter flowers:
Terrestrial or very rarely (*Pistia*) aquatic and then with well-developed leaves *Araceae*
Aquatic plants, floating; plant body minute, not differentiated into stem and leaves; flowers very minute, perianth absent *Lemnaceae*
Flowers dioecious or very rarely monoecious; floral bracts absent:
Herbaceous, aquatic plants; leaves without prickles; flowers in dense cylindrical spikes *Typhaceae*
Shrubs or trees; margins of the usually spirally coiled leaves often prickly; aerial roots often present *Pandanaceae*

GROUP 5

Ovary superior; perianth absent or represented by 'hypogynous setae' or 'scales' or 'lodicules'; flowers minute, generally in spikelets and in the axils of a scaly bract

Fruit dehiscent; small herbs mostly of the Southern Hemisphere; ovule pendulous; stamens 1 or rarely 2 *Centrolepidaceae*
Fruit indehiscent; ovule erect or ascending:
Flowers in the axil of a single bract and collected into spikelets, the latter variously arranged, from solitary to umbellate, paniculate, or capitate; leaves usually with closed sheaths; stems mostly solid and triquetrous; embryo free from the pericarp *Cyperaceae*
Flowers enclosed by a bract and bracteole (lemma and palea), arranged in spikelets; leaves usually with open sheaths; stems mostly with hollow internodes and usually terete; embryo usually adnate to the pericarp *Gramineae*
Here also the student may run down certain genera of *Xanthorrhoeaceae* (mainly Australian), with more or less woody stems, tufts of long linear leaves, and with panicles, dense spikes, or heads of small flowers, with dry chaffy bracts and with a small but distinct perianth.

GROUP 6

Ovary semi-inferior

Perianth-segments in two distinct series, the outer calyx-like, the inner petaloid; leaves mostly linear and spinulose on the margin *Bromeliaceae*
Perianth-segments similar or subsimilar, sometimes united into one tube:
Anthers opening by pores; rootstock a corm:
Perianth persistent, not circumscissile at the base *Haemodoraceae*
Perianth deciduous, circumscissile at the base *Tecophilaeaceae*

Anthers opening by slits:
Stamens and perianth-segments 6:
Filaments free from one another:
Ovules 2, fruit bursting before maturity and exposing the unripe seeds *Liliaceae* (*Ophiopogoneae*)
Ovules numerous *Haemodoraceae*
Filaments connate into an annulus *Liliaceae* (*Peliosantheae*)
Stamens and perianth-segments 4; rhizome creeping; leaves with close transverse veins *Roxburghiaceae*

GROUP 7

Ovary completely inferior, syncarpous; perianth of separate calyx and corolla, remaining in two distinct series, the calyx often green or different from the inner petaloid series

Inner perianth actinomorphic:
Stamens 3 or more; no petaloid staminodes:
Aquatic; ovules spread all over the inner surface of the carpels or rarely superposed in 2 series; flowers mostly unisexual, solitary or the males several within 2 folded or 1 bifid bracts; outer perianth valvate or induplicate; no endosperm *Hydrocharitaceae*
Terrestrial or epiphytic; ovules confined to placentas; flowers bisexual or very rarely by abortion dioecious:
Calyx actinomorphic, lobes imbricate; endosperm copious:
Stamens 6; bracts often coloured *Bromeliaceae*
Stamens 3; bracts usually membranous *Iridaceae*
Calyx tubular, soon split down one side, 3–5-dentate at the apex; bracts large and spathaceous; flowers unisexual *Musaceae*
Stamen 1, the remainder transformed into petaloid staminodes often more conspicuous than the inner perianth:
Anthers 2-locular; sepals united into a sometimes spathaceous tube; staminodes adnate to the base of the inner perianth; ovules numerous; embryo straight, central; mostly Old World Tropics *Zingiberaceae*
Anthers 1-locular; sepals free or at most connivent:
Ovules numerous in each loculus; embryo straight, central; Tropics generally *Cannaceae*
Ovules solitary in each loculus; embryo much curved; mostly New World Tropics *Marantaceae*
Inner perianth zygomorphic:
Stamens 6 or 5:
Ovary not spirally twisted; pollen granular; seeds with endosperm:
Leaves and bracts spirally arranged; calyx more or less spathaceous; fruit indehiscent *Musaceae*
Leaves and bracts distichous:
Sepals 3, free *Strelitziaceae*
Sepals united into a tube *Lowiaceae*
Ovary spirally twisted; seeds without endosperm *Orchidaceae*

Stamens 3; ovary not twisted; pollen granular; seeds with endosperm *Iridaceae*

Stamens 2 or 1, inserted on a prolongation of the axis (the column), with often the pollen agglutinated into masses; ovary often spirally twisted; seeds very numerous and minute, without endosperm; one of the petals (lip) different from the others *Orchidaceae*

GROUP 8

Ovary completely inferior, syncarpous; perianth-segments usually petaloid, mostly 6, sometimes 3, free or often united at the base into a single tube

Ovules spread all over the inner walls of the carpels or on the intrusive septa; flowers borne in spathaceous bracts; no endosperm *Hydrocharitaceae*

Ovules borne on placentas or at the base or apex of the ovary:

Inflorescence scapose, umbellate, subtended by an involucre of one or more spathaceous bracts, sometimes the flower solitary and subtended by one or more spathaceous bracts:

Perianth actinomorphic; ovary not twisted; stamens 6; seeds with endosperm *Amaryllidaceae*

Perianth zygomorphic; ovary usually twisted; stamens 2 or 1; seeds without endosperm *Orchidaceae*

Inflorescence not as above, or if appearing to be umbellate through crowding then not subtended by an involucre of spathaceous bracts (sometimes the leaves are more or less whorled below the flowers):

Small saprophytic herbs, usually with much reduced scale-like, colourless (rarely green) leaves:

Stamens 6 or 3; ovary not twisted:

Perianth actinomorphic:

Perianth-tube cylindrical, shortly lobed, lobes not appendaged; stamens 3; ovary and fruit winged *Burmanniaceae*

Perianth inflated or campanulate, with filiform or appendaged lobes; stamens usually 6 *Thismiaceae*

Perianth zygomorphic, one of the outer perianth-segments large and ovate-cordate, the remainder linear; stamens 6 *Corsiaceae*

Stamen 1; perianth zygomorphic; ovary usually twisted *Orchidaceae*

Not saprophytic:

Stamens 6 or more:

Fruit a capsule:

Stems leafy (sometimes only 1 leaf); leaves scattered on the stem or often the leaves all crowded at the apex of the shoots:

Flowers bisexual, usually very showy:

Seeds not winged or very slightly so; capsule not very elongated:

Leaves not all crowded at the apex of the stem or branches; stems not woody:

Perianth-segments free, sometimes somewhat unequal either in shape or colour, often mottled or spotted *Alstroemeriaceae*

Perianth-segments united at the base, subequal; leaf solitary on each shoot *Trichopodaceae*

Leaves all crowded at the apex of the woody stem, fibrous, the basal sheaths persistent and forming a dense covering *Velloziaceae*

Seeds winged; capsule much elongated; perianth-segments united into a tube; leaves with numerous nerves and cross-nerves *Stenomeridaceae*

Flowers unisexual, usually very small and inconspicuous; seeds mostly winged; usually climbers with tuberous roots *Dioscoreaceae*

Stems with a tuft of leaves only at the base or leaves all radical or stem leaves much reduced and smaller than the basal leaves:

Perianth usually very woolly-tomentose outside, the hairs often branched; embryo marginal, not wholly enclosed by the endosperm *Haemodoraceae*

Perianth usually glabrous, or if hairy then hairs not branched; embryo enclosed by the endosperm; leaves mostly fibrous:

Inflorescence scapose, radical, flowers solitary to spicate or racemose; perianth without a tube (but sometimes the ovary long-beaked and resembling a narrow tube) *Hypoxidaceae*

Inflorescence terminal, long-racemose, spicate, or paniculate, sometimes very large; perianth usually with a distinct tube *Agavaceae*

Fruit a berry or indehiscent:

Herbs (not climbing):

Leaves entire:

Leaves linear, with parallel nerves *Hypoxidaceae*

Leaves more or less ovate, with pinnate nerves *Trichopodaceae*

Leaves often much divided; flowers subumbellate *Taccaceae*

Climbers; leaves often broad and with reticulate venation, sometimes deeply divided:

Ovary 3-locular; herbaceous climbers, rarely somewhat woody; ovules 2 in each loculus, superposed *Dioscoreaceae*

Ovary 1-locular, with parietal placentas and numerous ovules *Petermanniaceae*

Stamens 3; perianth rarely zygomorphic; pollen granular:

Climbers, with usually broad sometimes compound leaves and small inconspicuous flowers *Dioscoreaceae*

Herbs, with rhizomes, corms, or rarely bulbs:

Filaments not adnate to the style:

Style lobed in the upper part; indumentum absent or if present not of branched hairs; embryo not marginal *Iridaceae*

Style entire or nearly so; indumentum often of branched hairs; embryo marginal *Haemodoraceae*

Filaments connate in the lower part and with the style; flowers spicate or racemose; style entire, with 3 minute stigmas *Apostasiaceae*

Stamen 1; pollen often agglutinated; ovary often twisted; perianth strongly zygomorphic *Orchidaceae*

DESCRIPTIONS OF ORDERS AND FAMILIES, WITH KEYS TO GENERA OF SMALLER FAMILIES

DIVISION I. CALYCIFERAE

ORDER 83. BUTOMALES

Perennial, aquatic herbs in fresh or salt water; leaves radical or cauline, alternate to whorled; flowers showy to small and minute, bisexual or unisexual, hypogynous to epigynous; perianth 2-*seriate*, the outer usually *green and sepal-like*, the inner petaloid, very rarely absent; stamens numerous or reduced to 3; gynoecium *apocarpous or syncarpous*, if the latter then inferior; ovules numerous, *scattered on the walls of the carpels*; seeds without endosperm.—Temperate and Tropical Regions; in some respects a group parallel to part of *Ranales* in the *Dicotyledons*, especially to the *Cabombaceae*, with similar placentation.

A. Gynoecium apocarpous, superior	*Butomaceae*
AA. Gynoecium syncarpous, inferior	*Hydrocharitaceae*

343. BUTOMACEAE

Perennial, aquatic or swamp rhizomatous herbs, usually with milky juice; leaves basal or cauline, ensiform or flat and dilated, or with elliptic or orbicular blades. Flowers solitary or umbellate. Torus small. Perianth 2-seriate, the outer 3 *sepal-like* or rarely coloured, imbricate, the inner 3 petal-like, imbricate, usually thin and deciduous, very rarely absent. Stamens hypogynous, 8–9, rarely 5, or numerous, in the latter case sometimes the outer filaments without anthers, filaments flattened, free; anthers basifixed, 2-locular, opening by lateral slits. Carpels 6 or more, *free or cohering only at the base*, sometimes crowded into a head. Ovules anatropous, numerous, *scattered on the reticulated branched parietal placentas*. Fruiting carpels free or nearly so, opening by the adaxial suture. Seeds numerous, without endosperm, and with straight or horseshoe-shaped embryo. B.H. 3,1 008 (under Alismataceae). E.P. **2**, 1, 232; Buchenau in Engl. *Pflanzenr.* **4**, 16 (1903); Micheli in DC. *Monographiae* **3**, 84 (1881); Rendle, 213.—Temperate and Tropical Regions; absent from Africa south of the equator.

In regard to its gynoecium the family *Butomaceae* represents probably the most ancient type of the Monocotyledons. Its free carpels recall those of some genera of the family *Helleboracae*. The peculiar placentation of the ovules (all over the inner surface of the carpels) perhaps shows a more ancient character than is to be found in any herbaceous Dicotyledons, except in *Cabombaceae* which is similar in this respect. The other floral parts, however, are generally more advanced than in the *Helleboraceae*, and we may look upon



FIG. 343. Hydrocleys nymphoides (*Willd.*) *Buchen.* (Butomaceae). A, bunch of flowers and leaves. B, young bud. C, staminodes. D, stamen. E, carpels and sepals. F, carpels. G, carpel laid open showing ovules spread over the inner surface. H, ovule. I, seed. (Orig.)

the placentation as a character which has been retained in an otherwise fairly advanced family of flowering plants. The straight embryo in the seed of *Butomus* seems to place that genus nearest to the *Helleboraceae*. The reticulately parietal placentation of the ovules finds its parallel in *Cabombaceae*, which I regard as an advanced type of *Helleboraceae*, whilst the *Cabombaceae* have also trimerous flowers as well as an aquatic habit. *Butomaceae* and *Cabombaceae* are only separated, therefore, by the number of the cotyledons and the absence of endosperm from the seeds of the former family. And we should remember that even some *Ranunculaceae* have only one cotyledon.

As mentioned in the introductory chapter it is difficult to trace the origin of *Amaryllidaceae* with any certainty. The genus *Butomus* perhaps supplies the key to the problem. Its umbels of flowers surrounded by an involucre of bracts suggest the beginning of a line of development which may have culminated in the *Amaryllidaceae*, the intermediate stages, in which the ovary became syncarpous and inferior, having disappeared. The *Butomaceae* have a rhizomatous rootstock and are aquatic or swamp plants, whilst most of the *Amaryllidaceae* are terrestrial and admirably adapted to life in very dry regions by reason of their bulbous rootstock.

Key to the Genera[1]

A. Stamens numerous; petals not persistent: **B.** Carpels numerous (15–20), broad, crowded into a head; stigma sessile; erect marsh herbs; flowers umbellate, with thick pedicels—LIMNOCHARIS (Trop. Amer.). **BB.** Carpels few (up to 8), narrow, with a short style; aquatic floating herbs; flowers solitary, though sometimes crowded—HYDROCLEYS (Trop. S. Amer.). **AA.** Stamens few (6–9); carpels 6–9: **C.** Petals persistent; flowers numerous in an umbel; perennial herbs with creeping rhizomes; leaves linear, erect; embryo of seed straight—BUTOMUS (Temp. Eur. and Asia). **CC.** Petals not persistent: **D.** Flowers few in an umbel; stamens 8–9; annuals; leaves with lanceolate blades; embryo folded—TENAGOCHARIS (*Butomopsis*) (Trop. Afr. to Austral.). **DD.** Flowers solitary; stamens 6 or fewer; perennial?; leaf-blades elliptic, floating—OSTENIA (Uruguay).

344. HYDROCHARITACEAE

Fresh-water or salt-water herbs, partly or wholly submerged; roots terrestrial or floating. Leaves radical and crowded, or dispersed on elongated stems and alternate, opposite, or whorled. Flowers actinomorphic, bisexual or more often unisexual and dioecious, *arranged in a bifid spathaceous bract or within two opposite bracts*, the males usually more than 1, the females solitary; spathes sessile or long-pedunculate, the peduncle sometimes spirally twisted. Perianth-segments free to the base, 1–2-seriate, 3 in each series, or rarely 2, the outer often *green*, *valvate*, the inner imbricate and petaloid. Stamens numerous to 1; anthers 2-locular, loculi parallel, opening by longitudinal slits. Rudimentary ovary present in the male flowers. Staminodes sometimes present in the female flower. Ovary *inferior*, sometimes beaked, 1-locular, with 3–6 (rarely more) *parietal placentas* which sometimes protrude nearly to the middle of the ovary; styles as many as placentas, entire or 2–3-branched; ovules numerous on the placentas. Fruit globose to linear, dry or pulpy, rupturing irregularly. Seeds numerous, without endosperm; embryo straight,

[1] *Elattosis* Gagnep. (*Bull. Soc. Bot. Fr. 86*, 301 (1939) is reported to be a depauperate state of some other plant.

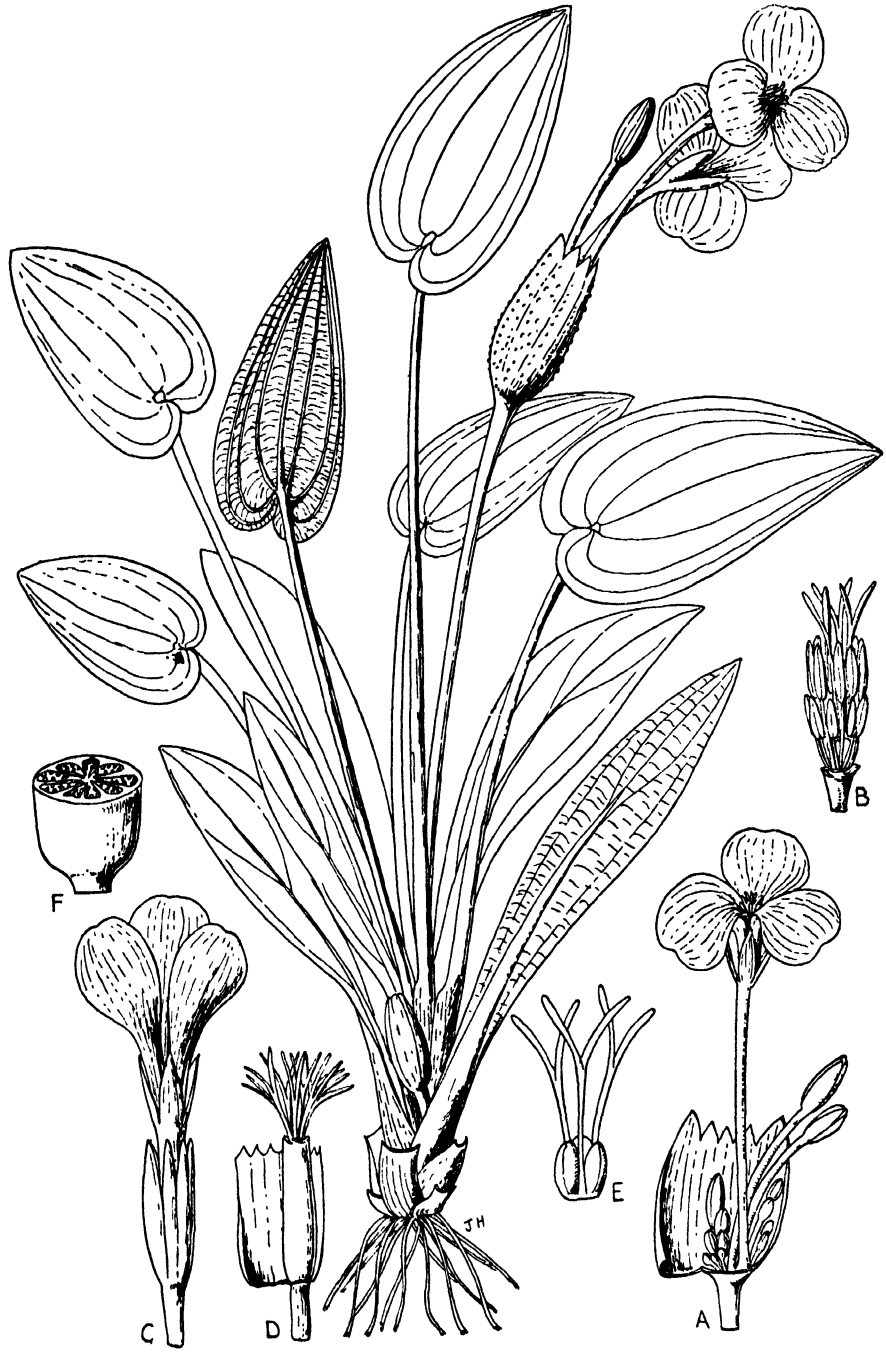


FIG. 344. Ottelia cordata (*Wall.*) *Dandy* (Hydrocharitaceae). A, male inflorescence (spathe opened out). B, stamens and pistillodes. C, female flower. D, ovary and styles (spathe open out). E, pistillodes. F, cross-section of ovary. (Orig.)

with a thick radicle and usually inconspicuous plumule. B.H. 3, 448; E.P. 2, 1, 238. Warmer regions of the world.

Closely allied to the *Butomaceae*, but with an inferior ovary and often with unisexual, even dioecious flowers. These two families were widely separated in Bentham and Hooker's system, but associated by Engler in the *Helobiae*, sub-order *Butomineae*. The peculiar placentation shared by these families is unique in the Monocotyledons.

Key to the Subfamilies, Tribes, and Genera (by J. E. DANDY)

A. Fresh-water (or rarely marine) plants, pollinated at or above the surface of the water; pollen sphaeroid I. *VALLISNERIOIDEAE*

B. Spathes composed of 1 or 2 free bracts; flowers unisexual; styles 6–9, free, 2-fid; dissepiments well developed, much intruded towards the centre of the ovary; acaulous plants with alternate leaves:

C. Female flower and fruit manifestly pedicellate; leaves (at least the upper) clearly differentiated into lamina and petiole, the lamina floating or emersed; perianth double (or sometimes single in the female flowers); stoloniferous fresh-water plants, rooted or floating 1. *Limnobieae*

CC. Female flower sessile or subsessile within the spathe, the fruit sometimes becoming shortly pedicellate; leaves undifferentiated into lamina and petiole, submersed or partially emersed; spathes composed of 2 bracts; perianth double:

D. Fresh-water plants, rising to the surface to flower; male spathes several-flowered, the flowers bracteolate; petals much larger than the sepals; fruit smooth 2. *Stratioteae*

DD. Marine plants, not rising to the surface to flower; male spathes many-flowered, the flowers ebracteolate; petals subequalling the sepals; fruit setose-tuberculate 3. *Enhaleae*

BB. Spathes composed of 2 bracts connate into a tube; fresh-water plants:

C. Styles 3–15, free, 2–3-fid or -lobed (or rarely styles entire and then plants caulescent with opposite or verticillate leaves):

D. Perianth double with the petals well developed and subequalling or larger than the sepals; flowers bisexual or unisexual:

E. Spathes pedunculate; plants acaulous or subcaulescent; leaves alternate, usually more or less differentiated into lamina and petiole, submersed or with the lamina floating; styles 3–15, 2-fid; dissepiments well developed or obsolescent, more or less intruded towards the centre of the ovary; petals much larger than the sepals 4. *Ottelieae*

EE. Spathes sessile in the axils of the leaves; plants caulescent; leaves alternate or opposite or verticillate, undifferentiated into lamina and petiole, submersed; styles 3, entire or 2–3-lobed or -fid; dissepiments obsolete 5. *Anachariteae*

DD. Perianth single or double with the petals rudimentary and much smaller than the sepals; flowers unisexual; male spathes many-flowered; female spathes 1-flowered, pedunculate; plants acaulous or caulescent; leaves alternate, undifferentiated into lamina and petiole, submersed; styles 3, 2-fid or -lobed; dissepiments obsolete 6. *Vallisnerieae*

CC. Styles 3, shortly connate at the base, entire; plants acaulous or caulescent; leaves alternate, undifferentiated into lamina and petiole, submersed; flowers bisexual or unisexual; spathes pedunculate or sessile in the axils of the leaves; perianth present, double, the petals much longer than the sepals but narrow in shape; dissepiments obsolete 7. *Blyxeae*

AA. Marine plants, pollinated beneath the surface of the water; pollen confervoid or united in strings; flowers unisexual; perianth single:

B. Styles 6–12, 2-fid; dissepiments well developed, much intruded towards the centre of the ovary; leaves alternate, undifferentiated into lamina and petiole; spathes composed of 2 bracts connate at the base into a tube, 1-flowered II. *THALASSIOIDEAE*

BB. Styles 2–5 (usually 3), entire; dissepiments obsolete; leaves opposite, undifferentiated or more or less differentiated into lamina and petiole; spathes composed of 2 free bracts III. *HALOPHILOIDEAE*

Subfamily I. VALLISNERIOIDEAE

Tribe 1. **Limnobieae. A.** Perianth double, with the petals much broader and longer than the sepals—HYDROCHARIS (Old World). **AA.** Perianth single or double with the petals narrower than the sepals and only up to about 1½ times as long—LIMNOBIUM (*Hydromystria, Rhizakenia*) (Amer.).

Tribe 2. **Stratioteae.** Only genus STRATIOTES (Eur. and NW. Asia).

Tribe 3. **Enhaleae.** Only genus ENHALUS (Indian and W. Pacific Oceans).

Tribe 4. **Ottelieae.** Only genus OTTELIA (*Bootia, Oligolobos, Xystrolobos, Beneditaea*) (Afr., SE. Asia, Austral., New Caled., and Southeastern S. Amer.).

Tribe 5. **Anachariteae. A.** Flowers entomophilous, unisexual, the petals much longer and broader than the sepals; male spathes 2- to several-flowered; stamens 9; styles 2–3-fid; leaves verticillate—EGERIA (S. Amer.). **AA.** Flowers hydrophilous, the petals subequalling or longer than the sepals but narrower: **B.** All spathes 1-flowered; leaves opposite or verticillate: **C.** Styles 2-lobed or -fid; stamens 3–9—ELODEA (*Philotria, Anacharis*) (Amer. and Brit. Is.). **CC.** Styles entire; stamens 3; flowers unisexual—HYDRILLA (Old World). **BB.** Male spathes several- to many-flowered; styles 2-lobed or -fid: **D.** Male flowers with 3 fertile stamens sometimes accompanied by staminodes; leaves alternate or verticillate—LAGAROSIPHON (Trop. and S. Afr.). **DD.** Male flowers with 2 fertile stamens unaccompanied by staminodes; leaves alternate—NECHAMANDRA (S.E. Asia and NE. Trop. Afr.).

Tribe 6. **Vallisnerieae.** Only genus VALLISNERIA (*Maidenia*) (widespread in the warmer parts of the world).

Tribe 7. **Blyxeae.** Only genus BLYXA (*Hydrotrophus, Blyxopsis, Enhydrias*) (Afr., S.E. Asia, and Austral.).

Subfamily II. THALASSIOIDEAE

Only genus THALASSIA (Indian, W. Pacific, and W. Atlantic Oceans).

Subfamily III. HALOPHILOIDEAE

Only genus HALOPHILA (*Barkania*) (Indian, W. Pacific, and W. Atlantic Oceans).

ORDER 84. ALISMATALES

Marsh or aquatic or rarely saprophytic herbs in fresh or brackish water; rootstock a rhizome; leaves radical, alternate, opposite or clustered; flowers *bracteate*, medium-sized to very minute, bisexual or unisexual, hypogynous; perianth with the *outer segments* often *calyx-like* and the inner petaloid, the inner segments rarely absent; stamens numerous to 3; gynoecium *apocarpous* or carpels united only at the base; ovules numerous to solitary, basal or on the inner angle; seeds without endosperm. Temperate and Tropical Regions, the subaquatic, more primitive members mainly in the former, the completely aquatic, more advanced mostly in the latter.

A. Not saprophytic; marsh plants or aquatics with well-developed green leaves:

B. Leaf-sheaths not ligulate; outer perianth-segments calyx-like; style usually present; carpels often numerous *Alismataceae*

BB. Leaf-sheaths ligulate; perianth-segments subequal and similar; stigma sessile; carpels 6–3 *Scheuchzeriaceae*

AA. Saprophytic; leaves reduced to scales; flowers racemose, small; perianth-segments subsimilar, colourless; carpels 3 *Petrosaviaceae*

345. ALISMATACEAE

Perennial or annual marsh or aquatic herbs, erect, or rarely with floating leaves; leaves basal, with elongated petioles sheathing but open at the base and linear-lanceolate to ovate-rounded often sagittate blades, the principal nerves parallel with the margins and converging at the apex of the blade, the transverse nerves often close and parallel. Flowers often *whorled*, racemose or paniculate, bisexual or rarely polygamous, actinomorphic. Torus flat to globose. Perianth 2-seriate, the outer 3 imbricate, persistent, *green and sepal-like*, the inner 3 petaloid, imbricate and deciduous or rarely absent. Stamens hypogynous, 6 or more, rarely 3, free; anthers 2-locular, extrorse. Carpels *free* or rarely united at the base, sometimes in a single whorl; style persistent; ovules solitary or several, basal or on the inner angle. Fruit a bunch or whorl of achenes, rarely dehiscing at the base. Seeds curved, with horseshoe-shaped embryo; endosperm none. B.H. **3**, 1003, partly; E.P. **2**, 1, 227; Micheli in DC. *Monographiae*, **3**, 29 (1881); Buchenau in Engl. *Pflanzenr.* **4**, 15 (1903); Rendle, 209. See also a paper by Pichon, *Not. Syst.* ed. Humbert **12**, 174 (1946).—Temperate and Tropical Regions, mainly N. Hemisphere.

The *Alismataceae* are familiar to most botanical students in the N. Hemisphere, where their general resemblance to *Ranunculaceae* is obvious. There is some divergence of opinion whether this resemblance is due to real relationship or merely to parallel development in the two great divisions. Although the absence of endosperm and the peculiarity of the embryo of *Alismataceae* point to a considerable gap between the two families, I consider that they are fairly closely related. But for its solitary cotyledon and lack of endosperm, the genus *Ranalisma* Stapf[1] might equally well be placed in *Ranunculaceae*. As may be inferred from the name, it combines the characteristics and appearances of *Ranunculus* and *Alisma*.

[1] The late Mr. H. N. Ridley discovered this remarkable plant in the Malay Peninsula in what he describes as 'the very last spot where one would expect an Alismad, *i.e.* a very dense forest in which rise huge limestone cliffs wooded to the top. In a wide valley between two of these cliffs was a patch of mud perhaps twenty paces across, no water or open swamps



FIG. 345. Machaerocarpus californicus (*Torr.*) *Small* (Alismataceae). A, sepal. B, flower. C, anther. D, section of carpel. E, fruiting carpel.—Partly after U.S. Pacif. Rail. Explor. and Surv.—Note general similarity to Ranunculaceal.

The carpels of *Ranalisma* are densely aggregated in a head, after the manner of *Ranunculus*, and its leaves have pinnate nervation.

The evolution of *Potamogeton* is already foreshadowed in the *Alismataceae* by the genus *Wiesneria*, an African aquatic with spikes of small flowers.

Bentham and Hooker considered the *Alismataceae* to be closely allied to *Najadaceae* ('Ordo Naiadeis artissime affinis, et potius pro subordine inflorescentia floribusque magis evolutis habendus'). A comparison of the characters of the two families, however, will reveal considerable differences. The importance of apocarpy was apparently not then judged to be of much account.

A. Carpels free from each other to the base, not spreading stellately in fruit and not long-beaked: **B.** Inner perianth longer than the outer, petaloid: **C.** Carpels inserted on a large globose to oblong receptacle, spirally arranged in several series: **D.** Flowers bisexual: **E.** Fruiting carpels turgid or more or less compressed, not or only narrowly wing-margined, more or less distinctly longitudinally ribbed: **F.** Stamens 8 or more; fruiting carpels usually 6–9-ribbed: **G.** Fruiting carpels with a short or more or less prominent terminal beak; inflorescence simple or compound—ECHINODORUS (Amer.). **GG.** Fruiting carpels unbeaked or with a very short sublateral beak; inflorescence simple; fruit enclosed in the persistent calyx—HELIANTHIUM (Amer.). **FF.** Stamens 6; fruiting carpels 4–5-ribbed, with a very short terminal beak, not wing-margined; inflorescence simple—BALDELLIA (Eur., NW. Afr.). **EE.** Fruiting carpels strongly compressed, conspicuously wing-margined, unribbed, prominently beaked; inflorescence simple, umbellate, 1–3-flowered—RANALISMA (Malay Penin., Indo-China, Trop. Afr.). **DD.** Flowers unisexual—SAGITTARIA (*Lophotocarpus*, *Hydrolirion*) (Trop. and Temp. Reg.). **CC.** Carpels on a very small receptacle, often in a single series: **H.** Flowers subsolitary; leaves floating—LURONIUM (*Elisma*). **HH.** Flowers several to numerous; leaves erect: **J.** Flowers bisexual: **K.** Carpels crowded, not in a whorl—CALDESIA (*Albidella*) (Eur. to N. Austral., Cuba). **KK.** Carpels in a single whorl—ALISMA (Widely spread). **JJ.** Flowers polygamous; carpels 15–20; stamens 6—LIMNOPHYTON (Trop. Afr., Madag., India). **BB.** Inner perianth shorter than the outer or absent: **L.** Stamens 9; carpels numerous—BURNATIA (*Rautanenia*) (Trop. Afr.). **LL.** Stamens 3; carpels 3–6; flowers mostly sessile—WIESNERIA (India, Afr., Madag.). **AA.** Carpels more or less connate at the base or adnate to the narrow floral axis, in a single whorl and spreading stellately, long-beaked: **M.** Petals toothed; carpels free from each other, 1-ovuled, indehiscent—MACHAEROCARPUS (Calif.). **MM.** Petals entire; carpels united at the base, 2- or more-ovulate, dehiscent—DAMASONIUM (Eur., N. Afr. to Persia, Austral.).

346. SCHEUCHZERIACEAE

Marsh perennial herbs. Leaves linear, sheathing at the base, sheath embracing the stem, *ligulate* at the junction with the blade. Flowers bisexual,

within miles except the river, a stream too rapid and gravelly for anything of this kind to grow in. This patch of mud was covered with the *Ranalisma*. There was no other aquatic plant with it, the whole place for many miles being jungle except of some coffee plantations. I had never seen it before or since.'

An African species, formerly included in *Echinodorus*, has since been found to be congeneric.



FIG. 346. Scheuchzeria palustris *Linn.* (Scheuchzeriaceae). A, part of leaf showing ligule. B, flower. C, stamen. D, carpel. E, same, laid open. F, fruit. G, seed. (Orig.)

racemose, racemes terminal, few-flowered, *bracteate*. Perianth-segments 6, persistent, subequal and similar, free. Stamens 6, free; anthers basifixed, linear, apiculate, extrorse, opening lengthwise. Gynoecium of 6–3 carpels shortly united towards the base on the adaxial side, laterally compressed; stigmas *sessile*, papillous; ovules 2 or few, basal, erect, anatropous. Fruiting carpels divaricate and *free* or nearly so, dehiscing on the curved adaxial side, 1–2-seeded. Seeds without endosperm, ellipsoidal, testa smooth, with rounded cotyledon and small plumule. B.H. **3**, 1012, under *Naiadaceae*; E.P. **2**, 1, 225; Rendle, 209 (under *Juncaginaceae*). In bogs amongst *Sphagnum* in the cooler parts of the N. Temperate Zone.—SCHEUCHZERIA.

A single genus, representing a very ancient type of Monocotyledon, allied to the *Alismataceae* and clearly a reduced type of that family, tending towards the *Liliaceae*.

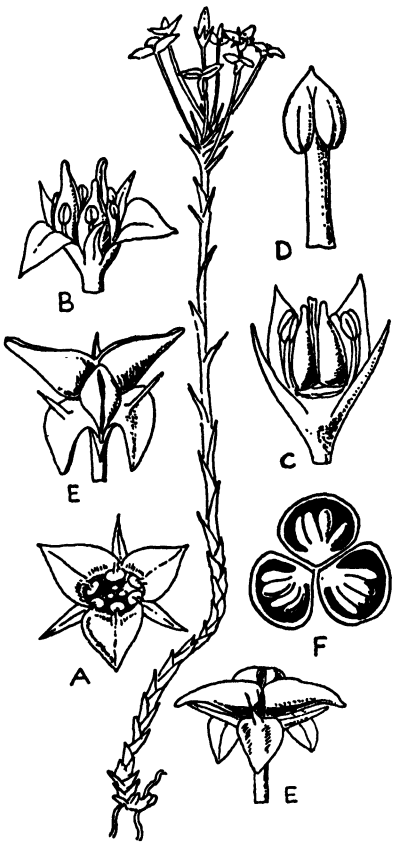


FIG. 347. Petrosavia stellaris *Becc.* (Petrosaviaceae). A, young flower from above. B, open flower. C, same in vertical section. D. stamen. E, fruit. F, transverse section of pistil. (Orig.)

347. PETROSAVIACEAE

Saprophytes; stem slender, simple, erect; leaves reduced, colourless, bract-like, alternate. Flowers bisexual, small, in a terminal corymbiform raceme; bracts small, 1-flowered. Perianth persistent, actinomorphic; segments in 2 distinct series but subsimilar, colourless. Stamens 6, attached at the base of the segments; filaments slender; anthers ovate, dorsifixed, introrse. Carpels 3, free almost to the base, stigma subcapitate on a very short style. Ovules numerous in each carpel, attached to the inner angle. Fruiting carpels spreading, opening by an adaxial slit. Seeds numerous, ribbed. B.H. **3**, 828; E.P. edn. 2, **15***a*, 256 (under *Liliaceae*).—PETROSAVIA (*Protolirion*, *Miyoshia*), (Malay Penin., Borneo, S. China, S. Japan).

This curious genus of 2–3 species, which finds no satisfactory place in any other family, grows in the dense shade of the tropical forests of the Malay Peninsula and Borneo, associated with *Dacrydium*, and it has lately been recorded from S. China and S. Japan. Beccari referred the genus to the *Melanthiaceae*, a group now included in the *Liliaceae*, in which family it was placed by Bentham and Hooker, and by Engler and Prantl. It bears considerable resemblance to some members of the tribe *Narthecieae*, wherein the gynoecium is completely syncarpous. But we should expect a saprophytic derivative from that group to have a syncarpous and not an apocarpous ovary.

I consider its true affinity to be with the genus *Scheuchzeria*, tending towards the *Triuridaceae* in its saprophytic habit.

ORDER 85. TRIURIDALES

Saprophytes, with scale-like, colourless leaves; flowers very small, racemose or subcorymbose, unisexual; perianth-segments 1-*seriate*, *valvate*; stamens 6–2; anthers 2-locular; gynoecium of several *free carpels*; ovule solitary, basal from the inner angle of the carpels; fruit dehiscent.—Tropics.

One family *Triuridaceae*

348. TRIURIDACEAE

Leafless *saprophytic herbs* with simple stems furnished with a few scales, not green. Flowers very small, racemose or subcorymbose, with decurved *bracteate* pedicels, *monoecious*, *dioecious*, or rarely polygamous, actinomorphic. Perianth-segments 3–8, 1-seriate, *valvate*, equal or unequal, sometimes tailed at the apex, reflexed after flowering. Male flowers with 2–6 stamens, sometimes 3 fertile and 3 staminodes, inserted at the base of the perianth; anthers sessile or not, free or immersed in the mass of the receptacle, 2-locular, loculi subglobose, at length confluent and opening by a transverse slit; connective sometimes produced into long subulate appendages (*Schlechter*) or pistilodia (of other authors). Female flowers rarely with staminodes. Carpels several, *free*, 1-locular; style terminal to almost basal. Ovules *solitary*, basal from the inner angle, with *one integument*. Fruiting carpels crowded in a mass, obovoid, opening by a slit lengthwise. Seed erect, with a fleshy white oily undifferentiated nucleus. B.H. **3**, 1001; E.P. **2**, 1, 235; Schlechter in Engl. *Bot. Jahrb.* **49**, 70 (1912).—Tropics.

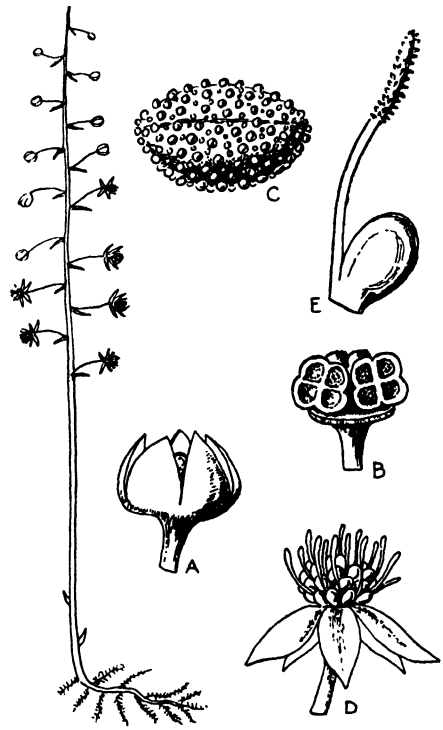


FIG. 348. Sciaphila albescens *Mart.* (Triuridaceae). A, male flower. B, same with perianth removed. C, pollen-grain. D, female flower. E, carpel. (Orig.)

A. Flowers very few (2–4); perianth not divided to the base.—TRIURIS (Trop. Amer.). **AA.** Flowers more numerous; perianth divided to the base or nearly so: **B.** Anther-connective (or pistilodes) produced into a long subulate appendage—ANDRURIS (Celebes, New Guin.). **BB.** Anther-connective (or pistilodes) not produced: **C.** Staminodes absent from the male flowers—SCIAPHILA (*Lilicella*, *Parexuris*) (Tropics). **CC.** Staminodes 3 in the male flowers; stamens 3—SEYCHELLARIA (Seychelles).

ORDER 86. JUNCAGINALES

Marsh perennial or annual herbs; roots from a rhizome, fibrous or tuberous; leaves mostly radical, sheathing at the base; sheaths open; flowers small, bisexual, polygamous, or unisexual, racemose or spicate; *bracts absent*; perianth 6- or 3-merous or of only 1 segment resembling a bract; stamens 6–1, on very short filaments; anthers extrorse; carpels 6–1, free or connate and superior; style various, sometimes elongated in the female flowers; ovules more or less basal; seeds without endosperm.—Temperate and Cold Regions, rare in the Tropics.

A. Perianth-segments 6 or 4; style short or absent from all the flowers; female flowers all of one kind *Juncaginaceae*

AA. Perianth-segment 1; bract-like; style in one kind of female flowers much elongated and filiform; female flowers of two kinds, some at the base of the spike and sessile within the leaf-sheath, others in a spike *Lilaeaceae*

349. JUNCAGINACEAE

Marsh annual or perennial scapigerous herbs; rhizome with sometimes tuberous roots. Leaves mostly radical, linear, sheathing at the base, sometimes

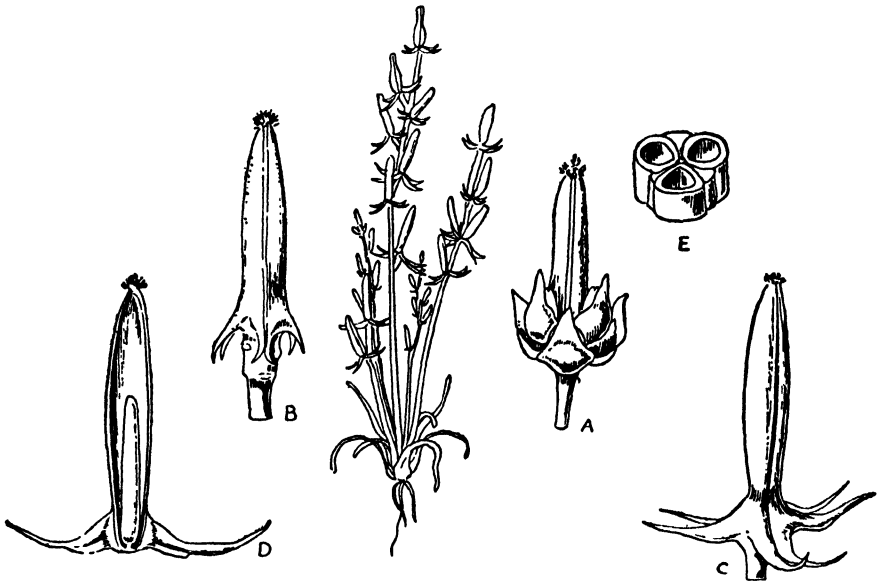


FIG. 349.—Triglochin calcitrapa *Hook.* (Juncaginaceae). A, flower. B, pistil. C, fruit. D, vertical section of fruit. E, transverse section of fruit. Note particularly the absence of bracts. (Orig.)

floating. Flowers *anemophilous*, protogynous, small, racemose or spicate, bisexual or unisexual and dioecious or polygamous, actinomorphic or slightly oblique; *bracts absent*. Perianth-segments 6, 2-seriate, herbaceous or reddish. Stamens 6 or 4; anthers *subsessile*, 2-locular, extrorse, opening by slits lengthwise. Carpels 6 or 4, superior, free or more or less connate; *style short and stout or absent*, stigma often *plumose* or *papillous*; ovule 1, basal, erect,

anatropous. Fruit cylindrical to obovoid, of distinct or connate carpels with straight or recurved apices and sometimes with 2 hooked spurs at the base, dehiscent or indehiscent, sometimes 3 carpels barren. Seeds basal, erect, without endosperm; embryo straight. B.H. **3**, 1012 (as part of tribe of *Naiadaceae*); E.P. **2**, 1, 222; Buchenau in Engl. *Pflanzenr. Scheuchzeriaceae* (1903), partly; L. C. Richard in DC. *Monographiae*, **3**, 94 (1881); Rendle, 208.—Fresh and salt marshes of Temperate and Cold Regions of both Hemispheres; rare in the Tropics and Subtropics.

A small family more abundantly represented in species in Australia. The flowers are protogynous and wind-pollinated. A remarkable feature is the complete absence of bracts, and this enables us to trace the origin of the much-reduced following families which have taken to the water and even to the sea.

Probably the primitive tribe *Helonieae* of the *Liliaceae* has been developed from the same stock as the *Juncaginaceae*; the general facies of its genera is the same and in both groups the flowers are quite *ebracteate*.

A. Ovules erect: **B.** Flowers trimerous, usually bisexual: **C.** Carpels free, not attached to a central axis; aquatic—CYCNOGETON (Austral.). **CC.** Carpels connate, in fruit parting from a central axis; marsh plants—TRIGLOCHIN (*Hexaglochin*) (widely distrib.). **BB.** Flowers dimerous, dioecious; fruits sharply deflexed—TETRONCIUM (Antarct. S. Amer.). **AA.** Ovules pendulous; flowers bisexual; scapes tall, thick, leafless except for a sheath at the base—MAUNDIA (E. Austral.).

350. LILAEACEAE

(Heterostylaceae[1])

Aquatic or marsh herbs; rhizome very short; roots fibrous; stemless; leaves radical, crowded, sheathing at the base, sheaths open, blades thick and linear-subterete, spongy. Flowers monoecious, with a single perianth-segment; male flowers bracteate in a unisexual or androgynous axillary spike; stamen 1, subsessile within the base of the perianth-segment; anthers 2-locular, extrorse, opening by a slit lengthwise, connective slightly produced beyond the loculi; pollen globose; female flowers of two kinds, some at the base of the spike and sessile within the leaf-sheath with a very long filiform style and capitate penicellate stigma, others arranged in a pedunculate spike, sessile and without a style. Ovule solitary, basal, erect, anatropous. Fruit compressed, ribbed, indehiscent, in the solitary flowers 3-angled and unequally 3-horned at the apex, in the spicate flowers narrowly winged and shortly beaked. Seed erect, with an elongated straight embryo, without endosperm. B.H. **3**, 1013 (under *Naiadaceae*).—LILAEA H. and Bpl. (L. subulata *H.* and *Bpl.*) (*Heterostylus* Hook.) (Western N. America, from British Columbia southwards to Chile and Argentine).

According to Jepson (*Fl. Calif.* 77), the pedunculate spikes of this very remarkable monotypic genus are either unisexual or with bisexual flowers in the middle, female below, and male above, all flowers except the female in the axil of a bract; the purely male flowers thus consist of a stamen and subtending bract, the bisexual flowers of a stamen, ovary, and bract, and the female flowers only of an ovary. I consider the so-called bract, however, to be a single perianth-segment as in some species of *Aponogeton*.

[1] I give this as an alternative name for anyone who may quite naturally object to the use of a family name so similar to that of *Liliaceae*.



FIG. 350. LILAEA subulata *Humb. and Bonpl.* (Lilaeaceae). A, fruit from base of plant. B, long-styled female flower from within leaf-bases. C, spike of bisexual flowers. D, seed. E, embryo. F, bisexual flower showing the bract-like perianth-segment, separate stamen, and vertical section of ovary. G, ripe fruit from this type of flower. (Orig.)

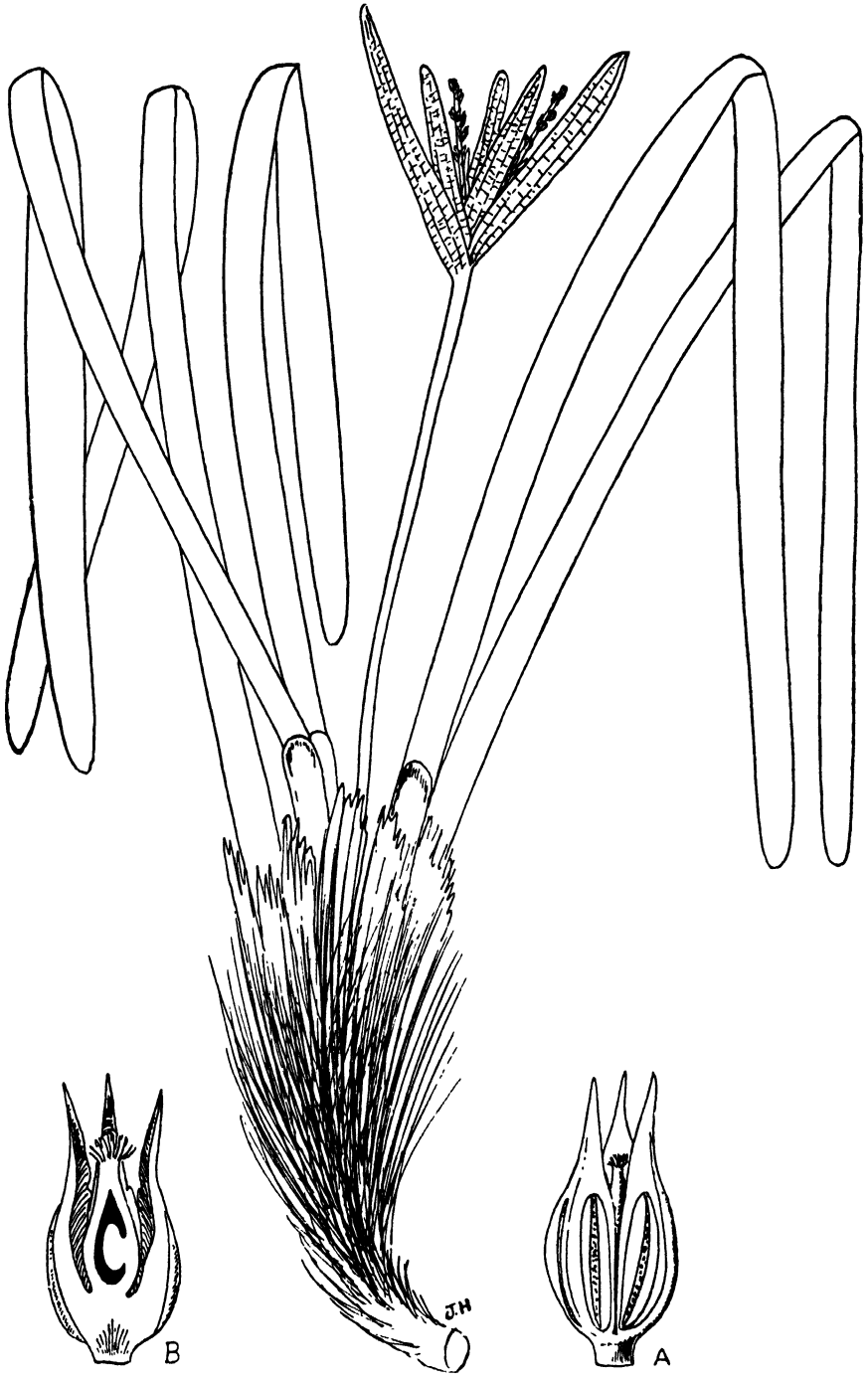


FIG. 351.—Posidonia oceania *Koenig* (Posidoniaceae). A, flower. B, vertical section of flower. (Orig.)

351. POSIDONIACEAE

Submerged *marine perennials*; rhizome and stem densely covered with the *persistent fibrous leaf-bases*. Leaves sheathing at the base, sheaths open and *ligulate*; blades linear, flat, rounded at the apex, leathery, entire or serrulate. Flowers bisexual, spicate, on long axillary and terminal peduncles; spikes several, subtended by reduced leaves; *floral bracts absent*. Perianth absent or of 3 caducous scales. Stamens 3–4, hypogynous; anthers extrorse, large, *sessile*, with a *thick connective* produced beyond the loculi, the latter widely separated; pollen *thread-like*. Ovary superior, 1-locular, with a *sessile* lacerate or muricate stigma; ovule elongated, parietal, micropyle inferior. Fruit ovoid, fleshy, indehiscent. Seed without endosperm; embryo with a straight cotyledon. B.H. 3, 1015 (under *Naiadaceae*); E.P. 2, 1, 205, and Rendle, 207 (under *Potamogetonaceae*). Marine plants on shores of warm seas.—POSIDONIA (S. Eur., N. Temp. Afr., SW. Temp. Asia, and Austral.).

A very interesting genus of which we still know little, good flowering material being rare in herbaria. In my opinion it represents an extreme (climax) marine stage of the *Juncaginaceae* and *Lilaeaceae*, agreeing with these families in its ebracteate, spicate flowers and sessile stigma. It appears to be an interesting parallel to the *Zosteraceae* in the next order, *Aponogetonales*.

ORDER 87. APONOGETONALES

Fresh-water or marine perennials; roots from a rhizome; leaves oblong to linear, *sheathing at the base*; flowers small, bisexual or unisexual, spicate, spikes secund, simple or forked, free or at first *enclosed in the leaf-sheath; bracts absent*; perianth-segments 3–1 or absent, sometimes bract-like on the margin of the flattened axis; stamens 6 or more, or only 1; anthers 2–1-locular; gynoecium *apocarpous* or of one ovary; ovules several to 2; seeds without endosperm.—Widely distributed.

A. Fresh-water habitat; stamens 6 or more; anthers 2-locular; gynoecium of 3–6 free carpels; ovules 2 or more, basal *Aponogetonaceae*

AA. Salt-water habitat; stamen 1; anther 1-locular; gynoecium an ovary with 2 stigmas; ovule solitary, pendulous *Zosteraceae*

352. APONOGETONACEAE

Fresh-water *aquatic herbs* with submerged or floating leaves; rhizome tuberous, with fibrous roots; leaves long-petiolate, oblong-elliptic to linear, with few principal parallel nerves and numerous transverse secondary nerves; flowers bisexual (or rarely by abortion unisexual), spicate-scapose, spike simple or usually 2- (rarely up to 8-) forked, *without bracts*; perianth-segments 1–3 or absent, *sometimes petaloid and bract-like*, equal or unequal, usually persistent; stamens 6 or more, free, hypogynous, persistent; anthers extrorse, small, 2-locular; pollen subglobose or ellipsoidal; gynoecium *apocarpous*; carpels 3–6, sessile; style short; ovules 2 or more, basal, anatropous; mature carpels opening on the adaxial side; seeds without endosperm,

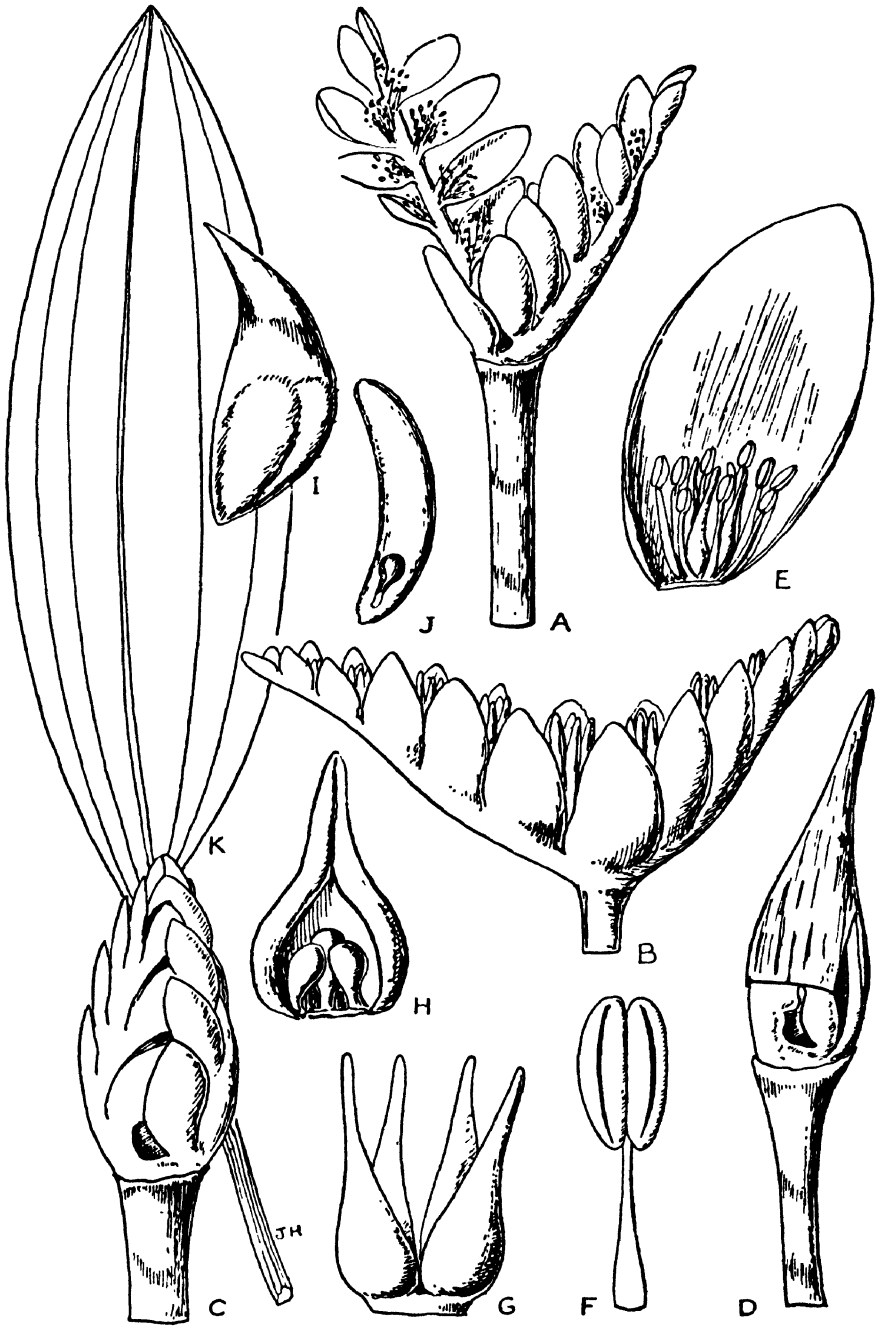
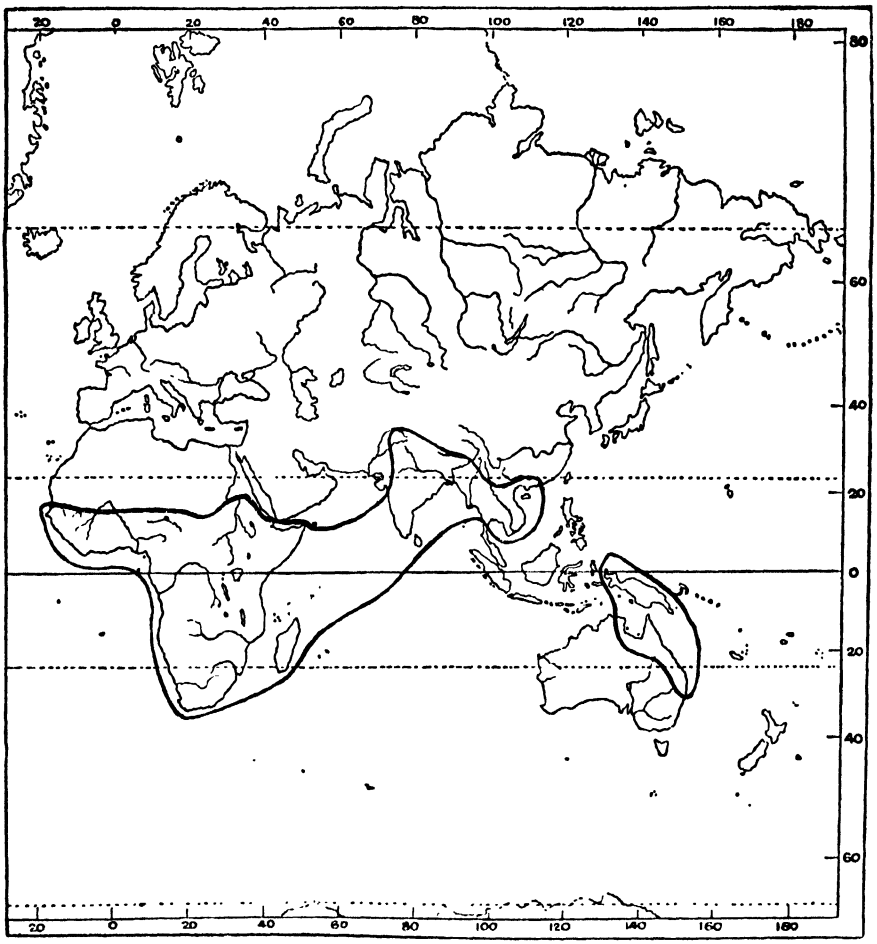


FIG. 352. Aponogeton distachyon *Linn. f.* (Aponogetonaceae). A, inflorescence, showing bract-like perianth-segments. B, the same in fruit. C, same in bud after fall of spathe-like bract. D, same with bract, just before falling. E, flower. F, stamen. G, gynoecium, H, carpel from within. I, seed. J, embryo. (Orig.) Note the bract-like perianth-segments.



Range of Aponogeton (Aponogetonaceae).

embryo straight. B.H. 3, 1013; E.P. 2, 1, 218; *Pflanzenr.* (1906).—Warm Regions from India and S. China through Malaya to Australia; most numerous in Tropical and S. Africa, Madagascar.

A small family of a single genus, APONOGETON, confined to the warmer parts of the Old World. *Aponogeton distachyon* Linn. f. (see Fig. 352), from S. Africa, is commonly cultivated in ponds in Britain and other parts of Europe. The perianth ranges from the more primitive 3-merous type to 1-merous; in the latter case it is often petaloid and bract-like. In some species the perianth is entirely reduced.

353. ZOSTERACEAE

Submerged *marine perennials*, with creeping or tuberous rhizomes; stems flattened, simple or branched, slender. Leaves in two rows, linear, *sheathing at the base*, sheaths with stipule-like margins. Flowers monoecious or dioe-

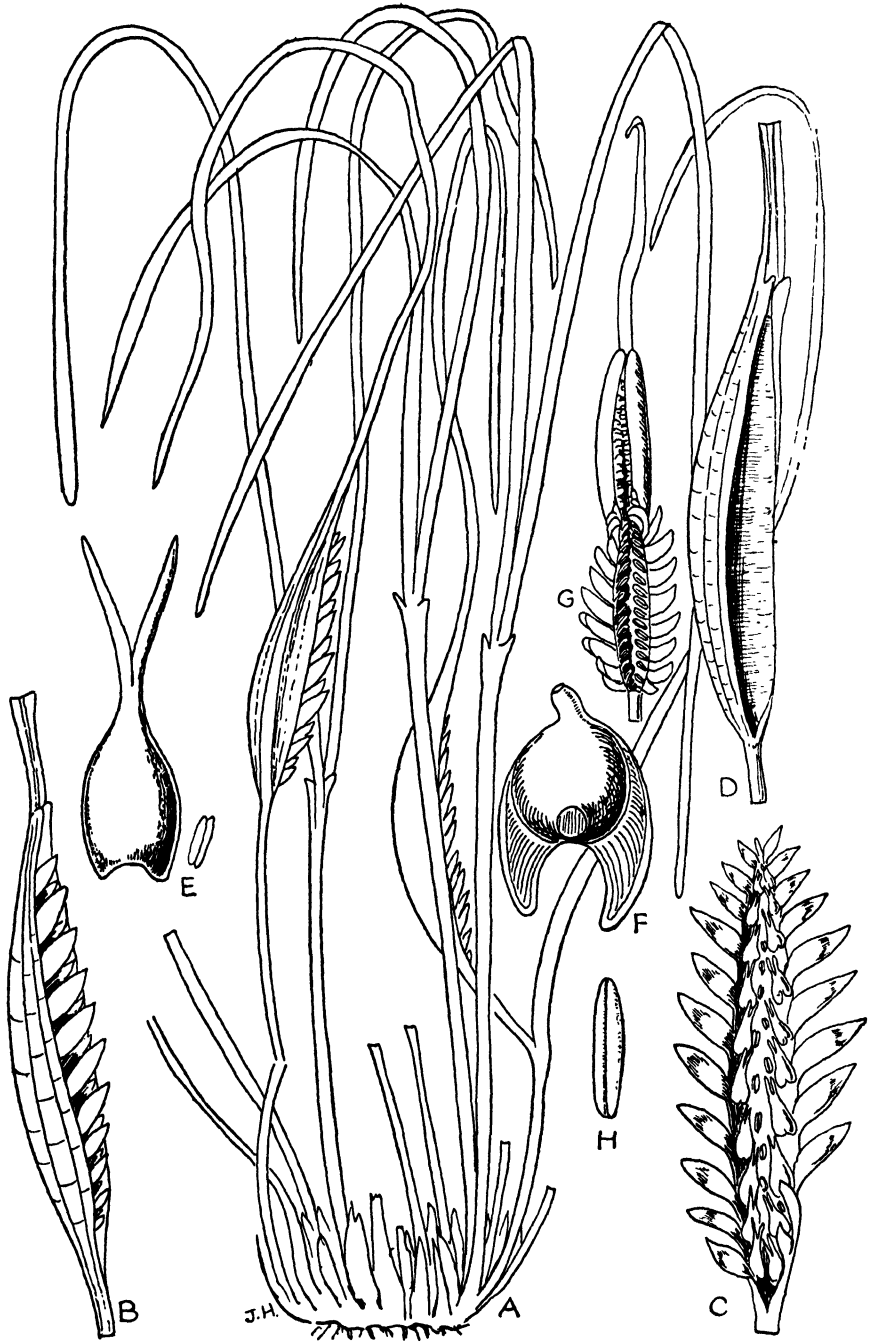


FIG. 353. Phyllospadix scouleri *Hook.* (Zosteraceae). A, whole plant. B, inflorescence. C, female inflorescence, showing bract-like single perianth-segments and female flowers each with a rudimentary stamen. D, leaf-sheath which enveloped the inflorescence. E, female flower without perianth. F, ripe fruit, winged at the base. G, male inflorescence. H, anther. (Orig.)

cious, arranged on one side of a *flattened axis* ('spadix'), at first *enclosed in the leaf-sheath*; *bracts absent*. Perianth absent or represented by a row of bract-like lobes on each side of the axis. Male flowers reduced to *one 1-locular dorsifixed sessile anther* opening by a slit lengthwise; pollen *thread-like*. Female flowers consisting of an ovary with 2 stigmas, and one pendulous orthotropous ovule. Fruit indehiscent or bursting irregularly. Seed pendulous, without endosperm. B.H. 3, 1017 (under *Naiadaceae*); E.P. 2, 1, 194, and Rendle, 207 (under *Potamogetonaceae*). Widely distributed marine plants, usually growing among rocks, from low tide to several feet deep.

USEFUL PRODUCTS: *Grass Wrack* (Zostera marina *L.*); the dried leaves are used for packing and for stuffing mattresses.

Wholly marine flowering plants are very rare, and the two genera composing the family *Zosteraceae* are remarkable in this respect. Family rank is accorded them here as they seem to me to be marine derivations from the fresh-water *Aponogetonaceae*, their inflorescence being very similar. The lateral lobes of the spadix-like inflorescence are probably homologous with the similar more petal-like organs of those species of *Aponogeton*, such as *A. distachyon* Linn. f. (see Fig. 352) whose perianth is reduced to a single bract-like segment.

In this marine family the flowers are very much reduced, the male to a single anther, the female to one carpel, showing even a greater reduction than in *Euphorbia*. The sagittate fruit of *Phyllospadix* is reminiscent of somewhat similar fruits in the more primitive family *Juncaginaceae*.

A. Flowers monoecious: fruits ovoid, not cordate at the base—ZOSTERA (Seas of both Hemisph.). **AA.** Flowers dioecious: fruit cordate-lobate at the base—PHYLLOSPADIX (Western N. Amer. and Japanese Seas).

ORDER 88. POTAMOGETONALES

Fresh-wáter or marine perennials; roots from a rhizome; leaves alternate or opposite, sheathing at the base, sheath often ligule-like at the apex, linear to nearly orbicular; flowers small to minute, *spicate*, *racemose*, or *solitary*, bisexual or unisexual; *bracts absent*; perianth-segments 3–4 or absent; stamens 4–1; anthers 2-locular, *extrorse*, usually on *very short filaments*; gynoecium of several free carpels or of one carpel; ovule solitary, *pendulous* or lateral; fruit indehiscent; seeds without endosperm.—Widely dispersed.

A. Fresh-water plants; perianth present, of 4 clawed valvate free segments; ovule lateral; fruiting carpels sessile *Potamogetonaceae*

AA. Saline water plants; perianth absent; ovule apical; fruiting carpels stipitate *Ruppiaceae*

354. POTAMOGETONACEAE

Aquatic herbs of *fresh water*. Leaves alternate or opposite, those immersed thin, those above water often leathery, sheathing at the base, sheath free or partially adnate to the petiole. Flowers bisexual, small, arranged in pedunculate *axillary spikes*, peduncle surrounded by a sheath at the base; bracts absent. Perianth *present*, of 4 free rounded shortly clawed *valvate segments*. Stamens 4, inserted on the claws of the segments; anthers extrorse, 2-locular, sessile. Gynoecium of 4 sessile free 1-locular carpels; stigmas *sessile* or on



FIG. 354. Potamogeton cheesemanii *A. Benn.* (Potamogetonaceae). A, upper part of plant. B, submerged leaf. C, flower. D, perianth-segment and stamen. E, the same from inside. F, carpels. G, vertical section of carpel. H, fruit. I, seed. J, vertical section of seed. (Partly after Cheeseman.)

short styles; ovule solitary, attached to the *adaxial angle of the carpel*, campylotropous. Fruiting carpels sessile, free, 1-seeded, indehiscent. Seeds without endosperm, embryo with a large 'foot', the plumule enclosed by the cotyledon. B.H. 3, 1018 (under *Naiadaceae*); E.P. 2, 1, 194, partly.

I have limited this family to the type genus *Potamogeton* and *Groenlandia* because I think they represent the first step towards those more highly evolved genera which are completely aquatic, even marine, and with a very reduced floral structure. Their exact relationships are, however, very problematical.

With regard to the interpretation of the floral evelope of *Potamogeton*, I cannot support the view held by some botanists on the Continent[1] (see also Rendle, p. 203) that the four petaloid structures are appendages to the connective of the anthers. This idea was probably held on account of the Englerian theory of the origin of petals. To my mind these petaloid structures are simply normal perianth-segments on the claws of which the extrorse anthers are sessile. In the petaloid Monocotyledons the stamens are always opposite to the perianth-segments, and it is not a great step from those species of *Aponogeton* with more than one perianth-segment to *Potamogeton*. If the anther were introrse in *Potamogeton*, then the petal-like organ might be regarded as an outgrowth from the base of the connective, a very unusual feature indeed in any flowering plant.

A. Leaves except the involucral ones alternate; fruiting carpels drupaceous with hard endocarp and soft exocarp—POTAMOGETON (widely spread). **AA.** Leaves all opposite; fruiting carpels achenial with thin pericarp—GROENLANDIA (Eur., W. Asia, NW. Afr.).

355. RUPPIACEAE

Aquatic herbs of *saline marshes*. Leaves opposite or alternate, linear or setaceous, sheathing at the base. Flowers bisexual, small, few, arranged in terminal spikes at first enclosed by the sheathing base of the leaves, at length much elongated; bracts absent. Perianth *absent*. *Stamens* 2, opposite each other, with very short broad filaments; anthers extrorse, the loculi reniform and separated by the connective. Gynoecium of 4 or more carpels, with peltate or umbonate stigmas; ovule solitary, pendulous from the apex of each carpel, campylotropous. Fruiting carpels *long-stipulate* with spirally twisted stalks, indehiscent. Seeds pendulous, without endosperm. B.H. 3, 1014 (under *Naiadaceae*). Salt marshes throughout Temperate and Subtropical Regions.—RUPPIA.

This family of one genus differs from *Potamogetonaceae* in the nature of its habitat, its terminal spikes, the absence of a perianth, and the long-stipitate fruiting carpels with pendulous seeds.

ORDER 89. NAJADALES

Submerged aquatic perennials or annuals; leaves alternate or opposite, sheathing; flowers minute, *unisexual*, *axillary*; perianth of small scales or absent; stamens 3–1; anthers mostly *sessile*, 4–1-locular; gynoecium of 1–9 free carpels; ovule 1; fruit indehiscent; no endosperm.—Widely distributed in fresh or salt water.

A. Ovule apical, pendulous; carpels 1 or more; perennials *Zannichelliaceae*
AA. Ovule basal, erect; carpel 1; annuals *Najadaceae*

[1] See Graebner in Engl. *Pflanzenr.*, *Potamogetonaceae*.

356. ZANNICHELLIACEAE

Submerged aquatic herbs in *fresh, brackish,* or *salt water*; rhizome creeping, slender. Leaves alternate or opposite, or crowded at the nodes, linear, sheathing at the base, sheaths mostly ligulate at the apex; flowering leaves sometimes reduced to sheaths. Flowers minute, *monoecious* or *dioecious,* axillary, solitary or in cymes. Perianth of 3 small free scales or absent. Stamens 3, 2, or 1; anthers 2–1-locular, opening lengthwise; pollen globose



FIG. 355. Zannichellia palustris *Linn.* (Zannichelliaceae). A, flower. B, stamen. C, carpel. D, same in vertical section. E fruits. (Partly after Martius.)

or thread-like. Gynoecium of 1–9 free carpels; style short or long, simple and with a capitate, peltate, or spathulate stigma, or style 2–4-lobed; ovule solitary, *pendulous.* Fruiting carpels sessile or stipitate, indehiscent. Seed pendulous, without endosperm. B.H. **3,** 1016 (under *Naiadaceae*).—Widely distributed, mainly in salt water.

A. Pollen sphaeroid; plants of fresh or brackish water: **B.** Perianth of the male flowers of 3 small scale-like segments or cupular; anthers sessile; carpels straight: **C.** Stamens 2–3, connate; anthers 2-locular—LEPILAENA (Austral., New Zeal.). **CC.** Stamen 1; anther 1-locular—ALTHENIA (Mediterr.). **BB.** Perianth absent from the male flowers; stamen 1, on a slender filament; carpels curved—ZANNICHELLIA (*Pseudalthenia*) (Cosmopol.). **AA.** Pollen thread-like; marine plants: **D.** Styles simple; one anther attached higher than the other —DIPLANTHERA (Indian Ocean to Polynesia, Southeastern N. Amer., West Indies). **DD.** Styles 2–4-lobed; anthers at an equal height: **E.** Pericarp of fruit not lobed; plants not viviparous; styles 2-fid—CYMODOCEA (*Phycoschoenus*) (widely distributed). **EE.** Pericarp of fruit with 4 accrescent at length pectinate lateral lobes; plants viviparous—AMPHIBOLIS (*Pectinella*) (Indian Ocean and Austral.).

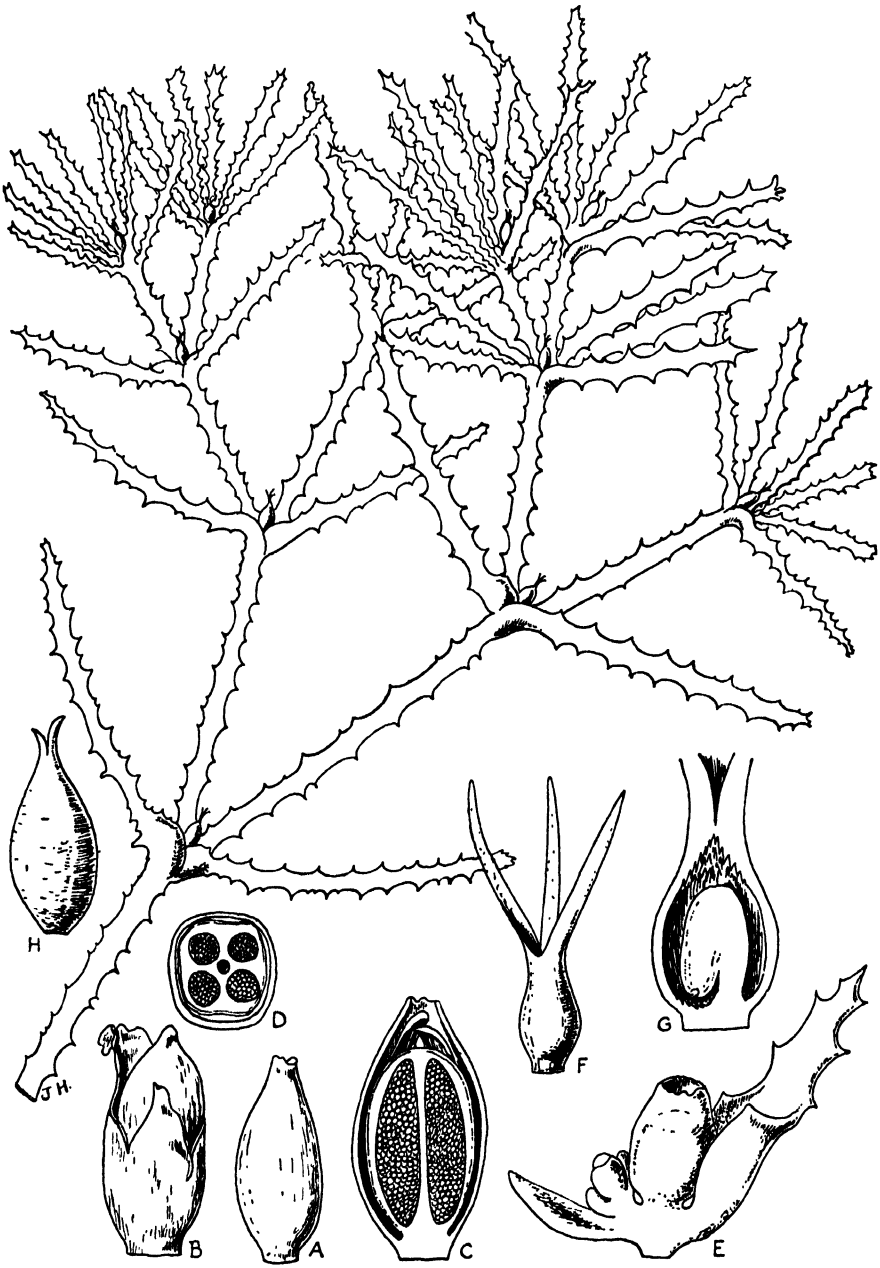


FIG. 356. Najas marina *Linn.* (Najadaceae). A, male flower. B, same within spathe. C, vertical section of male flower. D, cross-section of same. E, male flowers and leaf. F, pistil. G, vertical section of same. H, fruit. (Habit fig. orig., floral parts after Martius.)

357. NAJADACEAE (NAIADACEAE)

Small submerged annual water-plants in fresh or brackish water; stem slender, much branched. Leaves small, sub-opposite or verticillate, sessile, with a sheathing base and linear entire or toothed blade; within the sheath a pair of minute scales. Flowers unisexual, monoecious or rarely dioecious, very small, borne at the base of the branches. Male flower *with 1 stamen*, mostly subsessile and included in a spathe; perianth 2-lipped at the apex; anther sessile, 1–4-locular, opening by slits lengthwise. Female flower without a perianth or this very thin and adhering to the carpel; ovary of 1 carpel, 1-locular, with 2–4 stigmas; ovule solitary, erect from the base, anatropous. Fruit usually embraced by the leaf-sheath, indehiscent. Seed with a thin testa, straight embryo with large hypocotyl and radicle and no endosperm. B.H. **3**, 1018, partly; E.P. **2**, 1, 214; Rendle, in Engl. *Pflanzenr.*, *Najadaceae* (1901); Rendle, 199. Widely distributed in the Temperate and Warm Regions of the World.—NAJAS (*Naias*).

According to the Englerian view as expressed by Rendle (loc. cit.), *Najas* is regarded as an 'apparently primitive type of Monocotyledon'. According to the views on which the system in the present book is based, however, it is looked upon as a very advanced and much reduced type, too reduced in fact to enable us to be very sure of its relationship. For a flowering plant, the habitat—complete submergence in water even during flowering—is anything but primitive; so also the dioecious, minute flowers, the male reduced to a small perianth and a single stamen, the female usually achlamydeous composed of one carpel with one ovule and without endosperm in the seed.

ORDER 90. COMMELINALES

Terrestrial or rarely aquatic herbs; leaves with a *closed sheath* or rarely not sheathing; flowers actinomorphic or zygomorphic, most bisexual, often showy, in cymes or panicles, rarely solitary; perianth 2-seriate, the *outer green and calyx-like*, the inner of three often *clawed* and mostly free petals; stamens 6 or 3; anthers opening lengthwise or by pores; gynoecium of *united carpels*, *superior*; *style* 1; ovules several to solitary, on axial or parietal placentas; fruit capsular or baccate; seeds with endosperm, marked by a *disk-like callosity* ('embryostega', 'embryotega'). Tropical and Warm Regions of the world.

A. Ovary 3–2-locular, with ovules on axile placentas; leaf-sheaths closed:
  B. Perianth of calyx and corolla; ovules few to 1:
    C. Glandular hairs absent; flowers cymose or solitary *Commelinaceae*
    CC. Glandular hairs present; flowers spicate *Cartonemataceae*
  BB. Perianth dry or somewhat petaloid; ovule solitary; erect or climbing plants *Flagellariaceae*
AA. Ovary 1-locular, with parietal placentas; leaves not sheathing, linear or thread-like, bidentate at the apex *Mayacaceae*

358. COMMELINACEAE

Perennial herbs. Leaves with a basal membranous often nervose *closed sheath*, the sheath rarely perforated by the inflorescence. Flowers usually actinomorphic, rarely zygomorphic, bisexual or rarely polygamous, in axil-

lary clusters, or mostly in terminal cymes or panicles, frequently blue or white. Perianth very distinctly *2-seriate*, the *outer series sepal-like* and of usually free imbricate rarely united segments, the *inner petal-like* and usually free, imbricate, rarely united into a slender tube. Stamens 6, or fewer by abortion, hypogynous; filaments free or very rarely some united, in several genera adorned with moniliform often brightly coloured hairs; anthers basifixed, with 2 parallel usually contiguous loculi opening by longitudinal slits or rarely by an apical pore. Ovary always quite *superior*, sessile or shortly stipitate, 3- (rarely 2-) locular; style terminal, *simple*; stigma terminal, often small, capitate or rarely 3-fid. Ovules few to solitary in each loculus, axile, orthotropous. Fruit capsular, usually thin, loculicidally dehiscent, rarely fleshy and indehiscent. Seeds usually crowded with the contiguous faces flat, in one or two series, mostly muricate, ridged, or reticulate; endosperm abundant, mealy; embryo small, marginal or nearly marginal, its position indicated on the outside of the seed by a *disk-like callosity* (embryotega; embryostega). B.H. **3**, 844; E.P. **2**, 4, 60; edn. 2, 15*a*, 159; C. B. Clarke in DC. *Monographiae*, **3**, 115 (1881); Rendle, 275. See also Brückner in Engl. *Bot. Jahrb.* **59**, Beibl. 137 (1926); Pichon, 'Sur les Commelinacées', Lecomte, *Not. Syst.* **12**, 217 (1946).—Mainly Tropical, Subtropical, and Warm Temperate Regions.

USEFUL PRODUCTS: *Siyah Musli roots* (Aneilema scapiflorum *Wight*).

For the purpose of this book, I have abandoned the usual division of the family into tribes because I think it has led to artificial conceptions of the genera, especially with reference to *Tradescantia*. These tribes were determined mainly by the 'Linnean' characters of the relative number of fertile stamens. In the latest edition of the *Pflanzenfamilien*, however, Brückner has broken new ground, and divided the family into two main sections, one with actinomorphic, the other with zygomorphic flowers, the first group being subdivided into two, the one with 6 fertile stamens, the other with 3 fertile stamens, whilst the zygomorphic-flowered group is divided into the *Declinatae* and *Inclinatae*, determined by the flower-buds being bent away from or towards the axis respectively. From herbarium specimens these characters are not easy to observe, on account of the ephemeral nature of the flowers of *Commelinaceae*.

More easily noted characters may be obtained from the inflorescence, and I have used this as a primary character. On this basis, for example, the genus *Descantaria* is separated from *Tradescantia* proper (type *T. virginica*), and becomes an assemblage of closely related species which may have either 6 or 3 fertile stamens. The question as to whether three of the stamens are fertile or infertile is sometimes very difficult to determine, and I have used this character as little as possible in the key.

The key lays no claim to show a natural arrangement, but it is probably not less natural than those based primarily on the number of stamens. Whilst I have split up *Tradescantia* into at least four genera, all of which already bear names, I have not been able to do likewise with *Aneilema*, which needs a monographic study. In that genus, however, the inflorescence, again, would probably provide useful segregative characters, the type with secund subscorpioid cymules being particularly striking. For generic synonymy Brückner's latest work in the new edition of the *Pflanzenfamilien* should be consulted.

The morphology of the family is very interesting. Herbs are predominant, climbers being very rare (*Streptolirion*, *Spatholirion*). The leaves are of the typical monocotyledonous type, with parallel nerves, and sheathing at the base and encircling the stem. The leaf-sheath is always *closed*. A remarkable development has sometimes taken place with regard to the leaf-sheath and inflorescence and is characteristic of certain genera. As if impatient of its protection, the inflorescence has burst through the base of the leaf-sheath in *Forrestia*, *Coleotrype*, *Buforrestia*, and *Campelia*. The last-mentioned has also developed the leafy spathe-like boat-shaped bracts so characteristic of *Commelina* and other genera (see key).

The perianth is always 2-seriate, the outer calyx-like, the inner petaloid. The prevailing colour of the latter is blue or white, and the 'petals' are free and often clawed, or rarely the claws are united into a slender tube (*Coleotrype, Weldenia, Cyanotis* spp., *Zebrina, Setcreasea*). The stamens are usually 6, often three of them modified into staminodes. The anthers open by longitudinal slits, except in *Spironema* (by pores), and the genus *Cochliosperma* is unique in having spirally twisted anthers. The fruit, normally a loculicidal capsule, is indehiscent in *Pollia, Palisota,* and *Athyrocarpus.*

There is not much of phytogeographical interest in the family. It is generally distributed in the Tropics and Subtropics, a few in China and Japan, the Southern U.S.A., and in

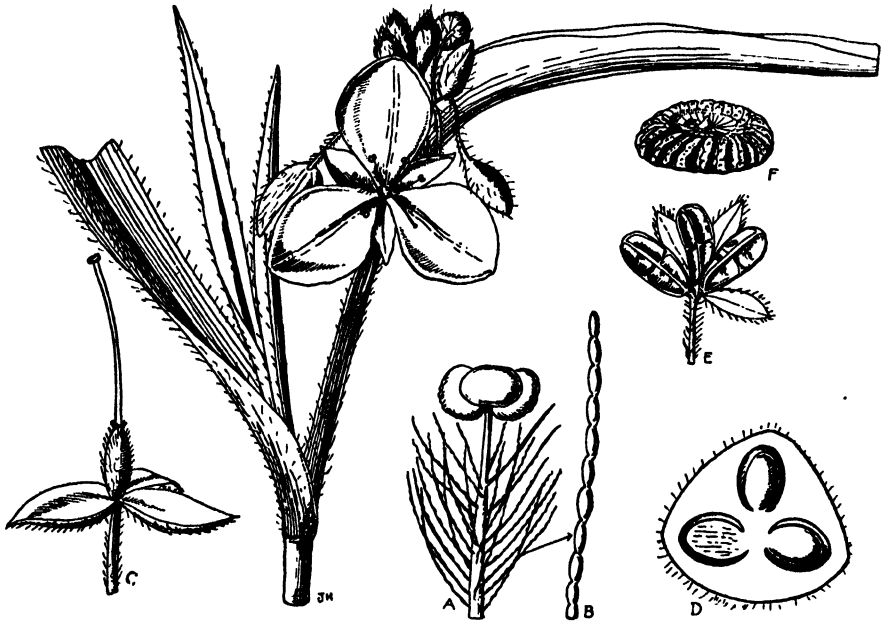


FIG. 357. Tradescantia virginiana *Linn.* (Commelinaceae). A, stamen. B, hair from filament. C, pistil and calyx. D, cross-section of ovary. E, fruit (open). F, seed. (Orig.)

Australia. *Buforrestia,* remarkable for its inflorescence perforating the base of the leaf-sheath, occurs in West Africa and in the Guianas on the opposite side of the Atlantic, whilst a very distinct genus with a similar peculiarity, *Coleotrype,* is common to East Africa, Natal, and the island of Madagascar.

**Inflorescence terminal (rarely also a few smaller clusters of flowers in the upper leaf-axils):*

A. Inflorescence or partial inflorescences not subtended by spathe-like boat-shaped leaves or bracts: **B.** Fruit a capsule: **C.** Fertile stamens 6: **D.** Petals free to the base: **E.** Ovary-loculi 2- or more-ovulate: **F.** Ovules 2-seriate in each loculus: **G.** Flowers bisexual; subacaulescent—PYRRHEIMIA (Trop. S. Amer.). **GG.** Flowers polygamous; acaulescent or climbing—SPATHOLIRION (Malay Penin., China). **FF.** Ovules 1-seriate in each loculus: **H.** Anthers opening by slits lengthwise: **I.** Inflorescence with raceme-like or spiciform branches: **J.** Flowers secund on the axis: **K.** Erect herbs—TINANTIA (Mexico to Brazil). **KK.** Climbers—STREPTOLIRION (Himal., W. China). **JJ.** Flowers



FIG. 358. Pollia crispata *Benth.* (Commelinaceae). A, open flower. B, same from below. C and D, fertile and barren stamens. E, fruit. F, same with shell removed. G, seed, showing 'stopper'. H, vertical section of seed. I, 'stopper' of seed. (Partly after Bauer.)

not secund. **JJ.** (1) Inflorescence and branches raceme-like or cymose—TRADESCANTIA (part)[1] (Amer.). **II.** Inflorescence with clustered flowers or cyme-like branches: **L.** Inflorescence a panicle of small cymules of pedicellate flowers—DESCANTARIA[2] (*Donnellia, Neodonnellia*) (Mexico to Amer.) **LL.** Inflorescence a panicle of head-like densely clustered sub-sessile flowers—SPIRONEMA (Trop. Cent. and S. Amer.). **HH.** Anthers opening by terminal pores—DICHORISANDRA (Trop. Amer.). **EE.** Ovary loculi 1-ovulate: **M.** Ovary and capsule 3-locular—LEPTORRHEO (Trop. Amer.). **MM.** Ovary and capsule 2-locular—FLOSCOPA (Tropics). **DD.** Petals united into a long slender tube; calyx long-tubular; ovules 2-seriate—WELDENIA (Cent. Amer.). **CC.** Fertile stamens 3, often accompanied by 3 staminodes: **O.** Flowers actinomorphic: **P.** Seeds 2-seriate in the loculi—ANTHERICOPSIS (*Gillettia*) (E. Afr.). **PP.** Seeds 1-seriate in the loculi—DESCANTARIA[2] (part) (Mexico to S. Amer.) (*Donnellia, Neodonnellia*). **OO.** Flowers zygomorphic—ANEILEMA (*Phaeneilema*) (Tropics). **BB.** Fruit indehiscent, shining or baccate; flowers paniculate or in dense spike-like racemes: **Q.** Pericarp of fruit thin and shining—POLLIA (*Aclisia*) (Old World Tropics and Subtropics). **QQ.** Pericarp of fruit fleshy or juicy—PALISOTA (Trop. Afr.). **AA.** Inflorescence or partial inflorescences subtended by 1 or 2 foliaceous boat-shaped spathaceous bracts or closely invested by the upper leaves: **R.** Inflorescence 1-flowered within the bract—SAUVALLEA (Cuba). **RR.** Inflorescence or partial inflorescences 2- to many-flowered: **S.** Perfect stamens 6: **T.** Petals free to the base: **U.** Flowering branches or peduncles not perforating the leaf-sheath—TRADESCANTIA (Amer.). **UU.** Flowering branches perforating the base of leaf-sheath—COMMELINANTIA (part) (Amer.). **TT.** Petals united into a short or long tube: **V.** Sepals united towards the base; spathe bracts usually numerous—CYANOTIS (Trop. Asia, Afr.). **VV.** Sepals free: **W.** Petals united into a short tube—SETCREASEA (*Treleasia; Neotreleasia*) (Texas to Mexico). **WW.** Petals united into a long tube—ZEBRINA (Mexico, Cent. Amer.). **SS.** Perfect stamens 3; petals free: **X.** Fruit a capsule. **Y.** Spathes solitary on the peduncle or in a dense head-like cluster—COMMELINA (Tropics and Subtropics). **YY.** Spathes racemosely arranged on the peduncles—POLYSPATHA (W. Afr.). **XX.** Fruit indehiscent, shining—ATHYROCARPUS (Cent. and S. Amer.).

***Inflorescence axillary (rarely also terminal):*

A. Inflorescence exserted from the top of the subtending leaf-sheath: **B.** Inflorescence not subtended by spathe-like foliaceous bracts: **C.** Perfect stamens 6—NEOMANDONIA (*Mandonia* Hassk.) (Mexico, Cent. Amer). **CC.** Perfect stamens 3–1: **D.** Anthers not spirally twisted—CALLISIA (Cent. and S. Amer.). **DD.** Anthers spirally twisted—COCHLIOSTEMA (Boliv., Ecuad.). **BB.** Inflorescence subtended by a spathe-like leafy bract: **E.** Stamens 6, all perfect: **F.** Sepals connate at the base—CYANOTIS (Trop. Asia and Afr.).

[1] This group of *Tradescantia*, with panicles of raceme-like branches, probably deserves generic status (cf. *T. holosericea* Kunth, &c.).

[2] This genus as here defined consists mainly of those species included by Clarke in *Tradescantia* and numbered 13–21 and 24–31 in DC. *Monograph.*, p. 289.

FF. Sepals free—RHOEO (Mexico, Cent. Amer.). **EE.** Stamens 3 perfect, and 3 staminodes—COMMELINA (Tropics and Subtropics). **AA.** Inflorescence perforating and emerging from near the base of the subtending leaf-sheath: **G.** Inflorescence sessile: **H.** Petals free—FORRESTIA (W. Afr., Trop. Asia). **HH.** Petals united—COLEOTRYPE (Madag., E. Afr. to Natal). **GG.** Inflorescence pedunculate: **I.** Inflorescence not subtended by spathe-like bracts: **J.** Anthers opening by longitudinal slits—BUFORRESTIA (Trop. Afr., Guianas). **JJ.** Anthers opening by terminal pores—DICHORISANDRA (part) (Trop. Amer.). **II.** Inflorescence subtended by spathaceous boat-shaped leafy bracts: **K.** Bracts 2—CAMPELIA (Mexico, West Indies to Brazil). **KK.** Bract 1—COMMELINANTIA (part) (Amer.).

****Inflorescence from the base of the stem, 'subterranean', fasciculate-umbellate; flowers long-pedicellate:*

GEOGENANTHUS (*Chamaeanthus*) (Brazil).

359. CARTONEMATACEAE

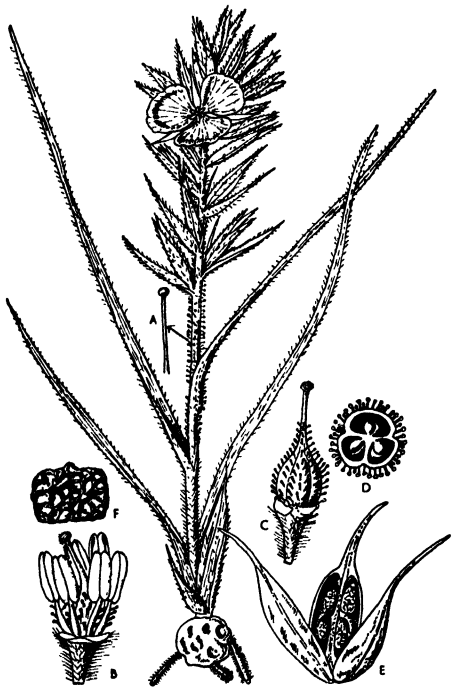


FIG. 359. Cartonema spicatum *R. Br.* (Cartonemataceae). A, gland-tipped hair from stem. B, stamens and pistil. C, pistil. D, cross-section of ovary. E, open fruit. F, seed. (Habit adapted from R. Br.)

Terrestrial perennial herbs, dry and not succulent, with the habit of *Xanthorrhoea*, covered with *gland-tipped hairs*; roots densely hairy; stem erect, leafy; leaves alternate, sheathing at the base, sessile, linear, with parallel nerves, *glandular-pilose*; stomata with 2 adjacent cells; flowers bisexual, actinomorphic, 3-merous, in simple or branched spike-like racemes; bracts 1-flowered; bracteole 1, narrow; sepals 3, green, *free, persistent*; petals 3, coloured, free, *marcescent*; stamens 6, equal, free, 3 outer opposite the sepals, 3 inner opposite the petals; filaments filiform or flattened, glabrous; anthers 2-locular, loculi parallel, contiguous, opening by a slit lengthwise, introrse; ovary superior, 3-locular; ovules 2 in each loculus, axile, superposed, orthotropous; style terminal, stigma capitate; fruit capsular, 3-locular, loculicidally dehiscent; seeds 2 in each loculus, superposed, *pitted-reticulate*, with a very small *ventral hilum*; endosperm abundant, starchy; embryo minute and *scarcely evident*. B.H. 3, 852; E.P. edn. 2, **15***a*, 171 (both in *Commelinaceae*).—CARTONEMA (Austral.).



FIG. 360. Flagellaria indica *Linn.* (Flagellariaceae). A, flower. B, same in vertical section. C, fruit. D, vertical section of seed. (Orig.; dissections after Baill.)

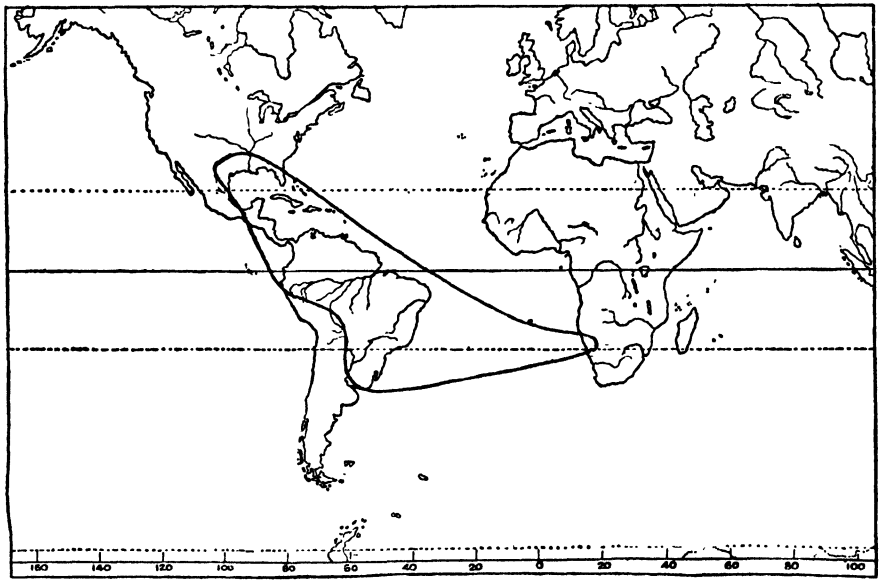
360. FLAGELLARIACEAE

Stems erect or climbing; leaves often long, sometimes ending in a *tendril*; leaf-sheaths embracing the stem, *closed.* Flowers bisexual or dioecious, actinomorphic, arranged in *terminal panicles.* Perianth hypogynous, persistent; segments 6, free, 2-seriately imbricate, dry or somewhat petaloid. Stamens 6, hypogynous or slightly adnate to the base of the perianth-segments; filaments free from each other; anthers 2-locular, introrse, opening lengthwise by slits. Ovary superior, 3-locular; style 3-*lobed.* Ovules *solitary* in each loculus, spreading or pendulous from the central axis. Fruit *indehiscent,* fleshy or drupaceous. Seeds with copious endosperm and small embryo. B.H. **3,** 860; E.P. **2, 4,** 1 (1887); edn. 2, **15***a,* 6 (1930).—Tropics and Subtropics of the Old World.

A. Stem erect; leaves not ending in tendrils: **B.** Flowers bisexual—JOINVILLEA (Malay Archip. to Pacific). **BB.** Flowers dioecious; leaves with conspicuous transverse veins—SUSUM (Ceylon to Malay Archip.). **AA.** Stem climbing, the leaves ending in a spirally coiled tendril-like apex; flowers bisexual—FLAGELLARIA (Old World Tropics).

361. MAYACACEAE

Herbs, submerged and creeping or floating in fresh water; leaves spirally arranged, numerous, *linear or threadlike,* 1-nerved, *bidentate* at the apex.



Range of Mayacaceae. One species, Mayaca baumii *Gürke,* in Angola, W. Africa.

Flowers bisexual, actinomorphic, axillary, solitary, or several towards the apices of the shoots and surrounded by membranous bracts, often reflexed after flowering. Perianth *double,* 3-merous, the *outer calycine,* of 3 distinct

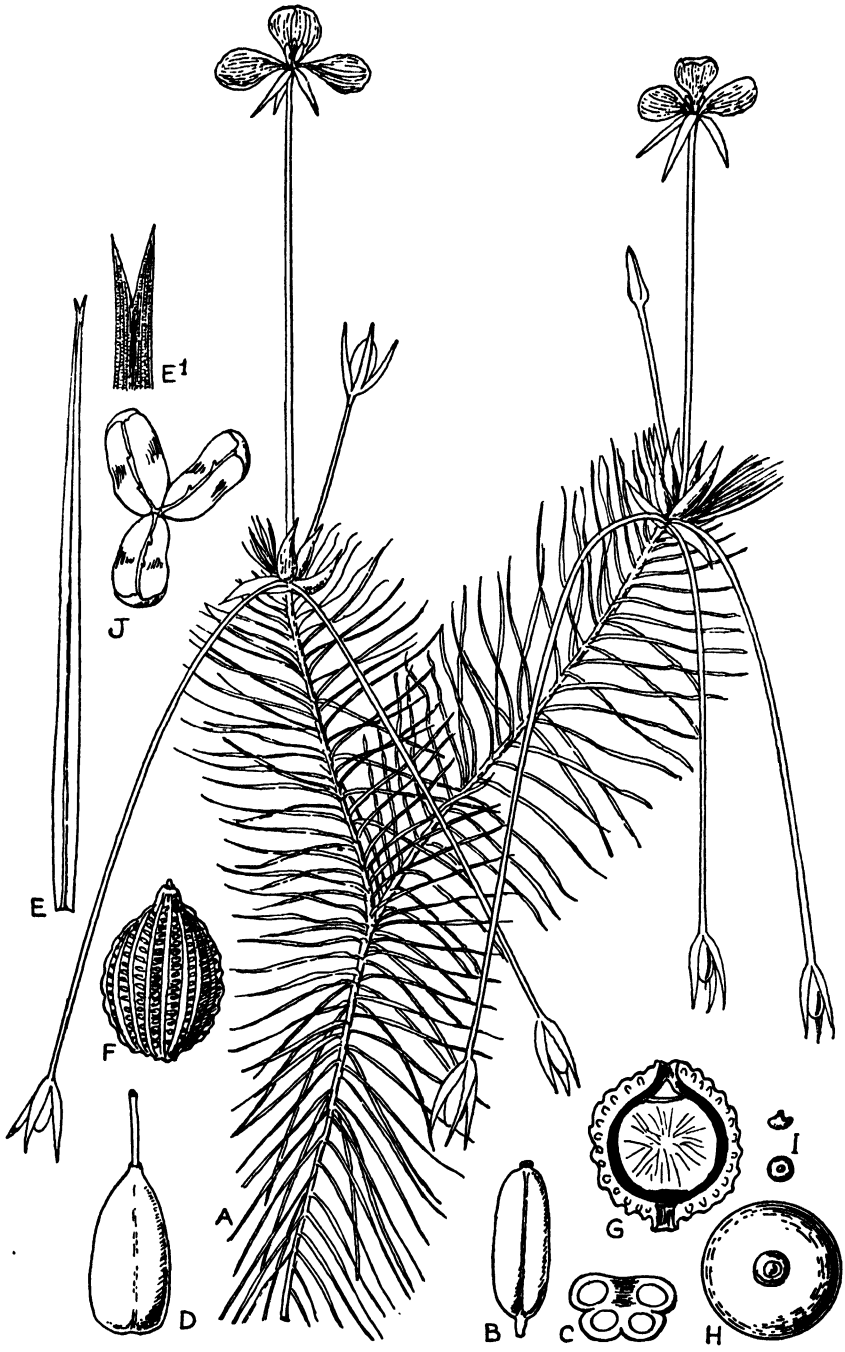


FIG. 361. Mayaca longipes *Mart.* (Mayacaceae). A, upper part of plant, showing reflexed fruiting pedicels. B, anther. C, transverse section of anther. D, pistil. E, leaf. E^1, leaf-tip. F, seed. G, vertical section of seed. H, seed from above showing 'stopper'. I, stopper. J, open capsule. (Partly after Martius.)

segments, *subvalvate*, the *inner corolline*, of 3 free broadly imbricate shortly clawed segments, violet, rose, or white. Stamens 3, hypogynous, opposite the outer segments; filaments free; anthers 4-*locular*, opening by a small *pore* or pore-like slit at the top. Ovary superior, 1-*locular*; style solitary; ovules several, biseriate on 3 parietal placentas, orthotropous. Fruit a 3-sided capsule opening by 3 valves each bearing a placenta in the middle. Seeds scrobiculate-reticulate, with endosperm and rather small embryo at the top, capped by a small *stopper* ('embryostegia'). B.H. **3**, 843; E.P. **2**, 4, 16 (1888); edn. 2, **15***a*, 33 (1930). Tropical America, Southeastern U.S.A., and Angola in W. Africa.—MAYACA.

A small family with an interesting distribution, and very closely allied to the *Commelinaceae*. It is little more, perhaps, than an aquatic representative of that family and might even be merged with it. The porous anthers are a constant feature, and this type of dehiscence is not unknown in *Commelinaceae*. The leaves, however, do not sheath at the base, as in *Commelinaceae*.

ORDER 91. XYRIDALES

Perennial or annual usually marsh herbs with radical linear to terete leaves, often with broad sheathing bases; sheaths open and embracing the nude flowering stem; flowers small, arranged in usually *bracteate heads*; perianth *double* and distinctly 2-seriate, the outer *hyaline* or glumaceous, imbricate, the inner *corolline*, with a *short or long tube*; stamens 6 or 3; anthers 2–4-locular, opening by slits or pores; gynoecium syncarpous, 1-locular or imperfectly 3-locular; ovules parietal or from the base; fruit capsular; seeds with copious endosperm.—Marsh plants of Warm Regions.

A. Stamens 3, often with 3 staminodes; anthers 2-locular, opening by slits lengthwise; flowers in heads *Xyridaceae*

AA. Stamens 6; anthers 4-locular, opening by pores; flowers in heads often embraced by two large opposite face-to-face bracts *Rapateaceae*

362. XYRIDACEAE

Perennial or sometimes annual herbs; leaves mostly radical, tufted, linear, terete, or filiform, sheathing at the base. Flowers bisexual, slightly zygomorphic, arranged in pedunculate terminal globose to cylindrical *heads*; bracts imbricate, leathery or rigid, the lower sometimes *forming an involucre*. Sepals 3 or rarely 2, the lateral 2 exterior, boat-shaped, keeled, glumaceous, the third interior, membranous, *forming a hood over the corolla* and pushed away by the development of the latter. Corolla with a *short or long tube* and 3 equal spreading lobes. Stamens 3, opposite the corolla-lobes, and 3 alternate *staminodes* or the latter absent; anthers 2-locular, opening lengthwise by slits. Ovary superior, 1-locular with 3 parietal placentas, or imperfectly 3-locular at the base, the placentas then arising from the base of the ovary; style simple or 3-lobed. Ovules numerous to few, in two or more series. Fruit a capsule enclosed in the persistent corolla-tube, opening by 3 valves. Seeds numerous, with copious endosperm and small embryo, apiculate, usually longitudinally striate. B.H. **3**, 841; E.P. **2**, 4, 18; edn. 2,



FIG. 362. Xyris indica *Linn.* (Xyridaceae). A, vertical section of flower. B, corolla laid open. C, pistil. D, cross-section of ovary. E, fruit. F, seed. (Orig. except A, after Baillon.)

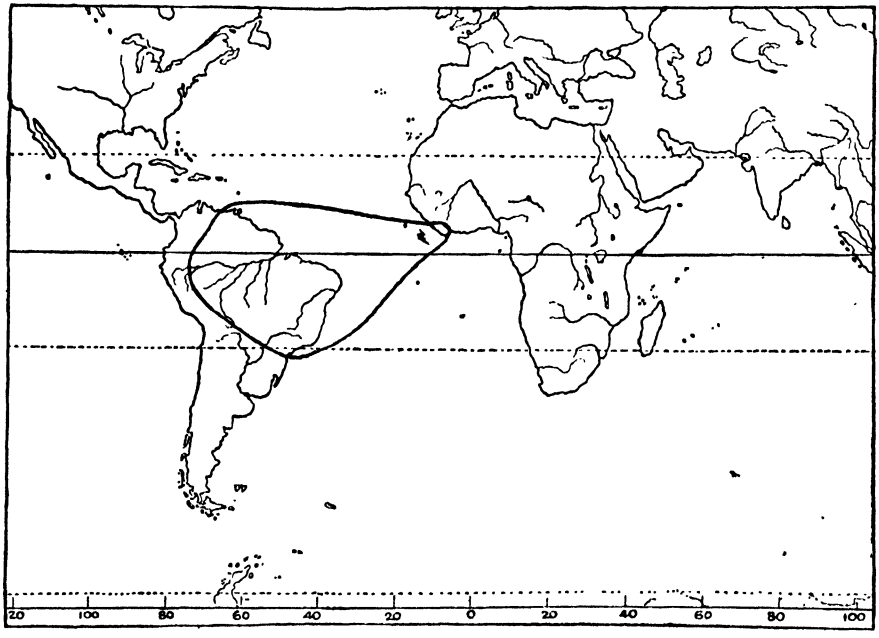
15*a*, 35 (1930).—Warmer Regions of the World, usually in saline marshes; numerous species in Florida.

The *Xyridaceae* are a homogeneous and somewhat isolated family about whose origin it is not possible to say very much with certainty. I consider them to be a very advanced or climax group of the *Calyciferae*, in which the calyx and corolla have remained distinct. The distinctive habit is not nearly approached in any of the *Corolliferae*, although there is a tendency to bunch the flowers into a dense spike with overlapping bracts in tribe *Asphodeleae* of *Liliaceae*. *Aphyllanthes* is somewhat similar, the flowers being subtended by a few scarious bracts.

A. Style provided near the base with 3 linear reflexed appendages; bracts laxly imbricate; sepals equal or subequal—ABOLBODA (Trop. Amer.). **AA.** Style not appendaged at the base; bracts densely imbricate; sepals unequal, the two lateral boat-shaped and glume-like, the third interior, hooded, and embracing the corolla, deciduous—XYRIS (Tropics and Subtropics).

363. RAPATEACEAE

Perennial herbs, with a thick rhizome. Leaves radical, narrow, with slender longitudinally parallel lateral nerves. Inflorescence *scapose*, *capitate*, or *uni-*



Range of Rapateaceae. One genus, Maschalocephalus, in Liberia, W. Africa.

laterally spicate. Flowers bisexual, actinomorphic. Perianth *double*, the inner *corolline*; outer *hyaline*, lobes chaffy, rigid, imbricate; inner tubular, hyaline; lobes ovate, spreading, broadly *imbricate*. Stamens 6, inserted in the tube, shorter than the inner perianth, erect; anthers basifixed, *4-locular*, loculi confluent in the upper part and opening by *two* or *one pore* or by a *terminal cleft*. Ovary superior, perfectly or imperfectly 3-locular; style terminal,



FIG. 363. Rapatea paludosa *Aubl.* (Rapateaceae). A, flower subtended by several bracteoles. B, flower. C, vertical section of same. D, sepal. E, stamen. F, pistil. G, fruit. Habit, A, D, E, and F, orig. B, C, G, after Baill. (The unshaded drawing shows the bracts closed as in nature.)

simple. Ovules few to solitary in each loculus, at the base or on the central axis, anatropous. Fruit a capsule opening by 3 valves septate in the middle. Seeds with copious mealy endosperm; embryo lenticular. B.H. **3**, 857; E.P. **2**, 4, 28; edn. 2, **15***a*, 5.—Tropical S. America and Liberia, W. Africa.

This small but very interesting family is still little known, no doubt because of its habitat in the dense forests of Tropical S. America and W. Tropical Africa. Until a few years ago it was recorded only from America, but Dinklage found a remarkable new genus, *Mascha-*

locephalus Gilg, in the evergreen forests of Liberia, thus adding one more link between the floras of these regions on opposite shores of the Atlantic. For some interesting notes on the family the student is referred to Gleason (*Bull. Torr. Club, 50*, 147–52, pl. 7), who honoured the royal family of Great Britain in naming a genus *Windsorina*, just as a German botanist long ago commemorated a contemporary ruler by the genus *Saxofridericia*.

The evolution of the genera within the family is best traced in the inflorescence, which is a cluster of densely bracteolate flowers, usually subtended by an involucre of 1 or 2 large remarkable bracts. The floral clusters mimic certain *Cyperaceae*, whilst the spathaceous involucre marks a high development and recalls the *Araceae*. The composition of the perianth, of course, removes the family far away from those mentioned, and the nearest affinity is probably with *Xyridaceae*, the calyx and corolla, as in that family, being quite distinct from each other.

A. Clusters of flowers without a common involucre: **B.** Clusters of flowers long-pedunculate; Trop. Amer.: **C.** Flowers pedicellate on the peduncle; anthers opening by 1 terminal pore; ovule 1 in each loculus—WINDSORINA. **CC.** Flowers sessile on the peduncle; anthers opening by 1 terminal pore—STEGOLEPIS (E. Trop. S. Amer.). **BB.** Clusters of flowers subsessile at the base of the leaves; ovule 1 in each loculus; W. Africa—MASCHALOCEPHALUS (Liberia). **AA.** Clusters of flowers with a common involucre of bracts: **D.** Involucral bracts 2 or more, not spathe-like: **E.** Involucral bracts free at the base: **F.** Flowers pedicellate within the involucre, pedicels bracteolate; ovule solitary in each loculus—RAPATEA (E. Trop. S. Amer.). **FF.** Flowers sessile within the involucre: **G.** Anthers opening by a terminal slit shortly produced at the back beyond the loculi—CEPHALOSTEMON (E. Trop. S. Amer.). **GG.** Anthers opening by pores: **H.** Anthers opening by 2 terminal pores, not produced at the apex; ovules 2 in each loculus—SCHOENOCEPHALIUM (Brazil). **HH.** Anthers opening by 1 terminal pore: **J.** Bracts 4–5—POTAROPHYTUM (Guiana). **JJ.** Bracts 3—AMPHIPHYLLUM (Venezuela). **JJJ.** Bracts 2—MONOTREMA (E. Trop. S. Amer.). **EE.** Involucral bracts united at the base; anthers opening by a pore or oblique slit—SAXOFRIDERICIA (E. Trop. S. Amer.). **DD.** Involucral bract 1, spathe-like and embracing the flowers; anthers not appendaged at the apex, opening by a single oblique pore—SPATHANTHUS (E. Trop. S. Amer.).—Whilst this volume was in the press an important paper by Maguire & Wurdack was published (*Mem. New York Bot. Gard.* 10, 19 (July 1958)) with a revised key to the family and descriptions of five new genera *Phelpsiella, Epiphyton, Kunhardtia, Guacamaya*, and *Duckea*.

ORDER 92. ERIOCAULALES

Perennials with tufted narrow leaves; flowers *capitate*, small, *unisexual*, usually monoecious; perianth *scarious* or membranous, segments in 2 *distinct series*, the inner often united; stamens free, anthers 2–1-locular; ovary superior, 3–2-locular, ovules *solitary, pendulous*; fruit a capsule; seeds with endosperm. —Mainly Tropical.

One family *Eriocaulaceae*

364. ERIOCAULACEAE

Perennial or rarely annual herbs with *narrow usually crowded* sometimes membranous leaves. Flowers actinomorphic, capitate, numerous, small, sessile or shortly pedicellate on a variously shaped receptacle, *unisexual*, the males and females often mixed or the males in the middle and the females

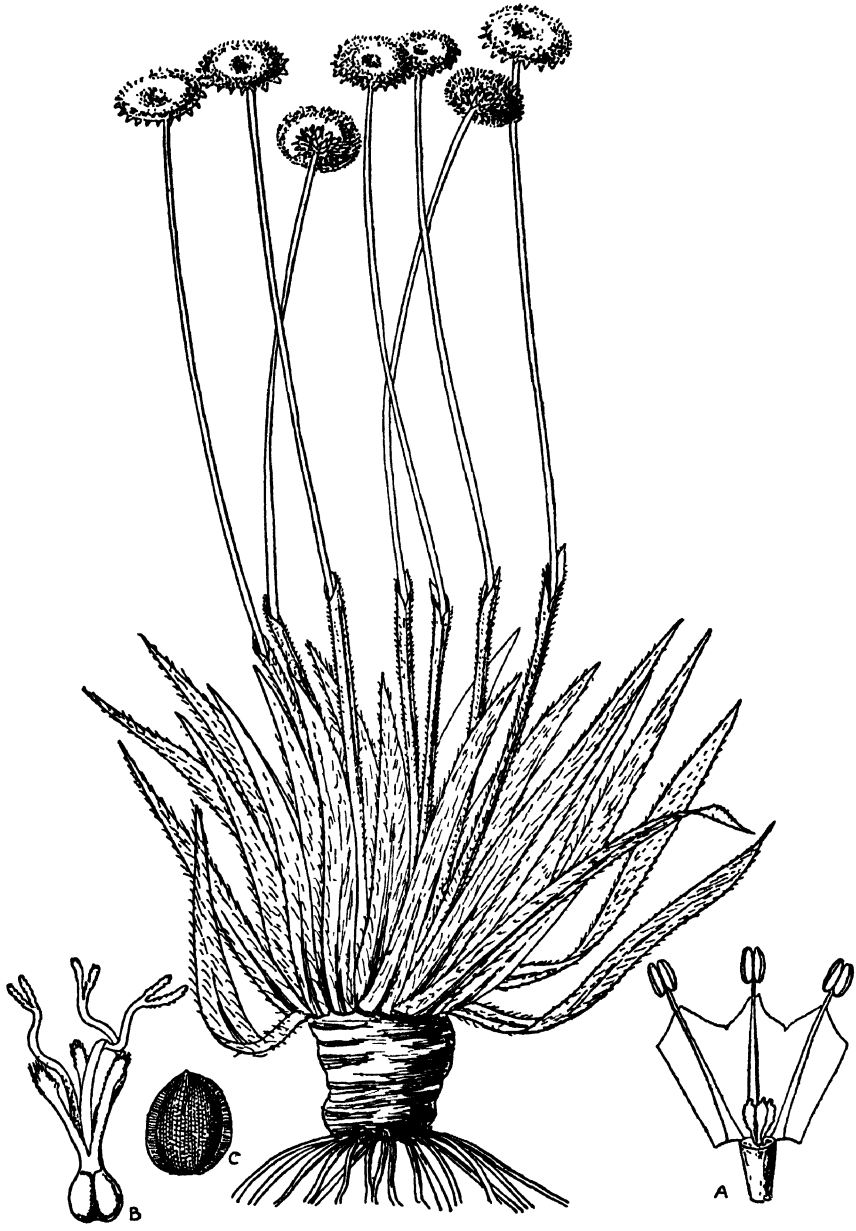


FIG. 364. Paepalanthus klotzschianus *Mart.* (Eriocaulaceae). A, male flower (opened). B, pistil. C, seed. (After Martius.)

around, very rarely the sexes in separate heads. Perianth *scarious* or *membranous*, segments 2–3-merous in two distinct series, the outer free or rarely partially connate, the inner often *stipitate* and *cupular*, rarely absent. Stamens as many as or double the number of the perianth-segments and opposite to them, rarely fewer; filaments free from one another; anthers small, 1–2-locular, opening by longitudinal slits; staminodes rare in the female flower. Ovary superior, 2–3-locular, with a terminal, lobed style; ovules *solitary and pendulous* in each loculus, orthotropous. Fruit membranous, loculicidally dehiscent. Seeds solitary, pendulous, with copious endosperm and small embryo. B.H. **3**, 1019; E.P. **2**, 4, 21; Koernicke in Martius, *Fl. Bras*, **3**, 1, 274–508, tt. 38–63; Ruhland in Engl. *Pflanzenr.*, *Eriocaulaceae* (1903); Rendle, 273.—Mainly in swampy places in the Tropics of both Hemispheres; a few in Temperate Regions.

A. Anthers 2–3-locular: **B.** Stamens double the number of the inner perianth-segments (6 or 4); the latter furnished with a gland within the apex: **C.** Petals in both sexes free—ERIOCAULON (mainly Tropics and Subtropics). **CC.** Petals in both sexes more or less connate—MESANTHEMUM (W. Afr., Madag.). **BB.** Stamens the same number as the inner perianth-segments (3 or 2), petals not glandular: **D.** Inner perianth-segments free: **E.** Hairs of the perianth and bracts blunt, often tuberculate; appendages of the style inserted at the same height as the style-branches—PAEPALANTHUS (*Rondonanthus*) (Trop. Amer.). **EE.** Hairs of the perianth and bracts acute, smooth; appendages of the style inserted below the style branches—LEIOTHRIX (Cent. Amer.). **DD.** Inner perianth-segments connate in the middle—SYNGONANTHUS (Trop. Amer., Trop. Afr.). **BBB.** Stamen 1; perianth-segments free—COMANTHERA (British Guiana). **AA.** Anthers 1-locular: **F.** Inner perianth-segments of the female flower connate in the middle—PHILODICE (Brazil). **FF.** Inner perianth-segments of the female flower free: **G.** Inner perianth-segments petaloid, not reduced to pilose bodies—BLASTOCAULON (Brazil). **GG.** Inner perianth-segments reduced to small pilose bodies: **H.** Inner perianth of male flowers present, segments united into a tube—TONINA (Trop. Amer.). **HH.** Inner perianth of male flowers absent—LACHNOCAULON (N. Amer.).

ORDER 93. BROMELIALES

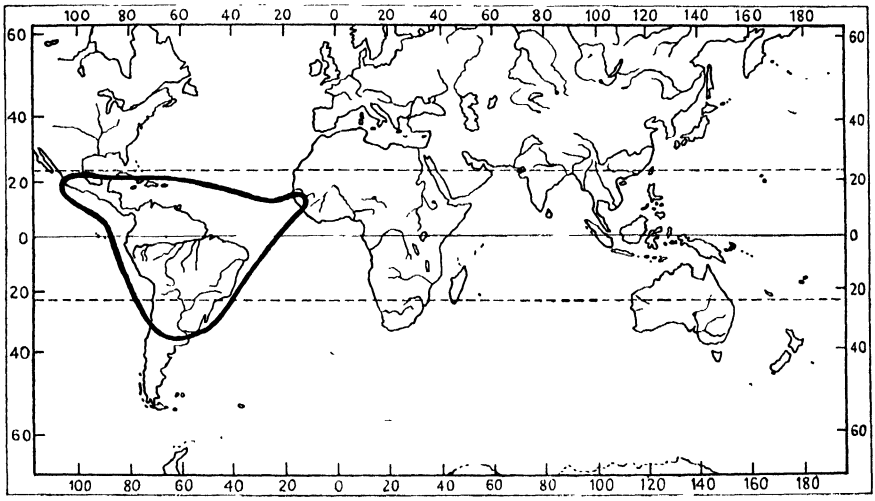
Mostly epiphytic or on moist rocks; leaves in a dense cluster, strap-shaped, mostly spinulose-toothed; inflorescence terminal, bracts often coloured; perianth *2-seriate, outer calyx-like*, imbricate, *inner corolla-like*; stamens 6; ovary superior to inferior, 3-locular; ovules numerous on axile placentas; fruit usually *fleshy*; seeds with endosperm.—American Tropics and Subtropics.

One family *Bromeliaceae*

365. BROMELIACEAE

Mostly short-stemmed *epiphytes* or growing on rocks. Leaves usually in a dense cluster, long and strap-shaped, rigid and spinulose-toothed or rarely flaccid, often *coloured towards the base*. Flowers in a *terminal* head, spike, or panicle often with *highly coloured bracts*, actinomorphic, bisexual or rarely

unisexual. Perianth hypogynous to epigynous, segments in *two series*, the *outer calyx-like*, imbricate, the *inner corolla-like* and free or variously connate, imbricate. Stamens 6, mostly inserted at the base of the segments, free or partially adnate to them; anthers free or rarely connate in a ring, linear, usually *versatile*, 2-locular, opening by longitudinal slits. Ovary *superior to inferior*, 3-locular; style slender, elongated, stigmas 3. Ovules numerous in each loculus, the axile placentas sometimes divided. Fruit *fleshy and indehiscent* or rarely opening unevenly, or rarely a septicidal or loculicidal capsule.



The family Bromeliaceae is confined to tropical and subtropical South America except the genus Pitcairnia, one species of which, P. feliciana (*A. Chev.*) *Harms & Mildbr.*, is found in French Guinea in West Africa. The range of Pitcairnia is shown.

Seeds with abundant mealy endosperm and a small embryo, sometimes winged. B.H. **3**, 657; E.P. **2**, 4, 32; edn. 2, **15***a*, 65 (1930); Mez in DC. *Monographiae Phanerogam.* 10: *Bromeliaceae* (1896); Baker, *Handbook of the Bromeliaceae* (1889); Mez, Engl. *Pflanzenr.*, *Bromeliaceae* (1934); Rendle, 277.—Tropical and Subtropical America and West Indies; one species in W. Tropical Africa.

USEFUL PRODUCTS: *Caraguata fibre* (Bromelia serra *Griseb.*); *Old Man's Beard* (Tillandsia usneoides *L.*); *Pineapple* (Ananas sativus *Schult. f.*), and fibres of leaves are used for *Pina cloth*; *Silk Grass* or *Pita fibre* (Bromelia magdalenae *C.H.Wr.*).

Bromeliaceae is a very homogeneous family of plants which appears to represent the climax of a line of descent wherein the calyx and corolla have remained distinct or fairly distinct from each other, a feature retained from the Dicotyledonous stock.

Very advanced characters are the winged or appendaged seeds of many genera, several of which are of epiphytic habit, the baccate fruit of tribe *Bromelieae*, and the structure of the pollen grains, which recalls that of the *Acanthaceae*. The scale-like appendages within the base of the petals are probably homologous with the corona so strikingly developed in the *Amaryllidaceae*, a family which terminates a separate line of development.

According to Harms, the flowers of *Navia* are wind-pollinated.

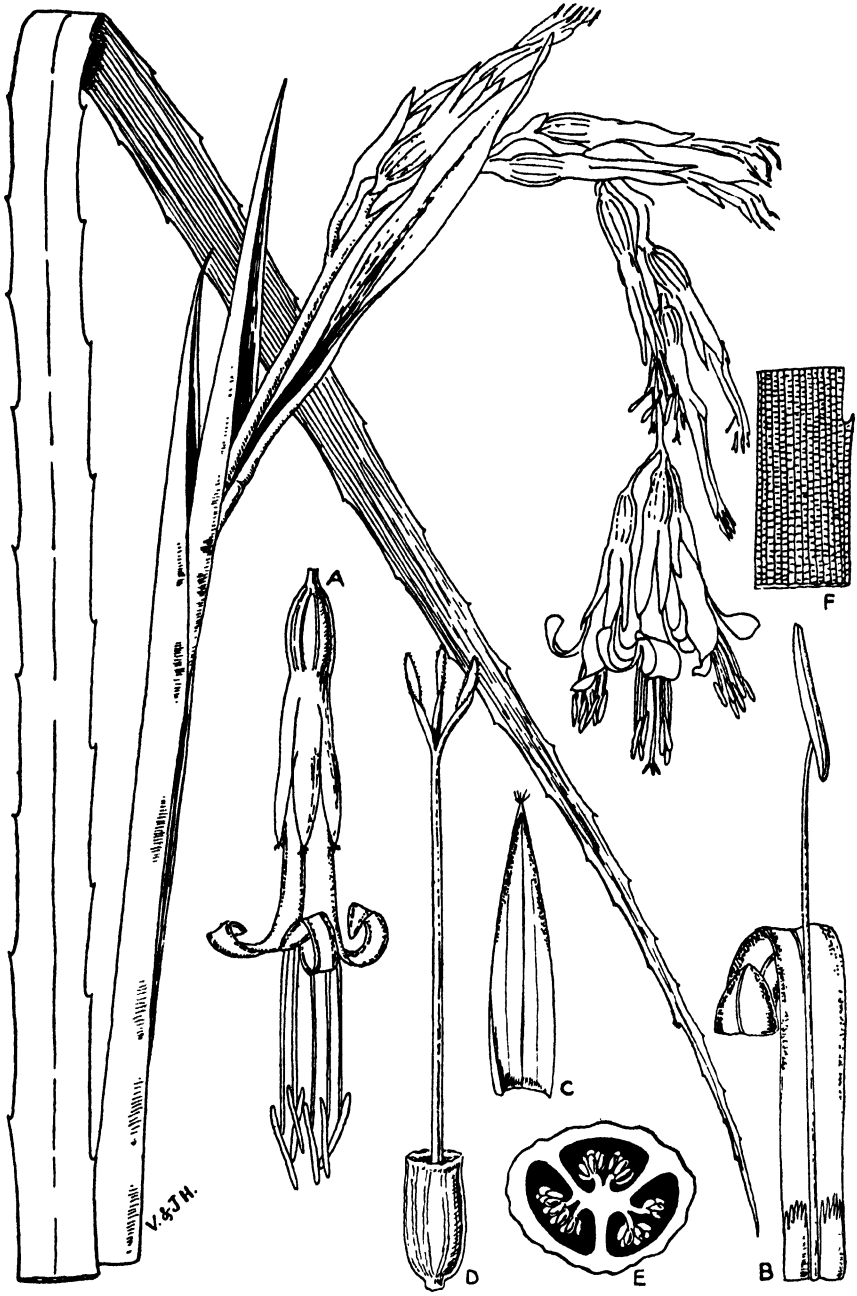


FIG. 365. Billbergia nutans *H. Wendl.* (Bromeliaceae). A, flower. B, inner perianth-segment showing scales at base and stamen. C, outer perianth-segment. D, pistil. E, transverse section of ovary. F, lower surface of leaf. (Orig.)

I have constructed the following key to genera from the *Genera Plantarum* of Bentham and Hooker (3:657), from Mez's monograph in De Candolle's *Monographiae* (10:(1896)), and to these I have added the additional genera from Harms's account in the second edition of the *Pflanzenfamilien* (15*a*, 65 (1930)). The last-mentioned should be consulted for generic synonymy. As the family is found only in Tropical and Subtropical America, the distribution of each genus has not been indicated, except *Pitcairnia* of which one endemic species is now known from W. Tropical Africa.

Key to the Tribes

A. Ovary superior or semisuperior; fruit a capsule:
B. Seeds neither winged nor appendaged; terrestrial plants; flowers wind-pollinated 1. *Navieae*
BB. Seeds winged all around or on the back, or tailed at each end, but tail not plumose; mostly terrestrial plants 2. *Pitcairnieae*
BBB. Seeds with a long plumose pappus-like appendage; mostly epiphytes 3. *Tillandsieae*
AA. Ovary inferior or nearly so; fruit a berry; seeds nude, neither tailed nor winged 4. *Bromelieae*

Key to the Genera

Tribe 1. **Navieae.** One genus NAVIA.

Tribe 2. **Pitcairnieae. A.** Ovary completely superior: **B.** Flowers bisexual. **C.** Petals without a scale within the base: **D.** Seeds suborbicular, surrounded by a wing: **E.** Style filiform; capsule loculidical—PUYA (*Connellia*). **EE.** Style very short; capsule septicidal—DYCKIA. **DD.** Seeds more or less elongated, with dorsal or terminal wing or tail: **F.** Ovules few, inserted at the base of the loculi—COTTENDORFIA. **FF.** Ovules numerous, inserted on the inner angle of the loculi—LINDMANIA. **FFF.** Ovules numerous—ENCHOLIRION. **CC.** Petals with a scale within the base: **G.** Leaves long and narrow, with coarse teeth—DEUTEROCOHNIA. **GG.** Leaves short and broad with few teeth—ABROMEITIELLA (*Meziothamnus*). **BB.** Flowers polygamous or dioecious: **H.** Flowers polygamous—PRIONOPHYLLUM. **HH.** Flowers dioecious—HECHTIA. **AA.** Ovary semisuperior: **I.** Flowers minute, actinomorphic; ovules few; petals without scales within the base: **J.** Petals clawed; inner filaments adnate to the petals—BROCCHINIA. **JJ.** Petals not or scarcely clawed; filaments free—BAKERANTHA (*Bakeria*). **II.** Flowers conspicuous, zygomorphic; ovules numerous; petals with or without scales within the base—PITCAIRNIA (*Willrussellia*) (also in W. Trop. Afr.).

Tribe 3. **Tillandsieae. A.** Sepals free or nearly so, not petaloid: **B.** Petals without scales within the base: **C.** Petals free: **D.** Seeds long-stipitate; apical appendage of the seed short—TILLANDSIA. **DD.** Seeds shortly stipitate; apical appendage of the seed long—CATOPSIS. **CC.** Petals more or less connate; flowers spirally arranged in the inflorescence: **E.** Inflorescence unbranched: **F.** Inflorescence capitate or pyramidal—CARAGUATA. **FF.** Inflorescence spicate or cone-like—GUZMANIA. **EE.** Inflorescence branched, paniculate—SCHLUMBERGERIA. **BB.** Petals with scales within the base: **G.** Petals free: **H.** Inflorescence simple or with more or less long branches: **I.** Basal appendage of the seed and also the apical appendage ending in a single row of cells—GLOMEROPITCAIRNIA. **II.** Seed with a crown of hairs formed from the collapse of the

outer integument: **J.** Petals not ribbon-like—VRIESEA (*Neovriesia*). **JJ.** Petals ribbon-like—ALCANTAREA. **JJJ.** Seeds not known; imperfectly known genus —MEZOBROMELIA. **HH.** Inflorescence with stout short branches—THECOPHYLLUM. **GG.** Petals more or less connate; flowers arranged in 2 rows—CIPUROPSIS. **AA.** Sepals united, mostly petaloid; petals united: **K.** Leaves grass-like; petals longer than the sepals—SODIROA. **KK.** Leaves broad; petals shorter than the sepals—MASSANGEA.

Tribe 4. **Bromelieae. A.** Pollen-grains smooth, neither marked with pores nor grooved: **B.** Petals free, with scales at the base: **C.** Filaments free—FASCICULARIA. **CC.** Inner filaments adnate to the petals: **D.** Flowers sessile, solitary in the axils of leafy bracts—CRYPTANTHOPSIS. **DD.** Flowers shortly pedicellate, mostly a few together in the axils of the bracts—SINCORAEA. **BB.** Petals united at the base, without scales: **E.** Petals united into a tube by the connate filaments but with free margins: **F.** Inflorescence a few-flowered head-like spike—DEINACANTHON. **FF.** Inflorescence a panicle: **G.** Panicle above the rosette of leaves; ovules numerous—BROMELIA. **GG.** Panicle sessile, head-like; ovules few—KARATAS. **EE.** Petals united by their margins into a tube: **H.** Inflorescence loose: **H(1).** Fruit a fleshy berry; style thick—GREIGIA. **H(2).** Fruit with a thin pericarp; style long—HESPEROGREIGIA. **HH.** Inflorescence contracted and very short—CRYPTANTHUS. **AA.** Pollen grains marked with pores: **I.** Inflorescence arising separately from the rhizome and apart from the leafy stem—DISTEGANTHUS. **II.** Inflorescence immersed in the middle of the rosette of leaves, the latter often coloured: **J.** Petals united at the base, without scales within the base; inflorescence racemose—AREGELIA (*Neoregelia*). **JJ.** Petals united at the base, sometimes with scales; inflorescence paniculate—NIDULARIUM. **JJJ.** Petals free, with scales; inflorescence paniculate—CANISTRUM. **III.** Inflorescence not in a rosette of leaves, borne on a stem or scape: **K.** Petals without scales: **L.** Stem-leaves green, not coloured: **M.** Pollen with 2 pores; leaves not toothed—ANDREA. **MM.** Pollen with 4 pores; leaves toothed—ORTHOPHYTUM. **LL.** Stem-leaves coloured: **N.** Anthers without appendages: **O.** Inflorescence simple, spike-like: **P.** Inflorescence dense, cone-like—CHEVALIERIA. **PP.** Inflorescence loose, spike-like—RONNBERGIA. **OO.** Inflorescence compound: **Q.** Ovules few (up to 10) in each loculus—ARAEOCOCCUS. **QQ.** Ovules numerous: **R.** Inflorescence thick compressed and cone-like—HOHENBERGIA. **RR.** Inflorescence loosely spicate or paniculate: **S.** Ovules arranged along the whole length of the loculi—WITTMACKIA. **SS.** Ovules arranged at the apex of the loculi: **T.** Ovules not tailed; panicle twice branched—STREPTOCALYX. **TT.** Ovules tailed; panicle thrice branched—PIRONNEAVA (*Pironneauella* O. Ktze.). **NN.** Anthers with 2 large appendages—ANDROLEPIS. **KK.** Petals with a pair of scales or wing-like appendages on the inside: **U.** Berries free from one another: **V.** Pollen with several pores: **W.** Flowers stalked; sepals united—PORTEA. **WW.** Flowers sessile; sepals free—GRAVISIA. **VV.** Pollen with 2–4 pores: **X.** Ovary not entirely inferior, the perianth somewhat perigynous—ACANTHOSTACHYS. **XX.** Ovary quite inferior, the perianth epigynous: **Y.** Inflorescence a spike or panicle; bracts mostly small; stigmas linear, often spirally twisted—AECHMEA. **YY.** Inflorescence cone-like, with transverse folded bracts; stigmas in a mass —QUESNELIA. **UU.** Berries at length consolidated into a fleshy cone-like

mass: **Z.** Petals with wing-like appendages on the inside—PSEUDANANAS. **ZZ.** Petals with scales on the inside—ANANAS. **AAA.** Pollen-grains with a longitudinal groove: **A, 1.** Petals with two scales on the inside: **B, 1.** Ovules numerous in each loculus—BILLBERGIA. **BB, 1.** Ovules few in each loculus—NEOGLAZIOVIA. **AA, 1.** Petals without scales on the inside: **C, 1.** Inflorescence elongated; stamens shorter than the petals—FERNSEEA. **CC, 1.** Inflorescence head-like or spicate; stamens as long as or longer than the petals: **D, 1.** Leaves not in a rosette, the stem elongated; epigynous tube large—OCHAGAVIA. **DD, 1.** Leaves in a rosette; epigynous tube short—RHODOSTACHYS.

Imperfectly known genera—CHIRRIPOA *Suesseng*, and PLACSEPTALIA *Espinosa*.

ORDER 94. ZINGIBERALES

Herbs with *rhizomes* and fibrous or tuberous roots; stems often very short or formed by the imbricate bases of the sheathing petioles; leaves spirally arranged or distichous; *sheath open or rarely closed*; calyx and corolla in *separate whorls*, usually inconspicuous; stamens 5–6 or reduced to 1, the remainder transformed into petaloid staminodes; ovary *inferior*; fruit a capsule or fleshy and indehiscent; seeds with endosperm, sometimes arillate.—Tropics and Subtropics, generally in moist or swampy forest regions.

A. Stamens 5–6; anthers 2-locular:
- **B.** Leaves and bracts spirally arranged; calyx tubular, soon split down one side; flowers often unisexual by abortion; fruit not dehiscent *Musaceae*
- **BB.** Leaves and bracts distichous; fruit a capsule:
  - **C.** Sepals free or at most adnate to the corolla; median petal not forming a labellum *Strelitziaceae*
  - **CC.** Sepals united into a tube; median (abaxial) petal large and forming a labellum *Lowiaceae*

AA. Stamen 1, the remainder transformed into staminodes:
- **D.** Anther 2-locular; sepals united into a sometimes spathaceous tube *Zingiberaceae*
- **DD.** Anther 1-locular; sepals free or at most connivent:
  - **E.** Ovules numerous in each loculus; petaloid staminodes shortly connate at the base *Cannaceae*
  - **EE.** Ovule solitary in each loculus; petaloid staminodes more or less connate *Marantaceae*

366. MUSACEAE

Stems formed by the imbricate bases of the petioles, erect, usually tall. Leaves spirally arranged, very large, with a thick midrib and numerous *pinnately parallel* nerves extending to the margin. Flowers mostly *unisexual*, clustered and subtended by large green *spathaceous bracts*, the male flowers within the upper bracts, the female within the lower bracts. Calyx elongated, at first narrowly tubular, soon splitting on one side, variously toothed at the apex. Corolla more or less 2-lipped, often truncate and variously dentate at

the apex. Stamens 5, perfect, with a small sixth rudimentary stamen added; filaments filiform; anthers linear, 2-locular, the loculi parallel and contiguous. Ovary inferior, 3-locular, each loculus with numerous ovules on an axile placenta; style filiform, with a lobulate stigma. Fruit *fleshy, indehiscent,* 3-locular. Seeds with a thick hard testa and straight embryo in copious endosperm. B.H. **3,** 655 (under *Scitamineae*); E.P. **2,** 6, 1; edn. 2, **15***a*, 505, partly; K. Schum. in Engl. *Pflanzenr.* (1900); Rendle, 326, partly.—Tropics of the Old World.

About 45 species of the single genus MUSA are recognized, some of them of very great commercial importance, especially in the Canary Islands, W. Africa, the West Indies, and other parts of the Tropics. The large leaves are much used in thatching, packing, plaiting mats, &c., whilst *Manila hemp* is prepared from *Musa textilis* Nees. The Canary banana, now the chief industry in the Canary Is., is *Musa cavendishii* Lamb. The common banana is *M. paradisiaca* var. *sapientum* L., the 'Plantain', *M. paradisiaca* L.

367. STRELITZIACEAE

Herbs or trees with *distichously arranged* medium-sized to very large leaves. Flowers bisexual, arranged in a *cincinnus* in the axil of a *spathe.* Sepals 3, free or more less adnate to the corolla. Petals 3, variously connate, sometimes very unequal. Perfect stamens 5 or rarely 6, sometimes the sixth imperfect and petaloid; anthers linear, 2-locular, loculi parallel. Ovary inferior, 3-locular, loculi 1- to many-ovuled, ovules from the inner angle of the loculi; style filiform. Fruit capsular and loculicidally 3-valved, or indehiscent. Seeds arillate or not, with straight embryo in endosperm. B.H. **3,** 655, 656 (under *Scitamineae*); E.P. edn. 2, **15***a*, 532 (as subfamily under *Musaceae*); Rendle, 326 (under *Musaceae*).—Tropical America, S. Africa, and Madagascar.

Travellers' Tree (Ravenala madagascariensis *Sonn.*).

A. Perianth-segments free; ovary with numerous ovules: **B.** Flowers slightly zygomorphic: **C.** Stamens 6; seeds arillate—RAVENALA (*Musidendron*) (Madag.). **CC.** Stamens 5—PHENAKOSPERMUM (Brazil, Guianas). **BB.** Flowers very zygomorphic; seeds arillate—STRELITZIA (S. Afr.). **AA.** Perianth-segments partly united; ovary with 1 basal ovule in each loculus; fruit a schizocarp, splitting into three 1-seeded parts; seeds not arillate—HELICONIA (Trop. Amer.).

368. LOWIACEAE

Acaulescent herbs. Leaves on long petioles *embracing each other by their sheaths,* broadly lanceolate or ovate-lanceolate, with a distinct midrib and several faint parallel nerves only visible below; *transverse nerves very marked,* closely parallel below. Flowers bisexual, *very zygomorphic,* in bracteate cymes from the base of the leaf-sheath; bracts oblong, 1–2-flowered. Sepals 3, linear, *united* below into a very long and *slender stalk-like tube.* Petals 3, very unequal, 2 lateral small, *the middle one forming a large coloured lip* (labellum). Stamens 5, inserted with the petals; anthers 2-locular, loculi parallel, opening by a slit lengthwise; pollen granular. Ovary inferior, at the base of the calycine tube, 3-locular, with numerous ovules on axile placentas; style as long as the stamens, 3-lobed, lobes laciniate. Fruit a 3-locular capsule. Seeds surrounded by a 3-*lobed aril* (Loesner). Ridley, *Fl.*

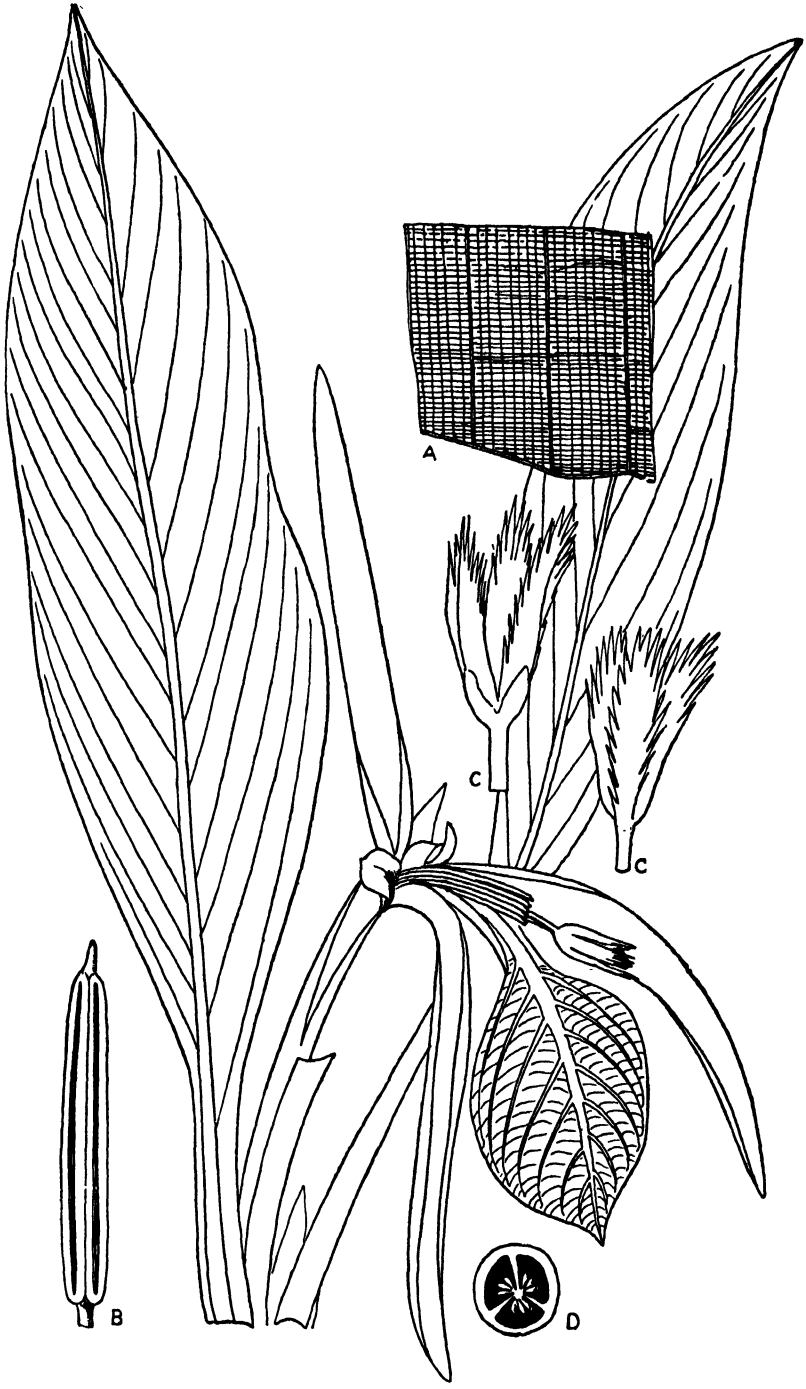


FIG. 366. Orchidantha longiflora *H. Winkl.* (Lowiaceae). A, part of leaf showing nervation. B, stamen. C, stigmas. D, cross-section of ovary. (After *Bot. Mag.*, partly.)

Malay Penin. **4,** 291; Winkler in Engl. *Pflanzenfam.* edn. 2, **15***a*, 541 (as subfamily of *Musaceae*). Malay Penin., Borneo.—ORCHIDANTHA (*Lowia, Protamomum*).

369. ZINGIBERACEAE

Perennial herbs, usually aromatic, with horizontal *tuberous rhizomes.* Stems sometimes very short, leafy, or bearing only flowers. Leaves in *two rows,* with an *open or closed sheath at the base,* sessile or stalked on the sheath, the blade usually large with numerous closely parallel pinnate nerves diverging obliquely from the midrib. Flowers solitary or in a distinct inflorescence accompanying or separate from the leaves, mostly bisexual, symmetric or asymmetric. Perianth 6-merous, *2-seriate, the outer calyx-like, the inner corolla-like* and often very showy and delicate; outer segments united into a tube, inner more or less united, the posterior segment usually the largest. Stamen 1, with a 2-locular anther sometimes accompanied by petaloid staminodes. Ovary inferior, 3-(rarely 2-) locular, with axile placentas, or 1-locular with parietal or rarely basal placentas; style terminal, undivided, free or more or less enveloped in a groove of the fertile stamen or sometimes 2-lipped or dentate. Ovules mostly numerous. Fruit fleshy and indehiscent, or loculicidally 3-valved. Seeds round or angular, mostly covered with a large divided aril; endosperm abundant, white, hard or mealy. B.H. **3,** 636, partly; K. Schum. in Engl. *Pflanzenr., Zingiberaceae* (1904); Rendle, 332. E.P. **2,** 6, 10; edn. 2, **15***a*, 541, partly. See also Holttum, '*Zingiberaceae* of the Malay Penin.', *Gardens Bull. Singapore* **13,** 1–249 (1950). Tropics and Subtropics.

USEFUL PRODUCTS: *Arrowroot* (East Indian; tubers of Curcuma angustifolia *Roxb.*); *Cardamon* (Bengal) (Amomum subulatum *Roxb.*); (Cameroon) (Aframomum angustifolium *K. Sch.*); (Malabar) (Ellettaria cardamomum *Maton*); *Galangal Root* (Alpinia officinarum *Hance*); *Greater Galangal* or *Siamese Ginger* (Alpinia galanga *Sw.*); *Ginger* (Zingiber officinale *Rosc.*); *Kafur-Kachri,* principal ingredient of scented powder known as *Abir* (Hedychium spicatum *Buch.*); *Mabcoboo* (Aframomum latifolium *Afz.*); *Miogo* (young shoots of Zingiber mioga *Rosc.*); *Tumeric* (Curcuma spp.); *Zedoary* (rhizome of Curcuma zedoaria *Rosc.*). *Grains of Paradise, Guinea Grain, Melegueta Pepper* (Aframomum melegueta *K. Sch.*) and other spp.

Loesner, in E.P., edn. 2, **15***a*, 557, classifies this family into tribes[1] as follows:

A. Leaves spirally arranged, their sheaths closed, at length sometimes opened by growth; lateral staminodes often absent or tooth-like; epigeal parts not aromatic 1. *Costeae*

AA. Leaves in 2 rows, their sheaths open on the upper side; aromatic plants:

B. Lateral staminodes large and petaloid:

C. Ovary 3-locular with axile placentas or if 1-locular with basal ovules 2. *Hedychieae*

CC. Ovary 1-locular with parietal placentation 3. *Globbeae*

BB. Lateral staminodes small to nothing (except sometimes in some species of Zingiber) 4. *Zingibereae*

[1] Loesner makes two subfamilies, the *Zingiberoideae* and *Costoideae*; these are here treated as tribes.

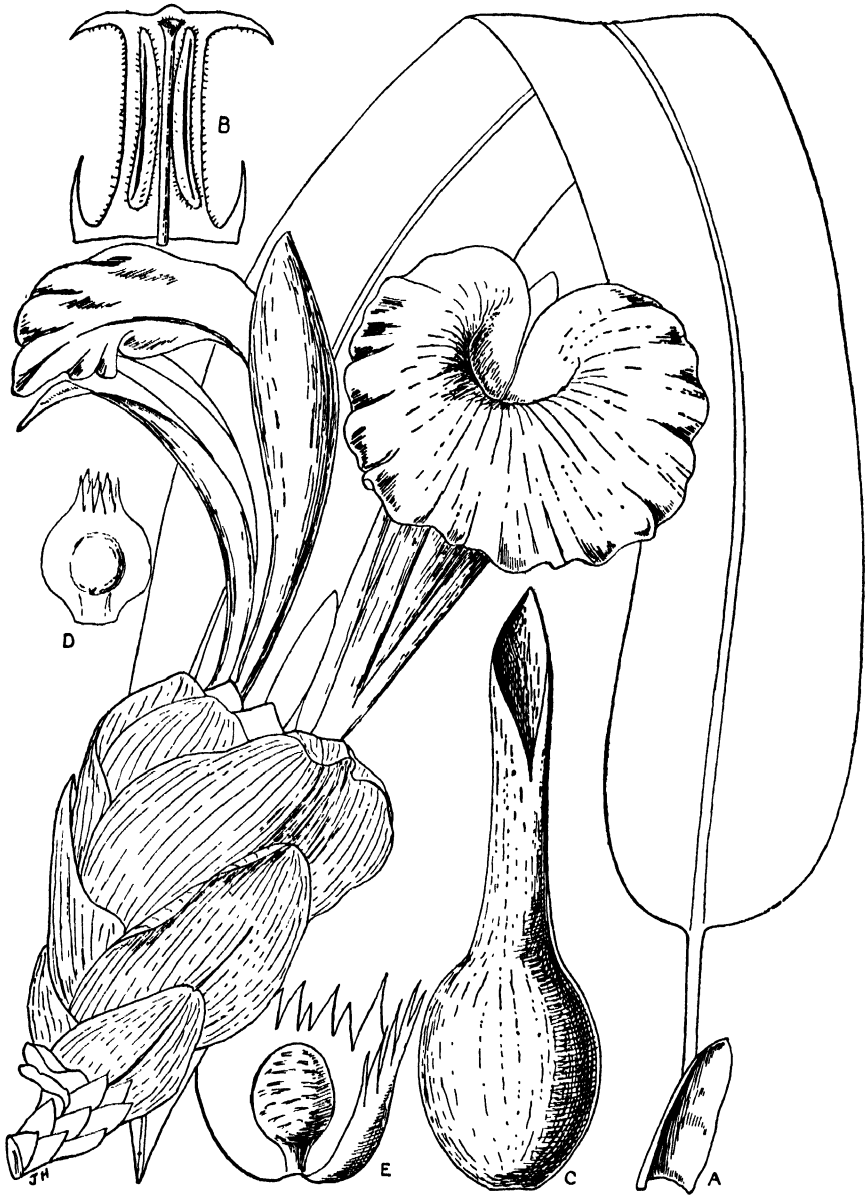


FIG. 367. Aframomum citratum (*Pareira*) *K. Schum.* (Zingiberaceae). A, leaf, showing ligule. B, stamen and part of style. C, fruit and persistent outer perianth. D, seed. E, the same opened out. (After Hook, *Ic. Pl.*)

Tribe 1. **Costeae.** **A.** Ovary 3-locular COSTUS (Tropics). **AA.** Ovary 2-locular: **B.** Lip large and conspicuous: **C.** Flowers solitary; ovules 1-seriate—MONOCOSTUS (Peru). **CC.** Flowers spirally spicate; ovules in several series—DIMEROCOSTUS (Trop. Amer.). **BB.** Lip small; lateral staminode tooth-like—TAPEINOCHILUS (*Tubutubka*) (Malay Archip. to N. Austral.). Imperfectly known genus, MULFORDIA (Boliv.).

Tribe 2. **Hedychieae.** **A.** Anthers entire or at most sagittate at the base, not spurred: **B.** Filament long or very long, with narrow connective; anther more or less versatile. **C.** Labellum long-exserted from the corolla-tube, mostly bilobed; spike several-flowered: **D.** Lobes of the labellum entire; dorsal corolla-lobe not appendiculate on the back—HEDYCHIUM (Madag. and E. Tropics). **DD.** Lobes of the labellum toothed; dorsal corolla-lobe with a thick appendage—ODONTYCHIUM (Malay Penin.). **CC.** Labellum very short, deeply bilobed; spike few-flowered—BRACHYCHILUS (Malay Archip.). **BB.** Filament short or with a broad connective: **E.** Anther-loculi divaricate at the apex; inflorescences very dense, arising from the rhizome; corolla-tube short and thick; filament short—CONAMOMUM (Malay Penin.). **EE.** Anther-loculi more or less parallel: **F.** Spike not surrounded by an involucre: **G.** Anther versatile—CAMPTANDRA (Malay Penin., China). **GG.** Anther not versatile: **H.** Ovary 3-locular: **I.** Filament short: **J.** Connective not appendaged: **K.** Labellum concave—BOESENBERGIA (*Gastrochilus*) (India). **KK.** Labellum flat; fruit elongated—SILIQUAMOMUM (Indo-China). **JJ.** Connective appendaged: **L.** Flowers bisexual: **M.** Bracts free: **N.** Labellum divided—KAEMPFERIA (*Zerumbet, Haniffia, Scaphochlamys*) (Old World Tropics and Subtropics). **NN.** Labellum entire—CARENOPHILA (Malay Penin.). **MM.** Bracts united; labellum entire or nearly so—HITCHENIOPSIS (Malaya, Indo-China). **LL.** Flowers polygamous; ovary subterranean—SIPHONOCHILUS (Natal). **II.** Filament elongated; bracts coloured—HITCHENIA (India). **HH.** Ovary 1-locular; ovules few, basal; connective broadly appendaged—HAPLOCHOREMA (Borneo). **FF.** Spike surrounded by an involucre—STAHLIANTHUS (India to Indo-China). **AA.** Anthers spurred at the base: **O.** Bracteoles absent; inflorescence spicate: **P.** Flowers purple, blue, or white; ovary elongated—ROSCOEA (India, China). **PP.** Flowers yellow; ovary short—CAUTLEYA (Himal.). **OO.** Bracteoles present; inflorescence dense and strobiliform—CURCUMA (Tropics, except Amer.).

Tribe 3. **Globbeae.** **A.** Filament short, not exceeding the perianth; lip broadly ovate—HEMIORCHIS (E. India). **AA.** Filament elongated, much longer than the perianth: **B.** Labellum 3-lobed, the middle lobe smaller—GAGNEPAINIA (Indo-China). **BB.** Labellum 2-lobed or undivided: **C.** Flowers white, yellow, or rose; lateral staminodes similar to the corolla-lobes—GLOBBA (E. Tropics and Subtropics). **CC.** Flowers violet or blue; lateral staminodes not similar to the corolla-lobes—MANTISIA (E. India).

Tribe 4. **Zingibereae.** **A.** Inflorescence terminal on the leafy shoot: **B.** Labellum conspicuous, often large: **C.** Labellum not pouched at the base: **D.** Labellum erect: **E.** E. Tropics: **F.** Filament elongated—POMMERESCHEA (Burma). **FF.** Filament short or absent—BURBIDGEA (Borneo). **EE.** Afr. and Amer.—RENEALMIA. **DD.** Labellum spreading or recurved: **G.** Inflorescence lax: **H.** Inflorescence not secund; labellum shortly bilobed—ALPINIA (*Elmeria,*

Adelmeria, Eriolopha, Conolophon, Catimbium, Languas) (E. Trop., few in Afr.). **HH.** Inflorescence more or less secund: labellum deeply 2-lobed: **I.** Bracts small and scale-like—RIEDELIA (Malaya). **II.** Bracts fairly large—VANOVERBERGIA (Philipp. Is.). **GG.** Inflorescence very dense; labellum subentire or shortly bilobed—PLAGIOSTACHYS (India to Malaya). **CC.** Labellum pouched at the base; calyx spathaceous, split to the base—THYLACOPHORA (New Guin.). **BB.** Labellum small or minute, not at all conspicuous: **BB(1).** Labellum deeply bilobed; filament narrow, flat—NANOCHILUS (Sumatra). **BB(2).** Labellum reduced to a tooth; filament dilated, folded—RHYNCHANTHUS (Burma). **AA.** Inflorescence borne on a leafless shoot apart from the leafy stems: **K.** Labellum not lobed; anther-connective without an appendage or the latter if present not forming a tube around the style: **L.** Inflorescence spicate: **M.** African genus; labellum usually large and spirally coiled—AFRAMOMUM (Trop. Afr.). **MM.** E. Tropical genera: **N.** Labellum not much longer or larger than the corolla-lobes: **O.** Inflorescence without an involucre: **P.** Spikes dense-flowered and mostly capitate—AMOMUM (E. Tropics and Austral.). **PP.** Spikes few-flowered and elongated—ELETTARIOPSIS (Indo-Malaya, New Guin.). **OO.** Inflorescence involucrate: **Q.** Spikes pointed; fruit a smooth capsule—HORNSTEDTIA (E. Tropics). **QQ.** Spikes rounded at the apex: **R.** Corolla-tube long—GEANTHUS (E. Tropics to Samoa). **RR.** Corolla-tube short—PHAEOMERIA (Ceylon to Indo-China and New Guin.). **NN.** Labellum elongated, often 3-lobed, the middle lobe split—ACHASMA (Indo-Malaya, Indo-China). **LL.** Inflorescence elongated and racemose or paniculate: **S.** Connective without or with a very short appendage: **T.** Calyx tubular, shortly 3-lobed; inflorescence simple—ELETTARIA (India, Ceylon). **TT.** Calyx spathaceous; inflorescence paniculate—GEOSTACHYS (Trop. Asia). **SS.** Connective with a petaloid appendage: **U.** Inflorescence prostrate; labellum free from the stamen—CYPHOSTIGMA (Ceylon). **UU.** Inflorescence erect; labellum united with the stamen—AULOTANDRA (Madag., W. Trop. Afr.). **KK.** Labellum mostly 3-lobed; connective of anthers elongated and folded around the style—ZINGIBER (E. Tropics and Subtropics). **KKK.** Labellum 2-lobed nearly to the base; connective of anthers small and hood-like at apex—GEOCHARIS (Malaya).

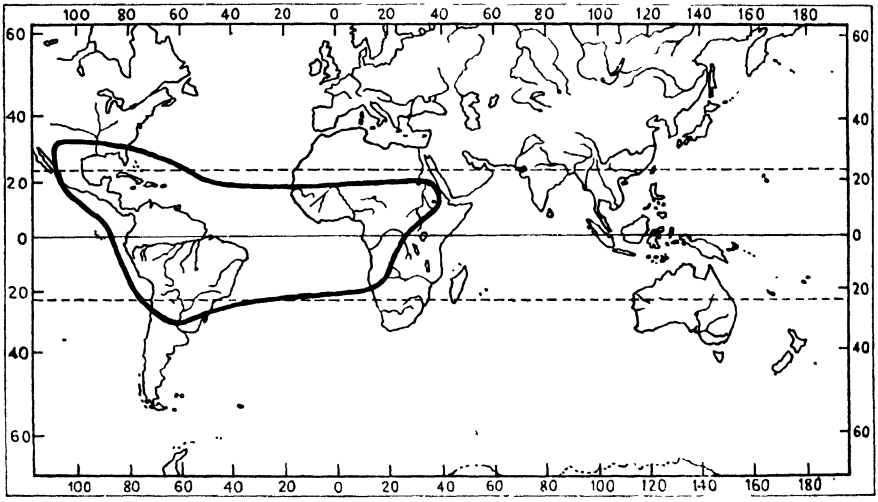
370. CANNACEAE

Tall leafy perennial rhizomatous herbs; leaves large, broad, pinnately nerved, with a distinct midrib. Flowers racemose or paniculate, bracteate, zygomorphic, bisexual, mostly large and brightly coloured. Perianth *double*, the *outer calycine*, the *inner corolline*. Sepals 3, imbricate, free, herbaceous. Petals 3, connate at the base and adnate to the staminal column. Stamens *petaloid*, shortly connate at the base, 3 outer sterile, imbricate, 2 inner more or less connate, 1 free; anther solitary, 1-locular, adnate to the side of petaloid portion. Ovary inferior, 3-locular, ovules numerous on axile placentas, anatropous. Fruit a capsule opening by the collapse of the at length fibrous often warted pericarp. Seeds many, rounded, with very *hard endosperm* and straight embryo. B.H. **3**, 654 (under *Scitamineae*); E.P. **2**, 6, 30; Rendle, 337.—Mainly Tropical and Subtropical America.

USEFUL PRODUCTS: Several species of the only genus CANNA have for a long time been favourite warm-greenhouse plants, Canna indica *L.* (*Indian Shot*) being sometimes used as a subtropical bedding plant. The preliminary chipping of the ultra-hard seeds before sowing is a familiar operation to gardeners.

371. MARANTACEAE

Perennial herbs. Leaves in *two rows*, differentiated into an *open sheath*, stalk, and blade, the stalk often winged but terete and *pulviniform towards the apex*,



Range of the natural (homogeneous) genus Thalia (Marantaceae), showing a link between the floras of Tropical Africa and Tropical America.

the blade sometimes with one straight and one curved side, with numerous closely parallel nerves diverging obliquely from the midrib. Flowers bisexual, asymmetric, in a terminal bracteate spike or panicle, or the inflorescence arising from the rhizome. Perianth mostly *differentiated into calyx and corolla.* Outer perianth-segments free, inner more or less tubular, divided into three mostly unequal parts. *Fertile stamen* 1; anther 1-locular; *staminodes variously petaloid.* Ovary inferior, 3–1-locular, sometimes two of the loculi infertile; style stout, simple, often involute or dilated at the apex. Ovule *solitary, erect* from the base of the loculus. Fruit fleshy or a loculicidal capsule. Seeds with abundant endosperm and much incurved or folded embryo, and often a basal, sometimes lamellate aril. B.H. **3**, 649 (as tribe of *Scitamineae*); E.P. **2**, 6, 33; edn. 2, **15***a*, 654 (1930); K. Schum. in Engl. *Pflanzenr., Marantac.* (1902); Rendle, 339.—Tropics and Subtropics, mostly in moist or swampy primary forest.

USEFUL PRODUCTS: *Arrowroot* and *Maranta Starch* (rhizomes of Maranta arundinacea *L.*); *Topee Tamboo* (tubers of Calathea allouia *Lindl.*).

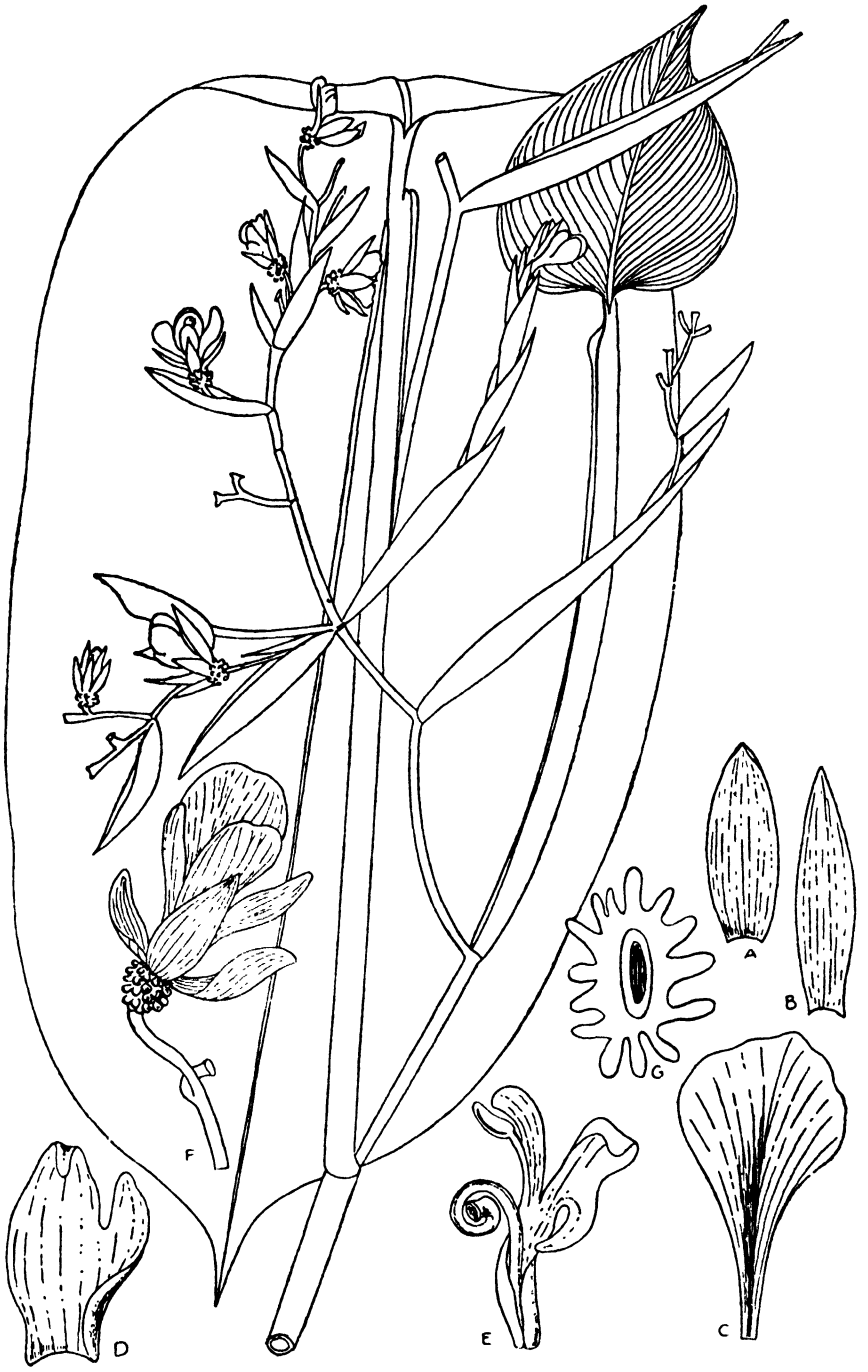


FIG. 368. Stromanthe papillosa *Petersen* (Marantaceae). A, outer perianth-segment. B and C, inner perianth-segments. D, staminode. E, staminodes, stamen, and style. F, flower. G, cross-section of ovary. (Adapted from Martius.)

Key to the Tribes and Genera

A. Ovary 3-locular, sometimes 2 loculi undeveloped, 3-ovuled 1. *Phrynieae*

AA. Ovary 1-locular, 1-ovuled 2. *Maranteae*

Tribe 1. **Phrynieae.** Old World Tropics (except CALATHEA). **A.** Outer staminodes 2: **B.** Bracts arranged in 2 rows: **C.** Pairs of flowers furnished with small thickened glandular bracteoles: **D.** Fruit smooth, not muricate: **E.** Herbs, unbranched (except the inflorescence); fruit fleshy: **F.** Fruit not winged; inflorescence terminating the leafy shoot: **G.** Seeds not arillate—SARCOPHRYNIUM (Trop. Afr.). **GG.** Seeds arillate—MEGAPHRYNIUM (Trop. Afr.). **FF.** Fruit winged; inflorescence from the rhizome—THAUMATOCOCCUS (W. Trop. Afr.). **EE.** Shrubs, often branched: **H.** Fruit a capsule; seeds arillate—CLINOGYNE[1] (*Schumannianthus*) (Indo-Malaya). **HH.** Fruit indehiscent; seeds not arillate—DONAX (Indo-Malaya). **DD.** Fruit muricate: **J.** Fruit dehiscent; seeds with a multilamellate basal aril; bracts deciduous—TRACHYPHRYNIUM (*Bamburanta*, *Hybophrynium*) (Trop. Afr.). **JJ.** Fruit indehiscent; seeds not arillate: **K.** Bracts convolute, oblong-lanceolate, caducous; each pair of flowers provided with 2 short horny bracteoles—HYPSELODELPHYS (Trop. Afr.). **KK.** Bracts suborbicular, strongly folded, spreading in flower and persistent; each pair of flowers enclosed by a large keeled bracteole—HAUMANIA (Trop. Afr.). **CC.** Pairs of flowers without bracteoles: **L.** Flower-pairs solitary: **M.** Sepals equal—STACHYPHRYNIUM (Indo-Malaya). **MM.** Sepals unequal—HALOPEGIA (Trop. Afr., Indo-Malaya). **LL.** Flower-pairs two or more together: **N.** Bracts persistent: **O.** Inflorescence on the leafy shoot, capitate: **P.** Fruit dehiscent; stems unbranched—PHRYNIUM (E. Tropics). **PP.** Fruit indehiscent; stems branched—ATAENIDIA (Trop. Afr.). **OO.** Inflorescence from the rhizome, spiciform—AFROCALATHEA (Trop. Afr.). **NN.** Bracts deciduous: **Q.** Corolla-tube long (1·5 cm.)—COMINSIA (New Guin.). **QQ.** Corolla-tube short—MARANTOCHLOA (Trop. Afr.). **CCC.** Flowers solitary in the bracts—MONOPHRYNIUM (Philipp. Is.). **BB.** Bracts not in two rows—CTENOPHRYNIUM (Madag.). **AA.** Outer staminodes solitary or absent: **R.** Inflorescence paniculate—PHACELOPHRYNIUM (India to New Guin.). **RR.** Inflorescence spiciform or capitate—CALATHEA (Trop. Amer.).

Tribe 2.[2] **Maranteae.** Trop. Amer. (except THALIA). **A.** Bracts persistent: **B.** Outer staminodes 2, large and petaloid: **C.** Leaves homotropous—MYROSMA. **CC.** Leaves antitropous—CTENANTHE. **BB.** Outer staminode 1: **D.** Flowers solitary in each bract—MONOTAGMA. **DD.** Flowers paired in each bract: **E.** Inflorescence loosely spicate, small—MONOPHYLLANTHE. **EE.** Inflorescence thickly spicate, cylindrical bracts convolute—ISCHNOSIPHON. **EEE.** Inflorescence thickly spicate, laterally flattened—PLEIOSTACHYA. **AA.** Bracts deciduous or at length deciduous: **F.** Outer staminodes 2: **G.** Bracts distichous; inflorescence with slender branches, few-flowered—MARANTA. **GG.** Bracts dorsiventral: **H.** Leaves homotropous—SARANTHE. **HH.** Leaves antitropous; bracts coloured—STROMANTHE. **FF.** Outer staminode 1; flowers laxly paniculate—THALIA (Trop. Afr. and Trop. Amer.).

[1] *Clinogyne* of Salisb. not Benth.

[2] Adapted from Loesener in E.P. edn. 2, 15*a*, 665 (1930).

DIVISION II. COROLLIFERAE

ORDER 95. LILIALES

Herbs with rhizomes, corms, or bulbs; stems leafy or leaves clustered at the base or all radical, rarely reduced and the branchlets leaf-like (cladodes); flowers small to large and very showy, usually bisexual; perianth *actinomorphic* or slightly zygomorphic, mostly *corolla-like*; stamens *usually* 6, opposite the perianth-segments or lobes; ovary *superior* or semi-inferior, usually 2-locular with axile placentas; fruit a capsule or berry; seeds with copious endosperm—World-wide distribution, most abundant in Temperate and Subtropical Regions.

A. Leaves usually well developed, if reduced then the cladodes linear and flowers axillary; filaments usually free from each other:
B. Terrestrial or rarely swamp plants; inflorescence not subtended by a spathe-like leaf-sheath:
C. Anthers usually 2-locular; flowers mostly bisexual:
D. Leaves alternate, never all whorled at the top of the stem:
E. Anthers opening by slits (or very rarely by a pore); ovary superior *Liliaceae*
EE. Anthers opening by terminal pores or short pore-like slits; ovary semi-inferior *Tecophilaeaceae*
DD. Leaves opposite, or whorled at the top of the stem *Trilliaceae*
CC. Anthers 1-locular by the confluence of the cells; flowers mostly dioecious; ovary superior; stems climbing or straggling, often prickly *Smilacaceae*
BB. Aquatic herbs; inflorescence subtended by a spathe-like leaf-sheath; seeds ribbed *Pontederiaceae*
AA. Leaves reduced to scales; flowers borne on the margins or surface of the leaf-like cladodes; filaments connate into a column; fruit a berry *Ruscaceae*

372. LILIACEAE

Herbs, mostly perennial, or rarely soft-wooded shrubs; roots from a rhizome, corm, or bulb, sometimes tuberous; stem erect or climbing, leafy or scapose. Flowers bisexual or rarely unisexual, *actinomorphic* or slightly zygomorphic, sometimes large and showy, *never in umbels*. Perianth mostly *corolla-like*, with or without a tube; segments or lobes 6, rarely 4 or more, mostly in 2 distinct but usually *very similar series*, imbricate or the outer valvate. Stamens usually 6 (rarely up to 12, or 3), hypogynous or adnate to and always opposite to the perianth-segments; filaments free or variously connate; anthers 2-locular, *opening by a slit lengthwise* or rarely by a terminal pore. Ovary *superior*, very rarely more or less adnate to the base of the perianth-tube and then semi-inferior, mostly 3-locular with axile placentas, or rarely 1-locular with parietal placentas; style entire or divided, rarely styles free. Ovules usually numerous and mostly 2-seriate in each loculus, rarely solitary. Fruit

a loculicidal or septicidal capsule, or a fleshy berry. Seeds with copious endosperm and straight or curved embryo. B.H. **3**, 748; E.P. **2**, 5, 10; edn. 2, **25a**, 227; Baker in *J. Linn. Soc.* **11**, 349–436 (1870); **13**, 209–92 (1873); **14**, 211–310 (1874); **14**, 508–632 (1875); **15**, 253–363 (1877); **17**, 405–510 (1879).—World-wide distribution, most abundant in Temperate and Subtropical Regions.

USEFUL PRODUCTS: *Aloe* (juice of most species has more or less purgative action, that of Cape species being the strongest, of Natal the weakest); edible *Asparagus* of gardens (Asparagus officinalis *L.*); *Colchicum seeds* (Colchicum autumnale *L.* contains alkaloid *Colchicine*); *Lily of the Valley* (Convallaria majalis *L.*; flowers used as a cardiac tonic instead of foxglove); *Meadow Saffron* (Colchicum autumnale *L.*); *Squill* (bulb of Urginea scilla *Steinh.*); *White Hellebore* (Veratrum album *L.*); *Mih-Mun-Tung* (tubers of Ophiopogon japonicus *Ker-Gawl*).

This remains a large and varied family even after the transfer of the tribes *Dracaeneae*, *Smiliaceae*, *Luzuriageae*, and *Allieae*. It would carry me too far in the present work to trace out the phylogeny of the various groups, as they are still somewhat artificially classified and need more intensive monographic study. I commend this task to some student so inclined.

The most primitive tribes are no doubt those with a rhizomatous rootstock. Among the more ancient are the *Heloniadeae*, which, as here defined, are devoid of bracts and are probably more advanced representatives of the primitive *Juncaginaceae*. The habit and general structure is essentially the same, but the carpels in *Heloniadeae* are united, which brings the group within the complex of the *Liliaceae*.

Parallel with the *Heloniadeae* are the *Narthecieae*, in which the styles are mainly free from each other, this being a primitive feature, accompanied by a simple, spicate, or racemose inflorescence. Thence we have a very large tribe which seems to represent the main stock of the family, the *Asphodeleae*, with rhizomes, whence various lines of development may be traced, some of which, although otherwise highly advanced, have retained the rhizomatous character, such as the *Aloineae*, &c.; and this rhizomatous character has persisted through the *Ophiopogoneae*, *Milliganieae*, right into the *Haemodorales*, which may be regarded as the prototypes of the *Orchidaceae* (see diagram, p. 517).

From the same stock as the *Peliosantheae* have arisen the *Aspidistreae*, *Convallarieae*, and *Polygonatae*. From *Aspidistreae* it is a very short step indeed to the most primitive types of the *Araceae*, the other two tribes representing more climax groups.

For the purposes of this book I have probably laid too much stress on the nature of the rootstock, and it may be possible for a monographer to associate the genera into a larger number of smaller groups in which plants with rhizomes and others with bulbs might be more happily associated. It is probable that the bulbous character, which is a climax habit, has arisen independently in several directions.

Artificial Key to Tribes of Liliaceae[1]

**Rootstock a rhizome; roots fibrous or sometimes tuberous; perennials or rarely annuals:*

A. Leaves more or less well developed or rarely reduced to sheaths but not to scales; branches never modified into cladodes:

B. Leaves all radical or at or towards the base of the stem, or with larger radical leaves and much smaller stem-leaves:

C. Fruit a loculicidal or septicidal capsule (not a berry):

D. Flowers ebracteate; anthers rounded 1. *Heloniadeae*

[1] The keying out of these tribes is a very difficult matter, as several of them overlap.

DD. Flowers bracteate:
E. Anthers extrorsely dehiscent:
F. Flowers in spikes or racemes 2. *Narthecieae*
FF. Flowers in panicles 19. *Veratreae* (part)
EE. Anthers introrse or opening at the side:
G. Inflorescence neither capitate nor covered with imbricate bracts:
H. Filament not inserted in a dorsal pit of the anther:
I. Fruit a normally opening capsule or rarely fleshy and indehiscent (not bursting irregularly):
J. Flowers spicate or racemose, if paniculate then not woolly-hairy:
K. Leaves more or less well developed:
L. Leaves numerous in a basal rosette or cluster 2. *Narthecieae* (part)
LL. Leaves few 3. *Asphodeleae*
KK. Leaves reduced to sheaths 4. *Aphyllanthideae*
JJ. Flowers paniculate; panicles woolly-hairy 13. *Milliganieae* (part)
II. Fruit soon bursting irregularly and exposing the unripe seeds; leaves linear, crowded; flowers in racemes; ovary superior to semi-inferior 5. *Ophiopogoneae*
HH. Filament inserted in a dorsal pit of the anther, the latter not or rarely slightly 2-lobed at the back:
M. Perianth-segments separate or nearly so:
N. Stems erect, scapose, not climbing, herbaceous 3. *Asphodeleae*
NN. Stems climbing, wiry; leaves like cladodes, in clusters 6. *Herrerieae*
MM. Perianth-segments more or less closely connivent or connate into a tube:
O. Leaves never fleshy or prickly, mostly long and narrow, rarely ovate; perianth funnel-shaped, cylindrical, or campanulate:
P. Inflorescence racemose or spicate; perianth-segments connivent into a straight or narrow tube 7. *Kniphofieae*
PP. Inflorescence paniculate or subcapitate, or if racemose then perianth-tube contracted in the lower part 8. *Hemerocallideae*
OO. Leaves mostly thick and fleshy, often prickly on the margin; perianth-segments connivent into a narrow tube 9. *Aloineae*
GG. Inflorescence capitate-spicate or fasciculate, with imbricate bracts; all Australian 10. *Johnsonieae*
CC. Fruit a berry or at length rupturing irregularly and exposing the seeds:
Q. Ovary superior; fruit an indehiscent berry:
R. Flowers bisexual:
S. Flowers in racemes or interrupted spikes 11. *Convallarieae*
SS. Flowers solitary or in a dense continuous aroid-like spike; leaves often broad and plicately nerved 12. *Aspidistreae*
RR. Flowers polygamo-dioecious, in woolly panicles 13. *Milliganieae*
QQ. Ovary semi-inferior; pericarp at length breaking away and exposing the seeds 14. *Peliosantheae*

BB. Leaves cauline, the stems more or less equally leafy throughout, mostly simple or little-branched, sometimes woody:
T. Anthers introrse or opening at the sides or by terminal pores:
U. Inflorescence spicate or racemose, terminal; leaves narrow or reduced 2. *Narthecieae* (part)
UU. Inflorescence axillary or paniculate or if racemose then leaves broad:
V. Anthers opening by slits 15. *Polygonateae*
VV. Anthers opening by terminal pores 16. *Dianelleae*
UUU. Inflorescence subumbellate 27. *Iphigenieae* (part)
TT. Anthers extrorse:
W. Leaves nearly all radical and crowded or the stem-leaves much smaller than the radical leaves; flowers usually racemose 2. *Narthecieae* (part)
WW. Leaves all cauline, sessile or amplexicaul; flowers axillary or terminal, solitary to few together:
X. Perianth-segments not saccate 17. *Uvularieae*
XX. Perianth-segments saccate at the base 18. *Tricyrtideae*
WWW. Leaves various, mostly cauline; flowers paniculate or racemose; perianth-segments not saccate 19. *Veratreae*
AA. Leaves reduced to scales, the branchlets cladodiform and green, often acicular; flowers small 20. *Asparageae*

***Rootstock a bulb or corm:*

A. Flowers ebracteate 21. *Anguillarieae*
AA. Flowers with a bract at the base or at the base of the pedicel, or subtended by a leaf or modified leaf:
B. Flowers not in heads or umbel-like heads:
C. Scape with 1 or more leaves:
D. Anthers extrorse; flowers mostly small and paniculate 19. *Veratreae* (part)
DD. Anthers introrse; flowers mostly large and few or solitary 22. *Tulipeae*
CC. Scape or flowering stem leafless or leafy only at the base:
E. Flowers several to numerous:
F. Flowers in unbranched racemes or spikes:
G. Inflorescence without a spathe-like bract at the base, usually racemose 23. *Scilleae* (part)
GG. Inflorescence with a spathe-like bract at the base, spicate 24. *Miluleae*
FF. Flowers in panicles:
H. Leaves present and persisting during flowering; inflorescence not scandent 3. *Asphodeleae* (part)
HH. Leaves soon disappearing; inflorescence scandent 25. *Bowieae*
EE. Flowers solitary or two together:
I. Flowers on a scape 23. *Scilleae* (part)
II. Flowers mostly close to the ground; leaves very narrow 26. *Colchiceae*
BB. Flowers in umbel-like heads:

J. Anthers extrorse or opening at the side — 27. *Iphigenieae*
JJ. Anthers introrse — 28. *Massonieae*

Tribe 1. **Heloniadeae** (emend.) *Rhizome short*, with fibrous roots; leaves in a radical tuft, the stem leaves much smaller or reduced and bract-like; flowers small, in dense spikes or racemes, *ebracteate*; perianth-segments *free*, mostly small and white; stamens 6, hypogynous; anthers basifixed, rounded, deeply cordate, subextrorsely and laterally dehiscent; ovary 3-locular; styles free or united; capsule loculicidally dehiscent; seeds *tailed* at one or both ends.—China and Japan, E. Tibet, Eastern U.S.A.

An ancient group characterized particularly by the complete absence of bracts subtending the flowers; probably derived from the *Juncaginales*, which are also ebracteate.

A. Flowers pedicellate; perianth-segments equal or subequal: **B.** Styles free or slightly connate at the base: **C.** Flowers bisexual; stem-leaves much reduced



FIG. 369. Chinographis japonica *Maxim.* (Liliaceae-Heloniadeae). A, flower showing zygomorphic corolla. B, stamen. C, pistil. D, vertical section of pistil. E, fruit. F, seed. (Adapted from *Bot. Mag.*)

and bract-like; capsule deeply lobed at the top—HELONIAS (Atlantic N. Amer.). **CC.** Flowers dioecious; stem-leaves green and oblanceolate; capsule not lobed at the top—CHAMAELIRIUM (Atlantic N. Amer.). **BB.** Styles united into one and inserted between the lobes of the ovary; stem-leaves reduced and bract-like—YPSILANDRA (China, Tibet). **AA.** Flowers sessile; perianth-segments very unequal, the flower zygomorphic; stem-leaves linear-lanceolate—CHIONOGRAPHIS (China, Japan).

Tribe 2. **Narthecieae.** Rootstock a short or creeping *rhizome*; radical leaves crowded, the stem leaves smaller or absent; flowers bisexual, arranged in spikes or racemes or corymbose cymes, *bracteate*; perianth persistent, segments free or shortly connate at the base and sometimes partly adnate to the

ovary, usually inconspicuous and white; stamens 12–6, or 3; anthers basifixed, introrse or extrorse; ovary 3-locular; ovules numerous or few; styles 3, *free*, or style simple or shortly lobed; fruit a loculicidal or septicidal capsule. Temp. N. Hemisphere, Tasmania, Andes of S. America, Mts. of Guiana.

An ancient group with a wide disconnected distribution.

A. Styles 3, free or slightly connate at the base: **B.** Fruit septicidally dehiscent: **C.** Anthers introrse: **D.** Stamens 6–12; anthers linear—PLEEA (Carolina). **DD.** Stamens 6; anthers ovate or rounded—TOFIELDIA (*Triantheila, Japanolirion*?) (Temp. N. Hemisph., Andes). **CC.** Anthers extrorse—HEWARDIA (Tasmania). **BB.** Fruit loculicidally dehiscent; radical leaves linear—XEROPHYLLUM (N. Amer.). **AA.** Style simple or very shortly lobed: **E.** Capsule septicidal: **F.** Leaves oblong, thin; ovary 3-lobed—HELONIOPSIS (Japan). **FF.** [Leaves linear, rigid—CLARA (Paraguay)]. **EE.** Capsule loculicidal: **G.** Inflorescence simple or subsimple: **H.** Perianth-segments free: **I.** Leaves rigid; perianth-segments rigid, spreading; seeds tailed at each end—NARTHECIUM (Temp. N. Hemisph.). **II.** Leaves thin; perianth-segments linear or oblanceolate; style gradually narrowed into the conical ovary and fruit—METANARTHECIUM (Japan, Formosa). **HH.** Perianth tubular-campanulate, lobes subvalvate; scape elongated, leafless—ALETRIS (*Meta-Aletris*) India to Japan, Malay Archip., N. Amer.). **GG.** Inflorescence cymose-corymbose—NIETNERIA (Guiana).

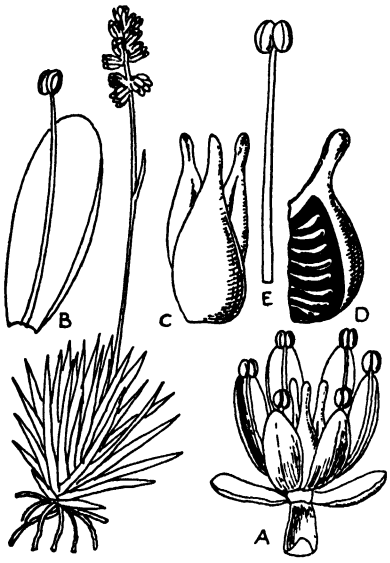


FIG. 370. Tofieldia calyculata. *Wahlenb.* (Liliaceae-Narthecieae). A, flower and tripartite bract. B, perianth-segment and stamen. C, carpels. D, one carpel in vertical section. E, stamen. (Orig.)

Tribe 3. **Asphodeleae.** Rootstock a *short rhizome* (very rarely a bulb); leaves in a *basal cluster*, if also on the stem then often reduced; inflorescence *racemose* or *paniculate*, sometimes much *elongated*; perianth-segments mostly *free*, equal, sometimes persistent; stamens 6 (rarely 3); anthers basifixed or dorsifixed and versatile, introrse; ovary 3-locular; ovules numerous to solitary; capsule *loculicidal*.

**Perianth spirally twisted after flowering:*

A. Flowers in a simple raceme—HODGSONIOLA (SW. Austral.). **AA.** Flowers in a panicle: **B.** Ovules numerous—CHAMAESCILLA (Austral.). **BB.** Ovules few: **C.** Ovules 4 in each loculus—PASITHEA (Chile and Peru). **CC.** Ovules 2 or 1 in each loculus: **D.** Fruit 3-seeded: **E.** Stamens free; anthers opening by pores—AGROSTOCRINUM (SW. Austral.). **EE.** Stamens united with the perianth; anthers opening by slits—CAESIA (Austral., S. Afr.). **DD.** Fruit 1-seeded;



FIG. 371. Asphodelus chambeironi *Jord.* (Liliaceae-Asphodeleae). A, flower. B, stamens. C, one stamen from inside. D, fruits. E, seed. (After Jordan and Fourreau.)

stems dichotomously branched—CORYNOTHECA (Austral.). **AAA.** Flowers 1–3 together; ovules 2 in each loculus—NANOLIRION (S. Afr.).

***Perianth not spirally twisted after flowering.*

†*Anthers basifixed or nearly so, not versatile:*

A. Inner perianth-segments not ciliate-fimbriate: **B.** Anthers free from each other: **C.** Perianth-segments similar or nearly so: **D.** Capsule subentire or with rounded lobes: **E.** Inflorescence several-flowered: **F.** Racemes simple, flowers very numerous, dense—EREMURUS (Asia). **FF.** Inflorescence usually branched or few-flowered and slender, with usually laxly arranged flowers: **G.** Filaments glabrous: **H.** Filaments short and thick—DEBESIA (*Acrospira*) (Angola). **HH.** Filaments more or less filiform: **I.** Seeds glabrous: **J.** Stamens 6: **K.** Ovules 4–8 in each loculus; filaments slender: **L.** Leaves linear: **M.** Perianth-segments 3–7-nerved, free—ANTHERICUM (widely distrib.). **MM.** Perianth-segments 1-nerved—LIRIOTHAMNUS (Namaqual.). **LL.** Leaves broadly elliptic; perianth-segments 1-nerved—VERDICKIA (Congo). **KK.** Ovules 2 in each loculus; filaments broader at the base—EREMOCRINUM (Calif.). **JJ.** Stamens 3; flowers monoecious—TERAUCHIA (Korea). **II.** Seeds with long hairs at the base—ALECTORURUS (Japan). **GG.** Filaments pubescent—GLYPHOSPERMA (N. Mexico). **EE.** Inflorescence 1-flowered—HERPOLIRION (New Zeal., Austral.). **DD.** Capsule acutely triquetrous or 3-winged: **N.** Flowers pedicellate—CHLOROPHYTUM (Tropics and Subtropics). **NN.** Flowers sessile—DASYSTACHYS (Trop. Afr.). **CC.** Perianth-segments dissimilar: **O.** Filaments long-pubescent—ARTHROPODIUM (Austral., New Caled., New Zeal.). **OO.** Filaments glabrous—DICHOPOGON (E. Austral.). **BB.** Anthers coherent into a tube around the style—ECHEANDIA (Mexico–Guianas). **AA.** Inner perianth-segments markedly ciliate-fimbriate: **P.** Capsule much longer than broad—BOTTINAEA (Chile). **PP.** Capsule only a little longer than broad —THYSANOTUS (S. Austral. to S. China).

††*Anthers dorsifixed, more or less versatile:*

A. Stamens 6, sometimes 3 infertile: **B.** Inflorescence not secund: **C.** Stem leafy; flowers mostly yellow—ASPHODELINE (Mediterr.-Orient). **CC.** Stem leafy only at the base or in the lower part, or leaves reduced: **D.** Filaments glabrous: **E.** Filaments expanded or thickened at the base and embracing the ovary—ASPHODELUS (Mediterr.–India, Mascar.). **EE.** Filaments not as above: **F.** Rootstock a short rhizome: **G.** Flowers numerous, small: **H.** Seeds neither compressed nor winged: **I.** Perianth-segments 3-nerved—SCHOENOLIRION (*Hastingsia*) (N. Amer.). **II.** Perianth-segments 1-nerved—BULBINELLA (S. Afr., New Zeal., Antarct.). **HH.** [Seeds compressed and winged—CLARA[1] (Paraguay)]. **GG.** Flowers few, rather large: **J.** Inflorescence more or less 1-sided—PARADISIA (*Liliastrum*) (Eur., Tibet). **JJ.** Inflorescence not 1-sided—DIURANTHERA (China). **FF.** Rootstock a tunicated bulb—CHLOROGALUM (Calif.). **DD.** Filaments villous: **K.** Ovules 2 in each loculus: **L.** Filaments inserted in a pit—SIMETHIS (W. Eur., NW. Afr.). **LL.** Filaments not inserted in a pit—BULBINOPSIS (Austral., Tasm.). **KK.** Ovules 4 or more in each loculus—BULBINE (S. Afr., New Zeal., Antarct.). **BB.** Inflorescence secund:

[1] See *Herrerieae*, p. 600.

M. Inflorescence horizontal, dense; ovules numerous—XERONEMA (New Caled.). **MM.** Inflorescence elongated: **N.** Ovules few—HEMIPHYLACUS (Mexico). **NN.** Ovules numerous—PARADISIA (Eur., Tibet). **AA.** Stamens 3: **O.** Flowers bisexual—ANEMARRHENA (N. China). **OO.** Flowers monoecious—TERAUCHIA (Korea).

Tribe 4. **Aphyllanthideae.** Rootstock a short *rhizome*; stems *Juncus*-like; leaves *reduced to sheaths*; flowers 1–3 in a short terminal bracteate spike;



FIG. 372. Aphyllanthes monspeliensis *Linn.* (Liliaceae-Aphyllanthideae). A, flowers with bract removed. B, vertical section of flower. C, bud. D, petal and stamen. E, pistil. F, ovary with one loculus opened. G, cross-section of ovary. H, fruit. I, vertical section of seed. (Orig.)

bracts *imbricate, membranous*; perianth persistent, segments equal, clawed, connivent at the base; no corona; stamens 6, attached to the claws of the perianth; anthers basifixed, introrse; ovary 3-locular; ovule *solitary*; fruit a loculicidal capsule.—Mediterranean Region.

One genus, APHYLLANTHES.

Further development, to IRIDACEAE (*Aristea* group).

Tribe 5. **Ophiopogoneae.** Rootstock a *rhizome*, with sometimes tuberous roots; leaves *linear*, crowded; flowers in *simple racemes*; perianth-segments *free*, subequal; stamens 6, free; anthers basifixed, subintrorse; ovary superior or *semi-inferior*, 3-locular; style columnar, 3-fid; ovules 2, *collateral, erect*; pericarp of fruit soon rupturing and exposing the seeds; seeds berry-like.—India to Japan.

Further development, to HAEMODORACEAE.

A. Ovary superior; perianth spreading from the base of the ovary—LIRIOPE (China, Japan). **AA.** Ovary semi-inferior; perianth spreading from near the top of the ovary—MONDO (*Ophiopogon*) (India to Japan).

Tribe 6. **Herrerieae.** Stems erect or wiry and *climbing* from a usually *tuberous rhizome*, sometimes armed with *prickles*; leaves in basal or *lateral clusters*, narrow and *cladode-like*, closely nerved; flowers small, bisexual, in slender racemes or panicles; pedicels articulate; perianth deciduous, segments free, spreading; stamens 6; anthers introrse, dorsifixed; ovary 3-locular; style short, with 3 subclavate stigmas; ovules few in each loculus; capsule laterally *deeply* 3-*lobed*, loculicidally dehiscent; seeds compressed, *winged* all around.—Subtropical and Temperate S. America, and Madagascar.

A. Leaves in radical clusters; flowering stem leafless, tall and scapose, simple or little-branched, rarely bearing a tuft of leaves—CLARA (Paraguay). **AA.** Stems scandent, with lateral clusters of narrow leaves; racemes simple or branched: **B.** Ovules 3–6 in each loculus—HERRERIA (Subtrop. and Temp. S. Amer.). **BB.** Ovules numerous in each loculus—HERRERIOPSIS (Madag.).

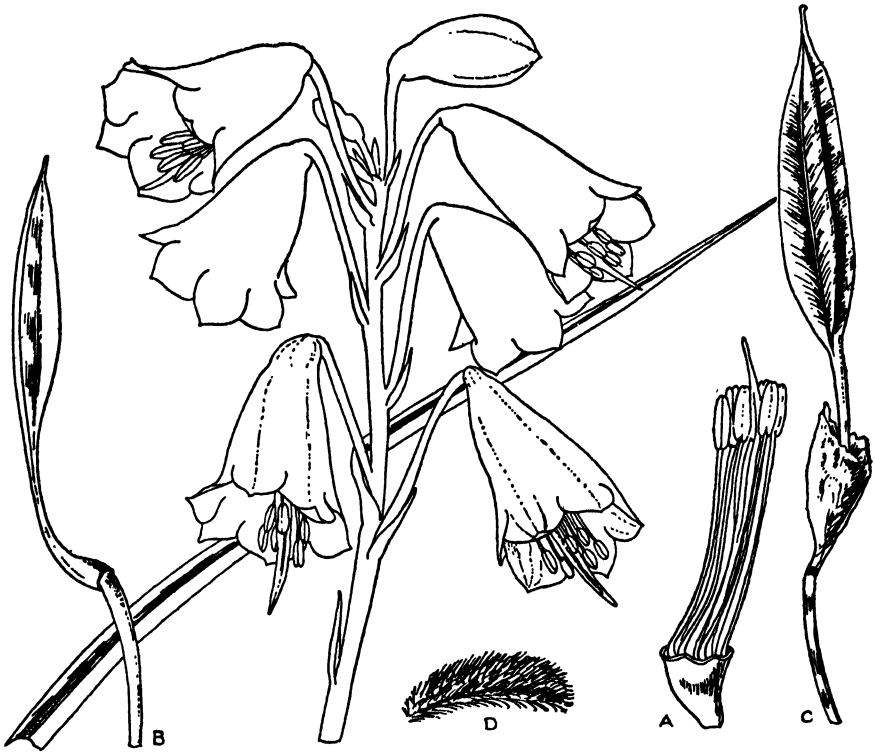


FIG. 373. Blandfordia flammea *Hook.* (Liliaceae-Kniphofieae). A, stamens and pistil. B, young fruit. C, mature fruit. D, seed. (Partly after *Bot. Mag.*)

Tribe 7. **Kniphofieae.** Rootstock a *rhizome*; leaves radical, *linear*, not fleshy; flowers in a terminal simple raceme or spike, often *pendulous* or reflexed; perianth-segments similar and equal or subequal, *united* into a campanulate or cylindric tube; stamens 6, hypogynous or on the tube; anthers dorsifixed,

introrse; ovary 3-locular; ovules numerous or few; fruit a loculicidal or septicidal capsule.—Australia, S. Tropical and S. Africa, Madagascar.

Further development, to ALOINEAE.

A. Flowers racemose, pendulous; perianth bell-shaped; seeds villous—BLANDFORDIA (Austral.). **AA.** Flowers densely spicate: **B.** Flowers not reflexed; perianth-tube short and campanulate—NOTOSCEPTRUM (Trop. and S. Afr.). **BB.** Flowers reflexed; perianth-tube narrow—KNIPHOFIA (Trop. and S. Afr., Madag.).

Tribe 8. **Hemerocallideae.** Rootstock a *rhizome* or the latter *bulb-like*; leaves all *basal* or towards the base; flowers usually racemose or paniculate;

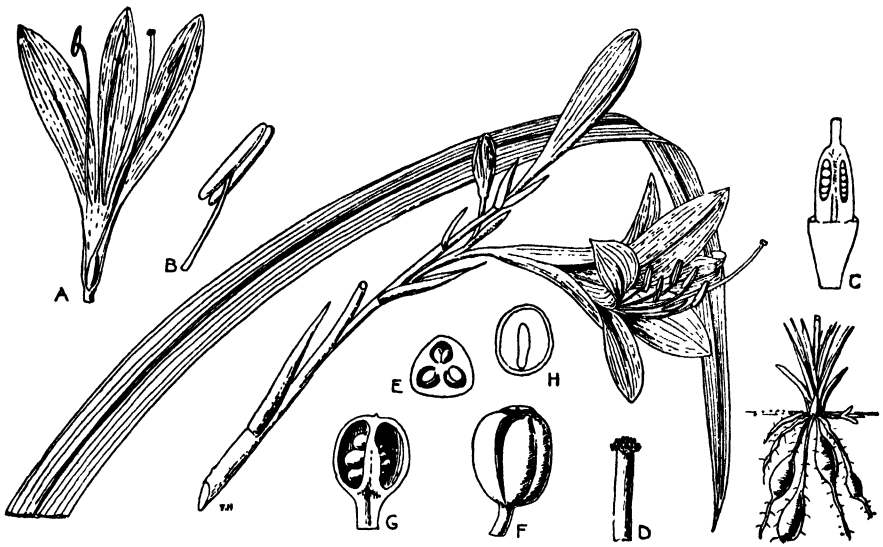


FIG. 374. Hemerocallis flava *Linn.* (Liliaceae-Hemerocallideae). A, vertical section of flower. B, anther. C, vertical section of ovary. D, stigma. E, cross-section of ovary. F, fruit. G, vertical section of fruit. H, section of seed. (Orig.)

perianth-segments *connate* into a funnel-shaped tube, erect or pendulous; corona absent; stamens hypogynous or on the tube; anthers dorsifixed, introrse; ovules numerous; fruit a loculicidal capsule.—E. Asia, N. America.

Further development, to TULIPEAE and AMARYLLIDACEAE.

A. Leaves petiolate: rhizome woody—HOSTA (*Funkia*) (China, Japan). **AA.** Leaves strap-shaped: **B.** Rootstock a rhizome; roots often thickened: **C.** Flowers in a panicle—HEMEROCALLIS (Eur.-Asia). **CC.** Flowers from the axils of radical bracts—LEUCOCRINUM (N. Amer.). **BB.** Rootstock bulb-like—HESPEROCALLIS (Calif.).

Tribe 9. **Aloineae.** Rootstock a *rhizome*; leaves crowded at the base of the stem, usually very fleshy and often margined with *prickly teeth*; flowers in a terminal spike, raceme, or panicle; perianth-segments equal and *connivent* or *connate* into a tube, often fleshy; stamens exserted or included; anthers dorsifixed, introrse; ovary 3-locular; ovules numerous; fruit a loculicidal capsule,

very rarely a berry; seeds often *compressed-angular* or *winged.*—Mainly S. Hemisphere (Africa). A climax group.

A. Fruit a capsule: **B.** Stamens as long as or longer than the perianth; leaves usually fleshy and prickly-toothed: **C.** Perianth-segments free to the base—CHAMAEALOE (S. Afr.). **CC.** Perianth-segments more or less united—ALOE (*Astroloba*) (S. Afr. to Arabia, Socotra, Madag.). **BB.** Stamens included in and shorter than the perianth: **D.** Perianth-tube not ventricose: **E.** Ovary and fruit rounded at the apex: **F.** Flowers in a subcorymbose raceme; perianth curved or bilabiate in the upper part; leaves not or only slightly fleshy—LEPTALOE (Trop. and S. Afr.). **FF.** Flowers in an elongated raceme; leaves thick and fleshy: **G.** Perianth with an equally spreading limb—APICRA (*Poellnitzia*) (S. Afr.). **GG.** Perianth with a bilabiate limb—HAWORTHIA (S. Afr.). **EE.** Ovary and fruit acuminate; leaves slightly fleshy—CHORTOLIRION (S. Trop. and S. Afr.). **DD.** Perianth-tube ventricose—GASTERIA (S. Afr.). **AA.** Fruit a berry; stamens a little shorter than the cylindrical perianth—LOMATOPHYLLUM (Mascar.).

Tribe 10. **Johnsonieae.** Rootstock a short or creeping rhizome; stems often *Juncus*-like; leaves linear, crowded, often grass-like; flowers in terminal heads or umbels, subtended by densely imbricate bracts; perianth-segments free or united towards the base, all similar; stamens 6 or 3; anthers introrse; ovary 3-locular; ovules numerous or few; fruit a loculicidal capsule.—Australia.

Further development, to IRIDACEAE (Aristeae).

A. Stamens 6: **B.** Ovules few: **C.** Flowers on slender pedicels and exserted from the head: **D.** Perianth not twisted after flowering—ALANIA: **DD.** Perianth twisted after flowering—TRICORYNE. **CC.** Flowers sessile or subsessile in the head—BARTLINGIA (*Laxmannia*). **BB.** Ovules numerous; flowers sessile in the heads—BORYA. **AA.** Stamens 3: **E.** Perianth-segments free: **F.** Flowers sessile in the head—STAWELLIA. **FF.** Flowers pedicellate in the head—SOWERBAEA. **EE.** Perianth-segments united towards the base: **G.** Perianth not twisted after flowering: **H.** Anther-loculi contiguous; head spike-like with scarious large bracts—JOHNSONIA. **HH.** Anther-loculi not contiguous—HENSMANIA (*Chamaecrinum*). **GG.** Perianth twisted after flowering; stems densely woolly at the base—ARNOCRINUM.

Tribe 11. **Convallarieae.** Rootstock a *rhizome*; leaves *clustered* on the rhizome; scape *leafless*, arising at the base of, or from the axils of the leaves; flowers racemose or spicate; perianth-segments free or united, subequal; stamens 6, inserted at the base of the segments or on the tube; anthers basifixed or dorsifixed, introrse; ovary 3-locular; ovules few (up to 10) in each loculus; style *columnar* or *filiform*; fruit a *berry*.—N. Temperate Zone. Climax group.

A. Perianth-segments free: **B.** Perianth-segments spreading from the base; stamens shorter than the perianth—SPEIRANTHA (China). **BB.** Perianth-segments campanulately connivent; flowers nodding; stamens shorter than the perianth—THEROPOGON (Himal.). **AA.** Perianth-segments united into a tube: **C.** Flowers racemose, nodding; stamens not exserted—CONVALLARIA (N. Temp. Reg.). **CC.** Flowers spicate, not nodding; stamens exserted—REINECKEA (China, Japan).

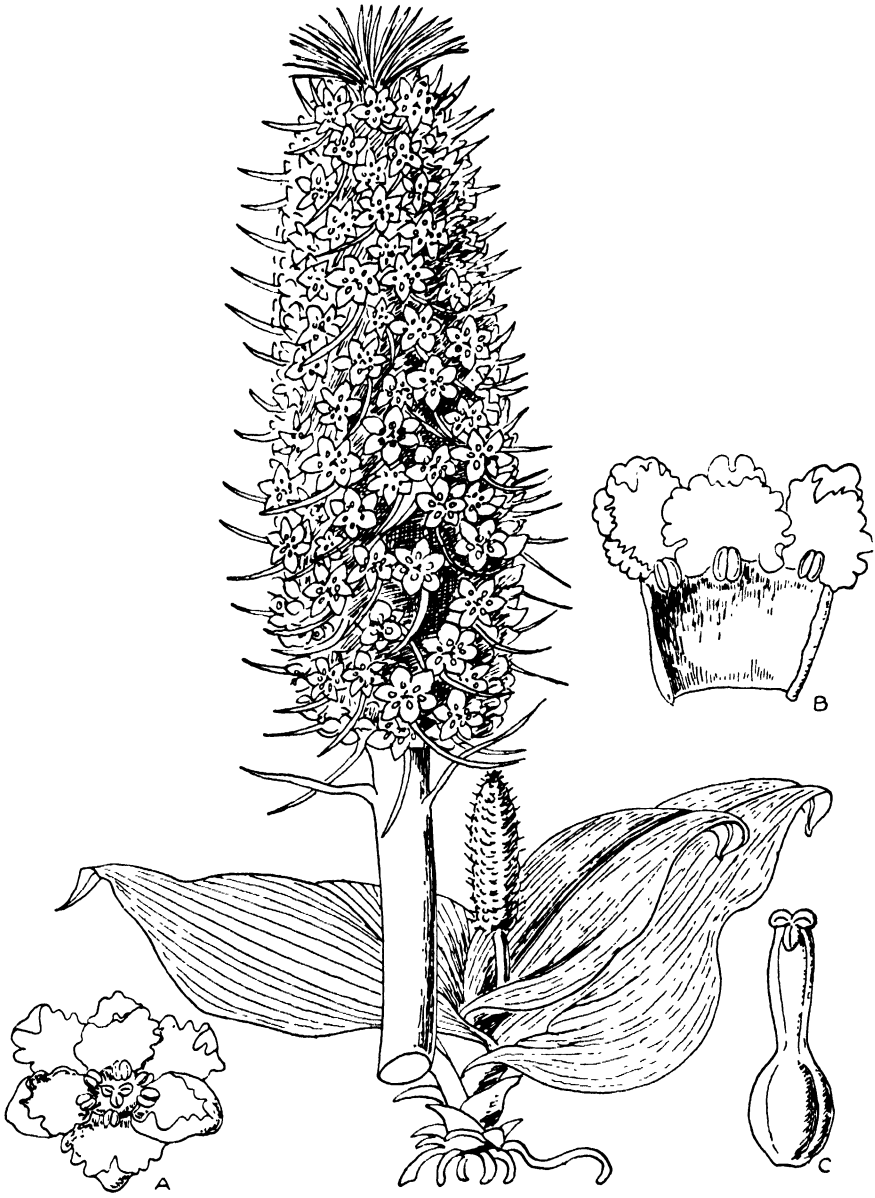


FIG. 375. Gonioscypha eucomoides *Baker* (Liliaceae-Aspidistreae). A, open flower. B, vertical section of corolla. C, pistil. (After *Bot. Mag.*)

Tribe 12. **Aspidistreae.** Rootstock a *rhizome*; leaves radical or on a short stem; flowers solitary, or small and in *dense bracteate spikes*; perianth 4–3-merous, *campanulate* or *broadly tubular*, shortly lobed; stamens 8 or 6, inserted on the perianth-tube; anthers dorsifixed, introrse; ovary 4–3-locular;

ovules usually 2, rarely about 6 in each loculus; fruit a *berry*.—India to Japan.

Further development, to ARACEAE (Orontieae).

A. Flowers solitary on each scape: **A(1)** Perianth 4-merous; stamens as many as segments—ASPIDISTRA (*Colania, Antherolophus*) (India–Japan) **A(2).** Perianth 6-merous; stamens twice as many as segments—EVRARDIELLA (Indo-China). **AA.** Flowers in dense spikes, 3-merous: **B.** Stigma small and trifid on a distinct style; floral bracts conspicuous, linear, tufted at the end of the spike; perianth-lobes frilled on the margin—GONIOSCYPHA (India). **BB.** Stigma sessile, or peltate on a columnar style: **C.** Stigma peltate on a distinct style; floral bracts usually conspicuous and foliaceous, sometimes tufted at the end of the spike; perianth-lobes frilled on the margin—CAMPYLANDRA (India–China). **CC.** Stigma peltate on a distinct style; floral bracts inconspicuous, never tufted; leaves elongated and often distinctly petiolate; perianth-lobes spreading, not frilled on the margin—TUPISTRA (*Tricalistra*) (India–China). **CCC.** Stigma subsessile, triquetrous; leaves not very elongated; floral bracts very inconspicuous; perianth-lobes inflexed, not frilled on the margin—ROHDEA (China–Japan).

Tribe 13. **Milliganieae.** Rootstock a short *rhizome*; leaves in a dense cluster from the base of the stem, linear; flowers bisexual or polygamo-dioecious, small, *in large woolly panicles*; perianth-segments connate into a campanulate tube, equal; stamens 6, inserted on the perianth; anthers dorsifixed, introrse; ovary 3-locular; styles 3, or style short and undivided; ovules numerous; fruit a loculicidal capsule or fleshy and indehiscent.—S. Hemisphere, but absent from S. Africa.

Further development, to HAEMODORACEAE.

A. Flowers bisexual; fruit a loculicidal capsule—MILLIGANIA (Tasm.). **AA.** Flowers polygamo-dioecious; fruit fleshy and indehiscent: **B.** Inflorescence branched; male and female flowers very similar; anthers dorsifixed, versatile, soon falling—ASTELIA (Réunion, New Zeal., Austral., Antarct. S. Amer.). **BB.** Inflorescence not branched; male flowers much larger than the females; anthers basifixed, sagittate, persistent—COLLOSPERMUM (New Zeal., Polynesia).

Tribe 14. **Peliosantheae.** Rootstock short, horizontal; leaves radical, long-petiolate, rather broad, *plicately nerved*; flowers small, in spikes or racemes, subtended by bracts; perianth tubular in the lower part, *partly adnate* to the ovary, limb 6-lobed, spreading, lobes subequal; stamens 6, the filaments *connate* into an *incurved annulus*; anthers introrse; ovary semi-inferior, 3-locular; ovules 2, erect; pericarp of fruit soon *breaking away and exposing the young seeds*; seeds often solitary, *berry-like.*

One genus, PELIOSANTHES (*Lourya, Neolourya*) (India to Malay Archip.).

Tribe 15. **Polygonatae.** Rootstock a *rhizome*; stem mostly *leafy* throughout; flowers axillary and nodding, or in a terminal raceme or panicle; perianth-segments 4 or 6, equal and similar, free or united into a tube; corona very rarely present; stamens as many as perianth-segments, free or adnate to the perianth; anthers introrse, basifixed; ovary 3-locular; style slender, more or less 3-fid; fruit a *berry*.—N. Hemisphere, 1 genus in Australia.

Further development, to ASPIDISTREAE.

A. Inflorescence axillary: **B.** Perianth-segments free or nearly so: **C.** Style 3-partite nearly to the base—DRYMOPHILA (Austral.). **CC.** Style 3-fid—STREPTOPUS (N. Temp. Reg.). **BB.** Perianth-segments united into a tube; style undivided or nearly so: **D.** Corona absent—POLYGONATUM (*Salomonia*) (N. Temp. Reg.). **DD.** Corona present—DISPOROPSIS (*Aulisconema*) (China). **AA.** Inflorescence terminal: **E.** Perianth-segments 4; raceme; leaves cordate, 2–3 to a stem—MAIANTHEMUM (*Unifolium, Valentinia, Racemaria*) (N. Temp.



FIG. 376. Polygonatum officinale *Linn.* (Liliaceae-Polygonatae). A, perianth laid open. B, stamen. C, pistil. D, cross-section of ovary. E, fruit. F, venation. G, rhizome.

Reg.). **EE.** Perianth-segments 6; raceme or panicle; leaves usually several to a stem—SMILACINA[1] (N. and Cent. Amer., E. Asia): **F.** Perianth-segments free or nearly so. **FF.** Perianth-segments connate into a tube—OLIGOBOTRYA (China). **EEE.** Perianth-segments 6; flowers solitary, paired, or umbellate-racemose: **G.** Stem leafy; perianth-segments often saccate or spurred at the base—DISPORUM (E. Asia). **GG.** Stem leafy only at the base; inflorescence scapose, sometimes 1-flowered—CLINTONIA (E. Asia to N. Amer.).

Tribe 16. **Dianelleae.** Rootstock a *rhizome*; stem *leafy*; flowers in *lax panicles*; perianth-segments mostly *blue*, equal and similar, spreading or reflexed; stamens 6, all perfect; anthers 2-locular, opening by slits and introrse, or by *terminal pores*; *connective swollen at the base* or filaments *woolly*; ovary 3-locular; ovules numerous; style slender, entire; fruit a loculicidal capsule, or a berry.—Mainly S. Hemisphere.

Further development, to TECOPHILAEACEAE.

A. Filaments glabrous: **B.** Fruit a capsule; anthers opening by slits—EXCREMIS (*Eccremis*) (S. Amer.). **BB.** Fruit a berry; anthers opening by pores:

[1] This name is conserved against TOVARIA Neck., not Ruiz and Pavon.

C. Flowers paniculate—DIANELLA (Mascar., Trop. Asia to New Zeal. and Pacific islands). CC. [Flowers axillary—WALLERIA (Trop. Afr.)].[1] AA. Filaments woolly-tomentose; fruit a capsule; anthers opening by slits—STYPANDRA (Austral.).

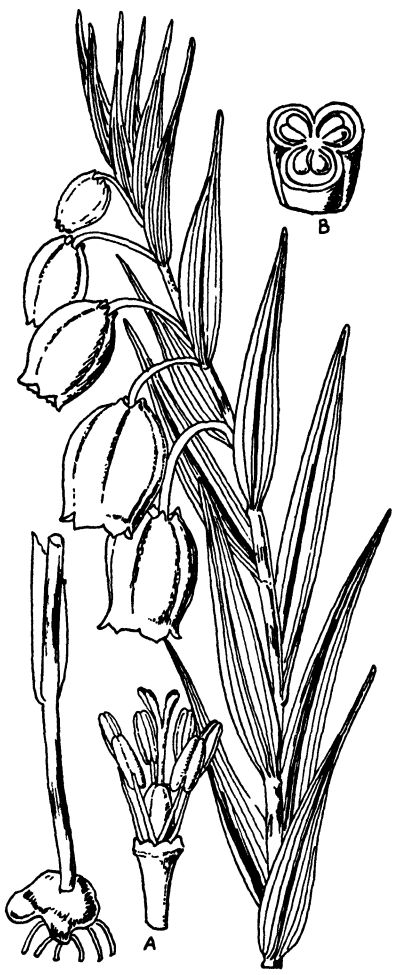


FIG. 377. Sandersonia aurantiaca *Hook.* (Liliaceae-Uvularieae). A, stamens and pistil. B, cross-section of ovary. (Orig.)

Tribe 17. **Uvularieae.** Rootstock a tuberous or creeping rhizome; stem *leafy*, sometimes *scandent*; leaves *sessile*, sometimes with *cirrhose tips*; flowers axillary or terminal, solitary or few; perianth-segments free or connate, equal or subequal; no corona; stamens 6, hypogynous or nearly so, free; anthers extrorse, basifixed or medifixed and versatile, opening by *slits* or by *terminal pores*; fruit a loculicidal capsule.—Mainly Tropics and Subtropics.

Further development, to TRILLIACEAE.

A. Style erect (in line with the axis of the ovary): B. Anthers opening by slits: C. Perianth-segments free to the base or nearly so: D. Flowers terminal: E. Perianth-segments spreading—SCHELHAMMERIA (Austral.). EE. Perianth-segments erect—UVULARIA (*Oakesiella*, *Tortipes*) (N. Amer.). DD. Flowers axillary: F. Perianth-segments spreading from the base—KREYSIGIA (Austral.). FF. Perianth-segments suberect; leaves often with cirrhose tips—LITTONIA (Trop. and S. Afr.). CC. Perianth-segments connate into an urceolate tube; flowers axillary—SANDERSONIA (S. Afr.). BB. [Anthers opening by terminal pores—WALLERIA (Trop. and S. Afr.[2])]. AA. Style sharply deflexed or spreading at a right angle from the ovarian axis; climbers (as a rule); leaf-tips usually tendril-like—GLORIOSA (Trop. Asia and Afr.).—Additional genus[3]—HEXACYRTIS (SW. Afr.).

Tribe 18. **Tricyrtideae.** Rootstock a short creeping rhizome; stem erect, leafy, simple; leaves more or less ovate, sessile; flowers axillary or few in terminal cymes, showy; perianth-segments equal and similar, except the outer which are *saccate at the base*, spotted; stamens 6, hypogynous, filaments more

[1] See *Tecophilaeaceae*, p. 615. [2] Ibid., p. 615.

[3] Referred to this tribe by its author, Dinter, but I have doubts as to its position—no specimens seen.

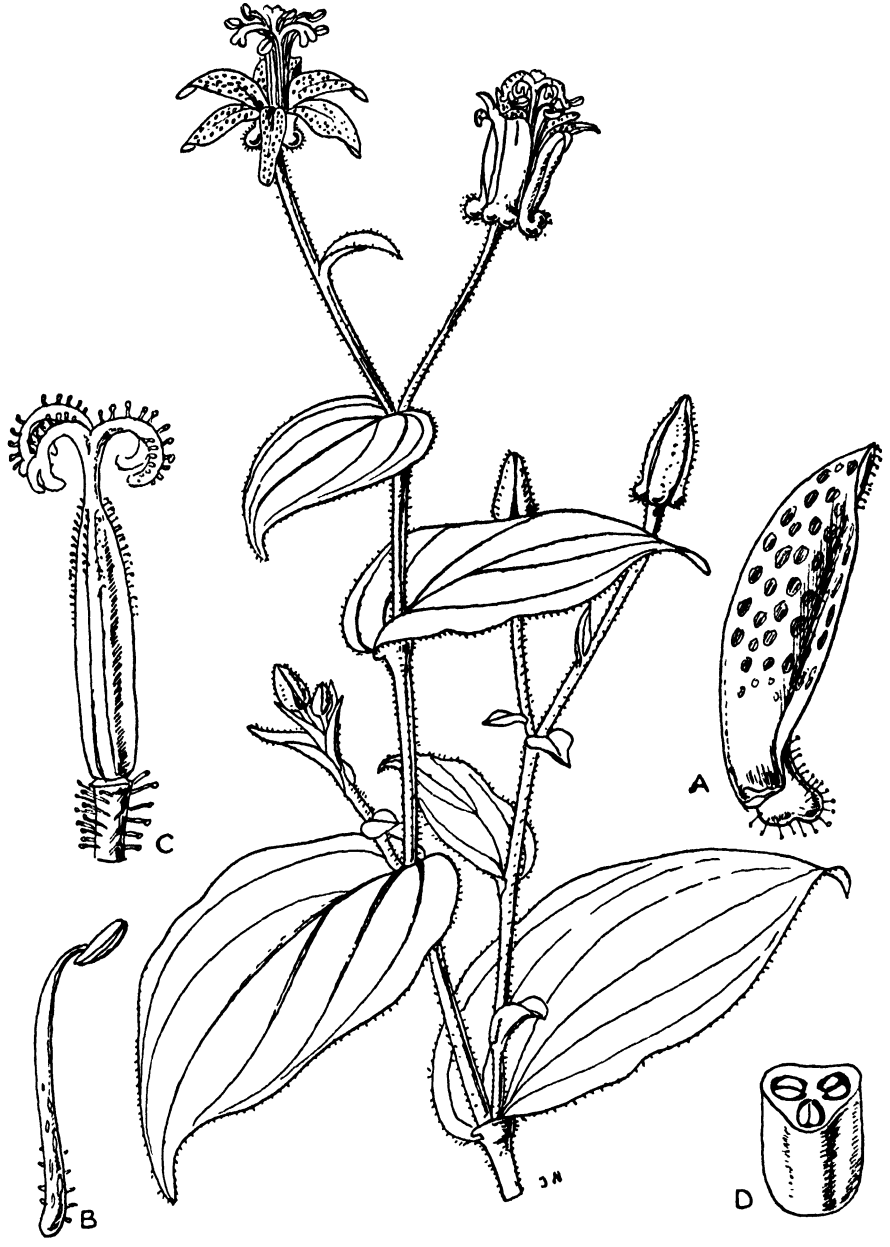


FIG. 378. Tricyrtis pilosa *Wall.* (Liliaceae-Tricyrtideae). A, perianth-segment, showing saccate base. B, stamen. C, pistil. D, cross-section of ovary. (After *Bot. Mag.*)

or less connivent; anthers extrorse, dorsifixed; ovary 3-locular; style columnar, with 3 spreading branches; ovules numerous; fruit a septicidal capsule.—Himalaya to Japan.

A. Leaves ovate-cordate; perianth-segments united only at the base—TRICYRTIS (*Brachycyrtis*) (Himal. to Japan). **AA.** [Leaves lanceolate, not cordate; perianth-segments united nearly to the top—SANDERSONIA[1] (S. Afr.).]

Tribe 19. **Veratreae.** Rootstock a short erect rhizome or bulb; stem leafy or leaves subradical; inflorescence subspicate, racemose, or paniculate; flowers bisexual or polygamous; perianth-segments subequal, free or nearly so; no corona; stamens 6, at the base of the segments; anthers subglobose, basifixed, extrorse; fruit a septicidal capsule; seeds *narrow* or *winged.*—Temperate N. Hemisphere.

A tribe probably of mixed origin derived from several of those with rhizomatous rootstock, the bulk of it perhaps from the *Narthecieae.*

A. Flowers sessile or subsessile in a dense spike-like inflorescence; leaves elongate-linear—SCHOENOCAULON (*Sabadilla*) (N. Amer.). **AA.** Flowers more or less pedicellate in panicles or racemes: **B.** Leaves linear or linear-lanceolate, mostly radical or on the lower part of the stem: **C.** Seeds winged all around—MELANTHIUM (N. Amer.). **CC.** Seeds not winged all around: **D.** Perianth-segments without glands at the base: **E.** Flowers bisexual—AMIANTHIUM (*Tracyanthus*) (N. Amer.). **EE.** Flowers polygamous—STENANTHIUM (*Stenanthella*) (N. Amer., Mexico). **DD.** Perianth-segments glandular at the base: **F.** Perianth-segments free to the base: **G.** Flowers bisexual—TOXICOSCORDION (N. Amer.). **GG.** Flowers polygamous—OCEANOROS (Southeastern U.S.A.). **FF.** Perianth-segments united at the base—ZYGADENUS (N. Amer., Siberia). **BB.** Leaves broad and plicately nerved, cauline—VERATRUM (N. Hemisph.).

Tribe 20. **Asparageae.** Rootstock a *rhizome*; stems erect or climbing, herbaceous or woody; leaves *reduced to scarious, often minute scales,* bearing in their axils green needle-like or angular or flat and falcate, rarely ovate, *modified branchlets* (*cladodes*) which function as leaves; flowers bisexual, solitary, fasciculate, subumbellate or racemose, the pedicels *articulated* near the top; perianth-segments free or nearly so; stamens 6, hypogynous or nearly so, free; anthers 2-lobed, dorsifixed, introrse; ovary 3-locular; styles free or connate; ovules 2 or more in each loculus; fruit a globose *berry*; seeds solitary or few.—Old World Tropics and Temperate Regions; absent from America.

Climax group.

Genus 1, ASPARAGUS; characters of the tribe.

Tribe 21. **Anguillarieae** (emend.). Rootstock a *bulb* or *corm*; stem *leafy*; leaves narrow, continuous with the sheathing base; flowers racemose or spicate, *ebracteate*; perianth-segments free or shortly united, often *glandular* above the base; stamens 6; anthers extrorse; styles free or shortly united; ovules numerous; fruit a loculicidal or septicidal capsule; seeds subglobose.—Australia, S. and Tropical Africa.

A very interesting tribe, as here emended being without floral bracts, a character shared by the more primitive *Heloniadeae.*

[1] See *Uvularieae*, p. 606.

A. Perianth-segments free to the base: **B.** Flowers racemose, few; stem leafy; capsule elongated—BAEOMETRA (S. Afr.). **BB.** Flowers spicate: **C.** Capsule loculicidal: **D.** Perianth-segments oblanceolate, sometimes glandular above the base; style or styles in the middle of the ovary—ANGUILLARIA (Austral.). **DD.** Perianth-segments filiform, slightly auriculate at the base; styles separate on the 'shoulders' of the ovary-lobes—NEODREGEA (S. Afr.). **CC.** Capsule septicidal; perianth-segments glandular on the margin at the base; styles in the middle of the ovary—DIPIDAX (S. Afr.). **AA.** Perianth-segments united into a short tube, spreading; capsule septicidal—WURMBEA (Austral., S. and Tropical Afr.).

Tribe 22. **Tulipeae.** Rootstock a *bulb*; stem bearing *one or more leaves*; flowers solitary to racemose-subumbellate; no involucre; perianth-segments free, usually similar; no corona; stamens 6; anthers basifixed, or dorsifixed and versatile; fruit a *loculicidal, rarely septicidal* capsule.—N. Hemisphere.

A climax or subclimax group; and from this stock possibly the *Alstroemeriaceae* have been evolved.

A. Anthers basifixed: **B.** Fruit loculicidal: **C.** Perianth-segments narrow, recurved; stem 2-leaved below the middle—ERYTHRONIUM (Temp. N. Hemisph.). **CC.** Perianth-segments not recurved: **D.** Perianth-segments with a nectariferous pit above the base; flowers nodding or pendulous—FRITILLARIA (N. Temp. Zone). **DD.** Perianth-segments not pitted at the base, sometimes spotted: **E.** Flowers usually large and solitary; perianth-segments more or less incurved—TULIPA (*Amana, Antherolophus, Eduardoregelia*) (Eur.–Japan, N. Afr.). **EE.** Flowers 1–2-together with small spreading perianth-segments—LLOYDIA (N. Temp. Zone). **EEE.** Flowers more or less racemose or subumbellate; perianth-segments spreading—GAGEA (Eur.–Temp. Asia, N. Afr.). **BB.** Fruit septicidal—CALOCHORTUS (*Mariposa*) (N. Amer.). **AA.** Anthers dorsifixed, versatile; capsule loculicidal: **F.** Perianth-segments all alike or nearly so: **G.** Bulb tunicated or semi-tunicated; basal leaves present; stigma trilobed—NOTHOLIRION (Himal.–China). **GG.** Bulb scaly; stigma capitate or trifid—LILIUM (*Ochrocodon*) (N. Temp. Reg.). **FF.** Perianth-segments dissimilar—NOMOCHARIS (China, Tibet).—Additional genus GIRALDIELLA (China) (not seen), closely allied to *Gagea*.

Tribe 23. **Scilleae.** Rootstock a *tunicated bulb*; leaves usually few and in a cluster at the base of the scapose raceme (rarely a spike), rarely the raceme with a tuft of leaves at the top; perianth-segments free or partially connate, equal; stamens 6, free or rarely united; anthers introrse, dorsifixed; ovary 3-locular; ovules many or few; capsule loculicidally dehiscent; seeds globose, angular or compressed.—General distribution.

A. Perianth-segments free to the base or very nearly the base: **B.** Seeds obovoid or subglobose (neither compressed nor angular): **C.** Inflorescence with a tuft of leafy bracts at the top—EUCOMIS (S. Afr.). **CC.** Inflorescence without a tuft of leafy bracts: **D.** Flowers racemose or paniculate, sometimes inflorescence nearly sessile: **E.** Perianth-segments 1-nerved, usually spreading: **F.** Perianth-segments equal or subequal—SCILLA (*Schizocarphus, Resnova, Fortunatia*) (Eur. to Temp. Asia, Afr.). **FF.** Perianth-segments very unequal,

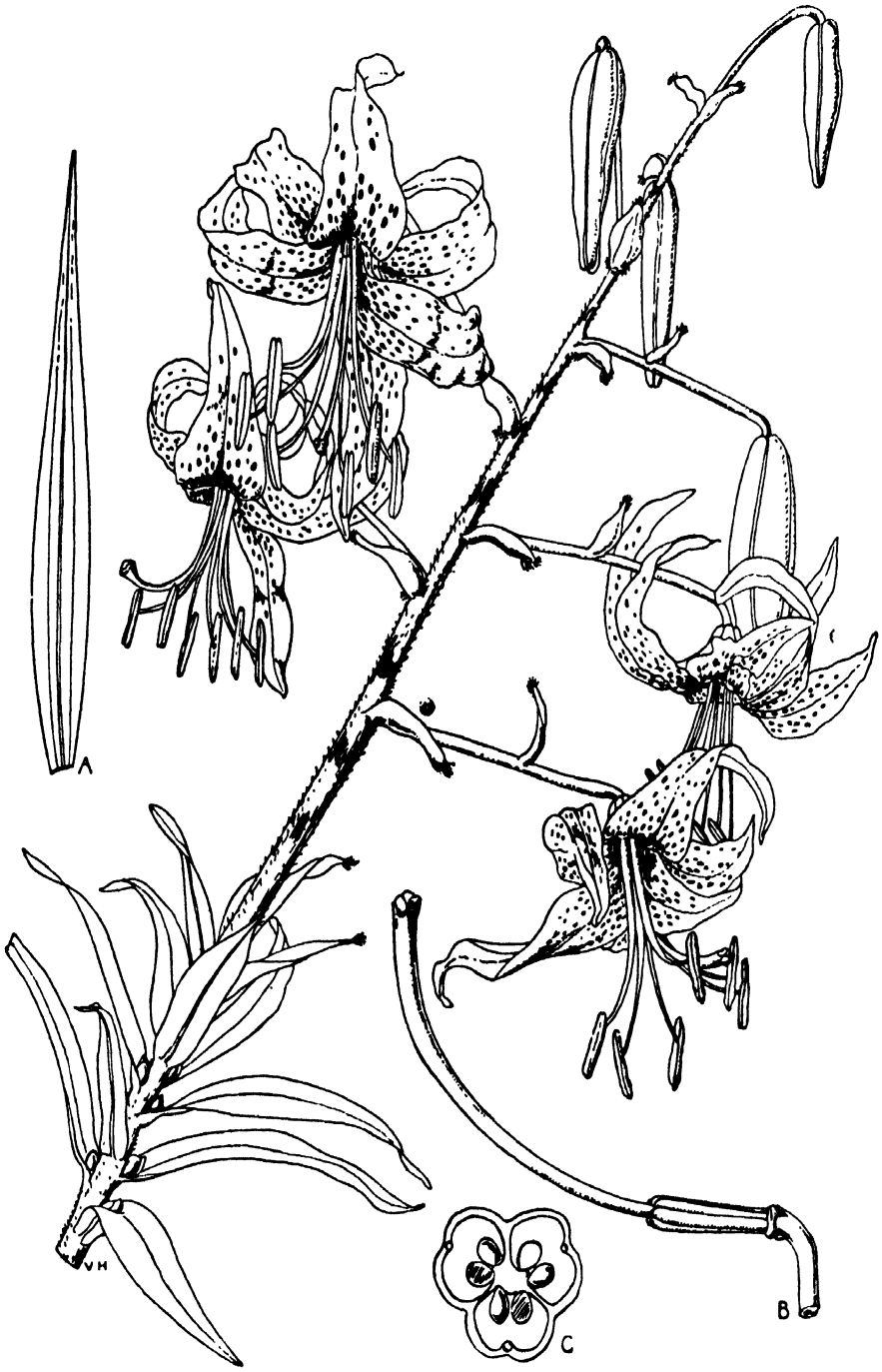


FIG. 379. Lilium tigrinum *Ker-Gawl.*, var. splendens. (Liliaceae-Tulipeae). A, leaf. B, pistil. C, cross-section of ovary. (Orig. by Violet Hutchinson.)

erect—BRACHYSCYPHA (S. Afr.). **EE.** Perianth-segments 3- or more-nerved, spreading—CAMASSIA (N. Amer.). **EEE.** Perianth-segments obscurely nerved —ORNITHOGALUM (*Neopatersonia, Battandiera, Elsiea*) (Eur. to S. Afr., Amer.). **DD.** Flowers spicate—DRIMIOPSIS (Trop. and S. Afr.). **BB.** Seeds much compressed: **G.** Perianth persistent in fruit—ALBUCA (Trop. and S. Afr.). **GG.** Perianth deciduous in fruit—URGINEA (*Thuranthos*) (Eur. to India, Afr.). **AA.** Perianth-segments more or less united in the lower part: **H.** Seeds neither angular nor compressed: **I.** Ovules numerous: **J.** Filaments free or connate only at the base: **K.** Filaments connate at the base into a ring—WHITEHEADIA (S. Afr.). **KK.** Filaments free: **L.** Perianth-segments equal; inflorescence dense and contracted—POLYXENA (*Neobakeria*) (S. Afr.). **LL.** Perianth-segments unequal; inflorescence racemose or spicate—LACHENALIA (S. Afr.). **JJ.** Filaments connate into a long tube—ANDROSIPHON (*Amphisiphon*) (S. Afr.). **II.** Ovules few: **M.** Stamens free from one another: **N.** Perianth-lobes longer than the tube—CHIONODOXA (Orient). **NN.** Perianth-lobes shorter than the tube: **O.** Perianth cylindrical—VELTHEIMIA (S. Afr.). **OO.** Perianth more or less campanulate: **P.** Perianth campanulate, lobes much shorter than the tube; flowers pendulous—RHODOCODON (Madag.). **PP.** Perianth funnel-shaped-campanulate, lobes shorter to slightly longer than the tube; flowers erect to pendulous—HYACINTHUS (*Muscarimia*) (Mediterr., Orient, Trop. and S. Afr.). **OOO.** Perianth urceolate-globose, constricted at the mouth—MUSCARI (Eur. to N. Afr., W. Asia). **MM.** Stamens united—PUSCHKINIA (W. Asia). **HH.** Seeds angular or compressed: **Q.** Flowers racemose: **R.** Perianth-tube cylindrical: **S.** Outer perianth-lobes spreading, inner erect, often narrower—DIPCADI (S. Eur. to India, Afr.). **SS.** Perianth-lobes all alike and erect—PSEUDOGALTONIA (S.W. Afr.). **RR.** Perianth-tube campanulate: **T.** Flowers large; perianth-segments spreading—GALTONIA (S. Afr.). **TT.** Flowers small or smallish: **U.** Perianth-segments spreading—DRIMIA (S. and Trop. Afr.). **UU.** Perianth-segments erect: **V.** Stamens not connivent; flowers erect—URGINEOPSIS (S. Afr.). **VV.** Stamens connivent around the style; anthers opening by large pores; flowers pendulous—RHADAMANTHUS (S. Afr.). **QQ.** Flowers solitary or paired—LITANTHUS (S. Afr.).

Tribe 24. **Miluleae.** Rootstock a tunicated *corm* covered with the *fibrous remains* of the leaf-bases; leaves linear, imbricate towards the base of the scape; flowers crowded in a cylindrical *spike* subtended by *one spathe-like bract*; perianth-segments 6, united into a campanulate tube, equal and similar; stamens 6, in 2 series, three with *filiform*, three with the *filaments petaloid* in the lower half; anthers versatile; ovary 3-locular; style *undivided*; ovules 2 in each loculus; fruit a loculicidal capsule.—E. Himalaya.

A climax genus, MILULA, with a great superficial resemblance to the Araceous type of inflorescence; probably an advanced type of tribe *Scilleae*.

Tribe 25. **Bowieae.** Rootstock a tuber or bulb, fleshy; leaves few and often soon disappearing; stem much branched, leafless; flowers small, often greenish; perianth-segments persistent, free, spreading, equal and similar; stamens 6; anthers introrse; ovary 3-locular; ovules numerous to few; fruit a loculicidal capsule.—Tropical and S. Africa.

Climax group, developed and modified largely to cope with extreme habitats, such as in S. Africa.

A. Seeds glabrous; flowering stem much branched: **B.** Bulb tuber-like; panicle scandent—BOWIEA (*Schizobasopsis*, *Ophiobostryx*) (Trop. E. and S. Afr.). **BB.** Bulb tunicated; panicle erect—SCHIZOBASIS (S. and Trop. Afr.). **AA.** Seeds covered with long hairs; flowering stem usually simple, with long pedicels; leaves usually solitary—ERIOSPERMUM (Trop. and S. Afr.).

Tribe 26. **Colchiceae.**—Rootstock a *corm*; leaves radical; scape *below the surface* within the leaf-sheaths, 1–3-*flowered*; perianth-segments equal, their claws connivent or connate; stamens 6; anthers dorsifixed, introrse; ovary 3-locular; styles *free from the base* or united only *within the perianth-tube*; fruit a septicidally dehiscent capsule.—Europe to Central Asia, Mediterranean and NE. Africa.

Climax group, with a close parallel habit in tribe *Croceae* of *Iridaceae*.

A. Styles free from the base upwards: **B.** Perianth-segments not clawed—COLCHICUM (Eur. to Cent. Asia, N. Afr.). **BB.** Perianth-segments clawed—MERENDERA (Mediterr., Afghan., Abyss.). **AA.** Styles united within the perianth-tube: **C.** Perianth-segments clawed—BULBOCODIUM (Eur. to Asiatic Cent. Russia). **CC.** Perianth-segments not clawed—SYNSIPHON (Cent. Asia).

Tribe 27. **Iphigenieae.** Rootstock a bulb or corm, rarely a short rhizome with tuberous roots; stem leafy, leaves narrow, or broader around the inflorescence and then coloured; flowers *bracteate*, racemose to capitate or subumbellate; perianth-segments *free*; stamens 6; anthers subextrorse or opening at the side; *filaments often dilated*; styles free or partly united; ovules numerous; capsule septicidal or loculicidal; seeds subglobose or angular.—Mediterranean, Tropical and S. Africa, Madagascar, India to Australia.

A. Flowers racemose, bracts leafy or small: **B.** Styles free to the base: **C.** Perianth persistent—ORNITHOGLOSSUM (Trop. and S. Afr.). **CC.** Perianth deciduous—IPHIGENIA (*Iphigeniopsis*) (India to Austral., Madag., S. and S. Trop. Afr.). **BB** .Styles united; filaments expanded in the middle—CAMPTORRHIZA (S. Afr.). **AA.** Flowers subumbellate or capitate; bracts often large and greenish white: **D.** Bracts small and narrow, not leaf-like; rootstock a short rhizome—REYA (*Burchardia*) (Austral.). **DD.** Bracts large and foliaceous or greenish white; flowers densely crowded into a head; rootstock a bulb—ANDROCYMBIUM (S. and Trop. Afr., Mediterr.).

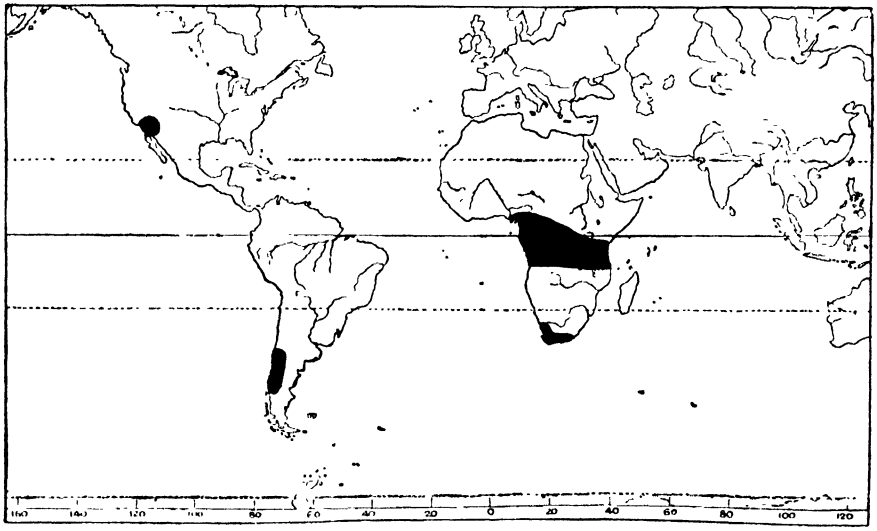
Tribe 28. **Massonieae.** Rootstock a *tunicated bulb*; *leaves* 2, radical, *subopposite*; flowers crowded in a *subsessile head* surrounded by 3 or more bracts; perianth-segments equal or unequal, united into a tube; stamens 6, inserted on the perianth; anthers dorsifixed, introrse; ovary 3-locular; *style entire*, stigma capitate; ovules numerous; fruit a loculicidal capsule.—S. Africa.

Climax group showing close approximation to AMARYLLIDACEAE.

A. Perianth-limb actinomorphic; stamens longer than the perianth—MASSONIA. **AA.** Perianth-limb very oblique; stamens shorter than the perianth—DAUBENYA.

373. TECOPHILAEACEAE

Herbs with fibrous tunicated corms or thick orbicular flattened tubers. Leaves radical or towards the base of the flowering stems, linear to ovate-orbicular and cordate, glabrous. Flowers bisexual, actinomorphic, in simple racemes separately from the tuber or corm, or paniculate; bracts large and membranous to small. Perianth-tube short or nothing; lobes 6, spreading or reflexed, subequal, imbricate. Stamens 6, perfect, or 3 and with 3 staminodes,



Range of Tecophilaeaceae.

inserted at the throat of the perianth; anthers 2-locular, often connivent, the connective often produced at both ends, the base then swollen or spur-like, loculi opening by a terminal pore, rarely by a slit to the base and introrse. Ovary more or less *semi-inferior*, 3-locular; style subulate or filiform. Ovules numerous, axile, 2-seriate in each loculus. Fruit a loculicidal capsule. Seeds numerous, with a fairly large embryo in fleshy endosperm. Leybold in *Bonplandia*, **10**, 370 (1862); Tribe *Conanthereae* of HAEMODORACEAE. B.H. **3**, 679; *Cyanastraceae* Engl. in E.P. edn. 2, **15***a*, 188 (1930).—Mainly S. Hemisphere (Andes of S. America, and Trop. and S. Africa) and California.

Tecophilaeaceae is a natural and more or less homogeneous group with a marked austral distribution. It is found only in Western S. America (Chile), California, Central and S. Africa. Engler separated *Cyanastrum* as a distinct family but I consider it should be associated with *Tecophilaea* and allied genera, for which the family name TECOPHILAEACEAE was used by Leybold in 1862. Engler seems to have considered the presence of perisperm in the seed of *Cyanastrum* to be an important character. But *Cyanastrum* is undoubtedly closely allied to *Cyanella*.

The family as here constituted seems to be a distinct link between the *Liliaceae* and *Iridaceae*, the ovary being semi-inferior.



FIG. 380. Cyanella lutea *Linn.* (Tecophilaeaceae). A, flower, showing the one big anther and five smaller ones. B, stamens. C, pistil. D, cross-section of ovary. E, semi-inferior fruit. (Orig.)

The close affinity of certain elements of the floras of Chile and of California is emphasized by *Conanthera* and *Odontostomum* respectively.

A. Stamens 6, all perfect and equal: **B.** Corm with a fibrous-reticulate covering: **C.** Anthers connivent in a cone—CONANTHERA (Chile). **CC.** Anthers not connivent—ODONTOSTOMUM (Calif.). **BB.** Corm without a reticulate covering; anthers free: **D.** Flowers axillary; ovary superior—WALLERIA (Trop. and S. Afr.). **DD.** Flowers scapose; ovary partly inferior—CYANASTRUM (*Schoenlandia*) (Trop. Afr.). **AA.** Stamens 6, 3 dissimilar or fewer perfect with the rest staminodal: **E.** Perianth-tube nothing—CYANELLA (S. Afr.). **EE.** Perianth-tube present: **F.** Stamens 4, perfect, with 2 staminodes—ZEPHYRA (Chile). **FF.** Stamens 3 perfect and unilateral, 3 opposite reduced to staminodes—TECOPHILAEA (Chile).

374. TRILLIACEAE

Rootstock a short thick or creeping rhizome; stem simple, erect, with a few short leaf-sheaths at the base. Leaves paired and opposite, or 3 or 4 or rarely

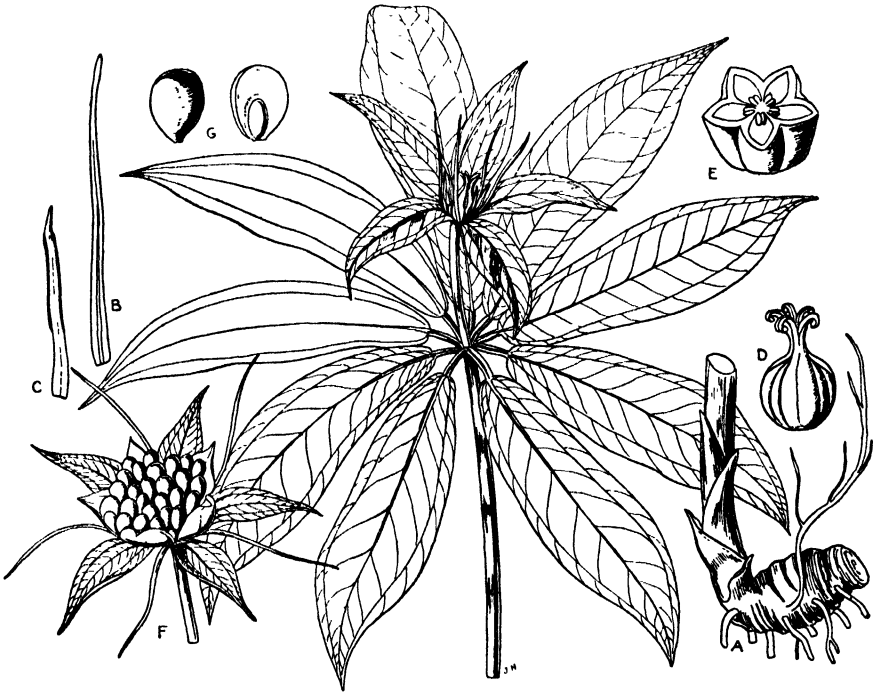


FIG. 381. Paris polyphylla *Smith* (Trilliaceae). A, rootstock. B, petal. C, stamen. D, pistil. E, cross-section of ovary. F, open fruit. G, entire and vertical section of seed. (After Wallich.)

more in a whorl at the top of the stem, sessile or petiolate, lanceolate to ovate or elliptic, distinctly nerved and reticulate between the nerves. Flowers one or more, terminal, sessile or pedicellate, variously coloured or sometimes greenish, bisexual, actinomorphic. Perianth deciduous or persistent; segments free; subequal or very different in the two series, in the latter case the

outer often broader and calyx-like, the inner petaloid or linear or filiform; no corona. Stamens as many as the perianth-segments, hypogynous or at the base of the segments and opposite to them; filaments filiform or slightly flattened, free; anthers 2-locular, basifixed, opening at the sides by slits lengthwise, the connective sometimes produced at the apex. Ovary superior, sessile, 1-locular with parietal placentas or 3- or more-locular with axile placentas; styles or style-branches 3–5; ovules numerous. Fruit a berry or a fleshy capsule at length loculicidally dehiscent. Seeds with hard or fleshy endosperm and a small embryo near the hilum. B.H. **3,** 832 (tribe *Medeoleae* of LILIACEAE); E.P. edn. 2, **15***a*, 373 (tribe *Parideae* of LILIACEAE).—Temperate and montane Regions of the N. Hemisphere.

A. Leaves paired on the stem; ovary 1-locular, with parietal placentas; umbel sessile—SCOLIOPUS (N. Amer.). **AA.** Leaves verticillate; ovary 3-locular or imperfectly 3- or more-locular: **B.** Flowers solitary in the whorl of leaves: **C.** Leaves 3 in a whorl; flowers 3-merous—TRILLIUM (*Kinugasa*) (E. Asia, N. Amer.). **CC.** Leaves 4 or more in a whorl; flowers 4- or more-merous—PARIS (Eur., Temp. Asia). **BB.** Flowers in a sessile umbel subtended by a whorl of 3 leaves—MEDEOLA (N. Amer.).

375. PONTEDERIACEAE

Aquatic erect or floating herbs. Leaves with floating or emersed blades sheathing at the base. Flowers bisexual, mostly quite actinomorphic, arranged in racemes or panicles subtended by a spathe-like leaf-sheath; bracts minute or absent. Perianth hypogynous, corolline; lobes 6, sub-biseriate. Stamens 6 or 3 or rarely 1, inserted on the perianth, sometimes somewhat unequal in length or one the largest of all; filaments free from each other; anthers 2-locular, opening lengthwise by slits or rarely by pores. Ovary superior, 3-locular with axile placentas or 1-locular with 3 parietal placentas; style entire or shortly lobed. Ovules anatropous, numerous to solitary and then pendulous. Fruit a capsule opening by 3 valves, or indehiscent. Seeds longitudinally ribbed, with copious endosperm and straight cylindrical embryo. B.H. **3,** 836; E.P. **2,** 4, 70; edn. 2, **15***a*, 18. See also O. Schwartz, 'Zur Systematik und Geographie der Pontederiaceae' in Engl. *Bot. Jahrb.* **61,** Beibl. 139, 28–50 (1927); Rendle, 281.—Tropics and Subtropics, in fresh water.

Pontederiaceae is an entirely aquatic family found only in fresh water in the warmer parts of the world. The genus *Eichhornia* is familiar in warm-greenhouse water-tanks. Quite late in the botanical history of the family a very interesting genus, *Hydrothrix*, was added by Hooker (*Ann. Bot.* 1:89–94, pl. 7: 1887). This remarkable plant had lain buried about half a century in the many herbaria which possess Gardner's collection from Brazil. The Kew example had been shown to many botanists, but its affinities were not recognized until the analyses which accompanied it were seen by Asa Gray, who suggested a comparison with the N. American *Heteranthera graminea.* This was confirmed by Hooker. In 1912 Goebel[1] further elucidated the structure of this remarkably advanced genus. It is a deep-rooted completely submerged *annual* and flowers only when the water recedes. According to Goebel's interpretation there are long shoots and short shoots; the long shoots have alternate filiform leaves within whose base is a large membranous sheath; inside the sheath is a short shoot with numerous similar leaves giving the whole an appearance of verticillate leaves as described by Hooker. The minute yellow flowers are axillary and in

[1] Goebel in *Flora, 105,* 88–100 (1912).



FIG. 382. Monochoria hastifolia *Presl.* (Pontederiaceae). A, flower. B, stamens. C, fruit. D, cross-section of ovary. E, seed. (Habit and E, orig.)

pairs in a 2-leaved membranous sheath; the perianth is 6-lobed, with only one stamen inserted towards the top of the tube; ovary 1-locular with 3 parietal placentas. The fruit at first splits along one side and at length into 3 linear valves with median placentas.

The *Pontederiaceae* are a difficult family to place. They appear to me to be aquatic *Liliaceae*, tending towards the Aroid type, the spiciform inflorescence having a spathe-like reduced leaf (leaf-sheath). The habit recalls that of the *Hydrocharitaceae*.

A. Perianth-segments free; stamens 6, hypogynous or nearly so; anthers basifixed, opening by a pore-like slit; ovary 3-locular, with numerous ovules; fruit a loculicidal capsule, with numerous seeds—MONOCHORIA (Old World Tropics and Subtropics). **AA.** Perianth segments partly connate into a tube: **B.** Stamens 6; anthers dorsifixed, versatile: **C.** Ovary 3-locular, with numerous ovules; fruit a loculicidal capsule; seeds numerous—EICHHORNIA (S. Amer., Trop. Afr.). **CC.** Ovary 1-locular; fruit membranous, indehiscent, with 1 pendulous seed: **D.** Perianth with 3 lobes to each lip—PONTEDERIA (Amer.). **DD.** Perianth with 5 lobes to the upper and 1 lobe to the lower lip—REUSSIA (S. Amer.). **BB.** Stamens 4; anthers basifixed; ovary 3-locular; flowers solitary—SCOLLEROPSIS (Madag.). **BBB.** Stamens 3 or 1, basifixed; ovary 1-locular or imperfectly 3-locular, with numerous ovules; fruit a capsule with parietal placentas and numerous small seeds: **E.** Stamens 3—HETERANTHERA (Amer., Trop. Afr.). **EE.** Stamen 1; submerged annuals with filiform leaves—HYDROTHRIX (Brazil).

376. SMILACACEAE

Shrubs, climbing or struggling, often with tendril-like petioles and prickly stems and branches; roots from an often stout rhizome; stems leafy. Leaves alternate or opposite, mostly leathery, 3-nerved, reticulate-veiny between the nerves. Flowers dioecious or rarely bisexual, small, arranged in axillary umbels, racemes, or spikes. Perianth-segments 6, equal or subequal, free or rarely united into a dentate tube. Stamens 6, rarely more or fewer; filaments free or united into a column; anthers apparently 1-locular by the confluence of the cells, introrse. Rudimentary ovary not present in the male flowers. Ovary superior, sessile, 3-locular; ovules 1–2 in each loculus, pendulous, orthotropous or half-anatropous. Staminodes present in the female flowers. Fruit a berry. Seeds 1–3, with a small embryo in hard endosperm. B.H. **3**, 763, as tribe of LILIACEAE; E.P. edn. 2, **15***a*, 381 (under LILIACEAE); Rendle, 298.—Widely distributed in the Tropics and Temperate Regions.

USEFUL PRODUCTS: *Sarsaparilla* (various species of *Smilax*); *China Root* (Smilax china *L.*).

As in the case of *Ruscaceae* I may not be followed by many botanists in separating the *Smilacaceae* from the *Liliaceae*, from which they differ mainly in habit, mostly dioecious flowers, and by the confluent anther-loculi. In any case the group is considerably advanced from the general stock of the *Liliaceae*.—A.DC. *Monogr. Phanerog.* 1: 1 (1878).

A. Flowers bisexual, in spikes, racemes or panicles; petioles not tendriliform—RIPOGONUM (*Rhipogonum*) (New Guin., Austral., New Zeal.). **AA.** Flowers dioecious, in umbels or panicles: **B.** Perianth-segments free; stamens 6 or more, free—SMILAX (Trop. and Temp. Reg.). **BB.** Perianth-segments united: **C.** Stamens 9, free or nearly so—PSEUDOSMILAX (Formosa). **CC.** Stamens 3, united into a column—HETEROSMILAX (India-Japan).

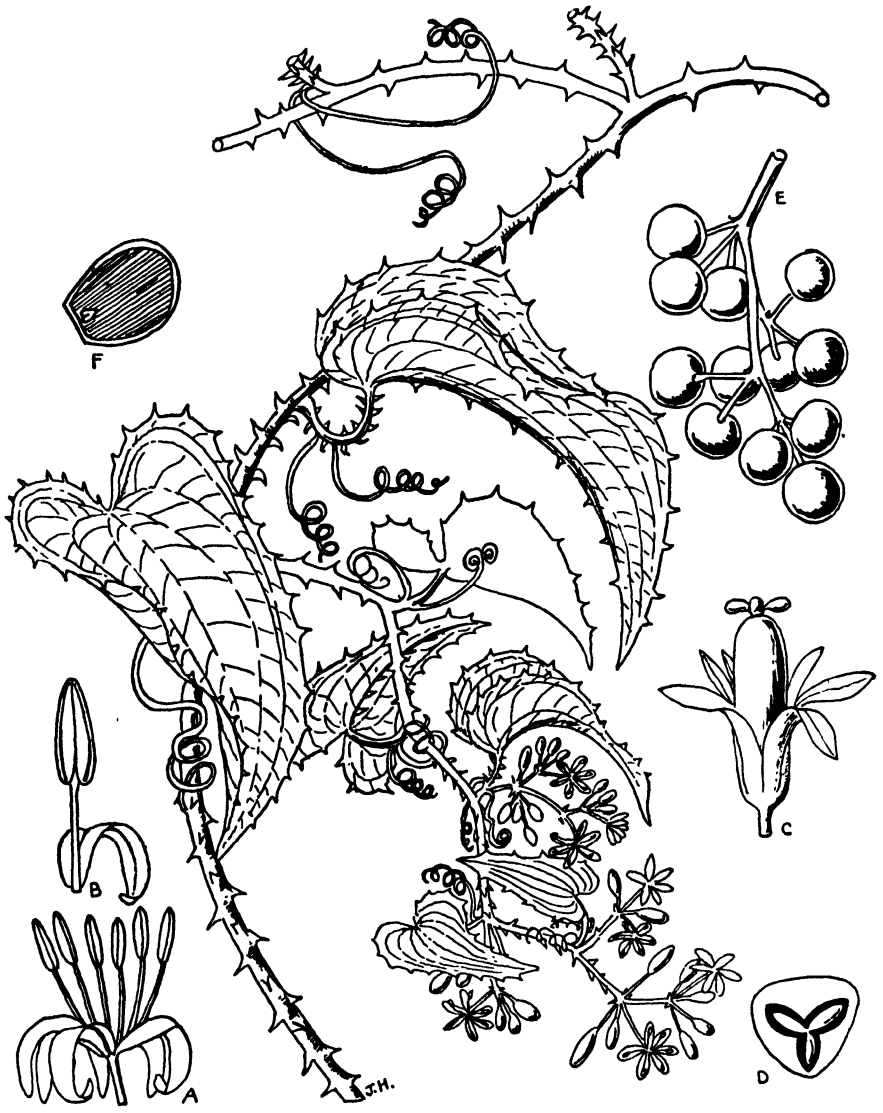


FIG. 383. Smilax aspera *Linn.* (Smilacaceae). A, male flower. B, segment and stamen. C, female flower. D, cross-section of ovary. E, fruits. F, vertical section of seed. (Orig.)

377. RUSCACEAE

Stems woody, erect or climbing. Leaves reduced to *small scarious scales* bearing in their axils leaf-like *modified branchlets* (cladodes), the latter sometimes acute or pungent-pointed and bearing on either surface or on their margins the small flowers, rarely the latter in short terminal racemes free from the cladodes. Flowers small, fasciculate or racemose, bisexual or

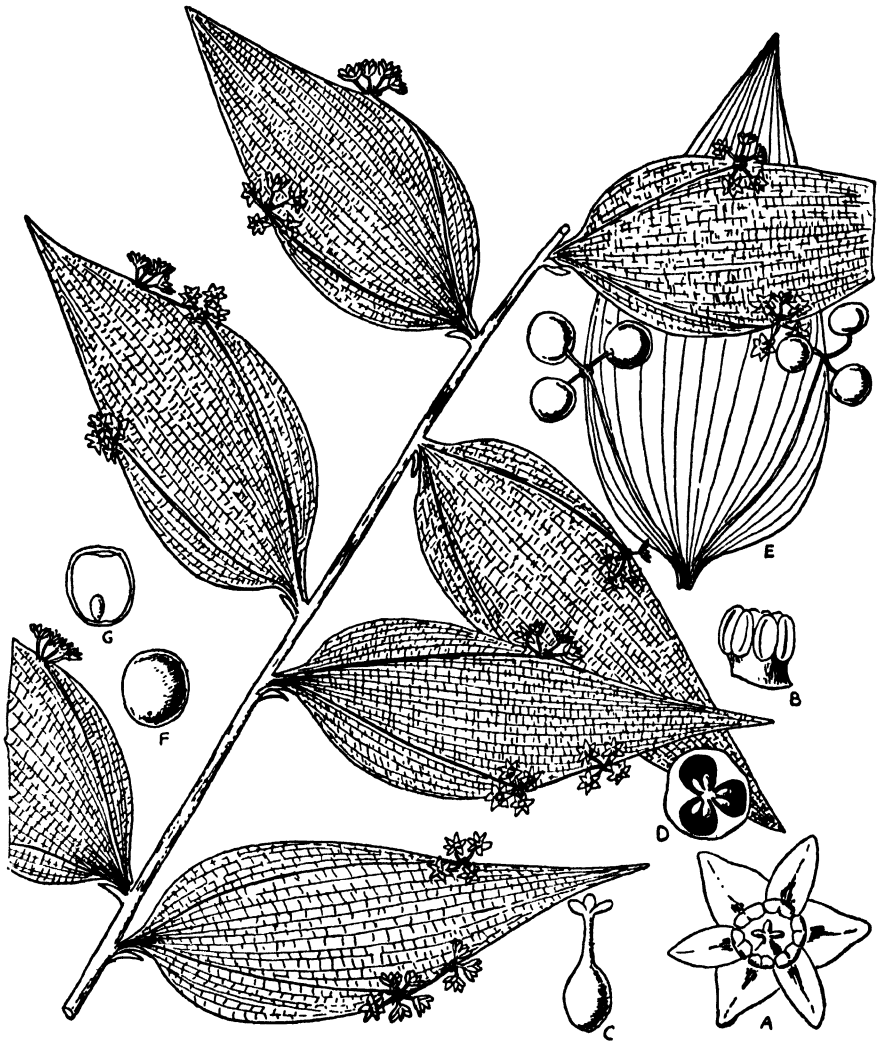
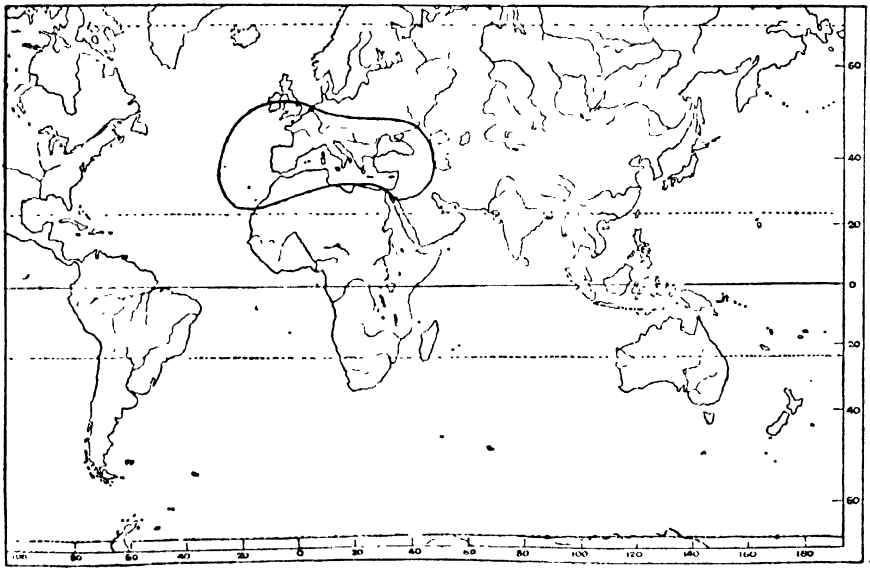


FIG. 384. Semele androgyna *Kunth* (Ruscaceae), with leaf-like branchlets (cladodes). A, flower. B, stamens. C, pistil. D, cross-section of ovary. E, cladode with fruits. F, seed. G, vertical section of seed. (Orig.)

dioecious. Perianth-segments 6, free or partly connate, in the latter case with a fleshy corona inside. Stamens 6 or 3, the filaments connate into a column; anthers sessile, extrorse; in the female flowers (when dioecious) represented by an anther-less tube. Rudimentary ovary sometimes present in the male flowers. Ovary 3- or 1-locular; ovules 2 in each loculus, collateral, orthotropous or hemianatropous. Fruit a globose berry. Seeds solitary and globose, or two and flat on one side; embryo cylindrical, 2–4 times shorter than the endosperm. B.H. 3, 764, as part of tribe *Asparageae*; Rendle, 297.—

W. Europe and the Mediterranean Region from the Azores, Madeira, and the Canary Is. to the Caucasus.

Probably not every botanist will follow me in regarding the *Ruscaceae* as a distinct family. Nevertheless, I think there is justification for this treatment of the group. It is of very restricted distribution, chiefly Mediterranean, and differs from *Liliaceae* in its androecium of united stamens, besides its highly specialized morphology. It may be regarded,



Range of Ruscaceae.

therefore, either as a very advanced tribe of the *Liliaceae*, or as a separate family, a less modified and possibly near relative in *Liliaceae* being the genus *Asparagus*.

A. Flowers bisexual; stamens 6: **B.** Flowers in terminal racemes free from the cladodes—DANAE (Orient). **BB.** Flowers in fascicles on the margin or rarely the face of the cladodes—SEMELE (Canary Is.). **AA.** Flowers dioecious, in fascicles on the upper or lower surface of the cladodes; stamens 3 —RUSCUS (W. Eur., Madeira and Azores to Caucasus).

ORDER 95. ALSTROEMERIALES

Rootstock a rhizome with *fibrous or tuberous roots*; stems *leafy, erect* or *climbing*; leaves alternate, linear to ovate; flowers showy, in a terminal cluster or raceme; perianth-segments 6, free or partly connate, equal or sometimes *one somewhat dissimilar*; stamens 6, free or partly connate; ovary *superior or usually inferior*; 3-locular with axile placentas, or 1-locular with parietal placentas; fruit a capsule or berry; seeds with copious endosperm.—Mainly S. Hemisphere.

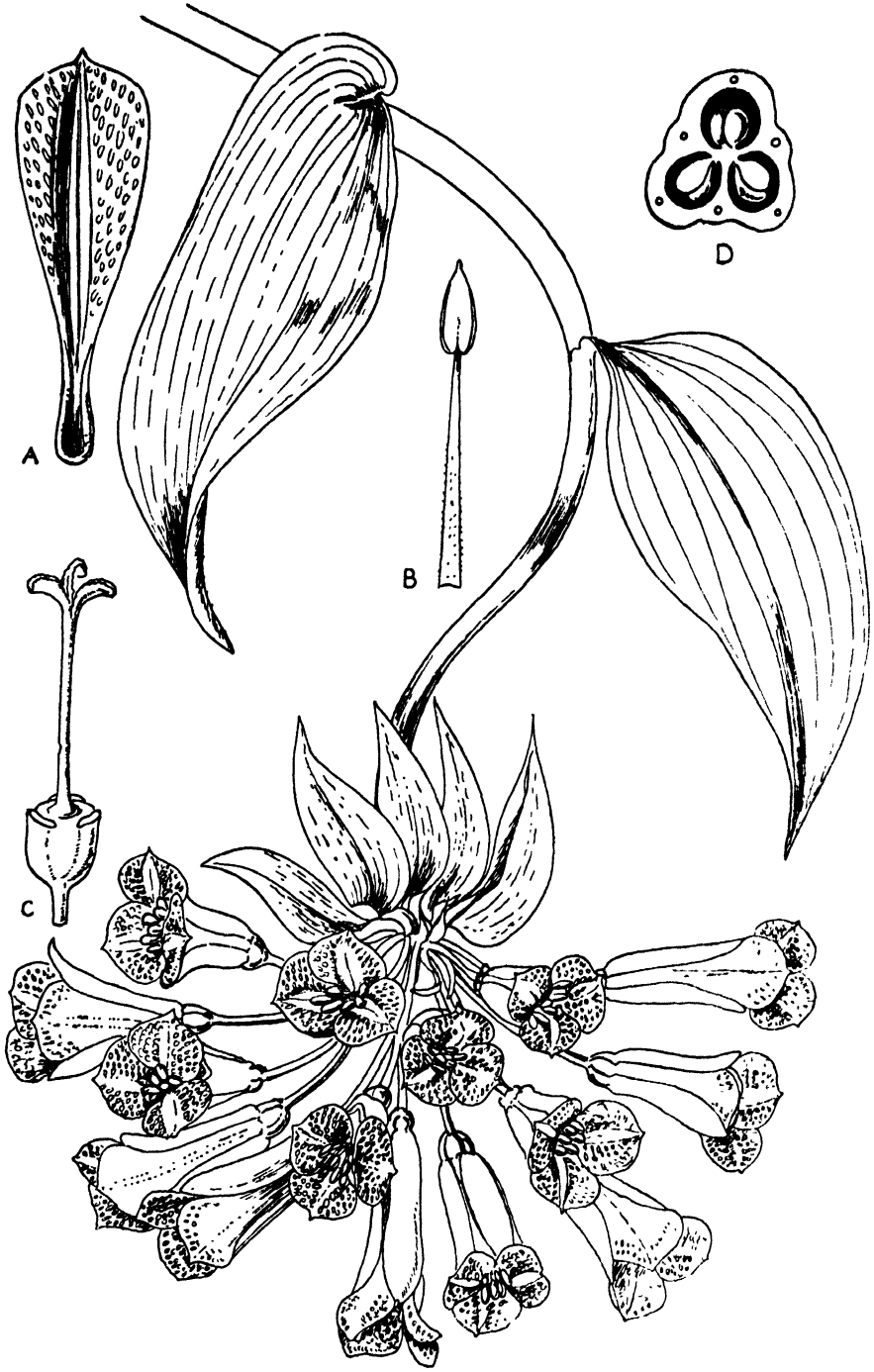


FIG. 385. Bomarea caldasiana *Herb.* (Alstroemeriaceae). A, inner perianth-segment. B, stamen. C, pistil. D, cross-section of ovary. (Adapted from *Bot. Mag.*)

A. Ovary inferior:

B. Fruit a capsule; inflorescence terminal, often surrounded by a whorl of leaves; stem herbaceous and erect or woody and climbing; Cent. and S. Amer. *Alstroemeriaceae*

BB. Fruit a berry; inflorescence leaf-opposed; ovary 1-locular, with parietal placentas; woody climber with reticulately veined leaves; Austral. *Petermanniaceae*

AA. Ovary superior; fruit a berry; flowers axillary or terminal; herbaceous or woody, often climbing; S. Hemisph. *Philesiaceae*

378. ALSTROEMERIACEAE

Rootstock a *rhizome* with fibrous roots sometimes bearing tubers; stems erect, ascending, or climbing, leafy. Leaves alternate, crowded or scattered, entire, the petiole usually twisted and reversing the surfaces. Flowers in a terminal cluster or irregular raceme, rarely solitary, showy, bisexual, more or less actinomorphic but often one segment of the perianth different from the others and more spotted. Perianth-segments *free to the base*, inserted on an epigynous annulus, in two series, often narrowed to the base or spathulate. Stamens 6, inserted on an annulus at the base of the segments; filaments free, anthers introrse, oblong or ovoid, *basifixed*, opening lengthwise. Ovary *inferior*, 3-locular with axile placentas or 1-locular with parietal placentas; style filiform, shortly 3-lobed. Ovules numerous in each loculus or on each placenta, anatropous. Fruit a *capsule*, more or less truncate, loculicidally 3-valved, crowned by the persistent epigynous annulus or by the persistent perianth-segments. Seeds numerous, with a small embryo in copious endosperm. B.H. **3**, 735, tribe *Alstroemerieae* (in greater part); Rendle, 308.—Confined to Central and S. America.

A. Ovary 3-locular, with axile placentas: **B.** Perianth-segments of the two series similar in size but often not in colour; roots not tuberous—ALSTROEMERIA (S. Amer.). **BB.** Perianth-segments dissimilar, the outer shorter than the inner; roots often tuberous—BOMAREA (Cent. and S. Amer.). **AA.** Ovary 1-locular, with parietal placentas: **C.** Inflorescence capitate, several-flowered; perianth-segments spathulate, persistent and erect-patent in fruit—LEONTOCHIR (Chile). **CC.** Inflorescence 1-flowered—SCHICKENDANTZIA (*Schickendantziella*) (Andes).

379. PETERMANNIACEAE

A tall *woody climber*; stem more or less *prickly*. Leaves alternate, shortly petiolate, lanceolate, acuminate, with numerous sub-parallel nerves and *reticulate veins*. Flowers bisexual, in lax few-flowered cymes; cymes *lateral* and *leaf-opposed*, sometimes modified into a *branched tendril*. Perianth 6-partite; segments oblong, spreading or at length deflexed, subequal. Stamens 6, inserted at the base of the perianth; filaments erect; anthers oblong, extrorse, loculi contiguous, the connective not produced. Ovary inferior, 1-locular *with 3 parietal placentas*; style slender, with a terminal capitate stigma; ovules



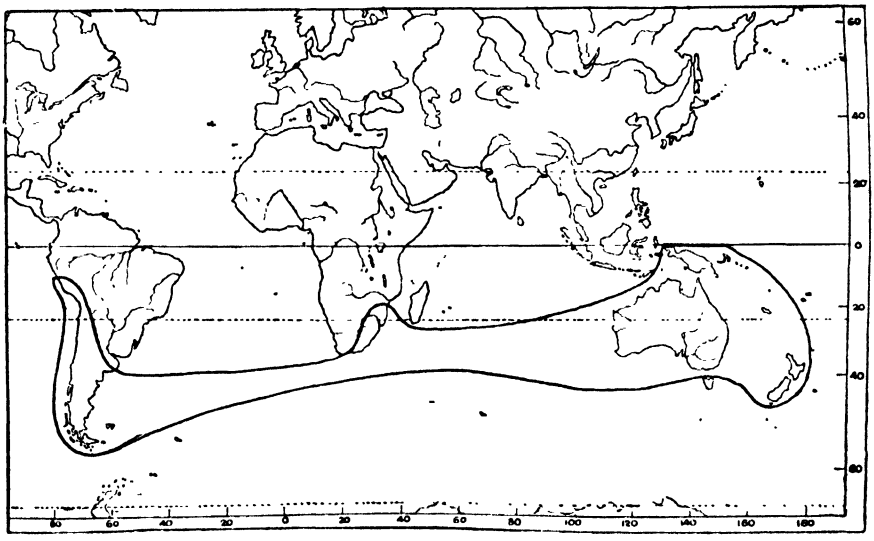
FIG. 386. Petermannia cirrhosa *F. Muell.* (Petermanniaceae). A, flower-bud. B, flower. C, stamens. D, cross-section of ovary. E, lower surface of leaf. (Orig.)

numerous. Fruit a many-seeded *berry*. B.H. 3, 746 (under *Dioscoreaceae*). Australia.—PETERMANNIA; species 1.

Bentham and Hooker f. say of *Petermannià* in the *Genera Plantarum* (loc. cit.):[1] 'genus habitu perianthio et staminibus potius Liliaceis (Smilaceis) quam Dioscoreaceis accedit, sed ovarium distincte inferum, et in utroque ordine insigne est placentis parietalibus multiovulatis'.

380. PHILESIACEAE

Shrubs, undershrubs, or tall climbers, sometimes semi-epiphytic from a slender branched rhizome. Leaves alternate, oblong to ovate, with prominent



Range of Philesiaceae.

parallel nerves and reticulate, or with prominent transverse veins between the nerves. Flowers terminal or axillary, pendulous, solitary, fasciculate or cymose-racemose, white, greenish, or red, bisexual, actinomorphic. Perianth at length deciduous; segments free or connivent or connate into an urceolate tube, subequal or the outer calyx-like and the inner petaloid; no corona. Stamens 6, hypogynous or at the base of the segments or on the perianth-tube; filaments free or partly connate into a tube; anthers dorsifixed in the middle or near the base, introrse or sublaterally introrse, opening by slits lengthwise. Ovary superior, 3- or 1-locular, with axile or parietal placentas; style 1, with a capitate or shortly 3-lobed stigma. Ovules numerous to few. Fruit a *berry*. B.H. 3, 766, as greater part of tribe *Luzuriageae*.—S. Hemisphere: New Guinea, Pacific Islands, New Caledonia, Australia, New Zealand, Temp. S. America, SE. Africa.

[1] 'A genus with the habit, perianth, and stamens rather of Liliaceae (Smilaceae) than of Dioscoreaceae, but the ovary distinctly inferior, and remarkable in either family in having parietal multi-ovulate placentas.'

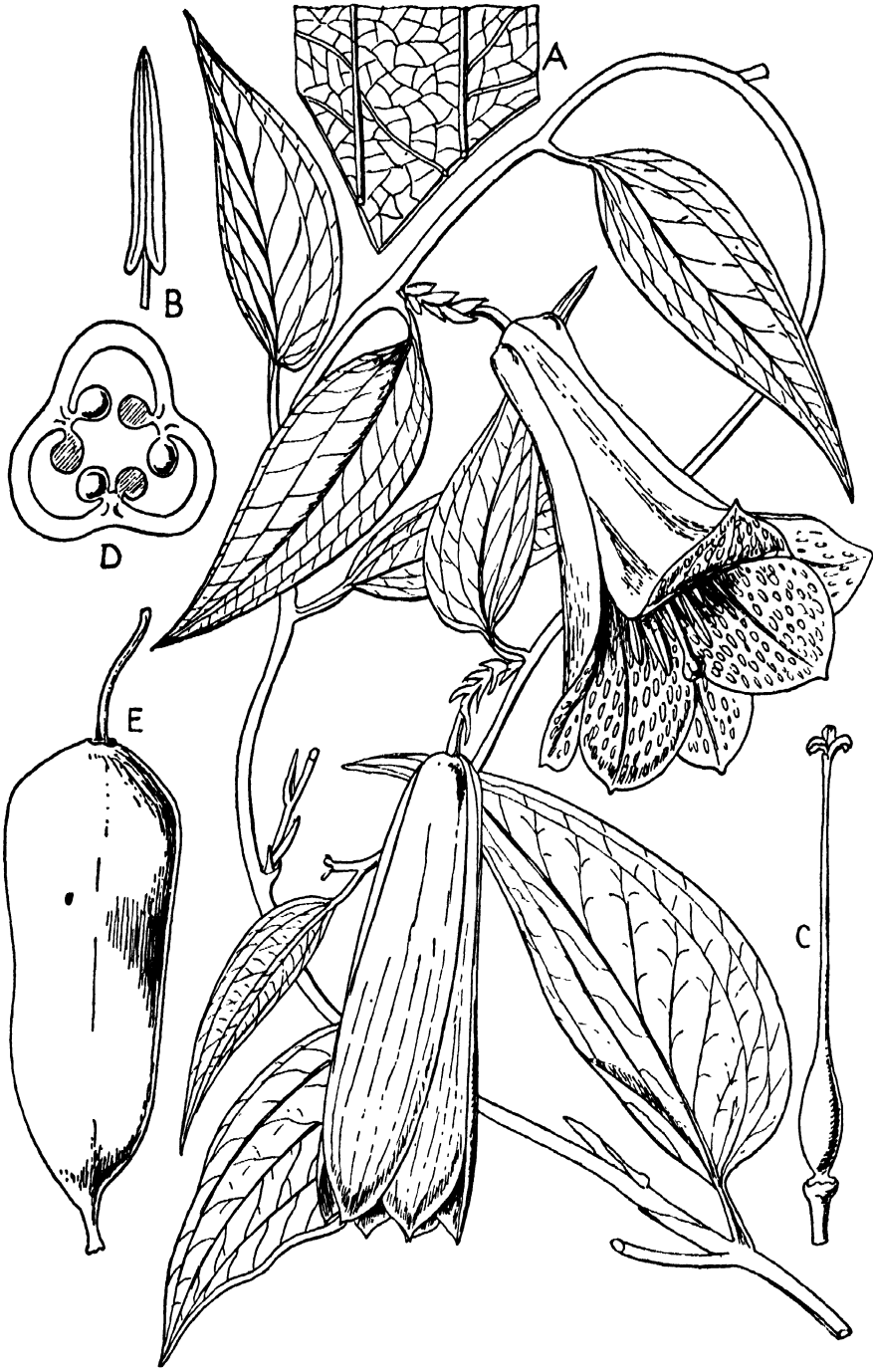


FIG. 387. Lapageria rosea *Ruiz and Pav.* (Philesiaceae). A, lower surface of leaf showing reticulate venation. B, anther. C, pistil. D, cross-section of ovary. E, fruit. (Partly after *Bot. Mag.*)

Philesiaceae is a very distinctive group of the *Liliales*, usually included in the family *Liliaceae* as a tribe or subfamily under the names *Luzuriageae* or *Luzuriagoideae* respectively. Although Lindley[1] knew only the genera *Philesia* and *Lapageria*, he considered the group to be worthy of family rank, a status maintained for it here, which it seems to require. The woody stems, reticulate-veined leaves, simple or slightly lobed style, and baccate fruit, coupled with the distinct geographical distribution, provide a combination of characters separating it from other families of the *Liliales*. The stems are woody and either climbing or suffruticose and sometimes semi-epiphytic, often growing on old rotting tree-stumps in forests.

The family as constituted here is found only in the S. Hemisphere, one monotypic genus, *Behnia* (*B. reticulata* Didr.), being in SE. Africa, from Uitenhage through the eastern provinces as far north as Gazaland. The link with this region and Australia is provided by *Elachanthera*, a monotypic genus which occurs at Nikol Bay, in NW. Australia 20° 35′ S., 116° 5′ E.). The genus *Luzuriaga* connects very closely the floras of Subantarctic S. America and New Zealand, *L. marginata* Benth. and Hook. f., and *L. parviflora* Kunth, occurring in these respective regions, having even been regarded as the same species.

A. Erect undershrubs: **B.** Perianth-segments subequal, spreading; habit of a *Phyllanthus*; ovary 3-locular—LUZURIAGA (Chile and New Zeal.). **BB.** Perianth-segments very unequal, erect, the inner much longer than the outer; leaves 1-nerved; ovary 1-locular, with parietal placentas—PHILESIA (Chile, Magell.). **AA.** Climbers: **C.** Perianth-segments free or nearly so: **D.** Perianth-segments erect, thick; leaves 3–5-nerved; ovary 1-locular, with parietal placentas—LAPAGERIA (Chile). **DD.** Perianth-segments spreading; ovary 3-locular: **E.** Inner perianth-segments fimbriate-ciliate—EUSTREPHUS (Austral.). **EE.** Inner perianth-segments not ciliate: **F.** Perianth-segments nerveless; anthers rounded-ovate—ELACHANTHERA (NW. Austral.). **FF.** Perianth-segments distinctly nerved; anthers oblong-linear—GEITONOPLESIUM (Austral., New Caled., Pacific islands). **CC.** Perianth-segments united into a campanulate tube; transverse veins prominent; ovary 3-locular—BEHNIA (SE. Afr.).

ORDER 97. ARALES

Herbs, rarely climbing and woody, very rarely aquatic; leaves radical, or if cauline alternate, entire or variously divided, often hastate; flowers *very small*, densely arranged on a *spike* (*spadix*) usually subtended by or enclosed in a *large bract* (*spathe*), bisexual or unisexual; perianth present and small, or absent; stamens hypogynous, free or united; ovary superior; fruit usually a *berry*; seeds with copious endosperm.—Temperate and Tropical Regions.

A. Terrestrial (or very rarely aquatic) plants, with usually very conspicuous spathe and spadix and numerous roots *Araceae*

AA. Minute floating aquatic stemless plants without roots, or roots simple and thread-like *Lemnaceae*

381. ARACEAE

Herbs with watery, bitter, or milky juice, with a tuberous or elongated rhizome, rarely woody and climbing. Leaves solitary or few, sometimes

[1] Lindl. *Veg. Kingd.* 217 (1841).

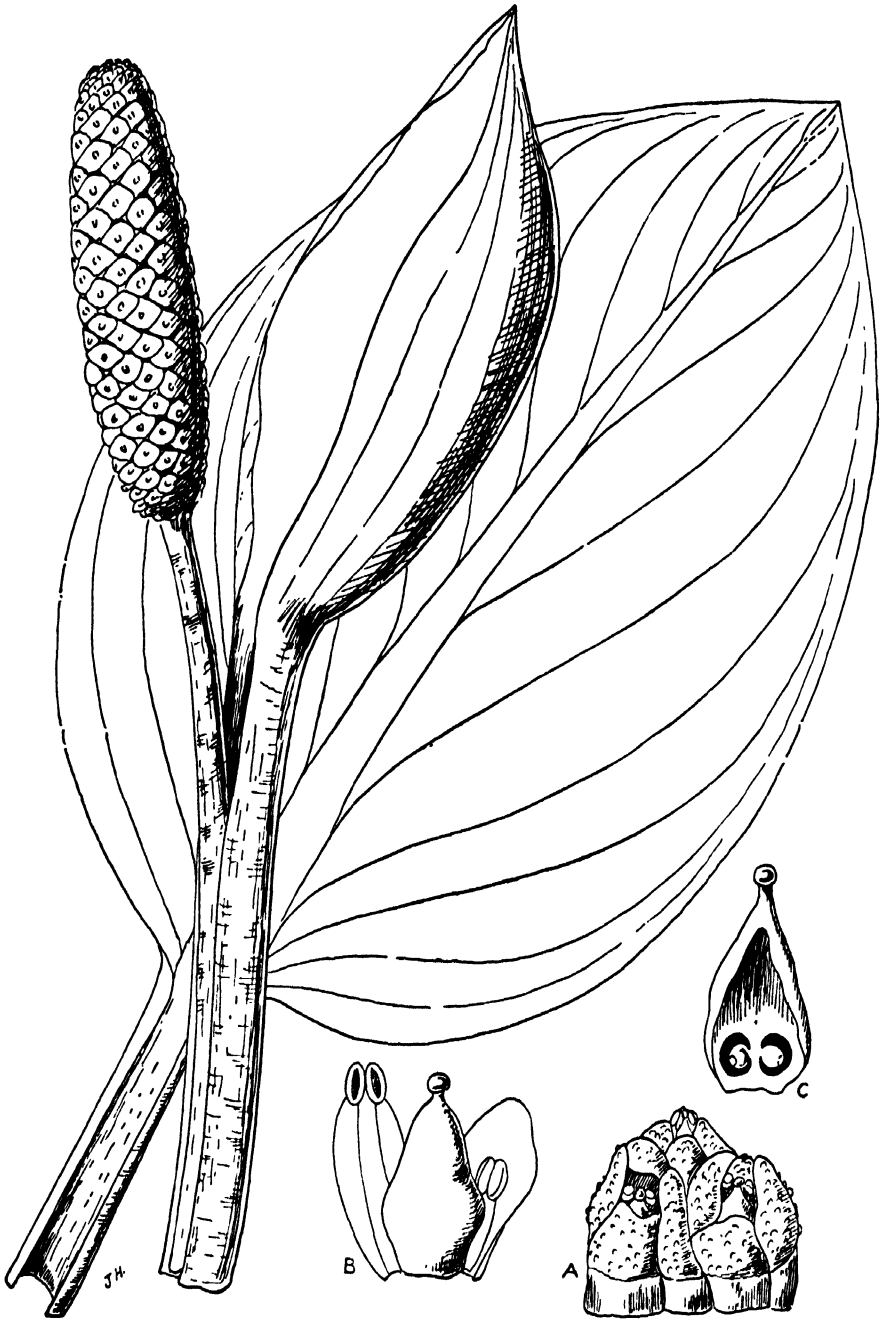


FIG. 388. Lysichitum camtschaticum *Schott* (Araceae). A, portion of spadix, showing the bisexual flowers. B, pistil, stamens, and segments. C, vertical section of ovary. (Orig.) Regarded (see notes p. 629) as a very primitive type of the family because of the free leaf-like spathe, and bisexual flowers covering the whole of the spadix.

appearing after the flowers, mostly radical, when cauline then alternate and distichous or spirally arranged, entire to variously divided, often hastate or sagittate, with a membranous sheath at the base. Flowers *small or minute*, often smelling offensively, *arranged on a spadix enclosed in a spathe*, either bisexual and all alike, or monoecious, the males in the upper part of the spadix, the females below, rarely dioecious. Perianth present in the bisexual flowers, segments 4–6 or connate into a truncate cup, mostly absent from the unisexual flowers. Stamens hypogynous 2–4–8, opposite the perianth-segments, anthers opening by pores or slits, free or united into a mass. Staminodes sometimes present among the female and below the male flowers. Ovary superior or immersed in the spadix, 1- to many-locular; style various, sometimes absent. Ovules parietal, axile, basal, or apical. Fruit a berry or coriaceous and rupturing, 1- to many-seeded. Seeds mostly with copious endosperm; embryo in the middle of the endosperm, or if no endosperm then curved. B.H. **3**, 955; E.P. **2**, 3, 102; Engler, *Pflanzenr.*, *Araceae* (1905–20); Rendle, 261.—Temperate and Tropical Regions, most numerous in the latter.

USEFUL PRODUCTS: *Coco Biscuits* (sliced tubers of Colocasia antiquorum *Schott*); *Elephant-Foot Yam* (Amorphophallus campanulatus *Blume*); *Indian Ipecacuanha* (roots of Cryptocoryne spiralis *Fisch.*); *Sweet Flag Rhizome* (Acorus calamus *L.*); *Water Cabbage* (Pistia stratiotes *L.*)

I have based the arrangement of the tribes and genera as given in the key according to the following principles: (1) That the family is monophyletic in its origin, i.e. from the stock of tribe *Aspidistreae* of *Liliaceae*, in which the flowers are arranged in dense spikes (*Tupistra*, *Rohdea*, *Gonioscypha* (see Fig. 375). (2) That the most primitive *Araceae* would have little or at most a poorly developed or leaf-like spathe, which would become increasingly protective as evolution proceeded (see Fig. 388, *Lysichitum*, a primitive type). (3) That the more primitive flowers would be bisexual and possess a perianth.

These are characteristics of the earlier tribes in the key below. (4) The more highly evolved *Araceae* would have unisexual flowers, an increasingly protective spathe, and owing to reduction some part of the spadix would become barren. These conditions are all attained in the last tribe, the *Areae*, to which our common *Arum* ('Lords and Ladies') belongs. In this group the very peak of evolution in the family is reached in *Ambrosina*, in the Mediterranean, in which the spathe is divided into two halves, the one containing a solitary female flower, the other a spadix of male flowers arranged in 2 rows.

For the compilation of the key the *Genera Plantarum* of Bentham and Hooker has mainly been used, the additional genera contained in Engler's *Pflanzenreich* having been incorporated.

Key to the Tribes

Series I. *Flowers all bisexual; spadix without a barren upper part (appendix); leaves mostly simple:*

A. Perianth present:
B. Herbs, erect or creeping; petiole not flat and leaf-like:
C. Spathe absent or not differentiated as such except perhaps in colour:
D. Spathe absent — 1. *Acoreae*
DD. Spathe present, resembling a leaf-sheath or with a coloured blade — 2. *Orontieae*
CC. Spathe present and well differentiated:
E. Spathe flat, persistent:
F. Spathe more or less foliaceous — 3. *Spathiphylleae*

FF. Spathe not foliaceous, often coloured 4. *Anthurieae*
EE. Spathe more or less folded or embracing the spadix:
G. Spathe hooded over the top of the spadix 5. *Dracontieae*
GG. Spathe not hooded, more or less acuminate 6. *Lasieae*
BB. Woody climbers; leaf-blade articulated with the often expanded leaf-like petiole 7. *Pothoeae*
AA. Perianth absent:
H. Aquatic herbs; spathe persistent 8. *Calleae*
HH. Terrestrial scandent herbs or usually shrubs; spathe deciduous 9. *Monstereae*

Series II. *Flowers all unisexual, monoecious, or rarely dioecious; perianth usually absent or at most represented by an annulus:*

A. Spadix without a barren terminal appendage, the flowers or neuter organs usually covering the whole of the upper part:
B. Spadix free from or only partially adnate to the spathe:
C. Stemless or nearly stemless herbs with radical leaves (rarely with a short leafy stem, but not climbing):
D. Stamens free from each other:
E. Perianth of 4 segments or annular or cupular 10. *Stylochitoneae*
EE. Perianth absent 11. *Richardieae*
DD. Stamens connate into a mass:
F. Staminodes (or perianth) present in the female flowers, separate or connate into a cup 12. *Dieffenbachieae*
FF. Staminodes (or perianth) absent from the female flowers 13. *Colocasieae*
CC. Climbers 14. *Philodendreae*
BB. Spadix adnate more or less its full length to the spathe:
G. Terrestrial 15. *Spathicarpeae*
GG. Aquatic, floating 16. *Pistieae*
AA. Spadix with a terminal appendage devoid of flowers or neutral organs:
H. Ovules anatropous 17. *Pythonieae*
HH. Ovules orthotropous:
J. Stamens free 18. *Areae*
JJ. Stamens connate 13. *Colocasieae*

Tribe 1. **Acoreae. A.** Spadix solitary, sessile—ACORUS (N. Temp. Reg.). **AA.** Spadices racemose, pedunculate—GYMNOSTACHYS (Austral.).

Tribe 2. **Orontieae. A.** Spathe represented by a leaf-sheath embracing the peduncle; spadix long-exserted from the sheath; ovary 1-locular—ORONTIUM (N. Amer.). **AA.** Spathe well developed and coloured, at first embracing the spadix; ovary 2-locular—LYSICHITUM (NE. Asia, W. N. Amer.).

Tribe 3. **Spathiphylleae.** One genus, SPATHIPHYLLUM (Trop. Amer., Malay Archip.).

Tribe 4. **Anthurieae.** One genus, ANTHURIUM (Trop. Amer.).

Tribe 5. **Dracontieae. A.** Spadix cylindrical: **B.** Leaves trisect or pinnatifid: **C.** Ovary 2–5-locular—DRACONTIUM (Trop. Amer.). **CC.** Ovary 1-locular—

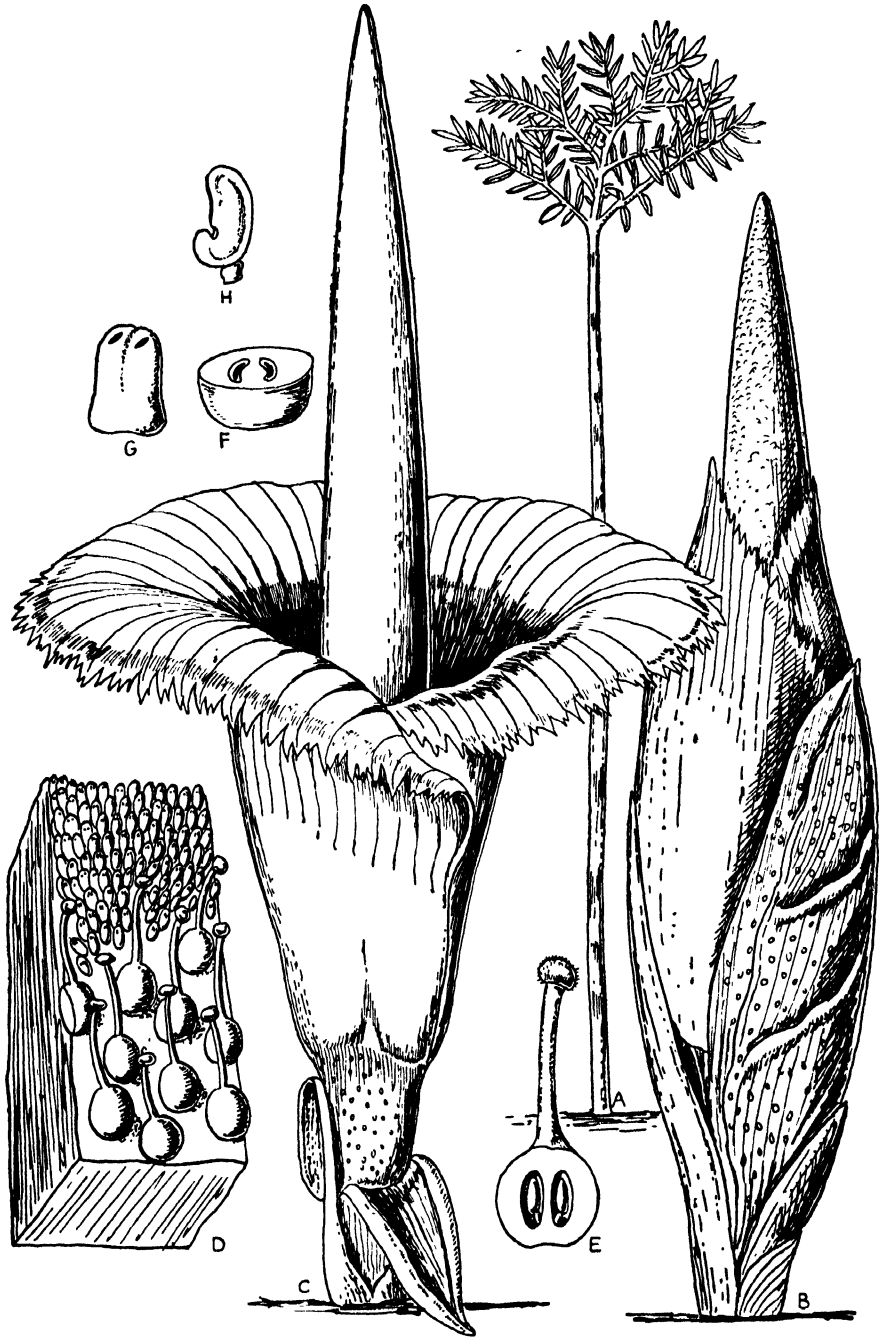


FIG. 389. Amorphophallus titanum *Becc.* (Araceae). A, leaf. B, spathe and spadix in bud. C, the same, open. D, part of spadix showing separate female and male flowers. E, vertical section of ovary, with style. F, cross-section of anther. G, stamen. H, stamen, side view. (After *Bot. Mag.*)

ECHIDNIUM (Trop. Amer.). **BB.** Leaves sagittate, entire—DRACONTIOIDES (Trop. Amer.). **AA.** Spadix globose; leaves cordate—SYMPLOCARPUS (N. Asia, N. Amer.).

Tribe 6. **Lasieae. A.** Ovary 4–5-locular—OPHIONE (S. Amer.). **AA.** Ovary 2-locular—UROSPATHA (Trop. Amer.). **AAA.** Ovary 1-locular: **B.** Ovules pendulous from the apex; style thick—LASIA (Trop. Asia). **BB.** Ovules parietal or basal; stigma sessile: **C.** Spathe boat-shaped, obtuse: **D.** Ovule solitary; leaves sagittate—PODOLASIA (Borneo). **DD.** Ovules several; leaves not sagittate—HOLOCHLAMYS (New Guin.). **CC.** Spathe lanceolate, acuminate, or acute: **E.** Ovules 2-seriate—CYRTOSPERMA (Tropics). **EE.** Ovule solitary—ANAPHYLLUM (India).

Tribe 7. **Pothoeae. A.** Ovary 3-locular—POTHOS (Madag., Trop. Asia to Austral.). **AA.** Ovary 1-locular—POTHOIDIUM (Malay Archip.).

Tribe 8. **Calleae.** One genus, CALLA (Eur., N. Amer.).—Related genus PYCNOSPATHA (Indo-China).

Tribe 9. **Monstereae. A.** Spadix stipitate: **B.** Ovules 4 or more in each loculus: **C.** Ovules 4–6 in each loculus—STENOSPERMATION (Trop. Amer.). **CC.** Ovules several in each loculus—RHODOSPATHA (*Anepsias*) (Trop. Amer.). **BB.** Ovules 1–2: **D.** Ovules 2, inserted at the base of the septa: **E.** Spathe oblong or elliptic—HETEROPSIS (Brazil, Guiana). **EE.** Spathe ovate—EPIPREMNOPSIS (E. Tropics). **DD.** Ovule solitary, basal—ANADENDRUM (Malay Archip.). **AA.** Spadix sessile: **F.** Berries free from each other: **G.** Ovary 2-locular—AMYDRIUM (Malay Archip.). **GG.** Ovary 1-locular or imperfectly 2-locular: **H.** Ovules 2 or more in the loculi—EPIPREMNUM (Malay Archip. to Pacific islands). **HH.** Ovule solitary—SCINDAPSUS (Indo-Mal., China, New Guin.). **FF.** Berries coherent: **I.** Ovules numerous—RHAPHIDOPHORA (*Aforaphidophora*) (Trop. Asia and Afr., Pacific islands). **II.** Ovules 2—MONSTERA (Trop. Amer.). **III.** Ovule 1, basal—ALLOSCHEMONE (Trop. Amer.).

Tribe 10. **Stylochitoneae. A.** Spathe-margins not connate—ZAMICULCAS (Trop. and S. Afr.). **AA.** Spathe-margins connate—STYLOCHITON (Trop. and S. Afr.). **AAA.** Imperfectly known genus—CARLEPHYTON (Madag.).—Related genera?—AROPHYTON (Madag.), COLLETOGYNE (Madag.).

Tribe 11. **Richardieae. A.** Fruit exserted from the tube or convolute part of the spathe; spathe completely deciduous and withering: **B.** Male and female flowers contiguous: **C.** Ovule 1, on the middle of the wall of the loculus: **D.** Stem erect; female flowers without staminodes—AGLAONEMA (E. Tropics). **DD.** Rhizome creeping; female flowers with staminodes—AGLAODORUM (Malay Penin. and Archip.). **CC.** Ovules 2, sub-basilar—MONTRICHARDIA (Trop. Amer.). **CCC.** Ovule 1, pendulous from the apex of the loculus—NEPHYTHYTIS (Trop. Afr.). **BB.** Male and female flowers not contiguous—PHILONOTION (*Nebrownia*) (Brazil). **AA.** Fruit included in the persistent or accrescent spathe-tube, the blade of the spathe deciduous: **E.** Blade of the spathe not circumscissile at the base, withering away; male and female flowers usually contiguous: **F.** Leaves sagittate, entire; peduncle smooth—ZANTEDESCHIA (*Richardia*) (S. Afr.). **FF.** Leaves sagittate or not; peduncle rough—ANCHOMANES (Trop. Afr.). **FFF.** Leaves narrowed to or at most

cordate at the base; peduncle smooth: **G.** Ovules numerous or several—HOMALONEMA (*Chamaecladon*) (Trop. Asia and Amer.). **GG.** Ovules about 4 in each loculus; stamens 2—DIANDRIELLA (New Guin.). **GGG.** Ovule solitary—PLESMONIUM (India). **EE.** Blade of the spathe circumscissile at or near the base: **H.** Stamens truncate at the apex: **I.** Ovaries free from each other: **J.** Upper male flowers sterile: **K.** No neuter organs at the top of the spadix—SCHISMATOGLOTTIS (Malay Archip.). **KK.** Neuter organs covering the top of the spadix—APATEMONE (Malay Archip.). **JJ.** Upper male flowers fertile: **L.** Leaves with lateral nerves—RHYNCHOPYLE (Borneo). **LL.** Leaves linear, without lateral nerves—ARIDARUM (Borneo). **LLL.** Here possibly also comes —PSEUDOHYDROSME (W. Afr.). **II.** Ovaries connate—GAMOGYNE (Borneo). **HH.** Stamens produced at the apex: **M.** Anthers 2-horned: **N.** Spadix without an appendix—BUCEPHALANDRA (Borneo). **NN.** Spadix with an appendix—MICROCASIA (Borneo). **MM.** Anthers with a produced connective—PIPTOSPATHA (Borneo) (Malay Penin.).—Additional genus FELIPPONIELLA (*Felipponia*) (Uruguay).

Tribe 12. **Dieffenbachieae. A.** Stigma sessile, cushion-like; stamens connate; leaves oblong—DIEFFENBACHIA (Trop. Amer.). **AA.** Stigma on a style, lobed or capitate: **B.** Ovary 3–6-locular: **C.** Ovary-loculi 2-ovulate; leaves sagittate —MANGONIA (Argentine).—Related genus AROPSIS (Argentine). **CC.** Ovary-loculi 1-ovulate: **D.** Stigma capitate: **E.** Leaves pinnatisect—TACCARUM (Brazil). **EE.** Leaves entire—SYNANDROSPADIX (S. Amer.).—Related genus?—LILLOA (Argentine). **DD.** Stigma lobed: **F.** Leaves pinnatisect—ASTEROSTIGMA (*Staurostigma*) (Trop. Amer.). **FF.** Leaves pedate: **G.** Ovules anatropous—ANDROMYCIA (Cuba). **GG.** Ovules orthotropous: **H.** Female flowers with filiform staminodes—GEARUM (Brazil). **HH.** Female flowers with obovate staminodes—GORGONIDIUM (New Guin.). **BB.** Ovary 2-locular; ovules solitary: **I.** Perianth present.—GONATOPUS (Trop. Afr.). **II.** Perianth absent —ZYGANTHERA (Trop. Afr.). **BBB.** Ovary 1-locular; ovules numerous—STEUDNERA (Burma).

Tribe 13. **Colocasieae. A.** Fruit enclosed in the tube of the spathe: **B.** Ovules orthotropous: **C.** Ovules numerous: **D.** Ovary perfectly 2-locular—AMAURIELLA (W. Afr.). **DD.** Ovary imperfectly 2-locular—ANUBIAS (Trop. Afr.). **DDD.** Ovary 1-locular (at the base): **E.** Blade of spathe open: **F.** Herbs flowering and leafy in alternate seasons—REMUSATIA (Trop. Afr., E. Tropics). **FF.** Herbs flowering and leafy in the same season—COLOCASIA (Trop. Asia). **EE.** Blade of spathe folded, the tube constricted in the middle—GONATANTHUS (Himal.). **CC.** Ovules few: **G.** Ovules basal—ALOCASIA (Trop. Asia). **GG.** Ovules subparietal—PELTANDRA (N. Amer.). **BB.** Ovules anatropous: **H.** Style present; female part of inflorescence wholly adnate to spathe: **I.** Style stout—CALLOPSIS (Trop. E. Afr.). **II.** Style slender—CALADIOPSIS (Trop. Amer.). **HH.** Style absent; only a portion of female part adnate to the spathe: **J.** Ovaries 2–3-locular: **K.** Leaves present at flowering time: **L.** Stigma not disk-like: **M.** Leaves not pedatifid; female inflorescence densely flowered—CALADIUM (Trop. Amer.). **MM.** Leaves pedatifid; female inflorescence lax-flowered—CHLOROSPATHA (Trop. Amer.). **LL.** Stigma disk-like—XANTHOSOMA (Trop. Amer.). **KK.** Leaves absent at flowering time; style absent—

APHYLLARUM (Brazil). **JJ.** Ovaries 1-locular; ovule solitary, basal—TYPHONODORUM (*Arodendron*) (Madag., Trop. E. Afr.). **AA.** Fruit not enclosed in the tube: **N.** Ovules numerous: **O.** Leaves peltate—ARIOPSIS (India). **OO.** Leaves not peltate—SCHIZOCASIA (Malaya). **NN.** Ovules 1–4: **P.** Ovules 4—SCAPHISPATHA (Boliv.). **PP.** Ovule 1—HAPALINE (Burma).

Tribe 14. **Philodendreae. A.** Stamens separate: **B.** Spadix without a terminal appendix: **C.** Leaves ovate or lanceolate—CULCASIA (Trop. Afr.). **CC.** Leaves sagittate or hastate-cordate—CERCESTIS (Trop. Afr.). **CCC.** Leaves

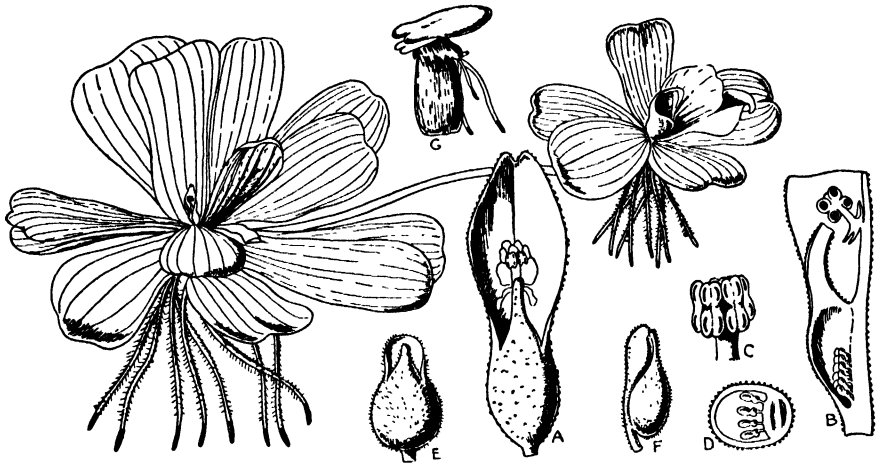


FIG. 390. Pistia stratiotes *Linn.* (Araceae). A, spathe and spadix. B, part of the same in vertical section. C, whorl of male flowers. D, cross-section of female part of spathe and spadix. E and F, young spathes, front and side view. G, germinating seed. (Orig.)

large, perforated or pinnatisect—RHEKTOPHYLLUM (Trop. Afr.). **B.** Spadix with a terminal appendix—THAMATOPHYLLUM (Brazil). **AA.** Stamens connate; Trop. Amer.: **D.** Ovaries separate: **E.** Ovules orthotropous; leaves various—PHILODENDRON. **EE.** Ovules anatropous; leaves sagittate or 3-sect—PORPHYROSPATHA. **DD.** Ovaries connate—SYNGONIUM.

Tribe 15. **Spathicarpeae. A.** Ovary 4- or more-locular—SPATHANTHEUM (Boliv.). **AA.** Ovary 1-locular—SPATHICARPA (Brazil).—Related genus (*fide* author) MAGUIREA (Guiana).

Tribe 16. **Pistieae.** One genus—PISTIA (floating in fresh water, in the Tropics generally).

Tribe 17. **Pythonieae. A.** Male and female flowers contiguous on the spadix: **B.** Appendix of spadix smooth: **C.** Spadix adnate to the spathe at the base on one side; female flowers on one side—ZOMICARPA (Brazil). **CC.** Spadix not adnate to the spathe; female flowers all around the spathe—AMORPHOPHALLUS (Indo-Mal., Trop. Afr.). **BB.** Appendix of spadix verrucose or covered with processes: **D.** Upper male flowers sterile—THOMSONIA (Himal.). **DD.** Upper male flowers fertile—PSEUDODRACONTIUM (Cochin China). **AA.** Male and female flowers remote, often with neutral organs between: **E.** Ovary 3-locular—

RHAPHIOPHALLUS (India). **EE.** Ovary 2-locular—SYNANTHERIAS (India). **EEE.** Ovary 1-locular: **F.** Ovules 6, basal; leaves partite—XENOPHYA (New Guin.). **FF.** Ovule 1, basal; leaves cordate or sagittate, entire—ZOMICARPELLA (*Ulearum*) (S. Amer.).

Tribe 18. **Areae. A.** Tube of spathe open at the top: **B.** Margins of spathe folded but not connate: **C.** Flowers monoecious: **D.** Ovules more than 2: **E.** Ovules numerous: **F.** Ovules parietal; leaves hastate or sagittate—ARUM (Eur., W. Asia). **FF.** Ovules basal and apical—THERIOPHONUM (India). **EE.** Ovules few, basal, or basal and apical: **G.** Male and female flowers remote: **H.** Ovules basal and apical; appendix crinkled—HELICODICEROS (Balear. Is.). **HH.** Ovules basal; appendix smooth—PROTARUM (Seychelles). **GG.** Male and female flowers contiguous—DRACUNCULUS (S. Eur., Canary Is.). **DD.** Ovules 1–2, basal: **I.** Herbs: **J.** Appendix stipitate above the inflorescence—TYPHONIUM (Trop. Asia to Pacific). **JJ.** Appendix not stipitate above the inflorescence—EMINIUM (*Helicophyllum*) (N. Asia). **II.** Climbers—[SYNGONIUM (Trop. Amer.)]. **CC.** Flowers dioecious—ARISAEMA (*Muricauda, Flagellarisaema, Heteroarisaema*) (Abyss., Temp. Asia, N. Amer.). **BB.** Margins of spathe connate in the lower part: **K.** Spadix not partly adnate to the spathe: **L.** Ovules 2–4; leaves divided—SAUROMATUM (Trop. Asia and Afr.). **LL.** Ovule 1; leaves entire—BIARUM (Mediterr.). **K.** Spadix partly adnate to the spathe; stamen 1—ARISARUM (Mediterr.). **AA.** Tube of spathe closed at the top: **M.** Spathe-tube 1-chambered: **N.** Both sexes enclosed by the spathe: **O.** Ovaries in several whorls: fruit baccate—LAGENANDRA (India). **OO.** Ovaries in one whorl, connate; fruit a dehiscent syncarp—CRYPTOCORYNE (Indo-Malay Is.). **NN.** Male part of inflorescence exserted from the spathe—PINELLIA (China, Japan). **MM.** Spathe-tube 2-chambered, the male inflorescence in one, the female in the other—AMBROSINA (Mediterr.).—Additional genus HUMBERTINA (Madag.).

Imperfectly known genera of Araceae: HETEROLOBIUM, MICROCULCAS, JAIMENOSTIA (Fernando Po).

382. LEMNACEAE

Small to minute floating or submerged herbs without roots or roots simple and thread-like. Flowers monoecious, nude or at first enclosed in a membranous sheath. Perianth absent. Male flowers: stamens 1–2, with slender filaments or the latter thickened in the middle or absent; anthers 1–2-locular. Female flowers: ovary sessile, 1-locular; style and stigma simple; ovules 1–7. Seeds with fleshy or no endosperm; embryo straight, axile. B.H. **3**, 1000; E.P. **2**, 3, 154; Rendle, 267.—Temperate and Tropical Regions, in fresh water.

A. Anthers 2-locular; stamens 1 or 2; plants provided with roots; flowers on the margins of the plant body; male flowers in pairs—LEMNA (*Spirodela*) (Cosmopol.). **AA.** Anthers 1-locular; stamen 1; plants rootless; flowers borne on the surface of the plant body; male flower solitary—WOLFFIA (Cosmopol.).



FIG. 391. Sparganium simplex *Huds.* (Sparganiaceae). A, male perianth-segment and stamen. B, female flower. C, fruit. D, vertical section of fruit. (Orig.)

ORDER 98. TYPHALES

Aquatic or marsh herbs with rhizomes; leaves elongate-linear, sheathing at the base; flowers unisexual, anemophilous, very small or minute, crowded into clusters or dense spikes; perianth much modified and reduced; stamens 2 or more; ovary 1-locular; ovule 1, pendulous.—Generally distributed.

A. Flowers in globose clusters	*Sparganiaceae*
AA. Flowers in dense cylindrical spikes	*Typhaceae*

383. SPARGANIACEAE

Aquatic herbs from a rhizome; stems simple or branched, leafy; leaves elongated, stiff or flaccid, erect or floating, sheathing at the base. Flowers unisexual, anemophilous, crowded in separate globose clusters, the male clusters above the female in each inflorescence. Perianth composed of a few membranous elongated scales. Male flowers: stamens 3 or more; filaments free or partially united; anthers oblong, basified; pollen globose. Female flowers: ovary sessile, narrowed at the base, 1-locular; styles simple or forked, with a unilateral stigma; ovule 1, pendulous. Fruits indehiscent, crowded, sessile, narrowed at the base, with a spongy exocarp and hard 1–2-celled endocarp. Seed with a thin testa and the embryo in the middle of mealy endosperm. B.H. **3**, 955; E.P. **2**, 1, 192; Rendle, 191. Temperate and coldish Regions of the N. Hemisphere and in Australasia.—SPARGANIUM, absent from Trop. and S. Africa and S. America.

Both in Bentham and Hooker's *Genera Plantarum* and in Engler and Prantl's *Pflanzenfamilien*, *Sparganium* is indicated as being allied to the *Pandanaceae*, the latter a family of very different habitat, habit, and structure. With this view I disagree entirely and consider the resemblance to be superficial and not due to real relationship. Engler even considered *Sparganium* to be nearer the *Pandanaceae* than to the *Typhaceae*.

I think a better position for the family and for *Typhaceae* is to place them as a reduced and very advanced group derived from the Liliaceous stock, not through the *Araceae*, but perhaps from the same stock that has also given rise to the *Xanthorrhoeaceae*, wherein the inflorescence tends towards the densely spicate type, as in *Typhaceae*.

384. TYPHACEAE

Marsh or lake herbs with creeping rhizomes, often tall, with simple stems submerged at the base; leaves mostly radical, elongated-linear, rather thick and spongy. Flowers unisexual, anemophilous, very numerous, densely crowded on a terminal spadix, the male and female similar, the male above, the female below, the two sexes contiguous or remote from each other. Perianth of very slender jointed threads or elongated spathulate scales mixed with imperfect ovaries or stamens. Male flowers: stamens 2–5; filaments free or variously connate; anthers linear, basifixed, the connective often produced. Female flowers: ovary 1-locular, stipitate, narrowed into the style, with a narrow or ligulate stigma. Fruit dry, at length splitting. Seed with a striate testa and mealy endosperm; embryo narrow, nearly as long as the seed. B.H. **3**, 954, partly; E.P. **2**, 1, 183; Rendle, 187. Temperate and Tropical Regions, gregarious in fresh water and marshy places.—TYPHA.

USEFUL PRODUCTS: *Bulrush* or *Red Mace* (Typha latifolia *L.*); leaves used for making chair-bottoms, hassocks, mats, baskets, &c.

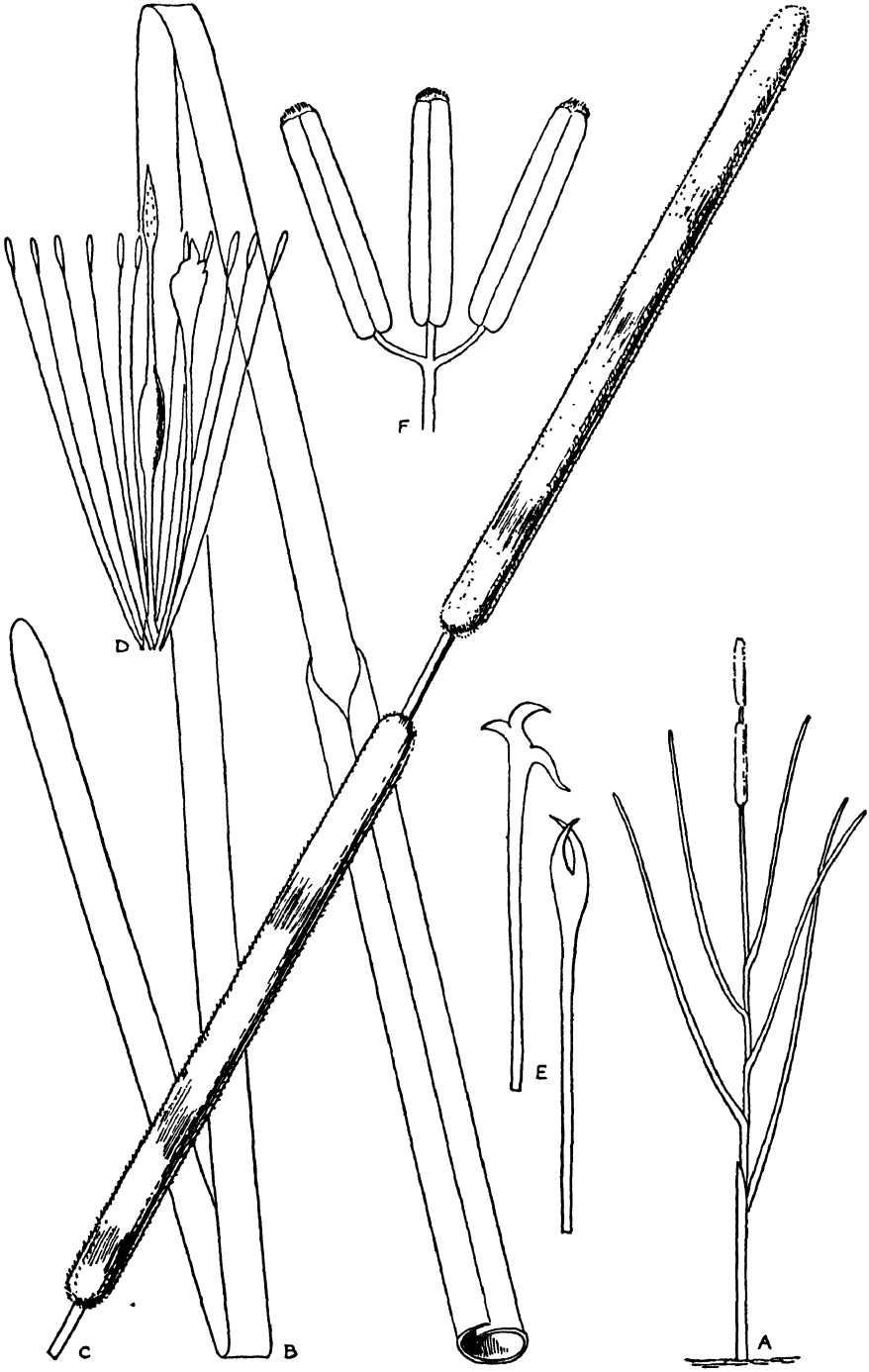


FIG. 392. Typha angustifolia *Linn.* (Typhaceae). A, whole plant, reduced. B, leaf. C, inflorescence. D, female flower. E, perianth-segments. F, stamens. (After *Fl. Bras.*)

ORDER 99. AMARYLLIDALES

Herbs with a tunicated bulb (very rarely a rhizome); leaves radical, usually linear; flowers mostly showy, umbellate or rarely solitary on a leafless stem (scape) and subtended by an involucre of 1 or more mostly thin bracts; stamens generally 6; corona present or absent; ovary superior or inferior, mostly 3-locular with axile placentas; fruit a capsule or berry.—Temperate and Warm-Temperate Regions, rarer in the Tropics.

One family *Amaryllidaceae*

385. AMARYLLIDACEAE

Herbs with a tunicated bulbous rootstock or very rarely a rhizome. Leaves few from the base of the stem or apex of the bulb, more or less linear, with parallel nerves and transverse secondary nerves. Flowers usually showy, bisexual, actinomorphic, solitary to many and umbellate at the top of the scape, subtended by an involucre of two or more (rarely only one) usually membranous bracts. Perianth inserted below or usually above the ovary, petaloid, often withering and persisting, with or without a tube; segments or lobes 6, in 2 series, all equal and similar or the inner smaller or larger than the outer; corona often present. Stamens 6 (rarely more), opposite the segments or lobes of the perianth, hypogynous or inserted on the tube or towards the base of the segments; filaments free or expanded at the base and connate and forming a 'false' corona; anthers 2-locular, introrse, basifixed or versatile, opening by slits lengthwise. Ovary superior or inferior, 3-locular (or rarely by abortion 1-locular), with axile (rarely parietal) placentas; style slender, with a capitate or 3-lobed stigma. Ovules mostly numerous in each loculus and superposed in 2 series, anatropous. Fruit a capsule, or fleshy and indehiscent. Seeds usually numerous, with fleshy endosperm surrounding the small embryo, sometimes angular or compressed and winged. B.H. **3**, 811, partly (as to tribe *Amarylleae* only), and incl. greater part of tribe *Allieae*, *Agapantheae*, and *Gilliesieae* of *Liliaceae*; E.P. **2**, 5, 97 (1887); edn. 2, **15***a*, 391 (partly); Baker, *Handbook of the Amaryllidaceae* (1888).—Temperate and Warm-Temperate Regions, rarer in the Tropics.

USEFUL PRODUCTS: *Onion* (Allium cepa *Linn.*). *Leek* (Allium ampeloprasum *Linn.*, var. porrum). Many beautiful garden plants.

The old distinction between the *Liliaceae* and *Amaryllidaceae*—'stamens 6, ovary superior' in the one, 'stamens 6, ovary inferior', in the other—was too simple, and separated genera which are otherwise very closely related. I have, therefore, taken a somewhat drastic step in including in the *Amaryllidaceae* certain groups formerly placed in the *Liliaceae*. These are the African tribe *Agapantheae*, the S. American tribe, *Gilliesieae*, and the widely spread tribe *Allieae*. As stated in the preface to this book, I consider in this case the type of inflorescence, *umbellate*, with an *involucre of bracts*, to be of greater taxonomic importance, and to give a more natural grouping than the superior or inferior ovary, the only character formerly separating the families *Liliaceae* and *Amaryllidaceae*. Although it is admitted that in many groups of plants the character of the superior or inferior ovary may be of fundamental importance for distinguishing families, its value in the petaloid Monocotyledons has been much over-emphasized, and has led to artificial classification.

But I have excluded the tribes *Hypoxideae*, *Alstroemerieae*, *Agaveae*, and the *Vellozieae*,

included in the family by Bentham and Hooker, and I can even less admit the *Conostyleae*, Bentham and Hooker's second tribe of the *Haemodoraceae*, transferred to the *Amaryllidaceae* by Pax in Engler's *Pflanzenfamilien*.

As here delimited *Amaryllidaceae* may have either a superior or an inferior ovary; they have nearly always 6 stamens, and the flowers are umbellate and subtended by an involucre of two or more bracts, or rarely the flowers are umbellate with a reduction to one bract or even one flower.

Except for the first and most primitive tribe, the *Agapantheae*, the rootstock is a corm or bulb; in *Agapantheae* it retains the rhizomatous character of the more primitive ancestral family *Liliaceae*, in which the rhizome has remained dominant. *Agapanthus*, a S. African genus commonly grown in our gardens, is thus a link between the two families.

From these we pass to other two tribes which are more familiar to students in boreal countries, the *Allieae* and *Gilliesieae*. Here the bulb has become a fixed character. In *Allieae* there is no true corona; a 'false' corona is sometimes present, for example in *Brevoortia*, in which there are only 3 fertile stamens, the others being petaloid and connate. In the tribe *Gilliesieae* there is a remarkable development of the androecium, which has become zygomorphic, whilst there is often a corona of scales quite apart from the six or more stamens. There is a decidedly orchidaceous look about the flowers of this tribe, especially of the genus *Gilliesia*, and it represents the most advanced type of flowers met with in those genera with a superior ovary.

The second half of the family, characterized by having an inferior ovary, may be divided primarily on the absence or presence of a corona. The more primitive types are without a corona, the *Galantheae*, *Amaryllideae*, *Crineae*, *Haemantheae*, *Ixolirieae*, and *Zephyrantheae*, the more advanced with a corona, the latter either 'false' and formed by the united and often petaloid bases of the filaments, or a 'true' corona separated from the filaments, formed either of separate teeth or scales or these united into an annulus or tube.

In the most advanced tribes of both these divisions, the *Zephyrantheae*, in the group without a corona, and the *Narcisseae*, in the group with a corona, the umbel is often reduced to a solitary flower. There seems a close affinity between the tribe *Hemerocallideae*, in the *Liliaceae*, especially between the genus *Hosta* (*Funkia*), and tribe *Eucharideae* of the *Amaryllidaceae*, the latter tribe probably representing epigynous types of the former.

Key to the Tribes[1] *of* AMARYLLIDACEAE

A. Ovary superior: **B.** Rootstock a rhizome; corona absent or present.—1. **Agapantheae. BB.** Rootstock a corm or bulb: **C.** Androecium actinomorphic; corona absent—2. **Allieae. CC.** Androecium more or less zygomorphic, the filaments connate; corona usually present; mostly Chile—3. **Gilliesieae. AA.** Ovary inferior: **D.** Corona absent; no scales or teeth between the filaments; filaments not or rarely thickened at the base: **E.** Scape leafless except at the base: **F.** Ovules numerous: **G.** Perianth-tube absent or very short; stamens epigynous or inserted near the base of the segments: **H.** Perianth actinomorphic; flowers solitary or few together—4. **Galantheae. HH.** Perianth more or less declinate or zygomorphic, flowers usually several in an umbel—5. **Amaryllideae. GG.** Perianth-tube distinct; stamens inserted on the perianth-tube: **I.** Flowers several together, usually large and showy—6. **Crineae. II.** Flowers solitary or paired—7. **Zephyrantheae. FF.** Ovules few—8. **Haemantheae. EE.** Scape leafy in the lower part; umbel subcompound—9. **Ixolirieae. DD.** Corona present, either formed by the expanded petaloid filaments ('false corona') or of teeth, scales, or an annulus or tube: **J.** Corona 'false', usually large and conspicuous, formed of the expanded filaments, the

[1] Descriptions only of those tribes transferred to this family from the *Liliaceae* are given in the following enumeration.

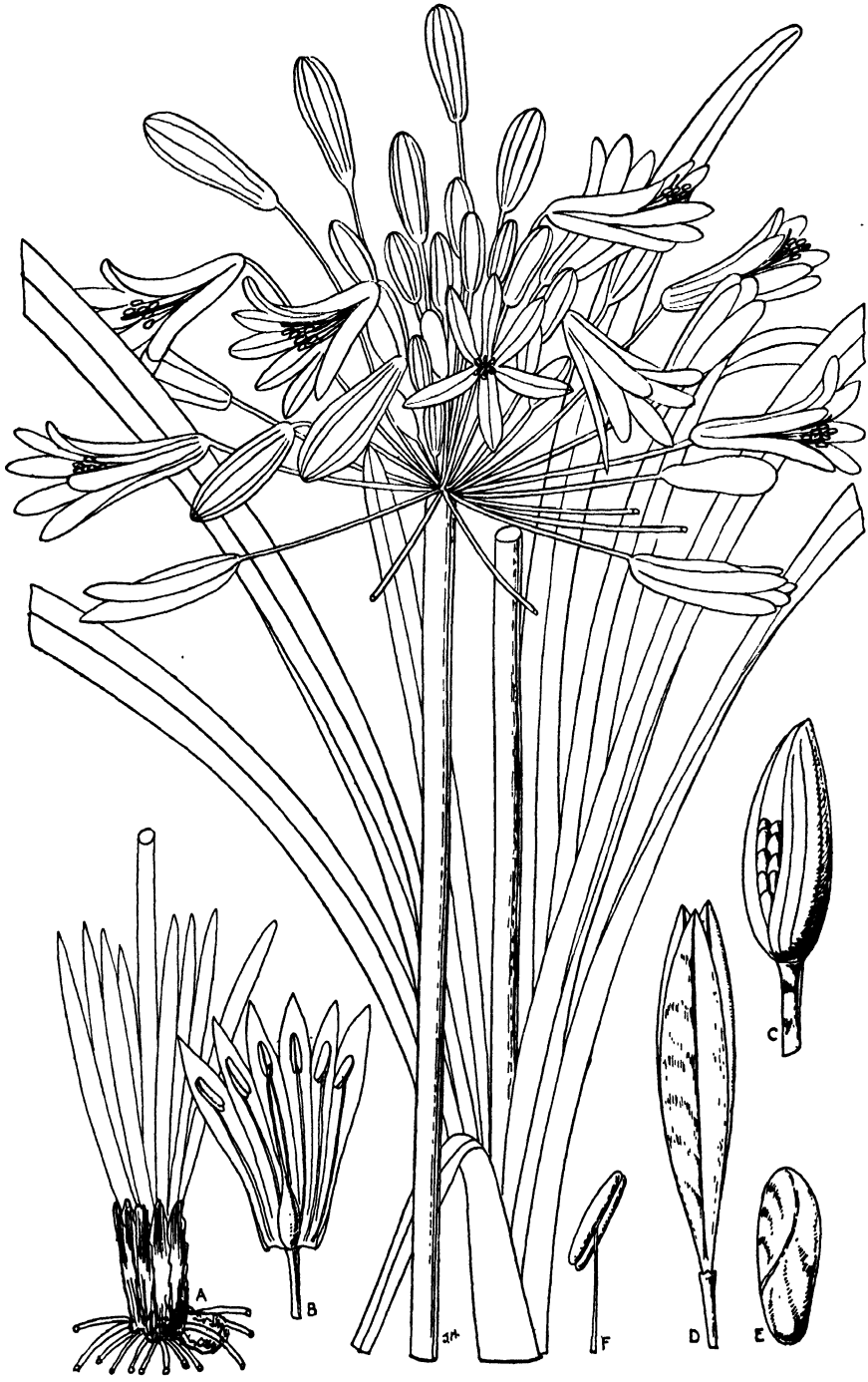


FIG. 393. Agapanthus africanus *Beauverd* (Amaryllidaceae). A, young plant. B, flower (opened). C, young bud of inflorescence, showing bract. D, fruit. E, seed. F, stamen. (Orig.)

latter often connate at the base into a tube—10. **Eucharideae. JJ.** Corona of separate teeth or scales between the filaments: **K.** Corona of small teeth; perianth-lobes not spreading—11. **Eustephieae. KK.** Corona of scales; perianth-lobes spreading—12. **Hippeastreae. JJJ.** Corona 'true', of separate scales apart from the filaments, or annular or tubular and separate from the filaments—13. **Narcisseae.**

Tribe 1. **Agapantheae.** Rootstock a *rhizome*; stem scapose; inflorescence an umbel, subtended by an involucre of 2 or more bracts; perianth-segments similar, united; corona present or absent; stamens 6, inserted on the perianth-tube; anthers dorsifixed; ovary superior; fruit a loculicidal capsule.—Tropical and S. Africa.

A. Perianth without a corona; stamens exserted—AGAPANTHUS (S. Afr.). **AA.** Perianth with an annular corona or the latter of entire or 2-fid free scales; stamens included in the tube—TULBAGHIA (Trop. and S. Afr.).

Tribe 2. **Allieae.** Rootstock a bulb or corm; stem scapose, leafless; leaves radical; inflorescence an umbel, subtended by an involucre of 2 or more bracts; perianth-segments similar, free or united; no corona; stamens 6 or 3; anthers dorsifixed; ovary superior; fruit a loculicidal capsule.—Almost all American, except *Allium*, widely spread in N. Hemisphere.

A. Perfect stamens 6: **B.** Perianth-segments free or united only below the middle: **C.** Rootstock a fibrous-coated corm: **D.** Filaments dilated at the base into scales surrounding the ovary—BLOOMERIA (Calif.). **DD.** Filaments only slightly thickened below the middle—MUILLA (Calif.–Mexico). **CC.** Rootstock a tunicated bulb: **E.** Perianth-segments free or united only at the very base; strongly odorous—ALLIUM (*Validalium*) (N. Hemisph.). **EE.** Perianth-segments distinctly united towards the base; not odorous—NOTHOSCORDUM (Amer.). **BB.** Perianth-segments united to above the middle: **F.** Stamens free from one another: **G.** Stamens included in the perianth-tube, 2-seriate: **H.** Perianth-tube free from the ovary: **I.** Perianth-tube cylindrical—TRISTAGMA (Chile). **II.** Perianth-tube campanulate—STEINMANNIA (*Garaventia*) (Chile). **III.** Perianth-tube funnel-shaped—BRODIAEA (Amer.). **HH.** Perianth-tube partly adnate to the ovary and ventricose—DIPHALANGIUM (Mexico). **GG.** Stamens shortly exserted—MILLA (Mexico). **FF.** Stamens united into a tube: **J.** Flowers mauve or blue—ANDROSTEPHIUM (N. Amer.). **JJ.** Flowers red: **K.** Filaments united only at the base—BEHRIA (Calif.). **KK.** Filaments united to the middle—BESSERA (Mexico). **AA.** Perfect stamens 3: **L.** Stamens included in the perianth-tube: **M.** Perianth-tube cylindrical—LEUCOCORYNE (*Lactace*) (Chile). **MM.** Perianth-tube funnel-campanulate—BRODIAEA (*Dipterostemon, Triteliopsis, Beauverdia*) (Amer.). **LL.** Stamens exserted from the tube: **O.** Perianth-tube subglobose—STROPHOLIRION (Calif.). **OO.** Perianth-tube broadly cylindrical—BREVOORTIA (Calif.).

Tribe 3. **Gilliesieae.** Rootstock a tunicated bulb; leaves radical, linear; flowers in a terminal umbel; involucre of 2 bracts; perianth-segments subequal to unequal, free or united into a short tube; corona absent or present, of separate scales; stamens 6 or 13, filaments usually more or less connate, and often oblique; anthers dorsifixed, introrse; ovary superior, 3-locular; style entire or shortly lobed; fruit a loculicidal capsule.—Mostly Chile.

A. Corona absent: **B.** Filaments free from one another—ERINNA. **BB.** Filaments connate at the base: **C.** Perianth-segments 6: **C(1).** Perianth-segments united at the base—SOLARIA. **C(2).** Perianth-segments free to the base—SPEEA. **CC.** Perianth-segments 3—TRICHLORA (Peru). **AA.** Corona present, of separate scales: **D.** Filaments 6: **E.** All 6 filaments bearing anthers—MIERSIA. **EE.** 3 of the filaments without anthers: **F.** Perianth-segments unequal—GILLIESIA. **FF.** Perianth-segments subequal—GETHYUM. **DD.** Filaments 3, only 2 bearing anthers—ANCRUMIA.

Tribe 4. **Galantheae. A.** Perianth-segments unequal—GALANTHUS (Eur. W. Asia). **AA.** Perianth-segments equal or nearly so: **B.** Flowers erect: **C.** Anthers sagittate at the base—LAPIEDRA (S. Spain). **CC.** Anthers not sagittate at the base, dorsifixed: **D.** [Scape 1-flowered—STERNBERGIA]. **DD.** [Scape several-flowered—STRUMARIA]. **BB.** Flowers nodding; anthers not sagittate at the base—LEUCOIUM (Mediterr. Reg.).

Tribe 5. **Amaryllideae. A.** Filaments free and not swollen at the base: **B.** Ovules closely sessile on or sunk in the placentas; perianth-tube curved—AMARYLLIS (S. Afr.). **BB.** Ovules more or less stalked on the placentas: **C.** Anthers attached in the middle—BRUNSVIGIA (S. Afr.). **CC.** Anthers attached at or towards the base; capsule 3-lobed: **D.** Stigma 3-fid—ANOIGANTHUS (Afr.). **DD.** Stigma capitate—UNGERNIA (Persia). **AA.** Filaments swollen at the base and continued beyond the point of insertion down to the ovary; perianth-segments narrow—NERINE (S. Afr.).

Tribe 6. **Crineae. A.** Anthers subbasifixed—CHLIDANTHUS (S. Amer.). **AA.** Anthers medianly dorsifixed: **B.** Ovules closely sessile or immersed in the placenta: **C.** Flowers subsessile or very shortly stalked—CRINUM (Tropics and Subtropics). **CC.** Flowers long-stalked: **D.** Perianth straight, actinomorphic; pedicels not elongated or changing position in fruit, the latter not strongly ribbed—AMMOCHARIS (S. Afr.). **DD.** Perianth declinate; flowers zygomorphic; stamens declinate; pedicels elongating, the outer spreading downward in fruit, the latter strongly ribbed—CYBISTETES (S. Afr.). **BB.** Ovules not immersed in the placentas; seeds winged; flowers sessile or stalked: **E.** Flowers more or less curved; perianth-lobes not connected at the base by a callus: **F.** Perianth-limb much shorter than the tube—CYRTANTHUS (Trop. and S. Afr.). **FF.** Perianth-limb nearly as long as the tube—STENOLIRION (E. Afr.). **EE.** Flowers straight: **G.** Perianth-lobes connected at the base by a callus—VALLOTA (S. Afr.). **GG.** Perianth-lobes not connected at the base by a callus—UNGERNIA (Persia).

Tribe 7. **Zephyrantheae. A.** Perianth-segments broad, more or less elliptic or obovate: **B.** Perianth-tube short—ZEPHYRANTHES (Trop. and Subtrop. Amer.). **BB.** Perianth-tube elongated: **C.** Anthers basally dorsifixed—COOPERIA (Mexico, Texas). **CC.** Anthers medianly dorsifixed: **D.** Filaments free, short: **E.** Scape very short—HAYLOCKIA (Extratrop. S. Amer.). **EE.** Scape long—ZEPHYRANTHES (Trop. and Subtrop. Amer.). **DD.** Filaments expanded and united into a tube in the lower part—CROCOPSIS (Peru). **AA.** Perianth-segments more or less narrow: **F.** Stamens arranged in 2 series at different levels—APODOLIRION (S. Afr.). **FF.** Stamens in 1 series inserted at the same

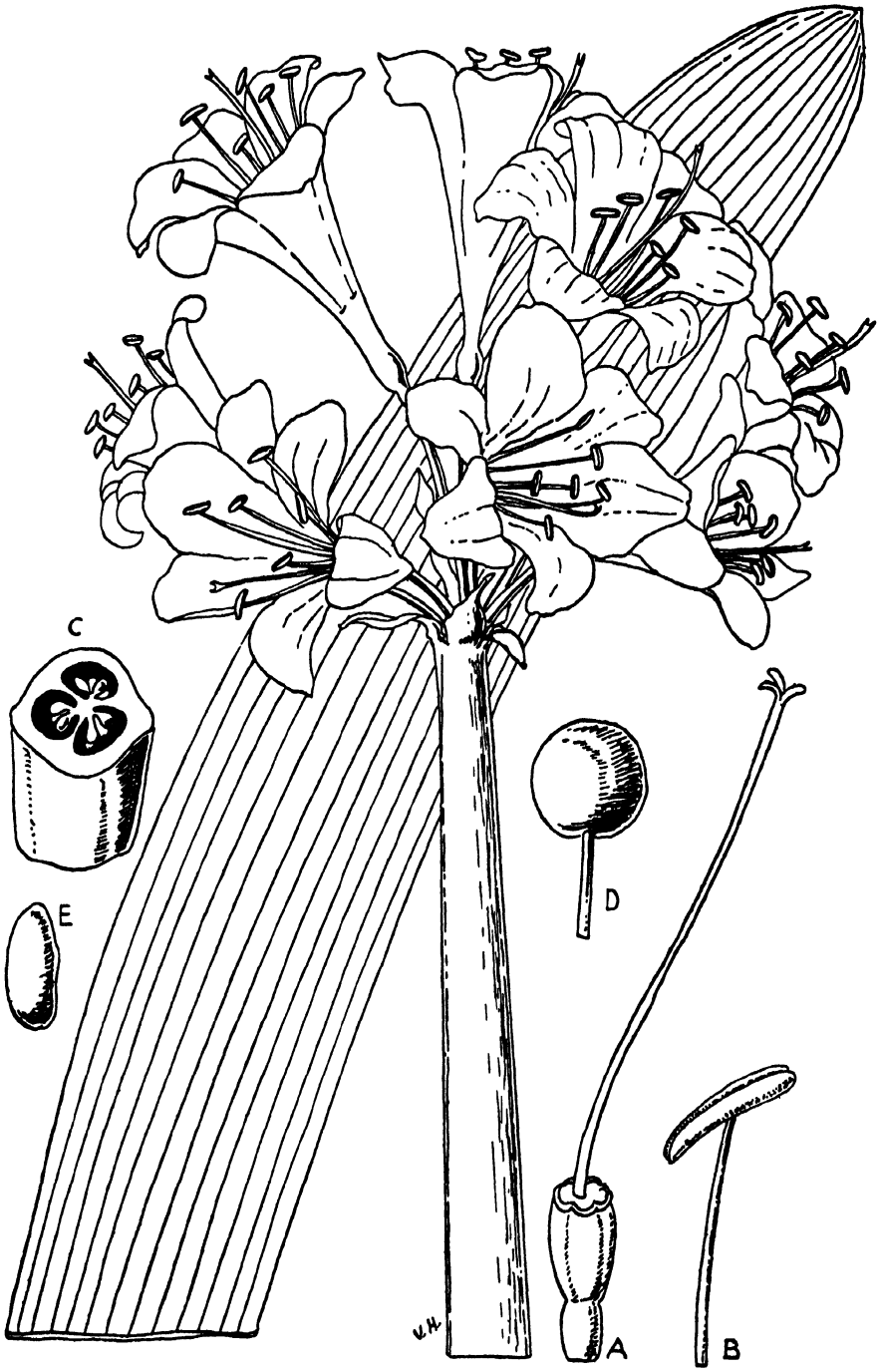


FIG. 394. Vallota speciosa (*Linn. f.*) *Dur. & Sch.* (Amaryllidaceae-Crineae). A, pistil. B, stamen. C, cross-section of ovary. D, fruit. E, seed. (Orig., drawn by Violet Hutchinson.)

levels: **G.** Filaments filiform—STERNBERGIA (Cent. Eur., Mediterr.). **GG.** Filaments very short, not filiform—GETHYLLIS (S. Afr.).

Tribe 8. **Haemantheae. A.** Anthers basifixed: **B.** Perianth-segments free to the base; flowers several or numerous in an umbel—HESSEA (S. Afr.). **BB.** Perianth-segments united into a fairly long tube; flowers few (1–5) in an umbel—CARPOLYZA (S. Afr.). **AA.** Anthers dorsifixed: **C.** Fruit a capsule: **D.** Ovules 6 or more in each loculus; style 3-angled or winged—STRUMARIA (S. Afr.). **DD.** Ovules 1–2; style not angular: **E.** Leaves sessile, linear—BUPHANE

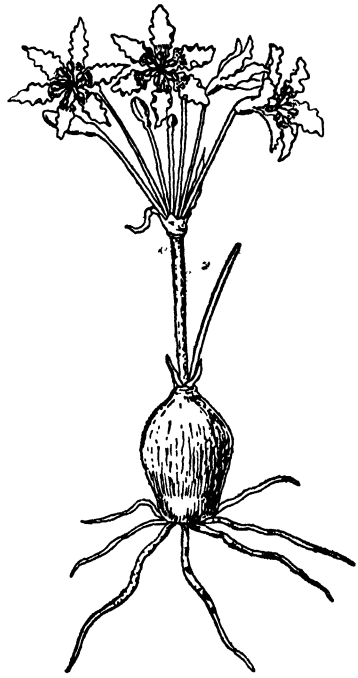


FIG. 395. Hessea crispa *Kunth.* (Amaryllidaceae-Haemantheae).

(Trop. and S. Afr.). **EE.** Leaves stalked—GRIFFINIA (Brazil). **CC.** Fruit a berry: **F.** Ovules 6 in each loculus—CLIVIA (S. Afr.). **FF.** Ovules 2 in each loculus—HAEMANTHUS (*Demensea*) (Trop. and S. Afr.). **FFF.** Ovule solitary in each loculus—CHOANANTHUS (E. Afr.).

Tribe 9. **Ixiolirieae.** One genus IXIOLIRION (Cent. and W. Asia).

Tribe 10. **Eucharideae. A.** Leaves narrow, linear or oblong-linear or lanceolate: **B.** Ovary 3-locular: **C.** Ovules numerous: **D.** Seeds flat: **E.** Seeds not winged: **F.** Corona very inconspicuous—HYLINE (Brazil). **FF.** Corona very conspicuous—STENOMESSON (*Pseudostenomesson*) (Trop. Amer.). **EE.** Seeds winged at one end: **EE(1).** Anthers exserted from the coronal tube —PAMIANTHE (S. Amer.). **EE(2).** Anthers included in the coronal tube—PARAMONGAIA (Peru). **DD.** Seeds angular—PANCRATIUM (Canaries to E.

Tropics). **DDD.** Seeds scarcely angular—LEPTOCHITON (Ecuad.). **CC.** Ovules 2 in each loculus: **G.** Perianth-tube very short—ELISENA (*Plagiolirion*). **GG.** Perianth-tube long: **H.** Staminal corona-cup rather large; free part of filaments short, incurved—ISMENE (S. Amer.). **HH.** Staminal corona-cup small; filaments long, not incurved—HYMENOCALLIS (S. Amer.). **BB.** Ovary locular —CALOSTEMMA (Austral.). **AA.** Leaves broad or broadish and petiolate: **I.** Ovules superposed: **J.** Membranes of filaments not connate or only slightly so—CALLIPHRURIA (S. Amer.). **JJ.** Membranes of filaments connate: **K.** Perianth-tube cylindrical with an expanded throat—EUCHARIS (Andes). **KK.** Perianth-tube narrowly funnel-shaped—STRICKLANDIA (Andes). **II.** Ovules ascending from the base (middle)—EURYCLES (Malay Archip., N. Austral.). Imperfectly known genus—KLINGIA (Namaqual.).

Tribe 11. **Eustephieae. A.** Perianth-tube much longer than the lobes: **B.** Filaments not winged beyond the corona—URCEOLINA (Andes). **BB.** Filaments winged to beyond the apex—HIERONYMIELLA (Argentine). **AA.** Perianth-tube shorter than the lobes: **C.** Filaments winged beyond the middle: **C(1).** Wings of filaments not united—EUSTEPHIA (Peru). **C(2).** Wings of filaments united upwards—EUSTEPHIOPSIS (Argentine). **CC.** Filaments not winged: **D.** Filaments declinate: **E.** Filaments not connate at the base—CALLIPSYCHE (Andes). **EE.** Filaments connate at the base—EUCROSIA (Andes). **DD.** Filaments straight—PHAEDRANANASSA (Andes).

Tribe 12. **Hippeastreae. A.** Ovules numerous in each ovary-loculus: **B.** Perianth at most more or less declinate; flowers usually several together: **C.** Corona-scales very conspicuous; flowers rather small—PLACEA (Chile). **CC.** Corona-scales very small; flowers large: **D.** Involucral bracts free to the base—HIPPEASTRUM (*Worsleya*) (S. Amer.). **DD.** Involucral bracts united at the base into a short tube—ZEPHYRANTHELLA (Argentine). **BB.** Perianth bilabiate, solitary—SPREKELIA (Mexico). **AA.** Ovules 2–3 in each loculus; seeds angular: **E.** Stamens exceeding the perianth-segments—LYCORIS (E. and E. Cent. Asia). **EE.** Stamens shorter than the perianth-segments—VAGARIA (*Mizonia, Hannonia*) (Syria).

Tribe 13. **Narcisseae. A.** Corona divided into lobes or scales: **B.** Corona of 12 scales; fruit a berry—CRYPTOSTEPHANUS (W. Trop. Afr.). **BB.** Corona of 6 small scales; fruit a capsule—TAPEINANTHUS (Spain, N. Afr.). **AA.** Corona often trumpet-like, sometimes a mere rim; fruit a capsule—NARCISSUS (Eur., Mediterr., W. Asia).

Imperfectly known genus of *Amaryllidaceae*—CHAPMANOLIRION *Dinter* (SW. Afr.).

ORDER 100. IRIDALES

Characters as for *Liliales*, whence this family has been evolved (and probably not through *Amaryllidaceae*), but ovary *inferior* (superior in *Isophysis*), and stamens 3; style-arms often divided, sometimes petaloid.—General distribution; most numerous in S. Africa and S. America.

One family *Iridaceae*

386. IRIDACEAE

Perennial herbs with the roots from underground rhizomes, corms, or bulbs; stems herbaceous, in bunches from the rhizome or bulb or solitary. Leaves often crowded at the base of the stem, mostly narrowly linear, flattened at the sides, sheathing at the base and equitant. Flowers bisexual, actinomorphic, with a straight perianth-tube, or the tube curved with an oblong limb, or completely zygomorphic, usually very ornamental and beautifully mottled or spotted. Perianth petaloid, withering and persistent for some time; segments or lobes 6, 2-seriate, subequal and similar, or the two series different in size, shape, and texture; when limb oblique then the dorsal lobe often the largest and sometimes hood-like. Stamens 3, opposite the outer perianth-lobes; filaments free or partially connate; anthers 2-locular, opening extrorsely or laterally by slits lengthwise. Ovary inferior, very rarely superior, 3-locular with axile placentas or 1-locular with 3 parietal placentas; style slender, 3-lobed in the upper part, the branches subulate and entire or deeply lobed, sometimes winged and petaloid, stigmatose at the top or within. Ovules numerous, rarely few to one, anatropous. Capsule loculicidally dehiscent by valves, usually with a marked circular scar at the top. Seeds with copious endosperm enclosing the small embryo. B.H. **3**, 681; E.P. **2**, 5, 137; edn. 2, **15***a*, 463 (1930); Baker, *Systema Iridacearum* in *J. Linn. Soc.* **16**, 61–180, (1877), and *Handbook of the Irideae* (1892).—Generally distributed.

USEFUL PRODUCTS: *Orris Root*, used as a perfume, dentifrice, &c. (Iris germanica *L.*, I. pallida *Lam.*, and I. florentina *L.*). *Blue Flag* (rhizomes of Iris versicolor *L.*). *Yellow Flag* (Iris pseudacorus *L.*). *Saffron* (Crocus sativus *L.*).

Iridaceae is on the whole a very homogeneous and natural family. In Bentham and Hooker's *Genera Plantarum*, it is divided into three tribes, these being subdivided into several subtribes, an arrangement still followed in the second edition of Engler and Prantl's *Natürlichen Pflanzenfamilien*. For the purpose of this work I have treated these subtribes as tribes, each of them being fairly well circumscribed and more or less of equal status. I have included in the family the genus *Isophysis* (*Hewardia*), a Tasmanian genus which is Iridaceous in all its characters except its superior ovary.

The most simple and primitive combination of characters occurs in tribe 2 *Sisyrincheae*, in which the perianth-segments are free or nearly so, the rootstock is a rhizome, and the style-branches are undivided. The genus *Libertia*, for example, recalls very closely the genus *Sagittaria*[1] in the primitive family *Alismataceae*. The next group, tribe 3 *Mariceae*, has the style-branches divided, but they are not winged or petaloid as they are in the more advanced tribe 4 *Irideae*. All these tribes are characterized by having a rhizomatous rootstock. It should be noted that of the remaining tribes, which are more advanced in that the perianth-segments are connate into a tube, only one, the *Aristeae*, has the roots from a rhizome, all the others being from a corm or bulb. The *Aristeae* seem to be connected with *Aphyllanthes* in the *Liliaceae*.

The more advanced tribes are the *Gladioleae* and *Antholyzeae*, the latter proposed here for the first time and arising out of some critical work by the late Dr. N. E. Brown.[2] In these two groups the perianth is more or less zygomorphic, the tube mostly curved, and the limb oblique, the dorsal lobe often hood-like. The most advanced tribe *Antholyzeae* is nearly confined to S. Africa, where the family as a whole is richly represented.

[1] *Sagittaria graminea* Michx., for example.

[2] At the time of my first edition he was 85 years old, and still studying *Iridaceae*, &c., in the herbarium at Kew.

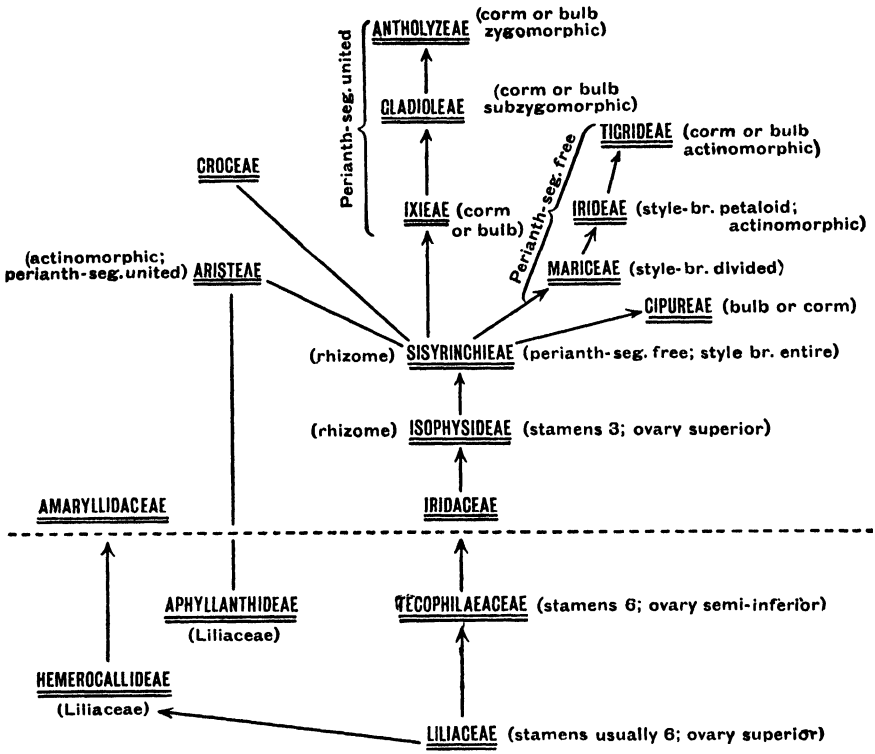


Diagram showing the relationship of *Liliaceae*, *Amaryllidaceae*, and *Iridaceae*, and indicating the main lines of evolution of the various groups of *Iridaceae*; all the *Iridaceae* above the ISOPHYSIDEAE have 3 stamens and inferior ovary.

Key to the Tribes of IRIDACEAE

A. Ovary superior—1. **Isophysideae. AA.** Ovary inferior: **B.** Perianth-tube nothing or very short: **C.** Roots from a rhizome: **D.** Style-branches undivided; filaments free or connate—2. **Sisyrinchieae. DD.** Style-branches deeply divided; filaments free: **E.** Style-branches not winged—3. **Mariceae. EE.** Style-branches winged and more or less petaloid—4. **Irideae. CC.** Roots from a bulb or corm: **F.** Style-branches entire (except *Nemastylis*); filaments free or connate only at the base—5. **Cipurieae. FF.** Style-branches divided: **G.** Filaments usually connate into a tube.—6. **Tigrideae. GG.** Filaments free—3. **Mariceae. BB.** Perianth with a distinct tube: **H.** Perianth actinomorphic, with a straight or nearly straight tube: **I.** Roots fibrous or from a rhizome—7. **Aristeae. II.** Roots from a corm or bulb; perianth-tube sometimes very long and slender: **J.** Flowers not solitary, in an often unilateral inflorescence; style-branches entire or bifid—8. **Ixieae. JJ.** Flowers solitary, sessile on the corm or in a tuft of radical leaves—9. **Croceae. HH.** Perianth zygomorphic or the limb oblique and the tube more or less curved, the stamens usually more or less together on one side: **K.** Tube of the perianth gradually tapered

from base to apex—10. **Gladioleae. KK.** Tube of the perianth abruptly narrowed near or below the middle into a narrow basal part—11. **Antholyzeae.**

Tribe 1. **Isophysideae.** Single genus ISOPHYSIS (*Hewardia*) (Tasmania).

Tribe 2. **Sisyrinchieae. A.** Perianth actinomorphic: **B.** Perianth-segments dissimilar in the two series, the outer smaller; stamens all fertile—LIBERTIA (Chile, New Zeal., E. Austral., New Guin.). **BB.** Perianth-segments similar in the two series: **C.** Inflorescence unbranched: **D.** Inflorescence with several 2-rowed imbricate bracts—BOBARTIA (S. Afr.). **DD.** Inflorescence without imbricate bracts: **E.** Spathes 1-flowered; low, branched herb—TAPEINIA (Magell. Straits). **EE.** Spathes 2- to several-flowered: **F.** Capsule exserted from the spathe—SISYRINCHIUM (*Oreolirion*) (Amer., naturalized in other parts of world). **FF.** Capsule enclosed by the spathe—ORTHOSANTHUS (Extratrop. S. Amer., Andes, Austral.). **CC.** Inflorescence 2–3-forked—BELAMCANDA (India to Japan). **AA.** Perianth zygomorphic, the posticous lobe larger than the others—DIPLARRHENA (Austral.).

Tribe 3. **Mariceae. A.** Rootstock a rhizome—NEOMARICA (*Marica*) (Trop. Amer., Trop. Afr.). **AA.** Rootstock a bulb: **B.** Style-branches produced beyond the stigmas—CYPELLA (*Mastigostyla, Anomalostylus*) (S. Amer.). **BB.** Style-branches not produced beyond the stigmas—TRIMEZIA (*Ennealophus, Zygella*) (Cent. Amer., West Indies, Brazil). **AAA.** [Rootstock a corm—ROMULEA (Eur.)].

Tribe 4. **Irideae. A.** Ovary 1-locular, with parietal placentas; inner perianth-segments much smaller than the outer—HERMODACTYLUS (S. Europ.). **AA.** Ovary 3-locular, with axile placentas: **B.** Perianth-segments united at the base—IRIS (*Cryptobasis, Sclerosiphon*) (N. Hemisph.). **BB.** Perianth-segments free: **C.** Rootstock a rhizome—DIETES (S. and E. Afr., Lord Howe Is.). **CC.** Rootstock a bulb or corm—MOREA (*Moraea*) (Trop. and S. Afr., Mascar.).

Tribe 5. **Cipureae. A.** Style-branches undivided: **B.** Filaments free: **C.** Style-branches subulate: **D.** Style long; capsule exserted from the spathe-bract—CALYDOREA (Amer.). **DD.** Style short; capsule enclosed by the spathe-bract—ELEUTHERINE (Trop. Amer.). **CC.** Style-branches expanded: **E.** Style-branches not petaloid—SPHENOSTIGMA (Trop. Amer.). **EE.** Style-branches petaloid—CIPURA (Trop. Amer.). **BB.** Filaments connate at the base—GELASINE (Extratrop. S. Amer.). **AA.** Style-branches divided—NEMASTYLIS (Amer.).—Additional genera, not seen (related to *Gelasine*), EURYNOTIA (Ecuad.), and (related to *Calydorea*), PSEUDOTRIMEZIA (Brazil).

Tribe 6. **Tigrideae. A.** Perianth-segments all alike: **B.** Filaments only slightly connate at the base; style-branches divided to the base—HEXAGLOTTIS (S. Afr.). **BB.** Filaments connate into a column: **C.** Style-branches petaloid, crested, papillous around the margins—HOMERIA (S. Afr.). **CC.** Style-branches small, petaloid, densely ciliate-fimbriate on the margins; perianth mottled—FERRARIA (Trop. and S. Afr.). **AA.** Perianth-segments dissimilar in the two series: **D.** Style-branches deeply divided: **E.** Smaller segments spreading; all irregularly mottled—TIGRIDIA (*Cardenanthus*?) (W. Amer., from Mexico to Chile). **EE.** Smaller segments erect and lanceolate, not mottled—RIGIDELLA

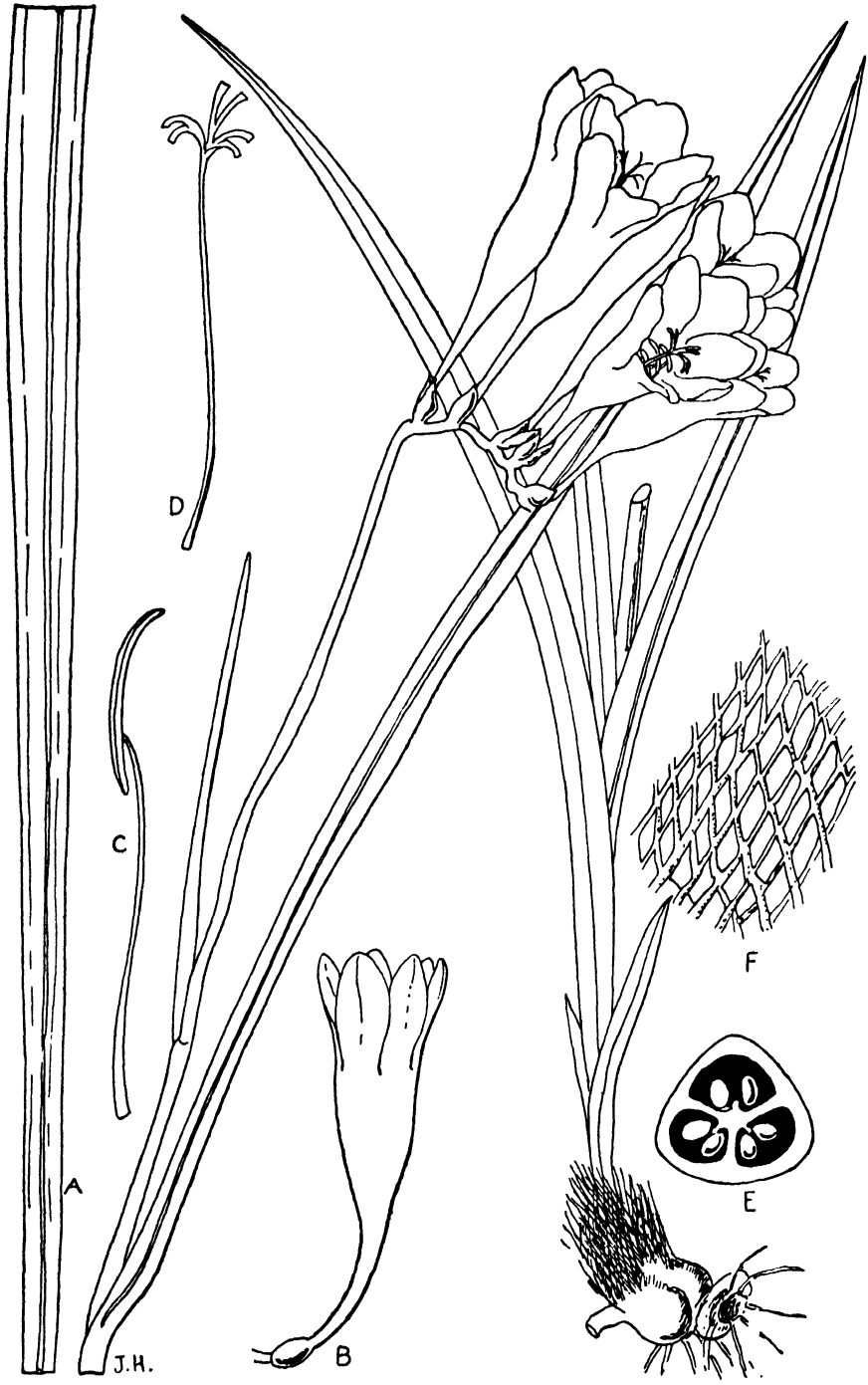


FIG. 396. Freesia refracta *Klatt* (Iridaceae). A, part of leaf. B, flower. C, stamen. D, style. E, cross-section of ovary. F, reticulate covering of corm. (Orig.)

(Cent. Amer.). **DD.** Style-branches shortly 2-fid—ALOPHIA (*Herbertia* Sweet) (Amer.).

Tribe 7. **Aristeae. A.** Filaments free; S. African: **B.** Perianth-segments erect: **C.** Perianth-segments filiform, blue—KLATTIA. **CC.** Perianth-segments ovate, yellow—WITSENIA. **BB.** Perianth-segments spreading: **D.** Perianth-segments more or less all alike, usually blue—ARISTEA and SCHIZOSTYLIS. **DD.** Perianth-segments dissimilar, the outer smaller and spathulate, purple, inner larger and blue—CLEANTHE. **AA.** Filaments united: **E.** Perianth-segments 6, all alike: **F.** Anthers versatile; perianth yellowish-white—SYMPHYOSTEMON (S. Amer.). **FF.** Anthers not versatile: **G.** Anthers long; style-branches very short, recurved; perianth yellow—CHAMELUM (Chile). **GG.** Anthers short; style not divided; perianth yellow—SOLENOMELUS (Chile). **EE.** Perianth-segments dissimilar or only 3, purplish; tube very slender—PATERSONIA (Austral.).

Tribe 8. **Ixieae. A.** Style-branches undivided: **B.** Style-branches subulate: **C.** Style longer than the branches—GEISSORHIZA (S. Afr., Madag.). **CC.** Style shorter than the branches—HESPERANTHA (Trop. and S. Afr.). **BB.** Style-branches expanded: **D.** Style-branches linear—IXIA (*Salpingostylis*) (S. Afr.). **DD.** Style-branches cuneate: **E.** Anthers not spirally twisted; branches of panicle very slender, pendulous—DIERAMA (Trop. and S. Afr.). **EE.** Anthers spirally twisted; flowers few—STREPTANTHERA (S. Afr.). **AA.** Style-branches 2-fid: **F.** Perianth-tube longer than the limb; ovules numerous: **G.** Filaments very short—LAPEYROUSIA (*Chasmatocallis*) (Trop. and S. Afr.). **GG.** Filaments rather long: **H.** Spathes rather long, oblong or lanceolate—WATSONIA (*Thereianthus*) (S. Afr.). **HH.** Spathes short and ovate; perianth-tube campanulate—FREESIA (S. Afr.). **FF.** Perianth-tube shorter than the limb: **I.** Ovules numerous—PILLANSIA (*Wredowia*) (S. Afr.). **II.** Ovules 2 in each loculus; flowers very small—MICRANTHUS (S. Afr., Mascar. Is.).

Tribe 9. **Croceae. A.** Filaments free from each other: **B.** Perianth-tube long and slender: **C.** Style-branches cuneate, dentate or lobate, stigmatose only at the apex—CROCUS (N. Hemisph.—Old World). **CC.** Style-branches subulate, undivided, stigmatose on the inside—SYRINGODEA (S. Afr.). **BB.** Perianth-tube short; style-branches not petaloid—ROMULEA (S. Eur. to S. Afr.). **AA.** Filaments connate into a tube; style-branches petaloid—GALAXIA (S. Afr.).

Tribe 10. **Gladioleae** (S. African except where otherwise stated). **A.** Perianth-tube straight or very nearly so: **B.** Perianth-tube shorter than the segments: **C.** Perianth-segments setaceously acuminate; panicle large and lax—MELASPHAERULA. **CC.** Perianth-segments not setaceously acuminate: **D.** Perianth-tube only slightly expanded upwards; spathes membranous: **E.** Spathes emarginate; capsule small, ovoid or oblong—TRITONIA. **EE.** Spathes entire or 2-fid; capsule inflated-globose, 3-lobed—CROCOSMA. **DD.** Perianth-tube expanded in the upper part: **F.** Spathes membranous, fimbriate at the apex; leaves not plicate in bud—SPARAXIS. **FF.** Spathes not fimbriate at the apex; leaves plicately folded in bud—BABIANA. **BB.** Perianth-tube longer than the segments, very slender: **G.** Perianth-lobes subequal—ACIDANTHERA (*Angysiphon, Dortania*) (Trop. and S. Afr.)—closely related, RADINOSIPHON. **GG.** Perianth-lobes unequal, the posterior lobe large and erect—SYNNOTIA. **AA.**

Perianth-tube curved: **H.** Spathes more or less lanceolate, mostly herbaceous; style-branches undivided—GLADIOLUS (*Hebea, Tritoniopsis, Montbretiopsis, Exohebea*) (Eur. to S. Afr., Mascar.). **HH.** Spathes coloured, almost enclosing the perianth; style-branches bifid—OENOSTACHYS (E. Trop. Afr.).

Tribe 11. **Antholyzeae** (S. African mainly). **A.** Stem ending in a normal inflorescence (not continued as a naked barren portion beyond the flowers): **B.** Perianth-lobes more or less similar in shape and often in size, the dorsal (adaxial) lobe not hooded; perianth not bilabiate: **C.** Spike many- (10–30-) flowered; flowers dense; inner bract longer than the outer—ANAPALINA (**A. triticea** *N. E. Br—Ixia triticea* Burm. f. (Burma). **CC.** Spike few- (1–7-) flowered; inner bract shorter than the outer—HOMOGLOSSUM (**H. watsonium** *N. E. Br.—Gladiolus Watsonius* Thunb. and 12 other spp.). **BB.** Perianth-lobes dissimilar in shape and often in size, the dorsal (adaxial) concave and hood-like, covering the stamens: **D.** Tube of perianth without a spur or sac (at most rounded) at the base of the wider part: **E.** Lateral lobes of the upper lip of perianth not wing-like and not reflexed behind the adaxial lobe, the lateral inserted with the abaxial lobes: **F.** Ovules several to numerous in each loculus: **G.** Inflorescence unbranched—PENTAMENES (*Chasmanthe*) (**P. abbreviatus** *N. E. Br.—Gladiolus abbreviatus* Andr., and other species, incl. *Antholyza aethiopica* Linn. and *A. caffra* Baker). **GG.** Inflorescence branched: **H.** Branches of inflorescence sessile, axis not zigzag—ANACLANTHE (**A.** plicata *N. E. Br.—Antholyza plicata* Linn. f.). **HH.** Branches of inflorescence stalked; axis very zigzag—CURTONUS (**C. paniculatus** *N. E. Br.—Antholyza paniculata* Klatt). **FF.** Ovules 2–3 in each loculus; flowers very small; inflorescence usually branched—ZYGOTRITONIA (Trop. Afr.). **EE.** Lateral lobes of the upper lip of perianth sharply reflexed and wing-like; lower lip very obscure—ANOMALESIA (**A. cunonia** *N. E. Br.—Antholyza cunonia* Linn.; and **A. splendens** *N. E. Br.*). **DD.** Tube of perianth with a spur or sac at the base of the widened part—KENTROSIPHON (**K. saccatus** *N. E. Br.—Anisanthus saccatus* Klatt, and 4 other spp.). **AA.** Stem produced beyond the inflorescence and naked except for barren bracts; perianth bilabiate, much compressed at the mouth, the lips widely gaping—ANTHOLYZA (**A. ringens** *Linn.—Babiana ringens* Ker.). See N. E. Br. in *Trans. Roy. Soc. S. Afr.* **20,** 268 (1932).

ORDER 101. DIOSCOREALES

Herbs or climbers from rhizomes or tubers; stems leafy; leaves alternate or rarely opposite, mostly ovate or cordate with prominent nerves and reticulate venation, sometimes digitately lobed; flowers small, bisexual or unisexual; perianth usually white or pale-coloured, segments mostly united; stamens 6–3; ovary usually inferior, rarely superior or semi-inferior, 3-locular or rarely 1-locular; fruit a capsule, rarely indehiscent or baccate; seeds with endosperm, often winged.—Mainly Tropical and Warm Temperate Regions.

A. Flowers bisexual:

B. Stamens 6; connective produced beyond the anther-loculi; ovary inferior:

C. Fruits elongated, with numerous winged seeds; ovary-loculi with numerous ovules superposed in two series *Stenomeridaceae*

CC. Fruits short, 1-seeded; ovary-loculi with 2 ovules *Trichopodaceae*

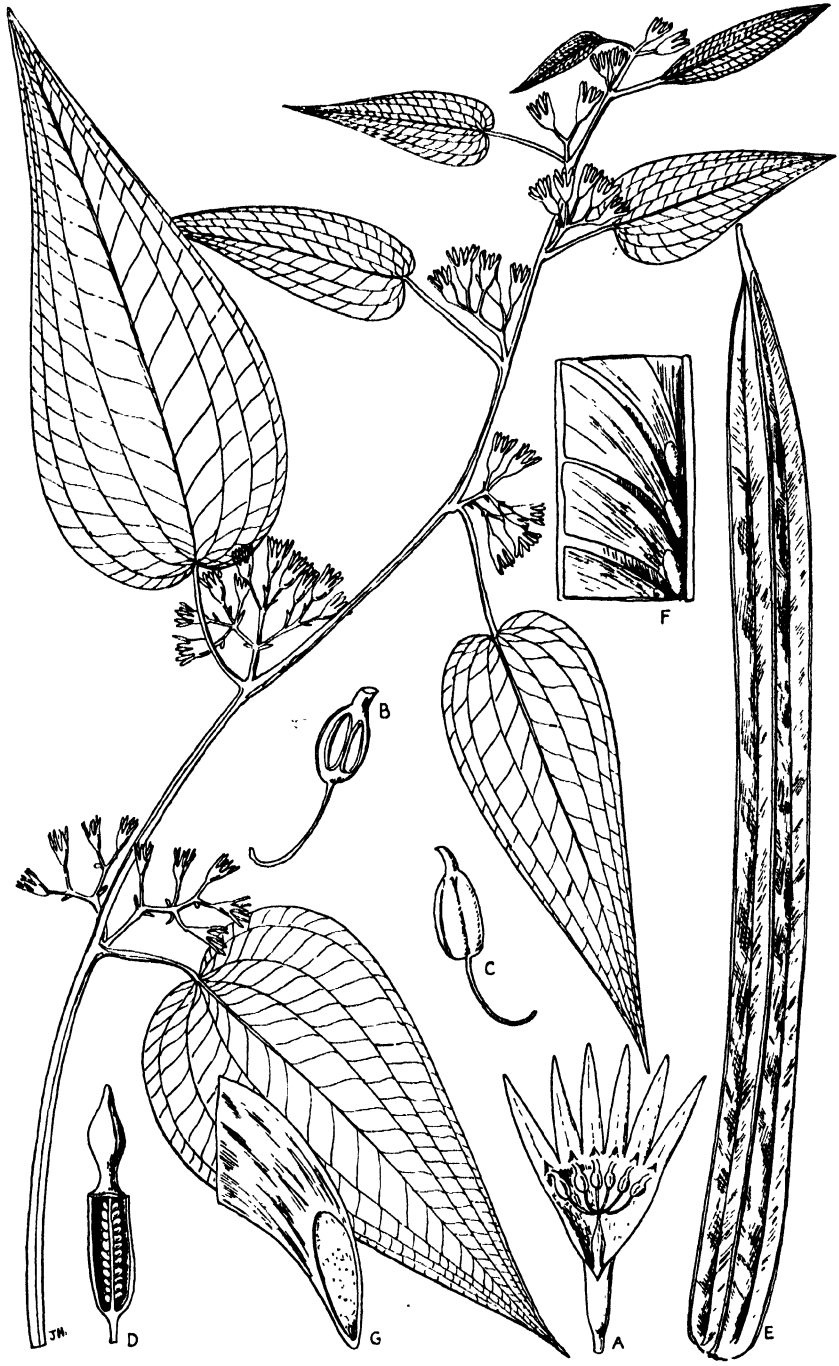


FIG. 397. Stenomeris borneensis *Oliv.* (Stenomeridaceae). A, opened flower. B and C, stamens. D, vertical section of pistil. E, fruit. F, seeds in part of capsule. G, vertical section of seed (partly after *Ic. Pl.*).

BB. Stamens 4; ovary superior to semi-inferior, 1-locular *Roxburghiaceae*

AA. Flowers unisexual; ovary inferior; fruits and seeds often winged; usually climbers with tuberous rootstocks or thick woody rhizomes; perianth 6-merous *Dioscoreaceae*

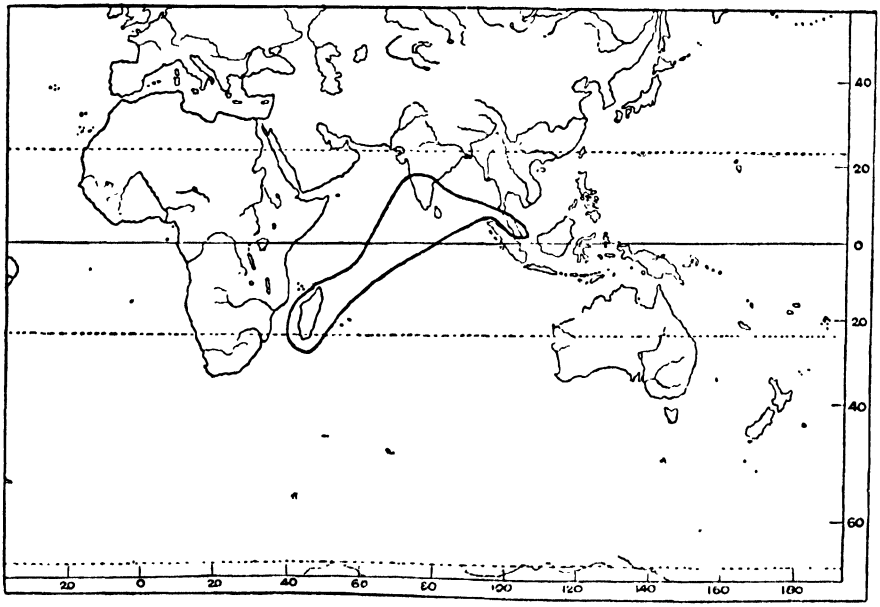
387. STENOMERIDACEAE

Tall climbers with tuberous roots. Leaves alternate, cordate, acuminate, with numerous principal nerves connected by transverse nerves. Flowers in lax axillary panicles, small, bisexual, actinomorphic. Perianth-tube urn-shaped, 6-lobed, lobes almost filiform from a broader base. Stamens 6, inserted in one series near the top of the tube, deflexed on short filaments; anthers 2-locular, loculi contiguous, on a broad connective, the connective produced above the loculi into an elongated appendage with a spathulate horned apex. Ovary inferior, 3-locular; style short, 3-winged; ovules numerous, superposed in 2 series, anatropous. Fruit linear and much elongated, 3-winged, loculicidally dehiscent; pericarp thin, shining inside; seeds longitudinally nerved, narrowly oblanceolate, with a large membranous wing on one side at the top. B.H. 3, 745 (under *Dioscoreaceae*); E.P. edn. 2, **15***a*, 485 (1930). Malay Penin., Borneo, and Philippine Is.—STENOMERIS; species 2.

Bentham and Hooker f. say of *Stenomeris* in the *Genera Plantarum*, loc. cit.:[1] 'Genus *Stenomeris* ab ordine (i.e. Dioscoreaceis) longe differt antheris, ovulis numerosis aliisque notis, sed nulli alio affinius videtur'.

388. TRICHOPODACEAE

Herbs or evergreen climbers from short rhizomes. Leaves ovate-elliptic,



Range of Trichopodaceae.

[1] 'The genus *Stenomeris* differs widely from the family *Dioscoreaceae* by the anthers, numerous ovules, and other characters, but seems to have no other relationships.'

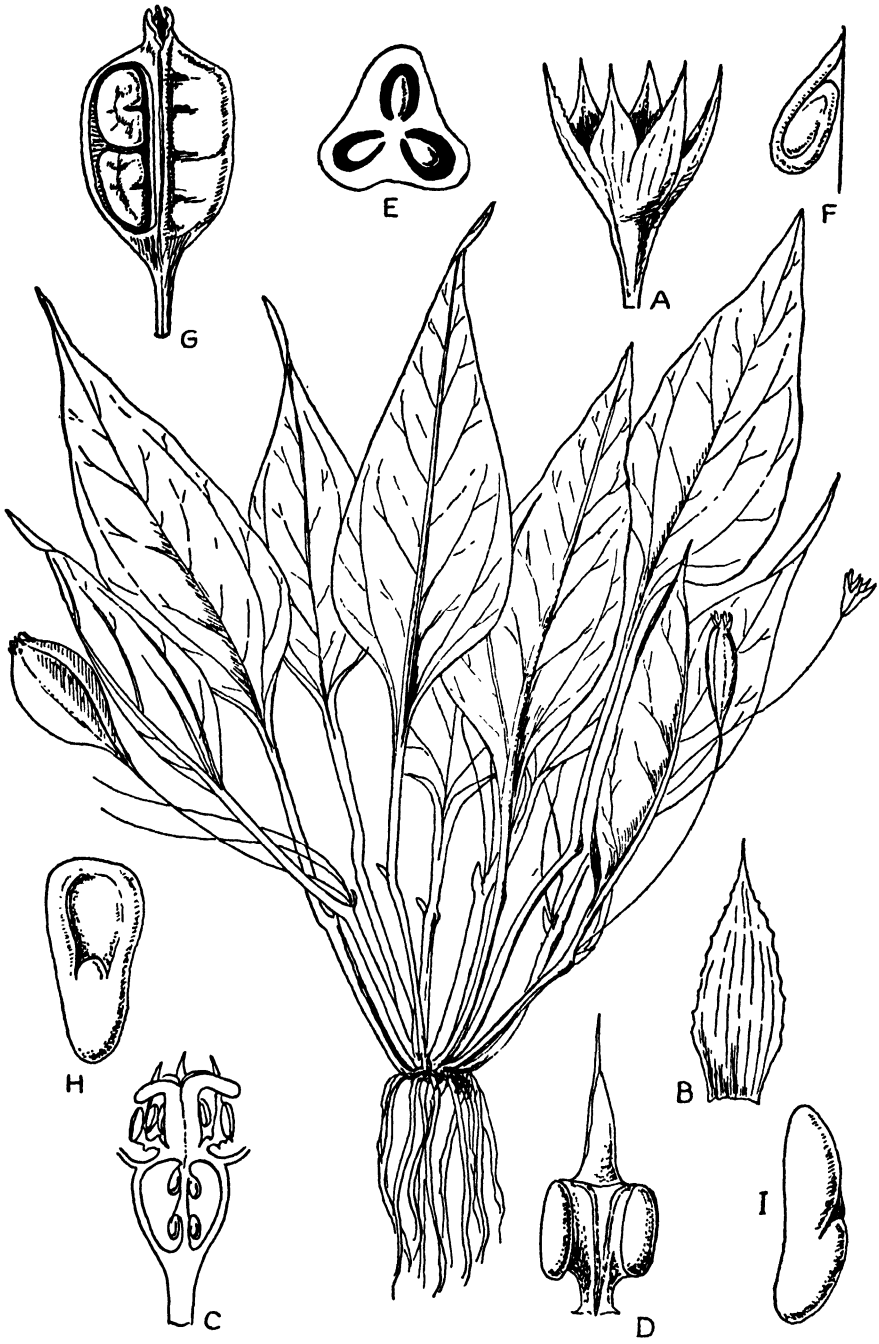


FIG. 398. Trichopus zeylanicus *Gaertn.* (Trichopodaceae). A, perianth. B, perianth-segment. C, vertical section of flower with perianth cut off. D, stamen. E, cross-section of ovary. F, ovule. G, fruit with one loculus opened. H embryo. I, same from the side. (Orig.)

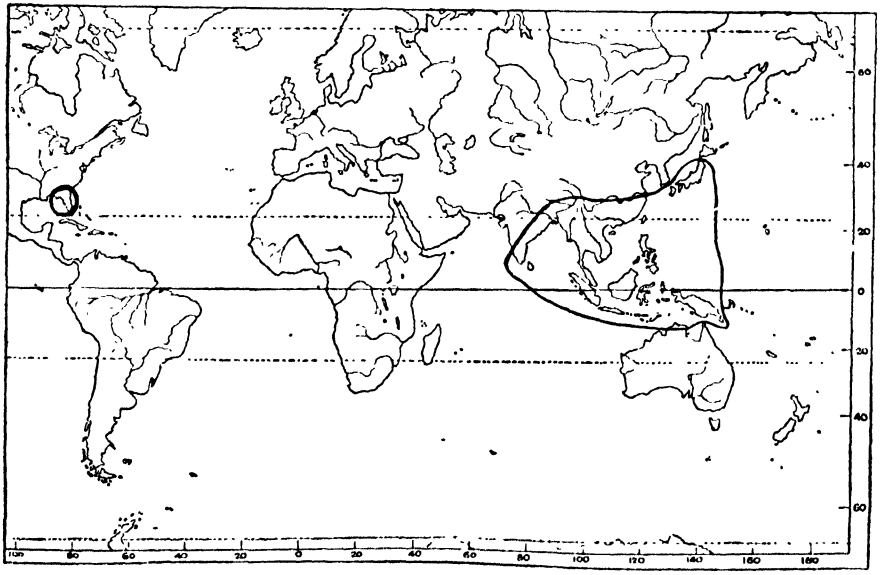
sagittate or rounded—truncate at the base, 3–5-nerved. Flowers bisexual, solitary or paired, long-pedicellate, pedicels bracteate at the base, axillary (*Avetra*) or at the base of the petiole at the apex of the short stem (*Trichopus*). Perianth shortly campanulate above the ovary, reflexed from the point of insertion, deeply 6-partite; segments equal, ovate-lanceolate or linear-filiform. Stamens 6, inserted at the base of the lobes; filaments very short; anthers introrse, 2-locular, loculi opening longitudinally, the connective produced into a long subulate appendage at the apex in *Avetra*, broadly winged in the upper half on the inside between the two widely separated anther-loculi. Ovary inferior, 3-locular, 3-winged; style very short and stout, with 3 bifid thick or 6 subequal ellipsoid lobes recurved over the back of the anthers; ovules 2 in each loculus, axile. Fruit elliptic or cuneate in outline, 3-winged, indehiscent, 1-seeded. Seeds with much-folded testa, with abundant endosperm and long straight embryo. B.H. 3, 745; E.P. edn. 2, 15*a*, 461 (1930) (under *Dioscoreaceae*).—Ceylon, Madras, Malay Penin., and Madagascar.

The discovery by Perrier de la Bathie of the genus *Avetra*, an evergreen climber of the littoral woods of Madagascar, added one more link between the flora of that island and that of Ceylon. The affinity of the two genera composing the family is more apparent on dissection of the flowers.

A. Stems short, each bearing one leaf; flowers terminal, on filiform pedicels —TRICHOPUS (Ceylon, Madras, Malay Penin.). **AA.** Stems climbing, bearing several leaves; flowers axillary—AVETRA (Madag.).

389. ROXBURGHIACEAE
(Stemonaceae)

Stems erect from a rhizome, or climbing from tuberous roots; leaves alternate, opposite, or whorled, with prominent nerves and close transverse



Range of Roxburghiaceae. The genus Croomia in the Southeastern United States and in Japan.

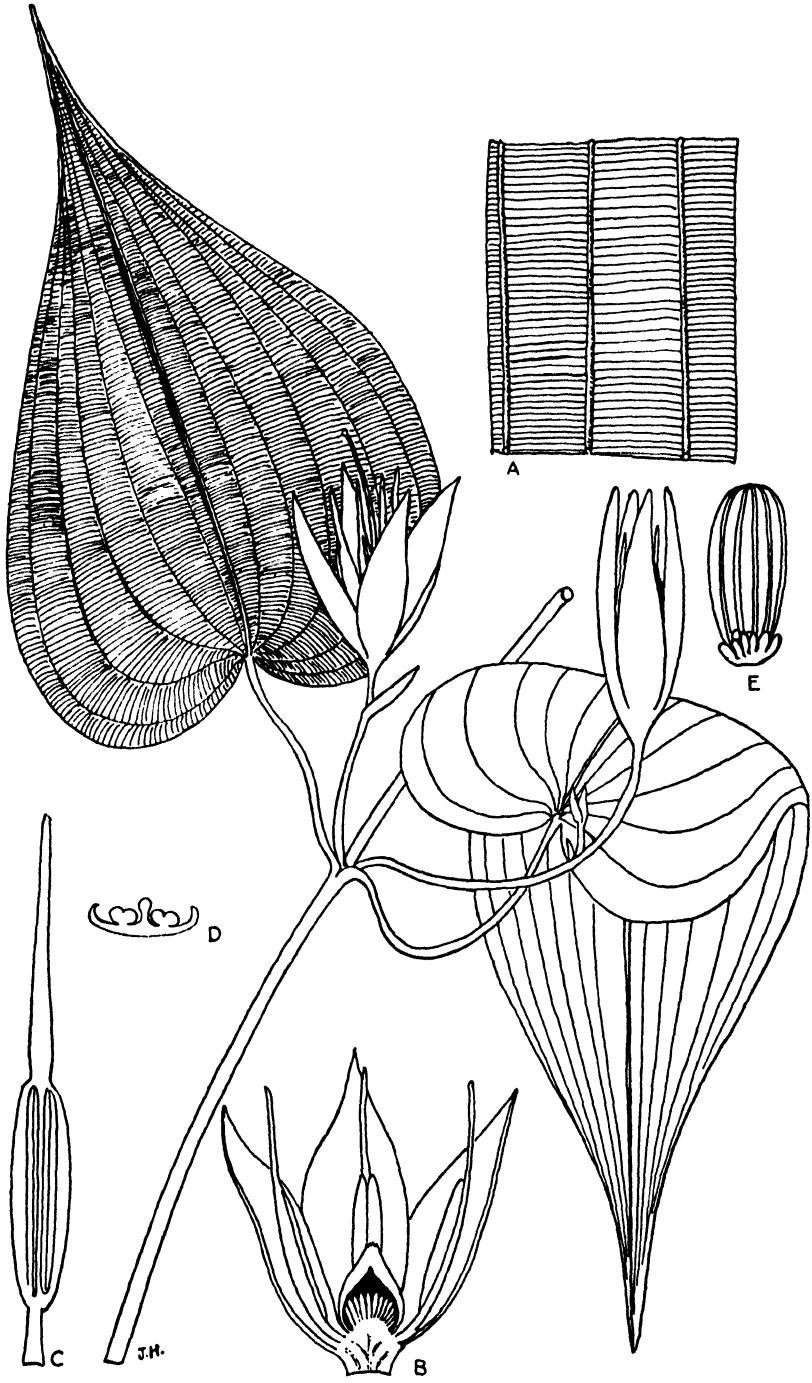


FIG. 399. Stemona tuberosa *Lour.* (Roxburghiaceae). A, part of leaf showing veins. B, vertical section of flower. C, stamen. D, cross-section of ovary. E, seed with abortive ovules attached. (Orig.)

parallel veins. Flowers axillary, bisexual, actinomorphic. Perianth corolline; segments 4, 2-seriate, subequal. Stamens 4, nearly hypogynous, filaments free from each other or nearly so; anthers basifixed or dorsifixed, 2-locular, introrse, opening inwards by slits, the connective usually produced far beyond the loculi. Ovary superior to semi-inferior, 1-locular; style simple or stigmas sessile. Ovules numerous to 2, basal or apical, anatropous. Capsule opening by 2 valves. Seeds with copious endosperm; embryo small, axile. B.H. **3**, 746; E.P. **2**, 5, 8; edn. 2, **15***a*, 224—India to Japan and N. Australia; Southeastern U.S.A.

This is a fairly homogeneous, small family, the stems of which may be either erect or climbing. Its distribution probably indicates it to be somewhat ancient, the genus *Croomia* being common to the Southeastern U.S.A. (*C. pauciflora* Torr.) and Japan (*C. japonica* Miq.), recalling the distribution of such ancient families as *Magnoliaceae* and the genus *Illicium* (*Illiciaceae*). *Croomia* has a strong superficial resemblance to some *Podophyllaceae*. Through *Stenomeris*, a genus of climbers and here treated as a separate family, we perhaps see the beginning of a line of descent which has ended in *Dioscoreaceae*. There is also affinity with the more primitive *Trilliaceae*, *Croomia* greatly resembling *Medeola* in that family. The closely parallel transverse nerves of the leaves are a constant feature of the family.

A. Anthers not appendaged at the apex; stem erect; ovules pendulous: **B.** Anther-loculi parallel; perianth-segments free—CROOMIA (Atlantic N. Amer. and Japan). **BB.** Anther-loculi divergent; perianth-segments adnate to the base of the ovary—STICHONEURON (Assam (Khasya) to Malay Penin.). **AA.** Anthers appendaged at the apex, the loculi parallel; stem scandent; ovules erect—STEMONA (*Roxburghia*) (India to S. China and Philipp. Is. to N. Austral.).

390. DIOSCOREACEAE

Usually climbers with tuberous rhizome or thick woody rootstock. Leaves alternate or rarely opposite, often cordate and more or less digitately nerved, entire or digitately divided; petiole often twisted and sometimes jointed at the base. Flowers small, spicate, racemose, or paniculate, unisexual, actinomorphic. Perianth campanulate or spreading, 6-lobed, lobes 2-seriate. Stamens in the male flowers attached to the base of the perianth, 6 perfect or sometimes 3 reduced to staminodes, or 3 perfect without staminodes; filaments free or shortly connate; anthers 2-locular, loculi contiguous or separated. Rudimentary ovary present or absent. Staminodes often present in the female. Ovary inferior, 3-locular; styles 3, free or connate; ovules 2 in each loculus, superposed on axile placentas. Fruit a 3-valved capsule or a berry. Seeds often winged, with endosperm and a small embryo. B.H. **3**, 741; E.P. **2**, 5, 130; edn. 2, **15***a*, 438 (1930); Kunth in Engl. *Pflanzenr.*, *Dioscoreaceae* (1924).—Tropics and Warm-Temperate Regions.

USEFUL PRODUCTS: *Yams* (various species of Dioscorea).

Elephant's Foot (Testudinaria elephantipes *Salisb.*). *Black Bryony* (Tamus communis *L.*).

A. Fruit capsular or samaroid: **B.** Fruit a 3-winged capsule: **C.** Seeds winged: **D.** Stem not enlarged at the base above ground—DIOSCOREA (*Higinbothamia*) (Tropics and Subtropics). **DD.** Stem much enlarged and woody at

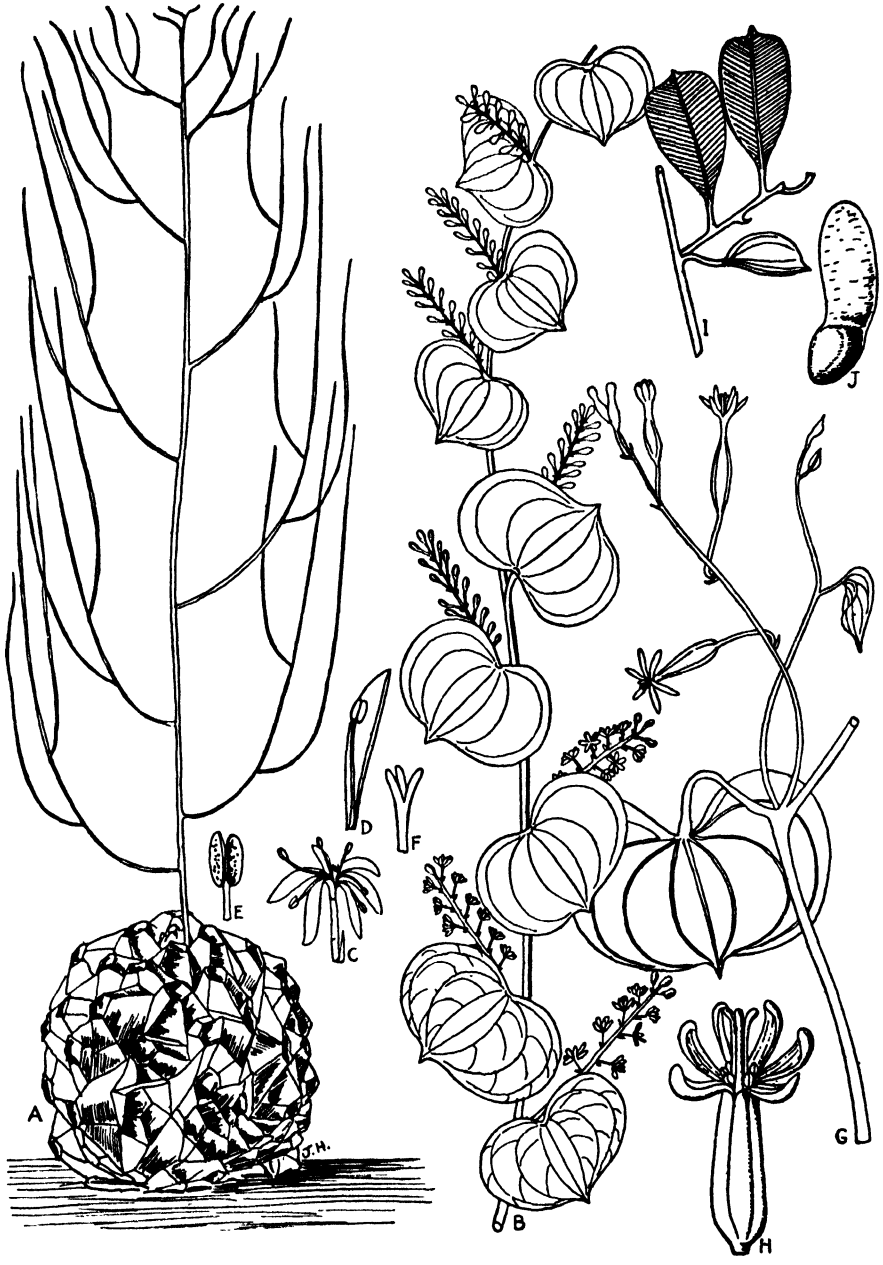


FIG. 400. Testudinaria elephantipes *Salisb.* (Dioscoreaceae). A, habit. B, male shoot. C, male flower. D, stamen and segment. E, anther. F, rudimentary styles. G, female inflorescence. H, female flower. I, fruits. J, seed. (Orig.)

the base above ground—TESTUDINARIA (SE. Afr.). **CC.** Seeds not winged: **E.** Seeds flat; rudimentary ovary in the male flowers small—BORDEREA (Pyrenees). **EE.** Seeds not flattened; rudimentary ovary large—EPIPETRUM (Chile). **BB.** Fruit with 1 wing, samara-like, indehiscent; seeds not winged—RAJANIA (West Indies). **AA.** Fruit a berry; seeds globose—TAMUS (Canary Is. and Eur. through the Mediterr. Reg. to Temp. Asia).

ORDER 102. AGAVALES

Perennials with a thick woody caudex or rhizome; stem reaching tree form; leaves usually crowded at the base or apex of the stem, thick and fleshy or fibrous, sometimes prickly; flowers bisexual to dioecious, mostly actinomorphic, bracteate, often small and in much-branched panicles; perianth dry and glumaceous to fleshy; lobes or segments more or less alike; stamens 6; anthers 2-locular, introrse or opening at the sides; ovary superior or inferior, 3- or 1-locular, with axile or centrally attached ovules; fruit a capsule or berry; seeds with endosperm.—Numerous in Australia, and in Tropics and Subtropics generally, often in arid regions.

A group intermediate between the orthodox *Liliaceae* and the *Palmae*.

A. Perianth dry and more or less glumaceous, of 6 free or almost free segments; stem simple or little branched *Xanthorrhoeaceae*

AA. Perianth not dry or glumaceous; segments usually united into a tube; leaves often tufted at the top of the stems *Agavaceae*

391. XANTHORRHOEACEAE

Perennials, usually xerophytic; rootstock a thick woody caudex or rhizome; stem when present sometimes very tall and woody, simple or little branched; leaves often tufted, mostly linear. Flowers bisexual or dioecious, usually small, rarely large and solitary, usually spicate, paniculate, or capitate. Perianth mostly dry and glumaceous, rarely coloured, of 6 segments in two whorls, the inner whorl rarely petaloid, all free or shortly connate. Stamens 6, usually the three inner attached to the base of the inner segments and the three outer more or less free and hypogynous; anthers 2-locular, basifixed or versatile, opening inwards or at the sides by longitudinal slits. Ovary superior, 3-locular with axile placentas or 1-locular with erect centrally attached ovules; styles free or style 3-lobed or subentire. Fruit a loculicidal capsule or rarely a 1-seeded nut, often surrounded by the persistent perianth. Seeds with rather hard endosperm and straight embryo. *Juncaceae*, partly of B.H. **3**, 863–66; *Liliaceae*, partly of E.P. **2**, 5, 49–53; edn. 2, **15***a*, 312–17.—S. Hemisphere only, in Australia (mainly SW.), Tasmania, and New Caledonia.

USEFUL PRODUCT: *Grass-Tree gum* (species of Xanthorrhoea).

As mentioned under *Juncaceae* this family is composed of Bentham and Hooker's first two tribes of *Juncaceae*, the *Xeroteae* and *Calectasieae*. In the German system they were included in the *Liliaceae*, under tribes *Dasypogoneae*, *Lomandreae*, and *Calectasieae*.

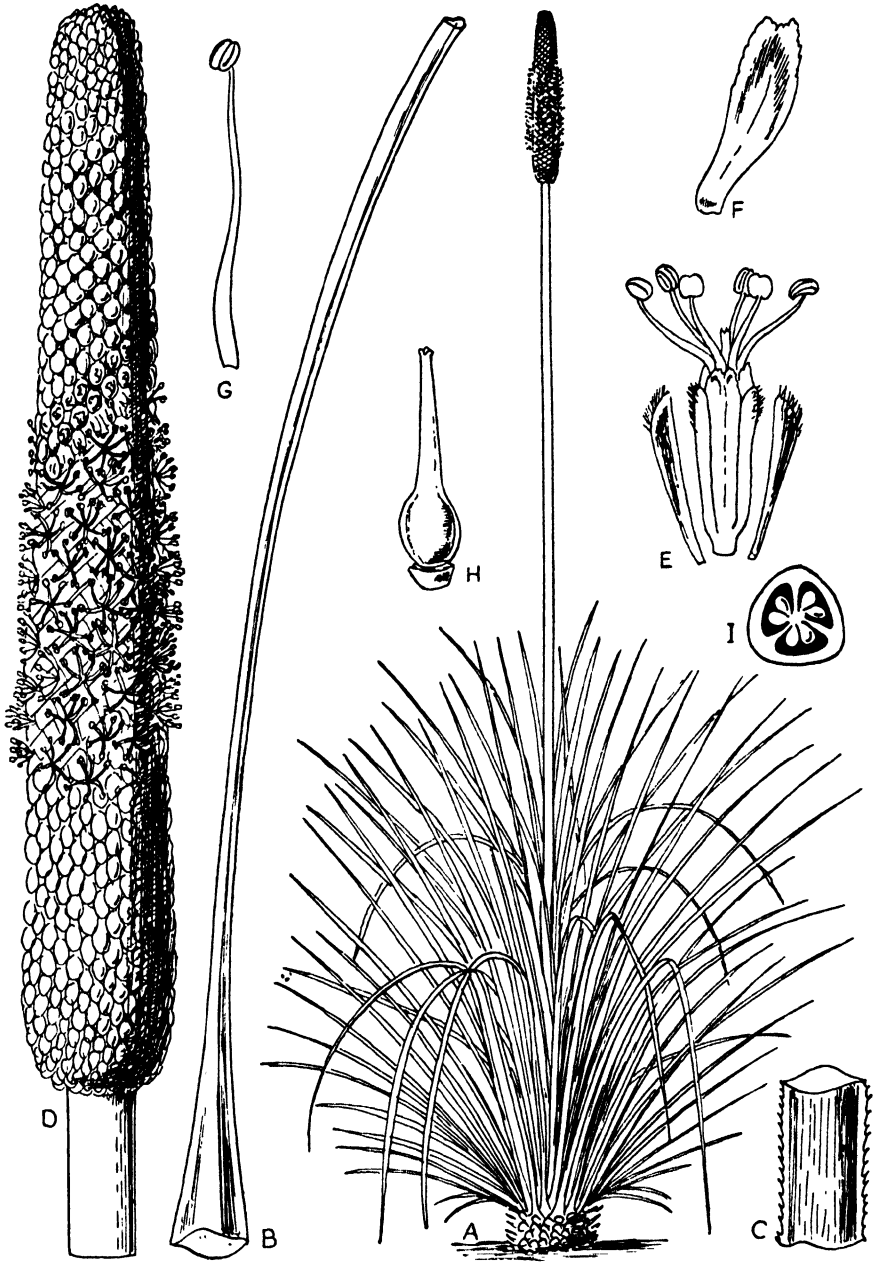


FIG. 401. Xanthorrhoea hastilis *R. Br.* (Xanthorrhoeaceae). A, whole plant. B, lower part of leaf. C, segment of leaf. D, flower-spike. E, flower and bracts. F, perianth-segment. G, stamen. H, pistil. I, cross-section of ovary. (After *Bot. Mag.*)

They are probably better considered as a separate family, and are clearly very advanced representatives of the Liliaceous stock, and something of a parallel to part of the *Agavaceae*, but tending towards the habit and unisexualism of the *Palmae*.

A. Flowers solitary; anthers basifixed: **B.** Flowers large, solitary in the middle of the radical leaves—BAXTERIA (SW. Austral.). **BB.** Flowers rather small, at the ends of leafy shoots—CALECTASIA (S. Austral.). **AA.** Flowers not solitary: **C.** Anthers dorsifixed: **D.** Flowers bisexual; style often filiform with a small often capitate stigma: **E.** Ovary 3-locular: **F.** Ovules few in each loculus; flowers in long dense cylindrical spikes on a long peduncle—XANTHORRHOEA (Austral.). **FF.** Ovules solitary in each loculus: **G.** Leaves radical; flowers on a scape; capsule smooth—CHAMAEXEROS (SW. Austral.). **GG.** Leaves on branched stems; flowers in a small terminal fascicle; capsule muricate—ACANTHOCARPUS (SW. Austral.). **EE.** Ovary 1-locular, with 3 basal ovules; flowers in globular heads on a terminal peduncle; bracts imbricate—DASYPOGON (SW. Austral.). **DD.** Flowers dioecious; inflorescence paniculate to dense and spike-like or capitate; ovary 3-locular; styles free or nearly so—LOMANDRA (*Xerotes*) (Austral., New Caled.). **CC.** Anthers basifixed; flowers capitate—KINGIA (SW. Austral.).

392. AGAVACEAE

Rootstock a rhizome; stem short or well developed. Leaves usually crowded on or at the base of the stem, narrow, often thick or fleshy, entire or with prickly teeth on the margin. Flowers bisexual, polygamous or dioecious, actinomorphic or somewhat zygomorphic, racemose or paniculate, sometimes arranged in a very large thyrse, the branches subtended by bracts. Perianth-tube short to rather long; lobes or segments unequal to subequal; corona never present. Stamens 6, inserted at the base of the lobes or on the tube; filaments filiform or thickened towards the base, free; anthers introrse, linear, usually dorsifixed, 2-locular, opening lengthwise by slits. Ovary superior or inferior, often beaked, 3-locular, with axile placentas; style slender. Ovules numerous to solitary in each loculus, superposed in 2 series, anatropous. Fruit a loculicidal capsule or berry. Seeds numerous or solitary, compressed, with fleshy endosperm surrounding the small embryo.—Tropics and Subtropics generally, abundant in semi-deserts, a few in Australia.

USEFUL PRODUCTS: *Bombay Aloe fibre* (Agave vivipara *L.*); *Bowstring Hemp* (Sansevieria zeylanica *Willd.*); *Dragon's Blood* (resin from Dracaena cinnabari *Balf. f.*); *Dragon Tree* of Canary Is. (Dracaena draco *L.*); *Henequen* (Agave fourcroydes *Lem.*); *Istle fibre* or *Mexican fibre* (Agave heteracantha *Zucc.*); *Keratto fibre* (Agave morrisii *Baker*); *Mauritius Hemp* or *Fique* (Furcraea gigantea *Vent.*); *New Zealand Hemp* or *Flax* (Phormium tenax *L. f.*); *Sisal Hemp* (Agave sisalana *Perr.*).

This group may be regarded as a half-way house between the Liliaceous stock and the climax group of the *Palmae*. It is not clearly marked by any one character from the *Liliaceae* and is based mainly on habit. As such it may not appeal to some botanists, especially those of the older school. It may be regarded as a family composed of the most advanced tribes formerly included in the *Liliaceae* and *Amaryllidaceae*, the ovary being either superior or inferior. The rootstock is never bulbous, the habit is usually arborescent, whilst the inflorescence is never umbelliform as in *Amaryllidaceae* (*sensu stricto*).



FIG. 402.—Agave schidigera *Lem.* (Agavaceae). A, part of inflorescence.

Key to the Tribes

A. Ovary superior: **B.** Flowers bisexual; fruit usually a capsule: **C.** Anthers not foveolate at the insertion of the filament: **D.** Perianth-segments free—1. **Yucceae. DD.** Perianth-segments united at the base—2. **Dracaeneae. CC.** Anthers foveolate at the insertion of the filament—3. **Phormieae. BB.** Flowers polygamo-dioecious or dioecious, in panicles; fruit indehiscent—4. **Nolineae. AA.** Ovary inferior: **E.** Flowers actinomorphic; inflorescence usually paniculate—5. **Agaveae. EE.** Flowers zygomorphic; inflorescence spicate or racemose—6. **Polyantheae.**

Tribe 1. **Yucceae.** Stem woody, short or tall; leaves crowded on the stem, linear or broader; flowers in racemes or panicles; perianth-segments free or rarely connate; stamens 6, inserted at the base of the segments or lobes; anthers dorsifixed, introrse; ovary 3-locular; ovules numerous; fruit a capsule.—N. and Central America.

A. Perianth-segments connivent into a cylindrical 'tube'; flowers large, in a simple raceme—HESPERALOE (Calif.). **AA.** Perianth-segments connivent into a globose or campanulate 'tube'; **B.** Style absent—CLISTOYUCCA (Calif., Ariz.). **BB.** Style present: Perianth-segments free—YUCCA (*Hesperoyucca, Sarcoyucca*) (N. and Cent. Amer.). Perianth-segments united—SAMUELA (Texas, Mexico).

Tribe 2. **Dracaeneae.** Stem woody, short or tall, sometimes scandent; leaves crowded at the base or on the stem, linear or broader; flowers in racemes or panicles or rarely in heads; perianth-segments variously connate, equal or sub-equal; stamens 6, inserted at the base of the segments or lobes; anthers dorsifixed, often versatile, introrse; ovary 3-locular; ovules numerous or solitary and erect; fruit a loculicidal capsule or berry.—Tropics and Subtropics.

A. Ovules numerous: **B.** Style well developed; perianth-segments united into a short tube—CORDYLINE (Tropics, except Afr.). **BB.** Style short; perianth-segments united only at the base—COHNIA (Mascar. Is., New Caled.). **AA.** Ovules solitary: **C.** Stem present, woody; fruit a berry—DRACAENA (Warm Reg.). **CC.** Stem absent or very short, often fibrous; leaves thick and leathery; fruit with a thin pericarp falling away from the berry-like seeds—SANSEVIERIA (Trop. and S. Afr. and India).

Tribe 3. **Phormieae.** Rootstock a short, thick rhizome; leaves radical, linear, fibrous; flowers paniculate, bisexual or by abortion male; perianth-segments connate in the lower part, subsimilar; corona absent; stamens 6, inserted in the tube at the base of the segments; anthers introrse; ovary perfectly or imperfectly 3-locular; style simple; ovules numerous; fruit a loculicidal capsule.—New Zealand.

One genus, PHORMIUM.

Tribe 4. **Nolineae.** Stem woody or very short from a rhizome; leaves crowded on the stem or from the rhizome, linear, entire or serrate; flowers polygamous-dioecious or dioecious, in panicles; perianth campanulate, segments distinct; stamens 6; anthers dorsifixed; ovary 3–1-locular; ovules 2 in

each loculus or 3 in the 1-locular ovary and erect; fruit indehiscent or tardily dehiscent.—Mexico–Texas region.

Further development, to PALMAE.

A. Ovary 3-locular, with 2 ovules in each loculus; flowers small in lax panicles: **B.** Fruit 3-angled or 3-winged—NOLINA (Southwestern U.S.A., Mexico). **BB.** Fruit not angled—CALIBANUS (Mexico). **AA.** Ovary 1-locular, with 3 erect ovules; flowers in dense narrow panicles—DASYLIRION (N. Amer.).

Tribe 5. **Agaveae.** Stem short; leaves crowded, often very fleshy and prickly; flowers bisexual, mostly in large (sometimes huge) panicles; perianth persistent, with a short or long tube: stamens 6; anthers basifixed or dorsifixed; ovary 3-locular; ovules numerous, axile; fruit a capsule.—America, Australia.

A. Stamens longer than the perianth; style filiform—AGAVE (*Runyonia*) (Amer.). **AA.** Stamens shorter than the perianth: **B.** Filaments and style thickened below the middle; panicle very large—FURCRAEA (Trop. Amer.). **BB.** Filaments and style not thickened: **C.** Anthers dorsifixed; perianth-segments erect—BESCHORNERIA (Mexico). **CC.** Anthers basifixed; perianth-segments spreading from the base—DORYANTHES (Austral.).

Tribe 6. **Polyantheae.** Stem short, from a tuberous rhizome; leaves basal, narrow; flowers bisexual, in long simple terminal racemes; perianth tubular or funnel-shaped; stamens 6, on the perianth; anthers dorsifixed in the middle; ovary 3-locular; ovules numerous, axile; fruit a capsule.—America.

A. Flowers usually paired: **B.** Perianth-tube cylindrical, expanded at the top—POLIANTHES (Cent. Amer., Trinidad). **BB.** Perianth-tube widened in the middle—PROCHNYANTHES (Mexico). **AA.** Flowers usually solitary—PSEUDOBRAVOA (Mexico).

ORDER 103. PALMALES

Stem herbaceous, from almost nothing to very tall and woody, sometimes climbing and armed with hooks, often covered by the persistent leaf-bases; leaves often very large, entire or pinnately or flabellately divided and nerved; rhachis often extended at the base into a fibrous sheath; flowers small, actinomorphic, bisexual to dioecious, mostly in panicles, and often furnished with large spathe-like bracts; perianth double; stamens usually 6; ovary superior, of free or united carpels; ovule solitary in each ovary or loculus; fruit a berry or drupe; seeds with endosperm.—Tropics and Subtropics.

One family *Palmae*

393. PALMAE

Stems stout or slender, sometimes climbing, sometimes very short or almost nothing, often covered by the persistent bases of the leaves; primary root soon disappearing and replaced by roots from the base of the stem. Leaves in a terminal cluster or in the climbing species scattered, sometimes very large, entire, pinnately or digitately divided, the segments or leaflets

folded induplicately or reduplicately in bud, often sharp at the apex and prickly on the margins or midrib; rhachis often expanded at the base into a fibrous sheath. Flowers small, actinomorphic, bisexual, monoecious or dioecious, sometimes polygamous, arranged in an often paniculate inflorescence (spadix) either amongst or below the leaves. Spathes various, sometimes numerous and enclosing the peduncle and branches of the inflorescence, or few, leathery or membranous; bracteoles often connate below the flowers. Perianth double. Sepals 3, separate or connate, imbricate or open in bud. Petals 3, separate or connate, usually valvate in the male flowers and imbricate in the female. Stamens usually 6, in two series, rarely numerous; anthers 2-locular, loculi globose to linear, opening by slits lengthwise; pollen smooth or rarely echinulate. Ovary superior, rudimentary or absent in the male flowers, 1–3-locular, rarely 4–7-locular, or carpels 3 and distinct or connate only at the base; ovule solitary and erect or pendulous from the inner angle of each carpel or loculus of the ovary. Fruit a berry or drupe, 1–2-locular, or fruiting carpels distinct; exocarp often fibrous, sometimes covered by reflexed scales. Seeds free or adherent to the endocarp; endosperm present, sometimes ruminate; embryo small. B.H. **3**, 870; E.P. **2**, 3, 1; Rendle, 249.—Widely distributed in the Tropics of both Hemispheres, a few in Warm Temperate Regions; either solitary or gregarious, often by the banks of rivers or in dense tropical forests.

USEFUL PRODUCTS: *Areca* or *Betel nuts* (Areca catechu *L.*); *Bahia Piassava* (Attalea funifera *Mart.*); *Bass Brooms* (Attalea funifera *Mart.*); *Coconut Palm* (Cocos nucifera *L.*); *Coco de Mer* or *Double Coconut* (Lodoicea sechellarum *Lab.*); *Coir fibre* (husk of Coconut); *Coquilla nuts* (Attalea funifera *Mart.*); *Date Palm* (Phoenix dactylifera *L.*); *Doum Palm* (Hyphaene thebaica *Mart.*); *Dragon's Blood* (Daemonorops propinquus *Becc.*, and D. ruber *Mart.*); *Ivory Nut Palm* or *Vegetable Ivory* (seeds of Phytelephas macrocarpa *R. and P.*); *Kittool fibre* (Caryota urens *L.*); *Lagos bass* (Raphia vinifera *Beauv.*); *Malacca canes* (Calamus scipionum *Lour.*); *Nipa Palm* (Nipa fruticans *Thunb.*); *Oil Palm* (Elaeis guineensis *Jacq.*); *Palmyra* (Borassus flabellifer *L.*); *Piassava fibre* (Leopoldinia piassaba *Wallace*); *Pupunha* or *Peach Palm* (Bactris gasipes *H. B. and K.*); *Raffia* (Raphia pedunculata *Beauv.*); *Rajah canes* (Eugeissonia minor *Becc.*); *Sago Palm* (Metroxylon sagu *Rottb.*); *Wine Palm* (Caryota urens *L.*).

In neither of the great systematic works are the Palms satisfactorily placed. In Bentham and Hooker's *Genera Plantarum* the family is associated with the *Flagellariaceae* and the *Juncaceae* in the series *Calycinae*, whilst Engler ranges it as a separate series between the Grasses and Aroids. Rendle (*Classif. Fl. Pl.* **1**, 249) includes them in his series *Spadiciflorae* together with *Aroideae* and *Lemnaceae*. He notes the approximation of the two larger families by the relative size of the embryo and endosperm, the presence of a spathe, and the association of a great number of small, inconspicuous flowers in often huge, indefinite inflorescences.

Apart from these characters, however, which in themselves seem of little importance, the palms and aroids have not much in common, and in the present work are widely separated.

In the absence of a recent monograph I have compiled a key to the tribes and genera mainly from Bentham and Hooker's *Genera Plantarum* chiefly to show the student how this difficult family has been classified (often from very incomplete material) and to give a list of the generic names. The additional genera described since are listed at the end of each tribe.

Key to the Tribes of PALMAE

A. Perianth 6-merous, that of the female at length enlarging and embracing the fruits: **B.** Leaves palmately nerved or divided: **C.** Leaf-segments induplicate in bud (V-shaped in cross-section): **D.** Flowers mostly bisexual—1. **Corypheae. DD.** Flowers dioecious—2. **Borasseae. CC.** Leaf-segments reduplicate in bud (A-shaped in cross-section)—3. **Lepidocaryeae. BB.** Leaves pinnately nerved or divided: **E.** Leaf-segments reduplicate: **F.** Pericarp of the fruit composed of the imbricate reflexed scales—4. **Calameae. FF.** Pericarp of the fruit not composed of scales: **G.** Endocarp of the fruit without pores—5. **Areceae. GG.** Endocarp of the fruit with 3 pores—6. **Cocoineae. EE.** Leaf-segments induplicate in bud—7. **Phoeniceae. AA.** Perianth rudimentary in either sex; fruits crowded into a head—8. **Phytelephantineae.**

Tribe 1. **Corypheae. A.** Style or stigma terminal in fruit: **B.** Petals imbricate—CHAMAEROPS (Mediterr.), RHAPIDOPHYLLUM (N. Amer.), ACANTHORHIZA (Cent. Amer.), TRITHRINAX (S. Amer.). **BB.** Petals valvate or very minute or obsolete: **C.** Flowers bisexual—BRAHEA, SERENOA, and ERYTHEA (N. Amer.), COLPOTHRINAX, HEMITHRINAX (Cuba), COPERNICIA (Trop. Amer.), PRITCHARDIA (Pacific islands), LICUALA, LIVISTONA (Trop. Asia and Austral.), TRACHYCARPUS (Himal., China, Japan), THRINAX (Florida, West Indies). **CC.** Flowers dioecious—RHAPIS (China, Japan). **AA.** Style or stigma basal in fruit: **D.** Petals imbricate—CORYPHA (Trop. Asia), SABAL (Trop. Amer.), WASHINGTONIA (N. Amer.). **DD.** Petals valvate—NANNORHOPS (Near East), TEYSMANNIA (Sumatra). Additional genera: INODES, ACANTHOSABAL, NEOWASHINGTONIA, PELAGODOXA, PAUROTIS, GLAUCOTHEA, PRITCHARDIOPSIS, STYLOMA, DAMMERA, COCCOTHRINAX, THRINCOMA, THRINGIS, CHELYOCARPUS, TESSMANIOPHOENIX, PHOLIDOCARPUS, ACOELORHAPHE, CRYSOPHILA.

Tribe 2. **Borasseae.** Stamens numerous—LODOICEA (Seychelles), LATANIA (Mascar.). **AA.** Stamens 6—BORASSUS (Trop. Afr., India), HYPHAENE (Trop. Afr., Madag.). Additional genus: BORASSODENDRON.

Tribe 3. **Lepidocaryeae. A.** Branches of inflorescence cylindrical—MAURITIA (Trop. Amer.). **AA.** Branches of inflorescence compressed—LEPIDOCARYUM (N. Brazil).

Tribe 4. **Calameae. A.** Inflorescence axillary: **B.** Ovary imperfectly 3-locular: **C.** Stemless—ZALACCA (Trop. Asia). **CC.** Stems developed: **D.** Stem erect—PIGAFETTA (Malay Archip., New Guin.). **DD.** Stem climbing—CALAMUS (Old World Tropics), KORTHALSIA (Malay Archip., New Guin.), CERATOLOBUS (Malay Archip.), PLECTOCOMIA (Trop. Asia, Malaya), DAEMONOROPS (Malaya). **AA.** Inflorescence terminal—EUGEISSONIA (Malay Archip.), METROXYLON (Malay Archip., Pacific islands). **BB.** Ovary perfectly 3-locular: **E.** Leaf-rhachis produced at the apex: **F.** Inflorescence axillary—ONCOCALAMUS, EREMOSPATHA (Trop. Afr.). **FF.** Inflorescence terminal—ANCISTROPHYLLUM (Trop. Afr.). **EE.** Leaf-rhachis not produced at the apex—RAPHIA (Trop. Afr.). Additional genera: ZALACELLA, PLECTOCOMIOPSIS, MYRIALEPIS, CALOSPATHA.

Tribe 5. **Areceae.**

Key to the Subtribes

A. Petals of female flower imbricate (except sometimes at the apex): **B.** Inflorescence borne below the leaves: **C.** Stigmas terminal in fruit (see also IV. **Iriarteeae**): **D.** Male flowers asymmetric; sepals not overlapping—I. **Euareceae. DD.** Male flowers symmetric; sepals broadly overlapping—II. **Ptychospermeae. CC.** Stigmas mostly lateral in fruit: **E.** Spathes numerous: **F.** Inflorescence club-shaped; ovary deeply 3-lobed—III. **Wettenieae. FF.** Inflorescence horn-shaped; ovary entire—IV. **Iriarteeae. EE.** Spathes 2; ovary entire; leaf-segments acuminate—V. **Oncospermeae. BB.** Inflorescence borne among the leaves: **G.** Stigmas terminal in fruit: **H.** Inflorescence unbranched; ovary 1-locular—VI. **Linospadiceae. HH.** Inflorescence branched; ovary perfectly or imperfectly 3-locular: **I.** Flowers monoecious; fruit elongate—VII. **Malortieae. II.** Flowers dioecious; fruit globose—VIII. **Ceroxyleae. GG.** Stigmas lateral or basal in fruit: **K.** Flowers immersed in a cavity; perianth glumaceous—IX. **Geonomeae. KK.** Flowers not immersed in cavities: **L.** Spathes 2—X. **Iguanureae. LL.** Spathes numerous—XI. **Chamaedoreae. AA.** Petals of female flower valvate throughout their length—XII. **Caryotideae.**

Subtribe I. **Euareceae. A.** Ovule basal, erect—ARECA (Trop. Asia to New Guin.), MISCHOPHLOEUS (Malay Archip.), PINANGA (Trop. Asia), KENTIA (New Guin.). **AA.** Ovule parietal, more or less pendulous: **B.** Flowers arranged in four vertical rows on the branches—HYDRIASTELE (New Guin., Austral.), ADELONENGA (New Guin.), GRONOPHYLLUM (New Guin.), NENGELLA (Malay Archip., New Guin.). **BB.** Flowers spirally arranged: **C.** Stamens numerous, 25 or more—KENTIOPSIS (New Caled.), ACTINORHYTIS (Malay Archip.). **CC.** Stamens fewer than 24: **D.** Filaments of the stamens inflexed at the apex—ARCHONTOPHOENIX (Austral.), RHOPALOSTYLIS (Norf. Is., New Zeal.), DICTYOSPERMA (Mascar. Is.). **DD.** Filaments of stamens not inflexed at the apex—VEITCHIA (Pacific islands), HEDYSCEPE (Lord Howe Is.), NENGA (Malay Archip.), LOXOCOCCUS (Ceylon). Additional genera: GULUBIOPSIS, GULUBIA, EXORRHIZA, LEPTOPHOENIX, ACTINOKENTIA, NEOVEITCHIA, LINOMA (LAOMA), DENEA, SIPHOKENTIA, MACROPHLOGA.

Subtribe II. **Ptychospermeae. A.** Stamens numerous (20 or more)—PTYCHOSPERMA (Malay Archip. to Austral.), DRYMOPHLOEUS (Molucc., Pacific islands), ACTINOPHLOEUS (Solomon Is.), BALAKA (Samoa). **AA.** Stamens less than 20: **B.** Endosperm ruminate; leaf-segments acuminate—RHOPALOBLASTE (Malay Archip.). **BB.** Endosperm not ruminate—CYRTOSTACHYS (Malay Archip.), CYPHOPHOENIX (New Caled.), CAMPECARPUS (New Caled.). Adtional genera: PTYCHOCOCCUS, PONAPEA, PTYCHORAPHIS, SOLFIA.

Subtribe III. **Wettenieae. A.** Leaf segments cuneate—CATOBLASTUS (N. Brazil, Venez.). **AA.** Leaf-segments lanceolate—WETTENIA (Andes). Additional genera: ACROSTIGMA, WETTINELLA, WETTINIICARPUS.

Subtribe IV. **Iriarteeae** (All Trop. Amer.). **A.** Stamens numerous (about 25)—SOCRATEA. **AA.** Stamens up to 15: **B.** Stamens 9–15: **C.** Stigmas terminal in fruit—IRIARTEA. **CC.** Stigmas basal—IRIARTELLA. **BB.** Stamens 6; stigmas basal in fruit—DICTYOCARYUM (Colombia).

Subtribe V. **Oncospermeae. A.** Male flowers symmetric; male sepals broad

and imbricate: **B.** Stamens numerous—PTYCHANDRA (Molucc.). **BB.** Stamens 1–12—CLINOSTIGMA (Austral., Pacific islands), CYPHOKENTIA, CYPHOSPERMA, RHYNCHOCARPA and BARSELINIA (*Microkentia*) (New Caled.). **AA.** Male flowers asymmetric; male sepals small or narrow, not or only slightly imbricate: **C.** Petals of female free: **D.** Ovule parietal: **E.** Anthers erect, not versatile; armed palms—ONCOSPERMA (Trop. Asia). **EE.** Anthers versatile—EUTERPE, OENOCARPUS, and JESSENIA (Trop. Amer.), ACANTHOPHOENIX (Mascar. Is.). **DD.** Ovule basal, erect—HYOSPATHE (N. Brazil), PRESTOEA (West Indies). **CC.** Petals of female connate, valvate at the top—OREODOXA (Trop. Amer.). Additional genera: BARKERWEBBIA, CLINOSPERMA, DOLICKOKENTIA, BRONGNIARTIKENTIA, PHYSOKENTIA, ROYSTONEA, ACRISTA, CATIS, PLECTIS.

Subtribe VI. **Linospadiceae.** **A.** Stamens numerous: **B.** Anthers basifixed—HOWEA (Lord Howe Is.). **BB.** Anthers dorsifixed, versatile—CALYPTROCALYX (Amboina, Trop. Austral.). **AA.** Stamens 6–12: **C.** Anthers dorsifixed, versatile—LINOSPADIX (New Guin.). **CC.** Anthers basifixed—BACULARIA (Austral.).

Subtribe VII. **Malortieae.** **A.** Leaf-segments free; stamens numerous—REINHARDTIA (Mexico). **AA.** Leaf-segments confluent; stamens 6–12—MALORTIEA (Cent. Amer.).

Subtribe VIII. **Ceroxyleae.** CEROXYLON (Andes); JUANIA (Juan Fernandez).

Subtribe IX. **Geonomeae.** **A.** Hypogynous disk absent: filaments free—PODOCOCCUS (W. Trop. Afr.), BENTINCKIA (S. India). **AA.** Hypogynous disk present, filaments connate: **B.** Stamens 20—WELFIA (Cent. Amer.). **BB.** Stamens 6: **C.** Anthers sagittate—CALYPTROGYNE (Trop. Amer.). **CC.** Anthers not sagittate—GEONOMA, ASTEROGYNE (Trop. Amer.). Additional genera: MANICARIA, LEOPOLDINIA, NEONICHOLSONIA, BENTINCKIOPSIS, KALBREYERA, TAENIANTHERA.

Subtribe X. **Iguanureae.** **A.** Stigma lateral in fruit (not basal)—HETEROSPATHA (Amboina); NEPHROSPERMA (Seychelles). **AA.** Stigma basal or nearly so in fruit: **B.** Stamens 15–20; armed palms; segments of leaves confluent and bifid—STEVENSONIA (Seychelles). **BB.** Stamens 6–9: **C.** Armed palms—VERSCHAFFELTIA (Seychelles). **CC.** Unarmed palms—DYPSIS, PHLOGA (Madag.); IGUANURA (Malay Archip.); SOMMIERA (New Guin.). Additional genera: TRICHODYPSIS, HAPLODYPSIS, HAPLOPHLOGA, NEODYPSIS, DYPSIDIUM, NEOPHLOGA, PHLOGELLA (all from Madag.); ADELODYPSIS, VONITRA, ANTONGILIA.

Subtribe XI. **Chamaedoreae.** **A.** Male and female flowers borne in the same inflorescence: **B.** Inflorescence among the leaves: **C.** Spinous palms; leaf-segments bifid at the apex—ROSCHERIA (Seychelles). **CC.** Unarmed palms; leaf-segments acuminate—SYNECHANTHUS (Cent. Amer.); GAUSSIS (Cuba). **B.** Inflorescence below the leaves; unarmed palms—HYOPHORBE (Mascar. Is.). **AA.** Male and female flowers on different trees or different inflorescences—CHAMAEDOREA (Mtns. of Trop Amer.). Additional genera: WENDLANDIELLA, KINETOSTIGMA, OPSIANDRA, PSEUDOPHOENIX, CYCLOSPATHE, AERIA.

Subtribe XII. **Caryotideae.** **A.** Stamens numerous: **B.** Male sepals free: **C.** Leaves simply pinnatisect—ARENGA (Asia to Austral.); SCLEROSPERMA (W. Trop. Afr.). **CC.** Leaves bipinnatisect; endosperm ruminate—CARYOTA (Asia to Austral.). **BB.** Male sepals united—DIDYMOSPERMA (Trop. Asia).

AA. Stamens 6: **D.** Spathes numerous; male flowers symmetric—WALLICHIA (India). **DD.** Spathes 2; male flowers asymmetric—ORANIA (Malay Archip., New Guin.). Additional genus: LOUVELIA.

Tribe 6. **Cocoineae. A.** Prickly palms, native of Trop. Amer.—BACTRIS, DESMONCUS, ASTROCARYUM, ACROCOMIA, MARTINEZIA. **AA.** Unarmed palms (Amer. except where otherwise stated)—ELAEIS (Trop. Afr., Trop. Amer.), DIPLOTHEMIUM, COCOS (also in E. Tropics), MAXIMILIANA, SCHEELEA, ATTALEA, JUBAEA, ORBIGNYA. Additional genera: CURIMA, TILMIA, POLYANDROCOCOS, ACANTHOCOCOS, COCOPS, BUTIA, ARECASTRUM, BARBOSA, RHYTICOCOS, ARIKURYROBA, ARIKURY, PINDAREA, JUBAEOPSIS, NEPHROCARPUS, PARAJUBAEA.

Tribe 7. **Phoeniceae.** Leaves pinnatisect, segments induplicate in bud; inflorescences among the leaves, with erect branches; flowers dioecious; carpels 3, free, only 1 fertile, with a terminal stigma—PHOENIX (Trop. and Subtrop. Afr. and Asia). Additional genus: CHAMAEPHOENIX.

Tribe 8. **Phytelephantineae. A.** Male flowers with numerous free stamens: female flower with a perianth—PHYTELEPHAS (Trop. Amer.). **AA.** Male flowers with 3 united stamens; female flower without a perianth—NIPA (E. Tropics). Additional genera: AMMANDRA? PALANDRA? YARINA.

ORDER 104. PANDANALES

Trees or shrubs, often with aerial roots; leaves mostly spirally arranged, cauline, spinulose on the margins; flowers minute, dioecious, in panicles or crowded into spadix-like inflorescences with large spathe-like bracts; ovary superior, sometimes connate into groups and in fruit forming a syncarp; fruits woody or baccate; seeds minute.

One family *Pandanaceae*

394. PANDANACEAE

Trees or shrubs, trunk and branches often emitting aerial roots; leaves in 4 rows or usually spirally arranged and crowded towards the top of the shoots, linear, sheathing at the base, leathery, keeled, mostly spinulose on the margins and keel. Flowers dioecious, paniculate or densely crowded into spadices, the latter axillary and terminal, fasciculate or paniculate, enclosed at first by spathaceous, sometimes coloured or leafy, bracts. Perianth rudimentary or absent. Male flowers: stamens numerous; filaments free or connate; anthers erect, basifixed, 2-locular, the loculi sometimes again once divided, opening lengthwise by slits; rudimentary ovary absent or very minute. Female flowers: staminodes absent or small and hypogynous or adnate to the base of the ovary; ovary superior, 1-locular, free or confluent with adjacent ovaries into bundles with separate or united stigmas; style very short or absent; ovules anatropous, solitary to many, basal or parietal. Syncarps oblong to globose; mature carpels woody, drupaceous or baccate, pulpy inside. Seeds minute, with fleshy endosperm and minute embryo.

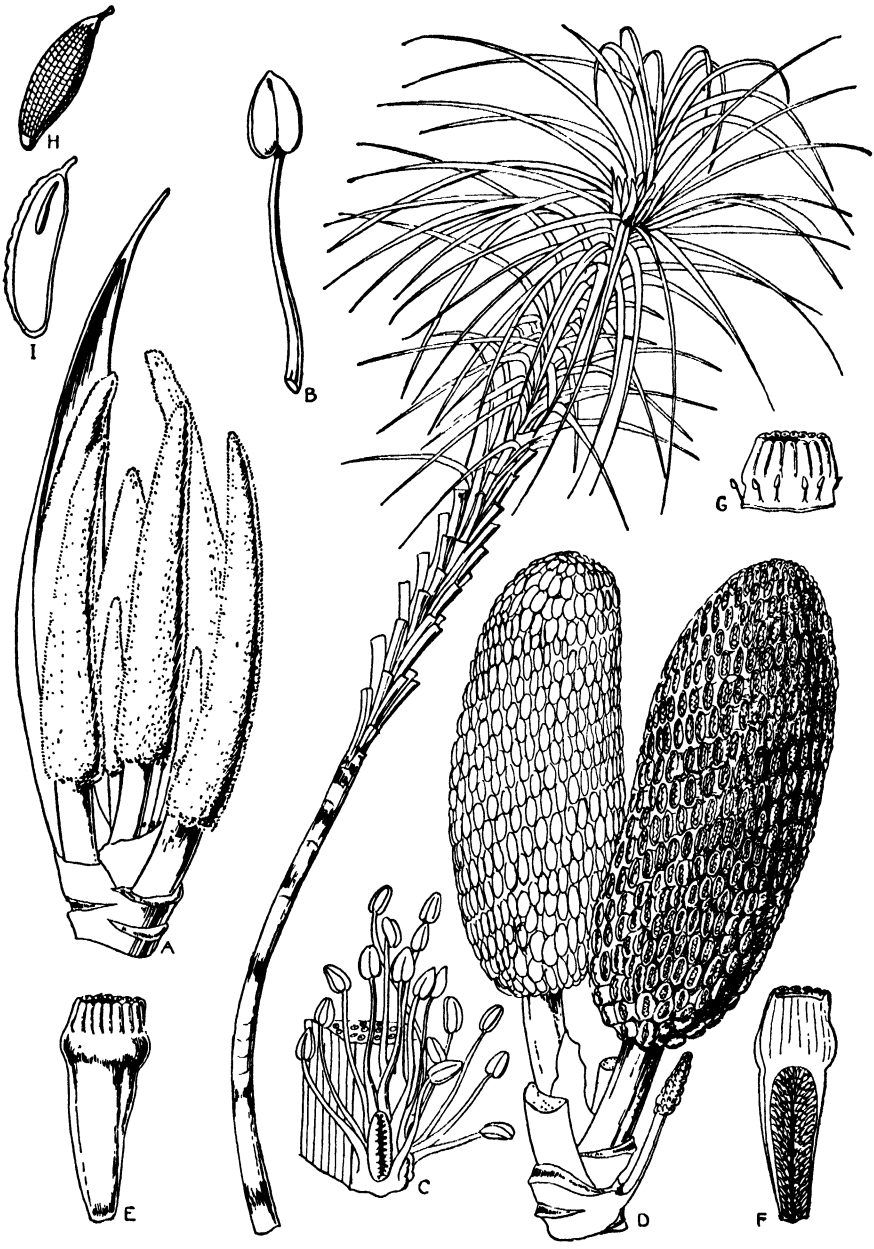


FIG. 403. Freycinetia banksii *Cunn.* (Pandanaceae). A, young male inflorescences. B, stamen. C, bunch of male flowers. D, female inflorescences. E, female flower, and F, same in vertical section. G, stigmas and staminodes. H, seed, and I, same in vertical section. (After Fitch)

B.H. 3, 949; E.P. 2, 1, 186; Warb. in Engl. *Pflanzenr.* 4, 9: *Pandanaceae* (1901).—Tropics and Subtropics of the Old World especially in oceanic islands.

USEFUL PRODUCTS: *Kewra* or *Keora Oil* (Pandanus tectorius *Sol.*). The fibre from the leaves of various species of *Pandanus* used for making bags, baskets, fans, and mats.

A. Inflorescence paniculate; flowers pedicellate; tree with no aerial roots; leaves not spirally arranged; perianth short, gamophyllous; ovary many-locular; fruit drupaceous—SARARANGA (Solomon Is.). **AA.** Inflorescence capitate or spicate, the flowers sessile, without a perianth: **B.** Ovaries with very numerous ovules, free or connate into clusters; placentas parietal, 2 or more; fruit berry-like; staminodes present in the female flowers, hypogynous—FREYCINETIA (Trop. Asia to Pacific, Austral., New Zeal.). **BB.** Ovaries with solitary ovules, free or connate into clusters; placentas sub-basal; fruit woody or drupaceous; staminodes absent from the female flowers—PANDANUS (Old World Tropics).—Doubtful genus, *Souleyetia.*

ORDER 105. CYCLANTHALES

Herbs of palm-like habit; leaves often deeply bilobed; flowers small, densely crowded into a spadix which is subtended by large, more or less caducous, spathe-like bracts enveloping the spadix when young; flowers spirally arranged on the axis, or the different sexes in alternating whorls; fruit a fleshy syncarp; seeds with abundant endosperm and small embryo.

One family *Cyclanthaceae*

395. CYCLANTHACEAE

Perennial stemless herbs or climbers and sometimes subepiphytic; juice watery or milky; leaves spirally arranged or distichous, petiolate, fan-like, entire or 2-lobed or 2-partite, the segments sometimes again several-lobed, parallel-nerved; petiole sheathing at the base. Flowers monoecious, both sexes densely crowded into a spadix, spirally arranged and the females single with males around, or the sexes in superposed whorls; spadix axillary, solitary, simple, the peduncle clothed with two or more caducous spathes enclosing the spadix when young. Male flowers: perianth 0 or cupular, oblique and several-toothed; stamens numerous; filaments connate in the lower part and confluent with the perianth; anthers ovoid or linear, 2-locular, opening by slits lengthwise; pollen ellipsoidal, smooth; rudimentary ovary absent. Female flowers: perianth 0 or of 4 segments free or connate, sometimes those of several flowers more or less confluent and enlarged and indurated in fruit; staminodes 4, short or long and flexuous, bare at the apex or with an imperfect anther; ovary free or sunk in the axis, 1-locular; style 0, or thick and pyramidal, stigmas 1–4, stellately spreading; ovules anatropous, numerous, spreading, more or less pendulous on the walls or from the apex of the loculus. Fruit a fleshy syncarp of distinct or united berries; seeds several, small with fleshy testa; endosperm copious; embryo minute, straight or curved. B.H. 3, 951; E.P. 2, 3, 93.—Tropical America and West Indies.

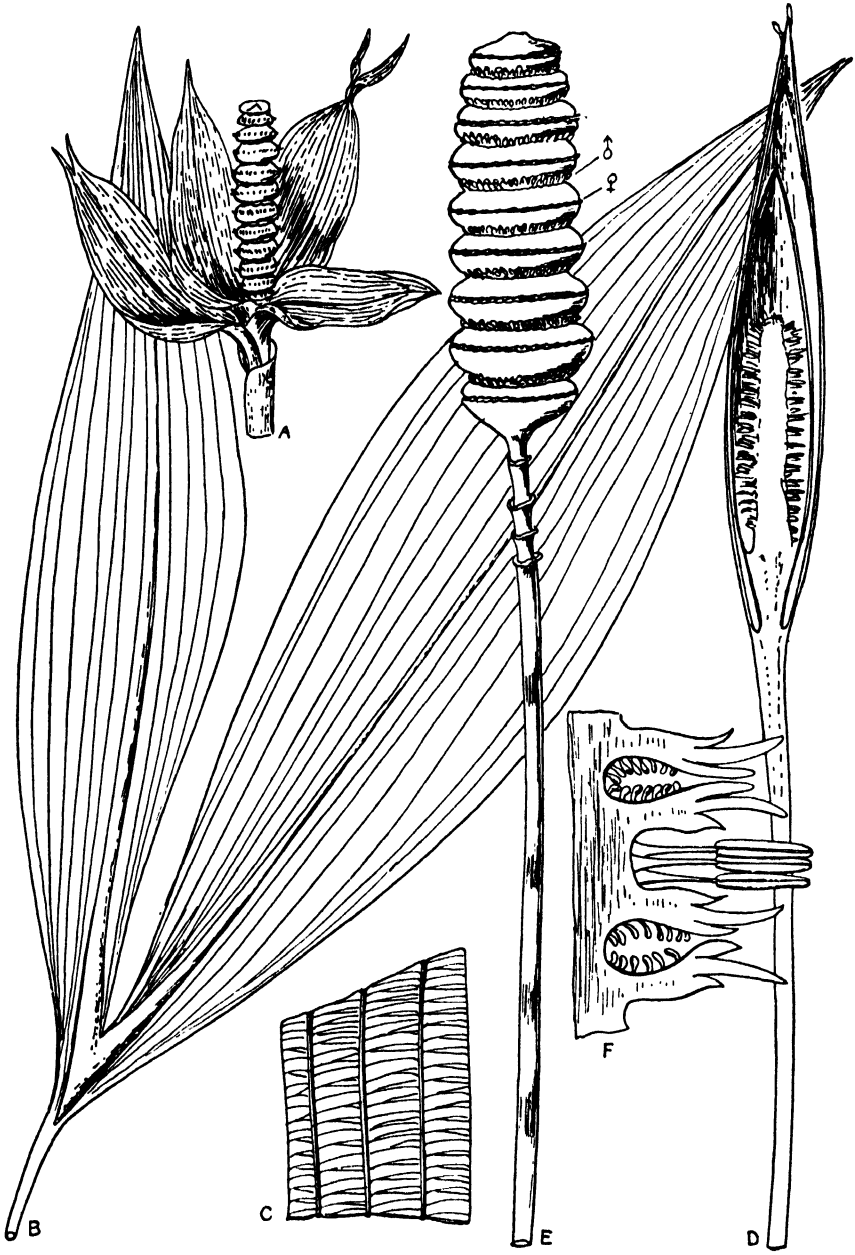


FIG. 404. Cyclanthus bipartitus *Poit.* (Cyclanthaceae). A, whole plant, much reduced. B, leaf. C, part of leaf showing venation. D, vertical section of young spathe. E, inflorescence, with spathe-bracts fallen off. F, vertical section of part of inflorescence. (Orig.)

USEFUL PRODUCT: *Panama hats* (from leaves of Carludovica insignis *Duch.*).

A. Male and female flowers spirally arranged on the spadix; stamens numerous: **B.** Leaves entire or crenate—LUDOVIA (Guiana). **BB.** Leaves deeply partite or rarely multipartite: **C.** Ovary superior: **D.** Female flowers not immersed in the spadix; style distinct—STELESTYLIS (Brazil). **DD.** Female flowers immersed in the spadix; style none: **E.** Stamens of male flowers arranged in the throat of the perianth—EVODIANTHUS (Cent. Amer.). **EE.** Stamens of the male flowers exserted from the teeth of the perianth—SARCINANTHUS (Cent. Amer.). **CC.** Ovary inferior; stigmas sessile—CARLUDOVICA (Trop. Amer. and West Indies). **AA.** Male and female flowers arranged in separate alternating whorls; stamens few—CYCLANTHUS (Trop. Amer.).

ORDER 106. HAEMODORALES

Rootstock a rhizome or rarely a corm; leaves entire or rarely lobed, often all radical, often very hairy, hairs sometimes branched; flowers bisexual, solitary to paniculate or subumbellate; perianth mostly with a distinct tube, segments or lobes in 2 or 1 series, in the latter case subvalvate; stamens numerous to 6 or rarely 3, free or in bundles; anthers 2-locular, opening lengthwise; ovary superior to inferior, 3-locular with axile placentas, or 1-locular with parietal placentas; seeds usually with copious endosperm.—Tropics and Subtropics, numerous in the S. Hemisphere.

Apostasiaceae, formerly included in the Orchids, seems better placed here. This stock has probably given rise to the *Orchidaceae*.

A. Flowers actinomorphic or very slightly zygomorphic:
- **B.** Ovary 3-locular:
  - **C.** Ovary superior to inferior; indumentum often of branched hairs; fruit a loculicidal capsule — *Haemodoraceae*
  - **CC.** Ovary inferior:
    - **D.** Stamens 6 or numerous (or rarely 3), free or in bundles:
      - **E.** Leaves radical or towards the base of the stem — *Hypoxidaceae*
      - **EE.** Leaves in a tuft at the apex of the woody shoots — *Velloziaceae*
    - **DD.** Stamens 3 or 2; filaments connate at the base and with the style; flowers in spikes or racemes — *Apostasiaceae*
- **BB.** Ovary 1-locular, inferior, with 3 parietal placentas; style short, with reflexed stigmas; flowers umbellate, with an involucre of bracts — *Taccaceae*

AA. Flowers strongly zygomorphic; perianth-segments 4, free, 2-seriate; stamen 1; ovary superior — *Philydraceae*

396. HAEMODORACEAE

Herbs with fasciculate *fibrous* roots, rounded *tubers* or short *rhizomes*, sometimes stoloniferous. Leaves radical, linear or ensiform, sheathing at the base, stem-leaves absent or small, very closely striately nerved or with plicate nervation, glabrous or very hairy. Flowers bisexual, actinomorphic or very

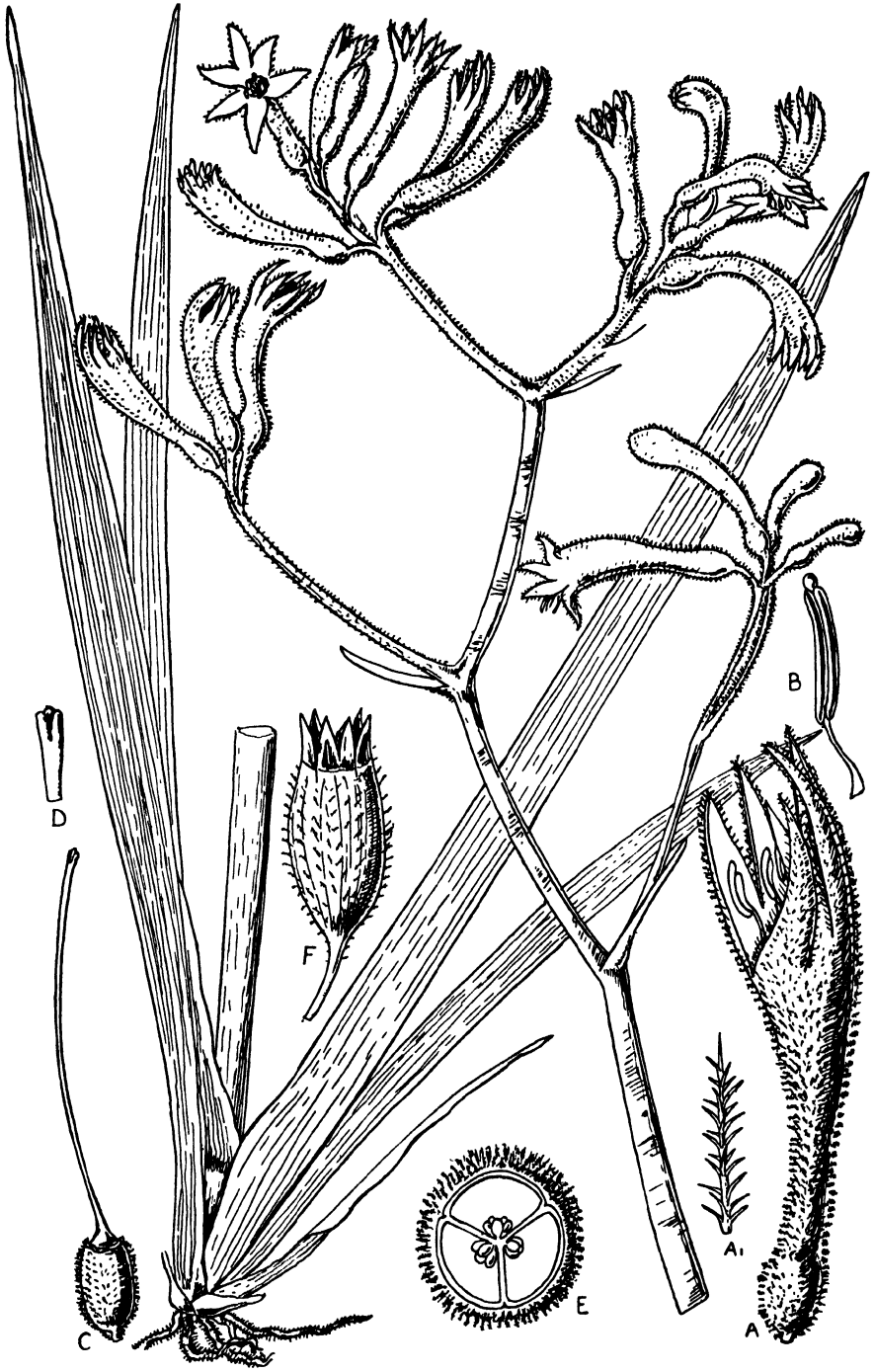


FIG. 405. Anigozanthos flavidus *Redouté* (Haemodoraceae). A, flower. A1, hair from perianth. B, stamen. C, pistil. D, stigmas. E, cross-section of ovary. F, fruit. (Orig.)

slightly zygomorphic, arranged in cymes, racemes, or panicles, sometimes the cymes subumbellate, often very densely villous with *plumose hairs*. Perianth *persistent*; tube absent or short or fairly long, straight or curved; lobes in 1 or 2 series, in the latter case the outer more or less covering the inner, *subvalvate* when in 1 series. Stamens 6 or 3; filaments free; anthers 2-locular, basifixed or versatile, opening by slits lengthwise. Ovary *superior to inferior*, sometimes subinferior in flower and becoming superior in fruit, 3-locular; style usually filiform. Ovules numerous to solitary, on axile placentas. Fruit a 3-valved loculicidal capsule. Seeds numerous to solitary in each loculus, with a small embryo in *abundant endosperm*. B.H. 3, 671, partly; E.P. 2, 5, 92; Rendle, 298, under Liliaceae.—Mainly in S. Hemisphere, few in N. and S. America.

Professor Pax, in both editions of Engler's *Pflanzenfamilien*, has limited the family to Bentham and Hooker's first tribe *Euhaemodoreae* and transferred the second tribe, *Conostyleae*, to the *Amaryllidaceae*. After a careful examination of all the genera of both families I cannot agree with this treatment, and I am firmly of the opinion that the two tribes should be again associated to form the *Haemodoraceae*. Thus constituted, but with the genus *Aletris* removed to the *Liliaceae*, the family is natural and homogeneous, not only in its *facies* but in its general distribution, which is predominantly austral, and mainly in Australia, with a few representatives in S. Africa and S. America. Tribe *Conostyleae* is very distinct and contains some remarkable genera in Australia.

Part of tribe *Ophiopogoneae* of the *Genera Plantarum* is here placed in the *Liliaceae* as in Engler's system, but the chief genus, *Sansevieria*, is included in the *Agavaceae*. Tribe *Conantherae* is treated in this book as a separate family, *Tecophilaeaceae* (see p. 613), which forms a connecting link between the *Liliaceae* and the *Iridaceae*.

Key to the Tribes

A. Perianth-segments 2-seriate; tube very short or absent; stamens 3 or rarely 6—1. **Haemodoreae. AA.** Perianth-segments 1-seriate, subvalvate; tube often fairly long and curved; stamens 6; flowers always tomentose or woolly —2. **Conostyleae.**

Tribe 1. **Haemodoreae. A.** Stamens 6; fruit 1-locular (by abortion) and 1-seeded: **B.** Inflorescence cymose, plumose-lanate—LANARIA (S. Afr.). **BB.** Inflorescence glabrous—PHLEBOCARYA (Austral.). **AA.** Stamens 3; capsule usually 3-locular: **C.** Inflorescence villous or tomentose, the hairs often plumose or glandular: **D.** Ovary superior: **E.** Ovary glabrous—SCHIEKIA (Trop. Amer.). **EE.** Ovary hairy—WACHENDORFIA (S. Afr.). **DD.** Ovary inferior: **F.** Ovules more than 1 in each loculus—LACHNANTHES (N. Amer.). **FF.** Ovules 1 in each loculus—DILATRIS (S. Afr.). **CC.** Inflorescence glabrous: **G.** Ovules numerous in each loculus—XIPHIDIUM (Trop. Amer.). **GG.** Ovules 1–few in each loculus. **H.** Ovary superior: **I.** All the ovary-loculi with 2 ovules—HAGENBACHIA (Brazil). **II.** Only 1 ovary-loculus with 1 ovule, the others abortive—BARBERETTA (S. Afr.). **HH.** Ovary inferior in flower, subsuperior in fruit—HAEMODORUM (Austral.).

Tribe 2. **Conostyleae** (all Austral. except *Lophiola*). **A.** Ovary superior: **B.** Anthers without a terminal appendage—LOPHIOLA (N. Amer.). **BB.** Anthers with a terminal appendage—TRIBONANTHES. **AA.** Ovary inferior: **C.** Perianth equally split into lobes: **D.** Flowers capitate; perianth-tube short—CONOSTYLIS. **DD.** Flowers in 1-sided racemes: perianth-tube rather long—BLANCA

(*Styloconus*). **CC.** Perianth more split on the lower side: **E.** Indumentum of perianth not black; ovules 2 or more in each loculus—ANIGOZANTHOS. **EE.** Indumentum of perianth black; ovule solitary in each loculus—MACROPIDIA.

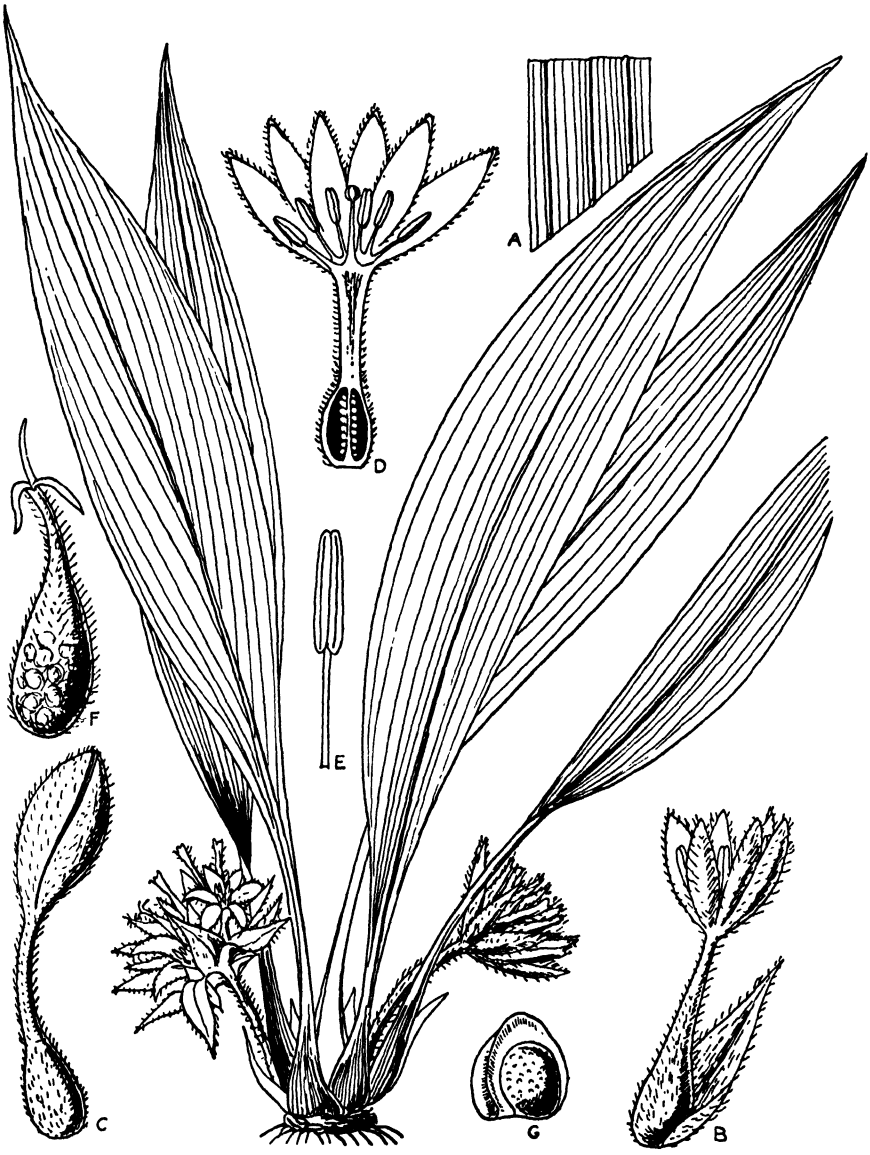


FIG. 406. Curculigo latifolia *Dryand.* (Hypoxidaceae). A, portion of leaf. B, flower and bract. C, flower-bud. D, vertical section of flower, showing all the stamens and segments. E, stamen. F, fruit. G, seed. (Orig.)

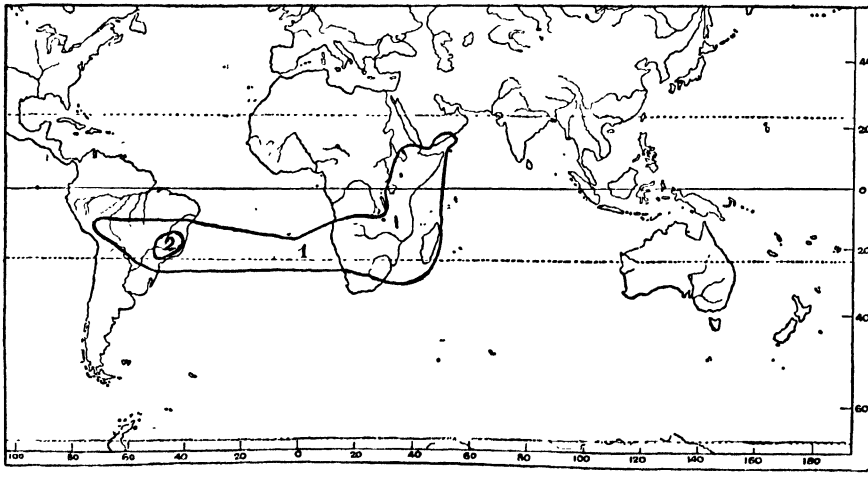
397. HYPOXIDACEAE

Herbs with a tuberous rhizome or a corm covered with membranous or fibrous sheaths. Leaves mostly all radical, usually prominently nerved and often clothed with long hairs. Flowers solitary, spicate, racemose, or subumbellate, mostly white or yellow, actinomorphic, bisexual. Perianth-tube nothing or very short or consolidated into a long beak on top of the ovary; segments 6, spreading, equal-sized and similar in colour. Stamens 6 or rarely 3, opposite the perianth-segments and inserted at their base; anthers introrse or extrorse, 2-locular, entire or 2-lobed at the base, opening by longitudinal slits. Ovary inferior, 3-locular; style short or the three styles separate. Ovules numerous in each loculus, in 2 series on axile placentas, or rarely few. Fruit either a capsule and mostly crowned by the persistent perianth, opening by a circular slit or by short vertical slits near the top, or indehiscent and fleshy. Seeds small, often black, with a distinct lateral hilum; embryo enclosed in abundant endosperm. B.H. **3**, 716 (under *Amaryllidaceae*); E.P. **2**, **15***a*, 425 (under *Amaryllidaceae*); Baker, *Synopsis of Hypoxidaceae* in *J. Linn. Soc. Bot.* **17**, 93–126 (1878).—Mainly S. Hemisphere and Tropical Asia.

A. Fruit a capsule: **B.** Stamens 6: **C.** Styles free; anthers sagittate; flowers solitary or subsolitary—CAMPYNEMA (Tasm.). **CC.** Style columnar: **D.** Anthers basifixed; inflorescence subumbellate-cymose—CAMPYNEMANTHE (New Caled.). **DD.** Anthers dorsifixed near the base; flowers solitary to subumbellate or racemose—HYPOXIS (*Ianthe*, *Rhodohypoxis*) (widely distrib.). **BB.** Stamens 3—PAURIDA (S. Afr.). **AA.** Fruit fleshy and indehiscent, ending in a long beak—CURCULIGO (*Molineria*, *Forbesia*) (widely distrib.).

398. VELLOZIACEAE

Stems woody and fibrous, dichotomously branched, covered with the persistent bases of the fallen leaves; habit arborescent or shrubby. Leaves crowded in a tuft at the ends of the branches, narrow, often pungent-pointed.



Range of Velloziaceae. 1. Vellozia. 2. Barbacenia.

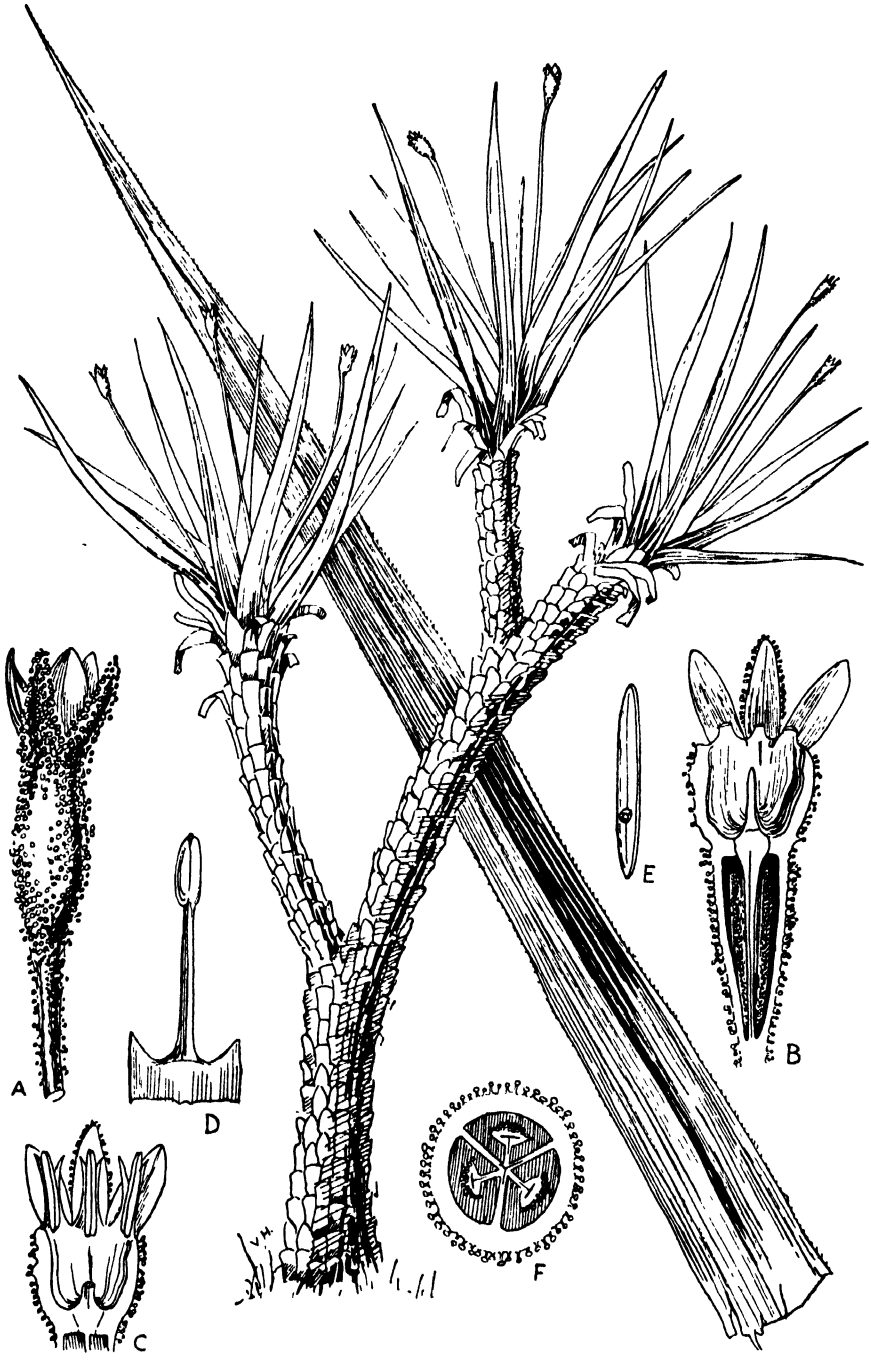


FIG. 407. Barbacenia bicolor *Mart.* (Velloziaceae). A, perianth. B, vertical section of flower with stamens removed. C, upper part of same showing stamens. D, stamen. E, anther. F, cross-section of ovary. (Adapted from Martius.)

Flowers solitary on each peduncle, white, yellow, or blue, sometimes very handsome, actinomorphic, bisexual. Perianth-tube very short or absent; segments equal, spreading. Stamens 6, or numerous and in 6 bundles of 2–6; anthers linear, basifixed, opening by longitudinal slits. Ovary inferior, 3-locular; style slender, with a capitate stigma or 3 short arms. Ovules very numerous on axile, stalked placentas. Fruit a dry or hard capsule, often flat or concave on the top, crowned with the scar of the perianth, or 6-toothed, sometimes spiny, loculicidally dehiscent. Seeds numerous, embryo small in copious, rather hard endosperm. B.H. **3**, 739 (under *Amaryllidaceae*); E.P. **2**, 5, 125 (1887); ed. 2, **15***a*, 431 (1931).—S. Arabia, Tropical and S. Africa, Madagascar, Tropical S. America.

Velloziaceae is a small family confined to Tropical S. America, Tropical and S. Africa, and Madagascar, with one species, *Vellozia arabica* Baker, in the Hadramaut region of S. Arabia. *Vellozia*, as I have seen it myself in Central Africa, grows mainly (perhaps exclusively?) on granite outcrops, and is often the host of small, epiphytic orchids.

Botanists differ as to the better method of distinguishing the genera. Baker, among others, regarded the character of the free or partially united perianth-segments as being of primary importance, whilst Pax relies on the number of stamens. Baker's classification, which is followed here, results in all the African species being named *Vellozia*, with a certain number of species in Tropical S. America, whilst *Barbacenia* is restricted to Brazil. The family needs a careful monograph, and possibly more than two genera should be recognized, a common solution to a difficulty such as this.

A. Perianth-segments free to the base—VELLOZIA (Arabia, Afr., Madag., S. Amer.). **AA.** Perianth-segments united into a tube at the base—BARBACENIA (Brazil).

399. APOSTASIACEAE

Terrestrial herbs from a short rhizome. Leaves elongated, petiolate, plicately nerved. Flowers rather small, in bracteate spikes or racemes. Perianth epigynous, of 6 free, similar, petaloid segments. Stamens 3 or 2, epigynous; filaments united at the base and with the style; anthers free, 2-locular, elongated, opening by slits lengthwise; pollen granular. Ovary inferior, 3-locular, with axile placentas; style slender with minute stigmas. Ovules numerous, anatropous. Fruit a capsule, sometimes shortly beaked. Seeds numerous, small, ellipsoidal. B.H. **3**, 488, as part of tribe *Cypripedieae* of *Orchidaceae*; E.P. **2**, 6, 52. See Rolfe in *J. Linn. Soc. Bot.* **25**, 211–43, t. 48 (1889), and in *Orchid Review*, **4**, 328 (1896)—India and Ceylon through Malay Archip. to Tropical Australia.

A small but intensely interesting family hitherto usually included in the *Orchidaceae*. As noted under that family many Orchidologists (including the late R. Schlechter) consider it quite distinct from *Orchidaceae* proper. I agree with this view and go so far as to place it not with the *Orchidaceae*, but with the *Haemodorales*, and as closely connected with the *Hypoxidaceae*, particularly with *Curculigo*. See diagram under *Orchidaceae*, p. 694.

I consider there may also be relationship between *Apostasia* and *Campylosiphon* in the *Burmanniaceae*.

Key to the Genera[1]

A. Perfect stamens 3; anthers linear or oblong; flowers in simple racemes—NEUWIEDIA (Malacca to New Guin.). **AA.** Perfect stamens 2, the adaxial one

[1] See Rolfe, loc. cit., **4**, 328 (1896).

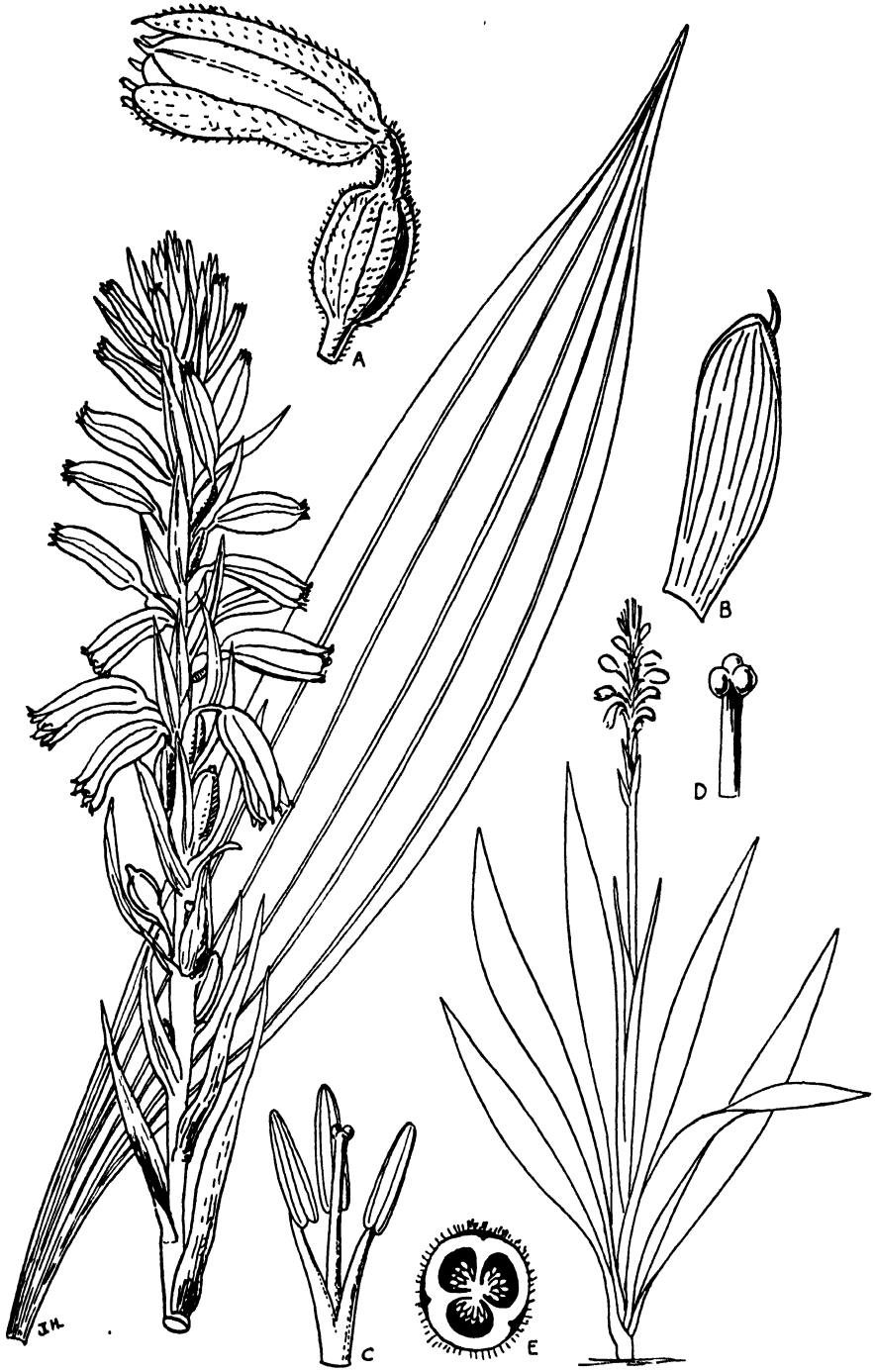


FIG. 408. Neuwiedia lindleyi *Rolfe* (Apostasiaceae). A, flower. B, outer perianth-segment. C, stamens and style. D, stigmas. E, cross-section of ovary. (After *Bot. Mag.*)



FIG. 409. Tacca cristata *Kunth* (Taccaceae). A, flower. B, stamens. C, one stamen, from the side. (After *Bot. Mag.*)

imperfect or absent: **B.** Dorsal stamen modified into a linear staminode partly adnate to the style; anthers oblique at the base—APOSTASIA (India to Trop. Austral.). **BB.** Dorsal stamen entirely suppressed; anthers equal at the base.—ADACTYLUS[1] (India, Malay Archip.).

400. TACCACEAE

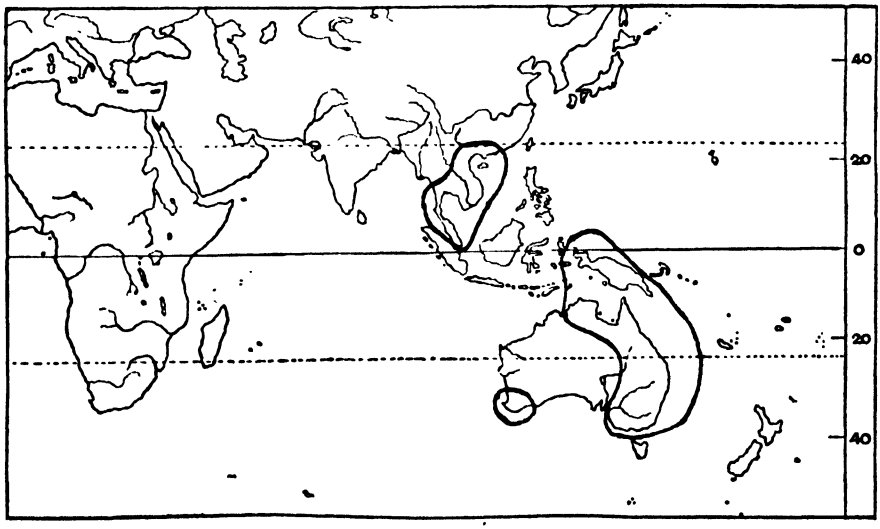
Perennial herbs with a tuberous or creeping rhizome; leaves all radical, large, entire or much-lobed. Flowers actinomorphic, bisexual, umbellate; bracts forming an involucre, the inner ones narrower and often thread-like. Perianth with a short tube and 6 lobes, lobes 2-seriate, mostly somewhat corolline. Stamens 6, inserted on the perianth; filaments short; anthers 2-locular, opening lengthwise by slits. Ovary inferior, 1-locular, with 3 parietal placentas; styles short, the 3 stigmas often petaloid and reflexed over the style; ovules numerous, anatropous. Fruit a berry or rarely opening by 3 valves. Seeds numerous, with copious endosperm and minute embryo. B.H.3, 740; E.P. 2, 5, 127.—Tropical Regions and China.

USEFUL PRODUCTS: An *Arrowroot* or starch is obtained in the South Sea Islands from Tacca pinnatifida *Forst.*

A. Leaves entire; fruit a 3-valved capsule—SCHIZOCAPSA (China). **AA.** Leaves much divided or entire; fruit a berry—TACCA (*Chaitaea, Leontopetaloides*) (Tropics).

401. PHILYDRACEAE

Erect herbs from a short rhizome; leaves linear, radical, or crowded at the base of the stem. Flowers bisexual, zygomorphic, solitary in the axil of spathaceous bracts. Perianth corolline; segments 4, free, 2-seriate. Stamen 1,



Range of Philydraceae.

[1] Probably little more than a section of *Apostasia.*

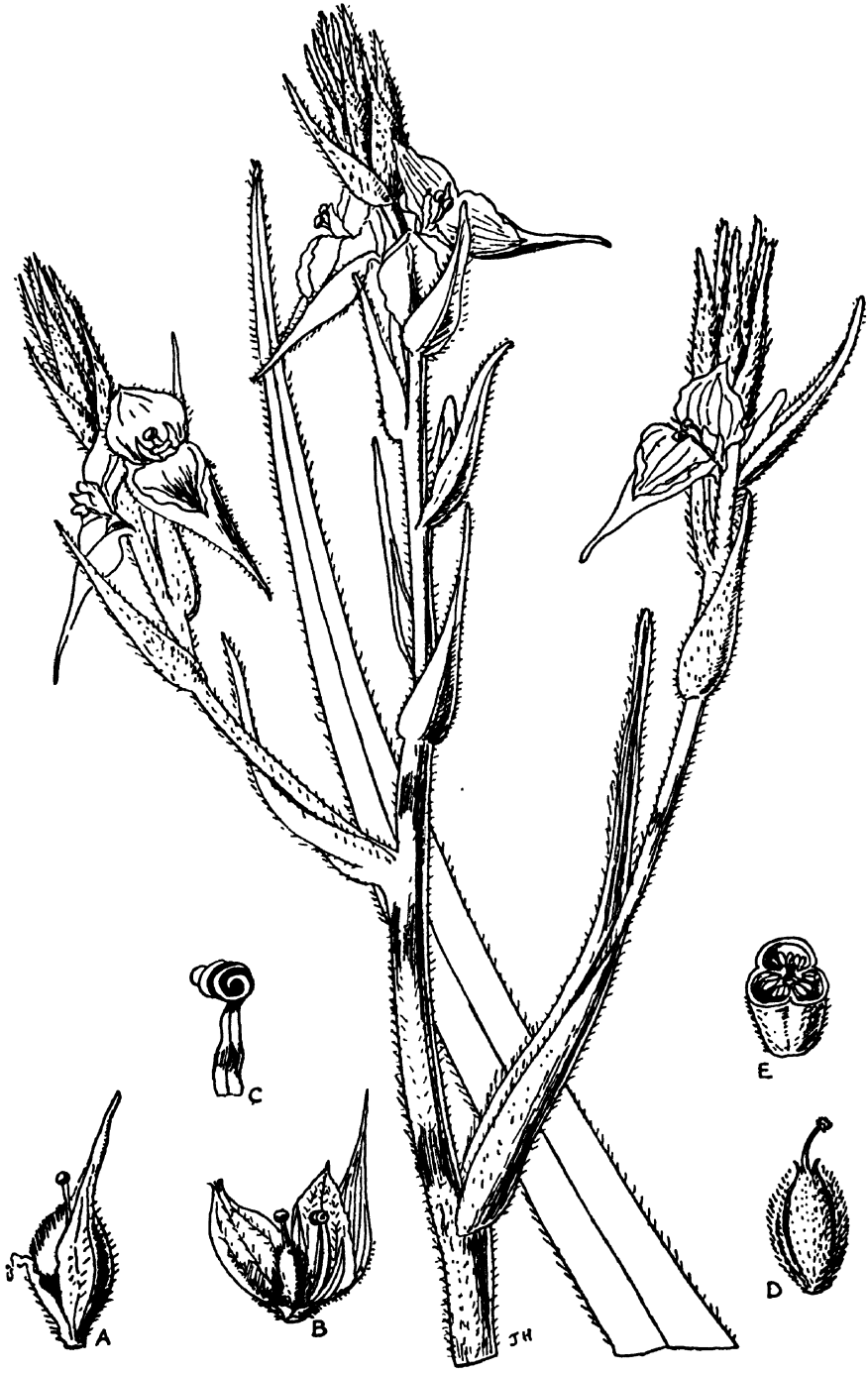


FIG. 410. Philydrum lanuginosum *Banks* (Philydraceae). A, flower. B, same opened out. C, stamen. D, fruit. E, cross-section of ovary.

inserted at the base of the abaxial segments; filament flattened; anther 2-locular, loculi straight or twisted, opening lengthwise by slits. Ovary superior, 3-locular with axile placentas or 1-locular with parietal placentas; style simple; ovules numerous, anatropous. Fruit a capsule opening by 3 valves with a placenta in the middle of each. Seeds numerous, with straight embryo. B.H. **3**, 840; E.P. **2**, 4, 75 (1888); Caruel in DC. *Monographiae* **3**, 1 (1881). See also Skottsberg in Engl. *Bot. Jahrb.* **65**, 253 (1932).—S.E. Asia, New Guinea to Australia.

A. Flowers in simple or little-branched spikes: **B.** Inner perianth-segments free from the filaments of the stamens; ovary imperfectly 3-locular—PHILYDRUM (Burma to E. Austral.). **BB.** Inner perianth-segments partly adnate to the filaments; anther-loculus reflexed from the apex of the filament; inflorescence simple, short, few-flowered—PHILYDRELLA (*Pritzelia*) (W. Austral.). **AA.** Flowers numerous in a much-branched panicle; anther-loculi straight: **C.** Perianth-segments united at the base—HELMHOLTZIA (Austral., New Guin.). **CC.** Perianth-segments free—ORTHOTHYLAX (Austral.).

ORDER 107. BURMANNIALES

Small herbs, often saprophytes, with usually reduced leaves; perianth tubular, outer lobes valvate; stamens 6 or 3; ovary inferior, 1–3-locular; ovules and seeds very numerous and small, the latter with scanty endosperm.

A. Perianth actinomorphic:

B. Perianth-tube cylindrical, shortly lobed, lobes not appendaged; ovary and fruit often winged; ovary 3- or 1-locular; stamens 3 *Burmanniaceae*

BB. Perianth inflated or campanulate, lobes more or less filiform or variously appendaged; ovary 1-locular; fruit not winged; stamens usually 6 *Thismiaceae*

AA. Perianth zygomorphic, one of the outer perianth-segments large and ovate-cordate, the remainder linear; ovary 1-locular, with parietal much-intruded placentas; stamens 6 *Corsiaceae*

A remarkable and very advanced group whose true affinity seems problematical. I have placed them next to *Haemodorales*, and especially near *Hypoxidaceae* (*Curculigo*).

In Bentham and Hooker's *Genera Plantarum* they are ranged in front of the orchids, and with the *Hydrocharitaceae* comprise the series *Microspermae*. There seems no close relationship with *Hydrocharitaceae*, but the affinity with *Orchidaceae* is probably closer than at first appears, the two groups having developed on parallel lines with regard to certain characters such as saprophytism and minute seeds. The common stock for these two lines of evolution seems to be the *Apostasiaceae* (q.v.). Engler also associates the group with the orchids, but excludes the *Hydrocharitaceae*.

402. BURMANNIACEAE

Slender and sometimes very delicate annual or perennial saprophytic herbs with or without leaves, the latter mostly reduced to scales; leaves, when present and well developed, crowded at the base of the stem, linear or lanceolate, green. Flowers mostly blue or white, very rarely yellow, single at the



FIG. 411. Burmannia bicolor *Mart.* (Burmanniaceae). A, upper part of perianth laid open. B, stamen. C, style. D, cross-section of ovary. E, fruit. (Orig.)

apex of the stem or racemosely arranged, or sometimes on one side of a bifurcate cyme, the branches often markedly zigzag. Perianth corolla-like, tubular, usually 6-lobed; tube sometimes 3-winged or 3-angled, outer three lobes *valvate*, inner three smaller and narrower or absent. Stamens 3, sessile or subsessile within the perianth-tube and opposite the inner lobes (when present); anthers 2-locular, dehiscing transversely, connective broadened into an entire or bilobed crest or wing, the loculi sometimes divaricate and stipitate. Ovary inferior, either 3-locular with axile placentas, or 1-locular with 3 parietal placentas, sometimes in the latter case the placentas meeting in the middle at the base of the ovary; style included in the perianth, shortly 3-lobed. Ovules very numerous, minute. Fruit a capsule and usually crowned by the dried up perianth, often 3-winged, usually opening longitudinally between the placentas. Seeds numerous, small, with undifferentiated embryo and scanty endosperm. B.H. 3, 455, partly; E.P. 2, 6, 44, partly.—Tropics and Subtropics of both Hemispheres.

A. Ovary 3-locular, with axile placentas: **B.** Perianth-tube and capsule not winged; tube curved; segments equal, linear—CAMPYLOSIPHON (Brazil). **BB.** Perianth-tube and capsule angled or winged; segments unequal, short. **C.** Capsule 3-angled or 3-winged; perianth-segments persistent; style not exserted —BURMANNIA (Tropics and Subtropics). **CC.** Capsule 6-winged; perianth-segments deciduous; style exserted—HEXAPTERELLA (Brazil). **AA.** Ovary 1-locular, with parietal placentas: **D.** Perianth persistent, not circumscissile: **E.** Seeds linear-lanceolate or almost linear—DICTYOSTEGIA (Trop. Amer.). **EE.** Seeds ovoid-elliptic to subglobose: **F.** Perianth-tube not winged: **G.** Inflorescence once-divided, contracted and head-like—MARTHELLA (Trinidad). **GG.** Inflorescence more or less elongated, laxly racemiform or reduced to one flower—APTERIA (Trop. Amer., West Indies). **GGG.** Inflorescence few-flowered, umbelliform—MIERSIELLA (Brazil). **FF.** Perianth-tube and ovary narrowly 2-winged; flowers 2 cm. long, in bifurcate cymes—DIPTEROSIPHON (Brazil). **DD.** Perianth circumscissile, the upper part deciduous: **H.** Capsule not boat-shaped—GYMNOSIPHON (Tropics). **HH.** Capsule compressed and boat-shaped, more or less winged-keeled on one side—CYMBOCARPA (Trop. Amer., West Indies).—Additional genus (not seen) DESMOGYMNOSIPHON (W. Trop. Afr.).

Note.—I have not seen GEOSIRIS Baill., placed by its author in *Iridaceae*, but considered by Engler and Pax to belong to *Burmanniaceae*. Raised to family rank, *Geosiridaceae*, by Jonker (*Meded. Bot. Mus. Herb. Rijks Univ. Utrecht* 1939:473).

403. THISMIACEAE

Small fleshy *saprophytic herbs* with the leaves reduced to scales. Flowers fairly large, solitary, terminal, mostly yellowish, actinomorphic. Perianth corolla-like, inflated-tubular or campanulate, open or constricted at the mouth; lobes 6 or 3, all with long filiform appendages or three of them broad and suborbicular. Stamens 6 or rarely 3, inserted in or below the throat of the perianth-tube, deflexed and included or shortly exserted; anthers 2-locular, dehiscing by longitudinal slits, the loculi often separated by a broad membranous connective. Ovary inferior, 1-locular, with 3 *parietal* placentas which soon break away from the ovary-locular-wall and become suspended;

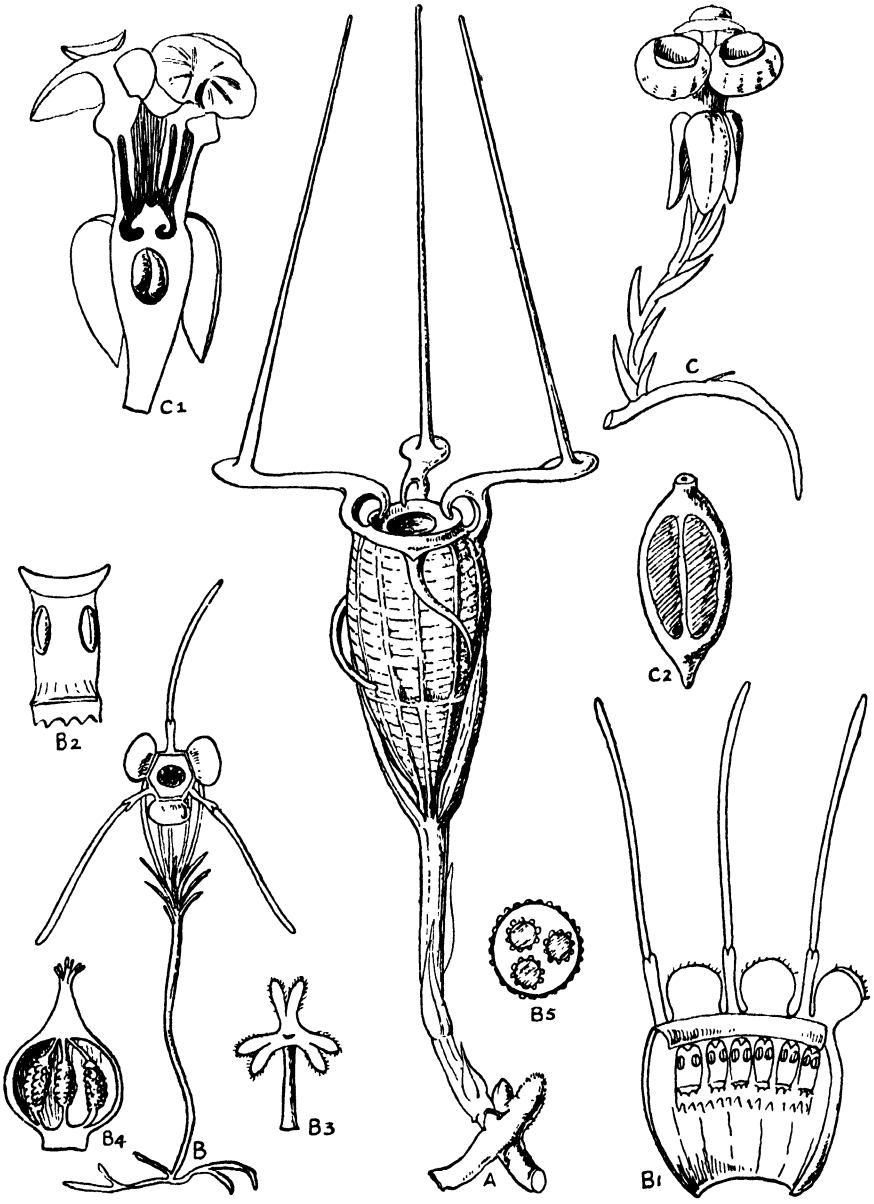


FIG. 412. A, Thismia neptunis *Becc.* (Thismiaceae). B, Thismia gardneriana *Hook. f.* B1, flower opened out. B2, stamen. B3, stigmas. B4, vertical section of ovary. B5, cross-section of ovary. C, Triscyphus fungiformis *Taubert.* C1, flower of same in vertical section. C2, fruit. A, after Beccari. B, after a drawing in Herb. Kew. C, after Warming.

style mostly short, with 3 stigmas; ovules numerous on each placenta. Fruit a circumscissile capsule, more or less truncate. Seeds numerous, small, *without endosperm.* B.H. **3,** 459 (as tribe of *Burmanniaceae*); E.P. **2,** 6, 45 (1889). See also Warming in *Overs. danske Vidensk. Selsk.* 1901, 173–88, tt. iii–iv, and Schlechter in *Notizbl. bot. Gart. Berl.* **8,** 31–45 (1921).—Tropical America, W. Africa, Ceylon, Burma, Malay Peninsula and Archipelago, New Guinea, Tasmania, New Zealand, N. America.

This remarkable group of plants differs so much in appearance and general structure from the *Burmanniaceae* in a restricted sense that I treat them here as a distinct family. They are much more modified from the orthodox type of Monocotyledon than the *Burmanniaceae.* Better collections of most of the species are much desired, especially spirit material, as dried specimens lose a good deal of their character.

The latest classification of this interesting group is by Schlechter in *Notizbl. bot. Gart. Berl.* **8,** 31–45 (1921), rearranged as follows:

Key to the Genera[1]

A. Stamens 6: **B.** Stamens free from one another; Trop. Amer. and W. Afr.: **C.** Inner segments of perianth free at the apices: **D.** Perianth actinomorphic: **E.** Anthers narrow at the base, not sagittate: **F.** Perianth broadly campanulate; anthers bifid at the apex—TRIUROCODON (Brazil). **FF.** Perianth narrowly campanulate; anthers entire at the apex—TRISCYPHUS (Brazil). **EE.** Anthers sagittate at the base—MYOSTOMA (Brazil). **DD.** Perianth zygomorphic: **G.** Stamens inserted at the mouth of the perianth, sagittate—OPHIOMERIS (Brazil). **GG.** Stamens inserted above the base, anther-base gradually narrowed into the filament—AFROTHISMIA (W. Trop. Afr.). **CC.** Inner segments of perianth connate at the top and produced into 3 long filiform appendages —GLAZIOCHARIS (Brazil). **BB.** Stamens connate into a ring or deflexed tube; Trop. Asia, Austral., Extratrop. N. Amer.: **H.** Perianth-segments free at the apex, spreading, or with erect appendages—THISMIA (Trop. Asia, Malay Archip.). **HH.** Perianth-segments (3 inner ones) connate at the apex: **I.** Column of inner perianth-segments nude at the top or with 3 free tips—SARCOSIPHON (*Bagnisia, Geomitra, Rodwaya*) Malay Archip., Tasm., New Zeal., N. Amer.). **II.** Column of inner perianth-segments produced at the top into 3 saucer-shaped lobes—SCAPHIOPHORA (New Guin.). **AA.** Stamens 3—OXYGYNE (W. Trop. Afr.).

404. CORSIACEAE

Erect saprophytic herbs from a perennial rhizome or tubers, the leaves reduced to rather large scales. Flowers solitary, terminal, bisexual or unisexual. Perianth 6-partite; segments 2-seriate, the posterior one of the outer series large and spade-like (cordate-ovate), brightly coloured, sometimes with a large gland inside towards the base, the others linear-filiform and more or less reflexed. Stamens 6, exserted, with distinct filaments; anthers 2-locular, loculi parallel, extrorse, dehiscing longitudinally. Rudimentary ovary present in the male flowers, staminodes in the female. Ovary elongated, 1-locular,

[1] I have seen only a small proportion of these genera and cannot vouch for their distinctness.



FIG. 413. Corsia ornata *Becc.* (Corsiaceae). A, whole plant. B, flower. C, side view of same with adaxial perianth-segment removed. D, back, and E, front of anther. F, ovary. G, cross-section of ovary. H, ovule. I, seed. J, same without appendages. (Orig.)

with 3 parietal, much-intruded, and bifurcate placentas; style short, with 3 short thick stigmas. Ovules numerous on each placenta. Fruit a short and broad or elongated capsule, cylindrical, opening vertically by 3 valves. Seeds numerous, very small, testa reticulate and slightly produced at each end beyond the embryo. B.H. 3, 460; E.P. 2, 6, 50 (1889) (as tribe of *Burmanniaceae*).—New Guinea and Chile.

A. Flowers bisexual; ovary and capsule elongated and cylindrical; placentas much intruded into the ovary-loculus and bifurcate—CORSIA (New Guin.).
AA. Flowers unisexual; ovary and capsule short and globose; placentas slightly intruded—ARACHNITES (Chile).

ORDER 108. ORCHIDALES

Terrestrial, epiphytic or saprophytic herbs; no bulbs; leaves undivided, often fleshy; flowers zygomorphic, mostly bisexual; inflorescence never umbellate or cymose; perianth of 6 petaloid segments in two whorls, or the outer calycine and the inner petaloid; stamens 2 or 1; pollen granular or more usually agglutinated into masses; ovary usually 1-locular with parietal placentas and very numerous ovules, often twisted through 180° and placing the labellum in an abaxial position; seeds minute and very numerous, without endosperm, often drawn out at each end; embryo not differentiated.—Widely distributed; epiphytes mostly in the Tropics.

One family *Orchidaceae*

405. ORCHIDACEAE

Perennial, terrestrial, epiphytic or saprophytic herbs with rhizomes or tuberous roots or rootstock; stem leafy or scapose, frequently thickened at the base into pseudobulbs and bearing aerial assimilating roots. Leaves undivided, alternate and often distichous, rarely opposite, sometimes all reduced to scales, often fleshy, sheathing at the base, the sheath nearly always closed and encircling the stem. Flowers often of very beautiful form and colour but sometimes small and colourless or brown or green, bracteate, bisexual or very rarely polygamous or monoecious, zygomorphic; inflorescence spicate, racemose, or paniculate, or flowers solitary. Perianth epigynous, composed of 6 petaloid segments in 2 whorls, or the outer whorl calyx-like and the inner corolla-like, or the outer rarely corolla-like and the inner minute, free or variously connate in each whorl; outer segments ('sepals') imbricate or subvalvate, the middle segments of each whorl generally different in size and colour from the lateral ones, especially the middle 'petal' which is often extremely complicated in structure and is termed the lip or *labellum*; on account of the twisting of the ovary through 180° the labellum is often placed in an abaxial position; frequently the labellum or more rarely the odd sepal is prolonged into a sac or spur (sometimes very long) often containing nectar or nectar-secreting tissue. Stamens 2 or 1; anther or anthers 2-locular, introrse, opening by a slit lengthwise; pollen granular or generally agglutinated into mealy, waxy, or bony masses (*pollinia*); at one end the pollinium may be extended into a sterile portion (*caudicle*); the pollinia may be free in the anther-loculi or more or less loosely united. Ovary inferior, 1-locular with 3 parietal placentas or very rarely 3-locular with axile placentas (*Selenipedium, Phragmipedium*), often produced at the apex into a special structure (*column*); stigmas 3, fertile (*Cypripedieae*) or more frequently the lateral 2 fertile, the other sterile and transformed into a small outgrowth(*rostellum*) which lies between the anther and the stigmas; a portion of the rostellum is

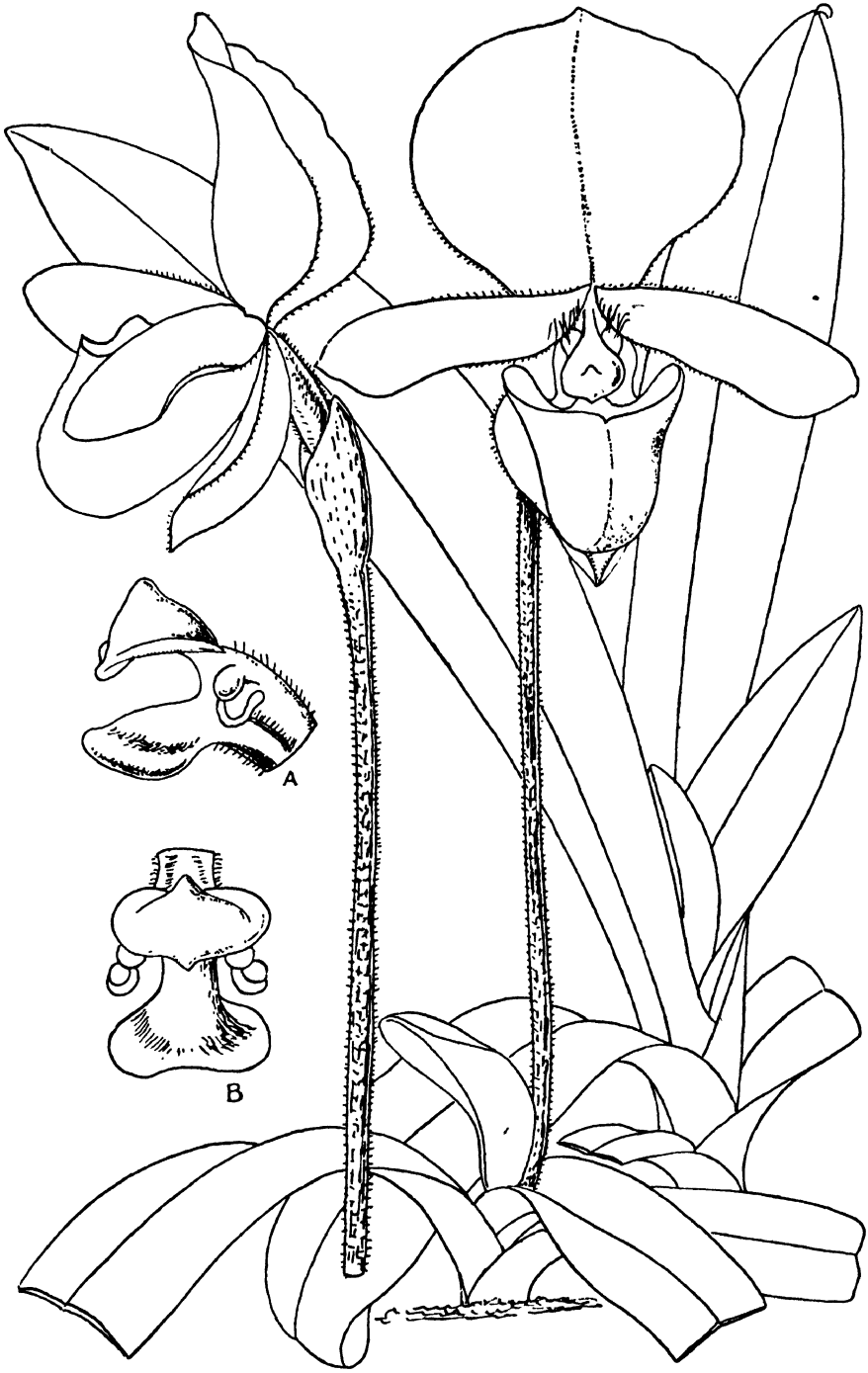


FIG. 414. Paphiopedilum charlesworthii (*Rolfe*) *Pfitz.* (Orchidaceae). A, side view, and B, front view of columella. (After *Bot. Mag.*)

sometimes modified into a viscid disk or disks (*viscidia*) to which the pollinia are attached. Ovules very numerous and minute, anatropous. Fruit usually a capsule, mostly opening laterally by 3 or 6 longitudinal slits. Seeds very numerous, minute, often drawn out at each end or rarely winged, without endosperm; embryo not differentiated. B.H. **3**, 460 (excl. *Apostasieae*); E.P. **2**, 6, 52; Schlechter in *Notizbl. bot. Gart. Berl.* **9**, 567 (1926); Rendle, 346.—Widely distributed, most numerous and of very diverse form in the Tropics; main centres of distribution Indo-Malaya and Tropical America.

USEFUL PRODUCTS: *Faham tea* (dried leaves of Jumellea fragrans (*Thouars*) *Schltr.*; also used in cigars); *Vanilla* (fruit of Vanilla planifolia *And.*); *Salep* (obtained from tubers of various species of Orchis).

As mentioned in the preface to this book, the Orchids require lifelong study and there is not space here to show their detailed classification.

Bentham and Hooker (*Genera Plantarum*) divided the family into 5 tribes, **Epidendreae** (9 subtribes), **Vandeae** (8 subtribes), **Neottieae** (6 subtribes), **Ophrydeae** (4 subtribes), and **Cypripedieae.** The last-mentioned tribe shows the most primitive characters, having 2 stamens and granular pollen. Two genera of that tribe, *Apostasia* and *Neuwiedia* are often now regarded by many orchidologists as sufficiently distinct for family rank, and that view is followed in the present work (see APOSTASIACEAE). I have gone even further and included them in the *Haemodorales*, near *Curculigo* (*Hypoxidaceae*). The remainder of the tribes mentioned have only the one stamen and the aggregation of the pollen into masses (pollinia) so characteristic of the family (and as in *Asclepiadaceae* in the Dicotyledons).

For an account of the family as classified in Engler and Prantl's *Pflanzenfamilien*, the student is referred to Rendle's *Classification of Flowering Plants*, vol. i, pp. 346–77, and I give below Schlechter's classification into tribes which follows the same general principles.

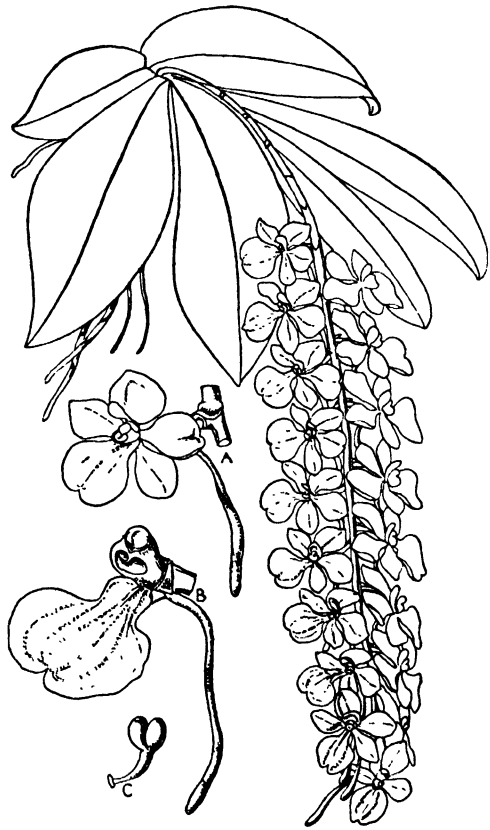


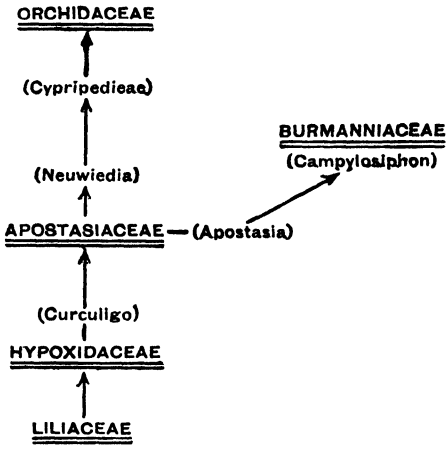
FIG. 415. Aerangis citrata *Schltr.* A, flower. B, lip and column. C, pollinia. (After *Bot. Mag.*)

My late colleague, R. A. Rolfe, was for many years the greatest British authority on the family, and fortunately he was keenly interested in phylogeny. In the *Orchid Review*, which he founded and edited for many years, he published a most interesting and comprehensive account of the phylogeny of the *Orchidaceae*, to which the student is referred for detailed information. See *Orchid Review*, **17**, 129–32, etc. (1909).

The evolution of the orchid flower and of genera and species with special reference to British genera is dealt with by the late Col. Godfrey in his comprehensive *Monograph of*

Native British Orchidaceae (Cambr. Univ. Press, 1933). See also Summerhayes, *Wild Orchids of Britain* (Collins, 1951).

I give below a small diagram showing the origin and connecting links between this wonderful and interesting family and other Monocotyledons.



Schlechter's Classification of ORCHIDACEAE[1]

A. Stamens 2, representing the lateral 2 of the inner whorl, a third stamen transformed into a large staminode placed above the anthers and more or less covering the style; 3 stigmatic lobes fertile; pollen granular, not united into masses or bodies.

Subfamily I. **DIANDRAE**

One tribe, CYPRIPEDIEAE (*Cypripedium*)

B. Stamen solitary, representing the abaxial[2] member of the outer whorl, the lateral completely abortive or forming small staminodes; 2 lateral stigmatic lobes fertile, the middle one extended into a usually small rostellum (small beak), placed in front of the anther-loculi and bearing the viscidia or apices of the pollinia; pollen united into masses or solid bodies (*pollinia*).

Subfamily II. **MONANDRAE**

I. Caudicle and viscidium arising from the base of the pollinia; anthers erect or more or less resupinate, very closely adnate to the broad-based column, never deciduous after flowering; pollinia always granular

Division I. *Basitonae*

One tribe, OPHRYDOIDEAE (*Habenaria, Orchis*, &c.)

II. Caudicle and viscidium arising from the apex of the pollinia; anthers erect or incumbent, the filament short, slender, generally

[1] I give above a translation of the latest classification of the tribes of Orchidaceae by Schlechter in *Notizbl. bot. Gart. Berl.* **9**, 567 (1926).

[2] In theory this is the *abaxial* member, but in most orchids the ovary is twisted through 180° and brings the stamen into an *adaxial* position.

narrowly joined to the column, usually deciduous, but if persistent soon withering

Division II. *Acrotonae*

(*a*) Pollen granular, soft; anther mostly persistent; inflorescence always terminal Tribe 3. POLYCHONDREAE (*Spiranthes, Vanilla,* &c.)

(*b*) Pollen waxy or bony; anther generally soon deciduous; inflorescence terminal or lateral Tribe 4. KEROSPHAEREAE

1. Inflorescence usually terminal or by the abortion of the terminal inflorescence axillary in the uppermost leaves

Series a. *Acranthae* (*Coelogyne, Dendrobium, Liparis,* &c.)

2. Inflorescence lateral, arising near the base of the pseudobulbs or in the axils of the lower leaves or sheaths

Series b. *Pleuranthae*

Plant forming a sympodium, the stem ending in leaves

Subseries a. *Sympodiales* (*Bulbophyllum, Cymbidium, Oncidium,* &c.)

Plant forming a monopodium, the stem with indefinite apical growth Subseries b. *Monopodiales* (*Vanda, Angraecum,* &c.)

DIVISION III. GLUMIFLORAE

ORDER 109. JUNCALES

Perennial or annual herbs, rarely shrubby; leaves linear, often grass-like, sheathing at the base, sheaths open or closed, or often the leaf-blade reduced and the sheath embracing the stem; flowers mostly *anemophilous*, very small, spicate or capitate or paniculate; perianth glumaceous, in 2 whorls or much reduced or absent; stamens 6, 3, or 2–1; anthers 2- or 1-locular; ovary superior; fruit a capsule or nut.—World-wide distribution; some families almost entirely austral.

A. Flowers bisexual or if unisexual then plants cushion-like and flowers solitary; leaf-blades not or rarely reduced:

B. Stamens 6 or 3; anthers basifixed; perianth usually present:

C. Flowers solitary or small and fasciculate, the fascicles variously paniculate; stamens 6 or 3 *Juncaceae*

CC. Flowers in dense globose or ellipsoidal heads subtended by leaf-like bracts; stamens 6 *Thurniaceae*

BB. Stamen 1 or rarely 2; ovule solitary in each loculus, pendulous; anthers versatile; perianth absent *Centrolepidaceae*

AA. Flowers dioecious; leaf-blades usually reduced, the sheaths more or less embracing the stems; stamens 3; perianth usually present *Restionaceae*

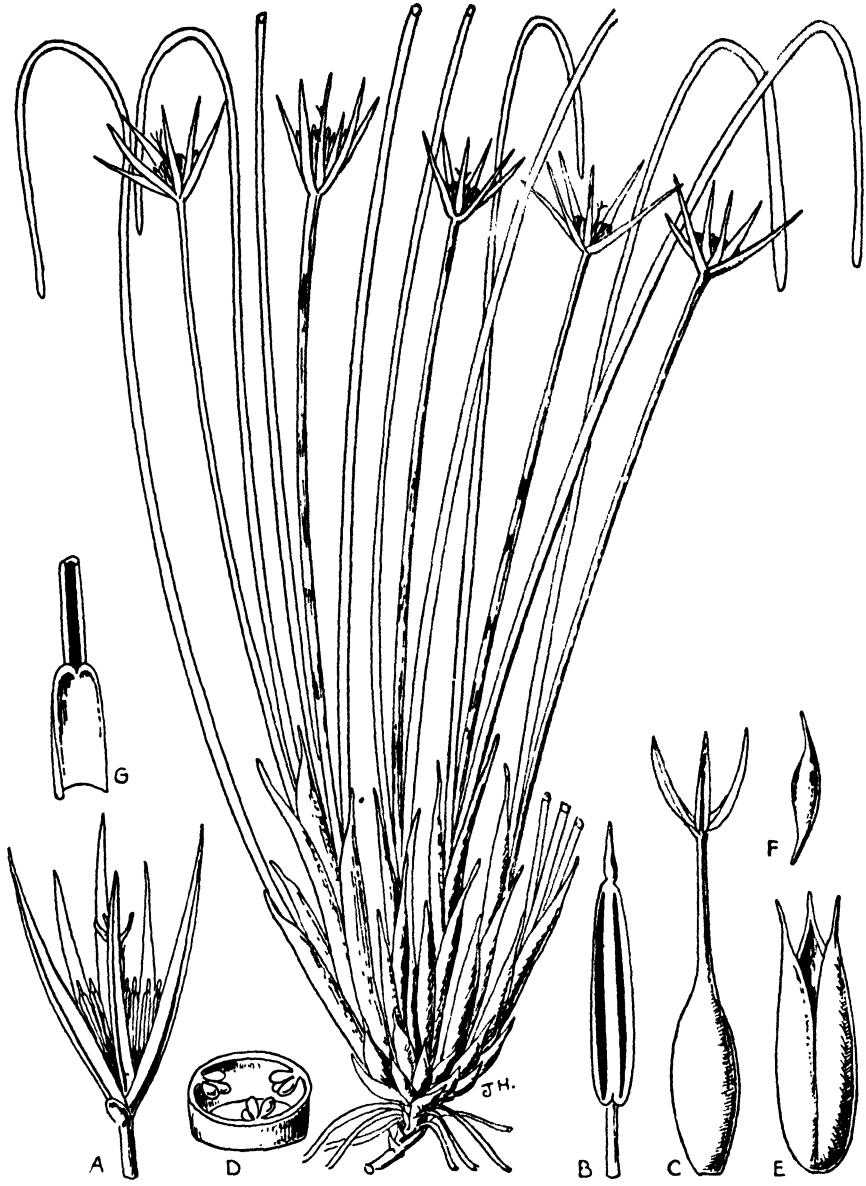


FIG. 416. Marsippospermum gracile (*Hook. f.*) *Buch.* (Juncaceae). A, flower. B, stamen. C, pistil. D, cross-section of ovary. E, fruit. F, seed. G, ligule. (Orig.)

406. JUNCACEAE

Perennial or annual herbs, rarely shrub-like (*Prionium*), often with hairy roots; rhizome erect or horizontal; stems mostly leafy only at the base. Leaves mostly in a basal tuft, cylindrical to flat and grass-like, mostly linear or filiform, sheathing at the base or entirely reduced to a sheath, sheaths open or closed, sometimes ciliate at the top. Flowers mostly anemophilous, solitary or more usually in panicles, corymbs, or heads, often very small, actinomorphic, bisexual or unisexual and dioecious. Perianth-segments 6, in two whorls, or rarely only 3, glumaceous to coriaceous, rarely scarious, greenish or reddish brown to black or rarely white or yellowish. Stamens 6 or 3, free, opposite the perianth-segments; anthers 2-locular, basifixed, introrse, opening by a slit lengthwise; pollen in tetrads. Ovary superior, 1-locular or divided by 3 septa or 3-locular; style long to almost nothing, or styles 3; stigmas 3. Ovules ascending or parietal, numerous to 3, inserted at the base of the ovary or biseriate on the parietal placentas. Fruit a dry capsule, 1–3-locular, loculicidally dehiscent. Seeds sometimes tailed, with a small, straight embryo in the middle of the endosperm. B.H. **3**, 861, partly (excl. tribes *Xeroteae* and *Calectasieae*); E.P. **2**, 5, 1 (1888); edn. 2, **15***a*, 192 (1930); Buchenau in Engl. *Pflanzenr.*, *Juncaceae* (1906).—World-wide distribution, more numerous in Temperate and cold or montane Regions; usually in wet or damp habitats.

USEFUL PRODUCTS: *Juncio* (Juncus maritimus *Lam.*); *Palmite* (Prionium palmita *E. Mey.*); *Split Rushes* (Juncus effusus *L.*).

I have followed the limits of the family *Juncaceae* as defined by Buchenau edn. 1, and by Vierhapper in edn. 2 of Engler's *Pflanzenfamilien*. Bentham and Hooker's first two tribes, *Xeroteae* and *Calectasieae*, which are exclusively Australian are thus excluded, leaving a more homogeneous group. In the present work these tribes are treated as a separate family, *Xanthorrhoeaceae*, whilst *Thurnia*, regarded in the *Genera Plantarum* as a 'genus anomalum', will be found as THURNIACEAE (see p. 699).

Juncaceae are closely related to *Liliaceae*, and are clearly reduced forms derived directly from that stock. They show a distinct tendency towards the evolution of higher and more reduced families such as *Restionaceae* and *Cyperaceae* on account of their glumaceous bracts, reduced perianth, and general facies. But their nearest relatives are the *Restionaceae*, which have become almost entirely dioecious.

Oreobolus (see fig. 420), a primitive genus of *Cyperaceae*, is very closely related to *Juncaceae*.

A. Flowers solitary: **B.** Flowers bisexual: **C.** Not cushion-plants: **D.** Perianth-segments equal in length; seeds obovoid—ROSTKOVIA (Antarct.). **DD.** Perianth-segments unequal, the inner shorter; seeds pointed at each end —MARSIPPOSPERMUM (Antarct.). **CC.** Thick cushion-plants; perianth-segments of equal length; seeds ovoid—ANDESIA (Andes of the Argentine). **BB.** Flowers dioecious; cushion plants: **E.** Leaves irregularly arranged, with spreading blades—OXYCHLOE (*Patosia*) (S. Amer. Andes). **EE.** Leaves in 2 rows, with erect blades—DISTICHIA (S. Amer. Andes). **AA.** Flowers not solitary, usually bisexual: **F.** Herbs with entire leaves: **G.** Leaf-sheaths open (very rarely closed), with glabrous blades or blades reduced; seeds numerous—JUNCUS (Cosmopol.). **GG.** Leaf-sheaths closed, with more or less ciliate blades; seeds 3—LUZULA (mostly N. Hemisph., rare in S. Hemisph.). **FF.** Subarborescent with a terminal tuft of toothed leaves; leaf-sheaths closed;

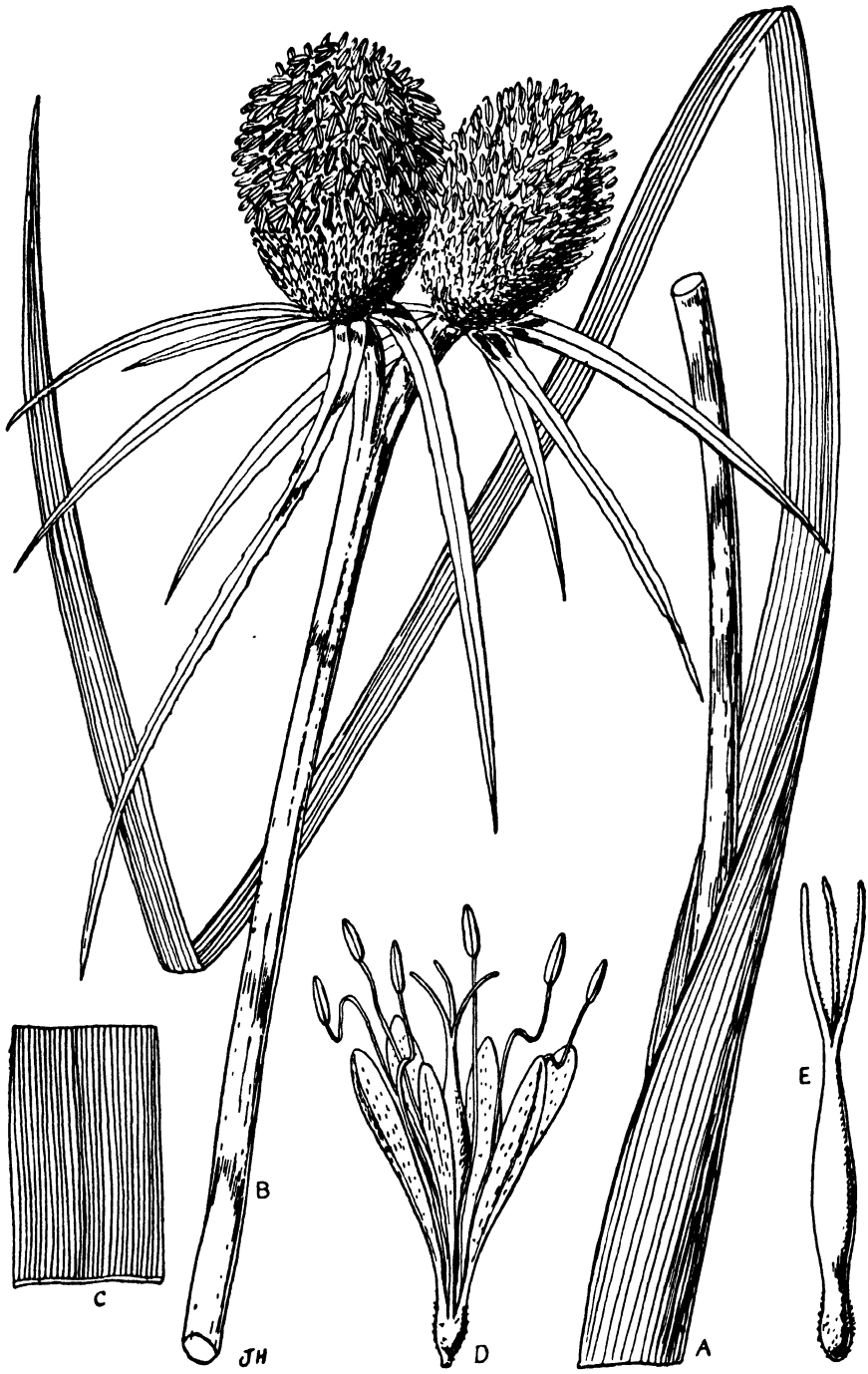


FIG. 417. Thurnia jenmanii *Hook. f.* (Thurniaceae). A, leaf. B, flowering scape. C, portion of leaf showing nerves. D, flower. E, pistil. (Orig.)

ovary 3-locular, with axile placentas; styles 3, free; flowers in large panicles—PRIONIUM (S. Afr.).

407. THURNIACEAE

Herbs; leaves elongated, leathery, sheathing at the base, with smooth or spinulose-serrate margins. Scapes stout, obtusely 3-angled. Flowers densely crowded in heads, with leafy bracts, sessile or stalked. Perianth-segments 6, free, irregularly arranged below the ovary, persistent. Stamens 6, hypogynous, free, much longer than the perianth and conspicuous at flowering time; filaments slender; anthers basifixed, erect, opening lengthwise by slits. Ovary 3-locular; stigmas 3, filiform; ovules axile, solitary to few towards the base of the ovary, anatropous. Fruit a 3-angled capsule, 3-locular, loculicidally 3-valved, 3-seeded. Seeds elongated, narrowed at one end into a slender point, with endosperm; embryo axile, fusiform. B.H. **3**, 869 (under Juncaceae); Engl. and Gilg, *Syllabus*, edn. 7, 152 (1924); E.P. edn. 2, **15***a*, 58. British Guiana, 2 species, one in the savannah, the other near rivers.—THURNIA.

408. CENTROLEPIDACEAE

Small, tufted, perennial or annual herbs resembling grasses, sedges, *Juncaceae*, or even mosses; leaves linear or thread-like, usually crowded or closely

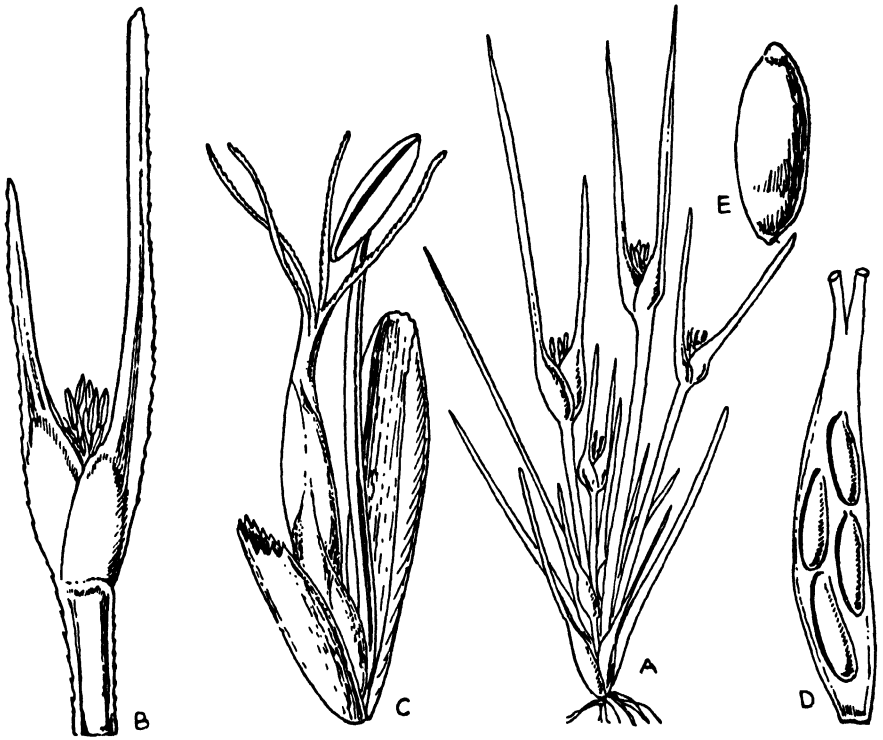


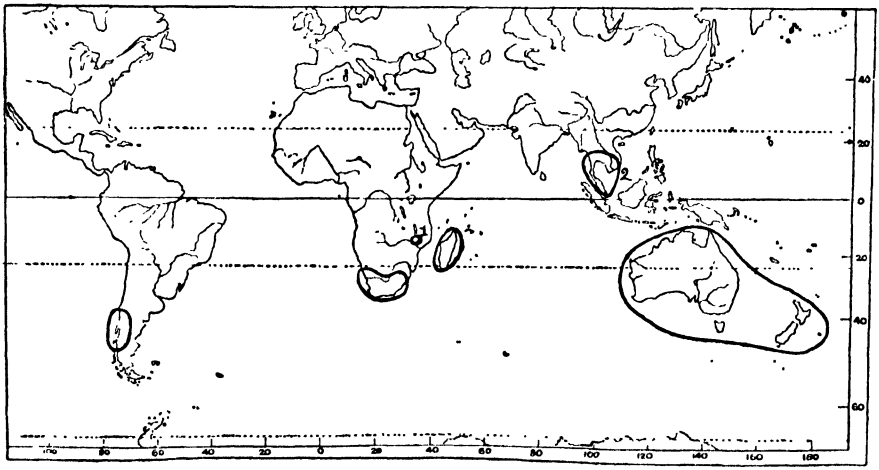
FIG. 418. Centrolepis aristata (*R. Br.*) *Roem. and Schult.* (Centrolepidaceae). A, whole plant. B, flowerhead. C, one flower. D, vertical section of ovary showing superposed ovules. E, seed. (After Hook. f.)

imbricate. Flowers very small, bisexual or unisexual, rarely solitary, usually spicate or capitate, mostly subtended by 1–3 glume-like bracts. Perianth absent. Stamen 1 or rarely 2; filaments thread-like; anthers 1–2-locular, introrse, versatile, oblong or linear, opening lengthwise by a slit. Ovary collaterally 1–3-locular, or loculi or carpels 2 or more and superposed in 1–2-series; styles free to connate, undivided. Ovule solitary and pendulous in each loculus or carpel, orthotropous. Fruit small, with a membranous pericarp opening lengthwise. Seeds solitary in each loculus or carpel, with abundant endosperm and small marginal embryo. B.H. **3**, 1025; E.P. **2, 4**, 11; edn. 2, **15***a*, 27; Benth. *Fl. Austral.* **7**, 198.—Mainly in Australia and New Zealand; a few in New Guinea, Borneo, Philippines, Cambodia, and S. America.

A. Perennials with tufted branches, densely leafy and moss-like: **B.** Flowers actinomorphic; stamens 2—GAIMARDIA (Antarct.). **BB.** Flowers zygomorphic, bisexual or unisexual; stamen 1—PSEUDALEPYRUM (*Alepyrum*) (Antarct.). **AA.** Annuals with radical leaves and scapigerous flowers: **C.** Anthers 2-locular; flowers in a head surrounded by bracts, unisexual—JUNCELLA (*Trithuria, Hydatella*) (S. Austral. to New Zeal.). **CC.** Anthers 1-locular: **D.** Flowers in a flat spike with several distichous bracts: **E.** Flowers bisexual except in the lowest bract; bracts narrow, loosely imbricate—APHELIA (S. Austral., Tasm.). **EE.** Flowers unisexual; bracts closely imbricate—BRIZULA (S. Austral., Tasm.). **DD.** Flowers within 2 alternate leaf-like bracts usually bisexual—CENTROLEPIS (Antarct.).

409. RESTIONACEAE

Perennial herbs with a tufted or creeping rhizome clothed with scale-like sheaths; stems quadrangular or flattened, solid or fistular with a deciduous or persistent leaf-sheath at each node; sheaths rarely produced at the apex



Range of family Restionaceae. 1. Hypolaena Mahoni in Nyasaland. 2. Leptocarpus in Cochin China, Thailand, Malay Penin., and in Chile. In Madagascar only 1 species, Restio madagascariensis *Chermez*, this genus being also in Australia and S. Africa.

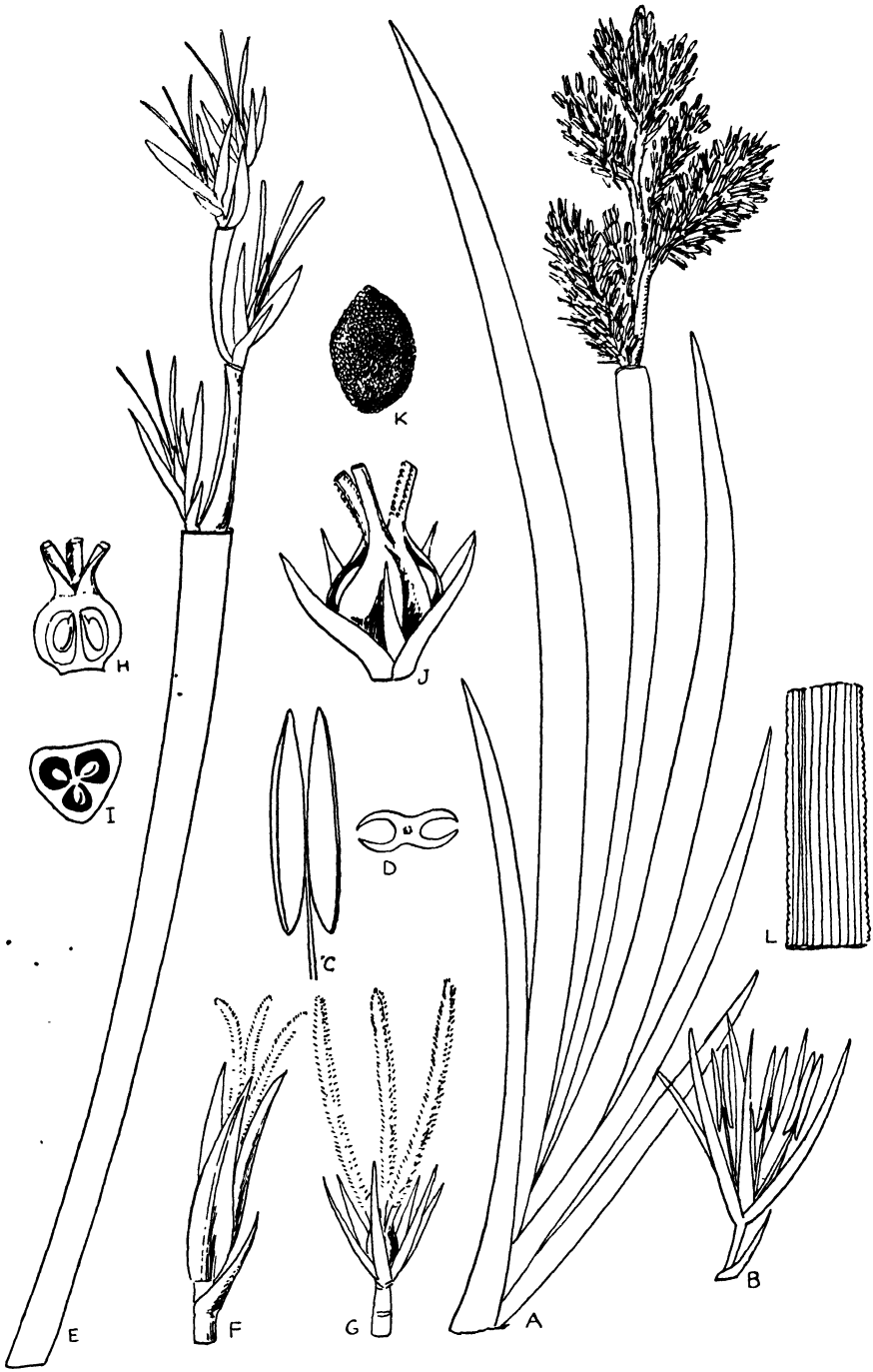


FIG. 419. Anarthria scabra *R. Br.* (Restionaceae). A, male plant. B, male flower. C, anther. D, cross-section of anther. E, female inflorescence. F, female flower and bracts. G, female flower. H, vertical section, I, cross-section, of ovary. J, fruit. K, seed. L, portion of leaf. (Orig.)

into a foliaceous reduced blade which sometimes falls off. Flowers small, dioecious or rarely monoecious (or bisexual), arranged in spikelets in usually lax inflorescences, the latter mostly similar but sometimes differing in the two sexes; spikelets 1- to many-flowered, usually with a sheath-like spathe at the base. Perianth actinomorphic, of 3–6-glume-like scarious or hyaline segments in two series, or rarely perianth absent. Stamens 3, opposite the inner perianth-segments; filaments slender, free or rarely connate; anthers 1-locular or rarely 2-locular, dorsifixed, often apiculate, introrse and opening lengthwise by slits; rudimentary ovary present or absent. Female flower with or without 3 small staminodes. Ovary superior, 1–3-locular; styles 1–3, free or variously connate, slender, sometimes plumose. Ovule solitary in each loculus of the ovary, pendulous from the apex, orthotropous. Fruit dry and nut-like, or a capsule compressed to 3-sided. Seeds pendulous, with copious endosperm and small embryo. B.H. **3**, 1027; E.P. **2**, 4, 3; edn. 2, **15***a*, 8 (1930); Bentham, *Fl. Austral.* **7**, 208; Pillans in *Trans. Roy. Soc. S. Afr.*, **16**, 207 (1928) (S. African species only); Rendle, 271.—S. Africa and S.E. Tropical Africa, Australia, New Zealand, Indo-China, Malay Peninsula, Chile.

USEFUL PRODUCTS: Many species used in S. Africa for thatching and making brooms.

This highly interesting family is nearly limited to the S. Hemisphere, the genus *Leptocarpus* alone occurring in Indo-Malaya (see map), and there represented by a single species, *L. disjunctus* Mast. The genus is also found in Chile, where there is an endemic species. It depends entirely on the point of view as to their limits in regard to the number of genera that may be said to occur both in S. Africa and Australia, the main centres of distribution of the family. According to Bentham and Hooker's classification, two genera are common to these areas, *Restio* and *Leptocarpus*; but, as in the case of *Proteaceae*, the same species is not found in the two regions. In the latest account of the family by Gilg–Benedict in Engler's *Pflanzenfamilien*, edn. 2 (1930), however, the S. African species previously referred to *Leptocarpus* are treated as a separate genus, *Calopsis*. Curiously, the family is represented by only one species, *Restio madagascariensis* Chermez, in the island of Madagascar.

Restionaceae are closely related to *Juncaceae*, differing by their pendulous ovule and unisexual, mostly dioecious flowers. Superficially they resemble *Cyperaceae*, and in certain regions of S. Africa and Australia, where they are numerous, they take the place of grasses in the vegetation.

The family is most conveniently divided into two groups, the more primitive having 2 anther-loculi, the more advanced and reduced, 1 anther-loculus. Those genera with 2 anther-loculi are found only in Australia, which is probably the ancestral home of the family. The most primitive living genus seems to be *Anarthria*, in SW. Australia. The leaves of some species of this genus are obviously *Juncaceous* and not reduced to sheaths, and the flowers also resemble those of *Juncaceae*. The perianth is well developed and the inflorescence of some species is a loose panicle of spikes.

According to Pillans, the genus *Phyllocomos* (S. Africa) has *bisexual* flowers, but Masters describes them as monoecious and this is repeated in the second edition of the *Pflanzenfamilien*. If the flowers of this rare S. African plant are really bisexual, then as regards sex it is comparatively ancient. Further investigation is desirable. Bisexual flowers are known in one species of *Lepyrodia*, *L. hermaphrodita* R. Br., in Australia. In regard to this one feature, therefore, these two genera still retain a character which links them with those *Juncaceae* which have bisexual flowers, such as *Juncus* and *Luzula*.

The most highly evolved *Restionaceae* are probably those in which the male and female inflorescences are different from each other.

In the key given below I have followed in the main the *Pflanzenfamilien*.

A. Anthers 2-locular: **B.** Filaments free: **C.** Ovary 3-locular; styles 3, free; radical leaves well-developed, Iris-like; spikelets several, arranged in spikes or

panicles—ANARTHRIA (SW. Austral.). **CC.** Ovary 2-locular; styles 2, free; no radical leaves; spikelets solitary; leaf-sheaths persistent—ECDEIOCOLEA (SW. Austral.). **CCC.** Ovary 1-locular; style 1, undivided; spikelets 1–2; leaf-sheaths persistent—HOPKINSIA (W. Austral.). **BB.** Filaments connate at the base or into a column; male spikelets few, spicate, female often solitary, 1-flowered; leaf-sheaths persistent—LYGINIA (SW. Austral.). **AA.** Anthers 1-locular: **D.** Flowers bisexual or monoecious: **E.** Ovary 1-locular: **F.** Styles 2, free; fruit indehiscent; leaf-sheaths persistent: **G.** Bracts present; membranous, aristate—PHYLLOCOMOS (S. Afr.). **GG.** Bracts absent—LOXOCARYA (W. Austral.). **FF.** Style 1, undivided—COLEOCARYA (NE. Austral.).—related genus MEEBOLDINA (W. Austral.). **EE.** Ovary 3-locular; fruit dehiscent—LEPYRODIA HERMAPHRODITA. **DD.** Flowers dioecious: **H.** Stems with leaf-sheaths only at the base; fruit unknown; ovary 1-locular, 1-ovulate; style simple—ONYCHOSEPALUM (SW. Austral.). **HH.** Stems provided with persistent or deciduous leaf-sheaths: **J.** Fruit dehiscent, angular and dehiscing at the angles: **K.** Leaf-sheaths deciduous or nearly all deciduous: **L.** Fruits 3-locular, 3-lobed: **M.** Stigmas 3, sessile—CHONDROPETALUM (*Dovea*) (S. Afr.). **MM.** Stigmas not sessile—LEPYRODIA (Austral., New Zeal.). **LL.** Fruits 2-locular; styles 2—ASKIDIOSPERMA (S. Afr.). **KK.** Leaf-sheaths persistent: **N.** Style thick and columnar in the lower part, 2-armed; spikes terminal, solitary, many-flowered—DIELSIA (W. Austral.). **NN.** Style not thick in the lower part, or styles free, or if united then not thick: **O.** Glumes not imbricate or only slightly so; spikelets of both sexes many-flowered—LEPYRODIA (Austral., New Zeal.). **OO.** Glumes imbricate; spikelets of both sexes many-flowered or female 1-flowered: **P.** Ovary 3–2-locular with 1 ovule in each—RESTIO (S. Afr., Austral.). **PP.** Ovary 1-locular with 1 ovule—LEPTOCARPUS (Cochin China to Austral. and in Chile). **JJ.** Fruit indehiscent, mostly rounded, rarely compressed or angular: **Q.** Glumes imbricate: **R.** Leaf-sheaths deciduous or most of them soon deciduous: **S.** Male spikelets few-flowered, female 1-flowered—ELEGIA (S. Afr.). **SS.** Male and female spikelets many-flowered—LEPIDOBOLUS (S. Austral.). **RR.** Leaf-sheaths persistent: **T.** Female spikelets several- to many-flowered: **U.** Perianth-segments not winged-keeled: **V.** Styles or style-arms 2–3; **W.** Fruits 3-angled; styles 3—CALOPSIS (S. Afr.). **WW.** Fruits ovoid or globose; styles 2, free—CANNOMOIS (S. Afr.). **WWW.** Fruits compressed; styles 2—LAMPROCAULOS (S. Afr.). **VV.** Style simple, stigmatic from below the middle; 3 outer perianth-segments linear, 3 inner hair-like—CHAETANTHUS (SW. Austral.). **UU.** Perianth-segments winged-keeled (or some of them, especially of the female flowers): **X.** Style 1—THAMNOCHORTUS (S. Afr.). **XX.** Styles 2–3, free or partially connate—STABEROHA (S. Afr.). **TT.** Female spikelets 1-flowered, rarely 2-flowered: **Y.** Fruits sessile: **Z.** Style or style-arms 3: **A, 1.** Male spikelets all pedicellate in a small panicle—HYPOLAENA (Austral.). **AA, 1.** Male spikelets solitary or paired, 1 sessile, the other pedicellate—CALOROPHUS (Austral.). **ZZ.** Style or style-arms 2: **B, 1.** Stem more or less 4-angled—ANTHOCHORTUS (S. Afr.). **BB, 1.** Stem terete or compressed—MASTERSIELLA (S. Afr.). **ZZZ.** Style 1, undivided: **C, 1.** Perianth-segments 6, or rarely absent from the female flower—LOXOCARYA (W. Austral.). **CC, 1.** Perianth-segments 5—HARPERIA (W. Austral.). **YY.** Fruit stipitate; styles 2, or style 2-branched:

D, 1. Ovary surrounded by a disk, 1-locular—HYPODISCUS (S. Afr.). **DD, 1.** Ovary not surrounded by a disk—CANNOMOIS (S. Afr.). **QQ.** Glumes not imbricate; fruit sessile or stipitate—WILLDENOWIA (*Ceratocaryum*) (S. Afr.).

ORDER 110. CYPERALES

Perennials (or rarely annuals) with rhizomes; stems usually full of pith, rarely hollow, mostly triquetrous; leaves narrow, grass-like, sheathing at the base, rarely ligulate; flowers very small, bisexual or unisexual, arranged in heads or small spikes, solitary within a glume-like bract, the latter spirally or distichously arranged; perianth reduced to scales or bristles or absent; stamens usually 3; anthers basifixed, 2-locular; ovary superior, 1-locular, with 1 erect ovule; fruit nut-like, indehiscent; endosperm copious.—World-wide distribution.

One family *Cyperaceae*

410. CYPERACEAE

Perennial or rarely annual herbs, usually in damp or marshy habitats, often tufted or from a creeping rhizome; stems solid or rarely hollow, often

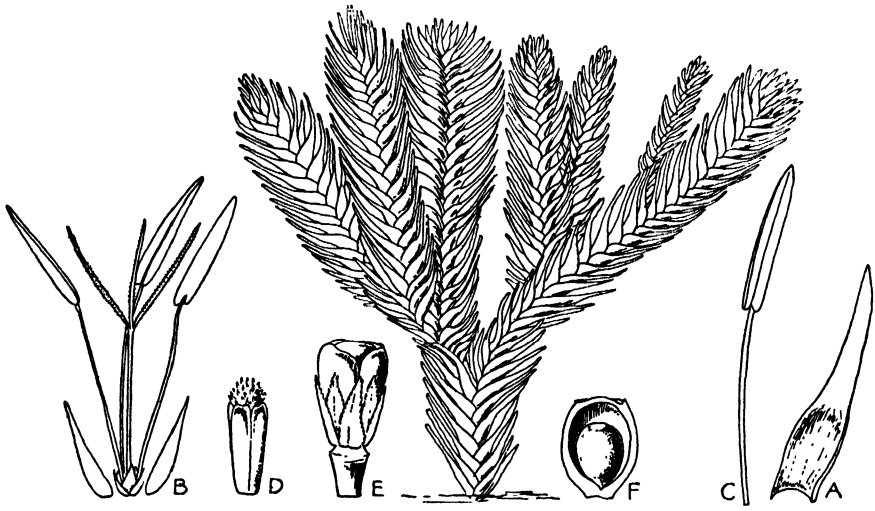


FIG. 420.—Oreobolus pectinatus *Hook. f.* (Cyperaceae), a very primitive type of the family. A, leaf. B, flower and bract. C, stamen. D, ovary. E, ovary and perianth. F, vertical section of fruit showing seed. (Orig.)

triquetrous, mostly simple below the inflorescence. Leaves usually in a basal tuft or crowded on the lower part of the stem, with a closed or open sheath at the base and a narrow grass-like blade, rarely the blades entirely reduced; ligule very rare. Flowers very small and inconspicuous, bisexual, or unisexual and monoecious or very rarely dioecious, arranged in small spikes (spikelets), and each usually solitary within a bract (glume); bracts (glumes) distichously



FIG. 421.—Cyperus compressus *Linn.* (Cyperaceae). A, flower and subtending glume. B, flower. C, stamen. D, nutlet and styles. (Orig.)

or spirally arranged; rarely the female spikelets reduced to one bract and one flower; spikes variously umbellate, paniculate or rarely spicately arranged; inflorescence subtended by one or more usually leaf-like involucral bracts. Perianth reduced to scales, bristles, or hairs, very rarely subpetaloid, often absent. Stamens hypogynous, 3 or fewer, very rarely more or numerous; filaments free; anthers basifixed, oblong or linear, 2-locular, opening lengthwise by a slit. Ovary superior, 1-locular; style with 2 or 3 branches or 2–3-toothed; ovule solitary, erect from the base of the ovary, anatropous. Fruit nut-like, indehiscent, that from a 2-lobed style often more or less 2-sided, that from a 3-lobed style often 3-sided. Seed erect, with a small embryo and abundant mealy or fleshy endosperm.—A very large family distributed throughout the world, mostly dominant in damp or marshy places, especially in Temperate and Cold Regions.—B.H. **3**, 1037; E.P. **2**, 2, 98.

USEFUL PRODUCTS: *Chufas, Tiger* or *Zulu nuts* (tubers of Cyperus esculentus *L.*). *Papyrus* (Cyperus papyrus *L.*), used in ancient times as paper; stems and leaves of many *Cyperaceae* used for making mats, &c. *Cotton grass* (Eriophorum spp.).

Key to Tribes of CYPERACEAE

A. Flowers bisexual (rarely a few flowers subfemale by abortion of the anthers): **B.** Hypogynous scales, when present, filiform, flat or perianth-like (not folded): **C.** Spikelets very few-flowered, mostly 1–2-flowered, often 2 or more of the lower glumes empty—1. **Rhynchosporeae. CC.** Spikelets several- to many-flowered, only 1 or rarely 2 of the lower glumes empty: **D.** Glumes not distichous—2. **Scirpeae. DD.** Glumes distichous—3. **Cypereae. BB.** Hypogynous scales 2, folded and keeled, free or completely connate, or several and then the outer two folded and keeled; spikelets several- to many-flowered—4. **Hypolytreae. AA.** Flowers unisexual, the male without a rudimentary ovary, the female without staminodes; no hypogynous setae present: **E.** Female flower not enclosed by a modified glume (utricle): **F.** Female flower solitary at the base of an androgynous spikelet or the spikelets unisexual, the female spikelets 1-flowered in the lower part of the panicle, or rarely at the base of the plant remote from the males, the male spikelets in the upper part and 2- or more-flowered—5. **Sclerieae. FF.** Female flower terminal in a unisexual spikelet or in the upper part of the panicle, the lower spikelets male and 2- or more-flowered—6. **Cryptangieae. EE.** Female flower enclosed by a modified glume (utricle); female spikelets 1-flowered, spicate; male spikelets 2- or more-flowered, terminal or rarely continuous at the base with the female spike—7. **Cariceae.**

Tribe 1. **Rhynchosporeae. A.** Spikelets more than 1-flowered: **B.** Hypogynous 'scales' of 6 perianth-like segments (see fig. 420)—OREOBOLUS (Antarct., Andes). **BB.** Hypogynous scales modified into setae, or thin, or absent: **C.** Hypogynous setae present: **D.** Hypogynous setae not plumose: **E.** Style 2-lobed or undivided; stamens 2; hypogynous setae 4 or 6: **F.** Empty glumes 2; hypogynous bristles 4, long and rigid—CYATHOCHAETE (Austral.). **FF.** Empty glumes several; hypogynous bristles often 6, slender or very small —RHYNCHOSPORA (*Syntrinema, Phaeocephalum*) (general distrib.). **EE.** Style

3-lobed; stamens 3–6 or more: **G.** Glumes not distichous: **H.** Stamens 3: **J.** Upper flower of spikelet fertile: **K.** Hypogynous setae more than 2: **L.** Inflorescence capitate—PHYLLOSCIRPUS (Argentine). **LL.** Inflorescence spicate or paniculate—TRICOSTULARIA (Ceylon to Austral.). **KK.** Hypogynous setae 2—MICROSCHOENUS (Himal.). **JJ.** Lower flower of spikelet fertile—CLADIUM (Trop. and Temp. Reg.). **HH.** Stamen 1; anther long-acuminate—CHRYSITHRIX (S. Afr., Madag.). **GG.** Glumes more or less distichous: **M.** Glumes few (up to 5 or so)—ASTEROCHAETE (S. Afr., Mascar. Is.). **MM.** Glumes more numerous: **N.** Nut not supported on a gynophore: **O.** Rhachilla flexuous and produced between the flowers or above the perfect flower: **P.** Lowest flower perfecting a nut—SCHOENUS (Temp. Reg., Malaya, S. Afr.). **PP.** Lowest flower not perfecting a nut: **Q.** Spikelets few in short racemes; leaves reduced to sheaths or narrow—EPISCHOENUS (S. Afr.). **QQ.** Spikelets in loose panicles; leaves long—LOPHOSCHOENUS (Malay, New Caled.). **OO.** Rhachilla not as described above: **R.** Hypogynous setae not accrescent: **S.** Lowest flower usually with an imperfect pistil—TETRARIA (*Boeckeleria, Decalepis, Elynanthes* Nees not of Beauv., *Neesenbeckia*) (S. Hemisph., from S. Afr. east to New Caled.). **SS.** Lowest flower male—COSTULARIA (S. Afr.). **RR.** Hypogynous setae accrescent and thickened—LEPIDOSPERMA (S. China to Austral. and New Zeal.). **NN.** Nut supported on a gynophore, often beaked; spikelets in dense head: **T.** Hypogynous bristles rigid, longer than the nut; flower-heads ovoid or oblong—MESOMELAENA (Austral.). **TT.** Hypogynous bristles short and slender; flower-heads globular, compound—GYMNOSCHOENUS (Austral.). **DD.** Hypogynous setae plumose: **U.** Setae 6: **V.** Glumes 4–5—CARPHA (*Oreograstis*) (Austral., New Zeal., cool S. Amer., Afr.). **VV.** Glumes numerous—CYCLOCAMPE (Mascar., Moluccas, New Caled.). **UU.** Setae 3, plumose only at the base—TRIANOPTILES (*Ecklonea*) (S. Afr.). **CC.** Hypogynous setae absent: **W.** Stamens 20–15; style 8-lobed; glumes numerous, imbricate—EVANDRA (SW. Austral.). **WW.** Stamens 8; style 5–3-lobed; glumes absent—TETRARIOPSIS (Austral.). **WWW.** Stamens 6 or fewer: **X.** Spikelets paniculate or spicate: **Y.** Stem simple: **Z.** Spikelets paniculate: **A, 1.** Style not swollen at the base—GAHNIA (*Phacellanthus*) (Austral. and New Zeal. to China). **AA, 1.** Style swollen at the base—CLADIUM (general distrib.). **ZZ.** Spikelets spicate—REEDIA (SW. Austral.). **YY.** Stem branched—CAUSTIS (Austral.). **XX.** Spikelets densely capitate or umbellate: **B, 1.** Stamens 6—ARTHROSTYLIS (Trop. Austral.). **BB, 1.** Stamens 3–2: **C, 1.** Stem densely leafy: **D, 1.** Style 3-lobed—REMIREA (Trop. Reg.). **DD, 1.** Style entire or 2-lobed—RHYNCHOSPORA (*Syntrinema, Phaeocephalum*) (general distrib.). **CC, 1.** Stem not leafy much above the base: **E, 1.** Style-branches 3: **F, 1.** Spikelets umbellate—COURTOISIA (India). **FF, 1.** Spikelets capitate; stems junciform—ACTINOSCHOENUS (Madag.). **EE, 1.** Style-branches 2: **G, 1.** Inflorescence capitate—KYLLINGA (general distrib.). **GG, 1.** Inflorescence umbellate—NEOLOPHOCARPUS (*Lophocarpus*) (Tonkin). **XXX.** Spikelets umbellate; style 2-lobed; stamens 2—TRACHYSTYLIS (Austral.). **AA.** Spikelets reduced to 1 flower: **H, 1.** Flowers bisexual—CHILLANIA (Chile). **HH, 1.** Flowers unisexual—CHAMAEGYNE (Brazil).

Tribe 2. **Scirpeae. A.** Hypogynous setae or scales present: **B.** Stems leafless; spikelet solitary, terminal, the lower bract glume-like—ELEOCHARIS

(*Heleocharis, Trichophyllum*) (general distrib.). **BB.** Stems leafy at the base; bracts not glume-like: **C.** Hypogynous setae often numerous, elongating after flowering and often cotton-like ('cotton-grass')—ERIOPHORUM (Temp. N. Hemisph.). **CC.** Hypogynous setae or scales not as above: **D.** Hypogynous setae (no scales) present: **E.** Style-base thickened and persistent on the nut—PENTASTICHA (Trop. Afr., Madag.). **EE.** Style-base not thickened, usually deciduous—SCIRPUS (*Leptolepis, Bolboschoenus, Schoenoplectus,* [*Helonema*?]) (Cosmopol.). **DD.** Hypogynous scales (with or without setae) present: **F.** Hypogynous scales 3, often with intervening setae—FUIRENA (Tropics and Subtropics). **FF.** Hypogynous scales 2: **G.** Inflorescence long-pedunculate—LIPHOCARPHA (Tropics and Subtropics). **GG.** Inflorescence sessile among the leaves; dwarf plants—VOLKIELLA (SW. Afr.). **FFF.** Hypogynous scale 1, minute: **H.** Styles 2; spikelets lateral, usually clustered—HEMICARPHA (Tropics and Subtropics). **HH.** Style-arms 3; spikelet terminal, single—NELMESIA (Trop. Afr.). **AA.** Hypogynous scales or setae absent: **J.** Style-base not persistent on the nut: **K.** Stipe of the ovary (and nut) expanded into a cartilaginous disk—FICINIA (Trop. and S. Afr.). **KK.** Stipe of the ovary (and nut) not expanded into a disk—FIMBRISTYLIS (Tropics and Subtropics). **JJ.** Style-base persistent on the nut: **L.** Stems leafy: **M.** Spikelets few in terminal subsessile head—DICHROMENA (Amer.). **MM.** Spikelets corymbose—PSILOCARYA (N. Amer.). **LL.** Stems leafy only at the base: **N.** Persistent style-base minute; spikelets not catkin-like—BULBOSTYLIS (*Stenophyllus*) (Tropics and Subtropics). **NN.** Persistent style-base large and spongy; spikelets catkin-like (though suberect)—TYLOCARYA (Thailand).

Tribe 3. **Cypereae. A.** Hypogynous scales present; spike subsessile, axillary—DULICHIUM (N. Amer.). **AA.** Hypogynous scales or setae absent: **B.** Stamens not elongating after flowering: **C.** Rhachilla deciduous: **D.** Rhachilla deciduous in one piece: **E.** Glume not winged on the keel: **F.** Style 3-branched; spikelets rounded—MARISCUS (*Cylindrolepis, Sphaeromariscus, Ascopholis*) (general distrib.). **FF.** Style 2-branched: **FF, 1.** Spikes crowded in a head, not radiate, compressed—KYLLINGA (general distrib.). **FF, 2.** Spikes radiate in a head—QUEENSLANDIELLA (*Mariscopsis*) (Old World Tropics). **EE.** Glumes winged on the keel—COURTOISIA (India). **DD.** Rhachilla deciduous in several pieces: **G.** Inflorescence a simple head or single spikelet—HEMICHLAENA (S. Afr.). **GG.** Inflorescence a compound umbel—TORULINUM (Tropics). **CC.** Rhachilla persistent: **H.** Style 3-branched—CYPERUS (*Acorellus*) (general distrib.). **HH.** Style 2-branched: **J.** Nut compressed laterally—PYCREUS (Trop. and Warm Temp. Reg.). **JJ.** Nut compressed dorsally—JUNCELLUS (Trop. and Warm Temp. Reg.). **BB.** Stamens elongating after flowering—ANDROTRICHUM (S. Amer.).

Tribe 4. **Hypolytreae. A.** Hypogynous scales numerous: **B.** Nut ribbed: **C.** Stamens numerous; style 3-fid—CHRYSITHRIX (S. Afr., Austral.?). **CC.** Stamens 12–6: **D.** Spikelets paniculate; stem 3-sided—SCIRPODENDRON (Ceylon, Malay Archip.). **DD.** Spikelets solitary, sessile; stems terete—CHORISANDRA (Austral., New Caled.). **DDD.** Spikelets capitate in a whorl of long plicately nerved leaves; stem 4–5-sided—CAPITULARIA (New Guin., Polynesia). **BB.** Nut smooth—LEPIRONIA (India, Austral., Madag.). **AA.** Hypogynous scales definite in number: **E.** Hypogynous scales not united into one

and not exceeding the glumes: **F.** Stamens 8–6; spikelets elongated, corymbose-paniculate—DIPLASIA (West Indies, Trop. S. Amer.). **FF.** Stamens 3–2; lateral scales not dentate: **G.** Style 3-lobed; spikelets capitate, with an involucre of one or more bracts; scapes leafless—MAPANIA (*Apartea, Langevinia*) (Trop. Reg.). **GG.** Style 2-lobed: **H.** Spikelets umbellate, without a definite involucre: **J.** Hypogynous scales 15—MAPANIOPSIS (Brazil). **JJ.** Hypogynous scales 6–5; style 3-lobed—THORACOSTACHYUM (Malaya, New Guin., Polynesia, Seychelles). **JJJ.** Hypogynous scales 4; style 2-lobed—EXOCARYA (Austral.). **JJJJ.** Hypogynous scales 2: **HH.** Spikelets paniculate or in a dense contracted fascicle, without a definite involucre: **K.** Style 2-lobed—HYPOLYTRUM (Trop. and Subtrop. Reg.). **KK.** Style 3-lobed—PRINCIPINA (Principe Is., W. Afr.). **FFF.** Stamens 2; lateral scales coarsely brown-dentate; scapes leafless; style very short, branches 4–3—PARAMAPANIA (Malaya, Philipp. Is., New Guin.). **EE.** Hypogynous scales united and split at the top on one side and enclosing the flower, often exceeding and more conspicuous than the glumes—ASCOLEPIS (Trop. and S. Afr.).

Tribe 5. **Sclerieae. A.** Ovary surrounded by numerous long hairs; nut without a disk-like base—ERIOSPORA (*Coleochloa*) (Trop. Afr.). **AA.** Ovary not surrounded by hairs: **B.** Glumes 1-flowered: **C.** Spikelets in a terminal simple or subsimple spike: **D.** Nut sessile—KOBRESIA (*Elyna, Holmia*) (Eur., N. Asia and Mts.). **DD.** Nut shortly stipitate—EXOCHOGYNE (Brazil). **CC.** Spikelets fasciculate into cymes or panicles; nut usually subtended by a disk-like gynophore: **E.** Style not thickened at the base: **F.** Inflorescence spiciform or paniculate—SCLERIA (*Durandia*) (Tropics and Subtropics, N. Amer.). **FF.** Inflorescence of small axillary clusters—DIPLACRUM (Tropics and Subtropics). **EE.** Style thickened at the base—ACRIULUS (Angola, Madag.). **CCC.** Male spikelets capitate on long slender peduncles; heads with 8 or more narrow rigid bracts; female spikelets numerous and radical among the leaves—CROSSLANDIA (Austral.). **BB.** Glumes 2-flowered—DIDYMIA (Chile).

Tribe 6. **Cryptangieae. A.** Spikelets paniculate, all separate or only the males glomerate: **B.** Hypogynous scales present—EVERARDIA (Guiana). **BB.** Hypogynous scales absent: **C.** Nut ovoid or globose, not angular: **D.** Herbs with short stems and persistent leaves—LAGENOCARPUS (*Ulea-Flos, Schoenodendron*) (Trop. Amer.). **DD.** Stems woody, tree-like, clothed with the persistent leaf-bases—MICRODRACOIDES (W. Trop. Afr.). **CC.** Nut 3-angled: **E.** Leaves scattered on the stems or at the base, narrowly linear—CRYPTANGIUM (Trop. Amer.). **EE.** Leaves more or less in whorls on the stem, lanceolate, with numerous nerves—DIDYMIANDRUM (Trop. S. Amer.). **AA.** Spikelets in a simple spike-like inflorescence; no scales or bristles—EXOCHOGYNE (Brazil). **AAA.** Spikelets small and crowded into clusters: **F.** Glumes present on the female spikelets: **G.** Glumes of the female spikelets enclosing the flower and nut: **H.** Fascicles of spikelets densely cymose, cymes corymbose-paniculate—BECQUERELIA (Trop. Amer.). **HH.** Fascicles of spikelets densely capitate; heads crowded into a compound head or umbellate—BISBOECKELERA (*Hoppia* Nees, not Willd.) (E. Trop. S. Amer.). **GG.** Glumes of the female flowers not embracing the flower or nut: **J.** Nut 3-angled: **K.** Spikelets in pedunculate clusters—CEPHALOCARPUS (Brazil). **KK.** Spikelets in a dense terminal sessile head—PTEROSCLERIA (Trop. Afr., Trop. Amer.). **JJ.** Nut not

3-angled—FINTELMANNIA (Brazil). **FF.** Glumes absent from the female spikelet, the flowers nude—CALYPTROCARYA (Trop. Amer.).

Tribe 7. **Cariceae. A.** Utricle split on the inside to the middle or nearly to the base—HEMICAREX (India, S. Afr.). **AA.** Utricle at most dentate or oblique at the apex: **B.** Rhachilla exserted: **C.** Rhachilla hooked at the apex—UNCINIA (Temp. and Cool S. Hemisph., Mexico, West Indies). **CC.** Rhachilla not hooked—SCHOENOXIPHIUM (*Archeocarex*) (S. Afr.). **BB.** Rhachilla not exserted and not hooked, sometimes absent: **D.** Leaves sheathing at the base, always with a distinct midrib—CAREX[1] (*Diplocarex, Homalostachys*) (widely distrib.). **DD.** Leaves not sheathing at the base, solitary, without a midrib—CYMOPHYLLUS (N. Amer.).

ORDER 111. GRAMINALES

411. GRAMINEAE (by C. E. HUBBARD)[2]

Annual or perennial herbs, rarely shrubs or trees; stems erect, ascending or prostrate and creeping, usually branched at the base, in perennials forming sterile shoots (innovations) and flowering stems (culms), in annuals only the latter present; culms cylindrical, rarely flattened, jointed, usually hollow in the internodes, closed at the nodes. Leaves solitary at the nodes, sometimes crowded at the base of the stems, alternate and two-rowed, consisting of sheath, ligule, and blade; sheaths encircling the culm, with the margins free and overlapping or more or less connate, frequently swollen at the base (sheath-node); ligule placed at the junction of the sheath and blade, membranaceous or reduced to a fringe of hairs, rarely absent; blades usually long and narrow, rarely broad, usually passing gradually into the sheath, rarely with a petiole-like base, flat convolute, involute, or terete, parallel-nerved. Flowers usually bisexual, sometimes unisexual, small and inconspicuous, usually consisting of stamens and pistil and of 2 or 3 minute hyaline or fleshy scales (lodicules) representing the perianth, subsessile between two bracts (lemma[3] and palea[4]), the whole forming a floret or false flower. Florets one to many, distichous, sessile on a short or minute slender axis (rhachilla) and bearing at the base two empty bracts (upper and lower glume), the florets and glumes forming a spikelet. Spikelets pedicelled in open or contracted panicles or racemes, or sessile in spikes. Stamens hypogynous, 1 to 6, rarely more, usually 3, with delicate filaments and 2-locular anthers, the latter opening usually by a longitudinal slit; ovary 1-locular, with one anatropous ovule often adnate to the adaxial side of the carpel; styles usually 2, rarely 1 or 3; stigmas generally plumose. Fruit mostly a caryopsis with a thin pericarp adnate to

[1] For segregation of CAREX into several (15) genera see Börner, *Abh. naturw. Ver. Bremen*, **21**, 262 (1913).

[2] I had hoped to include a revision and reclassification of the tribes of this family by Mr. C. E. Hubbard, but much regret that this is not possible owing to unforeseen circumstances. His rearrangement of the tribes represented in the British flora was published in my *British Flowering Plants* (1948).

[3] Lemma = flowering glume = valve = lower palea.

[4] Palea = valvule = pale = upper palea.

the seed, or rarely a nut or a berry or a utricle with a free pericarp, with starchy endosperm and a small embryo at the base on the abaxial face.

Taxonomic References to Gramineae. B.H. 3, pt. 2 (1883); Hackel in DC. *Monogr. Phan.* vi (1889) (Monograph of *Andropogoneae*); Hackel in E.P. 2, 2 (1887); *Nachträge*, by R. Pilger (1915); Hackel, *The True Grasses* (1896); Stapf in Dyer, *Fl. Cap.* vii (1897–1900); A. Chase, Notes on the Genera of Paniceae, i–iv (*Proc. Biol. Soc. Wash.* xix–xxiv, 1906–11); Hitchcock, The Genera of Grasses of the United States (*U.S. Dept. Agric. Bull.* 772: 1920); and the Grasses of Ecuador, Peru and Bolivia (*Contrib. U.S. Nat. Herb.* xxiv, 1927); E. G. Camus, *Les Bambusées* (1913); Stapf in Prain, *Fl. Trop. Afr.* ix (1917); Bews, *The World's Grasses* (1929).

Other References. J. Schuster, 'Über die Morphologie die Grasblüte' (*Flora*, vol. c, 1910); Hitchcock, *A Textbook of Grasses* (1914); E. A. Bessey, 'The Phylogeny of the Gramineae' (*Ann. Rep. Michigan Acad. Sci.* 1917); A. Hayek, 'Zur Systematik der Gramineae' (*Österr. Bot. Zeitschr.* lxxiv, 1925); A. Arber, 'Studies in the Gramineae, I–X' (*Ann. Bot.* xl–xlv, 1926–31); Church, 'Meiotic Phenomena in Certain Gramineae, I–II' (*Bot. Gaz.* lxxxvii–lxxxviii, 1929).

Genera, about 620.

One of the largest and most valuable groups of flowering plants, exceeding all others in the importance of its products. It provides food in the form of cereals for man and forage for most animals.

Grasses are distributed throughout all parts of the world where it is possible for phanerogamic vegetation to exist.

The typical structure of the spikelets may be altered or modified in various ways. The glumes or paleas may undergo reduction or suppression so that a correct interpretation of the remaining organs is not always obvious. This is particularly the case in the *Paniceae* and *Andropogoneae*. A floret may often be reduced, frequently to the lemma, or even that organ becoming very small or rarely entirely suppressed.

The exact position of some genera is doubtful, whilst a few others show extreme reduction or suppression of parts of the spikelet. It has not been possible to account for such genera in the following key. Note—Additions since publication of first edition of this work not included in totals under each tribe.

Key to the Tribes of GRAMINEAE

Spikelets 1- to many-flowered, breaking up at maturity above the more or less persistent glumes, or if falling entire then not 2-flowered with the lower floret male or barren and the upper bisexual, usually more or less laterally compressed or terete Subfamily *Pooideae*

A. Shrubs or trees with woody often tall persistent culms, very rarely perennial herbs; leaf-blades flat, many-nerved, often with transverse veins, usually with a petiole-like base and articulated with the sheath; spikelets bisexual; lemmas 5- to many-nerved, usually awnless; lodicules usually 3; stigmas mostly 2 or 3 1. *Bambuseae*

AA. Perennial or annual herbs, with herbaceous very rarely somewhat woody culms; leaf-blades usually sessile and not articulated with the sheaths, or if with a petiole-like base then not with the characters given above:

B. Lodicules 3, very large, longer than the palea which is bifid nearly to the base; stamens 6; stigmas 3; spikelets 1-flowered; lemmas long-awned 2. *Streptochaeteae*

BB. Lodicules 2, rarely 3, in both cases very small and shorter than the palea, rarely suppressed:

C. Spikelets not solitary at the apex of the culm and at the same time subtended by a sheath-like spathe or with the lemmas partly fused along their margins:

D. Spikelets borne in open or contracted or spike-like panicles, less often in racemes or spikes, and then with the lower or both glumes suppressed if on opposite sides of a continuous rhachis, or with 2 or more fertile florets if on one side of the rhachis, or in the latter case if with 1 fertile floret then the leaf-blades transversely veined:

E. Spikelets usually with 2 or more fertile florets, or if with 1 fertile floret then with sterile florets above it:

F. Lemma and rhachilla glabrous or hairy, in the latter case with the hairs not enveloping the lemma or if so then with the lemma bearing a geniculate awn; low or moderately tall grasses:

G. Glumes usually shorter than the lowest floret and with the upper florets distinctly exserted, rarely longer and then usually with firm dull margins like the lemmas; lemmas awnless or with a straight or curved awn from the entire or bifid apex, or several-awned or -lobed:

H. Lemmas usually 5- to many-nerved:

I. Lemmas entire or shortly 2- to 5-toothed at the apex, awnless or awned 3. *Festuceae*

II. Lemmas cleft into 3 to many subulate or lanceolate lobes, with or without fine straight awns from their sinuses 5. *Pappophoreae*

HH. Lemmas 1- to 3-nerved 7. *Eragrosteae*

GG. Glumes usually as long as or longer than the lowest floret, often as long as the spikelet and enclosing the florets; lemmas awnless or more often awned from the back or the sinus of the 2-lobed tip, the awn usually geniculate; glumes or lemmas or both frequently with thin shining margins 12. *Aveneae*

FF. Lemmas or rhachilla-joints bearing long silky hairs which envelop the lemma (at least in fertile florets); lemmas awnless or with a straight awn from the tip, often thin, tall grasses with usually large plume-like panicles 6. *Arundineae*

EE. Spikelets with 1 fertile floret (male or female in unisexual 1-flowered spikelets), with or without 1 or 2 male or barren florets below it:

J. Glumes very minute or suppressed; palea 3- to 9-nerved; stamens usually 6; leaf-blades not transversely veined 18. *Oryzeae*

JJ. Glumes usually well developed, at least the upper, rarely minute or suppressed and then either with 3 stamens or with transversely veined leaf-blades; palea usually 2-nerved:

K. Spikelets with 3 florets, the lower 2 florets male or barren and the terminal floret bisexual 17. *Phalarideae*

KK. Spikelets with 1 or 2 florets:

L. Spikelets with 2 florets, the lower floret male or barren, the upper bisexual:

M. Lower floret barren and without a palea; glumes up to half the length of the spikelet; rhachilla produced beyond the upper floret; spikelets disarticulating with part of the pedicel attached 23. *Thysanolaeneae*

MM. Lower floret male or barren, usually with a palea; upper glume as long as the spikelet; rhachilla disarticulating below the upper floret and not produced beyond it; glumes more or less persistent 24. *Arundinelleae*

LL. Spikelets with 1 floret:

N. Leaf-blades narrowly linear to linear, flat or rolled, sessile, rarely ovate and then very small and without cross-nerves; spikelets usually bisexual, more or less similar:

O. Spikelets usually breaking up at maturity, the rhachilla disarticulating above the more or less persistent glumes, very rarely falling entire and then with firmly membranous, awned or 5-nerved lemmas:

P. Lemmas hyaline or membranous at maturity, rarely indurated and then laterally compressed, awnless or awned from low down on the back or from the entire or bifid tip:

Q. Lemmas usually 3- to 5-nerved, frequently awned; glumes longer and firmer than the hyaline lemma or if shorter than the lemma herbaceous-membranous and dull; grain usually with an adhering pericarp 13. *Agrosteae*

QQ. Lemmas 1- to 3-nerved, awnless; glumes and lemma very similar in texture, hyaline or thinly membranous, shining; grain usually with a free pericarp 8. *Sporoboleae*

PP. Lemmas indurated and rigid at maturity, terete or dorsally compressed, with involute or convolute margins tightly enveloping the grain, with a terminal awn or sometimes awnless 14. *Stipeae*

OO. Spikelets falling entire at maturity, either singly or in clusters from the axis of slender spike-like panicles or racemes; lemma delicate, 1- to 3-nerved 15. *Zoysieae*

NN. Leaf-blades flat, lanceolate to ovate, elliptic or oblong, obovate or oblanceolate, with a petiole-like base, many-nerved with cross-nerves:

R. Spikelets bisexual, similar, in terminal spike-like inflorescences and enclosed in sheath-like spathes; stigma 1; stamens 4 19. *Anomochloeae*

RR. Spikelets unisexual, dissimilar, the sexes mixed or in different parts of the same inflorescence or in different inflorescences; stigmas 2 or 3; stamens 2, 3, or 6:

S. Leaf-blades with slanting nerves running obliquely from the midrib to the margin; fertile lemma papery, much longer than the glumes, clothed with minute hooked hairs; stigmas 3; stamens 6 21. *Phareae*

SS. Leaf-blades with lateral nerves parallel to the midrib; fertile

lemma coriaceous to cartilaginous, smooth, mostly shorter than the glumes; stigmas 2; stamens 2 or 3 22. *Olyreae*

DD. Spikelets sessile or shortly pedicelled along one side of the rhachis of solitary, digitate, or scattered spikes or spike-like racemes (with 1 fertile floret and 1- to 3-nerved lemmas), or on opposite sides of the rhachis of solitary spikes or racemes:

T. Spikelets on opposite sides of the rhachis of solitary spikes or spike-like racemes:

U. Leaf-blades broad and flat, with a short petiole-like base; spikelets unisexual, in opposite clusters of 3 at each joint of the rhachis, the middle spikelet of alternate clusters female, the remainder male; stamens numerous in each male floret 20. *Parianeae*

UU. Leaf-blades narrow, sessile; spikelets mostly bisexual or if unisexual then adjacent to a bisexual spikelet; stamens 1 to 3 in each floret:

V. Lemmas 5- to 9-nerved, at length indurated; spikelets 1- to many-flowered, solitary or in clusters of 2 to 6, not sunken in hollows in the rhachis, the latter continuous or articulated 4. *Hordeeae*

VV. Lemmas usually 1- to 3-nerved, hyaline or membranous; spikelets 1- to 2-flowered, solitary, more or less sunken in hollows or depressions in the articulate rhachis 11. *Leptureae*

TT. Spikelets in one or two rows on one side of the usually continuous rhachis of solitary digitate or scattered spikes or spike-like racemes; lemma 1- to 3-nerved:

W. Stigmas 2; spikelets 1- to several-flowered but in the latter case usually with only one fertile and the others imperfect; glumes usually well developed or the lower reduced; lodicules usually 2 9. *Chlorideae*

WW. Stigma 1; spikelets 1-flowered, in solitary spikes; glumes and lodicules suppressed 10. *Nardeae*

CC. Spikelets solitary and subtended by a sheath-like spathe at the apex of the culm; lemmas fused along their margins in the lower half to form a tube; stigma 1 16. *Lygeeae*

Spikelets 2-flowered, falling entire at maturity, usually with the upper floret fertile and the lower male or barren and in the latter case often reduced to the lemma, all alike or differing in size, shape, and structure, frequently dorsally compressed Subfamily *Panicoideae*

A. Spikelets all bisexual, or with male or barren and bisexual spikelets mixed in the same inflorescence and so arranged that a male or barren spikelet is near a bisexual spikelet, or if unisexual then the lemma of the fertile floret indurated:

B. Spikelets solitary or paired, more or less similar; glumes usually membranous, the lower usually smaller or sometimes suppressed; lower lemma mostly resembling the upper glume in texture; upper lemma papery to very tough and rigid, usually awnless 25. *Paniceae*

BB. Spikelets often paired, with one sessile and the other pedicelled, those of each pair similar or more often dissimilar, rarely solitary and all

alike; glumes as long as the spikelet and enclosing the florets, more or less rigid and firmer than the lemmas which are both hyaline or membranous; upper lemma usually awned 26. *Andropogoneae*

AA. Male and female spikelets in separate inflorescences or in different parts of the same inflorescence and of different appearance; lemmas hyaline or membranous and thinner than the glumes 27. *Maydeae*

Tribe 1. **Bambuseae.** *Shrubs or trees*, very rarely perennial herbs; culms erect or sometimes climbing, often tall, *usually woody*, rarely herbaceous, bearing sheaths with reduced blades; leaf-blades flat, usually linear or oblong-lanceolate, many-nerved, mostly with a *petiolate-like base* and frequently *articulated with the sheath*; spikelets all alike, 1- to many-flowered, arranged in panicles, racemes, dense clusters, or terminal heads; glumes usually 2 or sometimes more; lemmas resembling the glumes and exserted from them, *awnless* or rarely awned from the tip, 5- *to many-nerved*, herbaceous to coriaceous; paleas 2-keeled or keelless, or suppressed; *lodicules usually* 3, rarely more or less; *stamens* 3, 6, *or more*, with the filaments free or more or less connate; *styles mostly* 2 *or* 3; fruit a nut, berry, or a caryopsis.

Genera about 45.

The most recent classification of the *Bambuseae* is by E. G. Camus (*Les Bambusées*, 1913), who treats the bamboos as a subfamily of the *Gramineae* and divides them into 5 tribes and 4 subtribes. Both Bentham and Hackel recognize 4 subtribes. Their method of classification, somewhat modified by Stapf, is adopted here.

Key to the Subtribes of **Bambuseae**

A. Fruit a berry or a nut, with a thick fleshy or crustaceous pericarp; stamens 6 or more: **B.** Paleas 2-keeled, at least in the lower florets; spikelets 1- to many-flowered—1. **Dendrocalaminae**: DENDROCALAMUS, MELOCALAMUS, PSEUDOSTACHYUM, TEINOSTACHYUM, CEPHALOSTACHYUM. **BB.** Paleas keelless and resembling the lemmas, or suppressed; spikelets mostly 1-flowered—2. **Melocanninae**: DINOCHLOA, SCHIZOSTACHYUM, MELOCANNA, OCHLANDRA. **AA.** Fruit a true caryopsis or rarely with a thin free pericarp; paleas usually 2-keeled: **D.** Shrubby, usually tall, with woody culms: **E.** Stamens 6; lower and often the upper florets imperfect—3. **Bambusinae**: BAMBUSA, GIGANTOCHLOA, OXYTENANTHERA, OREOBAMBOS, GUADUA, NASTUS. **EE.** Stamens 3, rarely 6 and then with the lower florets perfect—4. **Arundinariinae**: ARUNDINARIA, SASA, PHYLLOSTACHYS, CHUSQUEA, ARTHROSTYLIDIUM, MEROSTACHYS. **DD.** Small undershrubs or with herbaceous culms; stamens 6; lower florets usually ♀, ♂, or barren—5. **Puelliinae**: PUELLIA, GUADUELLA, ATRACTOCARPA.

USES: Culms used for varied purposes, such as house and bridge building, fences, stakes, water-pipes, pots, &c.; young shoots edible in some species; frequently cultivated for ornamental purposes.

The *Bambuseae* are considered to have the most primitive characters of all the tribes of the *Gramineae*. The genera are unevenly distributed throughout the Tropical and Subtropical Regions of the world, frequently occurring in mountainous areas, a few penetrating into Temperate Regions.

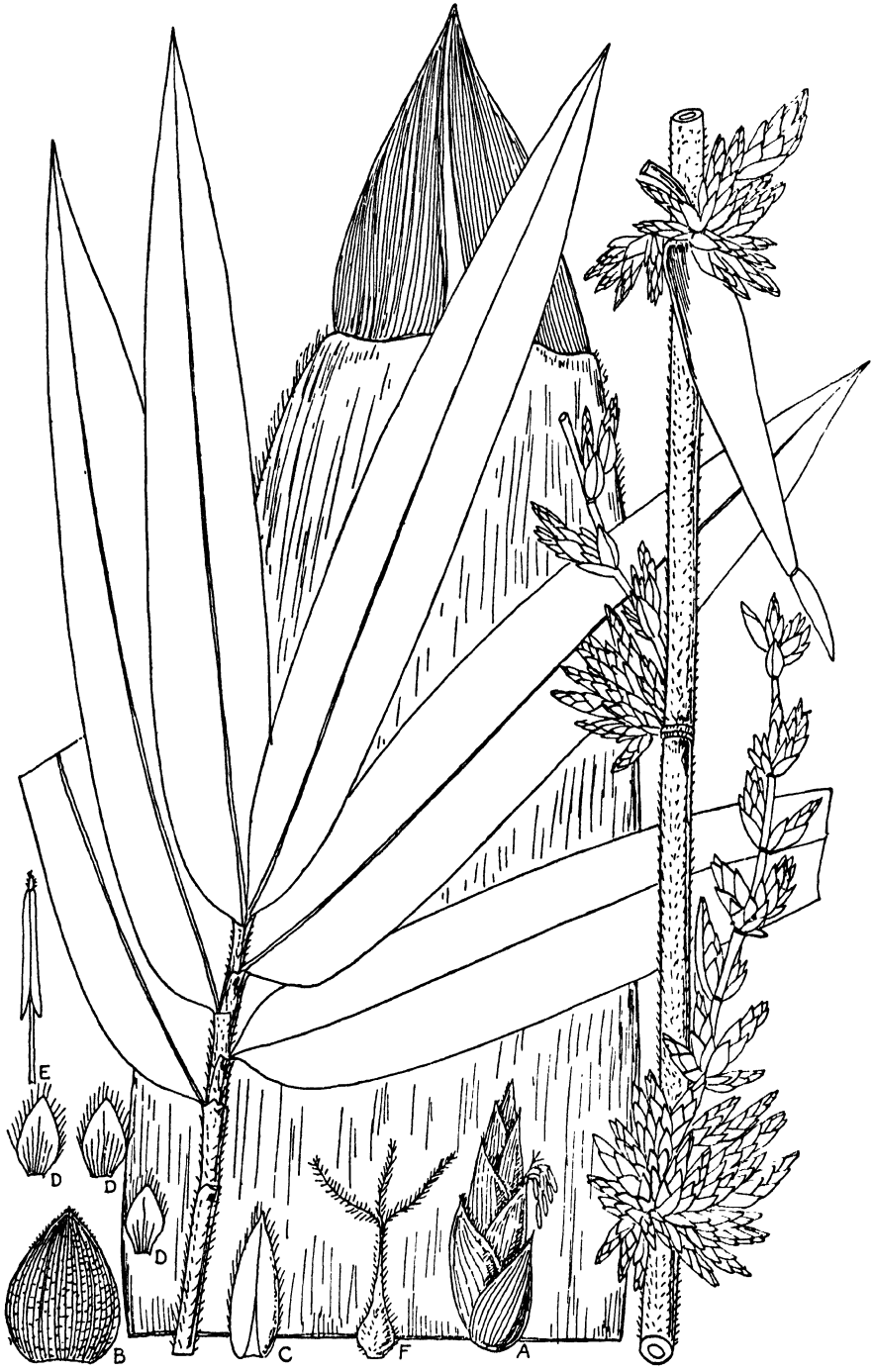


FIG. 422. Bambusa balcooa *Roxb.* (Bambuseae). A, spikelet. B, lemma. C, palea. D, lodicules. E, stamen. F, pistil. (After Gamble.)

Tribe 2. **Streptochaeteae.** Perennial herbs; leaf-blades *ovate to elliptic*, contracted into a very short *petiole-like base*, many-nerved, with *cross-nerves*; spikelets 1-flowered, bisexual, spirally arranged, *falling entire*, subsessile on the continuous rhachis of solitary terminal spike-like racemes; glumes 4 to 5, small, irregularly arranged; lemma much longer than the glumes, coriaceous, tapering into a very *long spirally twisted awn*; palea shorter than the lemma, *bifid nearly to the base*; lodicules 3, *large, longer than the palea, coriaceous*, convolute or with the dorsal outside the two lateral; stamens 6, filaments connate at the base or quite free; style solitary, with 3 stigmas; caryopsis elongated, free between the lemma and palea.

One genus, STREPTOCHAETA (Trop. Amer.; in forests).

Placed in the *Paniceae* by Bentham and in the *Oryzeae* by Hackel, but quite distinct from all members of both tribes. It shows certain primitive features in the possession of 3 lodicules, 6 stamens, and 3 stigmas.

Tribe 3. **Festuceae.** Annual or perennial herbs; leaf-blades very narrow to lanceolate or rarely ovate; spikelets usually all alike, bisexual, rarely unisexual, 2- *to many-* (*rarely* 1-) *flowered*, laterally compressed, arranged in loose, contracted, or spike-like panicles, rarely in spikes or racemes; rhachilla usually disarticulating above the glumes and between the florets, rarely below the glumes and the spikelets then falling entire; glumes *persistent*, similar, or the lower smaller, *usually shorter than the lowest lemma*; lemmas membranous to coriaceous, often *herbaceous-membranous*, usually 5- *to many-* (very rarely 3-) *nerved, awnless or awned from the entire or 2-lobed tip*, or just below the tip, rarely several-awned, the awn *straight or curved*, not geniculate; lodicules 2, rarely 3 or 0; stamens 3, rarely 2 or 1; caryopsis usually tightly enclosed between the lemma and palea.

Genera about 70.

Key to the Subtribes of **Festuceae**

A. Leaf-blades flat, broad, lanceolate to ovate, many-nerved, with transverse veins—1. **Centothecinae**: CENTOTHECA, ORTHOCLADA, LOPHATHERUM, ZEUGITES. **AA.** Leaf-blades flat, convolute or involute, narrow, without transverse veins: **B.** Lemmas awnless or awned from the usually entire or 2-toothed tip; stigmas usually laterally exserted from the florets, usually short and plumose: **C.** Lemmas dull, membranous to coriaceous, usually exserted from the glumes: **D.** Spikelets arranged in panicles or racemes or if in spikes then with the lower glume well developed—2. **Festucinae**: BROMUS, FESTUCA, POA, DACTYLIS, CYNOSURUS, BRIZA, GLYCERIA, LASIOCHLOA, DEMAZERIA, AELUROPUS. **DD.** Spikelets arranged in solitary spikes, the lower glume suppressed, except in the terminal spikelet—3. **Loliinae**: LOLIUM. **CC.** Lemmas membranous and shining, the upper usually tightly enclosing one another—4. **Melicinae**: MELICA. **BB.** Lemmas 1- to 5-awned or toothed; stigmas rather long, not plumose, projecting from the apex of the florets—5. **Sesleriinae**: SESLERIA.

Temperate Regions, or usually on mountains or in forests in the Tropics.

USES: Includes the most important fodder grasses of Temperate Regions.

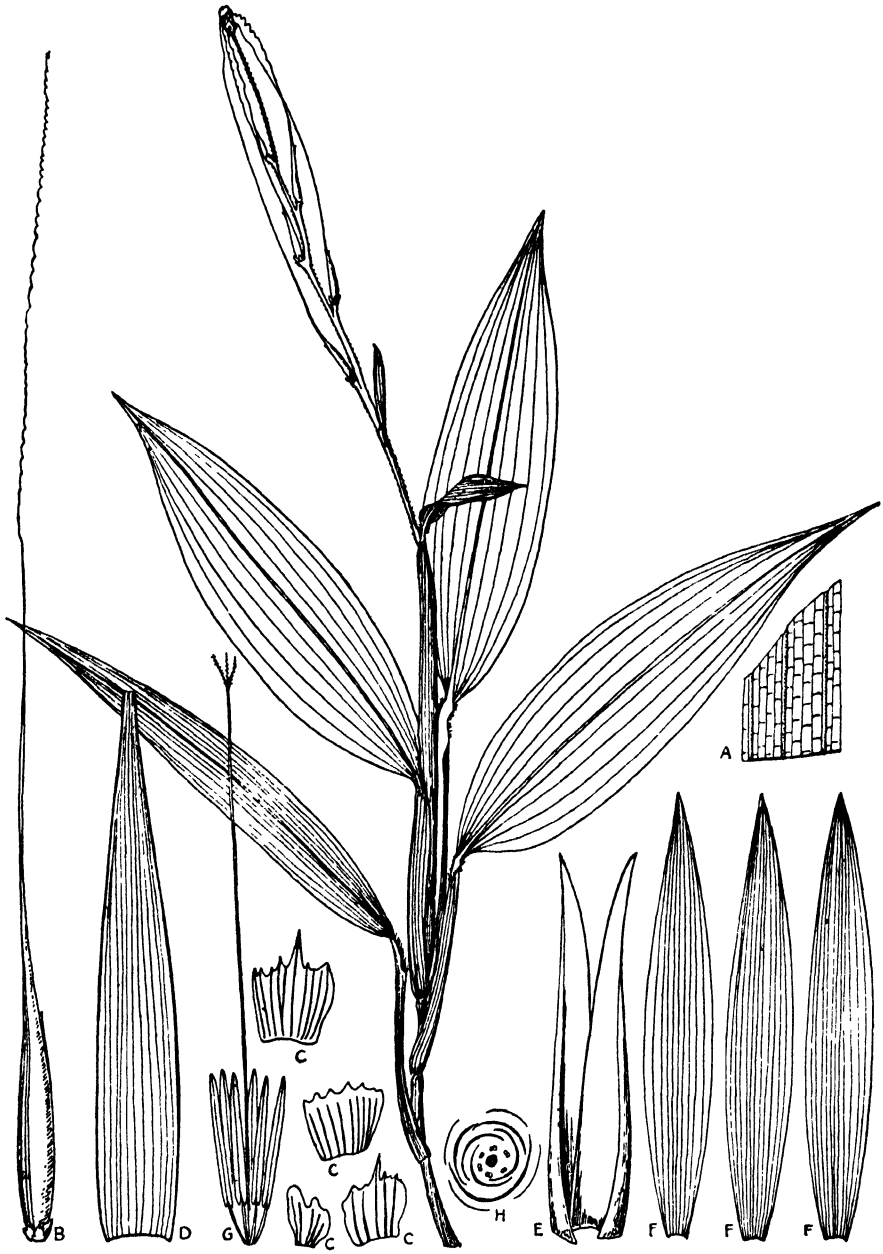


FIG. 423. Streptochaeta spicata *Schrad.* (Streptochaeteae). A, portion of leaf-blade. B, spikelet. C, empty glumes. D, lemma with awn removed. E, palea. F, lodicules. G, stamens and pistil. H, diagram of spikelet. (Habit after Doell; dissections after C. E. Hubbard.)

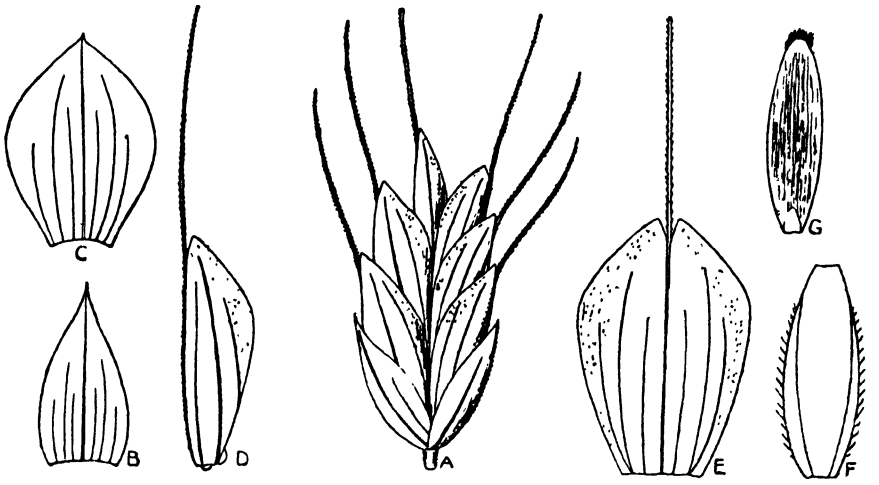


FIG. 424. Bromus lepidus *Holmb.* (Festuceae). A, spikelet. B, lower glume. C, upper glume. D, floret. E, lemma. F, palea. G, caryopsis. (After drawings by C. E. Hubbard.)

The *Festuceae* are probably the most primitive of all herbaceous temperate grasses. Bentham and also Hackel group the genera into 8 and 9 subtribes respectively. Several of these (following Stapf) are treated as distinct tribes, whilst the remainder are given in the above key with the addition of the *Loliinae*. This subtribe, as Holmberg has pointed out, is more closely allied to certain species of *Festuca* than to the *Hordeeae*, in which it was included by both Bentham and Hackel.

Tribe 4. **Hordeeae.** Annual or perennial herbs; leaf-sheaths usually with *small auricles* at the mouth; blades narrow; spikelets 1- to many-flowered, solitary or in clusters of 2 to 6, mostly bisexual and *sessile*, or the lateral spikelets of a cluster sometimes shortly pedicelled and male or barren, alternating on *opposite sides* of the continuous or jointed rhachis of *solitary spikes or spike-like racemes*; rhachilla disarticulating above the glumes and between the florets or continuous in cultivated races; glumes well-developed; lemmas at length indurated, 5- *to* 6-*nerved, awnless or awned from the tip*; lodicules 2; stamens 3; styles 2; caryopsis free or adhering to the lemma or palea.

Genera 10.

Key to the Subtribes of **Hordeeae**

A. Spikelets solitary at each node of the rhachis—1. **Triticinae**: AGROPYRON, TRITICUM, AEGILOPS, SECALE, HAYNALDIA. AA. Spikelets in clusters of 2 to 6 at each node of the rhachis—2. **Elyminae**: HORDEUM, ELYMUS, SITANION, ASPERELLA.

Common in Temperate Regions, mainly in open grasslands or cultivated ground.

USES: Includes the most important cereals, *Wheat* (Triticum spp.), *Barley* (Hordeum spp.), and *Rye* (Secale cereale *L.*). Some species of Agropyron and Elymus are good forage grasses.

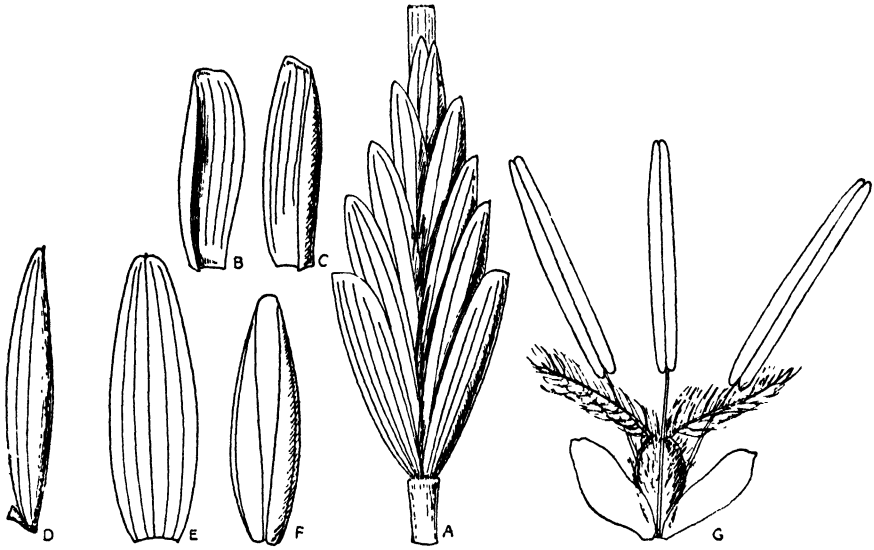


FIG. 425. Agropyron elongatum *Beauv.* (Hordeeae). A, spikelet and portion of rhachis. B, lower glume. C, upper glume. D, floret. E, lemma (flattened). F, palea. G, flower. (After drawings by C. E. Hubbard.)

The *Hordeeae* are related to the *Festuceae*, differing mainly in the spicate inflorescence.

Tribe 5. **Pappophoreae.** Annual or perennial herbs; leaf-blades narrow; spikelets all alike, 3- *to many-flowered*, with the lower florets bisexual and the upper male or barren and often much reduced, arranged in contracted or spike-like panicles or racemes; rhachilla disarticulating above the glumes and usually not between the florets; glumes similar, often as long as the florets; lemmas *broad*, rounded on the back, 7- *to many-nerved*, deeply cleft into 3 *to many subulate, or more or less lanceolate lobes*, with or without straight awns from their sinuses; lodicules 2; stamens 3, rarely 2; grain free between the indurated lemma and palea.

Genera 6: PAPPOPHORUM, ENNEAPOGON, SCHMIDTIA, COTTEA.

Usually in warm dry regions.

This tribe was placed by both Bentham and by Hackel as a subtribe of the *Festuceae*.

Tribe 6. **Arundineae.** Perennials, usually with tall stout sometimes woody culms; leaf-blades long and flat; spikelets bisexual, or unisexual with the sexes on different plants, 2- *to* 10-*flowered*, arranged in often *large panicles*; rhachilla disarticulating above the glumes or lowest floret and between the florets; glumes *hyaline or membranous*, similar or the lower smaller; lemmas somewhat similar to the glumes, acuminate, awnless or awned from the tip, 1- to 5- (rarely more-) nerved, enveloped by *long hairs either from the rhachilla or from the back of the lemmas* (at least in the fertile florets); lodicules 2; stamens 2 or 3.

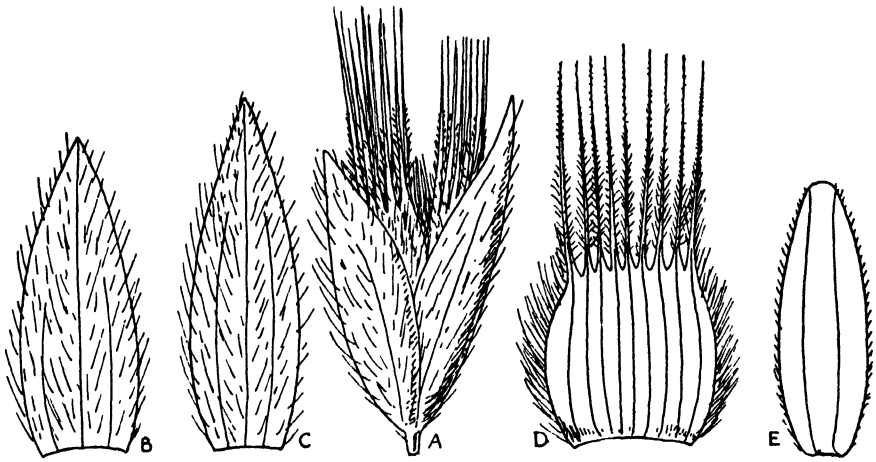


FIG. 426. Enneapogon scoparius *Stapf* (Pappophoreae). A, spikelet. B, lower glume. C, upper glume. D, lowest lemma. E, palea. (After Stapf.)

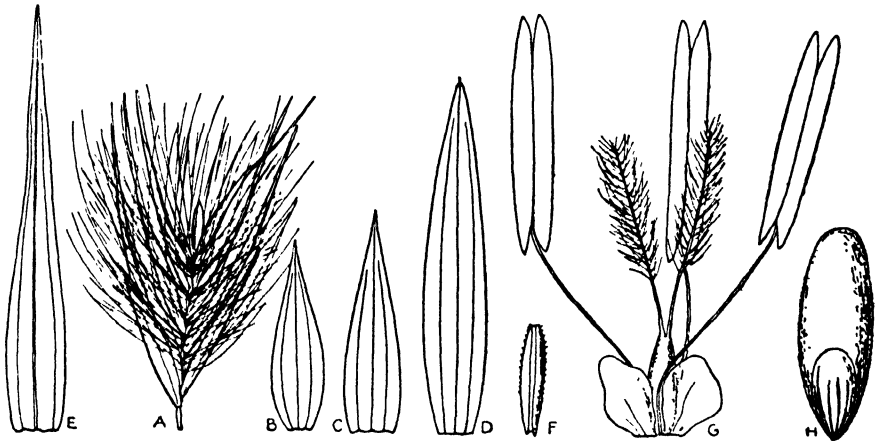


FIG. 427. Phragmites communis *Trin.* (Arundineae). A, spikelet. B, lower glume. C, upper glume. D, lowest lemma. E, second lemma. F, palea. G, flower. H, caryopsis. (After Stapf.)

Genera 6: ARUNDO, PHRAGMITES, GYNERIUM, CORTADERIA.
Temperate and Tropical Regions.
USES: Ornamental plants, *Pampas Grass* (Cortaderia spp.).

Treated as a subtribe of the *Festuceae* by Bentham and by Hackel.

Tribe 7. **Eragrosteae.** Annual or perennial herbs; leaf-blades narrow; spikelets 2- *to many-flowered*, mostly bisexual, usually laterally compressed, pedicelled in open or contracted panicles, or secund and sessile or subsessile in spikes or spike-like racemes; rhachilla usually disarticulating above the glumes and between the florets, rarely persistent or disarticulating below the

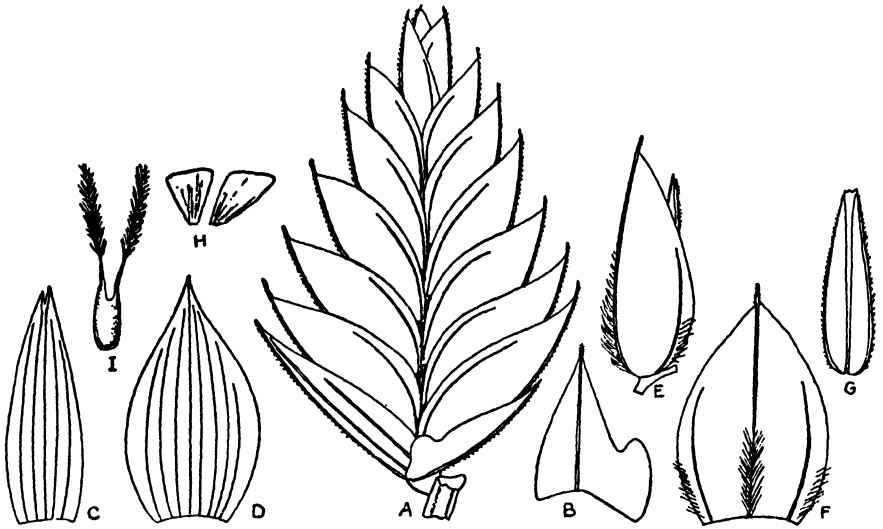


FIG. 428. Heterocarpha haareri *Stapf and Hubb.* (Eragrosteae). A, spikelet. B and C, lower glumes. D, upper glume. E, floret. F, lemma. G, palea. H, lodicules. I, pistil. (After drawings by C. E. Hubbard.)

glumes and the spikelets then falling entire; glumes usually persistent, membranous to coriaceous, usually *shorter than the lowest lemma*; lemmas mostly exserted from the glumes, rarely enclosed by them, membranous to coriaceous, scarcely changed at maturity, 1- *to* 3-*nerved*, entire, emarginate or 2- to 4-lobed at the tip, *awnless*, mucronate, or with a *straight awn* from the tip or sinus, rarely with the three nerves running out into awns; lodicules 2; stamens 2 or 3; grain loosely or tightly enclosed by the lemma and palea, sometimes with a free pericarp.

Genera about 40: ERAGROSTIS, DIPLACHNE, LEPTOCHLOA, ELEUSINE, DACTYLOCTENIUM, TRIRAPHIS, TRIPOGON, THELLUNGIA, TRIDENS, TRIPLASIS, COELACHYRUM, TRICHONEURA.

Tropical Regions, extending into Warm Temperate Regions.

USES: Cereals, *Teff* (Eragrostis tef *Trott.*), *Ragi* (Eleusin coracana *Gaestn.*); many are valuable fodder grasses.

A large number of the genera included here are usually placed in the *Chlorideae*, but as they are so closely related to *Eragrostis* and its allies, a more natural classification is attained by transferring them to the *Eragrosteae*.

Tribe 8. **Sporoboleae.** Annual or perennial herbs; leaf-blades narrow; spikelets all alike, bisexual, 1-*flowered*, small, pedicelled in *open or contracted panicles*; rhachilla disarticulating above the glumes, very rarely produced beyond the floret; glumes *more or less persistent*, as long as the floret or more often with the lower or both shorter, nerveless or 1-nerved; lemmas *awnless, thinly membranous* like the glumes, not changed at maturity, 1- *to* 3-*nerved* with the side-nerves when present delicate, frequently olive-green

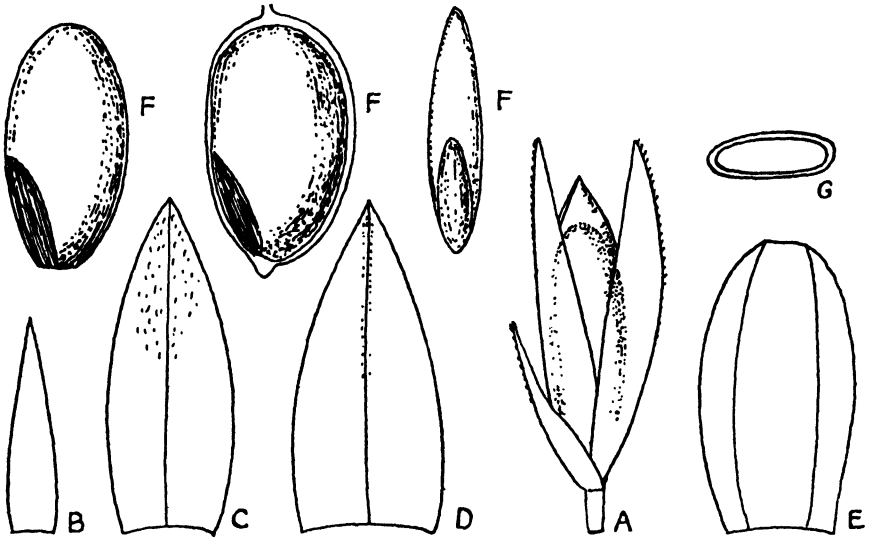


FIG. 429. Sporobolus patulus *Hack.* (Sporoboleae). A, spikelet. B, lower glume. C, upper glume. D, lemma. E, palea. F, grains. G, section of grain. (After drawings by C. E. Hubbard.)

or olive-grey, usually shining; stamens 1 to 3; grain loose between the lemma and palea, often *free in the delicate pericarp.*

Genera 2: SPOROBOLUS, BLEPHARONEURON.

Frequent in Warm Regions.

Usually included in the *Agrosteae.* It shows close relationship to *Eragrostis* and has probably been derived from that genus.

Tribe 9. **Chlorideae.** Annual or perennial herbs; leaf-blades narrow; spikelets usually laterally compressed, 1- to few-flowered with *one floret bisexual* and with or without imperfect florets above or below it, sessile or subsessile in one or two rows on *one side* of the continuous (rarely jointed) rhachis of solitary, digitate, or scattered *spikes* or *spike-like racemes,* or in a fascicle of few spikelets; rhachilla disarticulating above the glumes, rarely below them; glumes usually persistent; lemmas membranous to chartaceous, entire, emarginate or 2- to 4-lobed, awnless or awned, 1- *to* 3-*nerved* with the lateral nerves near the margins and often ciliate; lodicules 2, rarely suppressed; stamens usually 3; caryopsis enclosed in the scarcely changed lemma and palea.

Genera about 35: SPARTINA, CYNODON, MICROCHLOA, CTENIUM, CHLORIS, BOUTELOUA, TRICHLORIS, CRASPEDORRHACHIS, ENTEROPOGON.

Mainly in Tropical Regions and extending into Warm, rarely into Cold Temperate Regions.

USES: Spartina townsendii is a valuable reclaimer of tidal muds; Cynodon spp. are used as lawn grasses. The tribe contains some valuable fodder grasses.

This tribe is closely allied to genera placed in the *Eragrosteae.*

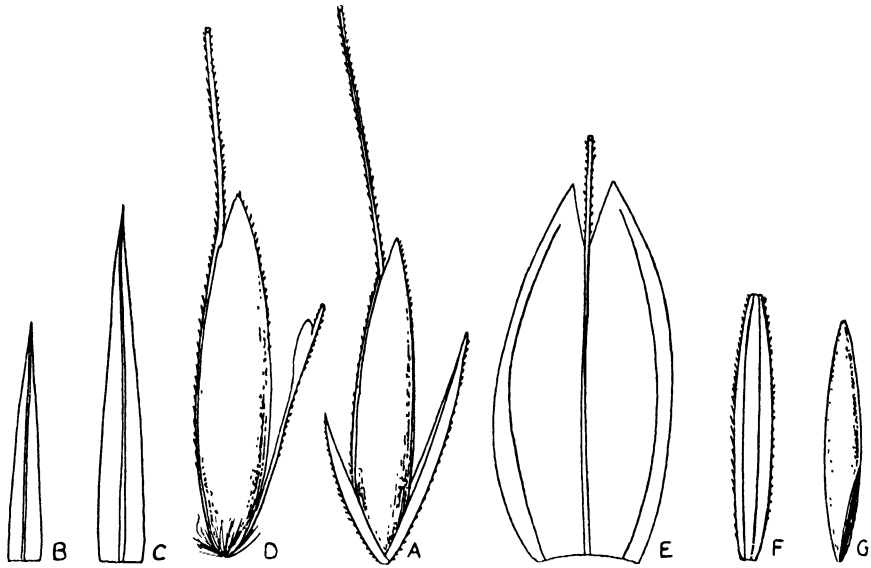


FIG. 430. Chloris pycnothrix *Trin.* (Chlorideae). A, spikelet. B, lower glume. C, upper glume. D, florets. E, lemma. F, palea. G, caryopsis. (After drawings by C. E. Hubbard.)

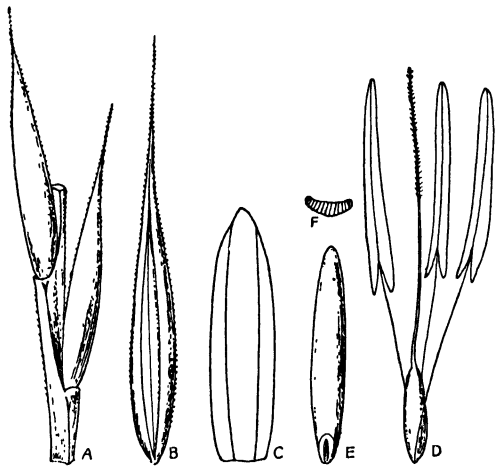


FIG. 431. Nardus stricta *Linn.* (Nardeae). A, part of spike. B, lemma. C, palea (flattened). D, stamens and pistil. E, caryopsis. F, cross-section of caryopsis. (After drawings by C. E. Hubbard.)

Tribe 10. **Nardeae.** Densely tufted perennials; leaf-blades setaceous; spikelets 1-*flowered*, bisexual, alternate, *sessile* in notches along one side of the continuous rhachis of *solitary terminal spikes*; rhachilla not produced beyond the floret; glumes *suppressed* (a minute outgrowth from the rhachis is sometimes referred to as the outer glume); lemma indurated,

acuminate or awned from the tip, *3-nerved*; lodicules *suppressed*; stamens 3; style *solitary*, with a papillose stigma; caryopsis free between the lemma and palea.

One genus, NARDUS (Eur., N. Asia, Greenland, and Newfoundland; in grasslands).

Classified as a subtribe of the *Hordeeae* by both Bentham and Hackel, but very different from *Hordeum* and related genera. There is a marked similarity between it and certain genera of the *Chlorideae*.

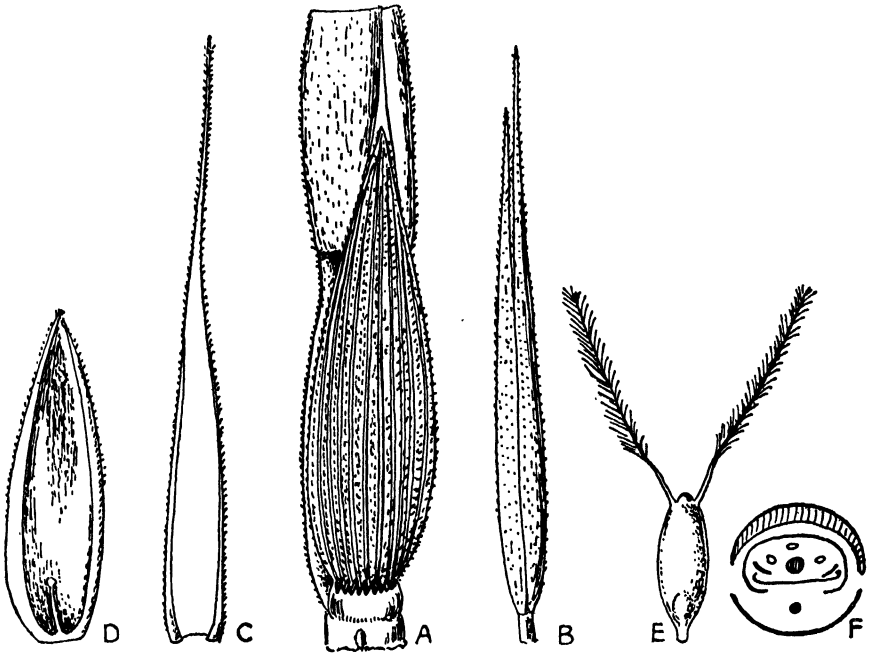


FIG. 432. Lepturus repens *R. Br.* (Leptureae). A, part of spike showing lateral spikelet. B, terminal spikelet. C, upper glume of terminal spikelet. D, floret of lateral spikelet. E, pistil. F, diagram of spikelet and rhachis. (After drawings by C. E. Hubbard.)

Tribe 11. **Leptureae.** Low annual or perennial herbs; leaf-blades narrow; spikelets 1- to 2-*flowered*, bisexual, *sessile*, solitary, alternate or rarely opposite, appressed to or sunken in the hollows of the joints on opposite sides of the readily disarticulating rhachis of slender *cylindric spikes*; glumes similar, usually *coriaceous*, or the lower suppressed; lemma with its back or sides against the rhachis, usually awnless, *hyaline or membranous and shorter than the glumes*, rarely indurated and longer than them, 1- *to* 3- (*rarely* 5-) *nerved*; lodicules 2; stamens 1 to 3; styles 2; caryopsis free between the lemma and palea.

Genera 6: LEPTURUS, ISCHNURUS, PHOLIURUS, PSILURUS.

Mainly in Warm Temperate Regions or along sea-shores in the Tropics.

Usually treated as a subtribe of the *Hordeeae*.

Tribe 12. **Aveneae.** Annual or perennial herbs; leaf-blades narrow; spikelets all alike, 2- *to* 7- (*rarely* 1-) *flowered*, with all the florets bisexual or the uppermost often barren, or in 2-flowered spikelets rarely with the lower or upper floret male, pedicelled in open or contracted panicles, rarely in racemes or spikes; rhachilla disarticulating above the glumes and usually between the florets; glumes persistent, rarely deciduous, mostly similar, usually *as long as the lowest lemma and often as long as the spikelet* and enclosing the florets, membranous to chartaceous, frequently with *shining margins*; lemmas membranous to cartilaginous, their *margins often hyaline or scarious and shining*, 5- *or more-* (*rarely* 3-) *nerved*, awnless or more often *awned from the back* or from the sinus of the 2-*lobed tip*, the awn usually *geniculate* and *twisted below the knee*; lodicules 2; stamens 3.

Genera about 38: AIRA, DESCHAMPSIA, ERIACHNE, HOLCUS, ARRHENATHERUM, GAUDINIA, TRISETUM, AVENA, DANTHONIA, PENTASCHISTIS, ASTREBLA, KOELERIA.

Temperate Regions, rare in the Tropics and then usually on mountains.

USES: Important cereal, *Oats* (Avena sativa); some are valuable fodder grasses.

More advanced than the *Festuceae*, although still retaining certain primitive features such as the several-flowered spikelets and 5- to many-nerved lemmas.

Tribe 13. **Agrosteae.** Annual or perennial herbs, usually with slender culms; leaf-blades mostly narrow; spikelets usually alike and bisexual, 1-*flowered*, small, mostly laterally compressed, pedicelled in *open or contracted or spike-like panicles*, very rarely in racemes; rhachilla *disarticulating above the glumes*, rarely below them, not produced beyond the floret or only as a point or bristle; glumes usually persistent, as long as the spikelet and enclosing the floret or sometimes shorter, rarely very small or suppressed; lemmas *hyaline or membranous*, thinner than the glumes or similar in texture, not or slightly changed at maturity, rarely indurated, *mostly* 3–5-*nerved*, awnless or awned from the back or less often from the entire or 2-lobed tip; awn geniculate or straight; stamens 3, 2, or 1; caryopsis mostly enclosed (often tightly) between the lemma and palea, rarely loose.

Genera about 45: AGROSTIS, CALAMAGROSTIS, LAGURUS, GASTRIDIUM, TRIPLACHNE, ECHINOPOGON, DICHELACHNE, POLYPOGON, EPICAMPES, MUEHLENBERGIA, PHLEUM, ALOPECURUS.

Mainly in Temperate Regions and usually on mountains if in the Tropics.

USES: Many valuable fodder grasses.

This tribe is still heterogeneous although certain subtribes have been segregated. Some genera with thin lemmas shorter than the glumes and with the former often bearing a dorsal geniculate awn appear to be related to genera in the *Aveneae*, whilst others with firmer lemmas longer than the glumes and with a terminal straight awn bear a distinct resemblance to certain genera of the *Festuceae*.

Tribe 14. **Stipeae.** Annual or perennial herbs, frequently with tough rigid culms; leaf-blades narrow; spikelets all alike, bisexual, *1-flowered*, arranged in *open or contracted panicles*, very rarely solitary; rhachilla *disarticulating above the glumes*, not produced beyond the floret; glumes mostly persistent, one or both usually as long as or longer than the floret; lemma usually *terete* with *convolute or involute margins*, rarely dorsally compressed, becoming

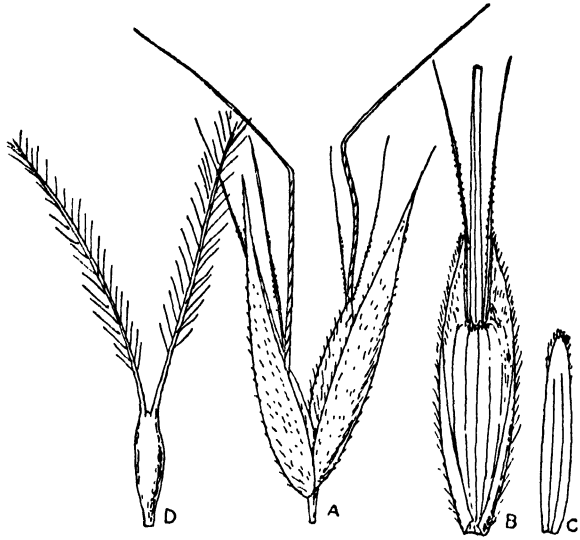


FIG. 433. Pentaschistis aristidoides *Stapf* (Aveneae). A, spikelet. B, lemma. C, palea. D, pistil. (After Stapf.)

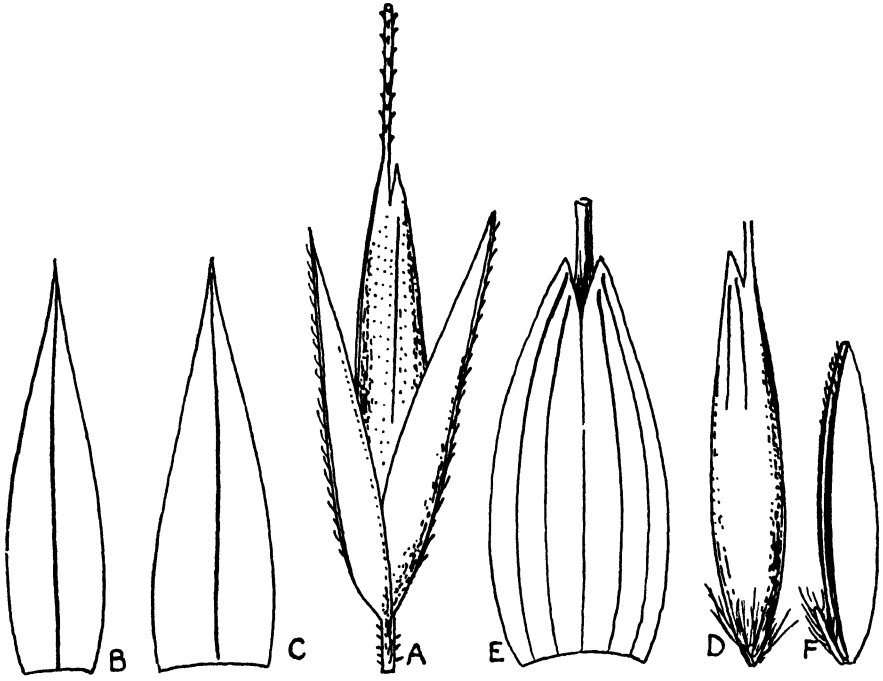


FIG. 434. Echinopogon ovatus *Beauv.* (Agrosteae). A, spikelet. B, lower glume. C, upper glume. D, floret. E, lemma. F, palea and rhachilla. (After drawings by C. E. Hubbard.)

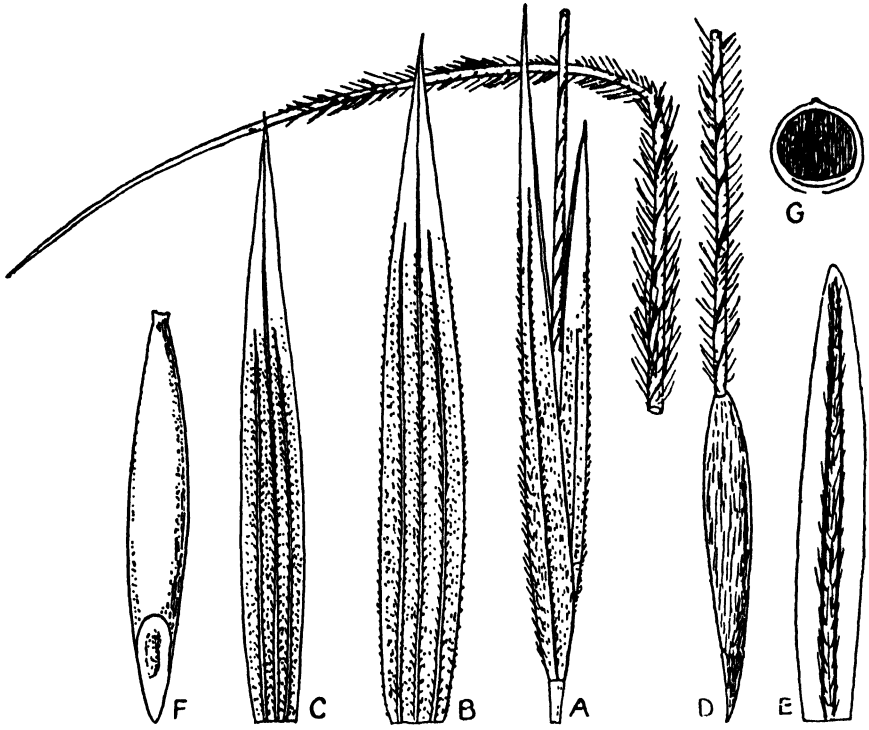


FIG. 435. Stipa mollis *R. Br.* (Stipeae). A, spikelet. B, lower glume. C, upper glume. D, floret. E, palea. F, caryopsis. G, diagram of floret. (After drawings by C. E. Hubbard.)

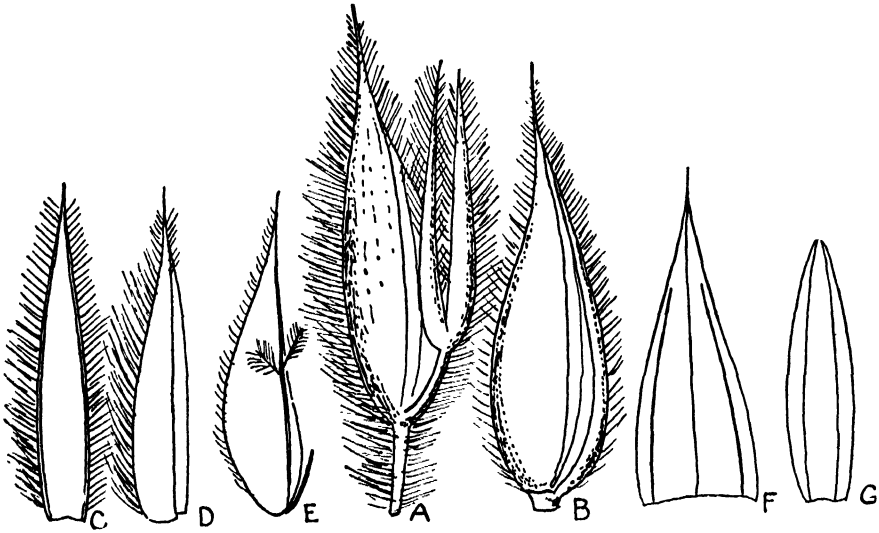


FIG. 436. Dignathia pilosa *C. E. Hubb.* (Zoysieae). A, cluster of spikelets. B, fertile spikelet. C, lower glume. D, upper glume. E, floret. F, lemma. G, palea. (After drawings by C. E. Hubbard.)

rigid and indurated at maturity, 3- to 7-nerved with the nerves close together at the apex, often with a bearded basal callus, awned from the entire or minutely 2-lobed tip, with the awn simple or divided into three branches, rarely awnless; lodicules 3 or 2; stamens 3; caryopsis tightly embraced by the lemma and palea.

Genera 8: ARISTIDA, STIPA, ORYZOPSIS, NASSELLA, PIPTOCHAETIUM, ACIACHNE, MILIUM.

Common in Tropical, Subtropical, and Warm Temperate Regions.

USES: Stipa tenacissima *L.*, one of the *Esparto Grasses*, is used in the manufacture of paper and cordage.

Included as a subtribe of the *Agrosteae* by Bentham and by Hackel.

Tribe 15. **Zoysieae** (*Nazieae*, *Trageae*). Low annual or perennial herbs; leaf-blades short and often rigid; spikelets bisexual or some bisexual and others male, 1-*flowered, falling entire either singly or in clusters* of 2 to 5, in slender spiciform panicles or racemes; rhachilla usually not produced beyond the floret; glumes equal or the lower much smaller or suppressed, awnless or with a straight awn from the tip, the upper or both often indurated; lemma shorter than the upper glume, *hyaline or delicately membranous*, 1- *to* 3-*nerved*, usually awnless; lodicules 2 or 0; stamens 2 or 3.

Genera about 14: TRAGUS, LATIPES, PEROTIS, MOSDENIA, LOPHOLEPIS, LEPTOTHRIUM, ZOYSIA, DIGNATHIA.

Tropical Regions; mainly in dry areas.

Placed in the subfamily *Panicoideae* by Bentham, but removed to the *Pooideae* by Stapf.

Tribe 16. **Lygeeae.** Perennial herbs; leaf-blades rigid, convolute or involute; spikelets solitary, bisexual, 2- (? *rarely* 3-) *flowered*, large, *falling entire at maturity*, short-pedicelled, at first enclosed, at length laterally projecting from a *terminal sheath-like spathe*; glumes *suppressed*; lemmas with their *margins fused in the lower half* to form a *rigid thickened cylindrical tube*, this densely bearded, the upper half free, chartaceous to thinly coriaceous; paleas longer than the lemmas, 2-nerved, *fused along their backs in the lower*

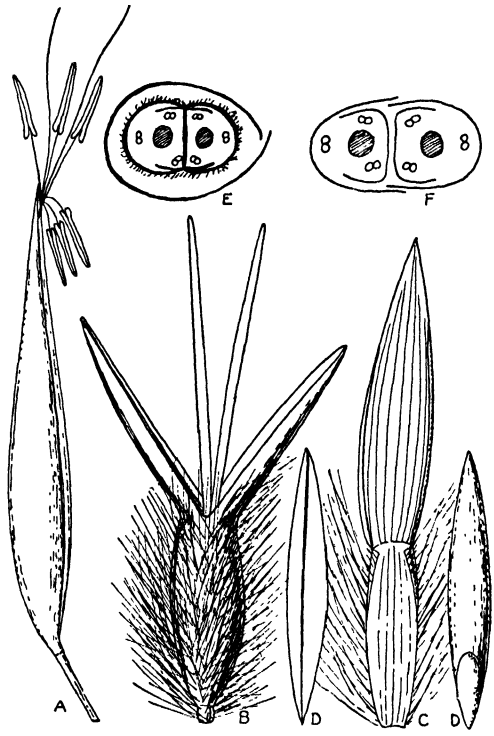


FIG. 437. Lygeum spartum *Linn.* (Lygeeae). A, sheath-like spathe with stamens and styles. B, pair of spikelets (fused). C, lemma. D, caryopses. E, diagram of spathe and spikelet (fused portion). F, diagram of spikelet (free portion). (After drawings by C. E. Hubbard.)

part, free above; lodicules *suppressed*; stamens 3; style and stigma *solitary*; caryopsis tightly enclosed between the lemma and palea.

One genus, LYGEUM.

Common in parts of the Mediterranean Region.

USES: One of the *Esparto Grasses*, used in the manufacture of paper, cordage, &c.

Included in the *Paniceae* by Bentham and in the *Oryzeae* by Hackel, but very different from all other members of these tribes. Its exact position in the family remains doubtful. Dr. A. Arber suggests that it may be related to *Nardus* (*Nardeae*).

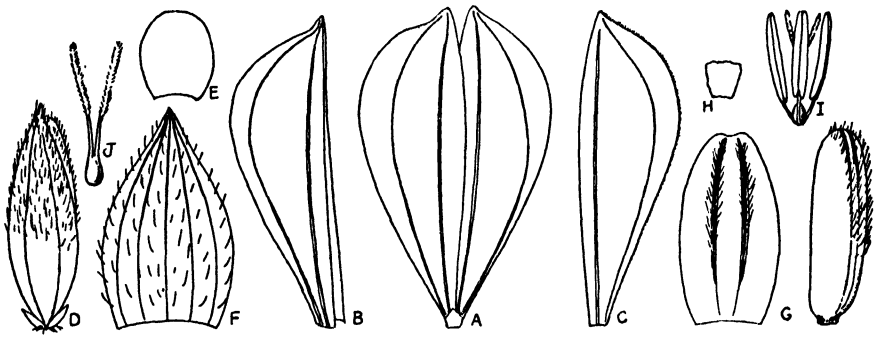


FIG. 438. Phalaris brachystachys *Link*. (Phalarideae). A, spikelet. B, lower glume. C, upper glume. D, florets. E, rudimentary lemma (flattened). F, lemma of fertile floret. G, palea, flat and side view. H, lodicule. I, stamens and pistil. J, pistil. (After drawings by C. E. Hubbard.)

Tribe 17. **Phalarideae.** Annual or perennial herbs; leaf-blades narrow; spikelets alike, bisexual, mostly strongly laterally compressed, 3-*flowered with the lower* 2 *florets male or barren and the terminal floret bisexual*, arranged in open or contracted sometimes spike-like panicles; rhachilla disarticulating above the glumes and not between the florets, not or rarely produced beyond the upper floret; glumes *persistent*, equal and as long as the spikelet, or the lower or both shorter, membranous to chartaceous; lower two lemmas longer than the third or smaller, in some cases reduced to minute scales, awnless or awned from the back or tip; terminal lemma *awnless*; lodicules 2 or 0; stamens 2 to 6.

Genera 6: HIEROCHLOË, ANTHOXANTHUM, PHALARIS, TETRARRHENA, MICROLAENA, EHRHARTA.

Mainly in Temperate Regions, a few on mountains in the Tropics.

USES: *Canary Grass* (Phalaris canariensis) is grown for the seed which is used for feeding birds. Other species of Phalaris are used for fodder.

Some of the genera of this tribe (*Anthoxanthum, Hierochloë*) suggest relationship with the *Aveneae*.

Tribe 18. **Oryzeae.** Annual or perennial herbs; leaf-blades narrow or rather broad; spikelets all alike and bisexual, or more or less dissimilar and unisexual, apparently falling entire, 1- (*rarely* 3-) *flowered*, with the terminal floret bisexual or unisexual and the lateral if present reduced to scale-like lemmas, pedicelled in open or contracted panicles, the unisexual spikelets

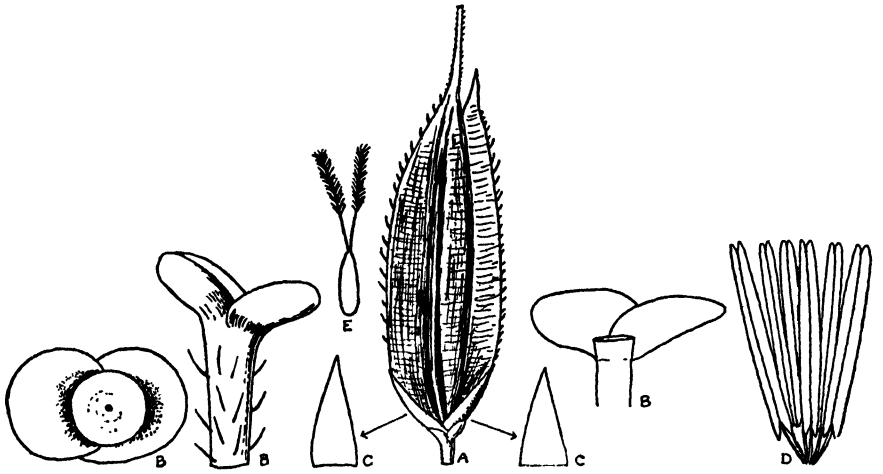


FIG. 439. Oryza australiensis *Domin* (Oryzeae). A, spikelet. B, glumes in various positions. C, sterile lemmas. D, stamens. E, pistil. (After drawings by C. E. Hubbard.)

with the sexes borne in different panicles on the same plant or in the same panicle, the female on the upper branches or at the ends of the branches, the male below them; rhachilla disarticulating below the floret or florets; glumes *very minute or confluent into an annular rim or suppressed*; sterile lemmas mostly shorter than the fertile floret or more often suppressed; fertile or male lemma *membranous to coriaceous*, awnless or with a straight awn from the tip, 3- *to* 9-*nerved*; palea 3- to 9-*nerved*; stamens 6, rarely 3, 2, or 1.

Genera: 9.

Key to the Subtribes of **Oryzeae**

A. Spikelets bisexual, laterally compressed and keeled—1. **Oryzinae**: ORYZA, LEERSIA, HYGRORYZA. **AA.** Spikelets unisexual, more or less terete or slightly compressed—2. **Zizaniinae**: ZIZANIA, ZIZANIOPSIS, HYDROCHLOA, LUZIOLA.

Temperate and Tropical Regions, mainly aquatic grasses.

USES: Very important cereal, *Rice* (Oryza sativa).

A tribe of doubtful affinity; placed in the *Panicoideae* by Bentham.

Tribe 19. **Anomochloeae.** Perennial herbs; leaf-blades *ovate*, rounded at the base and contracted into a *long petiole-like base*, many-nerved with *cross-nerves*; spikelets 1-*flowered, bisexual, articulated at the base*, 1 to 3 on short pedicels in the axils of small bracts and enclosed in large *sheath-like spathes* on opposite sides of the rhachis of a spike-like inflorescence; glumes *suppressed*; lemma (?) broad, laterally compressed and keeled, herbaceous-membranous, many-nerved, with cross-nerves, awnless, enclosing the palea; palea (?) at length rigid, *coriaceous*, *many-nerved*, with a narrow apical appendage; lodicules (?) represented by a *hairy disk around the stamens*; stamens 4; style *solitary*; stigma *solitary*, papillose; grain enclosed in the indurated palea.

One genus, ANOMOCHLOA.

Brazil, in forests.

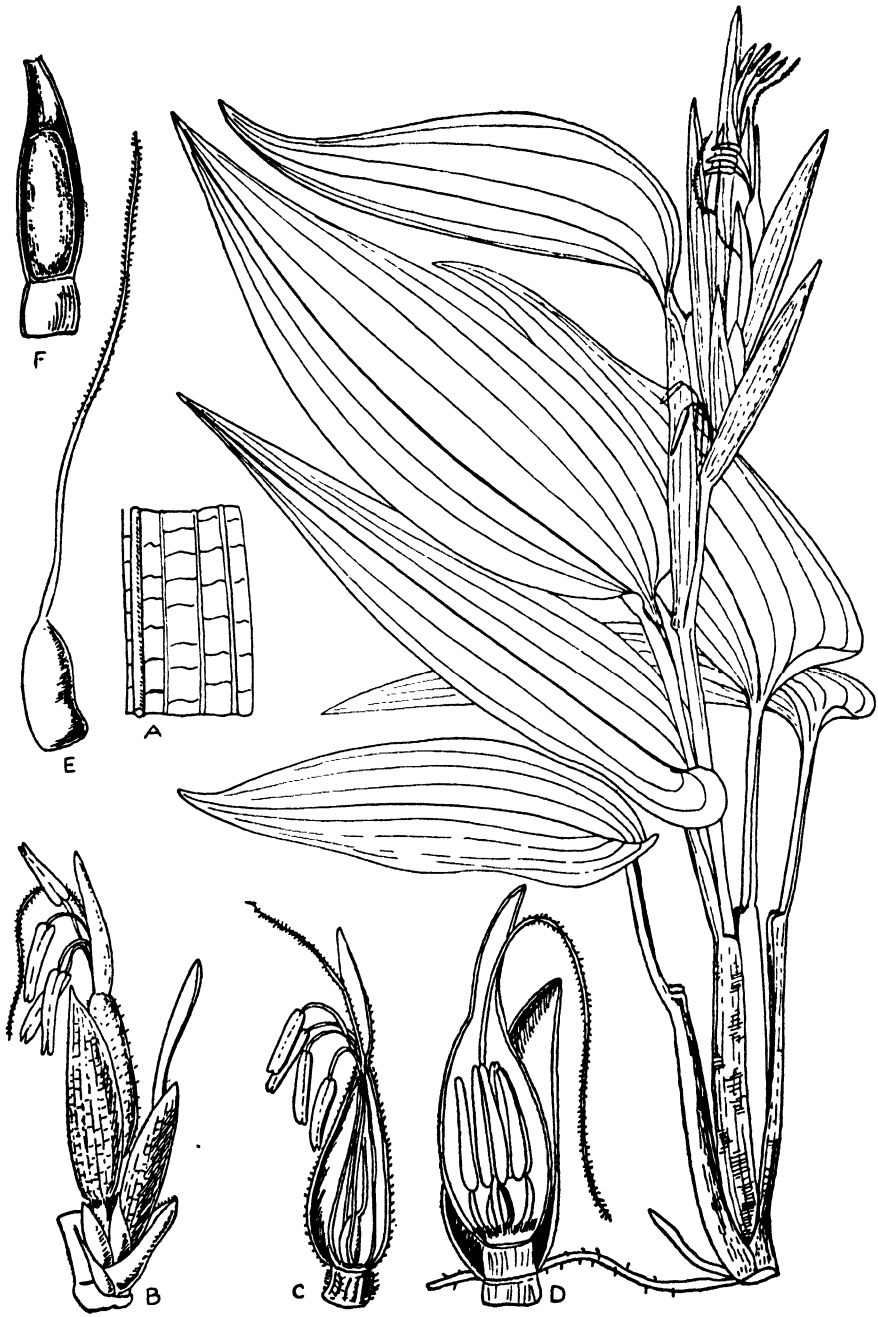


FIG. 440. Anomochloa marantoidea *Brongn.* (Anomochloeae). A, part of leaf-blade. B, pair of spikelets. C and D, vertical section of spikelet. E, pistil. F, caryopsis and (?) palea. (After *Bot. Mag.*)

This tribe is represented by only one species, *Anomochloa marantoidea* Brongn., a very curious grass (see Fig. 440), superficially resembling some of the *Marantaceae*. Bentham included it in the *Paniceae*, whilst Hackel referred it to the *Oryzeae*. The structure of its spikelets is fairly well known, but the correct interpretation of each part is a difficult matter. It shows no evident affinities with any other genus of grasses.

Tribe 20. **Parianeae.** Perennials; leaf-blades *broad*, lanceolate to ovate or elliptic, with a short *petiole-like base*, many-nerved; spikelets *unisexual*, *1-flowered*, *awnless*, in false verticels of six (usually) at each joint of the readily disarticulating rhachis of solitary terminal *spike-like racemes*; verticels consisting of two opposite groups of 3, the middle spikelet of alternate groups female, the remaining spikelets male and forming an involucre around the

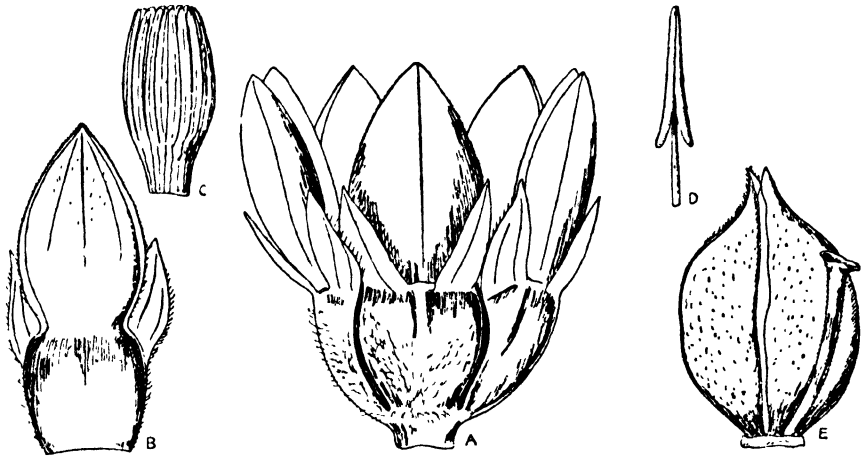


FIG. 441. Pariana campestris *Aubl.* (Parianeae). A, cluster of spikelets. B, male spikelet with flattened pedicel. C, stamens. D, stamen. E, female spikelet and joint of rhachis. (After drawings by C. E. Hubbard.)

female spikelet; male spikelets on broad flattened free or more or less connate pedicels; glumes lateral, similar, mostly shorter than the lemma; lemma flat on the back, 3-*nerved*; stamens usually *numerous*; female spikelets sessile, plump; glumes similar, opposite, thin; lemma convex, 3-*nerved*; lodicules 3; styles 2; caryopsis free between the lemma and palea. *Hordeeae* subtribe *Parianeae* Hack.

One genus, PARIANA.

Tropical America; in forests.

A rather isolated group of forest grasses superficially resembling the *Hordeeae* in the form of the inflorescence and suggesting parallel development in that respect.

Tribe 21. **Phareae.** Erect perennial herbs; leaf-blades flat, *broad*, obovate to oblanceolate, oblong, elliptic, or lanceolate, narrowed into a short *petiole-like base*, many-nerved with *slanting main nerves* and numerous *cross-nerves*; spikelets 1-*flowered*, *awnless*, *unisexual*, dissimilar, both sexes in the same panicle, paired or on short branchlets of 2–3 spikelets, the lower 1–2 spikelets

female, sessile or short-pedicelled, the male pedicelled and terminal; female spikelets *terete, ovoid or conchiform* and more or less inflated; glumes similar; lemma *papery,* much *longer than the glumes,* open down one side or closed except for a subapical or lateral hole, clothed with *minute hooked hairs*;

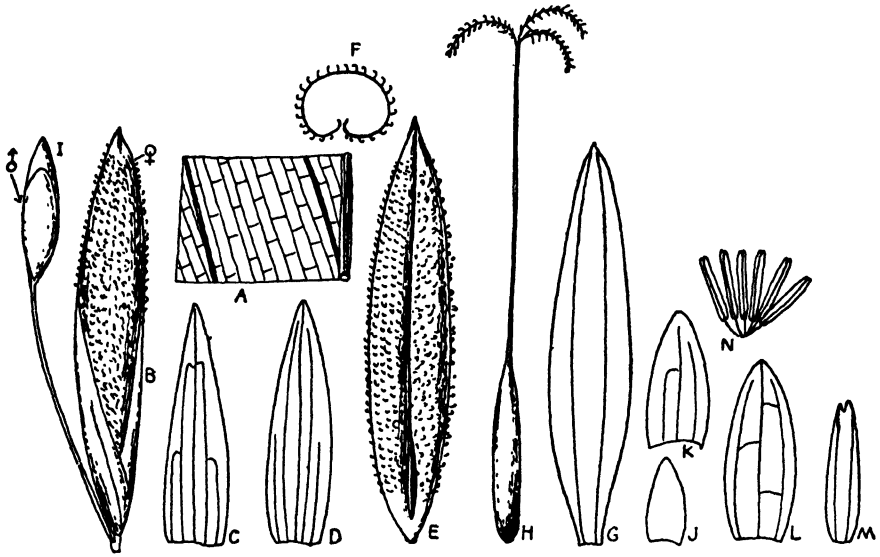


FIG. 442. Pharus glaber *H.B. and K.* (Phareae). A, portion of leaf-blade. B, female spikelet. C, lower glume. D, upper glume. E, lemma. F, cross-section of lemma. G, palea (flattened). H, pistil. I, male spikelet. J, lower glume. K, upper glume. L, lemma. M, palea. N, stamens. (After drawings by C. E. Hubbard.)

lodicules 3 or 0; style solitary; stigmas 3; male spikelets smaller than the female; glumes present; stamens 6.

Genera 2: PHARUS, LEPTASPIS.

Tropical Regions; in forests.

Bentham referred the genera of this tribe to the *Paniceae,* whilst Hackel includes them in the *Oryzeae.* Their affinities are, however, doubtful.

Tribe 22. **Olyreae.** Perennials with herbaceous or sometimes bamboo-like and woody culms; leaf-blades *broad,* lanceolate to ovate, elliptic or oblong, abruptly contracted into a *short petiole-like base,* many-nerved with parallel main nerves and numerous *cross-nerves*; spikelets 1-*flowered, unisexual,* dissimilar, both sexes in the same panicle or raceme or in different panicles or racemes on the same plant; female spikelets borne above the male if in the same inflorescence, very rarely below, larger than the male; glumes more or less similar, frequently acuminate or caudate-aristate, at length deciduous; lemma *coriaceous or cartilaginous,* mostly awnless and *shorter than the glumes*; lodicules 3, rarely 2; stigmas 2; male spikelets narrow; glumes suppressed or very minute; lemmas membranous, often acuminate or caudate-aristate; stamens 3, rarely 2.

Genera 6: OLYRA, RADDIA, LITHACHNE, MNIOCHLOA, DIANDROLYRA.

Tropical and Subtropical America, Tropical Africa, Mascarene Islands, Zululand, and New Guinea; in forests.

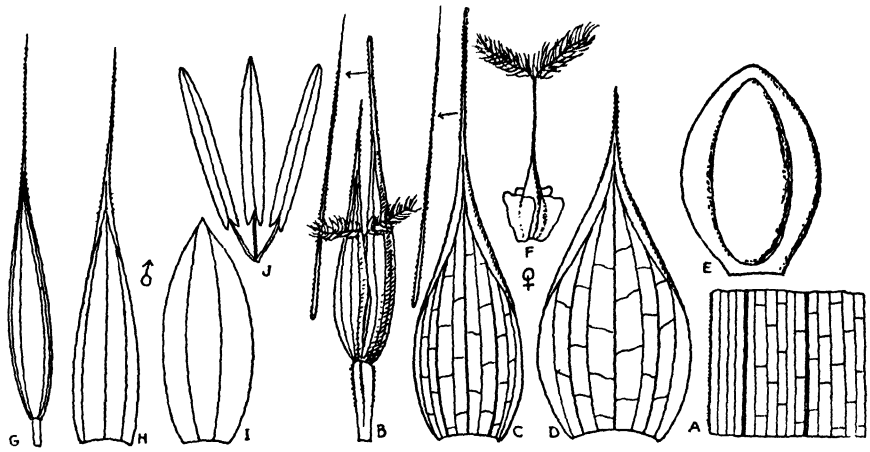


FIG. 443. Olyra latifolia *Linn.* (Olyreae). A, portion of leaf-blade. B, female spikelet. C, lower glume. D, upper glume. E, floret showing lemma and palea. F, female flower. G, male spikelet. H, lemma. I, palea (flattened). J, stamens. (After drawings by C. E. Hubbard.)

Included in the *Paniceae* by Bentham and by Hackel, and in the *Phareae* by Stapf. The fertile floret resembles that of many of the *Paniceae*.

Tribe 23. **Thysanolaeneae.** Perennial grasses; culms usually tall, solid; leaf-blades broad, many-nerved; spikelets very small, all alike, 2-*flowered* with the *lower floret barren* and *reduced to the lemma* and the *upper floret bisexual, falling with part of the pedicel* from the branches of large much-divided panicles; rhachilla tardily disarticulating above the glumes and between the florets, *produced beyond the upper floret* and sometimes bearing a rudimentary floret; glumes obtuse, up to *half the length of the spikelet*, nerveless; lower lemma as long as the spikelet, acuminate, 1- to 3-nerved, thinly membranous; upper lemma slightly shorter than the lower, acuminate or mucronate, becoming slightly hardened, 3-*nerved*, margins fringed with hairs; palea shorter than the lemma; stamens 2 or 3; grain free between the lemma and palea.

One genus, THYSANOLAENA.

Tropical and Subtropical Eastern Asia.

Thysanolaena has been referred to the *Tristegineae* (by Bentham and by Hackel), to the *Paniceae* (E. G. Camus), to *Arundinelleae* (Hitchcock), and *Arundineae* (Stapf in Kew Herb.).

Tribe 24. **Arundinelleae.** Annual or perennial herbs; leaf-blades linear to lanceolate; spikelets all alike, 2-*flowered with the lower floret male or barren and the upper bisexual*, pedicelled in open or contracted, rarely spike-like panicles; rhachilla *disarticulating between the florets*, not produced beyond the upper floret; glumes more or less persistent, mostly acute or acuminate, membranous to coriaceous, the lower shorter, the upper as long as the spikelet; lower lemma *similar to the upper glume*, 3- to 9-nerved; upper lemma *more*

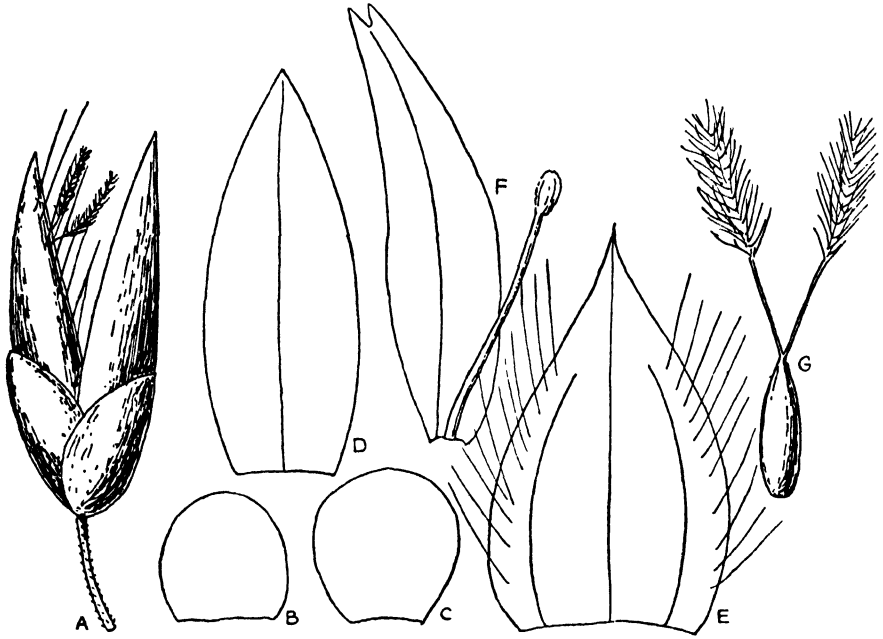


FIG. 444. Thysanolaena maxima *O. Kuntze* (Thysanolaeneae). A, spikelet. B, lower glume. C, upper glume. D, lower lemma. E, upper lemma. F, palea showing rhachilla produced. G, pistil. (After drawings by C. E. Hubbard.)

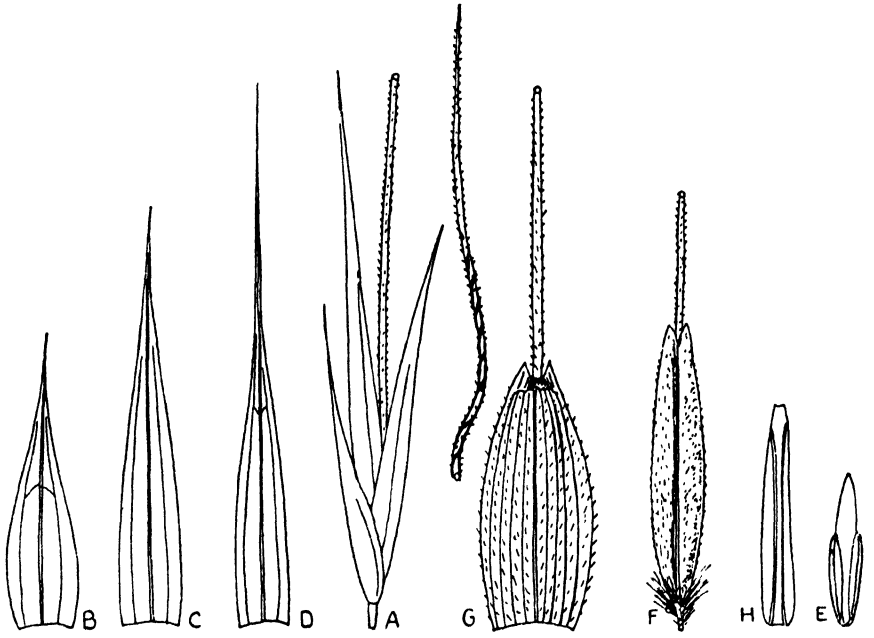


FIG. 445. Trichopteryx acuminata *Stapf* (Arundinelleae). A, spikelet. B, lower glume. C, upper glume. D, lemma of lower floret. E, palea of lower floret. F, upper floret. G, lemma of upper floret. H. palea of upper floret. (After drawings by C. E. Hubbard.)

or less terete, smaller than the lower, becoming *indurated*, 3- to 9-nerved, frequently *awned* from the entire or 2-lobed tip, the awn usually *geniculate* and *twisted below the knee*, rarely absent, often with a bearded basal callus; stamens 2 or 3; caryopsis tightly enclosed between the lemma and palea.

Genera 5: ARUNDINELLA, TRICHOPTERYX, TRISTACHYA, DANTHONIOPSIS, GILGIOCHLOA.

Tropical and Subtropical Regions, with an extension into Warm Temperate Regions in Eastern Asia and Australia.

Bentham and also Hackel included *Trichopteryx* and *Tristachya* in the *Aveneae*, and *Arundinella* in the *Tristegineae*. The other genera included by these authors in the *Tristegineae* have been transferred mainly to the *Paniceae*.

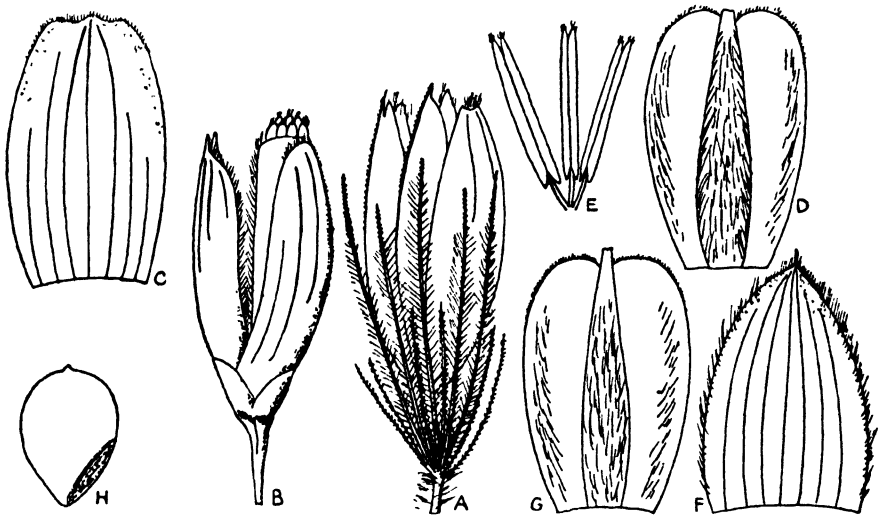


FIG. 446. Pennisetum spicatum *Koern.* (Paniceae). A, bunch of spikelets. B, spikelet. C, lemma of lower floret. D, palea of lower floret. E, stamens. F, lemma of upper floret. G, palea. H, caryopsis. (After drawings by C. E. Hubbard.)

Tribe 25. **Paniceae.** Annual or perennial grasses, with herbaceous, very rarely woody culms; leaf-blades linear to lanceolate or ovate; spikelets *usually similar*, bisexual, rarely unisexual, solitary or paired, usually *falling entire* at maturity, 2-*flowered* with the *lower floret male or barren* and with or without a palea and the *upper bisexual*, rarely with both florets bisexual or the upper female or male, arranged on the usually continuous rhachis of solitary, digitate, or scattered spikes or racemes or in open or contracted sometimes spiciform panicles; rhachilla not produced beyond the upper floret; glumes usually *membranous*, the lower usually *smaller*, sometimes very small or suppressed, the upper usually as long as the spikelet, or shorter, very rarely suppressed; lower lemma *similar to the upper glume*, at least in texture, rarely indurated; upper lemma and palea similar in texture, usually *indurated*, often chartaceous to crustaceous or at least firmer than the glumes, *awnless* very rarely with a straight short awn from the apex; lodicules usually 2; stamens usually 3.

Genera about 80.

Key to Subtribes of **Paniceae**

A. Upper floret alone fertile, the lower male or barren; lower lemma usually similar to the upper glume and not indurated—1. **Panicinae**: DIGITARIA, ALLOTEROPSIS, ERIOCHLOA, BRACHIARIA, AXONOPUS, PASPALUM, ECHINOCHLOA, OPLISMENUS, PANICUM, SETARIA, PENNISETUM, RHYNCHELYTRUM, ANTHEPHORA, XEROCHLOA, SPINIFEX. **AA.** Both florets fertile, or the lower staminate and then its lemma similar to that of the upper floret and indurated —2. **Isachninae**: ISACHNE, HETERANTHOECIA, DISSOCHONDRUS.

Mainly in Tropical and Warm Temperate Regions.

USES: Cereals, such as *Pearl* or *Bulrush Millet* (Pennisetum spp.); *Italian* or *Foxtail Millet* (Setaria italica); *Common* or *Proso Millet* (Panicum miliaceum); *Sanwa Millet* (Echinochloa colona var. frumentacea); *Iburu* and *Fundi* (Digitaria spp.). Fodder Grasses, such as Paspalum, Digitaria, Panicum, Pennisetum, Brachiaria spp., &c.

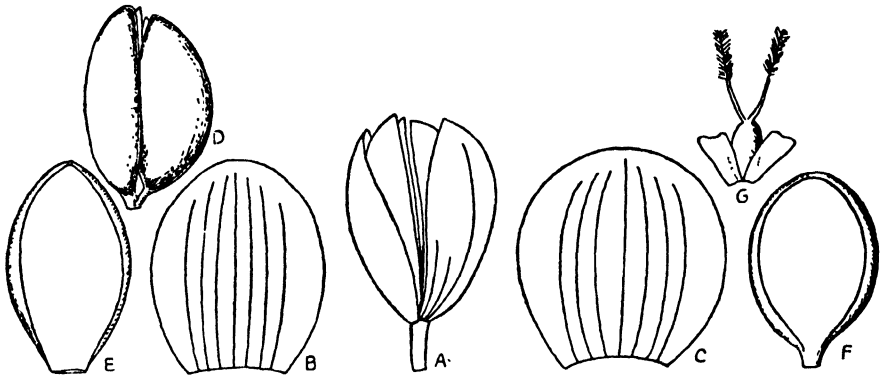


FIG. 447. Isachne australis *R. Br.* (Paniceae). A, spikelet. B, lower glume. C, upper glume. D, florets. E, lower floret. F, upper floret. G, female flower. (After drawings by C. E. Hubbard.)

A. Camus has described a new tribe, the *Boivinelleae*, from the Mascarene Islands, with two genera, *Boivinella* A. Camus and *Cyphochlaena* Hack. It is distinguished from the *Paniceae* by the strongly laterally compressed spikelets, indurated upper glume and lower lemma, and thinly membranous upper lemma and palea which do not become indurated. The genus *Perulifera* A. Camus has been placed in the same tribe and the author states that it forms a transition between the *Boivinelleae* and the *Paniceae*, the upper glume and the lower lemma being membranous whilst the upper lemma is subcoriaceous.

Tribe 26. **Andropogoneae.** Annual or perennial herbs, frequently with tall culms; leaf-blades linear to lanceolate or ovate; spikelets usually in *pairs* (rarely in threes or solitary), one of each pair (or three) *sessile*, the other (or both) *pedicelled*, those of each pair (or three) similar or more often *dissimilar*, *2-flowered* with the *lower floret male or barren* and the *upper bisexual* or female, or male or barren in the pedicelled spikelets, or the latter suppressed and with only the pedicel present, *falling entire* at maturity with the joints of the usually articulate rhachis of solitary, digitate or panicled spike-like racemes; rhachilla not produced beyond the upper floret; glumes more or less rigid and *firmer than the lemmas*, the *lower always longer than the florets*;

lemmas *membranous or hyaline*, the upper usually with a *geniculate awn* from the entire, or the sinus of the, 2-lobed tip; paleas shorter than the lemmas, frequently the lower or both suppressed; lodicules usually 2; stamens 3, rarely 1 or 2.

Genera about 80.

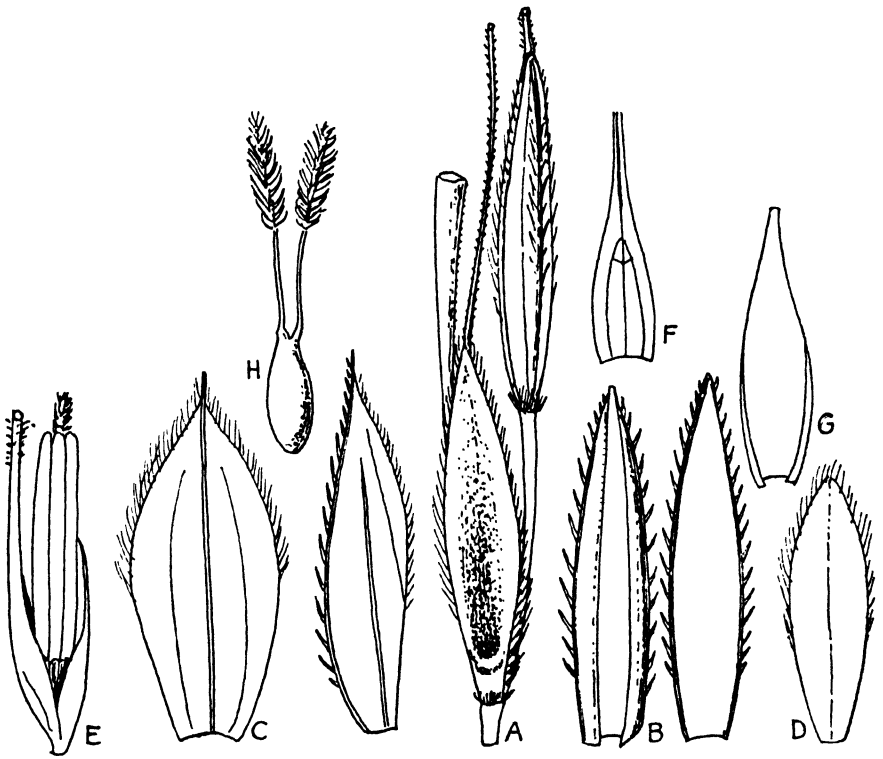


FIG. 448. Microstegium hendersonii *C. E. Hubb.* (Pollinia hendersonii *C. E. Hubb.*) (Andropogoneae). A, pair of spikelets. B, lower glume (inside and out). C, upper glume, flat and side view. D, lemma of lower floret. E, upper floret. F, lemma of upper floret. G, palea of upper floret. H, pistil. (After drawings by C. E. Hubbard.)

Key to the Subtribes of **Andropogoneae**

The following subtribes are those used by Hackel but somewhat modified by Stapf:

A. Spikelets more or less similar in shape and size and usually in sex; pedicels and joints of rhachis slender: **B.** Spikelets paired or in threes, in digitate or panicled (rarely solitary) racemes; rhachis articulate or continuous; glumes frequently surrounded by long hairs; lower floret barren, rarely male—1. **Saccharinae**: IMPERATA, MISCANTHUS, MISCANTHIDIUM, SACCHARUM, ERIOCHRYSIS, EULALIA, MICROSTEGIUM, POGONATHERUM. **BB.** Spikelets solitary, along one side of the continuous rhachis of solitary or digitate spikes or spike-like racemes; lower floret barren—2. **Dimeriinae**: DIMERIA. **AA.** Spikelets usually dissimilar in shape, size, and sex, or if similar then with

thickened or stout pedicels and joints, or with solitary spikelets and these not arranged in one-sided spikes or racemes: **C.** Sessile spikelets with the lower floret male, rarely barren, but then with the palea present; joints and pedicels thickened; upper lemma usually awned—3. **Ischaeminae**: ISCHAEMUM, SEHIMA, ANDROPTERUM, THELEPOGON, APLUDA. **CC.** Sessile spikelets often barren, rarely male and then with the upper lemma awnless: **D.** Joints and

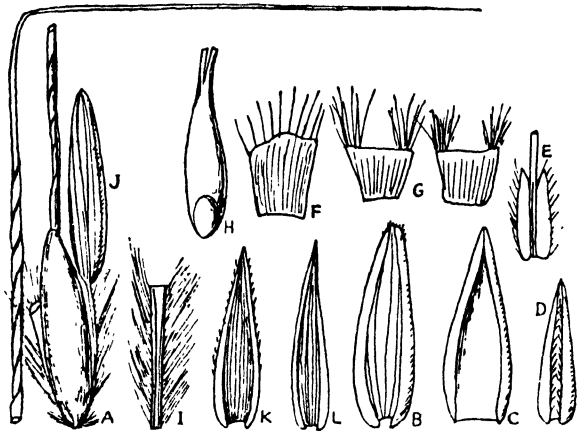


FIG. 449. Sorghum versicolor *Anders.* (Andropogoneae). A, sessile spikelet. B, lower glume. C, upper glume. D, lower lemma. E, upper lemma. F, palea. G, lodicules. H, ovary. I, pedicel. J, pedicelled spikelet. K, lower glume. L, upper glume. (After drawings by C. E. Hubbard.)

pedicels more or less stout, thickened upwards, contiguous, sometimes fused; lemma awnless—4. **Rottboelliinae**: VOSSIA, URELYTRUM, JARDINEA, HEMARTHRIA, HACKELOCHLOA, ELIONURUS, ROTTBOELLIA, OPHIURUS. **DD.** Joints and pedicels slender, rarely thickened upwards; upper lemma awned—5. **Andropogoninae**: SORGHUM, VETIVERIA, CHRYSOPOGON, ARTHRAXON, ANDROPOGON, CYMBOPOGON, HYPARRHENIA, TRACHYPOGON, HETEROPOGON, THEMEDA.

Almost confined to Tropical and Warm Temperate Regions, frequently forming an important part of the savannah grasses in the Tropics.

USES: Important cereals such as *Guinea Corn, Durra, Kaffir Corn, Milo,* &c. (Sorghum spp.). *Sugar Cane* (Saccharum officinarum). *Broom Corn* (Sorghum bicolor var. technicus). *Saccharine sorghum* or *Sorgo* (Sorghum spp.). Essential Oil Grasses:—*Palmarosa, Lemon,* and *Citronella Grasses* (Cymbopogon spp.), *Vetiver Grass* (Vetiveria zizanioides). Thatching Grasses (Hyparrhenia, Imperata, Saccharum spp., &c.).

In this and the next tribe the highest degree of specialization of the spikelet and inflorescence is reached, and represents the climax of evolution in the *Panicoideae.*

Tribe 27. **Maydeae** (*Tripsaceae*). Annual or perennial herbs, often with tall culms; leaf-blades linear to lanceolate; spikelets *unisexual, dissimilar, awnless,* the sexes in *different inflorescences* or in *different parts of the same inflorescence*

with the male above the female; male spikelets 2-flowered, mostly paired, one sessile, the other or both pedicelled, in solitary or panicled spike-like racemes; glumes *membranous to chartaceous, enclosing the florets*; lemmas *hyaline*;

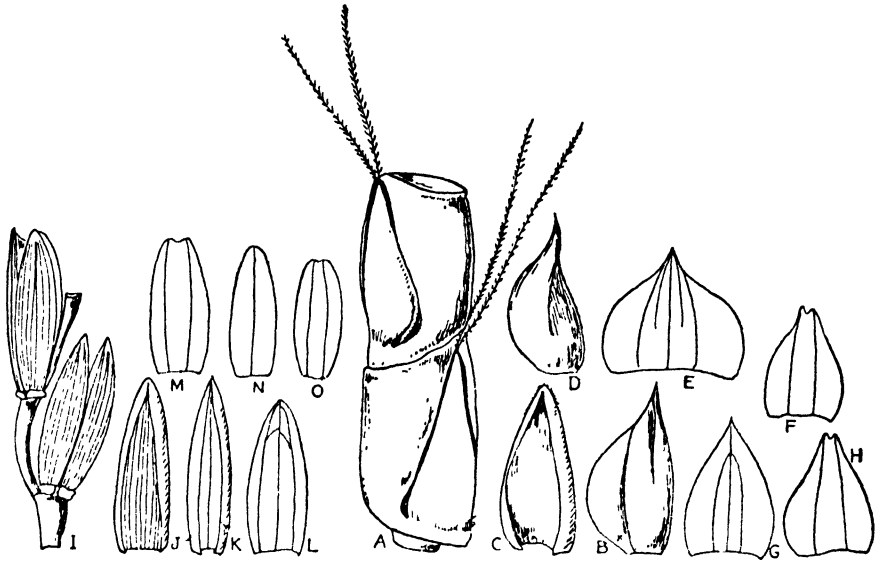


FIG. 450. Tripsacum dactyloides *Linn.* (Maydeae). A, part of female portion of inflorescence. B, female spikelet. C, lower glume. D, upper glume. E, lower lemma. F, palea. G, upper lemma. H, palea. I, part of male portion of inflorescence. J, lower glume. K, upper glume. L, lower lemma. M, palea. N, upper lemma. O, palea. (After drawings by C. E. Hubbard.)

stamens 3; female spikelets 2-flowered with the lower floret barren, solitary or sometimes paired, embedded in the hollows of a thickened jointed rhachis or enclosed in a thickened sheath or crowded in rows on a thickened rhachis; glumes hardened or thin; lemmas *hyaline*.

Genera 8: ZEA, EUCHLAENA, COIX, TRIPSACUM, CHIONACHNE, POLYTOCA.

Tropical Regions.

USES: The important cereal, *Maize* or *Indian Corn* (Zea mays) is cultivated throughout Tropical and Subtropical Regions. Some varieties of *Job's Tears* (Coix lacryma-jobi) are cultivated for ornament, &c. *Teosinte* (Euchlaena mexicana) is cultivated for fodder.

GLOSSARY

(*See also Vol.* I, *p.* 509)

anatropous, an ovule reversed, with the micropyle close to the side of the hilum, the chalaze at the opposite end.
annular, ring-like.
antitropous, turning against the sun.
articulate, jointed.
auricles, ears.
awn, bristle-like appendage.

bract, modified leaf subtending the flower stalk or flower.

callus, a thickening.
cartilaginous, hardened.
caryopsis, 1-seeded fruit with pericarp united to seed.
caudate, tailed.
chartaceous, papery.
conchiform, shell-shaped.
confervoid, composed of threads.
convolute, rolled around.
coriaceous, leathery.
crustaceous, brittle.
culms, stems of grasses and sedges.

distichous, arranged in two vertical ranks.

foveolate, marked with small pits.

geniculate, kneed.

homotropous, (1) an anatropous ovule with radicle next to the hilum; (2) curved or turned in one direction.
hyaline, thin and translucent.

indurate, hardened.
innovations, new-formed shoots.
internode, space between the nodes.
involucre, a ring of bracts or bristles.
involute, with margins inrolled.

lemma, outer bract of grass floret.
ligule, projection from inside junction of sheath and blade of grasses.
lodicule, a scale-like perianth-segment.

node, the 'knot' in a grass stem.

orthotropous, (1) assuming a vertical position; (2) ovule with straight axis.

palea, inner bract of grass floret.
panicle, branched inflorescence.
papillae, minute blunt hairs.
papillose, covered with papillae.
pedicelled, stalked.
petiole, leaf-stalk.
plumose, like a feather.

rhachilla, axis of grass and sedge spikelet.
rhachis, axis.

spathe, large bract, often coloured or membranous.
subulate, awl-shaped.

terete, cylindrical.
thyrse, a contracted or ovate panicle.

utricle, small fruit with pericarp free from the seed.

verticil, whorl.

ADDENDUM

Of importance to students. Whilst these two volumes were being printed the author's attention was drawn to a very important paper entitled 'The Systematics of the Angiosperms' by Lincoln Constance, reprinted from *A Century of Progress in the Natural Sciences 1853–1953*, California Academy of Sciences, San Francisco, 20 Oct. 1955. Students interested in taxonomy and phylogeny should read this scholarly historical dissertation accompanied by a valuable bibliography. The present author's system as originally published in the first edition is discussed and compared with others.

INDEX

Family names in **bold type**; synonyms and common names in *italics*.

Abelia, i. 178.
Aberia caffra, i. 208.
Abir, ii. 584.
Abolboda, ii. 572.
Abroma, i. 252.
Abromeitiella, ii. 579.
Abronia, i. 217.
— fragrans (Fig. 86), i. 217.
Abrus, i. 155.
Abutilon, i. 255.
Acacia, i. 54.
— catechu, i. 155.
— melanoxylon, i. 155.
— senegal, i. 155.
— suma, i. 155.
Acaena, i. 150, (map of) 149.
Acalypha, i. 270.
Acanthaceae, i. 29, **489.**
Acanthocarpus, ii. 662.
Acanthococos, ii. 670.
Acantholimon, i. 455.
— venustum (Fig. 296), i. 455.
Acanthopanax, i. 178.
— henryi (Fig. 47), 177.
Acanthophoenix, ii. 669.
Acanthorhiza, ii. 667.
Acanthosabal, ii. 667.
Acanthosicyos horrida, i. 244.
Acanthostachys, ii. 580.
Acanthus, i. 491.
— montanus (Fig. 325), i. 490.
Acer, i. 365.
— campestre, i. 364, (Fig. 219) 365.
— pseudoplatanus, i. 364.
— saccharum, i. 364.
Aceraceae, i. 26, **364.**
Aceranthus, i. 405.
Acharia, i. 241.
— tragodes (Fig. 108), i. 242.
Achariaceae, i. **241.**
Achasma, ii. 587.
Achatocarpaceae, i. **210.**
Achatocarpus, i. 211.
— mexicanus (Fig. 79), i. 210.
Achillea, i. 482.
Achimenes, i. 491.
Achlys, i. 491.
Achras, i. 350.
— zapota, i. 26, 350.
Achyranthes, i. 441.
Aciachne, ii. 729.
Acicarpha, i. 476.
Acidanthera, ii. 651.
Aciphylla, i. 472.
Aclisia, ii. 565.
Acmadenia, i. 354.
Acoelorhaphe, ii. 667.
Acokanthera, i. 381.
— schimperi, i. 381.
— venenata, i. 381.
Aconite root, i. 402.
Aconitum, i. 402.
— napellus, i. 27, 402.
Acoreae, ii. 630.
Acorellus, ii. 708.
Acorus, ii. 630.
— calamus, ii. 629.
Acridocarpus, i. 259.
— natalitius (Fig. 122), i. 258.
Acrista, ii. 669.
Acriulus, ii. 709.
Acrocephalus, i. 506.
Acrocomia, ii. 670.
Acrospira, ii. 598.
Acrostigma, ii. 668.
Acrotonae, ii. 695.
Acrotrema, i. 144.
Actaea, i. 402.
— spicata, i. 27.
Actinidia, i. 275.
— strigosa (Fig. 137), i. 275.
Actinidiaceae, i. **274.**
Actinodaphne, i. 140.
Actinokentia, ii. 668.
Actinophloeus, ii. 668.
Actinorhytis, ii. 668.
Actinoschoenus, ii. 707.
Adactylus, ii. 683.
Adansonia, i. 254, (map of) 253.
— digitata, i. 26, 254.
Adelmeria, ii. 587.
Adelodypsis, ii. 669.
Adelonenga, ii. 668.
Adenandra, i. 354.
Adenium, i. 381.
— honghel (Fig. 233), i. 380.
Adenocalymna, i. 389.
Adenocarpus, i. 155.
Adenogramma, i. 429.
Adenophora, i. 476.
Adenoplea, i. 375.
Adenoplusia, i. 375.
Adonis, i. 403.
Adoxa, i. 466.
— moschatellina (Fig. 306), i. 466.
Adoxaceae, i. **466.**
Aechmea, ii. 580.
Aechmolepsis, i. 382.
Aegiceras, i. 348, (map of) 347.
— corniculatum (Fig. 205), i. 348.
Aegicerataceae, i. **347.**
Aegilops, ii. 719.
Aeginetia, i. 492.
Aegiphila, i. 395.
Aegle marmelos, i. 354.
Aeluropus, ii. 717.

Aerangis citrata (Fig. 415), ii. 693.
Aeria, ii. 669.
Aerva, i. 441.
Aeschynanthus, i. 491.
— peelii (Fig. 326), i. 491.
Aeschynomene, i. 155.
Aesculus, i. 365.
— hippocastanum, i. 26, 365, (Fig. 220) 366.
Aethionema, i. 426.
Aetoxylon, i. 213.
Aextoxicaceae, i. 318.
Aextoxicon, i. 318.
— punctatum (Fig. 178), i. 319.
Affon, i. 202.
Aframomum, ii. 587.
— angustifolium, ii. 584.
— citratum, (Fig. 367), ii. 585.
— latifolium, ii. 584.
— melegweta, ii. 584.
African bread-fruit, i. 202.
— *Cedar*, i. 358.
— *Oak*, i. 283.
Afrocalathea, ii. 590.
Afrocrania, i. 173.
Afroraphidophora, ii. 632.
Afrostyrax, i. 170.
Afrothismia, ii. 689.
Afzelia, i. 154.
Agapantheae, ii. 642.
Agapanthus, ii. 642.
— africanus, ii, Fig. 393.
Agapetes, i. 296.
— serpens (Fig. 157), i. 296.
Agarista, i. 290.
Agathelpis, i. 505.
Agathosma, i. 354.
Agavaceae, i. 32; ii. 662.
AGAVALES, ii. 660.
Agave, ii. 665.
— amaniensis, i. 32.
— fourcroydes, ii. 662.
— heteracantha, ii. 662.
— morrisii, ii. 662.
— schidigera (Fig. 402), ii. 663.
— sisalina, i. 32; ii. 662.
— vivipara, ii. 662.
Agaveae, ii. 665.
Agdestidaceae, i. 437.
Agdestis, i. 438.
— clematidea (Fig. 281), i. 437.
Agelaea, i. 145.
Ageratum, i. 482.
Aglaia, i. 356.
Aglaodorum, ii. 632.
Aglaonema, ii. 632.
Agonandra, i. 331.
Agrimonia, i. 150.
Agropyron, ii. 719.
— elongatum (Fig. 425), ii. 720.
— repens, i. 34.
Agrosteae, ii. 726.
Agrostis, ii. 726.
Agrostocrinum, ii. 596.
Ailanthus, i. 355.
— altissima, i. 355.
Aira, ii. 726.
Aizoaceae, i. 430.
Aizoon, i. 430.
Ajuga, i. 508.
Akania, i. 368.
— lucens (Fig. 222), i. 368.
Akaniaceae, i. 368.
Akebia, i. 410.
— lobata (Fig. 255), i. 409.
Alangiaceae, i. 173, (map of) 17
Alangium, i. 174.
— chinense (Fig. 44), i. 174.
Alania, ii. 602.
Albizzia, i. 154.
Albuca, ii. 611.
Alcantarea, ii. 580.
Alchemilla, i. 150.
Alchornea, i. 270.
Alcimandra, i. 124.
Alder Buckthorn, i. 343.
Aldrovandra, i. 468.
Alectorurus, ii. 598.
Alepidea, i. 472.
Alepyrum, ii. 700.
Aletris, ii. 596.
Aleurites, i. 270.
— fordii, i. 26, 271.
Alexandrian Laurel, i. 299.
Alfaroa, i. 196.
Algerian Tea, i. 433.
Alibertia, i. 387.
Alisma, ii. 544.
Alismataceae, i. 29, 30; ii. 542.
ALISMATALES, ii. 542.
Alkanet root, i. 503.
Alkanna, i. 503.
— tinctoria, i. 503.
Allamanda, i. 381.
Allieae, i. 31; ii. 642.
Allium, ii. 642.
— ampeloprasum var. porrum, ii. 639.
— cepa, ii. 639.
Allophyllus, i. 361.
Alloplectus, i. 491.
Alloschemone, ii. 632.
Alloteropsis, ii. 737.
Allotropa, i. 295.
Allspice, i. 303.
Almeidea, i. 354.
Alniphyllum, i. 170.
Alnus, i. 191.
Alocasia, ii. 633.
Aloe, i. 31; ii. 602.
Aloe, ii. 592.
Aloineae, ii. 601.
Alona, i. 487.
Alopecurus, ii. 726.
Alophia, ii. 651.
Alpam Root, i. 415.
Alphitonia, i. 343.
Alpinia, ii. 586.
— galanga, ii. 584.
— officinarum, ii. 584.
Alsodeia, i. 231.
Alstonia, i. 381.
Alstroemeria, ii. 623.
Alstroemeriaceae, ii. 623.

ALSTROEMERIALES, ii. 621.
Alternanthera, i. 441.
Althaea, i. 255.
Althenia, ii. 559.
Altingia excelsa, i. 181.
Alyssum, i. 426.
Alyxia, i. 381.
Amana, ii. 609.
Amaranthaceae, i. 440.
Amaranthus, i. 440.
— retroflexus (Fig. 284), i. 441.
Amaryllidaceae, i. 31, 32; ii. 639.
AMARYLLIDALES, ii. 639.
Amaryllideae, ii. 643.
Amaryllis, ii. 643.
— belladonna, i. 32.
Amauriella, ii. 633.
Amborella, i. 136.
Ambrosina, ii. 635.
Amelanchier, i. 150.
American Ash, i. 379.
— *Plane*, i. 183.
— *Rosewood*, i. 156.
Amherstia, i. 153.
Amianthium, ii. 608.
Ammandra, ii. 670.
Ammannia, i. 446.
Ammi, i. 472.
Ammobroma, i. 296.
Ammocharis, ii. 643.
Ammophila arenaria, i. 34.
Amomum, ii. 587.
— subulatum, ii. 584.
Amoora, i. 356.
Amoracia lapathifolia, i. 28, 426.
Amoreuxia, i. 209.
Amorpha, i. 155.
Amorphophallus, ii. 634.
— campanulatus, ii. 629.
— titanum, i. 32; (Fig. 389) ii. 631.
Ampelidaceae, i. 26, 344.
Ampelocissus, i. 344.
Amphiblemma, i. 309.
Amphibolis, ii. 559.
Amphiphyllum, ii. 574.
Amphisiphon, ii. 611.
Amsinckia, i. 503.
Amydrium, ii. 632.
Amyris, i. 356.
Amyxa, i. 213.
Anabasis, i. 440.
Anacampseros, i. 431.
Anacardiaceae, i. 26, 363.
Anacardium, i. 363.
— occidentale, i. 26, 364, (Fig. 218) 364.
Anacharis, ii. 541.
Anachariteae, ii. 541.
Anaclanthe, ii. 652.
Anacolosa, i. 330.
— densiflora (Fig. 188) i. 330.
Anadendrum, ii. 632.
Anagallis, i. 453.
— arvensis, i. 28.
Anamirta paniculata, i. 411.
Ananas, ii. 581.
— sativus, i. 31; ii. 577.
Anapalina, ii. 652.
Anaphalis, i. 482.
Anaphyllum, ii. 632.
Anarthria, ii. 703.
— scabra (Fig. 419), ii. 701.
Anastatica, i. 426.
Anchomanes, ii. 632.
Anchovy Pear, i. 304.
Anchusa, i. 503.
Ancistrocladaceae, i. 286.
Ancistrocladus, i. 286, 287, (map of) 287.
— heyneanus (Fig. 149), i. 287.
Ancistrophyllum, ii. 667.
Ancrumia, ii. 643.
Andaman Marble wood, i. 350.
Andersonia, i. 293.
Andesia, ii. 697.
Andrea, ii. 580.
Androcymbium, ii. 612.
Androlepis, ii. 580.
Andromeda, i. 290.
Andromycia, ii. 633.
Andropogon, ii. 741.
Andropogoneae, ii. 739.
Andropterum, ii. 740.
Androsace, i. 453.
Androsiphon, ii. 611.
Androstephium, ii. 642.
Androtrichum, ii. 708.
Aneilema, ii. 565.
Anemarrhena, ii. 599.
Anemiopsis, i. 421.
Anemone, i. 27, 403.
Anemonella, i. 403.
Anemonopsis, i. 402.
Anemopaegma, i. 389.
Anemopsis, i. 421.
— californica (Fig. 265), i. 420.
Anepsias, ii. 632.
Aneulophus, i. 265.
Angelica, i. 472.
Angiosperms, i. 23.
ANGIOSPERMAE, i. 22.
Angraecum, ii. 695.
Anguillaria, ii. 609.
Anguillaricae, ii. 608.
Anguria, i. 244.
Angysiphon, ii. 651.
Anigozanthos, ii. 677.
— flavidus (Fig. 405), ii. 675.
Anisadenia, i. 261.
Anise, i. 472.
Anisophyllea, i. 305, (map of) 305.
— laurina (Fig. 164), i. 305.
Annamocarya, i. 196.
Annatto dye, i. 206.
Annona, i. 134.
— cherimolia, i. 23, 134.
— muricata, i. 134.
— reticulata, i. 23, 134.
— squamosa, i. 134.
Annonaceae, i. 23, 133.
ANNONALES, i. 133.
Anogeissus, i. 307.
Anomalesia, ii. 652.
Anomalostylus, ii. 649.

Anomochloa, ii. 733.
— marantoidea (Fig. 440), ii. 732.
Anomochloeae, ii. 731.
Anopterus, i. 166.
Anopyxis, i. 305.
Anredera, i. 444.
Antennaria, i. 482.
Anthemis, i. 482.
— nobilis, i. 28.
Anthephora, ii. 737.
Anthericopsis, ii. 565.
Anthericum, ii. 598.
Antherolophus, ii. 604, 609.
Anthobryum, i. 228.
Anthochortus, ii. 703.
Anthocleista, i. 371.
Anthodiscus, i. 280.
Antholyza, ii. 652.
Antholyzeae, ii. 652.
Anthostyrax, i. 169.
Anthoxanthum, ii. 730.
— odoratum, i. 34.
Anthriscus, i. 472.
Anthurieae, ii. 630.
Anthurium, ii. 630.
Anthyllis, i. 155.
Antiaris, i. 202.
Antidesma, i. 270.
Antirrhinum, i. 489.
Antongilia, ii. 669.
Antonia, i. 376.
— ovata (Fig. 228), i. 375.
Antoniaceae, i. **375.**
Anubias, ii. 633.
Apama, i. 415.
Apartea, ii. 709.
Apatemone, ii. 633.
Aphelandra, i. 491.
Aphelia, ii. 700.
Aphyllanthes, ii. 599.
Aphyllanthideae, ii. 599.
Aphyllarum, ii. 634.
Apicra, ii. 602.
Apinagia, i. 470.
Apium, i. 472.
— graveolens, i. 28, 472.
Apluda, ii. 740.
Apocynaceae, i. 27, **380.**
APOCYNALES, i. 379.
Apocynum, i. 381.
Apodanthes, i. 416.
Apodolirion, ii. 643.
Apodytes, i. 317.
Aponogeton, ii. 554, (map of) 554.
— distachyon, i. 30, (Fig. 352) ii. 553.
Aponogetonaceae, i. 30; ii. **552.**
APONOGETONALES, ii. 552.
Aporosa, i. 270.
Apostasia, ii. 683.
Apostasiaceae, i. 32; ii. **680.**
Apple, i. 150.
Apricot, i. 150.
Aptandra, i. 333, (map of) 332.
Aptandraceae, i. **332.**
Apteria, ii. 687.
Aquifoliaceae, i. 26, **311.**
Aquilaria, i. 214.
— agallocha, (Fig. 82), i. 213.
Aquilariaceae, i. **213.**
Aquilegia, i. 402.
Arabia tea, i. 320.
Arabis, i. 426.
Araceae, i. 31; ii. **627.**
Arachis, i. 155.
— hypogaea, i. 25, 156.
Arachnites, ii. 691.
Araeococcus, ii. 580.
ARALES, ii. 627.
Aralia, i. 178.
— nudicaulis, i. 178.
Araliaceae, i. 25, **177.**
ARALIALES, i. 171.
Arbutus, i. 290.
Archeocarex, ii. 710.
Archontophoenix, ii. 668.
Archytaea, i. 272.
Arctocrania, i. 173.
Arctostaphylos, i. 290.
— uva-ursi, i. 292.
Arctotis, i. 482.
Ardisia, i. 346.
— humilis (Fig. 203), i. 345
Areae, ii. 635.
Areca catechu, ii. 666.
— *nut*, ii. 666.
Arecastrum, ii. 670.
Areceae, ii. 668.
Aregelia, ii. 580.
Arenaria, i. 430.
Arenga, ii. 669.
Argemone, i. 423.
Argentacer, i. 365.
Argithamnia, i. 270.
Argophyllum, i. 165.
Argostemma, i. 386.
Argyrolobium, i. 155.
Aridarum, ii. 633.
Arikury, ii. 670.
Arikuryroba, ii. 670.
Ariopsis, ii. 634.
Arisaema, ii. 635.
Arisarum, ii. 635.
Aristea, ii. 651.
Aristeae, ii. 651.
Aristida, ii. 729.
Aristolochia, i. 415.
— clematitis (Fig. 260), i. 414.
— serpentaria, i. 415.
Aristolochiaceae, i. 27, **414.**
Aristotelia, i. 250.
— maqui, i. 251.
Armoria, i. 458.
Arnocrinum, ii. 602.
Arcdendron, ii. 634.
Aromadendron, i. 124.
Aropsis, ii. 633.
Arracacha i. 497.
Arrhenatherum, ii. 726.
Arrow poisons, i. 381.
Arrowroot, ii. 584, 683.
Artabotrys, i. 134.
Artemisia, i. 482, 484.

Artemisia cina, i. 28.
Arthraxon, ii. 740.
Arthrocnemum, i. 440.
Arthropodium, ii. 598.
Arthrosolen, i. 216.
Arthrostylidium, ii. 715.
Arthrostylis, ii. 707.
Artichoke, Chinese, i. 508.
Artocarpus, i. 202.
— altilis, i. 202.
— communis, i. 202.
— heterophyllus, i. 202.
Arum, ii. 635.
— maculatum, i. 31.
Arundinaria, ii. 715.
Arundineae, ii. 720.
Arundinella, ii. 736.
Arundinelleae, ii. 736.
Arundo, ii. 721.
Asan wood, i. 307.
Asarum, i. 415.
Ascarina, i. 422.
— lanceolata (Fig. 266), i. 422.
Asclepiadaceae, i. 27, **383.**
Asclepias, i. 383.
Ascolepis, ii. 709.
Ascopholis, ii. 708.
Ash, i. 27.
— *common*, i. 379.
Asimina, i. 134.
— triloba, (Fig. 10) i. 134.
Asiphonia, i. 415.
Anurosperma, i. 418.
Askidiosperma, ii. 703.
Aspalathus, i. 155.
Asparageae, ii. 608.
Asparagus, i. 31; ii. 592, 608.
— officinalis, ii. 592.
Asperella, ii. 719.
Asperula, i. 387.
— odorata, i. 27.
Asphodeleae, ii. 596.
Asphodeline, ii. 598.
Asphodelus, ii. 598.
— chambeironi (Fig. 371), ii. 597.
Aspidistra, i. 31; ii. 604.
Aspidistreae, ii. 603.
Aspidopterys, i. 259.
Aspidosperma, i. 381.
— excelsum, i. 381.
Astelia, ii. 604.
Aster, i. 482.
ASTERALES, i. 481.
Asteranthaceae, i. 304.
Asteranthos, i. 304.
Asterochaete, ii. 707.
Asterogyne, ii. 669.
Asteropyrum, i. 402.
Asterostigma, ii. 633.
Astilbe, i. 459.
Astragalus, i. 155.
— gummifer, i. 156.
Astrantia, i. 472.
Astrebla, ii. 726.
Astrephia, i. 473.
Astrocaryum, ii. 670.
Astroloba, ii. 602.
Astroloma, i. 293.
Astronia, i. 309.
Asystasia, i. 491.
Ataenidia, ii. 590.
Atherandra, i. 382.
Atherolepis, i. 382.
Atherosperma, i. 136.
— moschatum (Fig. 12), i. 137.
Atherostemon, i. 381.
Athyrocarpus, ii. 565.
Atractocarpa, ii. 715.
Atraphaxis, i. 432.
Atriplex, i. 440.
Atropa, i. 484.
— belladonna, i. 29, 484.
Attalea, ii. 670.
— funifera, ii. 666.
Aubrietia, i. 426.
Aucuba, i. 172.
Audouinia, i. 186.
Augea, i. 270.
Aulacodiscus, i. 386.
Aulisconema, ii. 605.
Aulotandra, ii. 587.
Australian Blackwood, i. 155.
— *Sassafras*, i. 137.
Austrobaileya, i. 138.
— maculata (Fig. 13), i. 137.
Austrobaileyaceae, i. **137.**
Auxemma, i. 394.
Avena, i. 34; ii. 726.
— sativa, ii. 726.
Aveneae, ii. 726.
Averrhoa, i. 356.
— bilimbi, i. 356.
— carambola, i. 356, (Fig. 212) 357.
Averrhoaceae, i. **356.**
Avetra, ii. 656.
Avicennia, i. 395.
Avocado Pear, i. 23, 140.
Axonopus, ii. 737.
Aydendron, i. 140.
Azadirachta, i. 356.
— indica, i. 358.
Azalea, i. 292.
Azara, i. 207.
Azima, i. 313, (map of) 313.
Azorella, i. 472.

Babiana, ii. 651.
Baccaurea, i. 270.
Baccharis, i. 482.
Bactris, ii. 670.
— gasipes, ii. 666.
Bacularia, ii. 669.
Baeckea, i. 303.
Bael fruit, i. 354.
Baeometra, ii. 609.
Bagnisia, ii. 689.
Bahera tree, i. 307.
Bahia Piassava, ii. 666.
Baikiaea, i. 154.
Baissea, i. 381.
Bakerantha, ii. 579.
Bakeria, ii. 579.

Balaka, ii. 668.
Balanitaceae, i. 267.
Balanites, i. 268.
— aegyptiaca (Fig. 131), i. 268.
Balanophora, i. 341.
Balanophoraceae, i. 340.
Balanops, i. 190.
— vieillardii (Fig. 60), i. 190.
Balanopsidaceae, i. 189.
BALANOPSIDALES, i. 189.
Balata tree, i. 350.
Balbisia, i. 263.
— peduncularis (Fig. 127), i. 264.
Baldellia, ii. 544.
Ballota, i. 508.
Balsaminaceae, i. 29, 499.
Balsamodendron, i. 356.
Balsam Poplar, i. 187.
Bamburanta, ii. 590.
Bambusa, ii. 715.
— falcooa (Fig. 422), ii. 716.
Bambuseae, i. 34; ii. 715.
Banana, i. 31; ii. 582.
Banara, i. 207.
Baneberry, i. 27.
Banisteria, i. 259.
Banksia, i. 218.
Baobab, i. 26, 254.
Baphia nitida, i. 156.
Barbacenia, ii. 680.
— bicolor (Fig. 407), ii. 679.
Barbarea, i. 426.
Barberetta, ii. 676.
Barbeuia, i. 435.
— madagascariensis (Fig. 278), i. 434.
Barbeuiaceae, i. 434.
Barbeya, i. 203.
— oleoides (Fig. 72), 203.
Barbeyaceae, i. 203.
Barbosa, ii. 670.
Barcelona nut, i. 194.
Barclaya, i. 403.
Bargemontia, i. 487.
Barkania, ii. 541.
Bark Bosch, i. 339.
Barkerwebbia, ii. 669.
Barleria, i. 491.
Barley, i. 34; ii. 720.
Barnadesia, i. 482.
Barneaudia, i. 403.
Baroniella, i. 382.
Barosma, i. 354.
— betulina, i. 354.
Barringtonia, i. 304.
Barselinia, ii. 669.
Bartlingia, ii. 602.
Bartsia, i. 489.
Basella, i. 444.
Basellaceae, i. 443.
Baseonema, i. 382.
Basitonae, ii. 694.
Bass brooms, ii. 666.
Bassia, i. 350.
— latifolia, i. 350.
Basswood, i. 251.
Bastard Teak, i. 156.
Batesanthus, i. 382.
Batidaceae, i. 442.
Batis, i. 443.
— maritima (Fig. 286), i. 443.
Battandiera, ii. 611.
Bauera, i. 166.
— rubioides (Fig. 38), i. 166.
Baueraceae, i. 166.
Bauhinia, i. 153.
Baxteria, ii. 662.
Bdallophyton, i. 416.
Beefwood, i. 199.
Bear-Berry, i. 292.
Beatsonia, i. 228.
Beauverdia, ii. 642.
Becquerelia, ii. 709.
Beech, i. 192.
Beesia, i. 402.
Beet, i. 28.
Beet-root, i. 440.
Begonia, i. 245.
— cathcartii (Fig. 110), i. 244.
Begoniaceae, i. 244.
Begoniella, i. 245.
Behnia, ii. 627.
— reticulata, ii. 627.
Behria, ii. 642.
Beilschmiedia, i. 140.
Belamcanda, ii. 649.
Belladonna, i. 32.
Belle Apple, i. 241.
Belliolum, i. 128.
Bellis, i. 482.
Belonanthus, i. 473.
Beloperone, i. 491.
Beneditaea, ii. 541.
Bentinckia, ii. 669.
Bentinckiopsis, ii. 669.
Berberidaceae, i. 27, 412.
BERBERIDALES, i. 407.
Berberis, i. 413.
— stenophylla (Fig. 259), i. 413.
Berchemia, i. 343.
Bergia, i. 428.
Bergenia, i. 459.
Berlinia, i. 154.
Berneuxia, i. 294.
Bersama, i. 360.
Bertholletia, i. 304.
— excelsa, i. 304.
Bertiera, i. 387.
Berzelia, i. 186.
Beschorneria, ii. 665.
Besleria, i. 491.
Bessera, ii. 642.
Beta, i. 440.
— vulgaris, i. 440.
Betel nut, ii. 666.
Betula, i. 192.
— alba, i. 191.
— lenta, i. 191.
— papyrifera (Fig. 61), i. 191.
— utilis, i. 191.
Betulaceae, i. 25, 191, 194.
Biarum, ii. 635.
Bidens, i. 482.

Bignonia, i. 389.
Bignoniaceae i. 27, **389.**
BIGNONIALES, i. 387.
Bikkia, i. 386.
Bilbergia nutans, (Fig. 365). ii. 578.
Bilberry, i. 296.
Bilimbi fruit, i. 356.
Billardiera, i. 220.
Billbergia, ii. 581.
Billia, i. 365.
Biophytum, i. 497.
— sensitivum (Fig. 332), i. 497.
Biovularia i. 493.
Birch, i. 191.
Bird-lime, i. 312.
Bisboechelera, ii. 709.
Bitter Almond, i. 150.
— *Apple*, i. 244.
— *Kola*, i. 299.
Bixa, i. 206.
— orellana, i. 206, (Fig. 74) 205.
Bixaceae, i. **205**, 207, 209, 253.
BIXALES, i. 204.
Blackberry, i. 150.
Black Birch, i. 191.
— *bryony*, i. 32; ii. 658.
— *Cohosh*, i. 402.
— *currant*, i. 162.
— *Iron Wood*, i. 379.
— *Snakeroot*, i. 402.
Blackstonia, i. 451.
Blaeria, i. 290.
Blancoa, ii. 676.
Blandfordia, ii. 601.
— flammea (Fig. 373), ii. 600.
Blastocaulon, ii. 576.
Blastus, i. 309.
Blepharis, i. 491.
Blepharocarya, i. 363.
Blepharoneuron, ii. 723.
Blood Root, i. 423.
Bloomeria, ii. 642.
Blue Flag, ii. 647.
— *gum*, i. 303.
Bluebell, i. 28, 31.
Blumenbachia, i. 239.
Blyxa, ii. 541.
Blyxeae, ii. 541.
Blyxopsis, ii. 541.
Bobartia, ii. 649.
Bocagea laurifolia, i. 134.
— virgata, i. 134.
Bocconia, i. 423.
Boeckeleria, ii. 707.
Boehmeria, i. 203.
— nivea, i. 203.
Boerhaavia, i. 217.
Boesenbergia, ii. 586.
Bog Myrtle, i. 189.
Bois Benzoin, i. 308.
Bolboschoenus, ii. 708.
Boldo, i. 137.
Bomarea, ii. 623.
— caldasiana (Fig. 385), ii. 622.
Bombacaceae, i. 26, **253.**
Bombax, i. 254.
Bombax buonopozense (Fig. 119), i. 254.
— malabaricum, i. 254.
Bombay Aloe fibre, ii. 662.
Bongardia, i. 405.
Bonnetia, i. 272.
— paniculata (Fig. 134), i. 272.
Bonnetiaceae, i. **271.**
Bonplandia, i. 501.
Bontia, i. 505.
Bonyunia, i. 376.
Boopis, i. 476.
Bootia, ii. 541.
Boquila, i. 410.
Boraginaceae, i. 29, **502.**
BORAGINALES, i. 502.
Borago, i. 503.
— officinalis (Fig. 338), i. 503.
Borasseae, ii. 667.
Borassodendron, ii. 667.
Borassus, ii. 667.
— flabellifer, ii. 666.
Borderea, ii. 660.
Boronia, i. 354.
— heterophylla (Fig. 209), i. 353.
Borya, ii. 602.
Boscia, i. 225.
Bossiaea, i. 155.
Boswellia, i. 356.
— carteri, i. 356, (Fig. 211) 355.
Bottinaea, ii. 598.
Bouchea, i. 395.
Bougainvillea, i. 217.
Bougueria, i. 456.
Bourreria, i. 394.
Boussingaultia, i. 444.
Bouteloua, ii. 723.
Bouvardia, i. 386.
Bowiea, ii. 612.
Bowieae, ii. 611.
Bowstring Hemp, ii. 662.
Box, i. 25.
Boxwood, i. 184.
Brachiaria, ii. 737.
Brachychilus, ii. 586.
Brachycyrtis, ii. 608.
Brachylepis, i. 382.
Brachynema, i. 330.
Brachyscypha, ii. 611.
Brachysiphon, i. 215.
Brachystegia, i. 154.
Brachystelma, i. 384.
Bragantia wallichii, i. 415.
Brahea, ii. 667.
Brasenia, i. 407.
Brassica, i. 426.
— alba, i. 426.
— nigra, i. 426.
— oleracea, i. 28, 426.
— rapa, i. 28, 426.
Braxilia, i. 290.
Brayera anthelmintica, i. 150.
Brayodendron, i. 350.
Brazil nuts, i. 304.
Brazzeia, i. 250.
Breadfruit, i. 202.
Bretschneidera, i. 361.

Bretschneideraceae, i. 361.
Brevoortia, ii. 642.
Brexia, i. 165.
Briar-root wood, i. 292.
Bridelia, i. 270.
Briza, ii. 717.
Brizula, ii. 700.
Broad Bean, i. 25, 156.
Brocchinia, ii. 579.
Brodiaea, ii. 642.
Bromelia, ii. 580.
— magdalenae, i. 31; ii. 577.
— serra, ii. 577.
Bromeliaceae, i. 29, 31; ii. **576.**
BROMELIALES, ii. 576.
Bromelieae, ii. 580.
Bromus, ii. 717.
— lepidus (Fig. 424), ii. 719.
Brongniartikentia, ii. 669.
Broom, i. 25, 156.
— *Corn*, ii. 741.
Brosimum, i. 202.
— utile, i. 202.
Broussaisia, i. 161.
Broussatea, i. 296.
Broussonetia, i. 202.
— papyrifera, i. 202.
Brownea, i. 153.
Brownlowia, i. 250.
Brugmansia, i. 417.
Bruguiera, i. 305.
Bruinsmia, i. 170.
Brunellia, i. 147.
— comocladifolia (Fig. 22), i. 146.
Brunelliaceae, i. **147.**
Brunfelsia, i. 484.
Brunia, i. 186.
Bruniaceae, i. **185.**
Brunonia, i. 480.
— australis (Fig. 318), i. 479.
Brunoniaceae, i. **479.**
Brunsoigia, ii. 643.
Bryanthus, i. 292.
Bryonia, i. 244.
— dioica, i. 244.
Bryony, i. 244.
Bryophthalmum, i. 290.
Bryophyllum, i. 458.
Bubbia, i. 128.
Bucephalandra, ii. 633.
Buchanania, i. 363.
Buchu, i. 354.
Bucklandia, i. 180.
Buckleya, i. 339.
Buckthorn, i. 343.
Buckwheat, i. 28, 432.
Buddleia, i. 374, (map of) 373.
— colvillei (Fig. 227), i. 374.
Buddleiaceae, i. **373.**
Buffalo berries, i. 342.
Buforrestia, ii. 566.
Bulbine, ii. 598.
Bulbinella, ii. 598.
Bulbinopsis, ii. 598.
Bulbocodium, ii. 612.
Bulbophyllum, ii. 695.
Bulbostylis, ii. 708.
Bully tree, i. 350.
Bulrush Millet, ii. 738.
Bumelia, i. 350.
Buphane, ii. 645.
Buphthalmum, i. 482.
Bupleurum, i. 472.
Burbidgea, ii. 586.
Burchardia, ii. 612.
Burchellia, i. 387.
Burmannia, ii. 687.
— bicolor (Fig. 411), ii. 686.
Burmanniaceae, ii. 685.
BURMANNIALES, ii. 685.
Burmese Lacquer tree, i. 364.
Burnatia, ii. 544.
Bursaria, i. 220.
Bursera, i. 356.
Burseraceae, i. **355.**
Butia, ii. 670.
Butomaceae, i. 29, 30; ii. **536.**
Butomopsis, ii. 538.
Butomus, ii. 538.
Butternut, i. 196.
Butter tree, i. 299.
Butyrospermum, i. 350.
— parkii, i. 350, (Fig. 207) 351.
Buxaceae, i. **184.**
Buxus, i. 25, 184.
— sempervirens, i. 184, (Fig. 54) 184.
Byblidaceae, i. **220**, (map of) 221.
Byblis, i. 222.
— gigantea (Fig. 89), i. 221.
Byronia, i. 312.
Byrsocarpus, i. 145.
Byrsonima, i. 259.
— spicata, i. 259.

Cabbage, i. 28, 426.
Cabomba, i. 407.
— aquatica (Fig. 253), i. 406.
Cabombaceae, i. **406.**
Cacoon bean, i. 154.
Cactaceae, i. 25, **247.**
CACTALES, i. 247.
Cadaba, i. 225.
Caesalpinia, i. 153.
Caesalpiniaceae, i. 25, **153.**
Caesia, ii. 596.
Caiophora, i. 239.
— lateritia (Fig. 105), i. 238.
Cajaput oil i. 303.
Cakile, i. 426.
Calabar bean, i. 156.
Caladiopsis, ii. 633.
Caladium, ii. 633.
Calamagrostis, ii. 726.
Calamander wood, i. 350.
Calameae, ii. 667.
Calamintha, i. 506.
Calamus, ii. 667.
— scipionum, ii. 666.
Calandrinia, i. 431.
Calathea, ii. 590.
— allouia, ii. 588.
Calathodes, i. 402.

Calceolaria, i. 489.
Caldesia, ii. 544.
Calectasia, ii. 662.
Calendula, i. 482.
Calibanus, ii. 665.
Calla, ii. 632.
Calleae, ii. 632.
Calliandra, i. 154.
Callianthemum, i. 403.
Callicarpa, i. 395.
Callicoma, i. 158.
Calligonum, i. 432.
Calliphruria, ii. 646.
Callipsyche, ii. 646.
Callisia, ii. 565.
Callistemma, i. 475.
Callistemon, i. 303.
Callisthene, i. 236.
Callitrichaceae, i. 449.
Callitriche, i. 449.
— verna (Fig. 292), i. 449.
Callopsis, ii. 633.
Calluna, i. 290.
— vulgaris, i. 292.
Calabashes, i. 244.
Calochortus, ii. 609.
Calodendrum, i. 354.
— capense, i. 354.
Calophyllum, i. 299.
— inophyllum, i. 299.
Calopsis, ii. 703.
Calorophus, ii. 703.
Calospatha, ii. 667.
Calostemma, ii. 646.
Calothamnus, i. 303.
Calotropis, i. 383.
— gigantea, i. 384.
Caltha, i. 402.
Calycanthaceae, i. 151, (map of) 151.
Calycanthus, i. 152.
— occidentalis (Fig. 26), i. 152.
Calycera, i. 476.
— balsamitifolia (Fig. 314), i. 475.
Calyceraceae, i. 475.
CALYCIFERAE, i. 29; ii. 536.
Calydorea, ii. 649.
Calyptranthes, i. 303.
Calyptrocalyx, ii. 669.
Calyptrocarya, ii. 710.
Calyptrogyne, ii. 669.
Calyptrotheca, i. 431.
Calystegia, i. 486.
— sepium (Fig. 322), i. 486.
Calythrix, i. 303.
Camassia, ii. 611.
Camecarpus, ii. 668.
Camellia, i. 274.
— chinensis, i. 26.
— sinensis, i. 274, (Fig. 135) 273.
CAMPANALES, i. 476.
Campanula, i. 476.
— allionii (Fig. 315), i. 476.
— rotundifolia, i. 28.
Campanulaceae, i. 28, 476.
Campelia, ii. 566.
Camphor, i. 140.
Campomanesia, i. 303.
Camptandra, ii. 586.
Camptocarpus, i. 382.
Camptorrhiza, ii. 612.
Camptotheca, i. 177.
Campylandra, ii. 604.
Campylopetalum, i. 361.
Campylosiphon, ii. 687.
Campylostachys, i. 396.
Campynema, ii. 678.
Campyremanthe, ii. 678.
Camwood, i. 156.
Canacomyrica, i. 189.
Canarina, i. 476.
Canarium, i. 356.
Canary Creeper, i. 499.
— *grass*, i. 34, ii. 730.
Candollea, i. 144.
Canella, i. 129.
— winterana i. 129, (Fig. 4) 128.
Canella bark, i. 129.
Canellaceae, i. 128.
Canistrum, ii. 580.
Canna, ii. 588.
— indica, ii. 588.
Cannabiaceae, i. 25, 201.
Cannabis, i. 201.
— sativa, i. 201.
Cannaceae, i. 31; ii. 587.
Cannomois, ii. 703, 704.
Canotia, i. 314.
Canscora, i. 451.
Cansjera, i. 331.
— timorensis (Fig. 189), i. 331.
Cantua, i. 501.
Canthium, i. 387.
Caoutchouc, i. 204.
Cape Boxwood, i. 184.
— *Chestnut*, i. 354.
— *Sumach*, i. 339.
Capers, i. 295.
Capitularia, ii. 708.
Capparidaceae, i. 25, 224, 227.
CAPPARIDALES, i. 224.
Capparis, i. 225.
— spinosa, i. 225, (Fig. 93) 225.
Caprifoliaceae, i. 178.
Capsella, i. 426.
Capsicodendron, i. 129.
Capsicum, i. 484.
— annuum, i. 484.
— frutescens, i. 484.
Capsicums, i. 484.
Capusia, i. 326.
Capusiaceae, i. 325.
Caracasia, i. 278.
Caragana, i. 158.
Caraguata, ii. 579.
— *fibre*, ii. 577.
Caraipa, i. 272.
Carallia, i. 305.
Carambola fruit, i. 356.
Carana gum resin, i. 356.
Carapa, i. 358.
— guianensis, i. 358.
Caraway, i. 28.

Caraway seeds, i. 472.
Cardamine, i. 426.
Cardamon, ii. 584.
Cardenanthus, ii. 649.
Cardiandra, i. 162.
Cardiopteridaceae, i. **314.**
Cardiopteris, i. 316.
Cardiopteryx, i. 316.
Cardiospermum, i. 361.
Carduus, i. 482.
Carenophila, ii. 586.
Carex, ii. 710.
Careya, i. 304.
Carica, i. 246.
— papaya, i. 246, (Fig. 112) 246.
Caricaceae, i. **246.**
Cariceae, ii. 710.
Carissa, i. 381.
— carandas, i. 381.
Carlephyton, ii. 632.
Carludovica, ii. 674.
— insignis, ii. 674.
Carmichaelia, i. 155.
Carpenteria, i. 159.
— californica (Fig. 32), i. 160.
Carpha, ii. 707.
Carpinus, i. 194.
— betulus, i. 194.
Carpodetus, i. 165.
Carpolobia, i. 233.
Carpolyza, ii. 645.
Carrot, i. 28, 472.
Cartonema, ii. 566.
Cartonemataceae, ii. **566.**
Carum, i. 472.
— carvi, i. 28, 472.
Carya, i. 196.
— alba, i. 25, 196.
— olivaeformis, i. 196.
— tomentosa, i. 196.
Caryocar, i. 280.
— glabrum (Fig. 142), i. 280.
— nuciferum, i. 279.
— tomentosum, i. 279.
Caryocaraceae, i. **279.**
Caryophyllaceae, i. 28, **429.**
CARYOPHYLLALES, i. 28, 427.
Caryota, ii. 669.
— urens, ii. 666.
Casava, i. 271.
Cascara sagrada, i. 26, 343.
Cascarilla, i. 386.
— *bark*, i. 26, 271.
Casearia, i. 207.
— lasiophylla (Fig. 76), i. 207.
Cashew nut, i. 26, 364.
Cassava meal, i. 26.
Cassia, i. 153.
— acutifolia, i. 154.
— angustifolia, i. 154.
— fistula, i. 154.
Cassia pods, i. 154.
Cassiope, i. 290.
Cassipourea, i. 305.
Cassytha, i. 140.
Castanea, i. 193.
Castanea sativa, i. 192.
Castanopsis, i. 193.
Castanospermum australe, i. 156.
Castela, i. 355.
Castilleja, i. 489.
Castilloa, i. 202.
— elastica, i. 202.
Castilloa rubber, i. 202.
Castor oil, i. 26, 271.
Casuarina, i. 197.
— equisetifolia, i. 199.
— stricta, i. 199.
— suberosa (Fig. 67), i. 198.
Casuarinaceae, i. **197.**
CASUARINALES, i. 197.
Catalpa, i. 389.
— bignonioides, i. 27.
— speciosa (Fig. 239), i. 390.
Catha edulis, i. 320.
Catimbium, ii. 587.
Catis, ii. 669.
Catoblastus, ii. 668.
Catopsis, ii. 579.
Caulophyllum, i. 405.
Caustis, ii. 707.
Cautleya, ii. 586.
Cavendishia, i. 296.
Cayenne Pepper, i. 484.
Ceanothus, i. 343.
— clinatus, i. 343.
Ceara rubber, i. 271.
Cecropia, i. 202.
Cedrela, i. 358.
— toona, i. 358.
Cedron, i. 355.
Ceiba, i. 254.
— pentandra, i. 26, 254.
Celastraceae, i. 320.
CELASTRALES, i. 309.
Celastrus, i. 320.
— orbiculatus (Fig. 180), i. 321.
Celery, i. 28, 472.
Celmisia, i. 482.
Celosia, i. 440.
— cristata, i. 441.
Celtis, i. 199.
Centaurea, i. 482.
Centaurium, i. 451.
Centotheca, ii. 717.
Centranthus, i. 474.
— ruber (Fig. 312), i. 473.
Centrolepidaceae, ii. 699.
Centrolepis, ii. 700.
— aristata, ii. 699.
Centropogon, i. 478.
Centrosema, i. 155.
Cephaelis, i. 387.
Cephalandra, i. 244.
Cephalaria, i. 474.
Cephalocarpus, ii. 709.
Cephalostachyum, ii. 715.
Cephalostemon, ii. 574.
Cephalotaceae, i. **458**, (map of) 458.
Cephalotus, i. 459.
— follicularis (Fig. 299), i. 458.
Ceraria, i. 431.

Cerastium, i. 430.
Ceratiola, i. 318.
Ceratocaryum, ii. 704.
Ceratolobus, ii. 667.
Ceratonia, i. 153.
Ceratopetalum, i. 158.
— apetalum, i. 159.
Ceratophyllaceae, i. **405.**
Ceratophyllum, i. 406.
— demersum var. (Fig. 252), i. 406.
Ceratosicyos, i. 242.
Ceratostemma, i. 296.
Ceratostigma, i. 455.
Ceratotheca, i. 391.
Cerbera, i. 381.
Cercestis, ii. 634.
Cercidiphyllaceae, i. **132.**
Cercidiphyllum, i. 132.
— japonicum (Fig. 9), i. 133.
Cercis, i. 153.
Cereus, i. 247.
Cerinthe, i. 503.
Ceropegia, i. 384.
Ceroxylon, ii. 669.
Cestrum, i. 484.
Cevallia, i. 239.
Chaerophyllum, i. 472.
Chaetanthus, ii. 703.
Chailletia, i. 151.
Chailletiaceae, i. **150.**
Chaitaea, ii. 683.
Chamaealoe, ii. 602.
Chamaeanthus, ii. 566.
Chamaecladon, ii. 633.
Chamaecrinum, ii. 602.
Chamaedorea, ii. 669.
Chamaegyne, ii. 707.
Chamaelirium, ii. 595.
Chamaepericlymenum, i. 173.
Chamaephoenix, ii. 670.
Chamaerops, ii. 667.
Chamaescilla, ii. 596.
Chamaexeros, ii. 662.
Chamelum, ii. 651.
Chamomile, i. 28.
Champereia, i. 331, 339.
Chapmanolirion, ii. 646.
Chascanum, i. 395.
Chasmanthe, ii. 652.
Chasmatocallis, ii. 651.
Chaulmoogra oil, i. 25, 208.
Cheilotheca, i. 295.
— malayana (Fig. 155), i. 294.
Cheiranthera, i. 220.
Cheiranthus, i. 426.
— cheiri, i. 28, 426, (Fig. 269) 425.
Chelidonium, i. 423.
Chelyocarpus, ii. 667.
Chenolea, i. 440.
Chenopodiaceae, i. 28, **438.**
CHENOPODIALES, i. 433.
Chenopodium, i. 440.
— rubrum (Fig. 283), i. 440.
Cherimoyer, i. 23, 134.
Cherry Laurel, i. 150.
Chevalieria, ii. 580.
Chew Stick, i. 343.
Chian Turpentine, i. 363.
Chickrassia tabularis, i. 358.
Chicory, i. 28, 484.
Chilianthus, i. 374.
Chillania, ii. 707.
Chillies, i. 484.
Chimaphila, i. 290.
Chimonanthus, i. 152.
China root, ii. 618.
Chinese Artichoke, i. 508.
— *Date*, i. 343.
Chingithamnus, i. 320.
Chionachne, ii. 742.
Chionanthus, i. 379.
Chionodoxa, ii. 611.
Chionographis, ii. 595.
Chiretta, i. 451.
Chirita, i. 491.
Chironia, i. 451.
Chirripoa, ii. 581.
Chittagong wood, i. 358.
Chlaenaceae, i. 283.
Chlidanthus, ii. 643.
Chloanthaceae, i. **396.**
Chloanthes, i. 397.
Chlora, i. 451.
Chloranthaceae, i. **421.**
Chloranthus, i. 421.
Chlorideae, ii. 723.
Chloris, ii. 723.
— pycnothrix (Fig. 430), ii. 724.
Chlorocodon, i. 382.
Chlorocyathus, i. 382.
Chlorogalum, ii. 598.
Chlorophora, i. 202.
— excelsa, i. 202.
— tinctoria, i. 202.
Chlorophytum, ii. 598.
Chlorospatha, ii. 633.
Chloroxylum swietenia, i. 358.
Choananthus, ii. 645.
Chocolate, i. 252.
Choisya, i. 354.
Chondropetalum, ii. 703.
Chorisandra, ii. 708.
Choristylis, i. 165.
Chorizanthe, i. 432.
Chorizema, i. 155.
Chortolirion, ii. 602.
Chosenia, i. 188.
Christisonia, i. 492.
Chrysanthemum, i. 482.
Chrysithrix, ii. 707, 708.
Chrysobalanus icaco, i. 150.
Chrysophyllum, i. 350.
— cainito, i. 350.
Chrysopogon, ii. 740.
Chrysosplenium, i. 459.
Chufas, ii. 706.
Chusquea, ii. 715.
Cichorium, i. 482.
— intybus, i. 28, 484.
Cimicifuga, i. 402.
— racemosa, i. 402.
Cinchona, i. 27, 386.

Cinnamodendron, i. 129.
Cinnamomum, i. 140.
— camphora, i. 140.
— zeylanicum, i. 25, 140.
Cinnamon, i. 125, 140.
Cinnamosma, i. 129.
Cipura, ii. 649.
Cipureae, ii. 649.
Cipuropsis, ii. 580.
Circaea, i. 446.
Circaeaster, i. 412, (Fig. 258) 412.
Circaeasteraceae, i. 412.
Cissampelos, i. 411.
Cissus, i. 344.
— discolor (Fig. 202), i. 344.
Cistaceae, i. 206.
Cistanche, i. 492.
— laxiflora (Fig. 327), i. 492.
Cistus, i. 206.
— loretii (Fig. 75), i. 206.
— polymorphus, i. 206.
Citharexylum, i. 395.
Citriobatus, i. 220.
Citronella grasses, ii. 741.
Citron gum, i. 303.
Citrullus, i. 244.
— colocynthis, i. 244.
— vulgaris, i. 244.
Citrus aurantium, i. 354.
— medica, var. acida, i. 354.
— —, var. limonum, i. 354.
Cladium, ii. 707.
Clara, ii. 596, 598, 600.
Clarkeifedia, i. 473.
Clarkia, i. 446.
Clavija, i. 347.
Claytonia, i. 431.
Cleanthe, ii. 651.
Clematis, i. 403.
Clematoclethra, i. 275.
Clematopsis, i. 403.
Cleome, i. 335.
Clerodendron, i. 395.
Clerodendrum, i. 395.
Clethra, i. 289, (map of) 289.
— arborea (Fig. 150), i. 289.
Clethraceae, i. 26, 288.
Cleyera, i. 274.
Clianthus, i. 155.
Clidemia, i. 309.
Cliffortia, i. 150.
Cliftonia, i. 316.
Clinogyne, ii. 590.
Clinosperma, ii. 669.
Clinostigma, ii. 669.
Clintonia, ii. 605.
Clistoyucca, ii. 664.
Clitoria, i. 155.
Clivia, ii. 645.
Clove, i. 26, 303.
Clover, i. 25, 156.
Clusia, i. 299.
Clusiaceae, i. 26, 298.
Cluytia, i. 270.
Cneoraceae, i. 314.
Cneorum pulverulentum (Fig. 173), i. 315.
Cnestis, i. 145.
Cobaea, i. 389.
— scandens (Fig. 238), i. 388.
Cobaeaceae, i. 387.
Cocaine, i. 265.
Coccoloba, i. 432.
Coccothrinax, ii. 667.
Cocculus, i. 411.
Cochineal dye, i. 247.
Cochlanthus, i. 382.
Cochlearia, i. 426.
Cochliostema, ii. 565.
Cochlospermaceae, i. 208.
Cochlospermum, i. 209, (map of) 208.
— religiosum, i. 209.
— tinctorium (Fig. 77), i. 208.
Cockburnia, i. 506.
Cockscomb, i. 441.
Cocoa, i. 25, 252.
Coco biscuits, ii. 629.
— *de Mer*, ii. 666.
Cocoineal, ii. 670.
Coco-nut, i. 32.
Coconut Palm, ii. 666.
Coco Plum, i. 150.
Cocops, ii. 670.
Cocos, ii. 670.
— nucifera, i. 32, ii. 666.
Codia, i. 158.
Codiaeum, i. 270.
Codon, i. 501.
Codonocarpus, i. 437.
— cotinifolius (Fig. 280), i. 436.
Codonopsis, i. 476.
Coelachyrum, ii. 722.
Coelogyne, ii. 695.
Coffea, i. 387.
— arabica, i. 27, 387.
Coffee, i. 27.
Cohnia, ii. 664.
Coinochlamys, i. 373.
Coir fibre, ii. 666.
Coix, ii. 742.
— lacryma-jobi, ii. 742.
Cola, i. 25, 252.
— nitida, i. 252.
Colania, ii. 604.
Cola nut, i. 252.
Colchiceae, ii. 612.
Colchicine, ii. 592.
Colchicum, i. 31; ii. 612.
— autumnale, ii. 592.
Colchicum seeds, ii. 592.
Coldenia, i. 394, 502.
Coleocarya, ii. 703.
Coleochloa, ii. 709.
Coleotrype, ii. 566.
Coleus, i. 506.
Colletia, i. 343.
Colletogyne, ii. 632.
Collomia, i. 500.
Collospermum, ii. 604.
Colocasia, ii. 633.
— antiquorum, ii. 629.

Colocynth, i. 244.
Colpoon, i. 339.
— compressum, i. 339.
Colpothrinax, ii. 667.
Coltsfoot, i. 28.
Colubrina, i. 343.
Columellia, i. 494.
— obovata (Fig. 329), i. 494.
Columelliaceae, i. **493.**
Columnea, i. 491.
Colutea, i. 155.
Comandra, i. 339.
Comanthera, ii. 576.
Combretaceae, i. **307.**
Combretum, i. 307.
— racemosum (Fig. 167), i. 308.
Comesperma, i. 233.
Cominsia, ii. 590.
Commelina, ii. 565, 566.
Commelinaceae, i. 30; ii. **561.**
COMMELINALES, ii. 561.
Comelinantia, ii. 565, 566.
Commersonia, i. 252.
Compositae, i. 38, **481.**
Comptonia, i. 189.
— peregrina, i. 189.
Conamomum, ii. 586.
Conanthera, ii. 615.
Condurango bark, i. 384.
Conium maculatum, i. 472.
Connaraceae, i. 25, **145.**
Connarus, i. 145.
— guianensis, i. 145.
— monocarpus (Fig. 20), i. 145.
Connellia, ii. 579.
Conocephalus, i. 202.
Conolophon, ii. 587.
Conomorpha, i. 346.
Conopodium, i. 472.
Conostyleae, ii. 676.
Conostylis, ii. 676.
Contrayerva root, i. 202.
Convallaria, ii. 602.
— majalis, i. 31; ii. 592.
Convallarieae, ii. 602.
Convolvulaceae, i. 29, **484.**
Convolvulus, i. 486.
— scammonia, i. 29, 486.
Cooperia, ii. 643.
Copaifera, i. 154.
— pubiflora, i. 154.
Copernicia, ii. 667.
Coprosma, i. 387.
Coptis, i. 402.
Coquilla nut, ii. 666.
Coral tree, i. 343.
Corchorus, i. 250.
Cordia, i. 394.
— abyssinica (Fig. 242), i. 394.
Cordyline, ii. 664.
Corema, i. 318.
Coreopsis, i. 482.
Coriander, i. 28.
Coriander seeds, i. 472.
Coriandrum sativum, i. 28, 472.
Coriaria, i. 148.
Coriaria myrtifolia (Fig. 23), i. 148.
Coriariaceae, i. **147**, (map of) 147.
CORIARIALES, i. 147.
Coris, i. 453.
Corispermum, i. 440.
Cornaceae, i. 25, **171.**
Cornelian cherry wood, i. 172.
Cornella, i. 173.
Cornulaca, i. 440.
Cornus, i. 173.
— mas, i. 172.
Corokia, i. 172.
COROLLIFERAE, i. 29; ii. 591.
Coronilla, i. 155.
Correa, i. 354.
Corrigiola littoralis, i. 433.
Corsia, ii. 691.
— ornata (Fig. 413), ii. 690.
Corsiaceae, ii. 689.
Cortaderia, ii. 721.
Cortesia, i. 394.
Cortusa, i. 453.
Corydalis, i. 424.
Corylaceae, i. 25, **193.**
Corylopsis, i. 180.
— spicata (Fig. 50), i. 181.
Corylus, i. 194.
— avellana, i. 194.
— mandshurica (Fig. 63), i. 193.
Corynaea, i. 341.
Corynocarpaceae, i. **321.**
Corynocarpus, i. 322.
— laevigata (Fig. 181), i. 321.
Corynotheca, ii. 598.
Corypha, ii. 667.
Corypheae, ii. 667.
Cosmos, i. 482.
Costaea, i. 316.
Costeae, ii. 586.
Costularia, ii. 707.
Costus, ii. 586.
Cotoneaster, i. 150.
Cottea, ii. 720.
Cottendorfia, ii. 579.
Cotton, i. 26, 255.
— *grass*, i. 33; ii. 707.
Cotyledon, i. 458.
Couch grass, i. 34.
Couratari, i. 304.
Couratari fibre, i. 304.
Couroupita, i. 304.
Courtoisia, ii. 707, 708.
Coussapoa, i. 202.
Couthovia, i. 378.
Cow tree, i. 202.
Cowberry, i. 296.
Crambe, i. 426.
Cranberry, i. 26, 296.
Craniolaria, i. 392.
Craspedorrhachis, ii. 723.
Crassula, i. 458.
Crassulaceae, i. 28, **457.**
Crataegus, i. 150.
Crateriphytum, i. 378.
Cratoxylon, i. 297.
Creosote bush, i. 26.

Crepis, i. 482.
Crescentia, i. 389.
Cricket Bat Willow, i. 187.
Crineae, ii. 643.
Crinum, ii. 643.
Cristaria, i. 255.
Crocanthemum, i. 206.
Croceae, ii. 651.
Crocopsis, ii. 643.
Crocosma, ii. 651.
Crocus, i. 32; ii. 651.
— sativus, i. 32; ii. 647.
Cromidon, i. 505.
Croomia, ii. 658.
Crosslandia, ii. 709.
Crossosoma, i. 146.
— californica (Fig. 21), i. 146.
Crossosomataceae, i. 145.
Crotalaria, i. 155.
Croton, i. 270.
— eleuteria, i. 26.
Crowberry, i. 26.
CRUCIALES, i. 425.
Cruciferae, i. 28, 425.
Crudia, i. 154.
Cryptandra, i. 343.
Cryptangieae, ii. 709.
Cryptangium, ii. 709.
Cryptanthopsis, ii. 580.
Cryptanthus, ii. 580.
Crypteronia, i. 167.
— paniculata (Fig. 39), i. 167.
Crypteroniaceae, i. 167.
Cryptobasis, ii. 649.
Cryptocarya, i. 140.
Cryptochaete, i. 403.
Cryptocoryne, ii. 635.
— spiralis, ii. 629.
Cryptolepis, i. 382.
Cryptophila, i. 295.
Cryptostegia, i. 382.
Cryptostephanus, ii. 646.
Crysophila, ii. 667.
Ctenanthe, ii. 590.
Ctenium, ii. 723.
Ctenolophon, i. 266, (map of) 266
— parvifolius (Fig. 129), i. 266.
Ctenolophonaceae, i. 265.
Ctenophrynium, ii. 590.
Cubebs, i. 420.
Cucumber, i. 244.
Cucumis, i. 244.
— melo, i. 244.
— sativus, i. 244.
Cucurbita, i. 244.
Cucurbitaceae, i. 25, 242.
CUCURBITALES, i. 242.
Cudrania, i. 202.
Culcasia, ii. 634.
Cunonia, i. 158, (map of) 159.
— capensis (Fig. 31), i. 158.
Cunoniaceae, i. 158.
CUNONIALES, i. 156.
Cupania, i. 361.
Cuphea, i. 446.
Cupuliferae, i. 191, 192, 194.
Curculigo, ii. 678.
— latifolia, ii, Fig. 406.
Curcuma, ii. 586.
— angustifolia, ii. 584.
— zedoaria, ii. 584.
Curima, ii. 670.
Currant, i. 25, 344.
Curroria, i. 382.
Curtisia, i. 172.
Curtonus, ii. 652.
Cuscuta, i. 502.
— europaea (Fig. 337), i. 502.
Cuscutaceae, i. 501.
Cusparia bark, i. 354.
Cusso, i. 150.
Cussonia, i. 178.
Custard Apple, i. 134.
Cutch, i. 155.
Cyananthus, i. 476.
Cyanastrum, ii. 615.
Cyanella, ii. 615.
— lutea (Fig. 380), ii. 614.
Cyanotis, ii. 565.
Cyathochaete, ii. 706.
Cyathula, i. 440.
Cybianthus, i. 346.
Cybistetes, ii. 643.
Cyclamen, i. 453.
Cyclanthaceae, ii. 672.
CYCLANTHALES, ii. 672.
Cyclanthera, i. 244.
Cyclanthus, ii. 674.
— bipartitus (Fig. 404), ii. 673.
Cyclocampe, ii. 707.
Cyclodiscus, i. 415.
Cyclospathe, ii. 669.
Cycnogeton, ii. 549.
Cylicomorpha, i. 246.
Cylindrolepis, ii. 708.
Cymbidium, ii. 695.
Cymbocarpa, ii. 687.
Cymbopogon, ii. 741.
Cymodocea, ii. 559.
Cymophyllus, ii. 710.
Cynanchum, i. 383.
Cynara scolymus, i. 28, 484.
Cynocrambaceae, i. 441.
Cynocrambe, i. 442.
Cynodon, ii. 723.
Cynoglossum, i. 503.
Cynometra, i. 154.
Cynomoriaceae, i. 341.
Cynomorium, i. 341.
Cynosurus, ii. 717.
Cynoxylon, i. 173.
Cypella, ii. 649.
CYPERALES, ii. 704.
Cyperaceae, i. 33; ii. 704.
Cypereae, ii. 708.
Cyperus, ii. 708.
— compressus (Fig. 421), ii. 705.
— esculentus, i. 33; ii. 706.
— papyrus, i. 33; ii. 706.
Cyphia, i. 478.
Cyphokentia, ii. 669.
Cyphophoenix, ii. 668.

Cyphosperma, ii. 669.
Cyphostigma, ii. 587.
Cypripedieae, ii. 694.
Cypripedium, ii. 694.
Cypselea, i. 430.
Cypselocarpus, i. 437.
Cyrilla, i. 316.
— brevifolia (Fig. 175), i. 316.
Cyrillaceae, i. 316.
Cyrillopsis, i. 316.
Cyrtandra, i. 491.
Cyrtanthus, ii. 643.
Cyrtosperma, ii. 632.
Cyrtostachys, ii. 668.
Cytinaceae, i. 416.
Cytinus, i. 416.
Cytisus, i. 155.
— palmensis, i. 156.
— scoparius, i. 25, 156.

Dabeocia, i. 292.
Daboecia, i. 292.
Dactylis, ii. 717.
Dactyloctenium, ii. 722.
Dactylophyllum, i. 501.
Daemonorops, ii. 667.
— propinquus, ii. 666.
— ruber, ii. 666.
Dahlia, i. 482.
Dalbergia, i. 156.
— latifolia, i. 156.
Dalechampia, i. 270.
Damasonium, ii. 544.
Dammera, ii. 667.
Dampiera, i. 479.
Danaë, ii. 621.
Danthonia, ii. 726.
Danthoniopsis, ii. 736.
Dapania, i. 267.
Daphne, i. 216.
— mezereum, i. 216, (Fig. 85) 216.
Daphniphyllaceae, i. 184.
Daphniphyllum, i. 185.
— macropodum (Fig. 55), i. 185.
Daphnopsis, i. 216.
Darlingtonia, i. 469.
Darwinia, i. 303.
Dasylirion, ii. 665.
Dasypogon, ii. 662.
Dasystachys, ii. 598.
Date palm, i. 32; ii. 666.
— *plum*, i. 26, 350.
Datisca, i. 246.
— cannabina (Fig. 111), i. 245.
Datiscaceae, i. 245.
Datura, i. 484.
— stramonium, i. 29.
Daubenya, ii. 612.
Daucus, i. 472.
— carota, i. 28, 472.
Davidia, i. 176.
— involucrata (Fig. 46), i. 176.
Davidiaceae, i. 176.
Davidsonia, i. 158.
Davilla, i. 144.
Dawea, i. 129.
Deadly Nightshade, i. 29, 484.
Debesia, ii. 598.
Decaisnea, i. 410.
Decalepis, i. 382; ii. 707.
Decavenia, i. 170.
Decumaria, i. 162.
Degeneria, i. 128.
Degeneriaceae, i. 128.
Deherainia, i. 347.
— smaragdina (Fig. 204), i. 346.
Deinacanthon, ii. 580.
Deinanthe, i. 162.
Deinbollia, i. 361.
Delphinium, i. 402.
— staphisagria, i. 402.
Demazeria, ii. 717.
Demensea, ii. 645.
Dendrobenthamia, i. 173.
— capitata (Fig. 43), i. 172.
Dendrobium, ii. 695.
Dendrocalamus, ii. 715.
Dendropanax, i. 178.
Dendrophthora, i. 338.
Denea, ii. 668.
Denisonia, i. 398.
Derris, i. 25, 156.
Desbordesia, i. 262.
— glaucescens (Fig. 125), i. 262.
Descantaria, ii. 565.
Deschampsia, ii. 726.
Desfontainea, i. 371.
Desmodium, i. 155.
Desmogynosiphon, ii. 687.
Desmoncus, ii. 670.
Desmostachys, i. 317.
Detarium, i. 154.
Deuterocohnia, ii. 579.
Deutzia, i. 160.
Dialium, i. 153.
Dialypetalanthaceae, i. 384.
Dialypetalanthus, i. 384.
— fuscescens (Fig. 236), i. 385.
Diandrae, ii. 694.
Diandriella, ii. 633.
Diandrolyra, ii. 735.
Dianella, ii. 606.
Dianelleae, ii. 605.
Dianthera, i. 491.
Dianthus, i. 429.
— barbatus, i. 430.
— seguieri (Fig. 273), i. 429.
Diapensia, i. 294.
— himalaica (Fig. 154), i. 293.
Diapensiaceae, i. 293.
Dicentra, i. 424.
— spectabilis (Fig. 268), i. 424.
Dicerocaryum, i. 391.
Dichapetalaceae, i. 150.
Dichapetalum, i. 151.
— thonneri (Fig. 25), i. 150.
Dichelachne, ii. 726.
Dichisma, i. 505.
Dichopogon, ii. 598.
Dichopsis, i. 350.
Dichorisandra, ii. 565, 566.
Dichroa, i. 160.

Dichromena, ii. 708.
Diclidanthera, i. 233.
Dicliptera, i. 491.
Dicoryphe, i. 180.
DICOTYLEDONES, i. 22, 23.
Dicraea, i. 470.
— algiformis (Fig. 309), i. 470.
Dicrastyles, i. 397.
Dictamnus, i. 354.
Dictyocaryum, ii. 668.
Dictyosperma, ii. 668.
Dictyostegia, ii. 687.
Didierea, i. 369.
— mirabilis (Fig. 224), i. 370.
Didiereaceae, i. **369.**
Didymia, ii. 709.
Didymiandrum, ii. 709.
Didymocarpus, i. 491.
Didymopanax, i. 178.
Didymosperma, ii. 669.
Didymotheca, i. 437.
Dieffenbachia, ii. 633.
Dieffenbachieae, ii. 633.
Dielsia, ii. 703.
Dierama, ii. 651.
Diervilla, i. 178.
Dietes, ii. 649.
Digitalis, i. 489.
— purpurea, i. 29, 489.
Digitaria, ii. 737.
Dignathia, ii. 729.
— pilosa (Fig. 436), ii. 728.
Dika bread, i. 261.
Dilatris, ii. 676.
Dill, i. 28.
Dillenia, i. 144.
Dilleniaceae, i. 25, **274.**
DILLENIALES, i. 143.
Dill seed, i. 472.
Dimeria, ii. 740.
Dimerocostus, ii. 586.
Dimorphandra, i. 154.
Dinochloa, ii. 715.
Dionaea, i. 468.
Dioncophyllaceae, i. 207.
Dioncophyllum, i. 207.
Dioscorea, ii. 658.
Dioscoreaceae, i. 32; ii. **658.**
DIOSCOREALES, ii. 652.
Diosma, i. 354.
Diospyros, i. 350.
— ebenum, i. 26, 350.
— embryopteris, i. 350.
— kaki, i. 26, 350.
— kurzii, i. 350.
— lotus, i. 350.
— mespiliformis (Fig. 206*b*), i. 349.
— quaesita, i. 350.
— virginiana, i. 350.
Dipcadi, ii. 611.
Dipentodon, i. 334.
— sinicus, i. 334, (Fig. 192) 334.
Dipentodontaceae, i. **333.**
Diphalangium, ii. 642.
Diphylleia, i. 405.
Dipidax, ii. 609.
Diplachne, ii. **722.**
Diplacrum, ii. **709.**
Dipladenia, i. **381.**
Diplanthera, ii. **559.**
Diplarrhena, ii. **649.**
Diplasia, ii. **709.**
Diplocarex, ii. 710.
Diplotaxis, i. 426.
Diplothemium, ii. 670
Dipsacaceae, i. 28, **474.**
Dipsacus, i. 475.
— fullonum, i. 28, 474.
Dipterocarpaceae, i. 26, **285**, 286, (map of) 285.
Dipterocarpus, i. 286.
— trinervis (Fig. 148), i. 286.
— tuberculatus, i. 286.
— turbinatus, i. 286.
Dipteronia, i. 364.
Dipterosiphon, ii. 687.
Dipterostemon, ii. 642.
Dipteryx odorata, i. 156.
Dirachma, i. 249.
— socotrana (Fig. 114), i. 249.
Dirachmaceae, i. **248.**
Dirca, i. 216.
Disanthus, i. 180.
Discaria, i. 343.
Dischidia, i. 384.
Disporopsis, ii. 605.
Disporum, ii. 605.
Dissochondrus, ii. 738.
Dissotis, i. 309.
Disteganthus, ii. 580.
Distichia, ii. 697.
Distylium, i. 180.
Ditassa, i. 383.
Diuranthera, ii. 598.
Dobera, i. 313.
Dobinea, i. 361.
— delavayi (Fig. 216), i. 362.
Dodecatheon, i. 453.
Dolia, i. 487.
Dolichandrone, i. 389.
Dolickokentia, ii. 669.
Doliocarpus, i. 144.
Domba oil, i. 300.
Dombeya, i. 252.
Donatia, i. 462, 465, 480, (map of) 463.
— fascicularis, i. 464, 465, (Fig. 304) 463.
Donatiaceae, i. **462.**
Donax, ii. 590.
Donnellia, ii. 565.
Doona, i. 286.
Dorema ammoniacum, i. 472.
Dorisia, i. 173, 387.
Dorstenia, i. 202.
— brasiliensis, i. 202.
Dortania, ii. 651.
Doryanthes, ii. 665.
Doryphora sassafras, i. 137.
Double Coconut, ii. 666.
Doum Palm, ii. 666.
Dovea, ii. 703.
Draba, i. 426.
Dracaena, ii. 664.

Dracaena cinnabari, ii. 662.
— draco, i. 32; ii. 662.
Dracocephalium, i. 506.
Dracontieae, ii. 630.
Dracontioides, ii. 632.
Dracontium, ii. 630.
Dracontomelon, i. 363.
Dracophyllum, i. 293.
Dracunculus, ii. 635.
Dragon tree, i. 32; ii. 662.
Dragon's Blood, ii. 662, 666.
Drapetes, i. 216, (map of) 215.
Drimia, ii. 611.
Drimiopsis, ii. 611.
Drimys, i. 128.
— winteri, i. 126, 127, (Fig. 3) 127.
Drosera, i. 28, 468.
—capensis (Fig. 307), i. 467.
Droseraceae, i. 28, 222, **467.**
Drosophyllum, i. 468.
Dryandra, i. 218.
Dryas, i. 150.
Drymaria, i. 430.
Drymophila, ii. 605.
Drymophloeus, ii. 668.
Dryobalanops aromatica, i. 286.
Duabanga, i. 306.
Duckea, ii. 574.
Duckeodendraceae, i. 393.
Duckeodendron, i. 394.
Duguetia quitarensis, i. 134.
Dulichium, ii. 708.
Durandea, i. 261.
Durandia, ii. 709.
Duranta, i. 395.
Durian fruits, i. 254.
Durio, i. 254.
— zibethinus, i. 254.
Durra, ii. 741.
Dyckia, ii. 579.
Dypsidium, ii. 669.
Dypsis, ii. 669.
Dysoxylum, i. 356.
Dysphania, i. 440.

Ebenaceae, i. 26, **348.**
EBENALES, i. 348.
Ebony, i. 26, 350.
Eccremis, ii. 605.
Eccremocarpus, i. 389.
Ecdeiocolea, ii. 703.
Echeandia, ii. 598.
Echidnium, ii. 632.
Echinocactus, i. 247.
Echinochloa, ii. 737.
— colona, var. frumentacea, ii. 738.
Echinocystis, i. 244.
Echinodorus, ii. 544.
Echinopogon, ii. 726.
— ovatus (Fig. 434), ii. 727.
Echinops, i. 482.
— sphaerocephalus (Fig. 320*b*), i. 483.
Echinospermum, i. 503.
Echites, i. 381.
Echium, i. 503.
Ecklonea, ii. 707.
Ectadiopsis, i. 382.
Ectadium, i. 382.
Eduardoregelia, ii. 609.
Eel grass, i. 30.
Egeria, ii. 541.
Egyptian Lotus, i. 403.
Ehretia, i. 394.
Ehretiaceae, i. **393.**
Ehrharta, ii. 730.
Eichleria, i. 497.
Eichornia, ii. 618.
Ekebergia, i. 358.
Elachanthera, ii. 627.
Elaeagnaceae, i. **342.**
Elaeagnus, i. 342.
— angustifolia, i. 342.
Elaeis, ii. 670.
— guineensis, i. 32; ii. 666.
Elaeocarpus, i. 250.
Elaeodendron, i. 320.
Elaphocera, i. 501.
Elatinaceae, i. **427.**
Elatine, i. 428.
— hexandra (Fig. 271), i. 428.
— triandra (Fig. 271), i. 428.
— hydropiper (Fig. 271), i. 428.
Elatostema, i. 203.
Elattosis, ii. 538.
Elder, i. 179.
—, *American*, i. 179.
Elegia, ii. 703.
Eleocharis, ii. 707.
Elephant-foot Yam, ii. 629.
Elephantopus, i. 482.
Elephant's Foot, i. 32; ii. 658.
Elettaria, ii. 587.
— cardamomum, ii. 584.
Elettariopsis, ii. 587.
Eleusine, ii. 722.
— coracana, ii. 722.
Eleutherine, ii. 649.
Elionurus, ii. 740.
Elisena, ii. 646.
Elisma, ii. 544.
Elliottia, i. 292.
Elm, i. 199.
Elmeria, ii. 586.
Elmerrillia, i. 124.
Elodea, ii. 541.
Elsholtzia, i. 506.
Elsiea, ii. 611.
Elymus, ii. 719.
Elyna, ii. 709.
Elynanthes, ii. 707.
Embelia, i. 346.
Embothrium, i. 218.
Eminium, ii. 635.
Emorya, i. 374.
Empetraceae, i. 26, **312**, (map of) 318.
Empetrum, i. 318.
— nigrum, i. 26, (Fig. 177) 317.
Encholirion, ii. 579.
Endodesmia, i. 297.
Endonema, i. 215.
Enemion, i. 402.
Engelhardtia, i. 196.

Engelhardtia nudiflora (Fig. 65), i. 195.
Eng Oil, i. 286.
Enhaleae, ii. 541.
Enhydrias, ii. 541.
Enkianthus, i. 290.
Ennealophus, ii. 649.
Enneapogon, ii. 720.
— scoparius, (Fig. 426), ii. 721.
Entada, i. 154.
— gigas, i. 154.
— phaseoloides, i. 155.
— pursaetha, i. 155.
Enteropogon, ii. 723.
Epacridaceae, i. **292**, (map of) 292.
Epacris, i. 293.
— nivalis (Fig. 153), i. 292.
Epicampes, ii. 726.
Epilobium, i. 446.
Epimedium, i. 405.
Epipetrum, ii. 660.
Epiphyllum, i. 247.
Epiphyton, ii. 574.
Epipremnopsis, ii. 632.
Epipremnum, ii. 632.
Epischoenus, ii. 707.
Episcia, i. 491.
Eragrosteae, ii. 721.
Eragrostis, ii. 722.
— tef, ii. 722.
Eranthemum, i. 491.
Eranthis, i. 402.
Erblichia, i. 237.
Eremocrinum, ii. 598.
Eremolaena, i. 283.
Eremophila, i. 505.
Eremospatha, ii. 667.
Eremosynaceae, i. **460.**
Eremosyne, i. 460.
— pectinata, (Fig. 301), i. 460.
Eremurus, ii. 598.
Eriachne, ii. 726.
Eriastrum, i. 501.
Erica, i. 290.
— arborea, i. 292.
Ericaceae, i. 26, 288, **290.**
ERICALES, i. 288.
Erigeron, i. 482.
Erinna, ii. 643.
Erinus, i. 489.
Eriobotrya japonica, i. 150.
Eriocaulaceae, i. 30; ii. **574.**
ERIOCAULALES, ii. 574.
Eriocaulon, ii. 576.
— septangulare, i. 30.
Eriochloa, ii. 737.
Eriochrysis, ii. 740.
Eriocoelum, i. 361.
Erioglossum, i. 361.
Eriogonum, i. 432.
Eriolopha, ii. 587.
Eriophorum, ii. 708.
— vaginatum, i. 33.
Eriospermum, ii. 612.
Eriospora, ii. 709.
Eriostemon, i. 354.
Erisma, i. 236.
Erismadelphus, i. 236.
Eritrichium, i. 503.
Erlangea, i. 482.
Erodium, i. 496.
— macradenium (Fig. 330), i. 495.
Eryngium, i. 472.
Erythea, ii. 667.
Erythraea, i. 451.
Erythronium, ii. 609.
Erythropalaceae, i. **324.**
Erythropalum, i. 325.
— scandens (Fig. 185), i. 325.
Erythrophloeum, i. 154.
— guineense, i. 154.
Erythroxylaceae, i. **263.**
Erythroxylum, i. 265.
— coca, i. 265, (Fig. 128) 265.
Erxlebenia, i. 290.
Escallonia, i. 165.
— macrantha (Fig. 37), i. 165.
Escalloniaceae, i. **165.**
Eschscholtzia, i. 423.
Esenbeckia, i. 354.
Esparto grass, ii. 729, 730.
Essential Oil grasses, ii. 741.
Eucalyptus, i. 26, 303.
— diversicolor, i. 303.
— globulus, i. 303.
— leucoxylon, i. 303.
— maculata, i. 303.
— marginata, i. 303.
— rostrata, i. 303.
Eucalyptus oil, 303.
Eucarya spicata, i. 339.
Eucharideae, ii. 645.
Eucharis, ii. 646.
Euchlaena, ii. 742.
— mexicana, ii. 742.
Euclea, i. 350.
Eucnide, i. 239.
Eucomis, ii. 609.
Eucommia, i. 204.
— ulmoides, i. 204, (Fig. 73) 204.
Eucommiaceae, i. **204.**
Eucrosia, ii. 646.
Eucryphia, i. 301.
— glutinosa (Fig. 160), i. 300.
Eucryphiaceae, i. **300**, (map of) 301.
Eugeissonia, ii. 667.
— minor, ii. 666.
Eugenia, i. 303.
— caryophyllus, i. 26.
— jambolana, i. 303.
— jambos, i. 303.
Eulalia, ii. 740.
Euonymus, i. 320.
— atropurpureus, i. 321.
— europaeus, i. 320.
Eunoymus bark, i. 321.
Eupatorium, i. 482.
Euplassa, i. 218.
Euphorbia, i. 270.
— lathyris (Fig. 133), i. 270.
Euphorbiaceae, i. 26, **270**, 319.
EUPHORBIALES, i. 270.
Euphrasia, i. 489.

Euphronia, i. 234.
Eupomatia, i. 135.
— laurina, i. 135, (Fig. 11) 135.
Eupomatiaceae, i. 134.
Euphelea, i. 132.
Eurya, i. 274.
Euryale, i. 404.
Eurycles, ii. 646.
Eurylobium, i. 396.
Eurynotia, ii. 649.
Euscaphis, i. 367.
Eustephia, ii. 646.
Eustephieae, ii. 646.
Eustephiopsis, ii. 646.
Eustoma, i. 451.
Eustrephus, ii. 627.
Euterpe, ii. 669.
Euthemis, i. 283.
Euthystachys, i. 396.
Evandra, ii. 707.
Evening Primrose, i. 447.
Everardia, ii. 709.
Evodia, i. 354.
Evodianthus, ii. 674.
Evolvulus, i. 486.
Evrardiella, ii. 604.
Exacum, i. 451.
Exbucklandia, i. 180.
Excremis, ii. 605.
Exocarpus, i. 339.
Exocarya, ii. 709.
Exochogyne, ii. 709.
Exochorda, i. 150.
Exogonium purga, i. 486.
Exohebea, ii. 652.
Exorrhiza, ii. 668.
Exospermum, i. 128.
Exostemma, i. 386.

Fabaceae, i. 155.
Fagaceae, i. 25, 192.
FAGALES, i. 25, 190.
Fagonia, i. 270.
Fagopyrum sagittatum, i. 432.
Fagraea, i. 371.
— lanceolata (Fig. 225), i. 371.
Fagus, i. 192.
— sylvatica, i. 192, (Fig. 62) 192.
Faham tea, ii. 693.
False Ipecacuanha, i. 221.
— *Jasmine root*, i. 373.
Faramea, i. 387.
Fascicularia, ii. 580.
Fatsia, i. 178.
Faurea macnaughtonii, i. 218.
Fauria, i. 451.
Fedia, i. 474.
Feijoa, i. 303.
Felipponia, ii. 633.
Felipponiella, ii. 633.
Fendlera, i. 159.
Fendlerella, i. 159.
Fennel, i. 28, 472.
Fernseea, ii. 581.
Ferula, i. 472.
Festuca, ii. 717.
Festuceae, ii. 717.
Ficalhoa, i. 274.
Ficaria verna, i. 27.
Ficinia, ii. 708.
Ficoidaceae, i. 28, 430.
Ficus, i. 202.
— carica, i. 202.
— elastica, i. 202.
— sycomorus, i. 202.
Fiddle wood, i. 395.
Field woodrush, i. 33.
Fig, i. 202.
Filberts, i. 194.
Fimbristylis, ii. 708.
Finlaysonia, i. 381.
Fintelmannia, ii. 710.
Fique, ii. 662.
Flacourtia, i. 207.
Flacourtiaceae, i. 25, 207, 253.
Flagellaria, ii. 568.
— indica (Fig. 360), ii. 567.
Flagellariaceae, ii. 568.
Flagellarisaema, ii. 635.
Flax, i. 26, 261.
Fleurya, i. 203.
Flindersia, i. 358.
— oxleyana, i. 358.
Floerkea, i. 497.
Floscopa, ii. 565.
Fodder grasses, ii. 738.
Foeniculum capillaceum, i. 28.
— vulgare, i. 472, (Fig. 311) 472.
Forbesia, ii. 678.
Forest Oak, i. 199.
Forrestia, ii. 566.
Forskohlea, i. 203.
Forstera, i. 481.
Forsteronia, i. 381.
Forsythia, i. 379.
Fortunatia, ii. 609.
Fothergilla, i. 180.
Fouquieria, i. 230.
— formosa (Fig. 98), i. 230.
Fouquieriaceae, i. 229.
Foxglove, i. 29, 489.
Fragaria, i. 150.
— vesca, i. 150.
Francoa, i. 459, 462.
— sonchifolia (Fig. 303), i. 462.
Francoaceae, i. 462.
Frangula alnus, i. 343.
— purshiana, i. 26.
Frankenia, i. 228.
— pulverulenta (Fig. 96), i. 228.
Frankeniaceae, i. 228.
Frankincense, i. 356.
Fraxinus, i. 379.
— americana, i. 379.
— excelsior, i. 27, 379.
— ornus, i. 379.
Freesia, i. 32; ii. 651.
— refracta (Fig. 396), ii. 650.
Fremontia, i. 254.
Freycinetia, ii. 672.
— banksii (Fig. 403), ii. 671.
Fritillaria, ii. 609.

Fuchsia, i. 446.
Fuertesia, i. 239.
Fuirena, ii. 708.
Fuller's teasel, i. 28, 474.
Fumana, i. 206.
Fumaria, i. 424.
Fumariaceae, i. **423.**
Fundi, ii. 738.
Funkia, ii. 601.
Funtumia, i. 27, 381.
— elastica, i. 381.
Furcraea, ii. 665.
— gigantea, ii. 662.
Fustic, i. 202.

Gaertnera, i. 387.
Gagea, ii. 609.
Gagnepainia, ii. 586.
Gahnia, ii. 707.
Gaimardia, ii. 700.
Galangal, Greater, ii. 584.
— *root*, ii. 584.
Galantheae, ii. 643.
Galanthus, ii. 643.
Galax, i. 294.
Galaxia, ii. 651.
Galega, i. 155.
Galenia, i. 430.
Galipea, i. 354.
— officinalis, i. 354.
Galium, i. 387.
Gallesia, i. 438.
Galtonia, ii. 611.
Gambier, i. 387.
Gamboge tree, i. 299.
Gamogyne, ii. 633.
Gampsoceras, i. 403.
Garaventia, ii. 642.
Garcinia, i. 299.
— hanburyi, i. 299.
— kola, i. 299.
— mangostana, i. 26, 299.
Gardenia, i. 387.
Garden Pea, i. 25.
Gardneria, i. 378.
Garidella, i. 402.
Garjan, i. 286.
Garrya, i. 174.
— elliptica (Fig. 45), i. 175.
Garryaceae, i. **174.**
GARRYALES, i. 174.
Garuga, i. 356.
Gasoul crystallinum, i. 430, (Fig. 274) 430.
Gasteria, ii. 602.
Gastridium, ii. 726.
Gastrochilus, ii. 586.
Gastrolobium, i. 155.
Gaub fruits, i. 350.
Gaudichaudia, i. 259.
Gaudinia, ii. 726.
Gaultheria, i. 290.
Gaura, i. 446.
Gaussis, ii. 669.
Gaylussacia, i. 296.
Geanthus, ii. 587.
Gearum, ii. 633.
Geissoloma, i. 214.
— marginatum (Fig. 83), i. 214.
Geissolomataceae, i. **214.**
Geissorhiza, ii. 651.
Geitonoplesium, ii. 627.
Gelasine, ii. 649.
Gelsemium, i. 373.
— sempervirens, i. 373.
Geniostoma, i. 372, 373, (map of) 372.
Genista, i. 155.
Genlisea, i. 493.
Gentian root, i. 28, 451.
Gentiana, i. 451.
— lutea, i. 28, 451.
Gentianaceae, i. 28, **450.**
GENTIANALES, i. 450.
Geocharis, ii. 587.
Geogenanthus, ii. 566.
Geomitra, ii. 689.
Geonoma, ii. 669.
Geosiris, ii. 687.
Geostachys, ii. 587.
Geraniaceae, i. 29, 223, 263, **495.**
GERANIALES, i. 494.
Geranium, i. 496.
Geranium, bedding, i. 495.
Gerbera, i. 482.
Gesneria, i. 491.
Gesneriaceae, i. **491.**
Gethyllis, ii. 643.
Gethyum, ii. 643.
Geum, i. 150.
Gigantochloa, ii. 715.
Gilgiochloa, ii. 736.
Gilia, i. 500.
Gillettia, ii. 565.
Gilliesia, ii. 643.
Gilliesieae, ii. 642.
Ginger, ii. 584.
—, *Siamese*, ii. 584.
Ginseng root, i. 178.
Giraldiella, ii. 609.
Gisekia, i. 429.
Gjellerupia, i. 331.
Gladioleae, ii. 651.
Gladiolus, i. 32, 652.
Glaucidium, i. 402.
Glaucothea, ii. 667.
Glaux, i. 453.
Glaziocharis, ii. 689.
Gleditschia, i. 153.
Glinus lotoides (Fig. 272), i. 429.
Glischrocolla, i. 215.
Globba, ii. 586.
Globbeae, ii. 586.
Globe Artichoke, i. 28, 484.
Globularia, i. 506.
— salicina (Fig. 341), i. 506.
Globulariaceae, i. **505.**
Globulariopsis, i. 505.
Glomeropitcairnia, ii. 579.
Gloriosa, ii. 606.
Gloxinia, i. 491.
GLUMIFLORAE, i. 29, 33, 695.
Glyceria, ii. 717.
Glycine max, i. 25, 156.

Glycyrrhiza, i. 155.
— glabra, i. 156.
Glyphaea, i. 250.
Glyphosperma, ii. 598.
Gnaphalium, i. 482.
Gnidia, i. 216.
Godoya, i. 283.
Gomortega, i. 141.
— nitida (Fig. 16), i. 140.
Gomortegaceae, i. 140.
Gomphandra, i. 317.
Gomphia, i. 283.
Gomphocarpus, i. 383.
Gomphostigma, i. 374.
Gomphrena, i. 441.
Gonatanthus, ii. 633.
Gonatopus, ii. 633.
Gongylosperma, i. 381.
Gonioscypha, ii. 604.
— eucomoides (Fig. 375), ii. 603.
Goniostoma, i. 125.
Gonocrypta, i. 381.
Gonolobus, i. 383.
Gonypetalum, i. 151.
Gonystylaceae, i. **212.**
Gonystylus i. 213.
— miquelianus (Fig. 81), i. 212.
Goodenia, i. 479.
Goodeniaceae, i. **478.**
GOODENIALES, i. 478.
Gooseberry, i. 25, 162.
Gordonia, i. 274.
Gorgonidium, ii. 633.
Gorse, i. 25.
Gosela, i. 505.
Gossypium, i. 26, 255.
Gouania, i. 343.
— corylifolia (Fig. 201), i. 343.
— domingensis, i. 343.
Goupia, i. 323.
— glabra (Fig. 183), i. 323.
Goupiaceae, i. **322.**
Gourds, i. 244.
Grains of Paradise, ii. 584.
GRAMINALES, ii. 710.
Gramineae, i. 30, 33; ii. **710.**
Grammanthes gentianoides (Fig. 298), i. 457.
Granadillas fruits, i. 241.
Granataceae, i. 306.
Grape Sugar, i. 344.
— *vine*, i. 26, 344.
Grapefruit, i. 26.
Grapple Plant, i. 391.
Grass-Tree gum, ii. 660.
Grass wrack, i. 30.
Gravisia, ii. 580.
Greenheart wood, i. 140.
Greigia, ii. 580.
Grevea, i. 166.
Grevillea, i. 218.
— robusta, i. 218.
Grewia, i. 250.
Greyia, i. 165.
— sutherlandii (Fig. 36), i. 164.
Greyiaceae, i. **164.**
Grias, i. 304.
— cauliflora, i. 304.
Griffinia, ii. 645.
Grisebachia, i. 290.
Griselinia, i. 172.
Groenlandia, ii. 558.
Gronophyllum, ii. 668.
Gronovia, i. 239.
Grossulariaceae, i. 25, **162.**
Ground nut, i. 25, 156.
Grubbia, i. 339.
— rosmarinifolia (Fig. 195), i. 338.
Grubbiaceae, i. **338.**
Guacamaya, ii. 574.
Guadua, ii. 715.
Guaduella, ii. 715.
Guaiacum, i. 270.
— officinale, i. 26, 270.
— sanctum, i. 270.
Guaiacum wood, i. 270.
Guarana, i. 26.
Guarea, i. 358.
Guatteria, i. 134.
Guava, i. 26.
— *fruit*, i. 303.
Guazuma, i. 252.
Guettarda, i. 387.
Guiana Crab tree, i. 358.
Guiera, i. 307.
Guinea Corn, ii. 741.
— *Grain*, ii. 584.
Gulubia, ii. 668.
Gulubiopsis, ii. 668.
Gum Ammoniacum, i. 472.
— *Arabic*, i. 155.
— *Benzoin*, i. 169.
— *Olibanum*, i. 356.
— *Tragacanth*, i. 156.
Gunnera, i. 449, (map of) 449.
— tinctoria (Fig. 291), i. 448.
Gunnia, i. 430.
Gustavia, i. 304.
Guthrica, i. 242.
Gutta percha, i. 26, 350.
Guttiferae, i. 26, 297, 298, 302.
GUTTIFERALES, i. 297.
Guzmania, ii. 579.
Gymnanthera, i. 382.
Gymnema, i. 384.
Gymnolaema, i. 381.
Gymnoschoenus, ii. 707.
Gymnosiphon, ii. 687.
GYMNOSPERMAE, i. 22.
Gymnosporia, i. 320.
Gymnostachys, ii. 630.
Gymnosteris, i. 501.
Gymnotheca, i. 421.
Gynandropsis, i. 225.
Gynerium, ii. 721.
Gynopleura, i. 240.
Gypsophila, i. 429.
— elegans, i. 430.
Gyrinops, i. 214.
Gyrinopsis, i. 214.
Gyrocarpus, i. 142.
Gyrostemon, i. 437.

Gyrostemonaceae, i. 436.

Habenaria, ii. 694.
Haberlea, i. 491.
Habropetalum, i. 207.
Hackelochloa, ii. 740.
Haemantheae, ii. 645.
Haemanthus, ii. 645.
Haemodoraceae, i. 32; ii. **674.**
HAEMODORALES, ii. 674.
Haemodoreae, ii. 676.
Haemodorum, ii. 676.
Hagenbachia, ii. 676.
Hakea, i. 218.
Halenia, i. 451.
Halesia, i. 170.
Halgania, i. 394.
Halopegia, ii. 590.
Halophila, ii. 541.
Halophiloideae, ii. 541.
Halophytum, i. 440.
Halorrhagaceae, i. **448.**
Halorrhagis, i. 449.
Hamadryas, i. 403.
Hamamelidaceae, i. 25, **180.**
HAMAMELIDALES, i. 179.
Hamamelis, i. 180.
Haniffia, ii. 586.
Hannoa, i. 355.
Hannonia, ii. 646.
Hapaline, ii. 634.
Haplochorema, ii. 586.
Haploclathra paniculata, i. 274.
Haplodypsis, ii. 669.
Haplophloga, ii. 669.
Hardenbergia, i. 155.
Harebell, i. 28.
Harmandia, i. 333.
Haronga, i. 297.
Harpagocarpus, i. 432.
Harpagophytum, i. 391.
— procumbens (Fig. 240), i. 391.
Harpanema, i. 382.
Harpephyllum caffrum, i. 364.
Harperia, ii. 703.
Harpullia, i. 361.
Hastingsia, ii. 598.
Haumania, ii. 590.
Haworthia, ii. 602.
Haylockia, ii. 643.
Haynaldia, ii. 719.
Hazel, i. 194.
Heather, i. 292.
Hebanthe, i. 441.
Hebe, i. 489.
Hebea, ii. 652.
Hebenstreitia, i. 505.
Hebepetalum, i. 261.
Hechtia, ii. 579.
Hedera, i. 178.
— helix, i. 178.
Hedycarya, i. 136.
Hedychieae, ii. 586.
Hedychium, ii. 586.
— spicatum, ii. 584.
Hedyosmum, i. 422.
Hedyotis, i. 386.
Hedysarum, i. 155.
Hedyscepe, ii. 668.
Heisteria, i. 330.
Heleocharis, ii. 708.
Heliamphora, i. 469.
Helianthemum, i. 206.
Helianthium, ii. 544.
Helianthus annuus, i. 28.
— tuberosus, i. 28, 484.
Helichrysum, i. 482.
— leucopsideum (Fig. 320*a*), i. 482.
Helicia, i. 218.
Helicodiceros, ii. 635.
Heliconia, ii. 582.
Helicophyllum, ii. 635.
Helicteres, i. 252.
Heliotropium, i. 503.
Helleboraceae, i. 27, **401.**
Helleborus, i. 402.
— niger (Fig. 248), i. 401.
Helmholtzia, ii. 685.
Helonema, ii. 708.
Heloniadeae, ii. 595.
Helonias, ii. 595.
Heloniopsis, ii. 596.
Helosis, i. 341.
Helwingia, i. 178.
Helxine, i. 203.
Hemarthria, ii. 740.
Hemerocallideae, ii. 601.
Hemerocallis, ii. 601.
Hemicarex, ii. 710.
Hemicarpha, ii. 708.
Hemichlaena, ii. 708.
Hemidesmus, i. 382.
— indicus, i. 382.
Hemiorchis, ii. 586.
Hemiphylacus, ii. 599.
Hemithrinax, ii. 667.
Hemlock, i. 472.
Hemp, i. 201.
Henbane, i. 29, 484.
Henequen, ii. 662.
Hensmania, ii. 602.
Hepatica, i. 403.
Heptapleurum, i. 178.
Heracleum, i. 472.
HERBACEAE, i. 22, 27.
Herbertia, ii. 651.
Hermannia, i. 252.
Hermodactylus, ii. 649.
Hernandia, i. 142, (map of) 141.
— peltata (Fig. 17), i. 142.
Hernandiaceae, i. **141.**
Herniaria, i. 432.
Herpolirion, ii. 598.
Herreria, ii. 600.
Herrerieae, ii. 600.
Herreriopsis, ii. 600.
Hesperaloe, ii. 664.
Hesperantha, ii. 651.
Hesperocallis, ii. 601.
Hesperogreigia, ii. 580.
Hesperoyucca, ii. 664.
Hessea, ii. 645.

Heteranthera, ii. 618.
Heteranthoecia, ii. 738.
Heteroarisaema, ii. 635.
Heterocarpha haareri (Fig. 428), ii. 722.
Heterolobium, ii. 635.
Heteropogon, ii. 741.
Heteropsis, ii. 632.
Heteropterys, i. 259.
Heteropyxidaceae, i. 341.
Heteropyxis, i. 341.
— canescens (Fig. 199), i. 341.
Heterosmilax, ii. 618.
Heterospatha, ii. 669.
Heterostylaceae, ii. 549.
Heterostylus, ii. 549.
Heuchera, i. 459.
Hevea, i. 270.
— brasiliensis, i. 26, 270.
Hevea rubber, i. 270.
Hewardia, ii. 596, 649.
Hewittia, i. 486.
Hexacyrtis, ii. 606.
Hexaglochin, ii. 549.
Hexapterella, ii. 687.
Hibbertia, i. 144.
— ericifolia (Fig. 19), i. 144.
Hibiscus, i. 255.
Hickory, i. 25.
— *nut*, i. 196.
Hieracium, i. 482.
Hierochloë, ii. 730.
Hieronymiella, ii. 646.
Higinbothamia, ii. 658.
Hillebrandia, i. 244, 245.
Hilleria, i. 438.
Himantandra, i. 131.
— belgraveana (Fig. 6), i. 130.
Himantandraceae, i. 130.
Hippeastreae, ii. 646.
Hippeastrum, i. 32; ii. 646.
Hippocastanaceae, i. 26, 365.
Hippocratea, i. 324.
— cymosa (Fig. 184), i. 324.
Hippocrateaceae, i. 324.
Hippophaë, i. 342.
— rhamnoides (Fig. 200), i. 342.
Hippuris, i. 449.
Hiraea, i. 259.
Hirda fruits, i. 307.
Hirtella, i. 150.
Hitchenia, ii. 586.
Hitcheniopsis, ii. 586.
Hodgsonia heteroclita (Fig. 109), i. 243.
Hodgsoniola, ii. 596.
Hoeckia, i. 475.
Hog Plum, i. 364.
Hohenbergia, ii. 580.
Hoheria lyallii (Fig. 120), i. 255.
Holboellia, i. 410.
Holcus, ii. 726.
Holly, i. 312.
Holmia, ii. 709.
Holmskioldia, i. 395.
Holochlamys, ii. 632.
Hololachne, i. 229.
Holoptelea, i. 199.
Holostylis, i. 415.
Holubia, i. 391.
Homalium, i. 207.
Homalonema, ii. 633.
Homalostachys, ii. 710.
Homoglossum, ii. 652.
Honesty, i. 28, 426.
Honeysuckle, i. 179.
Hoodia, i. 384.
Hopea, i. 286.
Hopkinsia, ii. 703.
Hoplestigma, i. 210.
— pierreanum (Fig. 78), i. 209.
Hoplestigmataceae, i. 209.
Hoppia, ii. 709.
Hops, i. 201.
Hordeeae, ii. 719.
Hordeum, i. 34; ii. 719.
Hornbeam, i. 194.
Hornstedtia, ii. 587.
Horse Chestnut, i. 26, 365.
— *Radish*, i. 28, 426.
— — *tree*, i. 226.
Hosackia, i. 155.
Hoslundia, i. 506.
Hosta, ii. 601.
Hottonia, i. 453.
Houstonia, i. 386.
Houttuynia, i. 421.
Hovenia, i. 343.
— dulcis, i. 343.
Howea, ii. 669.
Hoya, i. 384.
Hua, i. 263.
— gabonii (Fig. 126), i. 262.
Huaceae, i. 262.
Hudsonia, i. 206.
Huegelia, i. 501.
Hurtea, i. 367.
Hugonia, i. 261.
Humbertia, i. 486.
Humbertiaceae, i. 486.
Humbertina, ii. 635.
Humea, i. 482.
Humiria, i. 260.
— arenaria (Fig. 123), i. 260.
Humiriaceae, i. 259, (map of) 259.
Humulus, i. 201.
— lupulus, i. 201, (Fig. 69) 200.
Huodendron, i. 170.
Hura, i. 270.
Huthia, i. 501.
Hyacinthus, ii. 611.
Hyalocalyx, i. 236.
Hybanthus, i. 231.
— ipecacuanha, i. 231.
Hybophrynium, ii. 590.
Hydatella, ii. 700.
Hydnocarpus, i. 207.
— anthelminthicus, i. 208.
— kurzii, i. 25.
Hydnora, i. 415.
— longicollis (Fig. 261), i. 416.
Hydnoraceae, i. 415.
Hydrangea, i. 162.
Hydrangeaceae, i. 161.

Hydrastis, i. 402.
— canadensis, i. 402.
Hydrastis Rhizome, i. 402.
Hydriastele, ii. 668.
Hydrilla, ii. 541.
Hydrocaryaceae, i. 447.
Hydrocera, i. 500.
Hydrocharis, ii. 541.
Hydrocharitaceae, i. 30; ii. **538.**
Hydrochloa, ii. 731.
Hydrocleys, ii. 538.
— nymphoides (Fig. 343), ii. 537.
Hydrocotyle, i. 472.
Hydrolea, i. 501.
— spinosa (Fig. 336), i. 501.
Hydrolirion, ii. 544.
Hydromystria, ii. 541.
Hydrophyllaceae, i. **501.**
Hydrophyllum, i. 501.
Hydrostachyaceae, i. **470.**
Hydrostachys, i. 470.
— distichophylla (Fig. 310), i. 471.
Hydrothrix, ii. 618.
Hydrotropus, ii. 541.
Hygroryza, ii. 731.
Hyline, ii. 645.
Hymenaea, i. 154.
— courbaril, i. 154.
Hymenocallis, ii. 646.
Hymenocardia, i. 270.
Hymenosporum, i. 220.
Hyophorbe, ii. 669.
Hyoscyamus, i. 484.
— niger, i. 29, 484.
Hyospathe, ii. 669.
Hyparrhenia, ii. 741.
Hypecoum, i. 424.
Hypericaceae, i. 26.
Hypericaceae, i. **297**, 299, (map of) 297.
Hypericopsis, i. 228.
Hypericum, i. 297.
— hookerianum (Fig. 158), i. 298.
Hyphaene, ii. 667.
— thebaica, ii. 666.
Hypodiscus, ii. 704.
Hypoestes, i. 491.
Hypolaena, ii. 703.
Hypolytreae, ii. 708.
Hypolytrum, ii. 709.
Hypopitys, i. 295.
Hypoxidaceae, ii. **678.**
Hypoxis, ii. 678.
Hypselodelphys, ii. 590.
Hypseocharis, i. 497.
Hyptis, i. 506.

Ianthe, ii. 678.
Iburu, ii. 738.
Icacina, i. 317.
Icacinaceae, i. **316.**
Idenburgia, i. 139.
Idria, i. 230.
Iguanura, ii. 669.
Ilex, i. 312.
— aquifolium (Fig. 170), i. 312.
— paraguensis, i. 26, 312.
Ilicaceae, i. 311.
Illecebraceae, i. **432.**
Illecebrum, i. 432.
Illiciaceae, i. 23, **125.**
Illicium, i. 126, (map of) 125.
— anisatum (Fig. 2), i. 126.
— verum, i. 126.
Illigera, i. 142.
Imbricaria, i. 350.
Impatiens, i. 500.
— glandulifera (Fig. 334), i. 499.
Impatiens roylei (Fig. 334), i. 499.
Impatientella, i. 500.
Imperata, ii. 740.
Incarvillea, i. 389.
Indian Almond, i. 308.
— *copal*, i. 286.
— *corn*, i. 34; ii. 742.
— *Jujube*, i. 343.
— *Pink root*, i. 376.
— *Redwood*, i. 358.
— *Rosewood*, i. 156.
— *Sarsaparilla*, i. 382.
— *Tobacco*, i. 478.
Indiarubber Fig, 1, 202.
Indigo, i. 25.
— *dye*, i. 156.
Indigofera, i. 155.
— tinctoria, i. 156.
Indorouchera, i. 261.
Inga, i. 154.
Inodes, ii. 667.
In Oil, i. 286.
Inula, i. 482.
Iodes, i. 317.
Ipecacuanha, i. 27.
— *Indian*, ii. 629.
Ipecacuanha root, i. 387.
Iphigenia, ii. 612.
Iphigenieae, ii. 612.
Iphigeniopsis, ii. 612.
Ipomoea, i. 486.
— batatas, i. 29, 486.
Ipomopsis, i. 500.
Iresine, i. 441.
Iriartea, ii. 668.
Iriartella, ii. 668.
Iris, i. 32; ii. 649.
— florentina, ii. 647.
— germanica, ii. 647.
— pallida, ii. 647.
— pseudacorus, ii. 647.
— versicolor, ii. 647.
Iridaceae, i. 32; ii. **647.**
IRIDALES, ii. 646.
Irideae, ii. 649.
Iroko Tree, i. 202.
Iron Bark tree, i. 303.
Ironwood, i. 155, 379.
—, *black*, i. 379.
Irvingia, i. 261.
— barteri, i. 261.
Irvingiaceae, i. **261**, (map of) 261.
Isachne, ii. 738.
— australis (Fig. 447), ii. 738.
Isatis, i. 426.

Ischaemum, ii. 740.
Ischnolepis, i. 382.
Ischnosiphon, ii. 590.
Ischnurus, ii. 725.
Ismene, ii. 646.
Isolona, i. 491.
Ispaghul seeds, i. 455.
Isophysideae, ii. 649.
Isophysis, ii. 649.
Isopyrum, i. 402.
Isotoma, i. 478.
Isotrema, i. 415.
Istle fibre, ii. 662.
Italian Millet, ii. 738.
Itea, i. 166.
Ivory Nut Palm, ii. 666.
Ivy, i. 178.
Ixia, ii. 651.
Ixieae, ii. 651.
Ixiolirieae, ii. 645.
Ixiolirion, ii. 645.
Ixonanthes, i. 257.
— chinensis (Fig. 121), i. 257.
Ixonanthaceae, i. **256**, (map of) 257.
Ixora, i. 387.

Jaborandi, i. 354.
Jacaranda, i. 389.
Jacaratia, i. 246.
Jack-fruit, i. 202.
Jacobinia, i. 491.
Jacquemontia, i. 486.
Jacquinia, i. 347.
Jaimenostia, ii. 635.
Jalap, i. 486.
Jambolana fruit, i. 303.
Jamesia, i. 159.
Japan Pepper, i. 354.
Japanolirion, ii. 596.
Japanese Star Anise, i. 126.
Jardinea, ii. 740.
Jarilla, i. 246.
Jarrah, i. 303.
Jasione, i. 476.
Jasminum, i. 379.
Jatropha, i. 270.
Jeffersonia, i. 405.
Jerusalem Artichoke, i. 28, 484.
Jessenia, ii. 669.
Job's Tears, ii. 742.
Johnsonia, ii. 602.
Johnsonieae, ii. 602.
Joinvillea, ii. 568.
Josephina, i. 391.
Jovellana (map of), i. 488.
Juania, ii. 669.
Juanulloa, i. 484.
Jubaea, ii. 670.
Jubaeopsis, ii. 670.
Juglandaceae, i. 25, **195**.
JUGLANDALES, i. 194.
Juglans, i. 196.
— cinerea, i. 196.
— regia, i. 25, 196.
Juliania, i. 369.
— adstringens (Fig. 223), i. 369.
Julianiaceae, i. **368**.
Jumellea fragrans, ii. 693.
Juncaceae, i. 30, 33; ii. **697**.
Juncaginaceae, i. 30; ii. **548**.
JUNCAGINALES, ii. 548.
JUNCALES, ii. 695.
Juncella, ii. 700.
Juncellus, ii. 708.
Juncio, ii. 697.
Juncus, ii. 697.
— effusus, ii. 697.
— maritimus, ii. 697.
Jussiaea, i. 446.
— suffruticosa (Fig. 289), i. 446.
Justicia, i. 491.

Kadsura, i. 130.
Kaempferia, ii. 586.
Kaffir Date, i. 364.
— *Corn*, ii. 741.
Kafur-Kachri, ii. 584.
Kakaralli wood, i. 304.
Kaki plum, i. 26, 350.
Kalanchoe, i. 458.
Kalbreyera, ii. 669.
Kaliphora, i. 172.
Kalmia, i. 292.
Kamala, i. 271.
Kania, i. 159.
Kanyin oil, i. 286.
Kapok, i. 26.
— *tree*, i. 254.
Karatas, ii. 580.
Karaunda fruits, i. 381.
Karri timber, i. 303.
Kei Apple, i. 208.
Kennedya, i. 155.
Kentia, ii. 668.
Kentiopsis, ii. 668.
Kentrosiphon, ii. 652.
Keora Oil, ii. 672.
Keratto fibre, ii. 662.
Kerosphaereae, ii. 695.
Kerria, i. 150.
Kewra Oil, ii. 672.
Keyaki, i. 199.
Khaya, i. 358.
— senegalensis, i. 358.
Kibara, i. 136.
Kielmeyera, i. 272, 274.
Kigelia, i. 389.
Kiggelaria, i. 207.
Kingdonia, i. 403.
Kingia, ii. 662.
Kino, i. 156.
Kinugasa, ii. 616.
Kirengeshoma, i. 162.
— palmata (Fig. 33), i. 161.
Kissenia, i. 238, 239.
Kittool fibre, ii. 666.
Kinetostigma, ii. 669.
Klainedoxa, i. 262.
Klaprothia, i. 239.
Klattia, ii. 651.
Klingia, ii. 646.
Kmeria, i. 124.

Knautia, i. 475.
Kniphofia, ii. 601.
Kniphofieae, ii. 600.
Knowltonia, i. 403.
Kobresia, ii. 709.
Kochia, i. 440.
Koeberlinia, i. 314.
— spinosa (Fig. 172), i. 314.
Koeberliniaceae, i. 313.
Koeleria, ii. 726.
Koelreuteria, i. 361.
— paniculata (Fig. 215), i. 360.
Kokoon tree, i. 321.
Kokoona zeylanica, i. 321.
Kola, i. 25.
— *nut*, i. 252.
Komaroffia, i. 402.
Kombe seeds, i. 381.
Kompitsia, i. 381.
Korthalsia, ii. 667.
Krameria, i. 234.
— tomentosa (Fig. 101), i. 233.
— triandra, i. 234.
Krameriaceae, i. 233.
Kreysigia, ii. 606.
Kimhardtia, ii. 574.
Kuteera gum, i. 209.
Kyllinga, ii. 707, 708.

Labdanum, i. 206.
Labiatae, i. 29, 506.
Labordia, i. 373.
Labrador Tea, i. 292.
Laburnum, i. 155.
Laccopetalum, i. 403.
Lacewood, i. 183.
Lachenalia, ii. 611.
Lachnaea, i. 216.
Lachnanthes, ii. 676.
Lachnocaulon, ii. 576.
Lachnocistus, i. 209.
Lachnopylis, i. 374.
Lachnostachys, i. 397.
Lacistema, i. 211.
— robustum (Fig. 80), i. 211.
Lacistemataceae, i. 211, (map of) 211.
Lacistemopsis, i. 211.
Lacquer tree, i. 363.
Lactace, ii. 642.
Lactoridaceae, i. 131.
Lactoris, i. 131.
— fernandeziana, i. 131, (Fig. 7) 131.
Lactuca, i. 482.
— scariola, i. 28, 484.
Lagarosiphon, ii. 541.
Lagenandra, ii. 635.
Lagenocarpus, ii. 709.
Lagos bass, ii. 666.
Laguncularia, i. 307.
Lagurus, ii. 726.
LAMIALES, i. 503.
Lamium, i. 508.
Lamprocaulos, ii. 703.
Lanaria, ii. 676.
Lancewoods, i. 134.
Landolphia, i. 27, 381.
Landolphia heudelotii, i. 381.
— kirkii, i. 381.
— owariensis, i. 381.
Landolphia rubbers, i. 381.
Langevinia, ii. 709.
Langloisia, i. 501.
Langsat fruit, i. 358.
Languas, ii. 587.
Lansa fruit, i. 358.
Lansium domesticum, i. 358.
Lantana, i. 395.
Laoma, ii. 668.
Lapageria, ii. 627.
— rosea (Fig. 387), ii. 626.
Lapeyrousia, ii. 651.
Lapiedra, ii. 642.
Laplacea, i. 274.
Laportea, i. 203.
Leptomeria, i. 339.
Lardizabala, i. 410.
Lardizabalaceae, i. 408, (map of) 409.
Larrea mexicana, i. 26.
Laserpitium, i. 472.
Lasia, ii. 632.
Lasianthera, i. 317.
Lasianthus, i. 387.
Lasieae, ii. 632.
Lasiochloa, ii. 717.
Lasiopetalum, i. 252.
Lasiosiphon, i. 216.
Latania, ii. 667.
Latipes, ii. 729.
Lathraea, i. 492.
Lathyrus, i. 155.
Lauraceae, i. 23, 139.
LAURALES, i. 135.
Laurelia, i. 136.
Laurentia, i. 478.
Laurocerasus officinalis, i. 150.
Laurus, i. 140.
— nobilis, i. 23, 140.
Lautea, i. 172.
Lavandula, i. 506.
— officinalis, i. 29.
— vera, i. 508.
Lavatera, i. 255.
Lavender oil, i. 29, 508.
Lavradia, i. 283.
Laxmannia, ii. 602.
Leandra, i. 309.
Lebeckia, i. 155.
Lechea, i. 207.
Lecythidaceae, i. 303.
Lecythis, i. 304.
— grandiflora, i. 304.
— ollaria, i. 304.
— usitata, i. 304.
Lecythopsis, i. 304.
Ledenbergia, i. 438.
Ledocarpaceae, i. 263.
Ledocarpon, i. 263.
Ledum, i. 292.
Leea, i. 344.
Leek, ii. 639.
Leersia, ii. 731.
Legousia, i. 476.

LEGUMINALES, i. 152.
Leguminosae, i. 155.
Leianthus, i. 451.
Leiothrix, ii. 576.
Leitneria, i. 188.
— floridana (Fig. 58), i. 188.
Leitneriaceae, i. 188.
LEITNERIALES, i. 188.
Lemna, ii. 635.
Lemnaceae, ii. 635.
Lemon, i. 26; ii. 741.
Lemons, i. 354.
Lennoa, i. 296.
Lennoaceae, i. 295.
Lens culinaris, i. 156.
Lentibulariaceae, i. 492.
Lentils, i. 156.
Leonotis, i. 508.
— africana (Fig. 342), i. 507.
Leontice, i. 405.
Leontochir, ii. 623.
Leontopetaloides, ii. 683.
Leontopodium, i. 482.
Leonurus, i. 508.
Leopoldinia, ii. 669.
— piassaba, ii. 666.
Lepidagathis, i. 491.
Lepidium, i. 426.
Lepidobolus, ii. 703.
Lepidobotryaceae, i. 266.
Lepidobotrys, i. 267.
— staudtii (Fig. 130), i. 267.
Lepidocaryeae, ii. 667.
Lepidocaryum, ii. 667.
Lepidocordia, i. 394.
Lepidosperma, ii. 707.
Lepilaena, ii. 559.
Lepionurus, i. 331.
Lepironia, ii. 708.
Leprosy, i. 25.
Leptaloe, ii. 602.
Leptaspis, ii. 734.
Leptaulus daphnoides (Fig. 176), i. 317.
Leptocarpus, ii. 703.
Leptochiton, ii. 645.
Leptochloa, ii. 722.
Leptodactylon, i. 501.
Leptodermis, i. 387.
Leptolaena, i. 283.
Leptolepis, ii. 708.
Leptophoenix, ii. 668.
Leptorrheo, ii. 565.
Leptosiphon, i. 501.
Leptospermum, i. 303.
Leptothrium, ii. 729.
Leptureae, ii. 725.
Lepturus, ii. 725.
— repens (Fig. 432), ii. 725.
Lepyrodia, ii. 703.
Leschenaultia, i. 479.
Lespedeza, i. 155.
Lesser Celandine, i. 27.
Lessertia, i. 155.
Lettuce, i. 28, 484.
Leucadendron, i. 218.
— argenteum, i. 218.
Leucas, i. 508.
Leucocoryne, ii. 642.
Leucocrinum, ii. 601.
Leucoium, ii. 643.
Leucopogon, i. 293.
Leucopremna, i. 246.
Leucospermum, i. 218.
Leucothoe, i. 290.
Levant berries, i. 411.
Levenhookia, i. 481.
Lewisia, i. 431.
Leycesteria, i. 178.
Libertia, ii. 649.
Licania, i. 150.
Licuala, ii. 667.
Ligea, i. 470.
Lightfootia, i. 476.
Lightia, i. 234.
Lightwood, i. 159.
LIGNOSAE, i. 22, 23.
Lignum Vitae, i. 26, 270.
Ligusticum, i. 472.
Ligustrum, i. 379.
— massalongianum (Fig. 23), i. 378.
— vulgare, i. 379.
Lilac, i. 379.
Lilaea, ii. 549.
— subulata (Fig. 350), ii. 550.
Lilaeaceae, ii. 549.
Liliastrum, ii. 598.
Liliaceae, i. 30, 31; ii. 591.
LILIALES, ii. 591.
Lilicella, ii. 547.
Lilium, i. 31; ii. 609.
— tigrinum (Fig. 379), ii. 610.
Lilloa, ii. 633.
Lily, i. 31.
— *of the Valley*, i. 31; ii. 592.
Lime, i. 26.
— *tree*, i. 251.
Limes, i. 354.
Limeum, i. 429.
Limnanthaceae, i. 496.
Limnanthemum, i. 453.
Limnanthes, i. 497.
— douglasii (Fig. 331), i. 496.
Limnobieae, ii. 541.
Limnobium, ii. 541.
Limnocharis, ii. 538.
Limnophyton, ii. 544.
Limonium, i. 455.
Linaceae, i. 26, 256, 260, 265.
Linaloë Oil, i. 356.
Linanthus, i. 501.
Linaria, i. 489.
Linconia, i. 186.
Lindera, i. 140.
Lindleya, i. 150.
Lindmania, ii. 579.
Linnaea, i. 178.
Linociera, i. 379.
Linoma, ii. 668.
Linospadix, ii. 669.
Linseed, i. 261.
— *oil*, i. 261.
Linum, i. 261.

Linum usitatissimum, i. 26, 261, (Fig. 124) 260.
Liparis, ii. 695.
Liparophyllum, i. 453.
Liphocarpha, ii. 708.
Lippia, i. 395.
Liquidambar, i. 180.
— formosana, i. 181.
— styraciflua, i. 181.
Liquorice root, i. 156.
Liriodendron, i. 125.
— tulipifera, i. 123.
Liriope, ii. 599.
Liriosma, i. 330.
Liriothamnus, ii. 598.
Lisianthus, i. 451.
Lissocarpa, i. 168.
— benthamii (Fig. 40), i. 168.
Lissocarpaceae, i. 168.
Litanthus, ii. 611.
Lithachne, ii. 735.
Lithocarpus, i. 193.
Lithospermum, i. 503.
— officinale, i. 503.
Litsea, i. 140.
Littonia, ii. 606.
Littorella, i. 456.
Livistona, ii. 667.
Llavea, i. 207.
Lloydia, ii. 609.
Loasa, i. 239.
Loasaceae, i. 25, 237, (map of) 238.
LOASALES, i. 236.
Lobelia, i. 478.
— inflata, i. 478.
Lobeliaceae, i. 477.
Lobostemon, i. 503.
Locust, i. 154.
Lodh bark, i. 171.
Lodoicea, ii. 667.
— sechellarum, ii. 666.
Loeselia, i. 501.
Logania, i. 373.
— longifolia (Fig. 226), i. 372.
Loganiaceae, i. 27, 372.
LOGANIALES, i. 370.
Loiseleuria, i. 292.
Lolium, ii. 717.
Lomandra, ii. 662.
Lomatia, i. 218.
Lomatophyllum, ii. 602.
Lonchocarpus, i. 25, 156.
Lonchostoma, i. 186.
London Plane, i. 25, 183.
Lonicera, i. 178.
— periclymenum, i. 179.
Lopezia, i. 446.
Lophatherum, ii. 717.
Lophiocarpus, i. 438.
Lophiola, ii. 676.
Lophira alata, i. 283.
Lophocarpus, ii. 707.
Lopholepis, ii. 729.
Lophopyxis, i. 320.
Lophoschoenus, ii. 707.
Lophotocarpus, ii. 544.
Loquat, i. 150.
Loranthaceae, i. 26, 337.
Loranthus, i. 338.
Loropetalum, i. 180.
Lote fruit, i. 343.
Lotononis, i. 155.
Lotus, i. 155.
Lourya, ii. 604.
Louvelia, ii. 670.
Loweia, i. 237.
Lowia, ii. 584.
Lowiaceae, ii. 582.
Loxocarya, ii. 703.
Loxococcus, ii. 668.
Lozania, i. 211.
Luculia, i. 386.
Lucuma, i. 350.
— mammosa, i. 350.
Ludovia, ii. 674.
Ludwigia, i. 446.
Luffa, i. 244.
Luhea, i. 250.
Lukrabo seeds, i. 208.
Lumnitzera, i. 307.
Lunaria, i. 426.
— rediviva, i. 426.
Lupinus, i. 155.
Lupulin, i. 201.
Luronium, ii. 544.
Luxemburgia, i. 283.
Luziola, ii. 731.
Luzula, ii. 697.
— campestris, i. 33.
Luzuriaga, ii. 627.
— marginata, ii. 627.
— parviflora, ii. 627.
Lychnis, i. 430.
Lycium, i. 484.
Lycopersicum esculentum, i. 29, 484.
Lycoris, ii. 646.
Lygeeae, ii. 729.
Lygeum, ii. 730.
— spartum (Fig. 437), ii. 729.
Lyginia, ii. 703.
Lyonothamnus, i. 150.
Lysichitum, i. 31; ii. 630.
— camtschaticum (Fig. 388), ii. 628.
Lysiloma sabicu, i. 155.
Lysimachia, i. 453.
Lytanthus, i. 506.
Lythraceae, i. 28, 307, 445.
LYTHRALES, i. 444.
Lythrum, i. 446.

Maba, i. 350.
Mabcoboo, ii. 584.
Mabee bark, i. 343.
Macaranga, i. 270.
Macfadyena, i. 389.
Macgregoria, i. 322.
Machaerocarpus, ii. 544.
— californicus (Fig. 345), ii. 543.
Machilus, i. 140.
Mackay bean, i. 154.
Macleaya, i. 423.
Maclura, i. 202.
— aurantiaca, i. 202.

Macqui berries, i. 251.
Macrolobium, i. 153.
Macropelma, i. 382.
Macrophloga, ii. 668.
Macropidia, ii. 677.
Madar fibre, i. 384.
Madder dye, i. 27.
Madhuca indica, i. 350.
Maerua, i. 225.
Maesa, i. 346.
Mafekingia, i. 382.
Mafureira seeds, i. 358.
Magnolia, i. 124.
— campbellii (Fig. 1), i. 124.
Magnoliaceae, i. 23, **123**, (map of) 123.
MAGNOLIALES, i. 122.
Maguireea, ii. 634.
Mahernia, i. 252.
Mahwa tree, i. 350.
Mahogany, i. 26.
Mahogany wood, i. 358.
Mahonia, i. 413.
Mahurea, i. 272.
Maianthemum, ii. 605.
Maidenia, ii. 541.
Maize, i. 34; ii. 742.
Malacca canes, ii. 666.
Malesherbia, i. 240.
— thyrsiflora (Fig. 106), i. 240.
Malesherbiaceae, i. **240.**
Mallophora, i. 397.
Mallotus, i. 270.
— philippinensis, i. 271.
Malope, i. 255.
Malortiea, ii. 669.
Malpighia, i. 259.
Malpighiaceae, i. **258.**
MALPIGHIALES, i. 255.
Malus pumila, i. 150.
Malva, i. 255.
Malvaceae, i. 26, 254.
MALVALES, i. 254.
Malvastrum, i. 255.
Mamillaria, i. 247.
Mammea, i. 299.
— americana, i. 300.
Mammee Apple, i. 300.
— *Sapote Plum*, i. 350.
Mandevilla, i. 381.
Mandonia, ii. 565.
Manettia, i. 386.
Mangifera, i. 363.
— indica, i. 26, 364.
Manglietia, i. 124.
Mango, i. 26, 364.
Mangonia, ii. 633.
Mangosteen, i. 26.
Mangosteen fruits, i. 299.
Manicaria, ii. 669.
Manihot, i. 270.
— glaziovii, i. 271.
Manila hemp, ii. 582.
Manna Ash, i. 379.
Mantisia, ii. 586.
Mapania, ii. 709.
Mapaniopsis, ii. 709.
Maple, i. 26, 364.
Mappia, i. 317.
Maranta, ii. 590.
— arundinacea, ii. 588.
Maranta starch, ii. 588.
Marantaceae, i. 31; ii. **588.**
Maranteae, ii. 590.
Marantochloa, ii. 590.
Marathrum, i. 470.
Marcgravia, i. 279.
— umbellata (Fig. 141), i. 279.
Marcgraviaceae, i. **278.**
Margosa, i. 358.
Marianthus, i. 220.
Marica, ii. 649.
Mariceae, ii. 649.
Mariposa, ii. 609.
Mariscopsis, ii. 708.
Mariscus, ii. 708.
Marjoram, i. 29, 508.
Marquesia, i. 286.
Marram grass, i. 34.
Marrubium, i. 508.
Marsdenia, i. 384.
— cundurango, i. 384.
Marsippospermum, ii. 697.
— gracile (Fig. 416), ii. 696.
Marthella, ii. 687.
Martinezia, ii. 670.
Martynia, i. 392.
Martyniaceae, i. **392.**
Marvel of Peru, i. 217.
Maschalocephalus, ii. 572, 574.
Massangea, ii. 580.
Massonia, ii. 612.
Massonieae, ii. 612.
Mastersiella, ii. 703.
Mastic, i. 363.
Mastigostyla, ii. 649.
Mastixia, i. 172.
Mastixiodendron, i. 173, 387.
Maté tea, i. 26.
Mathurina, i. 236.
Matricaria, i. 482.
Maundia, ii. 549.
Mauritia, ii. 667.
Mauritius Hemp, ii. 662.
Maximiliana, ii. 670.
Mayaca baumii, ii. 568.
— longipes (Fig. 361), ii. 569.
Mayacaceae, ii. **568**, (map of) 568.
May Apple, i. 404.
Maydeae, ii. 741.
Maytenus, i. 320.
Meadow saffron, i. 31; ii. 592.
Meconopsis, i. 423.
Medeola, ii. 616.
Medeoleae, ii. 616.
Medicago, i. 155.
Medinilla, i. 309.
Medusagyne, i. 280.
— oppositifolia (Fig. 143), i. 281.
Medusagynaceae, i. **280.**
Medusandra, i. 335.
— richardsiana (Fig. 193), i. 336.
Medusandraceae, i. 241, **335.**

Meeboldina, ii. 703.
Megaphrynium, ii. 590.
Melaleuca, i. 303.
— leucadendron, i. 303.
Melampyrum, i. 489.
Melanophylla, i. 172.
Melanorrhoea usitata, i. 364.
Melanthium, ii. 608.
Melasphaerula, ii. 651.
Melastoma, i. 309.
— malabathricum (Fig. 168), i. 309.
Melastomataceae, i. 308.
Melegueta Pepper, ii. 584.
Melhania, i. 252.
Melia, i. 356.
— azedarach, i. 358.
Meliaceae, i. 26, 356.
MELIALES, i. 356.
Melianthus, i. 360.
— major (Fig. 214), i. 359.
Melianthaceae, i. 359.
Melica, ii. 717.
Melicope, i. 354.
Melientha, i. 331.
Melilotus, i. 155.
Meliosma, i. 363.
— henryi (Fig. 217), i. 363.
Melliodendron, i. 170.
Melocalamus, ii. 715.
Melocanna, ii. 715.
Melochia, i. 252.
Melodinus, i. 381.
Melon, i. 244.
Melothria, i. 244.
Memecylon, i. 309.
Menabaea, i. 382.
Meni oil, i. 283.
Menispermum, i. 411.
— canadense (Fig. 256), i. 410.
Menispermaceae, i. 410.
Mentha, i. 506.
— piperita, i. 29, 508.
— viridis, i. 508.
Mentzelia, i. 239.
Menyanthes, i. 451.
— trifoliata (Fig. 294), i. 452.
Menyanthaceae, i. 451.
Merendera, ii. 612.
Merostachys, ii. 715.
Mertensia, i. 503.
Mesanthemum, ii. 576.
Mesembryanthemum, i. 430.
Mesogyne, i. 202.
Mesomelaena, ii. 707.
Mesquit tree, i. 155.
Meta-Aletris, ii. 596.
Metanarthecium, ii. 596.
Metastelma, i. 383.
Metrosideros, i. 303.
Metroxylon, ii. 667.
— sagu, ii. 666.
Mexican fibre, ii. 662.
Mezereon bark, i. 216.
Meziothamnus, ii. 579.
Mezobromelia, ii. 580.
Mezoneurum, i. 153.
Michauxia, i. 477.
Michelia, i. 125.
Miconia, i. 309.
Micranthus, ii. 651.
Microcasia, ii. 633.
Microchloa, ii. 723.
Microculcas, ii. 635.
Microdon, i. 505.
Microdracoides, ii. 709.
Microkentia, ii. 669.
Microlaena, ii. 730.
Microlicia, i. 309.
Micromeria, i. 506.
Microschoenus, ii. 707.
Microsemma, i. 214.
Microstegium, ii. 740.
— hendersonii (Fig. 448), ii. 739.
Microsperis, i. 501.
Microtea, i. 438.
Microtropis, i. 320.
Miersia, ii. 643.
Miersiella, ii. 687.
Mignonette, i. 427.
Mih-Mun-Tung, ii. 592.
Mikania, i. 482.
Milium, ii. 729.
Milla, ii. 642.
Millet, ii. 738.
Millettia, i. 155.
Milligania, ii. 604.
Milliganieae, ii. 604.
Milnea, i. 356.
Milo, ii. 741.
Milula, ii. 611.
Miluleae, ii. 611.
Mimosa, i. 154.
Mimosaceae, i. 25, 154.
Mimulus, i. 489.
Mimusops, i. 350.
— globosa, i. 350.
Mint, i. 508.
Miogo, ii. 584.
Mirabilis, i. 217.
— jalapa, i. 217.
Miscanthidium, ii. 740.
Miscanthus, ii. 740.
Mischophloeus, ii. 668.
Mistletoe, i. 26, 338.
Mitolepis, i. 382.
Mitrasacme, i. 377.
Mitrasacmopsis, i. 377.
Mitreola, i. 376.
Miyoshia, ii. 546.
Mizonia, ii. 646.
Mniochloa, ii. 735.
Mniothamnus, i. 186.
Mocinna, i. 246.
Modecca, i. 241.
Molineria, ii. 678.
Mollinedia, i. 136.
Molluginaceae, i. 428.
Mollugo, i. 429.
Molopanthera, i. 386.
Momordica, i. 244.
Monandrae, ii. 694.
Monandrodendron, i. 211

Monanthes, i. 458.
Monanthium, i. 290.
Mondo, ii. 599.
Moneses, i. 290.
Monimia, i. 136.
Monimiaceae, i. **136**, (map of) 136.
Monkey Bread, i. 254.
— *Tamarind*, i. 254.
Monnina, i. 233.
Monochaetum, i. 309.
Monochoria, ii. 618.
— hastifolia (Fig. 382), ii. 617.
Monococcus, i. 438.
Monocostus, ii. 586.
MONOCOTYLEDONES, i. 22, 29.
Monodora, i. 134.
Monophyllanthe, ii. 590.
Monophrynium, ii. 590.
Monotagma, ii. 590.
Monotes, i. 286.
Monotrema, ii. 574.
Monotropa, i. 295.
Monotropaceae, i. **294.**
Monotropastrum, i. 295.
Monotropsis, i. 295.
Monsonia, i. 496.
Monstera, ii. 632.
Monstereae, ii. 632.
Montanoa, i. 482.
Montbretiopsis, ii. 652.
Montinia, i. 166.
Montiniaceae, i. 166.
Montrichardia, ii. 632.
Moraceae, i. 25, **201.**
Moraea, ii. 649.
Morea, ii. 649.
Morelodendron, i. 265.
Moreton Bay Chestnut, i. 156.
Morina, i. 474.
— longifolia (Fig. 313), i. 474.
Morinda, i. 387.
Moringa, i. 226.
— peregrina (Fig. 94), i. 226.
— pterygosperma, i. 226.
Moringaceae, i. **225.**
Morus, i. 202.
— alba, i. 202, (Fig. 70) 201.
— nigra, i. 202.
Moschosma, i. 506.
Mosdenia, ii. 729.
Mostuea, i. 373.
Mourira, i. 309.
Mowa tree, i. 350.
Mucherus gum, i. 254.
Muehlenbeckia, i. 432.
Muehlenbergia, ii. 726.
Muellerothamnus, i. 139.
Muilla, ii. 642.
Mulberry, i. 202.
Mulfordia, ii. 586.
Muraltia, i. 233.
Mura Piranga wood, i. 274.
Muricauda, ii. 635.
Musa, i. 31; ii. 582.
— cavendishii, ii. 582.
— paradisiaca, ii. 582.
Musa paradisiaca, var. sapientum, ii. 582.
— textilis, i. 31; ii. 582.
Musaceae, i. 31; ii. **581.**
Musanga, i. 202.
Muscari, ii. 611.
Muscarimia, ii. 611.
Muscatels, i. 344.
Musidendron, ii. 582.
Mussaenda, i. 387.
— erythrophylla (Fig. 237), i. 386.
Mustard, i. 426.
Mutisia, i. 482.
Myoporaceae, i. **503**, (map of) 504.
Myoporum, i. 504.
— viscosum (Fig. 339), i. 505.
Myosotis, i. 503.
Myostoma, ii. 689.
Myosurus, i. 403.
Myrcia, i. 303.
Myrialepsis, ii. 667.
Myrianthus, i. 202.
Myrica, i. 189.
— gale, i. 189.
— quercifolia (Fig. 59), i. 189.
Myricaceae, i. **189.**
MYRICALES, i. 189.
Myricaria, i. 229.
Myriophyllum, i. 449.
Myriopteron, i. 382.
Myristica, i. 142.
— fragrans, i. 25, 143, (Fig. 18) 143.
Myristicaceae, i. 25, **142.**
Myrobalans, i. 307.
Myrosma, ii. 590.
Myrothamnaceae, i. **181.**
Myrothamnus, i. 182.
— flabellifolius (Fig. 51), i. 182.
Myroxylon balsamum, i. 156.
Myrrh, i. 356.
Myrsinaceae, i. 26, **345.**
MYRSINALES, i. 345.
Myrsine, i. 346.
Myrtaceae, i. 26, **302**, 304.
MYRTALES, i. 302.
Myrtle, i. 26.
Myrtus, i. 26, 303.
— bullata (Fig. 162), i. 303.
Mystropetalon thomii (Fig. 198), i. 340.
Myzodendraceae, i. **339.**
Myzodendron, i. 340.
— punctulatum (Fig. 197), i. 340.

Naiadaceae, ii. 561.
Najas, ii. 561.
Najadaceae, ii. **561.**
NAJADALES, ii. 558.
Najas, ii. 561.
— marina (Fig. 356), ii. 560.
Nandina, i. 411.
— domestica (Fig. 257), i. 411.
Nandinaceae, i. **411.**
Nan-Mu wood, i. 140.
Nannorhops, ii. 667.
Nanochilus, ii. 587.
Nanolirion, ii. 598.
Napoleona, i. 304.

Napoleona vogelii (Fig. 163), i. 304.
Naras, i. 244.
Naravelia, i. 403.
Narcisseae, ii. 646.
Narcissus, ii. 646.
Nardeae, ii. 724.
Nardostachys, i. 473.
— jatamansi, i. 473.
Nardus, ii. 725.
— stricta (Fig. 431), ii. 724.
Narthecieae, ii. 595.
Narthecium, ii. 596.
Nassella, ii. 729.
Nasturtium, i. 426.
— microphyllum, i. 426.
— officinale, i. 28, 426.
Nastus, ii. 715.
Nauclea, i. 386.
Navarretia, i. 501.
Navel-wort, i. 28.
Navia, ii. 579.
Navieae, ii. 579.
Nazieae, ii. 729.
Nebelia, i. 186.
Nebrownia, ii. 632.
Nechamandra, ii. 541.
Neckia, i. 283.
Nectandra, i. 140.
— rodiaei, i. 140.
Nectaropetalum, i. 265.
Neea, i. 217.
Neem, i. 358.
Neesenbeckia, ii. 707.
Negundo, i. 365.
Nelmesia, ii. 708.
Nelumbium, i. 404.
Nelumbo, i. 404.
— lutea (Fig. 250), i. 404.
— nucifera, i. 403.
Nemastylis, ii. 649.
Nemesia, i. 489.
Nemopanthus, i. 312.
Nemophila, i. 501.
Nenga, ii. 668.
Nengella, ii. 668.
Neobakeria, ii. 611.
Neodeutzia, i. 160.
Neodonnellia, ii. 565.
Neodregea, ii. 609.
Neodypsis, ii. 669.
Neoglaziovia, ii. 581.
Neoleptopyrum, i. 402.
Neolophocarphus, ii. 707.
Neolourya, ii. 604.
Neomandonia, ii. 565.
Neomarica, ii. 649.
Neonicholsonia, ii. 669.
Neopatersonia, ii. 611.
Neophloga, ii. 669.
Neopringlea, i. 207.
Neoregelia, ii. 580.
Neotreleasia, ii. 565.
Neoveitchia, ii. 668.
Neovriesia, ii. 580.
Neowashingtonia, ii. 667.
Nepenthaceae, i. 27, **417.**
Nepenthes, i. 27, 418, (map of) 417.
— rafflesiana (Fig. 263), i. 418.
Nepeta, i. 506.
Nephelium, i. 361.
Nephrocarpus, ii. 670.
Nephrophyllum, i. 451.
Nephrosperma, ii. 669.
Nephythytis, ii. 632.
Nerine, ii. 643.
Nerium, i. 381.
Nertera, i. 387.
Nesaea, i. 446.
— erecta (Fig. 288), i. 445.
Neurada, i. 150.
Neurophyllodes, i. 496.
Neuwiedia, ii. 680.
— lindleyi, (Fig. 408), ii. 681.
Newberrya, i. 295.
Newbouldia, i. 389.
Newcastlia, i. 397.
— spodotricha (Fig. 245), i. 397.
New Zealand Flax, ii. 662.
— — *hemp*, i. 32; ii. 662.
Nicodemia, i. 375.
Nicotiana, i. 484.
— fragrans (Fig. 321), i. 485.
— tabacum, i. 29, 484.
Nidularium, ii. 580.
Niederleinia, i. 228.
Nietneria, ii. 596.
Nigella, i. 402.
Nipa, ii. 670.
— fruticans, ii. 666.
Nipa Palm, ii. 666.
Nitraria, i. 270.
Nolana, i. 487.
— paradoxa (Fig. 323), i. 487.
Nolanaceae, i. 29, **486.**
Nolina, ii. 665.
Nolineae, ii. 664.
Nomocharis, ii. 609.
Nonnea, i. 503.
Nopalea, i. 247.
Norantea, i. 278.
Norrisia, i. 376.
Notelaea, i. 379.
— ligustrina, i. 379.
Nothobuxus, i. 184.
Nothofagus, i. 192.
Notholirion, ii. 609.
Nothoscordum, ii. 642.
Notosceptrum, ii. 601.
Nouhuysia, i. 139.
Nuphar, i. 403.
Nutmeg, i. 25, 143.
Nuttallia, i. 150.
Nuxia, i. 374.
Nux vomica, i. 27, 377.
Nyctaginaceae, i. **216.**
Nyctaginia, i. 217.
Nymphaea, i. 403.
Nymphaeaceae, i. 27, **403.**
Nymphoides, i. 453.
Nyssa, i. 177.
— capitata, i. 176.
Nyssaceae, i. **174**, (map of) 177.

Oak, i. 192.
Oakesiella, ii. 606.
Oats, i. 34; ii. 726.
Oceanopapaver, i. 225.
Oceanoros, ii. 608.
Ochagavia, ii. 581.
Ochlandra, ii. 715.
Ochna, i. 283.
— andravinensis (Fig. 145), i. 282.
Ochnaceae, i. 278, **282.**
OCHNALES, i. 281.
Ochrocodon, ii. 609.
Ochthocosmus, i. 257.
Ocimum, i. 506.
Ocotea, i. 140.
Octoknema, i. 332.
— gabonensis (Fig. 190), i. 331.
Octoknemaceae, i. **331.**
Octolepis, i. 214.
Octomeles, i. 245.
Odina, i. 363.
Odontostomum, ii. 615.
Odontychium, ii. 586.
Oenanthe, i. 472.
Oenocarpus, ii. 669.
Oenostachys, ii. 652.
Oenothera, i. 446, 447.
Oenotheraceae, i. 446.
Oftia, i. 505.
Ogeechee Lime fruits, i. 176.
Oil-cake, i. 255, 261.
Oil of Sesamum, i. 391.
— *palm*, i. 32; ii. 666.
Okoubaka, i. 332.
Olacaceae, i. 317, **329.**
OLACALES, i. 329.
Olax, i. 330.
Old Man's Beard, ii. 577.
Oldenlandia, i. 386.
Olea, i. 379.
— europaea, i. 27, 379.
— laurifolia, i. 379.
Oleaceae, i. 27, **378.**
Olearia, i. 482.
Oligobotrya, ii. 605.
Oligolobos, ii. 541.
Oligomeris, i. 427.
Olinia, i. 164.
— acuminata (Fig. 35), i. 164.
Oliniaceae, i. **163.**
Olive, i. 27.
— *oil*, i. 379.
— *tree*, i. 379.
Olyra, ii. 735.
— latifolia (Fig. 443), ii. 735.
Olyreae, ii. 734.
Omphalodes, i. 503.
Omphalogonus, i. 382.
Onagraceae, i. 28, **446.**
Oncidium, ii. 695.
Oncoba, i. 207.
Oncocalamus, ii. 667.
Oncosperma, ii. 669.
Oncotheca, i. 312, 350.
Ongokea, i. 333.
— kamerunensis (Fig. 191), i. 333.
Onion, ii. 639.
Onobrychis, i. 155.
Ononis, i. 155.
Onosma, i. 503.
Onychosepalum, ii. 703.
Ophiobostryx, ii. 612.
Ophiocaryon, i. 363.
Ophiomeris, ii. 689.
Ophiopogon, ii. 599.
Ophiopogon japonicus, ii. 592.
Ophiopogoneae, ii. 599.
Ophiorrhiza, i. 387.
Ophiurus, ii. 740.
Opilia, i. 331.
Opiliaceae, i. **330.**
Opium poppy, i. 28, 423.
Oplismenus, ii. 737.
Opsiandra, ii. 669.
Opuntia, i. 247.
— vulgaris (Fig. 113), i. 247.
Orange, i. 26, 354.
Orania, ii. 670.
Orbignya, ii. 670.
Orchidaceae, i. 33; ii. **691.**
ORCHIDALES, ii. 691.
Orchidantha, ii. 584.
— longiflora (Fig. 366), ii. 583.
Orchis, ii. 694.
Oreithales, i. 403.
Oreobambos, ii. 715.
Oreobolus, i. 33; ii. 706.
— pectinatus (Fig. 420), ii. 704.
Oreodoxa, ii. 669.
Oreograstis, ii. 707.
Oreolirion, ii. 649.
Oreomunnea, i. 196.
Oreopanax, i. 178.
Oreostylidium, i. 480.
Oriental Plane, i. 183.
Origanum, i. 506.
— marjorana, i. 29, 508.
Ornithogalum, ii. 611.
Ornithoglossum, ii. 612.
Orobanchaceae, i. **492.**
Orobanche, i. 492.
Orontieae, ii. 630.
Orontium, ii. 630.
Orris root, i. 32; ii. 647.
Orthoclada, ii. 717.
Orthophytum, ii. 580.
Orthopterygium, i. 369.
Orthosanthus, ii. 649.
Orthothylax, ii. 685.
Oryza, i. 34; ii. 731.
— australiensis (Fig. 439), ii. 731.
— sativa, ii. 731.
Oryzeae, ii. 730.
Oryzopsis, ii. 729.
Osage orange, i. 202.
Osbeckia, i. 309.
Osiers, i. 87.
Osmanthus, i. 379.
Ossaea, i. 309.
Ostenia, ii. 538.
Ostrya, i. 194.
Ostryopsis, i. 194.

Osyris, i. 339.
Othonna, i. 482.
Ottelia, ii. 541.
— cordata (Fig. 344), ii. 539.
Ottelieae, ii. 541.
Oubanguia, i. 249.
— laurifolia (Fig. 115), i. 250.
Ouratea, i. 283.
Oxalidaceae, i. 29, **497**.
Oxalis, i. 497.
— crenata, i. 497.
Oxyanthus, i. 387.
Oxybaphus, i. 217.
Oxychloe, ii. 697.
Oxycoccus, i. 296.
— palustris, i. 26, 296.
Oxygonum, i. 432.
Oxygraphis, i. 403.
Oxygyne, ii. 689.
Oxylobium, i. 155.
Oxymeris, i. 309.
Oxypetalum, i. 383.
Oxyspora, i. 309.
Oxytenanthera, ii. 715.
Oxytropis, i. 155.

Pachira, i. 254.
Pachycarpus lineolatus (Fig. 235), i. 383.
Pachylarnax, i. 124.
Pachysandra, i. 184.
Paddle-wood, i. 381.
Paeonia, i. 27, 400.
— peregrina (Fig. 247), i. 400.
Paeoniaceae, i. 27, **400**.
Paepalanthus, ii. 576.
— klotzschianus (Fig. 364), ii. 575.
Paiche wood, i. 320.
Palandra, ii. 670.
Palaquium gutta, i. 26, 350.
Palicourea, i. 387.
Palisota, ii. 565.
Paliurus, i. 343.
Palmae, i. 32; ii. **665**.
PALMALES, ii. 665.
Palmarosa, ii. 741.
Palmite, ii. 697.
Palmyra, ii. 666.
Pamianthe, ii. 645.
Pampas grass, ii. 721.
Pamphilia, i. 70.
Panama hats, ii. 674.
Panax, i. 178.
— schinseng, i. 178.
Pancheria, i. 158.
Pancratium, ii. 645.
Panda, i. 311.
— oleosa (Fig. 169), i. 311.
Pandaceae, i. **311**.
Pandanaceae, i. 32; ii. **670**.
PANDANALES, ii. 670.
Pandanus, ii. 672.
— tectorius, ii. 672.
Panicoideae, ii. 714.
Panicum, ii. 737.
Panicum miliaceum, ii. **738**.
Panopsis, i. **218**.
Papaver, i. **423**.
— **rhoeas**, i. 28, (Fig. 267) **423**.
— **somniferum**, i. 28, **423**.
Papaveraceae, i. 27, **422**.
Papaw, i. 246.
Paper Mulberry, i. 202.
Paphiopedilum charlesworthii (Fig. 414), i 692.
Papilionaceae, i. 25, **155**.
Pappophoreae, ii. **720**.
Pappophorum, ii. 720.
Papyrus, i. 33; ii. 706.
Para rubber, i. 26.
Paradisia, ii. 598, 599.
Paraguay tea, i. 312.
Parajubaea, ii. 670.
Parampania, ii. 709.
Paraquilegia, i. 402.
Pararistolochia, i. 415.
Parastyrax, i. 170.
Parexuris, ii. 547.
Pariana, ii. 733.
— campestris (Fig. 441), ii. 733.
Parianeae, ii. 733.
Parideae, ii. 616.
Parietaria, i. 203.
Parinari, i. 150.
Paris, ii. 616.
— polyphylla (Fig. 381), ii. 615.
Parkia, i. 154.
Parkinsonia, i. 153.
Parnassia, i. 466.
— palustris (Fig. 305), i. 465.
Parnassiaceae, i. **465**.
Parochetus, i. 155.
Paronychia, i. 432.
— argentea, i. 433.
— capitata, i. 433.
Paropsia, i. 241.
Paropyrum, i. 402.
Paroxygraphis, i. 403.
Parrotia, i. 180.
Parsley, i. 28.
Parsnip, i. 28, 472.
Parsonsia, i. 381.
Parthenocissus, i. 344.
— tricuspidata, i. 26, 344.
Parvatia, i. 410.
Pasithea, ii. 596.
Paspalum, ii. 737.
Passerina, i. 216.
Passiflora, i. 241.
— laurifolia, i. 241.
— macrocarpa, i. 241.
— maliformis, i. 241.
— quadrangularis, i. 241.
Passifloraceae, i. 25, **240**, 241, **246**.
PASSIFLORALES, i. 239.
Patagonula, i. 394.
Patchouli, i. 29, 508.
Patersonia, ii. 651.
Patosia, ii. 697.
Patrinia, i. 473.
Paullinia, i. 361.

Paullinia cupana, i. 26.
Paulownia, i. 489.
Paurida, ii. 678.
Paurotis, ii. 667.
Pavetta, i. 387.
Pavonia, i. 255.
Pea, i. 156.
Peach, i. 150.
— *Palm*, ii. 666.
Pear, i. 150.
Pearl Millet, ii. 738.
Peccan nut. i. 196.
Pectinella, ii. 559.
Pedicularis, i. 489.
Pedaliaceae, i. 389.
Pedalium, i. 391.
Peganum, i. 270.
Peglera, i. 265.
Pelagodoxa, ii. 667.
Pelargonium, i. 496.
Peliosantheae, ii. 604.
Peliosanthes, ii. 604.
Pelliciera, i. 276.
— rhizophorae (Fig. 138), i. 276.
Pellicieraceae, i. 275.
Peltandra, ii. 633.
Peltanthera, i. 376.
Peltophorum, i. 153.
— vogelianum (Fig. 27), i. 153.
Penaeaceae, i. 214.
Penaea myrtifolia (Fig. 84), i. 215.
Pennantia, i. 317.
Pennisetum, ii. 737.
— spicatum (Fig. 446), ii. 738.
Penstemon, i. 489.
Pentaclethra, i. 154.
Pentadesma, i. 299.
— butyracea, i. 299, (Fig. 159) 299.
Pentadiplandra, i. 320.
— brazzeana (Fig. 179), i. 320.
Pentadiplandraceae, i. 319.
Pentamenes, ii. 652.
Pentanura, i. 381.
Pentapetiopsis, i. 382.
Pentaphragma, i. 476.
Pentaphragmataceae, i. 477.
Pentaphylacaceae, i. 276.
Pentaphylax, i. 277.
— euryoides (Fig. 139), i. 277.
Pentapterygium, i. 296.
Pentarhaphia, i. 491.
Pentas, i. 386.
Pentaschistis, ii. 726.
— aristidoides (Fig. 433), ii. 727.
Pentasticha, ii. 708.
Pentopetia, i. 382.
Peperomia, i. 420.
Peplis, i. 446.
Peponia, i. 244.
Pepper, i. 27, 420.
Peppermint, i. 29, 508.
Pera, i. 270.
Perebea, i. 202.
Pereskia, i. 247.
Pergularia, i. 383.
Peridiscaceae, i. 252.
Peridiscus, i. 253.
— lucidus (Fig. 118), i. 252.
Periploca, i. 382.
— graeca (Fig. 234), i. 382.
Periplocaceae, i. 381.
Peripterygiaceae, i. 314.
Peripterygium, i. 316.
— quinquelobum (Fig. 174), i. 315.
Pernettya, i. 290, (map of) 291.
Perotis, ii. 729.
Persea, i. 140.
— americana, i. 23, (Fig. 15) 139.
— gratissima, i. 140.
— nanmu, i. 140.
Persian Lilac, i. 358.
Persimmon, i. 350.
PERSONALES, i. 487.
Persoonia, i. 218.
Petalonema, i. 500.
Petalonyx, i. 239.
Petermannia, ii. 625.
— cirrhosa (Fig. 386), ii. 624.
Petermanniaceae, ii. 623.
Petersia, i. 304.
Petitia domingensis, i. 395.
Petiveria, i. 438.
— alliacea (Fig. 282), i. 439.
Petiveriaceae, i. 438.
Petraea, i. 395.
Petrosavia, ii. 546.
— stellaris (Fig. 347), ii. 546.
Petrosaviaceae, ii. 546.
Petroselinum crispum, i. 28.
Petunia, i. 484.
Peucedanum, i. 472.
— graveolens, i. 28, 472.
— sativum, i. 28, 472.
Peumus boldus, i. 137.
Pfaffia, i. 441.
Phacelia, i. 501.
Phacellanthus, ii. 707.
Phacelophrynium, ii. 590.
Phaedrananassa, ii. 646.
Phaeneilema, ii. 565.
Phaeocephalum, ii. 706, 707.
Phaeomeria, ii. 587.
Phalarideae, ii. 730.
Phalaris, ii. 730.
— brachystachys (Fig. 438), ii. 730.
— canariensis, i. 34; ii. 730.
Phaleria, i. 216.
Phareae, ii. 734.
Pharnaceum, i. 429.
Pharus, ii. 734.
— glaber (Fig. 442), ii. 734.
Phaulothamnus, i. 211.
Phebalium, i. 354.
Phelipaea, i. 492.
Phelline, i. 312.
Phelpsiella, ii. 574.
Phenakospermum, ii. 582.
Philadelphaceae, i. 25, 159.
Philadelphus, i. 159.
Philbornea, i. 261.
Philesia, ii. 627.
Philesiaceae, ii. 625.

Philibertia, i. 383.
Philippia, i. 290.
Phillyrea, i. 379.
Philodendreae, ii. 634.
Philodendron, ii. 634.
Philodice, ii. 576.
Philonotion, ii. 632.
Philotria, ii. 541.
Philydraceae, ii. **683.**
Philydrella, ii. 685.
Philydrum, ii. 685.
— lanuginosum (Fig. 410), ii. 684.
Phlebocarya, ii. 676.
Phleum, ii. 776.
Phloga, ii. 669.
Phlogella, ii. 669.
Phlomis, i. 508.
Phlox, i. 500.
Phoeniceae, ii. 670.
Phoenix, ii. 670.
— dactylifera, i. 32; ii. 666.
Pholida, i. 505.
Pholidocarpus, ii. 667.
Pholisma, i. 296.
— arenarium (Fig. 156), i. 295.
Pholiurus, ii. 725.
Phoradendron, i. 338.
Phormieae, ii. 664.
Phormium, ii. 664.
— tenax, i. 32; ii. 662.
Phoxanthus, i. 363.
Phragmites, ii. 721.
— communis (Fig. 427), ii. 721.
Phryma, i. 399, (map of) 398.
— leptostachya (Fig. 246), i. 399.
Phrymaceae, i. **398.**
Phrynieae, ii. 590.
Phrynium, ii. 590.
Phuodendron, i. 474.
Phycoschoenus, ii. 559.
Phylica, i. 343.
Phyllachne, i. 481.
Phyllactis, i. 473.
Phyllanthera, i. 381.
Phyllanthus, i. 270.
Phyllis, i. 387.
Phyllocomos, ii. 703.
Phyllocosmus, i. 257.
Phyllonoma, i. 166.
Phylloscirpus, ii. 707.
Phyllospadix, ii. 556.
— scouleri (Fig. 353), ii. 555.
Phyllostachys, ii. 715.
Phyllostylon, i. 199.
Phytelephantineae, ii. 670.
Phytelephas, ii. 670.
— macrocarpa, ii. 666.
Phyteuma, i. 476.
Phytocrene, i. 317.
Phytolacca, i. 436.
— americana (Fig. 279), i. 435.
Phytolaccaceae, i. 223, **435.**
Physalis, i. 484.
Physokentia, ii. 669.
Physopsis, i. 397.
Physostigma venenosum, i. 156.
Piassava fibre, ii. 666.
Picrasma, i. 355.
— excelsa, i. 355.
Picrodendraceae, i. **196.**
Picrodendron, i. 197.
—baccatum (Fig. 66), i. 197.
Pieris, i. 290.
Pigafetta, ii. 667.
Pilea, i. 203.
— microphylla (Fig. 71), i. 202.
Pileostegia, i. 162.
Pillansia, ii. 651.
Pilocarpus jaborandi, i. 354.
Pilostyles, i. 416.
Pimelea, i. 216.
Pimenta, i. 303.
Pimenta officinalis, i. 303.
Pimpernel, i. 28.
Pimpinella, i. 472.
— anisum, i. 472.
Pina cloth, ii. 577.
Pinacopodium, i. 265.
Pinanga, ii. 668.
Pindarea, ii. 670.
Pine-apple, i. 31; ii. 577.
Pinellia, ii. 635.
Piney Resin, i. 286.
Pinguicula, i. 493.
— vulgaris (Fig. 328), i. 493.
Pinks, i. 430.
Pinnay, i. 300.
Piper, i. 420.
— cubeba, i. 420.
— nigrum, i. 27, 420, (Fig. 264) 419.
Piperaceae, i. **419.**
PIPERALES, i. 27.
Pipewort, i. 30.
Piptadenia, i. 154.
Piptocalyx, i. 139.
Piptochaetium, ii. 729.
Piptospatha, ii. 633.
Pipturus, i. 203.
Piriqueta, i. 237.
Pironneauella, ii. 580.
Pironneava, ii. 580.
Pisonia, i. 217.
Pistachio nut, i. 26, 363.
Pistacia, i. 363.
— lentiscus, i. 363.
— terebinthus, i. 363.
— vera, i. 26, 363.
Pistia, ii. 634.
— stratiotes, i. 32.
Pistieae, ii. 634.
Pisum sativum, i. 25, 156, (Fig. 29) 155.
Pita fibre, i. 13; ii. 577.
Pitcairnia, ii. 579.
— feliciana, i. 31; ii. 577.
Pitcairnieae, ii. 579.
Pitcher plants, i. 27, 28, 418.
Pithecellobium, i. 154.
— saman, i. 155.
— spruceanum (Fig. 28), i. 154.
Pithecoctenium, i. 389.
Pittosporaceae, i. **219.**
PITTOSPORALES, i. 219.

Pittosporum, i. 220.
— viridiflorum (Fig. 88), i. 220.
Pityopus, i. 295.
Pityrodia, i. 398.
Piuttia, i. 403.
Placea, ii. 646.
Placseptalia, ii. 581.
Plagianthus, i. 255.
Plagiolirion, ii. 646.
Plagiorhegma, i. 405.
Plagiostachys, ii. 587.
Planchonia, i. 304.
Planera, i. 199.
Plantaginaceae, i. 28, 455.
PLANTAGINALES, i. 455.
Plantago, i. 455.
— lagopus (Fig. 297), i. 456.
— ovata, i. 455.
— psyllium, i. 455.
Plantain, i. 31; ii. 582.
Platanaceae, i. 182.
Platanus acerifolia, i. 183.
— occidentalis, i. 183.
— orientalis, i. 183, (Fig. 52) 182.
Platycarya, i. 196.
Platycodon, i. 476.
Platycrater, i. 160.
Platystemon, i. 423.
Platytheca, i. 224.
— verticillata (Fig. 92), i. 224.
Plectis, ii. 669.
Plectocomia, ii. 667.
Plectocomiopsis, ii. 667.
Plectranthus, i. 506.
Plectritis, i. 474.
Plectronia, i. 387.
Pleea, ii. 596.
Pleiostachya, ii. 590.
Pleodendron, i. 129.
Pleroma, i. 309.
Plesmonium, ii. 633.
Pleuricospora, i. 295.
Pleurospermum, i. 472.
Pleurostelma, i. 382.
Plocama, i. 387.
Plocosperma, i. 379.
— buxifolium (Fig. 232), i. 380.
Plocospermaceae, i. 379.
Ploiarium, i. 272.
Plum, i. 150.
Plumbaginaceae, i. 453.
Plumbago, i. 455.
Plumeria, i. 381.
Poa, ii. 717.
Podalyria, i. 155.
Podoaceae, i. 361.
Podococcus, ii. 669.
Podolasia, ii. 632.
Podoon, i. 361.
Podophyllaceae, i. 404.
Podophyllum, i. 404.
— hexandrum (Fig. 251), i. 405.
— peltatum, i. 404.
Podophyllum Roots, i. 404.
Podostemaceae, i. 470.
PODOSTEMALES, i. 468.
Podostemum, i. 470.
Poellnitzia, ii. 602.
Poga, i. 305.
— oleosa Pierre, i. 305.
Poga nuts, i. 305.
Pogonatherum, ii. 740.
Pogostemon, i. 506.
— heyneanus, i. 29, 508.
Poinciana, i. 153.
Poison Ivy, i. 363.
Polanisia, i. 225.
Polemoniaceae, i. 500.
Polemoniella, i. 501.
Polemonium, i. 501.
— caeruleum (Fig. 335), i. 500.
Polianthes, ii. 665.
Pollia, ii. 565.
— crispata (Fig. 358), ii. 564.
Polyandrococos, ii. 670.
Polyantheae, ii. 665.
Polycarpaea, i. 430.
Polychondreae, ii. 695.
Polygala, i. 233.
— eriocarpa (Fig. 100), i. 232.
— senega, i. 233.
Polygalaceae, i. 25, 232.
POLYGALALES, i. 231.
Polygonaceae, i. 28, 431.
POLYGONALES, i. 431.
Polygonanthus, i. 165.
Polygonatae, ii. 604.
Polygonatum, ii. 605.
— multiflorum, i. 31.
Polygonum, i. 432.
Polyosma, i. 166.
Polypogon, ii. 726.
Polypompholyx, i. 493.
Polypremum, i. 373.
Polyscias, i. 178.
Polyspatha, ii. 565.
Polytoca, ii. 742.
Polyxena, ii. 611.
Pomaderris, i. 343.
Pomegranate, i. 307.
Pomme d'Or, i. 241.
Pommereschea, ii. 586.
Ponapea, ii. 668.
Pontederia, ii. 618.
Pontederiaceae, ii. 616.
Pooideae, ii. 711.
Popli-chekké root bark, i. 343.
Poppy, i. 28.
Populus, i. 188.
— tacamahacca, i. 187.
Porphyrospatha, ii. 634.
Portea, ii. 580.
Portulaca, i. 431.
— grandiflora (Fig. 275), i. 431.
Portulacaceae, i. 430.
Portulacaria, i. 431.
Posidonia, ii. 552.
— oceania (Fig. 351), ii. 551.
Posidoniaceae, i. 30; ii. 552.
Poskea, i. 394.
Posoqueria, i. 387.
Potalia, i. 371.

Potaliaceae, i. **371.**
Potamogeton, ii. 558.
— cheesemanii (Fig. 354), ii. 557.
Potamogetonaceae, i. 30; ii. **556.**
POTAMOGETONALES, ii. 556.
Potarophytum, ii. 574.
Potato, i. 28, 484.
Potentilla, i. 150.
Poterium, i. 150.
Pothoeae, ii. 632.
Pothoidium, ii. 632.
Pothos, ii. 632.
Pourouma, i. 202.
Pouzolzia, i. 203.
Praravinia, i. 386.
Pratia, i. 478.
— physaloides (Fig. 316), i. 477.
Premna, i. 395.
Prestoea, ii. 669.
Prestonia, i. 381.
Preterothamnus, i. 391.
Pretrea, i. 391.
Principina, ii. 709.
Primrose, i. 28.
Primula, i. 453.
— calciphila (Fig. 295), i. 454.
— vulgaris, i. 28.
Primulaceae, i. 28, **453.**
PRIMULALES, i. 453.
Prionium, ii. 699.
— palmita, ii. 697.
— serratum, i. 33.
Prionophyllum, ii. 579.
Prismatocarpus, i. 476.
Pritchardia, ii. 667.
Pritchardiopsis, ii. 667.
Pritzelia, ii. 685.
Privet, i. 379.
Proboscidea, i. 392.
— fragrans (Fig. 241), i. 392.
Prochnyanthes, ii. 665.
Prockia, i. 250.
Procris, i. 203.
Pronaya, i. 220.
Proso Millet, ii. 738.
Prosopanche, i. 415.
Prosopis, i. 154.
— juliflora, i. 155.
Prostanthera, i. 508.
Protamomum, ii. 584.
Protarum, ii. 635.
Protea, i. 218.
— latifolia (Fig. 87), i. 218.
— mellifera, i. 219.
Proteaceae, i. 25, **217**, (map of) 219.
PROTEALES, i. 217.
Protium carana, i. 356.
Protolirion, ii. 546.
Prunella, i. 506.
Prunes, i. 150.
Prunus, i. 150.
— amygdalus, var. amara, i. 150.
— —, var. dulcis, i. 150.
— armeniaca, i. 150.
— domestica, i. 150.
— —, var. juliana, i. 150.
Prunus persica, i. 150.
Psammisia, i. 296.
Pseudalepyrum, ii. 700.
Pseudalthenia, ii. 559.
Pseudananas, ii. 581.
Pseudobaeckia, i. 186.
Pseudobravoa, ii. 665.
Pseudobrazzeia, i. 250.
Pseudocedrela kotschyi (Fig. 213), i. 358.
Pseudodracontium, ii. 634.
Pseudogaltonia, ii. 611.
Pseudogardneria, i. 378.
Pseudohydrosme, ii. 633.
Pseudomarsdenia, i. 384.
Pseudophoenix, ii. 669.
Pseudosmilax, ii. 618.
Pseudostachyum, ii. 715.
Pseudostenomesson, ii. 645.
Pseudostreblus, i. 202.
Pseudotrimezia, ii. 649.
Pseudowintera, i. 128.
Psidium, i. 303.
— guajava, i. 26, 303.
Psilocarya, ii. 708.
Psilurus, ii. 725.
Psoralea, i. 155.
Psorospermum, i. 297.
Psychotria, i. 387.
— ipecacuanha, i. 27.
Psyllium seeds, i. 455.
Pteleocarpa, i. 394.
Pteleopsis, i. 307.
Pterisanthes, i. 344.
Pterocarpus marsupium, i. 156.
Pterocarya, i. 196.
Pterocephalus, i. 475.
Pterodiscus, i. 391.
Pterolepis, i. 309.
Pterolobium, i. 153.
Pteronia, i. 482.
Pteroscleria, ii. 709.
Ptersopermum, i. 252.
Pterospora, i. 295.
Pterostemon, i. 158.
— mexicanus (Fig. 30), i. 157.
Pterostemonaceae, i. **157.**
Pterostyrax, i. 170.
Ptilotus, i. 441.
Ptychandra, ii. 669.
Ptychococcus, ii. 668.
Ptychoraphis, ii. 668.
Ptychosperma, ii. 668.
Puccoon, i. 423.
Puellia, ii. 715.
Pulicaria, i. 482.
Pulmonaria, i. 503.
Pultenaea, i. 155.
Punica granatum, i. 307, (Fig. 166) 307.
Punicaceae, i. **306.**
Pupalia, i. 440.
Pupunha Palm, ii. 666.
Purdiaea, i. 316.
Purple Heart wood, i. 154.
Puschkinia, ii. 611.
Puya, ii. 579.
Pycnanthus, i. 142.

Pycnocomon, i. 475.
Pycnospatha, ii. 632.
Pycreus, ii. 708.
Pygeum, i. 150.
Pyrola, i. 290.
— rotundifolia (Fig. 151), i. 290.
Pyrolaceae, i. **289**, 294.
Pyrrheimia, ii. 563.
Pyrus, i. 150.
— communis, i. 150.
Pythonieae, ii. 634.
Pyxidanthera, i. 294.

Qualea, i. 236.
Quassia, i. 355.
— amara, i. 355, (Fig. 210) 354.
Quassia wood, i. 355.
Quebrachia lorentzii, i. 364.
Quebracho Colorado wood, i. 364.
Queenslandiella, ii. 708.
Quele, i. 141.
Quercus, i. 192, 193.
Quesnelia, ii. 580.
Quiina, i. 302.
— longifolia (Fig. 161), i. 301.
Quiinaceae, i. **301**.
Quinine, i. 27, 387.
Quisqualis, i. 307.

Racemaria, ii. 605.
Raddia, ii. 735.
Radinosiphon, ii. 651.
Radiola, i. 261.
Radish, i. 28, 426.
Raffia, ii. 666.
Rafflesia, i. 416.
— arnoldii, i. 416.
— patma (Fig. 262), i. 417.
Rafflesiaceae, i. 416.
Rafnia, i. 155.
Ragi, ii. 722.
Raintree, i. 155.
Raisins, i. 344.
Rajah canes, ii. 666.
Rajania, ii. 660.
Rajmahal Hemp, i. 384.
Ramie fibre, i. 203.
Ramischia, i. 290.
Ramondia, i. 491.
RANALES, i. 399.
Ranalisma, i. 30; ii. 544.
Randia, i. 387.
Ranunculaceae, i. 23, 27, **402**.
Ranunculus, i. 27, 403.
— cortusifolius (Fig. 249), i. 402.
Ranzania, i. 405.
Raoulia, i. 482.
Rapatea, ii. 574.
— paludosa (Fig. 363), ii. 573.
Rapateaceae, i. 30; ii. **572**, (map of) 572.
Raphanus, i. 426.
— sativus, i. 28, 426.
Raphia, ii. 667.
— pedunculata, ii. 666.
— vinifera, ii. 666.
Raphionacme, i. 382.
Raspalia, i. 186.
— phylicoides (Fig. 56), i. 186.
Ratibida columnifera (Fig. 320*b*), i. 483.
Ratonia, i. 361.
Rautanenia, ii. 544.
Rauwolfia, i. 381.
Ravenala, i. 31.
— madagascariensis, ii. 582.
Reaumuria, i. 229.
Red Currant, i. 162.
— *Gum*, i. 303.
Reedia, ii. 707.
Reedmace, i. 32.
Reevesia thyrsoidea (Fig. 117), i. 252.
Rehderodendron, i. 170.
Rehmannia, i. 489.
Reineckea, ii. 602.
Reinhardtia, ii. 669.
Reinwardtia, i. 261.
Remirea, ii. 707.
Remusatia, ii. 633.
Renealmia, ii. 586.
Reseda, i. 427.
— arabica (Fig. 270), i. 426.
— odorata, i. 427.
Resedaceae, i. **426**.
RESEDALES, i. 28, 426.
Resnova, ii. 609.
Restiaceae, i. 33.
Restio, ii. 703.
Restionaceae, ii. **700**.
Reussia, ii. 618.
Reya, ii. 612.
Rhabdia, i. 394.
Rhadamanthus, ii. 611.
Rhagodia, i. 440.
Rhamnaceae, i. 26, **343**.
RHAMNALES, i. 341.
Rhamnus, i. 343.
— catharticus, i. 343.
— purshiana, i. 343.
Rhamphocarya, i. 196.
Rhaphidophora, ii. 632.
Rhaphiophallus, ii. 634.
Rhapidanthe, i. 350.
Rhapidophyllum, ii. 667.
Rhapis, ii. 667.
Rhaptopetalum, i. 250.
Rhatany root, i. 234.
Rheedia, i. 299.
Rhektophyllum, ii. 634.
Rheum, i. 432.
— nobile (Fig. 276), i. 432.
— rhaponticum, i. 432.
Rhexia, i. 309.
Rhinanthus, i. 489.
Rhipogonum, ii. 618.
Rhipsalis, i. 247.
Rhizakenia, ii. 541.
Rhizophora, i. 305.
Rhizophoraceae, i. **304**.
Rhodocodon, ii. 611.
Rhododendron, i. 292.
— cinnamomum (Fig. 152), i. 291.
Rhodohypoxis, ii. 678.
Rhodolaena, i. 283.

Rhodolaena altivola (Fig. 146), i. 283.
Rhodoleia, i. 180.
Rhodospatha, ii. 632.
Rhodostachys, ii. 581.
RHOEADALES, i. 422.
Rhoeo, ii. 566.
Rhoiptelea, i. 195.
— chiliantha (Fig. 64), i. 195.
Rhoipteleaceae, i. 194.
Rhopaloblaste, ii. 668.
Rhopalocarpus, i. 285.
— alternifolius (Fig. 147), i. 284.
Rhopalopilia, i. 331.
Rhopalostylis, ii. 668.
Rhubarb, i. 28, 432.
Rhus, i. 363.
— coriaria, i. 26, 363.
— toxicodendron, i. 363.
— vernicifera, i. 363.
Rhynchanthus, ii. 587.
Rhynchelytrum, ii. 737.
Rhynchocarpa, ii. 669.
Rhyncholacis, i. 470.
Rhynchopyle, ii. 633.
Rhynchospora, ii. 706, 707.
Rhynchosporeae, ii. 706.
Rhynchotheca, i. 263.
Rhyticocos, ii. 670.
Ribes, i. 162, (map of) 163.
— rubrum, i. 162.
— sanguineum (Fig. 34), i. 163.
— uva-crispa, i. 162.
Rice, i. 34; ii. 731.
Richardia, ii. 632.
Richardieae, ii. 632.
Richea, i. 293.
Ricinus, i. 293.
— communis, i. 26, 271, (Fig. 133) 270.
Riedelia, ii. 587.
Rigidella, ii. 649.
Rindera, i. 503.
Rinorea, i. 231.
Ripogonum, ii. 618.
Rivina, i. 438.
Robinia, i. 155.
Rochea, i. 458.
Rochefortia, i. 394.
Rodwaya, ii. 689.
Roella, i. 476.
Rogeria, i. 391.
Rogersia, i. 459.
Rohan tree, i. 358.
Rohdea, ii. 604.
Rollinia, i. 134.
Romneya, i. 423.
Romulea, ii. 649, 651.
Rondeletia, i. 386.
Rondonanthus, ii. 576.
Ronnbergia, ii. 580.
Roridula, i. 222.
Roridulaceae, i. 220.
Rosa, i. 150.
— spinosissima (Fig. 24), i. 149.
Rosaceae, i. 25, 149, 301.
ROSALES, i. 148.
Roscheria, ii. 669.
Roscoea, ii. 586.
Rose Apple, i. 303.
Rosmarinus, i. 506.
— officinalis, i. 508.
Rosemary, i. 508.
Rostkovia, ii. 697.
Rotenone, i. 156.
Rottboellia, ii. 740.
Rotula, i. 394.
Roucheria, i. 261.
Roupala, i. 218.
Rourea, i. 145.
Roxburghia, ii. 658.
Roxburghiaceae, ii. 656.
Royena, i. 350.
— lucida (Fig. 206*a*), i. 349.
Roystonea, ii. 669.
Rubia, i. 387.
— tinctorum, i. 27.
Rubiaceae, i. 27, 386.
RUBIALES, i. 384.
Rubus, i. 150.
Rudbeckia, i. 482.
Rue, i. 26.
Ruellia, i. 491.
Rufacer, i. 365.
Rulingia, i. 252.
Rumex, i. 432.
Runyonia, ii. 665.
Ruppia, ii. 558.
Ruppiaceae, ii. 558.
Ruprechtia, i. 432.
Ruscaceae, ii. 619.
Rush, i. 33.
Ruta, i. 354.
Rutaceae, i. 26, 353.
RUTALES, i. 353.
Ruyschia, i. 278.
Ryania, i. 207.
Rye, ii. 720.

Sabadilla, ii. 608.
Sabal, ii. 667.
Sabbatia, i. 451.
— campestris (Fig. 293), i. 450.
Sabia, i. 363.
Sabiaceae, i. 361.
Sabicea, i. 387.
Sabicu, i. 155.
Saccarodendron, i. 365.
Saccellium, i. 394.
Saccharine sorghum, ii. 741,
Saccharum, ii. 740.
— officinarum, ii. 741.
Sacchrosphendamnus, i. 365.
Saccoglottis, i. 260.
Saffron, ii. 647.
Saffron dye, i. 32.
Sage, i. 29, 508.
Sageretia, i. 343.
Sagina, i. 430.
Sagittaria, ii. 544.
Sago Palm, ii. 666.
Salacia, i. 324.
Salep, ii. 693.
Salicaceae, i. 25, 187.

SALICALES, i. 187.
Salicornia, i. 440.
Salix, i. 188.
— alba (Fig. 57), i. 187.
— coerulea, i. 187.
Salomonia, ii. 605.
Salpiglossis, i. 484.
Salpingostylis, ii. 651.
Salsola, i. 440.
Saltera, i. 215.
Sal tree, i. 286.
Salvadora, i. 313.
— persica, i. 313, (Fig. 171) 313.
Salvadoraceae, i. 312.
Salvertia, i. 236.
Salvia, i. 506.
— officinalis, i. 29, 508.
Sambucus, i. 178.
— canadensis, i. 179.
— nigra, i. 179.
Samolus, i. 453.
Samuela, ii. 664.
Samyda, i. 207.
Samydaceae, i. 207.
Sandalwoods, i. 339.
Sandersonia, ii. 606, 608.
Sanguinaria, i. 423.
— canadensis, i. 423.
Sanicula, i. 472.
Sansevieria, ii. 664.
— zeylanica, ii. 662.
Santalaceae, i. 339.
SANTALALES, i. 337.
Santalum, i. 339.
— album, i. 339, (Fig. 196) 339.
— freycinetianum, i. 339.
— yasi, i. 339.
Santolina, i. 482.
Santonin, i. 28, 484.
Sap Green, i. 343.
Sapindaceae, i. 26, 360.
SAPINDALES, i. 358.
Sapindus, i. 361.
Sapium, i. 270.
Sapodilla, i. 26.
— *Plum*, i. 350.
Saponaria, i. 429.
Sapotaceae, i. 26, 350.
Sapria, i. 417.
Sapucaia nuts, i. 304.
Saraca, i. 154.
Saranthe, ii. 590.
Sararanga, ii. 672.
Sarcinanthus, ii. 674.
Sarcocaulon, i. 496.
Sarcococca, i. 184.
Sarcocolla, i. 215.
Sarcodes, i. 295.
Sarcolaena, i. 283.
Sarcophrynium, ii. 590.
Sarcophyte, i. 341.
Sarcosiphon, ii. 689.
Sarcosperma, i. 352.
— arboreum (Fig. 208), i. 352.
Sarcospermaceae, i. 351.
Sarcostemma, i. 384.
Sarcostigma, i. 317.
Sarcotheca, i. 267.
Sarcoyucca, ii. 664.
Sargentodoxa, i. 408.
— cuneata (Fig. 254), i. 408.
Sargentodoxaceae, i. 407.
Sarracenia, i. 28, 469.
— purpurea (Fig. 308), i. 469.
Sarraceniaceae, i. 28, 468, (map of) 468.
SARRACENIALES, i. 467.
Sarsaparilla, ii. 618.
Sarum, i. 415.
Sasa, ii. 715.
Sassafras, i. 25, 140.
— officinale, i. 140.
— variifolium, i. 25.
Sassy bark, i. 154.
Satin Walnut, i. 181.
— *wood*, i. 358.
Saul tree, i. 286.
Saurauia, i. 274.
— barbigera (Fig. 136), i. 274.
Saurauiaceae, i. 274.
Sauromatum, ii. 635.
Saururaceae, i, 420, (map of) 421.
Saururus, i. 421.
Sauvagesia, i. 283.
Sauvallea, ii. 565.
Saxifraga, i. 459.
— flagellaris (Fig. 300), i. 459.
Saxifragaceae, i. 28, 459.
SAXIFRAGALES, i. 456.
Saxofridericia, ii. 574.
Scabiosa, i. 475.
Scaevola, i. 479.
— gracilis (Fig. 317), i. 479.
— koenigii, i. 479.
Scammony, i. 29, 486.
Scandix, i. 472.
Scaphiophora, ii. 689.
Scaphispatha, ii. 634.
Scaphochlamys, ii. 586.
Scheelea, ii. 670.
Schelhammeria, ii. 606.
Scheuchzeria, ii. 546.
— palustris (Fig. 346), ii. 545.
Scheuchzeriaceae, ii. 544.
Schickendantzia, ii. 623.
Schickendantziella, ii. 623.
Schieckia, ii. 676.
Schindleria, i. 438.
Schinus, i. 363.
Schisandra, i. 130.
— glabra (Fig. 5), i. 130.
Schisandraceae, i. 129, (map of) 129.
Schismatoglottis, ii. 633.
Schismocarpus, i. 239.
Schizanthus, i. 484.
Schizobasis, ii. 612.
Schizobasopsis, ii. 612.
Schizocapsa, ii. 683.
Schizocardia, i. 289.
Schizocarphus, ii. 609.
Schizocasia, ii. 634.
Schizocodon, i. 294.
Schizoglossum, i. 383.

Schizolaena, i. 283.
Schizolaenaceae, i. 283.
Schizophragma, i. 162.
Schizostachyum, ii. 715.
Schlagintweitiella, i. 403.
Schlechterella, i. 382.
Schlumbergia, ii. 579.
Schmidelia, i. 361.
Schmidtia, ii. 720.
Schoenlandia, ii. 615.
Schoenocaulon, ii. 608.
Schoenocephalium, ii. 574.
Schoenodendron, ii. 709.
Schoenolirion, ii. 598.
Schoenoplectus, ii. 708.
Schoenoxiphium, ii. 710.
Schoenus, ii. 707.
Schoepfia, i. 330.
Scholtesia, i. 451.
Schrebera, i. 379.
Schumannianthus, ii. 590.
Schwenkia, i. 484.
Sciadophyllum, i. 178.
Sciaphila, ii. 547.
— albescens (Fig. 348), ii. 547.
Scilla, ii. 609.
Scilleae, ii. 609.
Scindapsus, ii. 632.
Scirpeae, ii. 707.
Scirpodendron, ii. 708.
Scirpus, ii. 708.
Scleranthus, i. 432.
— annuus (Fig. 277), i. 433.
Scleria, ii. 709.
Sclerieae, ii. 709.
Sclerocarya, i. 363.
Sclerosiphon, ii. 649.
Sclerosperma, ii. 669.
Sclerothrix, i. 239.
Scoliopus, ii. 616.
Scolleropsis, ii. 618.
Scolopia, i. 207.
Scoparia, i. 489.
Screw pine, i. 32.
Scrophularia, i. 489.
Scrophulariaceae, i. 29, **488.**
Scutellaria, i. 506.
Scutia, i. 343.
Scybalium, i. 341.
Scyphanthus, i. 239.
Scyphogyne, i. 292.
Scyphostegia, i. 328.
— borneensis, i. 328, (Fig. 187) 327.
Scyphostegiaceae, i. 309, 311, **326.**
Scyphostrychnos, i. 378.
Scytopetalum, i. 249.
Scytopetalaceae, i. 249.
Sea bean, i. 154.
Sebaea, i. 451.
Secale, ii. 719.
— cereale, ii. 720.
Secamone, i. 383.
Sechium, i. 244.
Securidaca, i. 233.
Sedum, i. 458.
Seguieria, i. 438.
Sehima, ii. 740.
Selaginaceae, i. 505.
Selago, i. 505.
— corymbosa (Fig. 340), i. 505.
Selinum, i. 472.
Selliera, i. 479.
— radicans (map of), i. 478.
Semecarpus, i. 363.
Semele, ii. 621.
— androgyna (Fig. 384), ii. 620.
Semiaquilegia, i. 402.
Semibegoniella, i. 245.
Sempervivum, i. 458.
Semul, i. 254.
Senecio, i. 482.
Senega root, i. 233.
Senna, i. 154.
Serenoa, ii. 667.
Sergena root, i. 433.
Sericocoma, i. 440.
Sericodes, i. 270.
Serjania, i. 361.
Serratula, i. 482.
Sesamothamnus, i. 391.
Sesamum, i. 391.
— indicum, i. 391.
Sesbania, i. 155.
Seseli, i. 472.
Sesleria, ii. 719.
Sesuvium, i. 430.
Setaria, ii. 737.
— italica, ii. 738.
Setcreasea, ii. 565.
Seychellaria, ii. 547.
She Oak, i. 199.
Shea butter tree, i. 350.
Shepherdia, i. 342.
— argentea, i. 342.
Sherwoodia, i. 294.
Shoemakers' bark, i. 259.
Shorea, i. 286.
— robusta, i. 286.
Shortia, i. 294.
Shortiopsis, i. 294.
Sibthorpia, i. 489.
Sicyos, i. 244.
Sida, i. 255.
Sidalcea, i. 255.
Sideritis, i. 508.
Sideroxylon, i. 350.
Silene, i. 430.
Siliquamomum, ii. 586.
Silk Cotton, i. 254.
— *grass*, i. 31; ii. 577.
— *Rubber tree*, i. 381.
Silky Oak wood, i. 218.
Silver Tree, i. 218.
Simaba, i. 355.
— cedron, i. 355.
Simarouba, i. 355.
— amara, i. 355.
Simaroubaceae, i. 261, **268**, 314.
Simarouba bark, i. 355.
Simethis, ii. 598.
Simmondsia, i. 184.
Simocheilus, i. 292.

Sincoraea, ii. 580.
Singhara flour, i. 448.
Sinningia, i. 491.
Sinofranchetia, i. 410.
Sinojackia, i. 170.
Siparuna, i. 136.
Siphocampylus, i. 478.
Siphokentia, ii. 668.
Siphonochilus, ii. 586.
Siphonodon, i. 326.
— celestroides (Fig. 186), i. 326.
Sisal hemp, i. 32; ii. 662.
Sisymbrium, i. 426.
Sisyndite, i. 270.
Sisyrinchieae, ii. 649.
Sisyrinchium, ii. 649.
Sitanion, ii. 719.
Sladenia, i. 275.
Sloanea, i. 250.
Smeathmannia, i. 241.
— pubescens (Fig. 107), i. 241.
Smilacaceae, ii. 618.
Smilacina, ii. 605.
Smilax, ii. 618.
— aspera (Fig. 383), ii. 619.
— china, ii. 618.
Smyrnium, i. 472.
Snake root, i. 233.
Snowberry, i. 179.
Socratea, ii. 668.
Sodiroa, ii. 580.
Solanaceae, i. 29, **484.**
SOLANALES, i. 484.
Solanum, i. 484.
— tuberosum, i. 29, 484.
Solaria, ii. 643.
Soldanella, i. 453.
Solenomelus, ii. 651.
Solfia, ii. 668.
Solidago, i. 482.
Sollya, i. 220.
Solmsia, i. 214.
Solomon's seal, i. 31.
Sommiera, ii. 669.
Sonchus, i. 482.
Sonerila, i. 309.
Sonneratia, i. 306.
— acida (Fig. 165), i. 306.
Sonneratiaceae, i. **306.**
Sopubia, i. 489.
Sorbus, i. 150.
Sorghum, ii. 740.
— bicolor, var. technicus, ii. 741.
— versicolor (Fig. 449), ii. 740.
Sorgo, ii. 741.
Sorindeia, i. 363.
Sorrel, i. 28.
Souari nuts, i. 279.
Souleyetia, ii. 672.
Souliea, i. 402.
Souroubea, i. 278.
Sour Sop, i. 134.
Sowerbaea, ii. 602.
Soy Bean, i. 25, 156.
Soyauxia, i. 241, 335.
Soymida febrifuga, i. 358.
Spanish chestnut, i. 192.
Sparattanthelium, i. 142.
Sparaxis, ii. 651.
Sparganiaceae, i. 32; ii. **637.**
Sparganium, ii. 637.
— simplex (Fig. 391), ii. 636.
Sparganophorus, i. 482.
Sparrmania, i. 250.
— africana (Fig. 116), i. 251.
Spartina, i. 34; ii. 723.
— townsendii, ii. 723.
Spartium, i. 155.
Spartothamnus, i. 398.
Spathantheum, ii. 634.
Spathanthus, ii. 574.
Spathicarpa, ii. 634.
Spathicarpeae, ii. 634.
Spathiphylleae, ii. 630.
Spathiphyllum, ii. 630.
Spathodea, i. 389.
Spatholirion, ii. 563.
Specularia, i. 476.
Spcea, ii. 643.
Speirantha, ii. 602.
Spermacoce, i. 387.
Sphaeralcea, i. 255.
Sphaeranthus, i. 482.
Sphaeromariscus, ii. 708.
Sphaerosepalum, i. 285.
Sphaerosepalaceae, i. **284.**
Sphenoclea, i. 476.
Sphenocleaceae, i. 477.
Sphenostemon, i. 139.
Sphenostigma, ii. 649.
Spiderwort, i. 30.
Spigelia, i. 377.
— marilandica, i. 376, (Fig. 229) 376.
Spigeliaceae, i. **376.**
Spikenard, i. 473.
Spinach, i. 28, 440.
Spinacia oleracea, i. 440.
Spindle tree, i. 320.
Spineless Cactus, i. 247.
Spinifex, ii. 737.
Spiraea, i. 150.
Spiraeanthemum, i. 158.
Spiranthes, ii. 695.
Spirodela, ii. 635.
Spironema, ii. 565.
Split Rushes, ii. 697
Spogel seeds, i. 455.
Spondias, i. 363.
— mangifera, i. 364.
Spongostemma, i. 475.
Sporoboleae, ii. 722.
Sporobolus, ii. 723.
— patulus (Fig. 429), ii. 723.
Sprekelia, ii. 646.
Spyridium, i. 343.
Squill, ii. 592.
Staavia, i. 186.
Staberoha, ii. 703.
Stachyphrynium, ii. 590.
Stachys, i. 508.
— sieboldii, i. 508.
Stachytarpheta, i. 395.

Stachyuraceae, i. **183.**
Stachyurus, i. 184.
— praecox (Fig. 53), i. 183.
Stackhousia, i. 322.
— pulvinaris (Fig. 182), i. 322.
Stackhousiaceae, i. **322.**
Stahlianthus, ii. 586.
Stangea, i. 474.
Stapelia, i. 384.
Staphylea, i. 367.
— pinnata (Fig. 221), i. 367.
Staphyleaceae, i. **367.**
Star Anise, i. 23, 126.
— *Apple*, i. 350.
Statice, i. 455.
Stauntonia, i. 410.
Staurostigma, ii. 633.
Stavesacre seeds, i. 402.
Stawellia, ii. 602.
Stegnosperma, i. 223.
— halimifolium (Fig. 90), i. 222.
Stegnospermaceae, i. **222.**
Stegolepis, ii. 574.
Steinmannia, ii. 642.
Stelestylis, ii. 674.
Stellaria, i. 430.
Stellera, i. 216.
Stelmatocrypton, i. 382.
Stemona, ii. 658.
— tuberosa (Fig. 399), ii. 657.
Stemonaceae, ii. 656.
Stenanthella, ii. 608.
Stenanthium, ii. 608.
Stenocarpus, i. 218.
Stenolirion, ii. 643.
Stenomeridaceae, ii. **654.**
Stenomeris, ii. 654.
— borneensis (Fig. 397), ii. 653.
Stenomesson, ii. 645.
Stenophyllus, ii. 708.
Stenospermation, ii. 632.
Stephania, i. 411.
Stephanopodium, i. 151.
Stephanotis, i. 384.
Sterculia, i. 252.
Sterculiaceae, i. 25, **251.**
Stereospermum, i. 389.
Sternbergia, ii. 643.
Steudnera, ii. 633.
Stevensonia, ii. 669.
Stevia, i. 482.
Stichoneuron, ii. 658.
Stigmaphyllon, i. 259.
St. Ignatius' Beans, i. 377.
Stilbe, i. 396.
— vestita (Fig. 244), i. 396.
Stilbeaceae, i. **395.**
Stipa, ii. 729.
— mollis (Fig. 435), ii. 728.
— tenacissima, ii. 729.
Stipeae, ii. 726.
Stokesia, i. 482.
Stomatostemma, i. 382.
Storax, i. 169.
Strasburgeria, i. 282.
— robusta (Fig. 144), i. 282.
Strasburgeriaceae, i. **281.**
Stratioteae, ii. 541.
Stratiotes, ii. 541.
Strawberry, i. 150.
Streblus, i. 202.
Strelitzia, i. 31; ii. 582.
Strelitziaceae, i. 31; ii. **582.**
Streptanthera, ii. 651.
Streptocalyx, ii. 580.
Streptocarpus, i. 491.
Streptocaulon, i. 382.
Streptochaeta, ii. 717.
— spicata (Fig. 423), ii. 718.
Streptochaeteae, ii. 717.
Streptolirion, ii. 563.
Streptomanes, i. 382.
Streptopetalum, i. 237.
Streptopus, ii. 605.
Stricklandia, ii. 646.
Striga, i. 489.
Strobilanthes, i. 491.
Stromanthe, ii. 590.
— papillosa (Fig. 368), ii. 589.
Strombosia, i. 330.
Strophanthus, i. 381.
— kombe, i. 381.
Stropholirion, ii. 642.
Strumaria, ii. 643, 645.
Struthiola, i. 216.
Strychnaceae, i. 27, **377.**
Strychnine, i. 377.
Strychnos, i. 378.
— ignatii, i. 377.
— nux-vomica, i. 27, 377.
— spinosa (Fig. 230), i. 377.
— toxifera, i. 377.
Stuartia, i. 273, 274, (map of), 273.
Stylidiaceae, i. **480**, (map of) 480.
Stylidium, i. 481.
— adnatum, var. abbreviata (Fig. 319), i. 481.
Styloceras, i. 184.
Stylochiton, ii. 632.
Stylochitoneae, ii. 632.
Styloconus, ii. 677.
Styloma, ii. 667.
Stylosanthes, i. 155.
Stypandra, ii. 606.
Styracaceae, i. 25, **168**, (map of) 169.
STYRACALES, i. 167.
Styrax, i. 169.
— benzoin, i. 169, (Fig. 41) 169.
— officinale, i. 169.
Suaeda, i. 440.
Succisa, i. 475.
Sudd, i. 32.
Sugar bush, i. 219.
— *Cane*, ii. 741.
— *Maple*, i. 364.
Sultanas, i. 344.
Sumach, i. 26, 363.
Sumatra Camphor tree, i. 286.
Sunflower, i. 28.
Suriana, i. 355.
Surinam Quassia wood, i. 355.
Susum, ii. 568.

Sutera, i. 489.
Swainsonia, i. 155.
Sweet Almond, i. 150.
— *Bay*, i. 23.
— — *Laurel*, i. 140.
— *Chestnut*, i. 192.
— *Cup*, i. 241.
— *Fern*, i. 189.
— *Flag Rhizome*, ii. 629.
— *Gale*, i. 189.
— *potato*, i. 29, 486.
— *Sop*, i. 134.
— *vernal grass*, i. 34.
— *William*, i. 430.
Swertia, i. 451.
— chirata, i. 451.
Swietenia, i. 358.
— mahagoni, i. 26, 358.
Sycamore, i. 26, 364.
— *Fig*, i. 202.
Sycopsis, i. 180.
Symbegonia, i. 245.
Symingtonia, i. 180.
Sympetaleia, i. 239.
Symphonia, i. 299, (map of) 299.
Symphoricarpos, i. 178.
— albus, i. 179.
— racemosus, i. 179.
Symphyostemon, ii. 651.
Symphytonema, i. 382.
Symphytum, i. 503.
Symplocaceae, i. 170.
Symplocarpus, ii. 632.
Symplocos, i. 171.
— paniculata (Fig. 42), i. 170.
— racemosa, i. 171.
Synandrospadix, ii. 633.
Synantherias, ii. 635.
Synaptanthera, i. 386.
Synechanthus, ii. 669.
Syngonanthus, ii. 576.
Syngonium, ii. 634, 635.
Synnotia, ii. 651.
Synsiphon, ii. 612.
Syntrinema, ii. 706, 707.
Syringa, i. 379.
Syringodea, ii. 651.
Syzygium, i. 303.

Tabebuia, i. 389.
Tabernaemontana, i. 381.
Tacazzea, i. 382.
Tacca, ii. 683.
— cristata (Fig. 409), ii. 683.
— pinnatifida, ii. 683.
Taccaceae, ii. 683.
Taccada Pith, i. 479.
Taccarum, ii. 633.
Tacsonia, i. 241.
Taenianthera, ii. 669.
Ta-Fung-Tsze seeds, i. 208.
Tagasaste, i. 156.
Tagetes, i. 482.
Talauma, i. 124.
Talinum, i. 431.
Talisia, i. 361.
Tallow tree, i. 299.
Tamaricaceae, i. 25, 228.
TAMARICALES, i. 227.
Tamarind, i. 154.
Tamarindus, i. 154.
— indica, i. 154.
Tamarix, i. 229.
— orientalis (Fig. 97), i. 229.
Tambourissa, i. 136.
Tamus, ii. 660.
— communis, i. 32; ii. 658.
Tanulepis, i. 382.
Tapeinanthus, ii. 646.
Tapeinia, ii. 649.
Tapeinochilus, ii. 586.
Tapioca, i. 271.
Tapiscia, i. 367.
Tapura, i. 151.
Taraktogenos kurzii, i. 208.
Tarchonanthus, i. 482.
Tea, i. 26.
— *plant*, i. 274.
Teak, 27.
— *wood*, i. 395.
Tecoma, i. 389.
Tecomaria, i. 389.
Tecophilaea, ii. 615.
Tecophilaeaceae, ii. 613.
Tectona, i. 395.
— grandis, i. 27, 395.
Teff grass, ii. 722.
Teinostachyum, ii. 715.
Telanthera, i. 441.
Telectadium, i. 382.
Telopea, i. 218.
— speciosissima, i. 219.
Tenagocharis, ii. 538.
Teosinte, ii. 742.
Tephrosia, i. 155.
Terauchia, ii. 598, 599.
Terblanz wood, i. 218.
Terminalia, i. 307.
— angustifolia, i. 308.
— belerica, i. 307.
— catappa, i. 308.
— chebula, i. 307.
— tomentosa, i. 307.
Terniola, i. 470.
Ternstroemia, i. 274.
Ternstroemiaceae, i. 272, 274, 275, 276, 278, 279.
Tersonia, i. 437.
Tessmaniophoenix, ii. 667.
Testudinaria, ii. 660.
— elephantipes, i. 32; (Fig. 400), ii. 658.
Tetilla, i. 462.
Tetracentraceae, i. 179.
Tetracentron, i. 180.
— sinense (Fig. 49), i. 180.
Tetracera, i. 144.
Tetrachondra, i. 503.
Tetraclis, i. 353.
Tetradiclis, i. 270.
Tetragonia, i. 430.
Tetrameles, i. 246.
Tetramerista, i. 278.

Tetramerista glabra (Fig. 140), i. 278.
Tetrameristaceae, i. **277.**
Tetrapterys, i. 259.
Tetraria, ii. 707.
Tetrariopsis, ii. 707.
Tetrarrhena, ii. 730.
Tetrathalamus, i. 128.
Tetratheca, i. 224.
Tetroncium, ii. 549.
Teucrium, i. 508.
Teysmannia, ii. 667.
Thalassia, ii. 541.
Thalassioideae, ii. 541.
Thalia, ii. 590.
Thalictrum, i. 403.
Thamatophyllum, ii. 634.
Thamnea, i. 186.
Thamnochortus, ii. 703.
Thatching grasses, ii. 741.
Thaumatococcus, ii. 590.
Thea, i. 274.
Theaceae, i. 26, **272**, 276, 278.
THEALES, i. 271.
Thé Arabe, i. 433.
Thé de Montagne, i. 503.
Thecophyllum, ii. 580.
Thelepogon, ii. 740.
Theligonum, i. 442, (map of) 441.
— prostratum (Fig. 285), i. 442.
Thellungia, ii. 722.
Thelycrania, i. 172.
Themeda, ii. 741.
Theobroma, i. 252.
— cacao, i. 25, 252.
Theophrasta, i. 347.
Theophrastaceae, i. **346.**
Thereianthus, ii. 651.
Theriophonum, ii. 635.
Theropogon, ii. 602.
Thesium, i. 339.
Thespesia, i. 255.
Thismia, ii. 689.
— neptunis, ii. Fig. 412.
Thismiaceae, ii. **687.**
Thomasia, i. 252.
Thomsonia, ii. 634.
Thonningia, i. 341.
Thoracostachyum, ii. 709.
Thorn apple, i. 29.
Thottea, i. 415.
Thouinia, i. 361.
Thrinax, ii. 667.
Thrincoma, ii. 667.
Thringis, ii. 667.
Thunbergia, i. 491.
Thuranthos, ii. 611.
Thurnia, ii. 699.
— jenmanii (Fig. 417), ii. 698.
Thurniaceae, ii. **699.**
Thylacophora, ii. 587.
Thyme, i. 29, 508.
Thymelaea, i. 216.
Thymelaeaceae, i. 25, 213, 214, **215.**
THYMELAEALES, i. 212.
Thymus, i. 506.
— vulgaris, i. 29, 508.
Thyrsacanthus, i. 491.
Thysanolaeneae, ii. 735.
— maxima (Fig. 444), ii. 736.
Thysanolaeneae, ii. 735.
Thysanotus, ii. 598.
Tibouchina, i. 309.
Ticorea, i. 354.
Tiger nuts, ii. 706.
Tigrideae, ii. 649.
Tilia, i. 250.
— americana, i. 251.
— europaea, i. 251.
Tiliaceae, i. 25, **250.**
TILIALES, i. 248.
Tillandsia, ii. 579.
Tillandsieae, ii. 579.
Tilmia, ii. 670.
Tinantia, ii. 563.
Tinospora, i. 411.
Tittmannia, i. 186.
Tobacco, i. 29, 484.
Tofieldia, ii. 596.
Toisusu, i. 188.
Tolu Balsam, i. 156.
Tomato, i. 29, 484.
Tonina, ii. 576.
Tonka bean, i. 156.
Toon wood, i. 358.
Tooth-brush tree, i. 313.
Topee Tamboo, ii. 588.
Torenia, i. 489.
— fournieri (Fig. 324), i. 489.
Toricellia, i. 172.
Tortipes, ii. 606.
Torulinum, ii. 708.
Tournefortia, i. 503.
Tournonia, i. 444.
Tovaria, i. 227.
— pendula (Fig. 95), i. 227.
Tovariaceae, i. **226.**
Tovomita, i. 299.
Toxicoscordion, ii. 608.
Trachelium, i. 476.
Trachycarpus, ii. 667.
Trachyphrynium, ii. 590.
Trachypogon, ii. 741.
Trachystylis, ii. 707.
Tracyanthus, ii. 608.
Tradescantia, ii. 565.
— virginica, i. 30; (Fig. 357) ii. 563.
Trageae, ii. 729.
Tragia, i. 270.
Tragus, ii. 729.
Trapa, i. 448.
Trapa bispinosa, i. 448, (Fig. 290) 447.
Trapaceae, i. **447.**
Trapella, i. 391.
Trapellaceae, i. 391.
Trautvetteria, i. 403.
Travellers' tree, i. 31; ii. 582.
Trebizonde Dates, i. 342.
Treculia, i. 202.
— africana, i. 202.
Tree of Heaven, i. 355.
Treleasia, ii. 565.
Trema, i. 199.

Trema commersonii (Fig. 68), i. 200.
Tremandra, i. 224.
Tremandraceae, i. 223.
Trianoptiles, ii. 707.
Trianosperma, i. 244.
Trianthella, ii. 596.
Trianthema, i. 430.
Tribonanthes, ii. 676.
Tribulus, i. 270.
— terrestris (Fig. 132), i. 269.
Tricalistra, ii. 604.
Trichilia, i. 358.
— emetica, i. 358.
Trichinium, i. 441.
Trichlora, ii. 643.
Trichloris, ii. 723.
Trichocladus, i. 180.
Trichodesma, i. 503.
Trichodypsis, ii. 669.
Trichoneura, ii. 722.
Trichophyllum, ii. 708.
Trichopodaceae, ii. 654.
Trichopteryx, ii. 736.
— acuminata (Fig. 445), ii. 737.
Trichopus, ii. 656.
— zeylanicus (Fig. 398), ii. 655.
Trichosanthes, i. 244.
Trichostigma, i. 438.
Tricoryne, ii. 602.
Tricostularia, ii. 707.
Tricuspidaria, i. 250.
Tricyrtideae, ii. 606.
Tricyrtis, ii. 608.
— pilosa (Fig. 378), ii. 607.
Tridens, ii. 722.
Trientalis, i. 453.
Trifolium, i. 25, 155.
— pratense, i. 156.
— repens, i. 156.
Triglochin, ii. 549.
— calcitrapa (Fig. 349), ii. 548.
Trigonella, i. 155.
Trigonia, i. 234.
— pubescens (Fig. 102), i. 234.
Trigoniaceae, i. 234.
Trigoniastrum, i. 234.
Trilliaceae, ii. 615.
Trillium, ii. 616.
Trilocularia, i. 190.
Trimenia, i. 139.
— weinmanniifolia (Fig. 14), 138.
Trimeniaceae, i. 138.
Trimezia, ii. 649.
Triphyophyllum, i. 207.
Triplachne, ii. 726.
Triplaris, i. 432.
Triplasis, ii. 722.
Triplostegia, i. 475.
Tripogon, ii. 722.
Tripsaceae, ii. 741.
Tripsacum, ii. 742.
— dactyloides (Fig. 450), ii. 741.
Tripterococcus, i. 322.
Triraphis, ii. 722.
Triscaphis, i. 367.
Triscyphus, ii. 689.
Triscyphus fungiformis (Fig. 412), ii. 688.
Trisetum, ii. 726.
Tristachya, ii. 736
Tristagma, ii. 642.
Tristellateia, i. 259.
Tristemma, i. 309.
Tristicha, i. 470.
Triteliopsis, ii. 642.
Trithrinax, ii. 667.
Trithuria, ii. 700.
Triticum, i. 34, ii. 719.
Tritonia, ii. 651.
Tritoniopsis, ii. 652.
Triumfetta, i. 250.
Triuridaceae, i. 30, ii. 547.
TRIURIDALES, ii. 547.
Triurocodon, ii. 689.
Trochodendraceae, i. 131.
Trochodendron, i. 132.
— aralioides, i. 132, (Fig. 8) 132.
Trochomeria, i. 244.
Trollius, i. 402.
Tropaeolaceae, i. 29, 498.
Tropaeolum, i. 499, (map of) 498.
— majus (Fig. 333), i. 498.
— peregrinum, i. 499.
Trophis, i. 202.
Tryphostemma, i. 241.
Tulbaghia, ii. 642.
Tulip, i. 31.
— *tree*, i. 123.
Tulipa, i. 31; ii. 609.
Tulipeae, ii. 609.
Tumeric, ii. 584.
Tung oil, i. 26, 271.
Tunica, i. 429.
Tupistra, ii. 604.
Turanga, i. 188.
Turkey Filberts, i. 194.
Turnera, i. 236.
— salicifolia (Fig. 104), i. 237.
Turneraceae, i. 236.
Turnip, i. 28, 426.
Turpinia, i. 367.
Turraea, i. 356.
Tussilago, i. 482.
— farfara, i. 28.
Tylocarya, ii. 708.
Tylophora, i. 384.
Typha, ii. 637.
— angustifolia (Fig. 392), ii. 638.
Typhaceae, i. 32, ii. 637.
TYPHALES, ii. 637.
Typhonium, ii. 635.
Typhonodorum, ii. 634.

Ulea-Flos, ii. 709.
Ulex, i. 155.
— europaeus, i. 25.
Ullucus, i. 444.
— tuberosus (Fig. 287), i. 444.
Ulmaceae, i. 25, 199.
Ulmus, i. 199.
UMBELLALES, i. 471.
Umbelliferae, i. 28, 471.

Umbellularia, i. 140.
Umbilicus pendulinus, i. 128.
Uncaria, i. 386, 391.
— gambier, i. 387.
Uncinia, ii. 710.
Ungernia, ii. 643.
Unifolium, ii. 605.
Urceolina, ii. 646.
Urelytrum, ii. 740.
Urena, i. 255.
Urera, i. 203.
Urginea, ii. 611.
— scilla, ii. 592.
Urgineopsis, ii. 611.
Urobotrya, i. 331.
Urophyllum, i. 387.
Urospatha, ii. 632.
Ursinia, i. 482.
Urtica, i. 203.
Urticaceae, i. 25, 201, **202**.
URTICALES, i. 199.
Urvillea, i. 361.
Usteria, i. 376.
Utleria, i. 382.
Utricularia, i. 493.
Uvaria, i. 134.
Uvularia, ii. 606.
Uvularieae, ii. 606.

Vacciniaceae, i. 26, **296**.
Vaccinium, i. 296.
— arctostaphylos, i. 296.
— myrtillus, i. 26, 296.
— vitis-idaea, i. 296.
Vagaria, ii. 646.
Vahlia, i. 462.
— dichotoma (Fig. 302), i. 461.
Vahliaceae, i. **461**.
Valentinia, ii. 605.
Valeriana, i. 474.
— officinalis, i. 28, 473.
Valerianaceae, i. 28, **473**.
VALERIANALES, i. 472.
Valerian, i. 28.
Valerianella, i. 473.
Valerian Roots, i. 473.
Validalium, ii. 642.
Vallisneria, ii. 541.
Vallisnerieae, ii. 541.
Vallota, ii. 643.
— speciosa (Fig. 394), ii. 644.
Valvanthera, i. 141.
Vancouveria, i. 405.
Vanda, ii. 695.
Vangueria, i. 387.
Vanilla, ii. 693.
Vanilla, ii. 695.
— planifolia, ii. 693.
Vanoverbergia, ii. 587.
Vantanea, i. 260.
Vateria, i. 286.
— indica, i. 286.
Vatica, i. 286.
Vegetable Ivory, ii. 666.
Veitchia, ii. 668.
Velleia, i. 479.
Vellozia, ii. 680.
Velloziaceae, ii. 678.
Veltheimia, ii. 611.
Ventilago, i. 343.
—maderaspatana, i. 343.
Veratreae, ii. 608.
Veratrum, ii. 608.
— album, ii. 592.
Verbascum, i. 489.
Verbena, i. 395.
Verbenaceae, i. 27, **395**.
VERBENALES, i. 393.
Verdickia, ii. 598.
Vernonia, i. 482.
Veronica, i. 489.
Verschaffeltia, ii. 669.
Verticordia, i. 303.
Vetiver grass, ii. 741.
Vetiveria, ii. 740.
— zizanioides, ii. 741.
Viburnum, i. 178.
— carlesii (Fig. 48), i. 178.
Vicia, i. 155.
— faba, i. 25, 156.
Victoria, i. 404.
— amazonica, i. 403.
Victoria Water Lily, i. 403.
Villaresia, i. 317.
Villarsia, i. 451, (map of) 451.
Vinca, i. 381.
Vincetoxicum, i. 383.
Viola, i. 231.
— tricolor (Fig. 99), i. 231.
Violaceae, i. 25, **230**.
VIOLALES, i. 230.
Virginia creeper, i. 26, 344
Virginian Sarsaparilla, i. 178
— *Snake Root*, i. 415.
Viscum, i. 338.
— album, i. 26, 338.
— bolleanum (Fig. 194), i. 337.
Vismia, i. 297.
Visnia, i. 274.
Vitaceae, i. 26, **344**.
Vitex, i. 395.
— agnus-castus (Fig. 243), i. 395.
Vitis, i. 344.
— vinifera, i. 26, 344.
Viviania, i. 223.
— rosea (Fig. 91), i. 223.
Vivianiaceae, i. **223**.
Vochysia, i. 236.
— guianensis (Fig. 103), i. 235.
Vochysiaceae, i. **234**, (map of) 235.
Volkiella, ii. 708.
Vonitra, ii. 669.
Vossia, ii. 740.
Voyria, i. 451.
Vriesea, ii. 580.

Wachendorfia, ii. 676.
Wadadura wood, i. 304.
Wahlenbergia, i. 476.
Walafrida, i. 505.
Walleria, ii. 606, 615.
Wallflower, i. 28, 426.

Wallichia, ii. 670.
Walnut, i. 25, 196.
Waltheria, i. 252.
Waratah, i. 219.
Warburgia, i. 129.
Washingtonia, ii. 667.
Watercress, i. 28, 426.
Water Melon, i. 244.
— *soldier*, i. 32.
— *uintje*, i. 30.
Watsonia, ii. 651.
Wattle barks, i. 155.
Webera, i. 387.
Weihea, i. 305.
Weinmannia, i. 158.
Weldenia, ii. 565.
Welfia, ii. 669.
Wendlandia, i. 386.
Wendlandiella, ii. 669.
Wendtia, i. 263.
Wettenia, ii. 668.
Wettinella, ii. 668.
Wettiniicarpus, ii. 668.
Wheat, i. 34, 720.
Whin, i. 25.
Whipplea, i. 159.
White Birch, i. 191.
— *Currant*, i. 162.
— *Dammar*, i. 286.
— *Hellebore*, ii. 592.
— *Mulberry*, i. 202.
Whiteheadia, ii. 611.
Whortleberry, i. 26, 296.
Wiesneria, ii. 544.
Wigandia, i. 501.
Wikstroemia, i. 216.
Willdenowia, ii. 704.
Willrussellia, ii. 579.
Windsorina, ii. 574.
Wine Palm, ii. 666.
Wines, i. 344.
Winteraceae, i. **126**, (map of) 127.
Winter's Bark, i. 126.
Wissadula, i. 255.
Wistaria, i. 155.
Witch Hazel, i. 25.
Withania, i. 484.
Witsenia, ii. 651.
Wittmackia, ii. 580.
Wittsteinia, i. 296.
Wolffia, ii. 635.
Woodruff, i. 27.
Wormia, i. 144, (map of) 144.
Wormskioldia, i. 237.
Worsleya, ii. 646.
Wourali Poison bark, i. 377.
Wredowia, ii. 651.
Wurmbea, ii. 609.

Xanthium, i. 482.
Xanthochymus, i. 299.
Xanthorhiza, i. 402.
Xanthorrhoea, ii. 662.
— hastilis (Fig. 401), ii. 661.
Xanthorrhoeaceae, i. 32; ii. **660.**
Xanthosoma, ii. 633.
Xerochlamys, i. 283.
Xerochloa, ii. 737.
Xeronema, ii. 599.
Xenophya, ii. 635.
Xerophyllum, ii. 596.
Xeroplana, i. 396.
Xerotes, ii. 662.
Ximenia, i. 330.
Xiphidium, ii. 676.
Xylia dolabriformis, i. 155.
Xyloolaena, i. 283.
Xylopia, i. 134.
Xylosma, i. 207.
Xymalos, i. 139.
Xyridaceae, i. 30; ii. **570.**
XYRIDALES, ii. 570.
Xyris, ii. 572.
— indica (Fig. 362), ii. 571.
Xysmalobium, i. 383.
Xystrolobos, ii. 541.

Yam, i. 32, ii. 658.
Yams,
Yarina, ii. 670.
Yellow Flag, ii. 647.
— *wood*, i. 358.
Yerba de Maté tea, i. 312.
Yercum fibre, i. 384.
Ypsilandra, ii. 595.
Yucca, ii. 664.
Yucceae, ii. 664.

Zaczatea, i. 382.
Zalacca, ii. 667.
Zalacella, ii. 667.
Zamiculcas, ii. 632.
Zannichellia, ii. 559.
— palustris (Fig. 355), ii. 559.
Zannichelliaceae, ii. **559.**
Zantedeschia, ii. 632.
— aethiopica, i. 31.
Zanthoxylum, i. 354.
— piperitum, i. 354.
Zea, ii. 742.
— mays, i. 34; ii. 742.
Zebra-wood, i. 145, 350.
Zebrina, ii. 565.
Zehneria, i. 244.
Zelkova acuminata, i. 199.
Zeodary, ii. 584.
Zephyra, ii. 615.
Zephyrantheae, ii. 643.
Zephyranthella, ii. 646.
Zephyranthes, ii. 643.
Zerumbet, ii. 586.
Zeugites, ii. 717.
Zingiber, ii. 587.
— mioga, ii. 584.
— officinale, ii. 584.
Zingiberaceae, i. 31; ii. **584.**
ZINGIBERALES, ii. 581.
Zingibereae, ii. 586.
Zinnia, i. 482.
Zizania, ii. 731.
Zizaniopsis, ii. 731.
Zizyphus, i. 343.

Zizyphus jujuba, i. 343.
— lotus, i. 343.
Zomicarpa, ii. 634.
Zomicarpella, ii. 635.
Zostera, ii. 556.
— marina, i. 30.
Zosteraceae, i. 30; ii. **554.**
Zoysia, ii. 729.
Zoysieae, ii. 729.
Zulu nuts, ii. 706.
Zygadenus, ii. 608.
Zyganthera, ii. 633.
Zygella, ii. 649.
Zygogynum, i. 128.
Zygophyllaceae, i. 26, **268.**
Zygophyllum, i. 270.
Zygostelma, i. 382.
Zygotritonia, ii. 652.

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