THE FAMILIES OF FLOWERING PLANTS

VOLUME II
MONOCOTYLEDONS

SECOND EDITION

J. HUTCHINSON

THE FAMILIES OF FLOWERING PLANTS

VOLUME II

MONOCOTYLEDONS

arranged according to a new system based on their probable

PHYLOGENY

BY

J. HUTCHINSON

LL.D. (St. Andrews), F.R.S., V.M.H.

LATE KEEPER OF MUSEUMS OF BOTANY
ROYAL BOTANIC GARDENS, KEW

SECOND EDITION

OXFORD
AT THE CLARENDON PRESS
1959

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

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).

First edition 1934
published by Macmillan & Co., Ltd.
St. Martin's St., London

PRINTED IN GREAT BRITAIN

CONTENTS

VOLUME II

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 *Graminèae*, 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]

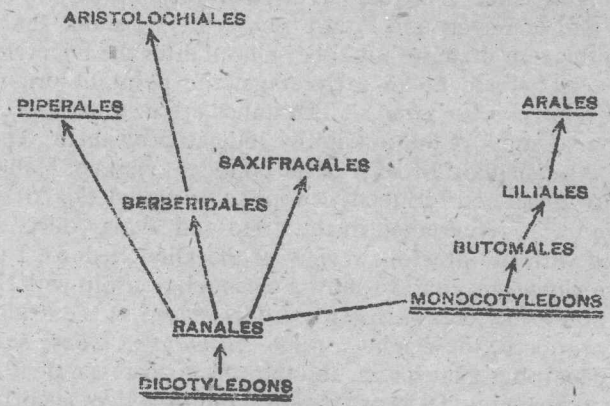
As is well known, the *Ranunculaceae* have without exception abundant endosperm in the seeds, with a very small embryo. Now the seeds of nearly all Monocotyledons are also provided with abundant endosperm, the *Alismatales* and allied families and the Orchids being almost the only exceptions. There is 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 ssprophytic 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.

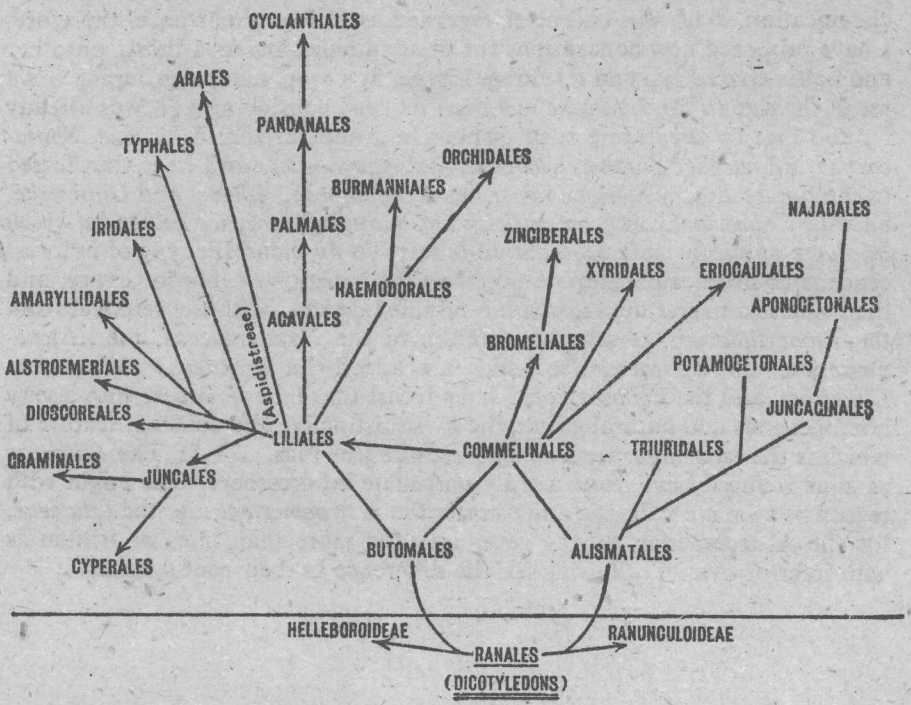
From the Liliaceous stock very prolific evolution has taken place, most of it purely terrestrial or epiphytic, with very few aquatics. And in the family *Liliaceae* the evolution of a more advanced type of root system may be clearly traced, its culmination being the bulb, so characteristic a feature 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)

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.
	* * * * *	