EDWIN BINGHAM COPELAND *was born at Monroe, Wisconsin, September 30, 1873. Educated at the University of Wisconsin, Stanford (B.A., 1895), Leipzig, Halle-Wittenberg (Ph.D., eximia cum laude, 1896), Chicago. Taught at the University of Indiana, Chico State Normal School, University of West Virginia, and Stanford. Systematic Botanist, Bureau of Government Laboratories (later, Bureau of Science, Manila), 1903. Established College of Agriculture, University of the Philippines, 1909. Dean and Professor of Botany in same until retirement in 1917. In charge of herbarium, University of California, 1928/32. Technical Adviser, Department of Agriculture and Natural Resources, Manila, and director of National Economic Garden, Los Baños, 1932/35.—Author of 'Philippine Agriculture', 'The Coconut', 'Rice', and an outline of natural ethics.—Identified foreign ferns in the herbarium of the University of Wisconsin, 1893. Studied ferns under Professor D. H. Campbell, 1894/95. Published about a hundred papers on ferns prior to 1935, and has worked exclusively on them since that date. Has a most valuable private fern herbarium, including more than five hundred holotypes.*

• ANNALES CRYPTOGAMICI et PHYTOPATHOLOGICI •

Volume V

GENERA FILICUM

ANNALES CRYPTOGAMICI

et PHYTOPATHOLOGICI

(incorporating Annales Bryologici)

edited by

FRANS VERDOORN, Ph.D.

Managing Editor of Chronica Botanica, 'A New Series of Plant Science Books', etc.; Bibliographer, Arnold Arboretum of Harvard University; Bot. Adviser, Board for the Neth. Indies; Hon. Sec., Bot. Section, Intern. Union of Biological Sciences; etc.

Wij en konnen den Heer en maker van het geheel Al niet meer verheerlijken, als dat wij in alle zaken, hoe klein die ook in onse bloote oogen mogen zijn, als ze maar leven en wasdom hebben ontfangen, zijn al wijsheit en volmaaktheit, met de uiterste verwondering sien uit steken.

Antoni van Leeuwenhoek

1947

WALTHAM, MASS., U.S.A.

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GENERA FILICUM

the Genera of Ferns

by

EDWIN BINGHAM COPELAND, Ph.D.

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PREFACE

There are two reasons for the preparation and publication of this book.

The first reason is the fact that progress in our understanding of systematic pteridology during the past half-century has been so great that no existing general work on the subject retains much more than a historical value.

The second is that it beseems the author of a large number of papers dealing with details and with parts of a general subject to digest and summarize his work, and to present it properly integrated with that of his predecessors and contemporaries.

This may be something of wider significance than a treatise on the genera of ferns. It is my belief that pteridology has returned to its position of a century ago, as the best developed field of systematic botany; that it is possible to demonstrate the phylogeny of fern genera more clearly and convincingly than that of any other similarly great group of plants can be presented. To the extent that this is true, and only to the extent that I fairly present the condition, this may mark today's advanced post in plant taxonomy.

For assistance in the preparation of this book, I am glad to acknowledge my debt to Doctors MAXON *and* MORTON *of the United States National Herbarium, and* WEATHERBY *of the Gray Herbarium of Harvard University; and particularly to my long-time associate and friend, Doctor* ELMER D. MERRILL.

THE AUTHOR

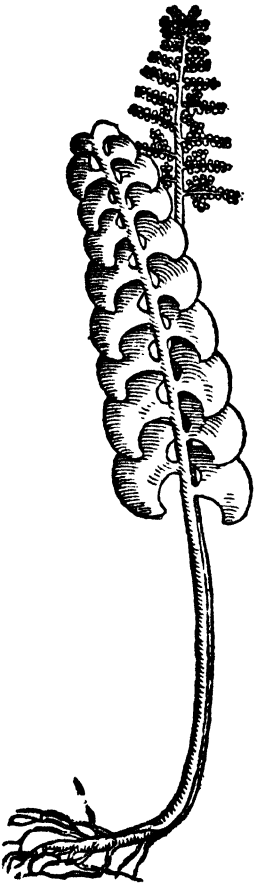
TO THE MEMORY

OF MY MOTHER, WHO MADE

ME A BOTANIST, AND TO MY WIFE

WHOSE INTEREST IN THIS BOOK IS

LARGELY RESPONSIBLE FOR ITS COMPOSITION



Ignoto genere proprio
nulla descriptio,
quis accurate tradita,
certam demonstrat,
sed plerumque fallit.

CAESALPINIUS

I stooped and picked a leaf of fern,
And recollected I might learn
From books, how many myriad sorts
Of fern exist, to trust reports,
Each as distinct and beautiful
As this, the very first I cull.
Think, from the first leaf to the last!
Conceive, then, earth's resources!

BROWNING

Confusis generibus omnia
confundi necesse est.

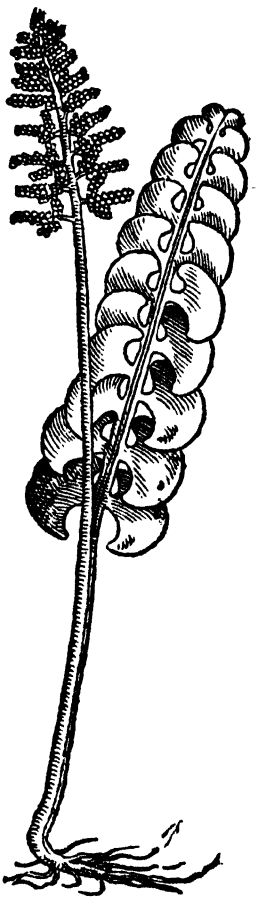
CAESALPINIUS

The green and graceful Fern,
How beautiful it is!
There's not a leaf in all the land
So wonderful, I wis.

TWAMLEY

Vana sunt nova genera,
sine universali specierum
cognitione et praecipue
morphoseos historia.

ELIAS FRIES



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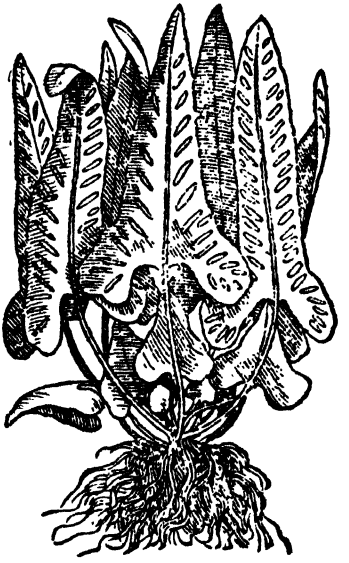

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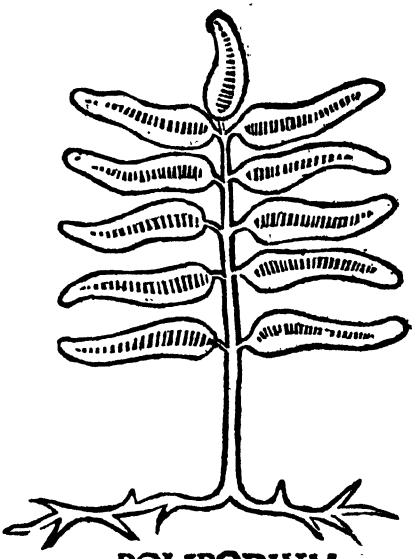


POLIPODIVM

¶Polipodium calidum eſt in ſecundo:ſiccum in tertio gradu. Virtus eſt in radice que in ſapore dulcis eſt & nodoſa. & qđ' naſcitur ſuper radices quercus eſt efficatius. Eſt reſolitiuum uentoſitatum & humiditatum & in decoctione polipodii debet poni aliquod excluſiuum uentoſitatis ut ẽ aniſi & ſemen feniculi & cimini : quia polipodium reſoluit humores in uentoſitates. Virtutem etiam habet ipſum polipodium diſſoluendi & attrahendi. & etiam purgandi principaliter flegma & melancoliam ſecundario. unde competenter ponit in decoctione flegma & melancoliã purgãte.

Et flegmaticis & melancolicis ſanis datur ad preſeruationem. Contra febrem quotidianam & quartanam & doloꝛẽ arteticum & contra dolorem colice & yliace paſſionis cõ ferre habet. Et talis eſt uſus. Recipe floꝛum ſene:radicis polipodii & radi. eſuele aã. ℥.ſ. ſeminum feniculi petroſilini:leuiſtici aã. ſ.ii. uuarum paſſularum:florum uiolaꝛ boraginis an. m.ſ.ſi uiricie. ſ.i. omnium contuſorum fiat decoctio in aqua & uino an. lb. i. ſ. ad conſumationem ſere medietatis coletur & colatura dulcoretur cum ſufficiẽti ℥ucaro quod ſufficit & fiat potus & utatur eo modo ut ſupra. quo coſumpto ſequentes pillule ſumantur. Recipiãtur maſſe pillularum fetidarum:maſſe pillularum de lapide lazuli aã. ℥.ſ. turbit. ℈.ſ. dyagredii gra. iii. ℥inciberis: maſticis an. gra. i. miſce cum ſiꝛupo acetoſo compoſito & fiant pillule. vii. aut. ix. R. dyagaláge uel dyacoꝛos pro cõ fortatiuis. Item radix polipodii cum paꝛum aniſi decoquatur in pullo cum aliis ſpeciebus odoꝛiferis & delicatis hominibus multum opitulatur. Contra arteticam buliatur radix eius cum ſemine feniculi & hermodactuli puluerizatum in aqua multum prodeſt. Auicenna.

'Polipodium': showing the illustration and text about one of the principal genera of ferns in the *Tractatus de Virtutibus Herbarum* (Vincensiae, 1491), the famous 'Latin Herbarius', based on mediaeval manuscripts, one of the earliest printed botanical books. — The vignettes on pages xi, xv, and 270 have been reproduced from woodcuts from MATTHIOLI'S *Compendium* (1571) and those on pages 233 and 249 from FUCHS' polyglot botanical picture dictionary (*De Stirpium historia commentariorum . . .*). — *Courtesy Arnold Arboretum of Harvard*

INTRODUCTION

Since the literary histories of the genera must be presented severally, the history of the subject as a whole may be brief. Technically, the foundation of the subject is that of all plant nomenclature, LINNAEUS' *Species Plantarum,* published in 1753. LINNAEUS recognized 14 genera of ferns—*Onoclea, Ophioglossum, Osmunda, Acrostichum, Pteris, Blechnum, Hemionitis, Lonchitis, Asplenium, Polypodium, Adiantum, Trichomanes, Marsilea* and *Pilularia.* In these he included 182 species.

A period of activity in the publication of genera, shared in by J. E. SMITH, ROTH, BERNHARDI, CAVANILLES and SWARTZ found general expression in SWARTZ' *Synopsis Filicum,* dated 1806. His genera numbered 38, and the described species 720. A considerable number of species were even then listed as named but imperfectly known. With this *Synopsis* and with WILLDENOW's edition of the *Species Plantarum,* ended the time when the acceptable species of ferns could be described in one volume.

Except for characters of the sporangia, which have characterized orders and families as long as such categories have been recognized, SWARTZ' classification, like LINNAEUS', was based chiefly on the shape and protection of the sori. With increase in the number of genera, other characters came inevitably into use. And, for a classification designed primarily for convenience, the venation was particularly useful. BROWN and others explored this path, but it found full use in the next beacon light of this history, in PRESL's *Tentamen Pteridographiae* (1836). Several families being omitted, the *Tentamen* described and classified 112 genera. In later works, *Hymenophyllaceae* (1843), and *Supplementum Tentaminis Pteridographiae* (1845), PRESL added 19 and 34 genera, bringing his total to 165. Still later, he proposed still more, but with and without descriptions, so that a total may not be stated.

The title, *Genera Filicum,* was not new, but the first book to bear it and to attempt a presentation of all genera began to appear in 1838 and was finished in 1842. Its subtitle is *Illustrations of the Genera of Ferns.* These are by FRANCIS BAUER, but the text is by W. J. HOOKER, who was therefore effectively the author. The genera listed number 162. HOOKER's endorsement of PRESL was at once enthusiastic and tentative, his final judgment being withheld for development in his *Species Filicum.* This great work appeared from 1844 to 1864. As it did not include all ferns, HOOKER's final conclusion must be drawn from his *Synopsis Filicum* (1867), in which only 75 genera are recognized, not including *Marsileaceae* and *Salviniaceae.*

PRESL had two contemporaries, JOHN SMITH and A. L. A. FÉE, who adopted his policy of recognizing many genera and followed it consistently. SMITH described many genera, and a treatise on genera, in periodicals, but his work in book form did not appear until 1875, as *Historia Filicum.* This work includes a presentation of the history — using the word in its English sense; SMITH's use was Greek — of the subject, so complete that it may

be referred to rather than repeated here. SMITH distinguished 217 genera, again omitting *Marsileaceae* and *Salviniaceae*. SMITH knew his ferns as living things — he once stated that he had grown a thousand species from spores — and his judgments were entitled to a respect they have never received.

FÉE published a series of Mémoires, of which the one of most interest here is his *Genera Filicum*, customarily dated 1850-52, the exact dates of its parts being unknown. He recognized 181 genera in what he called *Polypodiaceae*, including, as I have done, *Cyathea* and *Dicksonia* and their relatives.

In the time of SMITH and FÉE, and such contemporaries as KUNZE, immediately preceding the appearance of the *Origin of Species*, pteridology was probably the most advanced division of botany. Affinity was a word in common use, and, except that it lacked a philosophical foundation, it seems to have meant very much what it means to-day. Under the incubus of HOOKER's prestige, earned by his monumental work on species and effective in spite of his archaic attitude on genera, pteridology lost its advanced position, and in forty years became one of the most backward divisions.

The first protest against this condition, except for SMITH's which no man might hear, was by CHRIST, in *Farnkräuter der Erde* (1893). The revulsion became effective with the appearance of the volume on Pteridophyta, largely by DIELS (1898), in the *Natürliche Pflanzenfamilien* of ENGLER and PRANTL. Perhaps because METTENIUS, the last eminent Berlin pteridologist, had shared the attitude of HOOKER, DIELS did not, in the material content of his work, catch up with SMITH and FÉE, but its guiding principles were worthy of its time. Its numbered genera are 141.

The effectiveness of the new prestige of Berlin was promptly shown by CHRISTENSEN's *Index Filicum* (1906), listing 146 genera, almost exactly the ENGLER and PRANTL list, except as some names were changed in conformity with rules. The increase in number was due to genera described as new in the interim. In the three supplements to the Index, the last in 1934, CHRISTENSEN tried to avoid changes, preferring to hold them for a new edition, with complete revision; nevertheless, the number grew to 213. Through these years, CHRISTENSEN changed from a bibliographer, content with a list of genera imposed by authority, to a keen student of genera in his own right. In his last publication on the subject, in VERDOORN's *Manual of Pteridology*, the number of recognized genera is not quite clear, but is probably 247.

Very recently, R. C. CHING, Sunyatsenia 5 (1940) 201, has proposed the division of the *Polypodiaceae* of CHRISTENSEN's Index into 33 families, and has listed the genera in each. These genera number 257, which is 28 more than I present within the same limits. The slight difference shows that our concept of a genus is practically the same.

A genus is a single isolated species or a convenient group of related species. Primary emphasis is on the word related; convenience is a secondary consideration; and there are no others. I do not try here to define a species. It is no fixed concept. I construe it more narrowly than did HOOKER, but do not know that my idea is very different from that of DARWIN, or SWARTZ, or LINNAEUS. To use a commoner synonym, a species is a *kind* of plant. Whatever one means by a species, my definition

of a genus will stand. In pre-Darwinian science, the corresponding definition would have been "a convenient group of similar species."

The fact that we can see, define, analyse and appraise similarity, while we can only deduce relationship from resemblance, does not alter or impair the further fact that to-day's taxonomy has no trustworthy foundation except relationship, or, to use a word commoner in science, affinity. The confidence with which we predicate affinity is a matter of degree, and the progress of this kind of science consists essentially of the collection and digestion of evidence which enhances our confidence in our judgments. The genera which conform most perfectly with our proper demands are those whose affinity is above question, whose immediate phylogeny is clear — genera like *Diblemma, Hemigramma, Haplodictyum* and *Cochlidium.*

It is true, but not a ground for satisfaction, that we hold many genera in full respect simply because they are so essentially different from anything else that we cannot even guess at their immediate phylogeny. Such genera are *Matonia, Plagiogyria, Osmunda* and *Thyrsopteris.* These are indeed "good" genera. But to regard them as better because their origin is unknown is to rate our ignorance as better than our knowledge.

Subject always to the primary demand for naturalness (phyletic unity), we are completely free to be guided by convenience in determining the limits of a genus. This is made clear, if any argument is needed, by comparison with the family of men, a valid comparison, not a mere analogy. The parents and their children constitute a family, two generations. So equally do grandparents and their descendants; so likewise, great-grandparents and their family of four generations. The Roman group known by the cognate term *gens* was in theory still a family, bound together by common blood. In the more stable culture of the Chinese, family ties are recognized however remote the common ancestor, over several thousand years in actual practice. With equal right, we recognize the Chang of China, with a common ancestor sixty or more generations ago, and an American family in which the parents immigrated, breaking all old ties and adopting a new name, and so modified, albeit superficially, by the environment, that if they met their cousins the affinity would not be suspected.

So a genus *Asplenium* may comprise all descendants of a common ancestor of thirty million years ago. But if it suits our convenience, we may segregate as a genus the descendants of an *Asplenium* of a million years ago, and give this group a distinctive name — as *Phyllitis,* or *Camptosorus,* or *Diplora,* or *Antigramma.* Nothing but convenience determines which, or all, or if any of these should be recognized as genera. And convenience is a function of our knowledge and understanding. It is not to be expected that we will all agree as to convenience, and still less that convenience will remain the same while knowledge increases.

Good examples of change in convenience have just been named. It was convenient for LINNAEUS to include *Scolopendrium* in *Asplenium.* Then, for nearly two centuries it suited most botanists to treat it as a genus, named *Phyllitis* or *Scolopendrium.* Other species were discovered, which conformed to the generic description and were conveniently included. But later it became evident that these species, called *Phyllitis* or *Scolopendrium,* in the New Guinea region, in South America, in China, and in Mexico, although all descended from *Asplenium,* were mutually independent in

their origin. At this point, the master-criterion. unity of descent, naturalness, controls us. We can recognize six genera, all alike in the soral characters used to define *Phyllitis*. Or we can return all of these species to *Asplenium,* since they are its descendants. Or we can return a part of them to *Asplenium,* keeping distinct such as, aside from the sorus, have characters by which they can be defined.

What seems most convenient to-day and to me is to return *Phyllitis,* which is of Northern lands, *Diplora* of the New Guinea-Philippine region, and *Boniniella,* the Chinese variant, to *Asplenium;* but to hold the plants of Brazil and Mexico as distinct genera, *Antigramma* and *Schaffneria*. This course involves some inconvenience, in the definition of *Asplenium,* but not so much as would be involved by the recognition of six genera, all alike in the conspicuous character originally sufficient for the definition of *Phyllitis*.

In the appraisal of convenience, each case should be judged by itself. In general, ease of recognition and definition justifies the separation of genera with strongly dimorphic fronds from parent genera with uniform fronds. More than a score of our genera would have been included in the *Acrostichum* of LINNAEUS, SWARTZ and HOOKER, and as many more in HOOKER'S *Gymnogramme*. We could not restore the old *Acrostichum* and *Gymnogramme,* but we could include very many of these genera in what we now recognize as parent genera. While we hold them distinct, we still maintain *Loxogramme* as a genus, typically with uniform fronds, but including several species with subdimorphic fronds, and two species, not directly related, which exhibit extreme dimorphism. *Oleandra* has always had uniform fronds, but two species are now known with fertile fronds too contracted to be self-supporting. Uniform and dimorphic species have long been included in *Humata;* the dimorphic species do not constitute a natural group, and are therefore not subject to collective segregation. Precedent has little or no proper weight in making these decisions.

From decade to decade, the number of recognized genera increases. Most obviously, this results from the discovery of new species representing new genera. Increase in number is a possible consequence of the vanity and ambition of botanists. It results sometimes from the more careful study of species already known. Japanese botanists have described and named a number of genera as the result of study of their vascular structures. I do not recognize these; to do so would be too inconvenient; but such study of numerous species might compel the recognition of some such genera, by correcting our assumptions about phylesis. The number of genera may increase in mere harmony with the trend of the times, as it becomes customary to attach significance to differences once considered trivial; or, with increase in the number of species, to divide genera as a matter of convenience. Finally, the change in generic concept, from a group of similar species to a group of related species, has resulted almost inevitably in an increase in the number.

Nobody questions that the human family is a group of individuals, whatever its size, definable by its ancestry, and only thus, describable rather than definable by its common inherited characteristics. Equally, and as unquestionably, the genus exists, is a concrete entity. I am not writing about concepts or abstractions, but about the actual components of the

fern vegetation of the world. It would better suit the convenience of most people if ferns were classified by definitions. LINNAEUS, and SWARTZ, and PRESL and HOOKER classified them so. Their genera were figments of the human brain, not the components of nature. As a mere matter of convenience, it is unfortunate that we can no longer deal with their kind of genera.

The plants themselves provide the material for decisions as to what genera we should recognize. After these decisions are made, it remains to determine the names the genera should bear, and these names are determined not so much by the plants as by what has been written about them. In most cases, the proper name is clear. When it is not so, we ascertain it by the application of a code carefully prepared on the basis of long experience with genera. Some botanists have seemed to expect that the strict application of a code would rid our nomenclature of all confusion, perhaps forgetting that the law is based on longer experience and has been interpreted with more care and perhaps more competently, but that lawyers still live by disputes about its application. I would have liked to apply the code strictly; would particularly have liked to do this because my decisions, published in a work of this kind, may have some weight as precedents. But I find, as countless others have found, that in some cases doubt persists in the application of the code; and that in others the result of its application is too disagreeable for ready acceptance.

As to the latter class of difficulties, our congresses have adopted the policy of conserving by competent fiat certain familiar generic names. Of fern generic names, *Pteridium, Cystopteris, Dryopteris* and *Ceterach* have been so conserved. It is well known that some other names, some of them almost sanctified by usage and familiarity, require this protection. Rather than displace them, as strict application of the rules would require, I retain them and recommend their conservation by the next congress. Among these are *Angiopteris, Schizaea, Anemia, Pyrrosia* and *Coniogramme.*

In cases where the application of the rules involves doubt, I have tried to decide each case individually. The rules say that each genus should have a type species, and each species a type specimen. By implication, the type specimen of the species is the type specimen of the genus, if — which may not have been contemplated — the genus has any material type. Before this doctrine of types was adopted or foreseen, a genus was a concept with a definition, but it is still possible in most cases to go back and designate a type species with confidence. Three illustrations of doubt or difficulty will suffice in this introduction. Others, some of them quite different, will be found under the several genera.

1) *Craspedodictyum.* — I described this genus naming *C. quinatum, Acrostichum quinatum* HOOKER, as the type species. In describing this species, HOOKER cited specimens from two widely separated localities, from both of which I have specimens. They are congeneric, but doubtfully conspecific. To obviate any doubt, I cited a specimen in my own herbarium as the type of the genus. This action has no sanction in the code; but in my opinion a genus should have a type specimen for exactly the same reason that a species needs one. Usually, but not always, the same specimen will typify both species and genus.

2) *Ptilopteris.* — HANCE provided a good generic description and named two species, both now well known, and not congeneric. One species fits the generic description; the other does not. In my opinion, the one which fits the description is the type

species, regardless of any reasons for choosing the other. There are some such reasons, and on the strength of them HAYATA renamed the genus as *Monachosorella,* and reduced *Ptilopteris* to synonymy with *Polystichum.*

3) *Dictymia.* — JOHN SMITH described this genus with a single named species, *D. attenuata, Polypodium attenuatum* R. Brown of Australia. Almost immediately, he published a more complete, concordant description, accompanied with an illustration of a New Zealand plant mistakenly believed to be the same species. I do not regard the two as congeneric. BROWN'S species is the proper type, but the better presentation of the New Zealand species has made the status of the genus uncertain for a century.

For a case involving several kinds of uncertainty as to typification, see *Goniophlebium.*

The postulate of an ancestor, descent from which is the essence of the naturalness of a group, involves the assumption of a time and a place for this ancestor. By any degree of probability with which we can approximately fix this time and this place, we improve our understanding of the ancestry of the group. And this understanding is the goal of taxonomic study. The fixing of time, of the age of a genus, is obviously relative, usually hardly approximate.

Fossils provide botanists with their commonest evidence as to age, and there is a general belief that ferns are a favored group in this respect. Except as to quite primitive ferns, their fossil record seems to me to be singularly uninteresting. It seems to have a gap, like that between the Siege of Troy and the First Olympiad, during which almost all of our larger genera were evolved. *Gleicheniaceae,* for instance, are known by fossils of Northern lands, perhaps forty million years old; but there is no suggestion of continuity between the flora of which they were a part and the fern world of to-day. Fossils are instructive, as they show how very long ago ferns reached the evolutionary level of *Gleicheniaceae, Lygodium* and *Matonia,* but help us less than morphology does to close the gap between this level and that of the great mass of the ferns, which we have been treating collectively as *Polypodiaceae.*

By integrating time and space in our thought while we examine the evidence presented by the distribution of extant ferns, we can throw a flood of light on their history. We have long been used to explaining distribution in Northern lands by the known geologic history of that part of the globe. The discontinuous distribution of a few genera in the far South has also been noted for nearly a century, first, I believe, by J. D. HOOKER. Several years of careful study of the *Hymenophyllaceae* showed that the family as a whole is austral in present distribution; that its isolated genera are found in the South, and along lines of migration, and nowhere else; and that the larger, presumably more primitive genera are all discontinuous in present range. A monographic study of *Grammitis,* a genus of 150 species, revealed the same conditions.

The presence in places far apart of the same species or related species proves migration in past time from one place to the other or from a common source. The distribution of land and water in the South Temperate Zone, and particularly in the colder latitudes, is such that direct migration from one land area to another looks impossible. However, farther South, and now uninhabitable, is the Antarctic Continent, in the place where a common source of the floras of Fuegia, New Zealand, Tasmania, Kerguelen and

The Cape would have to be sought. The evidence that there was this common source is so strong that we would be forced to assume, if assumption were necessary, that Antarctica, like Greenland, was at some time habitable by ferns.

Fortunately, the assumption is unnecessary, because geologists tell us that Antarctica has been fit for vegetation at various times in the past, and that the last such era ended during the Miocene. Measured in years, this was a long time ago. To use round figures, representing orders of magnitude, not dates, we may say that free migration in the circumarctic zone ended one million years ago; in the antarctic region, twenty million years ago. Free migration in the North has had apparently little effect on tropical fern floras, and was so recent that almost every Northern fern genus is common to the Eastern and Western hemispheres. In the South, the hemispheres have been isolated twenty times as long, and many genera are peculiar to one or the other.

Practically the whole fern world of the tropics is descended from the ferns of old Antarctica. In my basic treatise on this subject, Philippine Journal of Science 70 (1939) 157, I concluded (p. 186) "that more than half of the living fern species are descendants of migrants from Antarctica." Nine-tenths are more than half, and I now believe that this larger part of the species and genera of ferns are of Antarctic ancestry.

With this thesis as to the source of tropical ferns, an understanding as to paths and direction of migration is naturally integrated. It becomes clear that the ferns of the oriental tropics, coming originally probably through New Zealand, have migrated Westward from the Solomons and New Guinea — as ought, indeed, to have been supposed long ago, since the prevailing wind is in that direction.

It is obvious that with this understanding of the immediate and more remote origin of our ferns, we have the most valuable possible guide to their phylogeny. We look to New Guinea for the ancestry of a Mindanao fern, not, as we used to do, to Borneo, or Java or India; and if we are dealing with a species we are likely to find it. If we are seeking a common source of groups of species, as for a common ancestor of *Phymatodes* and *Microsorium,* we look farther, and find in the New Zealand region approximate ancestors of these, and of *Crypsinus* as well.

At this point, dealing with time and geography and phylogeny, I must disagree emphatically with those who look to the periphery of the area occupied by a genus for its most primitive members. The basis of this idea may be the proposition that the oldest species have had time to migrate farthest, which is evidently true. But the evolution from them of younger, less primitive species has been under the influence of the environment, naturally encountered in the course of and in consequence of migration. Except under very special conditions, I cannot imagine a species becoming extinct in its original habitat, but persisting under the different conditions encountered in new places. At any rate, it is certainly the case with ferns that the most primitive, even archaic, representatives of many groups are to be found as near as is now possible to their Antarctic source.

A treatise on the genera of ferns is so large a part of a treatise on their classification that it cannot ignore the rest of the field. The genera must be placed in families, and the families in orders. Like the genera, these are

natural groups; must be natural. Subject to the imperative demand for naturalness, they should be convenient. The size and number of the families we recognize depend upon our ideas of convenience. Until three decades or so ago, pteridologists were agreed in including all of the "higher" ferns in one great family, *Polypodiaceae,* ideally characterized by a longitudinal annulus.

Unfortunately for our convenience, it became evident that that family *Polypodiaceae* was polyphyletic — a more explicit synonym of unnatural. Aside from some groups of still uncertain phylogeny, it included three great phyla, each of more than 60 genera. A polyphyletic family is not a family at all. If the three great phyla had been practically definable, the proper course would have been clear, to treat them as three families. Since the three are very difficult to distinguish by definition, I tried to make the family natural by enlarging it to include a common ancestor of all its elements. I have reluctantly abandoned this attempt, convinced that to succeed it would be necessary to include *Gleicheniaceae* and *Schizaeaceae,* which would be carrying a good idea altogether too far.

When one adopts the other course, breaking the old *Polypodiaceae* into natural groups treated as families, there is no practical limit to their number. The several smaller groups of genera, typified by *Davallia, Blechnum, Asplenium* and *Vittaria,* easily and reasonably included in the old *Polypodiaceae,* are not with similar propriety to be included in any of the great phyla comprised by that family. They too become families. Then, in the exercise of the varying judgments of different men, families are created or distinguished for the genera which fit possibly or probably but not certainly into the seven families already suggested, and we get *Cheiropleuriaceae, Culcitaceae,* and a host of others. CHING has proposed 33 families, fragments of the *Polypodiaceae* of the *Index Filicum.*

As in the case of the genera, the families must have names, and these have to be determined and sponsored on the basis of what has been written about the ferns. I have been fairly amazed by the difficulty encountered in determining the proper names of the families and the authors of these names. This should be done under the guidance of a code, and the only code is that adopted by the International Congress of 1930, published in 1935. The pertinent provision is a foot-note to Article 16: "In genera and groups of higher rank, the valid name is the earliest name published *with the same rank*" (italics mine) — earliest meaning in or after 1753.

This and the associated rules are based on experience with genera, and in general work well with genera. Genus has meant practically the same thing to all botanists for two centuries or longer. The rules are inapplicable to families, because the term Family has had a great variety of meanings. The most dependable mark of identification as the name of a family is the termination "aceae," since this is stipulated by the code. Of fern families, ROBERT BROWN published *Polypodiaceae* in 1810, apparently as an order, and at any rate in synonymy, which invalidates it. He also published *Marsiliaceae,* explicitly as an Ordo. He is commonly cited as authority for both, as names of families. S. F. GRAY, in 1821, used *Polypodiaceae* as subdivision B of his Family Filices. This is our use of the term, except that Filices are now an order and we call *Polypodiaceae* a family. GRAY also used *Marsiliaceae* explicitly as a family name, but meant what we mean

by an order. The most of the fern families bear names dating between 1820 and 1860, but I do not believe there is one of them free from some objection under the code.

The world became familiar with the family as a category between genus and order from its use by SACHS in his *Lehrbuch der Botanik,* in 1868. SACHS got his scheme from that of A. BRAUN in ASCHERSON'S *Flora d. Prov. Brandenburg,* of 1864. Because family and order owe their present recognized position to SACHS, I believe that priority in family names ought not to go back of 1868, at the earliest. An obvious alternative is to fix their status by conserving them, as was done for 186 families of flowering plants by the International Botanical Congress of 1935. But conservation of names has its perils.

I am not trying to make rules. Having no usable code as a guide, but having to use names, and wanting authority for them, I follow a suggestion of Doctor REHDER, and state the category to which the family name was applied by its author.

I will not presume to elaborate the second justification for this book. It is full forty years since my first description of a new genus, *Christiopteris.* Of the genera herein enumerated, 33 are on my authority. I have revived or validated 69 others, some time discredited. Over the same four decades, phylogeny has been my principal interest — longer, in fact, because I absorbed it fifty years ago as a student of Professor CAMPBELL. I published a family tree of *Polypodiaceae* in 1906, in a paper, *The Comparative Ecology of San Ramon Polypodiaceae,* quite creditable in other respects. In 1929, in *Oriental Genera of Polypodiaceae,* a sort of prodromus to the present book, I stressed and exemplified the principles of fern classification, more thoroughly than it seems necessary to repeat.

It is a maxim that, to know genera, one must know all of the species. This is a practical ideal as to small genera, but not as to large ones. Even in SWARTZ' time, many species were mysterious. CHRISTENSEN visited and worked in most of the European herbaria, was able to borrow freely from abroad, and doubtless saw more species than any other man has ever done, but had constantly to avow ignorance of species still doubtful. One writing about genera might be expected to have personal acquaintance at least with those given a place in the enumeration; but even this is not quite possible, at present, if ever. A number of genera — as *Luerssenia, Cerosora, Parasorus, Saffordia* — are known by single collections. A number of others are but little better known or more available for study. Of the 305 enumerated, I have been unable to see six.

A century ago, it was a fortunate time for a fern specialist to live. The recent past has been another such period. CHRIST was my early mentor. CHRISTENSEN'S period of activity has been quite exactly my own. MAXON began just before us. WEATHERBY and MAXON'S assistant, MORTON, are more than worthy colleagues. HOLTTUM and ALSTON have kept English interest alive. HAYATA, TAGAWA and others have created a position for Japan. DIELS, BRAUSE and ROSENSTOCK have upheld German prestige. BONAPARTE and Mme. TARDIEU-BLOT have kept France in the field, as VAN ALDERWERELT VAN ROSENBURGH and POSTHUMUS have done for the Netherlands. Just now, Mrs. GAY-SMITH and WAKEFIELD display a new and active interest in Australia. Most indefatigable under the direst diffi-

culties is CHING, earning for China a new place in scientific progress. While this unprecedented galaxy of descriptive pteridologists and taxonomists worked in its own ways, the necessary associated field of morphology has kept apace, promoted particularly by GOEBEL, BOWER and CAMPBELL.

New collection has enriched our herbaria to an extent not at all anticipated at the beginning of the century. Beginning, in this period, with the Philippines, every part of the world has contributed its share, the most surprising yields, in quantity and novelty, coming from China and New Guinea. The most remarkable collections coming into my hands have been by C. J. BRASS in New Guinea, and H. S. PARKS in Polynesia. I would also express particular appreciation of the collections of two ladies, Mrs. MARY STRONG CLEMENS in Borneo and New Guinea, and YNEZ MEXIA throughout Latin America.

CLASS FILICINEAE

Plants with a conspicuous alternation of generations, of which the better developed is the sporophyte, sexually produced and producing spores; leaves typically large and highly developed in comparison with the stem; male gamete a multiciliate, free-swimming spermatozoid.

ORDER 1 — OPHIOGLOSSALES

Terrestrial (with two exceptions) herbs; stem short, fleshy, not scaly; fronds solitary or few, straight (or bent, not circinnate) in vernation, of moderate size; fertile fronds (with few exceptions) consisting of a sterile segment like a sterile frond, from which, on stipe or lamina, springs the fertile segment; sporangia produced from plural subepidermal cells, large and containing many spores, walls more than one cell in thickness, without annulus; prothallium of terrestrial species hypogaeous, tuberous, provided with mycorrhiza, without chlorophyll.

The most evidently primitive Filicineae, probably descended directly (*i.e.*, without intermediate Pteridophytes) from ancestors most nearly represented, among surviving plants, by *Anthoceros*.

A single family, with the same characters as the order:

OPHIOGLOSSACEAE

This name originated with PRESL, Tent. (1936) 10, as the name of an order, and without definition. Still as an order, it was defined in Suppl. Tent. (1845).

Fifty to 90 species, in four genera.

Sporangia borne on a segment of a typically partly sterile frond.
- Sterile blade simple, veins anastomosing ..... **1. Ophioglossum**
- Both segments compound, veins free
  - Sterile blade pinnate or decompound ..... **3. Botrychium**
  - Sterile blade palmately divided ..... **4. Helminthostachys**

Fronds completely dimorphous ..... **2. Rhizoglossum**

1. Ophioglossum

Ophioglossum L., Sp. Pl. (1753) 1062; Genera (1745) 503.
The name goes back to BAUHIN (1620).
Ophioderma (Blume, Enum. (1828) 259, as Section of *Ophioglossum*) Endl., Genera Pl. (1836) 66; Presl, Suppl. Tent. (1845) 55.
Cheiroglossa Presl, Suppl. Tent. (1845) 56.

Vegetative frond simple and usually entire, more or less fleshy, with reticulate venation; fertile frond consisting of a sterile segment like a vegetative frond, and a single (rarely plural) fertile segment springing from the sterile, the fertile segment a compact stalked "spike", with a row of large immersed sporangia in each side, the sporangia opening by transverse slits.

TYPE: *O. vulgatum* L., Sp. Pl. 1062.

In a recent monograph, CLAUSEN, Mem. Torrey Bot. Club 19 (1938) 111, recognizes 28 species, including *Rhizoglossum*. Other writers less addicted to subspecies run the number up to 54, besides two described by CLAUSEN. These are scattered with

remarkable uniformity over the habitable globe. Some of the species are wide-ranging, apparently variable, and ill defined. The genus is believed to be very ancient, but there is no fossil evidence on the subject.

As here constituted, the genus comprises three subgenera:

1) *Euophioglossum,* almost all of the species, always small and terrestrial, the lamina always entire, rarely as narrow as linear.

2) *Ophioderma,* typified by *O. pendulum* L., an epiphyte, with narrow pendent fronds up to a meter in length, not rarely forked, rarely with paired fertile segments. Range: India to Formosa, Australia, Polynesia and Hawaii, reported from Madagascar. Because it is connected with *Euophioglossum* by intermediate species—*O. Moultoni* Copel, and a similar or identical plant of the Solomon Islands, and *O. intermedium* HOOKER, Malaya to Luzon, *Ophioderma* may not well be raised to generic status. There are also three species, *O. simplex* Ridley; Bower, of Sumatra, *O. lineare* Schlechter and Brause, of New Guinea, and *O. Ramosii* Copel., of the Philippines which have almost or quite lost the sterile segment of the frond. These have become thus simplified by reduction, and are regarded as reduced representatives of *Ophioderma.* Apparently, they might with equal propriety constitute another subgenus; but no one of them is well enough known to provide any assurance that it does not produce sterile fronds.

3) *Cheiroglossa,* a single species, *O. palmatum* L., the sterile segment palmatifid, and with plural fertile segments. Range: the American Tropics to Florida; Indo-China; Réunion and Madagascar. The Mascarene form, var. *malgassica* C. Chr., is somewhat distinct. *Cheiroglossa* is more susceptible than *Ophioderma* of recognition as a genus.

2. Rhizoglossum

Rhizoglossum Presl, Suppl. Tent. (1845) 47. Subsequent writers have treated this plant as a section or subgenus of *Ophioglossum,* but have usually so defined *Ophioglossum* as to exclude it.

Fronds fasciculate, dimorphous; sterile frond normally terete, fleshy, venation unknown, the stipe with a single bundle (*teste* Presl; the bundles in the stipe of *Ophioglossum* are plural); fertile frond on a longer stipe, followed by a short "spike" and sterile apex. All recent writers agree in regarding these distinctions as justifying generic separation in the *Polypodiaceae.*

TYPE and only species: *R. bergianum* (Schl.) Presl, *Ophioglossum bergianum* Schlechtendahl, a rare little fern of South Africa.

ICONES: HOOKER, Icones Pl. No. 263; SIM, Ferns of South Africa, 2nd. Ed. Pl. 167, f. 1 (text, p. 319).

3. Botrychium

Botrychium Swartz, Schrader's Journ. (1801) 8, 110; Synopsis XIV, 8, 171.
Botrypus Richard, Cat. Hort. Med. Paris (1801) 120, not seen; Michaux, Fl. Bor. Am. II (1803) 274.
Sceptridium Lyon, Bot. Gaz. 40 (1905) 457.
Japanobotrychium Masamune, Journ. Soc. Trop. Agric, Formosa 3 1931) 246.

Sterile segment of the frond pinnate in plan and usually compound, veins free; fertile segment normally representing the pair of basal pinnae of the frond, usually paniculate, the sporangia globose, not immersed, each opening by a transverse slit.

TYPE: *B. Lunaria* (L.) Swartz, *Osmunda Lunaria* L.

A cosmopolitan genus, the number of accepted species running from 23 (CLAUSEN) to 36 (CHRISTENSEN); they fall into three fairly definable subgenera or sections.

1) *Eubotrychium.* Small plants, the sterile lamina pinnatifid or pinnate and the pinnae sometimes palmatifid, glabrous and fleshy. Mostly northern, but with two far-southern species.

2) *Phyllotrichium* Prantl, Ber. deut. bot. Ges. 1 (1883) 349. Larger and more compound; cosmopolitan. LYON'S study of the embryology of *B. obliquum* Muhl.

showed the development of a long suspensor growing down into the prothallium, and consequently of a root growing through the prothallium into the soil. Because of this striking peculiarity, he proposed the genus *Sceptridium,* and included in it the other species of this section, 19 in number. As the presence or absence of the suspensor has been established for very few species, this genus is hard to appraise; if such a genus be recognized, it will bear LYON's name, and PRANTL's section name will be a synonym.

3) *Osmundopteris* Milde, Fil. Europae etc. (1867) 209. Still larger, decompound, thin, the bud hairy and the lamina sometimes so. Mostly northern, never far-southern.

I have never seen *Japanobotrychium,* but suspect its distinctness, both generic and specific. It is described as an epiphyte, from Mt. Arisan, Formosa. In montane tropical forests, epiphytic individuals of normally terrestrial species are common.

4. Helminthostachys

Helminthostachys Kaulfuss, Flora (1822) 103; HOOKER, Genera (1840) Pl. 47 B.
Botryopteris Presl, Rel. Haenk. I (1825) 76.
Ophiala Desvaux, Prod. (1827) 195.

Rhizome creeping; sterile segment of frond palmately compound, veins free; fertile segment springing from the base of the sterile but sometimes adnate for a short distance to one of its divisions, stalked, compound but so condensed that it is stipate in general form; sporangia crowded, not immersed, ovoid, each opening by a longitudinal slit.

TYPE: *H. zeylanica* (L.) Hooker, as *H. dulcis* Kaulfuss, which is a synonym.

A single species, variable in size and dissection, from India to Formosa and New Caledonia. The young fronds, before expansion of the lamina, have some importance as food. The fronds are usually found solitary, but can be produced at intervals as short as six weeks, as many as five remaining active at once.

ORDER 2—MARATTIALES

Terrestrial plants; fronds small to huge, circinnate in vernation, compound (rarely with a single leaflet), attached to rhizome or globose stem by an enlarged joint flanked by stipule-like outgrowths of the stem, pinnae similarly jointed to the rachis or top of stipe; sporangia in elongate or round dorsal sori, each sporangium derived from plural cells and with a wall more than one cell thick, opening by a ventral longitudinal slit (contracted to a terminal pore in *Danaea*); prothallium epigaeous, green, with mycorrhiza.

A very natural order, comprising four groups which may be treated as families. CHRISTENSEN, in VERDOORN'S Manual (1938) 527, 528, recognizes two families, *Angiopteridaceae* and *Marattiaceae*, the latter including *Marattia, Christensenia* and *Danaea*. I do not follow him, because *Marattia* seems more nearly related to *Angiopteris* than to *Christensenia* or *Danaea*. CAMPBELL, Evolution of Land Plants (1940) 333, suggests that *Christensenia* be segregated as a family (*Kaulfussiaceae*), leaving all other genera in *Marattiaceae*. If more than one family be recognized, there will best be four; but this is not demanded by phylogeny, and would not serve convenience. Therefore, and in accord with general usage, I recognize a single family, with the characters of the Order:

MARATTIACEAE

Marattiaceae Kaulfuss, Enum. (1824) 31, as *Ordo.*
Danaeaceae, Agardh, Aphor. (1822) 117, as *Ordo.* This is the older ordinal name.
Angiopteridaceae C. Chr., in Verdoorn, Manual (1938) 527.
Kaulfussieae Presl, Suppl. Tent. (1845) 17.

Key to the Genera of Marattiaceae: —

Sporangia free,—*Angiopterideae.*
- Fronds bipinnate ..... **1. Angiopteris**
- Fronds simply pinnate.
  - Stem globose, sori submarginal ..... **2. Macroglossum**
  - Stem dorsi-ventral, sori medial ..... **3. Archangiopteris**

Sporangia fused into synangia.
- Stem globose—*Marattieae* ..... **4. Marattia**
- Stem dorsi-ventral.
  - Venation reticulate, sori round—*Kaulfussieae* ..... **5. Christensenia**
  - Veins free, sori linear—*Danaeiae* ..... **6. Danaea**

1. Angiopteris

Angiopteris Hoffmann, Comment. Soc. Gott. 12 (1796) 29, *non* Adanson (1763) *quae Onoclea.*
Clementia Cav., Descr. Pl. (1803) 553.
Psilodochea Presl, Suppl. Tent. (1845) 27.

I retain *Angiopteris,* the generic name in universal use, in the hope that it will be validated by fiat.

Huge ferns with globose, radially symmetrical adult stems; fronds bipinnate; veins free; sori dorsal near the margin, elongate along the veins,

sporangia in double rows, usually under twenty, contiguous but not coherent. A group of dark cells at the top of the sporangium has been called an annulus but is not homologous with the annulus of *Filices*. Recurrent false veins, and a so-called indusium subtending or surrounding the sorus, are found in many species, but do not characterize natural groups.

The number of accepted species ranges from 1 (one), in the Synopsis of HOOKER and BAKER, to 111, listed with misgivings by CHRISTENSEN, Index and Supplements. The number of distinct known species is large, but there has been no monograph since that of DE VRIESE and HARTIG (1853), which set the example of excessively fine species-discrimination.

RANGE: Madagascar across Polynesia, north to Japan.

TYPE: *A. cvecta* (Forster) Hoffmann, *Polypodium cvectum* Forster, of Tahiti. If *Clementea* be adopted as the generic name, the type is *C. palmiformis* Cav., more commonly but improperly known as *Angiopteris angustifolia* Presl.

2. Macroglossum

Macroglossum Copeland, Philip. Journal Sci. 3 Bot. (1909) 342, Pl. 1; 4 (1909) 9, Pl. 5; Campbell, Philip. Journal. Sci. 9 Bot. (1914) 218, Pl. 1 and four text figures.

Adult stem large and globose; fronds very large, simply pinnate; veins free, recurrent veinlets wanting; sori dorsal but reaching the margin, contiguous, each consisting of very many sporangia in a groove on each side of a vein, the sporangia crowded but not fused. Related to *Angiopteris*, and perhaps to *Archangiopteris*. Known in Borneo and Sumatra.

TYPE: *M. Alidae* Copel., from Bidi, Sarawak, Borneo, *1.* C. J. BROOKS. The one other supposed species is *M. Smithii* (Racib.) Campbell. I mistrust their distinctness, because neither has been collected sufficiently to insure the stability of the distinctions, and *M. Smithii* was described from a rather weak plant, which I have seen in the Buitenzorg Garden.

3. Archangiopteris

Archangiopteris Christ et Giesenhagen, Flora 86 (1899) 72, 77, figs. 1-5.
Protomarattia Hayata, Bot. Gaz. 67 (1919) 88, Pl. 1.
Protangiopteris Hayata, Bot. Mag. Tokyo 42 (1928) 305 (Japanese), 346 (Latin), with figure.

Stem a short dorsi-ventral rhizome; frond simply pinnate, smaller than in *Angiopteris* and *Macroglossum*, veins free; sorus elongate along the vein, sometimes forking with it, not in contact with other sori, remote from costa and more or less remote from margin. Related to *Angiopteris*, but less nearly than *Macroglossum*.

TYPE: *A. Henryi* Christ & Gies., from Yunnan, south-east of Mengtse, *Henry 11544.*

RANGE: Yunnan, Tonkin, Formosa. Four species are recognized, of which only one has been collected twice; they are suspiciously alike.

Protomarattia tonkinensis Hayata, the only species ascribed to the genus, is, *fide* CHRISTENSEN & TARDIEU in LECOMPTE, Fl. Gén. Indo-Chine VII (1939) 17, *Archangiopteris tamdaoensis* Hayata.

Protangiopteris was segregated on anatomical characters. So long as phylogeny does not demand separation, I will recognize no genus which can not be distinguished without dissection.

4. Marattia

Marattia Swartz, Prod. Fl. Ind. Occ. (1788) 128.
Calanthera Thouin, Acad. Sci. Paris (1786), not properly published.
Myriotheca Commerson in Jussieu, Gen. (1789) 15; Poir., Enc. (1797) 403.

Eupodium J. Smith in Hooker, Genera (1842) Pl. 118.
Discostegia Presl, Suppl. Tent. (1845) 11.
Gymnotheca Presl, Suppl. Tent. (1845) 12.
Stibasia Presl, Suppl. Tent. (1845) 15.

Adult stem globose; frond bipinnate or tripinnate, veins free; sori dorsal on frond and vein, each composed of a short double row of sporangia tightly fused into a synangium, which splits over the vein exposing the ventral face of the sporangia (loculi), each of which then opens by a ventral longitudinal slit.

TYPE: *M. alata* Swartz, of Jamaica.

Sixty supposed species, pantropic, and in South Africa and New Zealand, suggesting that the extant species are antarctic in ancestry.

Myriotheca and *Discostegia* are complete synonyms, having the same type species, *M. alata.*

Eupodium, typified by *M. Kaulfussii* J. Sm., is distinguished by having the synangium raised on a stalk, sometimes longer than the height of the synangium. Aside from its lack of phyletic significance, this is a weak generic distinction, because the stalk is commonly shorter and flattened in the direction of the vein, rarely about as long (along the vein) as the synangium, rarely obsolete; I have seen all conditions on a single frond.

Gymnotheca, typified by *M. cicutifolia* Kaulf., was to be distinguished from *Marattia* by the absence of an indusium. No *Marattia* has an indusium homologous with that of many or most *Polypodiaceae,* but many species do have a basal outgrowth homologous with that of *Angiopteris,* already referred to. It does not seem to characterize a natural group of species.

Stibasia, typified by *S. Douglasii* Presl, *Marattia Douglasii* (Presl) Baker, of Hawaii, was distinguished from *Marattia* by absence of indusium and globose receptacle, from *Eupodium* by sessile synangia, and from *Gymnotheca* "quoque receptaculo globoso praeter habitum alienum." It is fully tripinnate, with short-oblong ultimate pinnules.

Three New Guinea species, *M. Werneri* Ros., *M. tafaensis* C. Chr. and *M. coronata* Copel., have the ultimate pinnules still more numerous and smaller, even down to 6 mm long. Correlated with this reduction, the synangia are necessarily few on each pinnule—about three on *M. coronata,* a single one, on the costa, of *M. Werneri,* for which ROSENSTOCK proposed a section name, *Mesosorus. M. melanesica* Kuhn is intermediate between these species and *M. Douglasii.*

5. Christensenia

Christensenia Maxon, Proc. Biol. Soc. Washington 18 (1905) 239.
Kaulfussia Blume, Enum. (1828) 260, *non* Dennstaedt *nec* Nees.
Macrostoma Griffith, Asiatic Res. 19 (1836) 94, Pl. 18; Journ. of Bot. (Hooker) 2 (1840) 375, Pl. 11, 12; Icones Pl. Asiat. II (1849) Pl. 137, *non* Hedwig.

Rhizome creeping; frond palmate (rarely with a single leaflet), venation reticulate; sporangia fused into circular synangia scattered over the nether surface, each opening by a slit on the ventral side (toward the center of the synangium).

TYPE: *C. aesculifolia* (Blume) Maxon, *Kaulfussia aesculifolia* Blume.

RANGE: Java to Assam and Luzon. Five species have been described, but all may better be regarded as forms of one. *Macrostoma* was a tentative name of one of these, *Kaulfussia assamica* Griffith, published after its author's death and with evidence that it would not have had his sanction.

6. Danaea

Danaea Smith, Mém. Acad. Turin 5 (1793) 420.
Heterodanaea Presl, Suppl. Tent. (1845) 38.
? *Danaeopsis* Presl, Suppl. Tent. (1845) 39.

Stem a dorsi-ventral rhizome; frond usually pinnate, rarely with a single pinna, with joint-like nodes at the insertion of the opposite pinnae and on the stipe, veins free, fertile fronds moderately contracted; sorus a double row of sporangia extending from costa to margin, tightly fused into a synangium, each sporangium opening by a terminal pore.

TYPE: *D. nodosa* (L.) Smith, *Acrostichum nodosum* L., from Haiti.

RANGE: tropical America. Thirty-two accepted species.

Heterodanaea, typified by *Danaea stenophylla* Kunze, from Guadaloupe, was based on a distinction in the attachment of the synangium.

Danaeopsis was typified by *Danaea paleacea* Raddi, a mysterious fern known by a sterile pinna, probably not in this family.

ORDER 3 — FILICALES

Sporangium developed from a single epidermal cell, and with a wall one cell in thickness. The Leptosporangiate Ferns.

Although including ferns of extreme diversity, this is an obviously natural order. It remains equally so if the Hydropterides are excluded and treated as constituting one or two distinct orders. The homosporous leptosporangiate ferns, the order *Filicales* as more commonly construed, have been more familiarly known by the older ordinal name *Filices*.

Key to the Families of Filicales: —

Spores of one kind.
- Annulus rudimentary.
  - Terrestrial perennials ..... 1. **Osmundaceae**
  - Aquatic annuals ..... 7. **Parkeriaceae**
- Annulus transverse, apical ..... 2. **Schizaeaceae**
- Annulus, transverse, medial ..... 3. **Gleicheniaceae**
- Annulus oblique.
  - Fronds pinnate in plan or very small.
    - Lamina thin, without stomata.
      - Stems hairy ..... 5. **Hymenophyllaceae**
      - Stems paleate ..... 8. **Hymenophyllopsidaceae**
    - Lamina of normal structure.
      - Stems hairy.
        - Stem ascending to erect ..... 6. **Pteridaceae**
        - Rhizome creeping ..... 4. **Loxsomaceae**
      - Stems paleate ..... 11. **Cyatheaceae**
      - Trichomes wanting ..... 10. **Plagiogyriaceae**
  - Fronds large, flabellate or pseudo-dichotomous ..... 15. **Matoniaceae**
- Annulus longitudinal, interrupted.
  - Sori enclosed by revolute lamina ..... 12. **Aspidiaceae**
  - Sporangia protected by reflexed margin.
    - Aquatic or subaquatic ferns ..... 7. **Parkeriaceae**
    - Terrestrial or epiphytic ferns.
      - Sporangia on apical segment of simple frond ..... 16. **Polypodiaceae (Belvisia)**
      - Sporangia not confined to one segment ..... 6. **Pteridaceae**
  - Sporangia not protected by reflexed margin.
    - Sporangia in roundish sori.
      - Sori indusiate.
        - Stipe articulate.
          - Indusium opening at end and sides ..... 9. **Davalliaceae**
          - Indusium opening on top ..... 12. **Aspidiaceae (Woodsia)**
        - Stipe not articulate.
          - Indusium affixed under sorus.
            - Pinnae not articulate to rachis ..... 12. **Aspidiaceae**
            - Pinnae articulate to rachis.
              - Pinnae auricled on lower side ..... 12. **Aspidiaceae (Cyclopeltis)**
              - Lower side of pinnae not auricled ..... 9. **Davalliaceae (Nephrolepis)**
          - Indusium affixed by base and sides ..... 6. **Pteridaceae**

Sori exindusiate.
Stipe articulate.
Frond finely dissected.
Rachis naked.....**9. Davalliaceae (Araiostegia)**
Rachis setose.....**16. Polypodiaceae**
Frond not finely dissected.....**16. Polypodiaceae**
Stipe not articulate.
Sori on laminar cells.....**17. Vittariaceae (Pteridanetium)**
Sori on veins, marginal.....**6. Pteridaceae**
Sori on veins, dorsal.
Sori notably small.....**6. Pteridaceae (Monachosorum)**
Sori of ordinary size.
Spores bilateral.
Rhizome hairy.....**6. Pteridaceae (Hypolepis)**
Rhizome paleate.....**12. Aspidiaceae**
Spores globose-tetrahedral.....**16. Polypodiaceae**

Sporangia in elongate sori.
Sori indusiate.
Sori elongate parallel to costa.....**13. Blechnaceae**
Sori oblique to costa.
Paleae clathrate.....**14. Aspleniaceae**
Paleae not clathrate.....**12. Aspidiaceae**
Sori exindusiate.
Sori parallel to costa.
Rhizome hairy.....**6. Pteridaceae (Taenitis)**
Rhizome paleate.
Spicular idioblasts present.....**17. Vittariaceae**
Spicular idioblasts absent.
Paleae clathrate.....**16. Polypodiaceae**
Paleae not clathrate.....**12. Aspidiaceae**
Sori not parallel to costa.
Spicular idioblasts present.....**17. Vittariaceae**
Spicular idioblasts absent.
Stipe articulate.....**16. Polypodiaceae**
Stipe not articulate.
Frond simple, not incised.....**16. Polypodiaceae**
Frond cut or compound.
Trunk very stout.....**13. Blechnaceae (Brainea)**
Trunk absent or not stout.
Spores tetrahedral.....**6. Pteridaceae**
Spores bilateral.
Paleae clathrate.....**14. Aspleniaceae**
Paleae not clathrate.....**12. Aspidiaceae**

Sporangia not in distinct sori or coenosori.
Veins free.
Spores tetrahedral.....**6. Pteridaceae**
Spores bilateral.....**12. Aspidiaceae**
Veins anastomosing.
Areolae in one costal row.....**6. Pteridaceae**
Areolae more numerous.
Frond or veins dichotomous.....**16. Polypodiaceae**
Frond pinnate in plan.
Spores tetrahedral.....**6. Pteridaceae**
Spores bilateral.

Frond simple and entire.
Fronds herbaceous.....**16. Polypodiaceae (Dendroglossa)**
Fronds firmer in texture.....**12. Aspidiaceae (Elaphoglossum)**
Frond not simple and entire.
Coriaceous, not toothed.....**16. Polypodiaceae (Christiopteris)**
Thinner or toothed.....**12. Aspidiaceae**
Spores of two kinds.
Small ferns normally rooting in mud.....**18. Marsileaceae**
Minute floating aquatics.....**19. Salviniaceae**

The foregoing key is submitted for what it is worth. It has known defects. The introduction of spore characters is particularly regretted. But the recurrence of many gross characters in *Pteridaceae, Aspidiaceae* and *Polypodiaceae* makes their use the only alternative to extending the key to a length regarded as a still greater disadvantage.

FAMILY 1 — OSMUNDACEAE

Osmundaceae R. Brown, Prod. Pl. Nov.-Holl. (1810) 161, as name of an entity not specified, but by inference an *Ordo*, or possibly a *Tribus*, including *Schizaea* and *Lygodium*. S. F. Gray, Brit. Pl. II (1821) 3, used the name for a division of a family. Reichenbach used it as name of a *Familia* in 1828, including *Marattia etc.* The first to use the word with the present definition was probably Martius.

Terrestrial ferns with erect, non-paleate stems; fronds circinnate in vernation, pinnately compound, veins free; sporangia large, not in definite sori, maturing simultaneously, each with some thickened cells near the apex which are construed as a rudimentary annulus, opening by a ventral-distal (partial longitudinal) slit; prothallium green, epigaeous, flat, cordate, costate.

A natural family, of three likewise natural genera, evidently the most primitive family of *Filicales*. It is geologically old; palaeozoic fossils are referred to it. Its points of resemblance to still more primitive ferns would seem to relate it to *Marattiaceae*, but the affinity is remote.

Key to the Genera of Osmundaceae: —

Lamina wanting on fertile fronds or pinnae ..... **1. Osmunda**
Sporangia on vegetative fronds and pinnae.
  Frond of typical frond-structure ..... **2. Todea**
  Lamina thin, without stomata ..... **3. Leptopteris**

1. Osmunda

Osmunda Linnaeus, Sp. Pl. (1753) 1063.
Struthopteris Bernh., Schrader's Journ. (1801) 126.
Aphyllocalpa Cav., Anal. Cien. 5 (1802) 164.
Plenasium Presl, Tent. (1836) 109.
Osmundastrum Presl (Suppl. Tent. (1845) 68) Abh. Böhm. Ges. Wiss. V 5 (1848) 326.

Stem stout and woody; fronds in a dense crown, dimorphous as a whole or as to the pinnae, the fertile fronds or pinnae destitute of green lamina.

Type: *O. regalis* L. This genus in Species Plantarum was a comprehensive mixture; but Linnaeus took the name from Tournefort, who had used it for the one species which is accordingly to be regarded as the type.

Range: Cosmopolitan. Fossil at least as old as Jurassic. Fourteen species may be recognized; the number depends chiefly upon how many of those described are reduced to *O. regalis*. They fall into three natural groups, here treated as subgenera:

Euosmunda, with bipinnate fronds, dimorphous or fertile at the apex; cosmopolitan, but discontinuous in range.

Osmundastrum, with bipinnatifid fronds, dimorphous or with some lateral pinnae fertile. Two species, both found in the eastern parts of Asia and North America.

Plenasium, with entire to serrate pinnae, the fertile ones lateral or basal and lateral. Java to Kamtschatka.

Struthopteris and *Aphyllocalpa* had the same type as *Osmunda*, and are therefore exact synonyms.

Osmundastrum, typified by *O. cinnamomea* L., was established for species with completely dimorphous fronds. Redefined to make it a natural group, it includes *O. claytoniana* L., but not *O. lancea* Thunb., which is a relative of *O. regalis*, but completely dimorphous.

Plenasium was typified by *O. banksiifolia* (Presl) Kuhn, originally described from a sterile fragment as questionably *Nephrodium;* then confused with *Asplenium*, of

which its name is an anagram; and finally placed in its proper genus by J. SMITH as *Osmunda presliana*—a *nomen nudum*, but satisfactory enough to make PRESL abandon his own prior specific name. In spite of its history, the group, of about 6 species, is a natural one.

Being natural, easily definable and recognizable groups, *Osmunda*, *Osmundastrum* and *Plenasium* can be treated as distinct genera. But, as *Osmunda* in the usual broader sense is equally natural and not a large genus, there is no evident object in dividing it.

2. Todea

Todea Willdenow, Acta Acad. Erford. (1802) 14.

Stem massive, woody, erect; frond bipinnate, coriaceous; sporangia closely placed along the veins of normal or slightly contracted pinnules.

TYPE: *T. barbara* (L.) Moore, *Acrostichum barbarum* L., as *T. africana* Willd., a synonym.

A single species, in South Africa, Australia and New Zealand.

3. Leptopteris

Leptopteris Presl, Suppl. Tent. (1845) 70.

Stem stout, erect; fronds crowning the stem, at least bipinnate, exceedingly thin, without mesophyll or stomata; sporangia along the veins and veinlets.

TYPE: *L. Fraseri* (H. & G.) Presl, *Todea Fraseri* Hooker et Grev.

Six similar species, ranging from New Zealand and Tasmania to Samoa and New Guinea. Sometimes small tree-ferns of remarkable beauty; or branching and forming compact clumps, as does also *Todea*.

Leptopteris and *Todea* are nearly related. Their present distribution indicates that as extant genera they are of Antarctic origin. However, European fossils are confidently ascribed to *Todea*.

FAMILY 2—SCHIZAEACEAE

Schizaeaceae Martius. This is the usual citation. MARTIUS, Icones Selectae Bras. (1834) 112, used the word, for an entity of unstated rank; but it is doubtful that this was the first publication of the word.
Aneimiaceae Presl, Suppl. Tent. (1845) 77, as *Subordo.*
Mohriaceae Presl, Suppl. Tent. (1845) 95, as *Subordo.*
Lygodiaceae Presl, Suppl. Tent. (1845) 98, as *Ordo.*

Terrestrial ferns, with creeping or ascending rhizome; fronds various; sporangia regarded as marginal in origin, but often apparently dorsal, each with a complete distal annulus, opening by a longitudinal slit.

A thoroughly natural family, though the four genera are so distinct that all have given names to orders or suborders.

Key to the Genera of Schizaeaceae: —

Fronds erect, simple or dichotomous.....**1. Schizaea**
Frond scandent by twining rachises.....**2. Lygodium**
Fronds erect, pinnate in plan.
  Fertile pinnae or fronds very contracted.....**3. Anemia**
  Sporangia on normal fronds and pinnae.....**4. Mohria**

1. Schizaea

Schizaea Smith, Mém. Acad. Turin 5 (1793) 419.
Lophidium Rich., Acta Soc. Hist, Nat. Paris 1 (1792) 114.
Ripidium Bernh. Schrader's Journ. (1801) 127.
Actinostachys Wallich, List (1828 or 1829) No. 1; Hooker, Genera (1842) Pl. 111 A.

Frond erect, simple or dichotomous, lamina and stipe hardly distinguished; sporangia sessile on the branches of a compact, pectinate-pinnate or pseudo-digitate distal segment of frond or branch of frond; spores bilateral; prothallium filamentous.

TYPE: not explicit, but best *S. dichotoma* (L.) Smith, *Acrostichum dichotomum* L.

Some thirty recognized species, predominantly southern and of the most evidently Antarctic ancestry. Only one, *S. pusilla* Pursh, New Jersey to Newfoundland, occurs north of the Tropic of Cancer.

PRESL distinguished three genera, which are usually maintained as subgenera:

Euschizaea, with terete, angular or sulcate, usually simple vegetative frond, typically without laminar expansion.

Lophidium, with more or less flattened, usually dichotomously branched lamina. Its type is *S. elegans* (Vahl) Swartz, as *Lophidium latifolium* Rich., a synonym.

Actinostachys Wallich, with apparently digitate fertile segment, and the sporangia in four rows, instead of in two as in the other subgenera. Its type is *S. digitata* (L.) Swartz. *Actinostachys* might be maintained as a genus, although the fertile segment is essentially pinnate, with few congested, elongate, erect pinnae. WALLICH'S listing, with its reference to R. BROWN, Prod. Fl. Nov. Holl. p. 162 (161 by error), was valid publication.

Because *Lophidium* is the older name, I have tried to recognize it as distinct from *Schizaea,* but find this impossible. Effectively, they blend. And the selection, as the type of *Schizaea,* of a species which is not *Lophidium* is at best arbitrary. I retain *Schizaea* in the confident hope that the name will be conserved by a botanic congress. If this be not done, the confusion will be intolerable, far from limited to changes in taxonomists' names of species. *Schizaea* is a name entrenched in the literature of

morphology; and if the generic name be dropped, that of the family will be changed by some writers and not by others.

2. Lygodium

Lygodium Swartz, Schrader's Journ. (1801) 106; Syn. Fil. XII, 6, 152.
Odontopteris Bernh., Schrader's Journ. (1801) 127.
Gisopteris Bernh., Schrader's Journ. (1801) 129, Pl. 2, f.1.
Ugena Cav., Icones et Descr. Pl. (1801) Pl. *73.*
Ramondia Mirbel, Bull. Soc. Philom. 2 (1801) 179.
Hydroglossum Willd., Acta Acad. Erford. (1802) 20.
Cteisium Michaux, Fl. Bor. Am. (1803) 275.
Vallifilix Thouars, in Römer, Coll. Bot. (1809) 195.
Lygodictyon J. Sm. in Hooker, Gen. (1842) Pl. 111 B.

Stem a hairy rhizome; rachis indefinitely long, twining and rampant, monopodial, the alternate branches, right and left, dwarfed, each with one pair of pinnae and an abortive bud, pinnae variously palmate or pinnately compound, veins usually free; sporangia biseriate on marginal spikes, each sporangium subtended by an outgrowth serving as an indusium; spores tetrahedral; prothallium green, flat.

TYPE: *L. scandens* (L.) Swartz, *Ophioglossum scandens* L.

Thirty-nine recognized species, pantropic, south to New Zealand and South Africa, north to Japan, with one species, *L. palmatum* (Bernh.) Swartz, in the eastern United States. Antarctic origin of the extant species is most probable; but fossil *Lygodium* is reported from Europe in Cretaceous and subsequent rocks. The genus is natural, and so homogeneous that there has been no agreement as to its division into natural groups. On whatever basis this is attempted, the several resulting groups seem, like the genus as a whole, to be Antarctic in ancestry.

It will be observed that *Lygodium* received seven generic names so nearly simultaneously that they must mostly have been independent. *L. scandens,* the type species, is also the type of *Odontopteris, Hydroglossum* and *Vallifilix. Ugena* is typified by the nearly related *U. semihastata* Cav., *Lygodium semihastatum* (Cav.) Desv. The type of *Ramondia* is *L. flexuosum* (L.) Swartz. *L. palmatum* (Bernh.) Swartz is the type of *Gisopteris,* as *G. palmata Bernh.,* and of *Cteisium,* as *C. paniculatum* Michaux, a synonym.

Lygodictyon, typified by *L. Forsteri* J. Sm., a synonym of *Lygodium reticulatum* Schkuhr, is characterized by reticulate venation. PRESL, Suppl. Tent. (1845) 112, accepted this as a genus, but improperly applied to it WILLDENOW's name, *Hydroglossum.* Reticulate venation is found also in *L. lanceolatum* of Madagascar and the Comores, and *L. heterodoxum* Kunze of tropical America; but the three species are not near relatives.

Four species of New Guinea and Melanesia, of which the oldest is *L. trifurcatum* Baker, and the most characteristic may be *L. dimorphum* Copel., are dimorphous as to the pinnae, and do form a natural group.

3. Anemia

Anemia Swartz, Syn. Fil. (1806) 6, 155; changed to *Aneimia* by Kaulfuss, Enum. (1824) 51.
Ornithopteris Bernh., Schrader's Neues Journ. 12 (1806) 40, Pl. 3, f. 15 a, b.
Anemidictyon J. Sm., in Hooker, Gen. (1842) Pl. 103; changed to *Aneimidictyon* by Presl, Suppl. Tent. (1845) 91.
Trochopteris Gardner, London Journ. Bot. 1 (1842) 73, Pl. 4.
Coptophyllum Gardner, London Journ. Bot. 1 (1842) 133.
Anemirhiza J. Sm., Bot. Voy. Herald (1854) 243.
Anemiaebotrys Fée, Crypt. Vasc. Bras. I (1869) 267, Pl. 78, f. 2.

Rhizome hairy, usually short with fronds therefore contiguous; frond pinnatifid or usually pinnately compound, rarely completely dimorphous, usually with the basal pinnae fertile, long-stalked, and without lamina, rarely

with these pinnae only partly modified, veins reticulate in the type but free in most species; sporangia biseriate on the fertile segments, naked or partially protected as in *Schizaea.*

TYPES *A. Phyllitidis* (L.) Swartz, *Osmunda Phyllitidis* L., from Santo Domingo.

RANGE: Tropical America, north to Florida and Texas; Africa and Madagascar, one species reaching India. A genus of about 90 species, nearly all in America, where the recent evolution of species has evidently been active.

Ornithopteris may be typified by *O. adiantifolia* (L.) Bernh., *Anemia adiantifolia* (L.) Swartz, and then *Anemirhiza* J. Smith is its exact synonym. SMITH later, Hist. Fil. (1875) 354, abandoned his genus, as not distinct from *Anemia.* But there is a complication: SWARTZ, in the index of Synopsis Filicum, wrote "Ornithopteris Bernh. — est Anemia." This indicates but does not prove that *Ornithopteris* has priority. To settle the question, *Anemia* should be conserved by congressional action. SMITH'S tentative genus was distinguished by elongate rhizome. Other writers have added a solenostele and distichous leaves, as contrasted with the dictyostele and polystichous leaves of the more numerous species with crowded fronds. This sounds fundamental and imposing; but the three apparent distinctions are really correlated expressions of one. If the elongate rhizome is a poor generic character, nothing is added to it by apparent structural distinctions which are consequent on its length.

Anemidictyon is typified, like *Anemia,* by *A. Phyllitidis;* its generic character was reticulate venation.

Trochopteris is typified by *T. elegans* Gardner, *Anemia elegans* (Gardner) Presl, a rosette-forming little plant, with the sporangia restricted to the basal pinnules of the otherwise normally vegetative basal pinnae. It looks very distinct from typical *Anemia;* but *A. Brandegaea* Dav., *A. intermedia* Copel., and *A. aspera* (Fée) Baker present a series of intermediate forms. *A. aspera* is the type of *Anemiaebotrys.*

Coptophyllum, typified by *C. buniifolium* Gardner, *Anemia buniifolia* (Gardner) Moore, was to be distinguished by complete dimorphism of the fronds. It can be maintained as a genus if it represents a natural group. With this exception, *Anemia* can hardly be broken into natural groups clearly enough distinguished to be convenient genera.

4. Mohria

Mohria Swartz, Syn. Fil. (1806) XIII, 5, 159.
Colina Greene, Erythea 1 (1893) 247.

Rhizome short, scaly; frond bipinnate, scaly and hairy, not dimorphous; sporangia sessile, submarginal, solitary on the veinlets, somewhat protected by the revolute margin.

TYPE: *M. Caffrorum* (L.) Desv., as *M. thurifera* Swartz, a synonym.

Mohria is peculiar in its family in bearing sporangia on its vegetative frond, and in bearing paleae. The former feature may be primitive. The latter can hardly be so. The paleae intergrade with hairs, and are to be regarded as dilated hairs, such as are found on *Lindsaea* and other genera of chaetopterid ancestry. The resemblance of *Mohria* to Cheilanthoid ferns has been remarked repeatedly, and goes beyond superficial aspect, as to the large and few sporangia — compare CHING'S genus *Sinopteris.* In the absence of probable affinity, this resemblance is a remarkable example of convergent evolution.

Colina was a substitute name proposed on the ground that *Mohria* was a homonym of *Morea* — whatever that is.

FAMILY 3 — GLEICHENIACEAE

Gleicheniaceae Gaudichaud, in Freyc., Voy., Bot. (1826) 260, as *Classis*. Presl, Tent. (1836) 47, ascribed the name to KUNZE, using it for a *Tribus*.
Mertensiaceae Corda, Fl. d. Vorwelt (1845) 89.

Terrestrial ferns with long-creeping rhizome; fronds pinnate or more compound, but often pseudodichotomous by abortion of the terminal bud and free development of the pinnae, usually coriaceous, veins free; sporangia few in dorsal sori, each with complete transverse medial annulus, opening by a longitudinal slit; prothallium green flat, costate.

A most natural family, of some 130 known species, tropical and southern, with two species reaching Japan; obviously and entirely of Antarctic ancestry. Elsewhere known fossil, positively in rocks as old as Jurassic, and considerably older with probability. The family is on about the same evolutionary level as *Schizaeaceae*, higher than *Osmundaceae*.

Most writers have treated the family as a single genus, *Gleichenia*, or have segregated only one or two species, leaving a residual genus too large for convenience, and composed of natural and easily distinguishable groups. I follow PRESL, Tent. 47 *et seq.*, and CHRISTENSEN, VERDOORN'S Manual (1938) 530, in treating these groups as genera.

Key to the Genera of Gleicheniaceae: —

Fronds simply pinnate.
  Pinnae or segments 3-5 mm long ..... **3. Stromatopteris**
  Pinnae hardly 1 mm long ..... **2. Platyzoma**
Fronds bipinnate or more compound.
  Pinnules very small, roundish ..... **1. Gleichenia**
  Ultimate pinnules much larger.
    Fronds pectinate above highest fork.
      Veins once forked ..... **4. Sticherus**
      Veinlets several ..... **5. Dicranopteris**
    Fronds bipinnate above last fork ..... **6. Hicriopteris**

1. Gleichenia

Gleichenia Smith, Mém. Acad. Turin 5 (1793) 419, Pl. 9, f. 10; *non* Necker (1790), *genus haud recte conditum*.
Calymella Presl, Tent. (1836) 48.
Gleicheniastrum Presl, Abh. Böhm. Ges. V. 5 (1848) 338.

Rhizome creeping, scaly; frond bipinnate or pseudodichotomous and bipinnate, ultimate pinnules commonly 1 mm in diameter, concave or cucullate, coriaceous; sori solitary, of few (commonly 4) sporangia.

TYPE: *G. polypodioides* (L.) Sm., *Onoclea polypodioides* L., of South Africa.
Ten species, austral and tropical.
Calymella was typified by *C. microphylla* (R. Br.) Presl; *Gleicheniastrum*, probably by the same species. The names of the Australian species have been confused badly. There is no real reason to respect either of these supposed genera.

2. Platyzoma

Platyzoma R. Brown, Prod. Fl. Nov.-Holl. (1810) 160.

Like *Gleichenia,* but frond simply pinnate, narrowly linear, and sori plural, on pinnae with the edges rolled back until they meet.

TYPE: *P. microphyllum* R. Br.

A single species, in Queensland.

3. Stromatopteris

Stromatopteris Mettenius, Ann. Sc. Nat. IV 15 (1861) 84, Pl. 3.

Rhizome slender, subterranean, giving off erect, freely branched stems; fronds tufted, linear, simply pinnate, coriaceous; pinnae contiguous, about 4 mm long, margins deflexed; sori solitary, rather large, sporangia about ten.

TYPE: *S. moniliformis* Mett.

A single species, in New Caledonia.

The three preceding genera form a natural group. Being local and within the range of *Gleichenia, Platyzoma* and *Stromatopteris* may be regarded as derived genera, perhaps evolved where they now are.

4. Sticherus

Sticherus Presl, Tent. (1836) 51; C. Chr. in Verdoorn, Manual of Pterid. (1938) 530; Ching, Sunyatsenia 5 (1940) 281; Copel., Philip. Journ. Sci. 75 (1941) 350.
Mertensia Willd., Vet. Acad. Nya Handl. (1804) 163, *non* Roth (1797).
? *Mesosorus,* Hassk. Observ. Bot. I (1856) 2.

Rhizome creeping, paleate; frond typically pinnate or bipinnate and further pseudodichotomously divided, without stipular appendages where it forks, foliar segments on the ultimate axes and usually on one to several preceding ones; veins once forked; sori on many veins, sporangia few, most commonly four.

TYPE: *S. laevigatus* (Willd.) Presl, *Mertensia laevigata* Willd.

The genus was misdescribed, dubiously typified, and unseen and afterward ignored by its author. I follow CHRISTENSEN in the resurrection of the name because there is no better alternative. *Mertensia* is unavailable because there is an older genus so named. *Mesosorus* was proposed as a substitute name by HASSKARL, who discarded *Sticherus* because of PRESL's error in describing the venation as reticulate. HASSKARL's first species and the most of those which follow are *Hicriopteris,* and only one, his *M. bifurcatus* (Blume, *Gleichenia*), is a *Sticherus.*

A genus of about 100 species, in the Tropics of both hemispheres, and southward to Chile, New Zealand and South Africa. I have listed 15 species of *Sticherus,* those of New Guinea, in Philip. Journ. Sci. 75 (1941) 350. Among the many species remaining so to be placed are:

S. hispidus (Mett.) Copel., *Gleichenia hispida* Mett. *apud* Kuhn, Verh. Zool. Bot. Ges. 25 (1876) 600. Malaya to Luzon.

S. Loheri (Christ) Copel., *Gleichenia Loheri* Christ, Bull. Herb. Boiss. II 6 (1906) 1009. Luzon.

S. Kajewskyi Copel., *Gleichenia Kajewskyi* Copel., Philip. Journ. Sci. 60 (1936) 102, Pl. 6. Solomon Ids.

S. gracilis (Mart.) Copel., *Mertensia gracilis* Mart., Ic. Cr. Bras. (1834) 107, Pl. 105, f. 2. Brazil.

S. penniger (Mart.) Copel., *Mertensia pennigera* Mart., Ic. Cr. Bras. (1834) 106 (*M. gracilis sphalm.*), 130, Pl. 59, f. 1. Brazil.

S. longipes (Fée) Copel., *Mertensia longipes* Fée, Crypt. Vasc. Bras. II (1872-3) 87. Pl. 105, f. 2. Brazil.

S. remotus (Kaulf.) Copel., *Mertensia remota* Kaulf., Enum. (1824) 39. Brazil, Colombia.

S. paulistanus (Ros.) Copel., *Gleichenia paulistana* Ros., Fedde's Repert. 21 (1925) 343. Brazil.

S. yungensis (Ros.) Copel., *Gleichenia yungensis* Ros., Fedde's Repert. 5 (1908) 228. Bolivia.

S. Buchtienii (Christ et Ros.) Copel., *Gleichenia Buchtienii* Christ et Ros., Fedde's Repert. 5 (1908) 229. Bolivia.

S. velatus (Kunze) Copel., *Mertensia velata* Kunze, Linn. 9 (1834) 15. Andes.

S. hypoleucus (Sod.) Copel., *Gleichenia hypoleuca* Sod., Rec. (1883) 8; Crypt. Vasc. Quit. (1893) 36. Ecuador.

S. strictissimus (Christ) Copel., *Gleichenia strictissima* Christ, Bull. Herb. Boiss. II 5 (1905) 13. Costa Rica.

S. bicolor (Christ) Copel., *Gleichenia bicolor* Christ, Bull. Herb. Boiss. II 6 (1906), 279. Costa Rica.

S. trachyrhizoma (Christ) Copel., *Gleichenia trachyrhizoma* Christ, Bull. Herb. Boiss. II 6 (1906) 280. Costa Rica.

S. pteridellus (Christ) Copel., *Gleichenia pteridella* Christ, Bull. Herb. Boiss. II 6 (1906) 284. Costa Rica.

S. Bradeorum (Ros.) Copel., *Gleichenia Bradeorum* Ros., Fedde's Repert. 10 (1912) 274. Costa Rica.

S. nitidulus (Ros.) Copel., *Gleichenia nitidula* Ros., Fedde's Repert. 10 (1912) 275. Costa Rica.

S. dichotomus (L.) Copel., *Pteris dichotoma* L., Sp. Pl. (1753) 1076; commonly known as *Gleichenia furcata* (L.) Spr. West Indies. This is the type species of *Mertensia* Willd.

S. palmatus (Schaffner) Copel., *Mertensia palmata* Schaffner, in Fée, Mém. IX, 32, *nomen nudum; Dicranopteris palmata* Underwood, Bull. Torrey Bot. Club 34 (1907) 259. Mexico.

Several other species have been described from Costa Rica, of which quite the most remarkable is:

S. retroflexus (Bommer) Copel., *Gleichenia retroflexa* Bommer, in Bommer et Christ, Bull. Soc. Bot. Belg. 35[1] (1896) 175; Christ, Bull. Herb. Boiss. II 5 (1905) 15.

5. Dicranopteris

Dicranopteris Bernhardi, Schrader's Neues Journ. 1[2] (1806) 26, 28.

Stem a creeping, hairy rhizome; frond pinnate, or pseudodichotomous at the top of the stipe, pinnae repeatedly pseudodichotomous, typically with a pair of foliaceous stipule-like outgrowths at each forking except the ultimate ones, only the "stipules" and the ultimate branches foliaceous, veinlets forked more than once; sori typically of more than 6 sporangia.

TYPE: *D. dichotoma* (Thunb.) Bernhardi, a synonym of *D. linearis* (Burm.) Underwood, *Polypodium lineare* Burm.

RANGE: Pantropic, passing the Tropic of Cancer, southward to New Zealand. Less than ten species if *D. linearis* is treated inclusively, more if it is strictly construed. The American vicar of *D. linearis* is *D. pectinata* (Willd.) Underwood.

D. nervosa (Kaulf.) Maxon is aberrant, having small sori, and the "stipules" more or less completely suppressed because the frond forks only once; the venation is typical of the genus.

6. Hicriopteris

Hicriopteris Presl, Epim. (1849) 26; Copel., Philip. Journ. Sci. 75 (1941) 357.

Stem a creeping, scaly rhizome; fronds large, pinnate and pseudodichotomous, the pinnae bipinnate, veins once forked; sori of about 4 sporangia.

TYPE: H. *speciosa* Presl, believed to be **H. glauca** (Thunb.) Copel., *comb. nova*, *Polypodium glaucum* Thunb., in Houttuyn, Nat. Hist. XIV (1783) 117; Fl. Jap. (1784) 338. I assume this to be another (like *Sticherus*) Preslian genus based on defective observation of the veins, alleged to anastomose along the margin. The type was a fragment, collector unknown, from the Kingdom of Punjab. The description

of the vegetative structure is detailed, and makes the plant fairly certainly the same as *Mertensia gigantea* (Wall.) Presl, hardly distinguishable from *H. glauca.*

RANGE: Pantropic, and north to Japan.

The genus is a natural one, clearly distinguished from *Sticherus* by the bipinnate pinnae. Species are:

H. glauca. Malaya to India and Japan. Very variable. *Gleichenia gigantea* Wall.: Hooker, *G. longissima* Blume, and some other forms, while not very distinct, can be retained as species.

H. laevissima (Christ) Copel., *Gleichenia laevissima* Christ, Bull. Acad. Géog. Bot. Mans (1902) 268. China, Luzon.

H. blotiana (C. Chr.) Copel., *Gleichenia blotiana* C. Chr., Bull. Mus. Paris II 6 (1934) 103. Indo-China.

H. Norrisii (Mett.) Copel., *Gleichenia Norrisii* Mett.: Kuhn, Linn. 36 (1869) 165. Malay Peninsula.

H. volubilis (Jungh.) Copel., *Gleichenia volubilis* Jungh., Reisen d. Java (1845) 452. Java. This may include *G. arachnoides* Mett. (1863).

H. bullata (Moore) Copel., *Gleichenia bullata* Moore, Index (1862) 374. Borneo.

H. novoguineensis (Brause) Copel., Philip. Journ. Sci. 75 (1941) 358. New Guinea.

H. astrotricha Copel., Philip. Journ. Sci. 75 (1941) 358. New Guinea.

H. Bancroftii (Hooker) Copel., *Gleichenia Bancroftii* Hooker, Sp. Fil. I (1844) 5, Pl. 4 A. Trop. Am.

FAMILY 4 — LOXSOMACEAE

Loxsomaceae Presl, Abh. böhm. Ges. Wiss. V, 5 (1848) 330, 339, as *Ordo.*

Terrestrial, with creeping, bristly rhizome; frond pinnately compound, with typical leaf structure, veins free; sori marginal, terminal on veins, with a short- or long-urceolate indusium, and elongate, hairy receptacle bearing the sporangia on all sides; sporangia pyriform, subsessile, with oblique, complete or imperfect annulus; spores tetrahedral; prothallium thalloid, cordate.

A family of two genera, in New Zealand and tropical America, resembling *Trichomanes* in the sorus, and *Dennstaedtia* in vegetative structure. Both of these resemblances may be evidence of affinity; which implies that *Loxsomaceae* may be relatively primitive plants, preserving a combination of characters, of which some have been inherited by *Hymenophyllaceae* and others by "higher" ferns.

Key to the Genera of Loxsomaceae: —

Sporangium with imperfect annulus, opening by a longitudinal slit.....**1. Loxsoma**
Sporangium with complete annulus, opening by a transverse slit.....**2. Loxsomopsis**

1. Loxsoma

Loxoma R. Brown, *apud* A. Cunningham, Hooker's Comp. Bot. Mag. 2 (1836) 336, Pl. 31-32; name corrected to Loxsoma by ENDLICHER (1841). CHRIST, in describing *Loxsomopsis,* remarked that the name of *Loxsoma* is about as remarkable as the plant; and its strangeness extends to that of the family.

Annulus surrounding a swelling on one side of the sporangium, only a part of the cells thickened, without stomium, sporangium opening longitudinally.

TYPE and sole species: *L. Cunninghamii* R. Br.
Endemic in northern New Zealand.

2. Loxsomopsis

Loxsomopsis Christ, Bull. Herb. Boiss. II 4 (1904) 399, Pl. 1.

Annulus slightly oblique, all cells thickened but with a distinct stomium, sporangium opening transversely.

TYPE: *L. costaricensis* Christ.
Three species, Bolivia to Costa Rica.

FAMILY 5—HYMENOPHYLLACEAE

Hymenophyllaceae Gaudichaud, Freyc. Voy. Bot. (1826) 262. The name is published here as that of a subdivision of the Class *Gyratae*. The subdivision and its name are ignored in the ensuing text.

Epiphytes and terrestrial ferns; stem usually a rhizome bearing distichous fronds, less commonly becoming erect and radially symmetrical; fronds commonly small, the expanded lamina almost always one cell in thickness, always without stomata, very rarely absent, typically circinnate in vernation but extremely reduced fronds sometimes straight, veins with few exceptions free; sporangia on all sides of marginal or extramarginal extensions of the veins (receptacles), protected by urceolate to tubular or bivalvate laminal growth (involucre or indusium), maturing simultaneously or basipetally, annulus complete, oblique or approaching transverse, opening by a more or less longitudinal slit; spores tetrahedral or becoming globose; prothallium filamentous or thallose, various.

A family of manifestly Antarctic immediate ancestry, though fossils in European tertiary deposits are ascribed to it. About 650 species have been accepted, but the number is excessive. All have usually been put into two cumbrous and then unnatural genera, *Trichomanes* and *Hymenophyllum*. I follow here my own recent treatment, Genera Hymenophyllacearum, Philip. Journ. Sci. 67 (1938) 1-110, recognizing 33 genera. This follows in general the older work of PRESL and VAN DEN BOSCH, to be cited under the several genera.

Key to the Genera of Hymenophyllaceae: —

Typical lamina wanting, and replaced.
- By filaments of cells ..... **5. Apteropteris.**
- By veinless teeth ..... **10. Myriodon**

Typical lamina present.
- Involucre valvate.
  - Margin entire and naked.
    - Frond large, simple ..... **15. Hymenoglossum.**
    - Frond minute, simple ..... **2. Craspedophyllum.**
    - Frond pinnately divided.
      - Accessory wings present ..... **9. Amphipterum.**
      - Accessory wings absent.
        - Walls thick, coarsely pitted ..... **8. Meringium spp.**
        - Walls not coarsely pitted.
          - Fronds pinnate, axes red-pilose ..... **14. Serpyllopsis.**
          - Fronds more compound or without red hairs.
            - Veins in segments plural ..... **13. Rosenstockia.**
            - Veins in segments single.
              - Base of involucre cyathiform, receptacle exserted **3. Hemicyatheon (baileyanum)**
              - Base of involucre not cyathiform or receptacle included **1. Mecodium**
  - Margin hairy.
    - Receptacle included ..... **4. Sphaerocionium**
    - Receptacle long-extruded ..... **12. Leptocionium**

Margin toothed.
Receptacle long-extruded.
Accessory wings present ..... **9. Amphipterum**
Accessory wings wanting.
Base of involucre obconic ..... **8. Meringium**
Base of involucre cyathiform ..... **3. Hemicyatheon (Deplanchei)**
Receptacle not long-exserted.
Receptacle cylindric or clavate. (Cf. also **Mecodium Reinwardtii** and others.) ..... **7. Hymenophyllum**
Receptacle subglobose ..... **11. Buesia**
Involucre tubular or obconic, not valvate.
Rhizome filiform, fronds remote.
False veinlets present.
Fronds pinnately divided or compound.
False veinlets in the position of veins ..... **29. Didymoglossum**
False veinlets unrelated to veins ..... **22. Crepidomanes**
Fronds simple or lobed.
With marginal vein ..... **23. Microgonium**
Without marginal vein.
Without marginal scales ..... **29. Didymoglossum**
With marginal scales ..... **30. Lecanium**
False veinlets absent.
Fronds marginate.
With hairy axial pads ..... **19. Pleuromanes**
Naked, without axial pads ..... **21. Crepidopteris**
Fronds not marginate.
Axes of fronds proliferous ..... **20. Gonocormus**
Axes not proliferous.
Veins branched within segments ..... **18. Polyphlebium**
Segments one-nerved.
Fronds dichotomous or simple ..... **6. Microtrichomanes**
Fronds pinnate in plan.
Axes coarsely red-pilose ..... **14. Serpyllopsis**
Axes not red-pilose ..... **17. Vandenboschia**
Rhizome stout or fronds clustered.
Cells transversely elongate ..... **34. Abrodictyum**
Cells not transversely elongate.
Fronds simple ..... **16. Cardiomanes**
Fronds once pinnate.
Oriental ..... **26. Cephalomanes**
American.
Fronds not dimorphous ..... **27. Trichomanes**
Fronds dimorphous.
Sterile fronds pinnate ..... **27. Trichomanes**
Sterile fronds pinnatifid ..... **28. Feea**
Fronds more divided.
Segments stiff and very narrow ..... **33. Macroglena**
Segments broader or soft.
Rhizome creeping, fronds remote.
Fronds soft in texture. (Cf. also **Trichomanes rupestre** and others) ..... **17. Vandenboschia**
Fronds harsh ..... **31. Selenodesmium**
Fronds clustered.
Fronds 1 cell thick.
Walls thick, coarsely pitted ..... **31. Selenodesmium**
Walls not coarsely pitted.
American ..... **27. Trichomanes**
Palæotropic.
Stipes bristly ..... **24. Callistopteris**
Stipes not bristly ..... **25. Nesopteris**
Fronds thicker ..... **32. Davalliopsis**

1. Mecodium

Mecodium Presl, Epim. Bot. (1849 ?) 258, *nomen;* Copeland, Philip. Journ. Sci. 67 (1938) 17.
Diploophyllum v. d. Bosch, Eerste Bijdrage (1861) 322, *non Diplophyllum* Lehm.

Epiphytes, rhizome filamentous; fronds pinnately compound, with entire margin, cell-walls typically thin; involucre bivalvate, deeply or to the base, receptacle included.

TYPE: *M. sanguinolentum* (Forster) Presl, *Trichomanes sanguinolentum* Forster, of New Zealand.

A pantropic and austral genus of about 100 species, one ranging north to Saghalien and Ussuriland. The most familiar is *M. polyanthos* (Swartz) Copel., a pantropic species, which, as I construe it, has at least 16 synonyms.

Diploophyllum was proposed by v. d. BOSCH to be characterized by fronds more than one cell in thickness. This is the case of two New Zealand species, and partly so of two others.

Three species of New Guinea and the Philippines are aberrant in having toothed margins.

Mecodium Levingei (Clarke) Copel., *comb. nova., Hymenophyllum Levingei* Clarke, Trans. Linn. Soc. II Bot. 1 (1880) 439, Pl. 49, f. 3, described from Sikkim and in hand from Yunnan, bears, besides hairs, ecostate fragments of lamina (called lanceolar scales by CLARKE), like those known also on *Meringium plicatum* and on *Buesia,* and replacing the entire lamina of *Myriodon.* It is a relative of *M. polyanthos.*

Mecodium represents *Hymenophyllum,* sect. *Euhymenophyllum* of SADEBECK in Natürlichen Pflanzenfamilien, improperly so called because it does not include the type of the genus.

2. Craspedophyllum

Craspedophyllum (Presl, Hymen. (1843) 33 (of reprint), as sect. of *Hymenophyllum*) Copel., Philip. Journ. Sci. 67 (1938) 27, as genus.
Pachyloma v. d. Bosch, Eerste Bijdrage (1861) 318, *non* de Candolle.

Rhizome filamentous; frond minute, simple and entire or two-lobed, with a black margin; involucre valvate to the base, receptacle cylindric, included.

TYPE: *C. marginatum* (H. & G.) Copel., *Hymenophyllum marginatum* H. & G., Icones Fil. (1828) Pl. 34.

RANGE: New Zealand, Tasmania, New South Wales.

Director RAE of the Melbourne Botanic Gardens calls my attention to the fact that *Hymenophyllum Armstrongii* Baker, which I had transferred to *Microtrichomanes,* is really a *Craspedophyllum;* its proper name is *C. Armstrongii* (Baker) Rae. Nearly related to it — or a form of the same species according to Holloway — is *Hymenophyllum Cheesemanii* Baker, black-marginate on the valves only.

3. Hemicyatheon

Hemicyatheon (Domin, Bibl. Bot. 20 Heft 85 (1913) 20, as subgenus of *Hymenophyllum*) Copel., Philip. Journ. Sci. 67 (1938) 27, as genus.

Rhizome slender; frond tripinnatifid, cell-walls thickened; involucre cleft part-way down, base urceolate, receptacle extruded.

TYPE: *H. baileyanum* (Domin) Copel., *Hymenophyllum baileyanum* Domin, of Queensland. The only other species is *H. Deplanchei,* of New Caledonia. Related to *Mecodium* and *Meringium.*

4. Sphaerocionium

Sphaerocionium Presl, Hymen. (1843) 125; Copel., Philip. Journ. Sci. 67 (1938) 28.
Dermatophlebium Presl, Epim. Bot. (1849-52) 258.

Epiphytes, with filamentous rhizome, and roots; fronds pinnately compound, hairy, the hairs typically branched, but sometimes simple and re-

stricted to the margin, cell-walls thin, chromatophores minute; involucre cleft, usually deeply, receptacle included.

TYPE: *S. hirsutum* (Swartz) Presl, *Hymenophyllum hirsutum* Swartz.

A pantropic and austral genus of about 50 species, best developed in tropical America.

Dermatophlebium, typified by *D. tomentosum* (Kunze) Presl, *Sphaerocionium tomentosum* (Kunze) Presl, is characterized by lamellar outgrowths of the rachises. It is an apparently natural group of four or five American species, eligible to generic recognition.

5. Apteropteris

Apteropteris Copeland, Philip. Journ. Sci. 64 (1937) 176, as subgenus; 67 (1938) 34, as genus.

Epiphytic, rhizome filiform; frond pinnately compound, its divisions coarsely filiform, surrounded by stellate trichomes, under which green filaments grow from the axes, destitute of expanded lamina; involucre cup-shaped, receptacle included.

TYPE: *A. Malingii* (Hooker) Copel., *Trichomanes Malingii* Hooker, Garden Ferns, (1862) Pl. 64.

A single species, in New Zealand and Tasmania; derived from *Sphaerocionium.* The most specialized member of the family in adaption to the life of an exposed epiphyte.

6. Microtrichomanes

(*Micro-trichomanes* Mett., Hymen. (1864) 413, as *Gruppe* of *Trichomanes.*)
Microtrichomanes (Prantl, Hymen. (1875) 51, as Sect. of *Gonocormus;* Copel., Philip. Journ. Sci. 51 (1933) 153, as Group of *Trichomanes*) Copel., *ibid.* 67 (1938) 35, as genus.

Epiphytes, with filamentous, root-bearing rhizomes; frond small to minute, repeatedly dichotomous, or forked, or simple by reduction, without false veins, costae winged throughout but stipe not so, margin typically setiferous, cell-walls thin; involucre obconic or rarely campanulate, entire, receptacle slender, short-exserted.

TYPE: *M. digitatum* (Swartz) Copel., *Trichomanes digitatum* Swartz.

RANGE: Madagascar to Polynesia, south to New Zealand. Ten recognized species. Derived, by reduction of the frond, from *Sphaerocionium.*

Plants undergoing considerable or extreme reduction necessarily lose characteristics, of form, and eventually of structure. Reduction of plants of distinct ancestry is a phenomenon of convergent evolution. It results in resemblance; and if this is complete enough, we are likely to combine in one genus species not really nearly related. For this reason, several genera of this family are not positively natural.

7. Hymenophyllum

Hymenophyllum Smith, Mém. Acad. Turin 5 (1793) 418.

Terrestrial or epiphytic, with slender rhizome; frond small, pinnately compound, margin toothed but not hairy; involucre bivalvate, deeply or to the base, receptacle not or but slightly extruded.

TYPE: *H. tunbridgense* (L.) Smith, *Trichomanes tunbridgense* L.

As here construed, a genus of not more than 25 known species, mostly very similar; but including some, such as *H. pectinatum* Cav., so aberrant that they might well be excluded. *Hymenophyllum* is found around the world in the far South, is weakly developed in the Tropics, and ranges north to Scotland, Norway and Japan.

8. Meringium

Meringium Presl, Hymen. (1843) 24, Pl. 8 B.
Myrmecostylum Presl, Hymen. (1843) 27, Pl. 10 A.
Ptychophyllum Presl, Hymen. (1843) 28, Pl. 11 E.

Typically epiphytic, with slender rhizome; frond pinnately compound, margin toothed or rarely entire, cell-walls usually thick and coarsely pitted; involucre obconic or funnel-shaped at the base, bivalvate in the upper part, receptacle usually far extruded.

TYPE: *M. meyenianum* Presl, of Luzon.

A genus of 60 or more species, well and typically developed in New Guinea, ranging to Formosa, Ceylon, Africa, Fiji, New Zealand, and extra-tropical South America. I have referred to it a number of variously aberrant American species— perhaps incorrectly. *M. magellanicum* is typical enough *Meringium*. But, as a generality, *Meringium* and *Hymenophyllum* are less sharply distinguished in the far South — New Zealand and southern Chile — than are the genera as a whole. Accordingly, while supposing on the basis of present range that *Meringium* migrated as such from Antarctica, I regard it as a genus which has reached its more perfect development in more recent time.

Besides *Hymenophyllum pectinatum*, already referred to, *H. dentatum* Cav., more like *Meringium*, is too aberrant for convenient inclusion in either genus.

There is a group of species, ranging from Malaya to the Philippines and Madagascar, which have entire margins, but are typical *Meringium* in other respects. It would simplify definition if these could be removed from the genus, but the difference between entire and serrulate margins is not in nature sharply enough drawn to make this practicable.

In cell-walls, receptacle, and involucre, there is a notable resemblance between *Meringium* and *Selenodesmium*, but I believe that real affinity is remote.

9. Amphipterum

Amphipterum Presl, Epim. Bot. (1849 ?) 258, *nomen;* Copel., Philip. Journ. Sci. 64 (1937) 68, as subgenus; 67 (1938) 46, as genus.

A genus derived from *Meringium*, from which it is distinguished by bearing accessory laminar plates on one or both surfaces of the minor axes; fronds pinnately compound, margins serrulate or entire, cell-walls much or but slightly thickened, pitted if thick; involucre cleft less than half-way down, receptacle long.

TYPE: *A. fuscum* (Blume) Presl, *Trichomanes fuscum* Blume.

Four species in New Guinea, and one, the type, in Java and Sumatra. Although diverse in margin and in cell-walls, I believe that these species constitute a natural group. As a matter of convenience, this group is treated as a genus. It has already been noted that a similar development of lamellae can characterize a genus *Dermatophlebium*, derived from *Sphaerocionium*, but the convenience of its segregation is less evident.

10. Myriodon

Myriodon Copeland, Philip. Journ. Sci. 64 (1937) 73, as subgenus; 67 (1938) 47, as genus.

A genus derived from *Meringium*, from which it is distinguished by the absence of any continuous laminar expansion and its replacement by ecostate teeth or fragments of lamina longitudinally attached, in all planes, to the axes; involucre cleft half-way down, receptacle long.

TYPE: *M. odontophyllum* Copel., of New Guinea.

My publication of this species was more than two years in press. Two months before its appearance, CHRISTENSEN, Brittonia 2 (1937) 273, published *Hymenophyllum Brassii*, "quite different from all described species known to me." On material of

its type collection, and on a rich series of specimens later collected by BRASS — see Philip. Journ. Sci. 73 (1940) 463 — I find fragments on which the lamina is wholly replaced by discrete teeth in various planes, but elsewhere on all fronds continuous normal lamina is found; it is further characterized by unique trichomes. Though I have, *l.c.*, transferred it to *Meringium*, it will better be moved again, to Myriodon, as **M. Brassii,** *comb. nova. M. odontophyllum* was described from comparatively scant material, and possibly is the same species with completely dissolute lamina.

Myriodon is thus a *genus tantum natum*, characterized at least by the presence of laminar fragments in all planes, and probably also by its trichomes, so bizarre that its removal from *Meringium* remains convenient.

Similar laminar outgrowths are known on *Meringium plicatum*, which is PRESL's genus *Ptychophyllum;* on *Buesia;* and on *Mecodium Levingei.*

11. Buesia

Buesia (Morton, Bot. Gaz. 93 (1932) 336, as subgenus) Copeland, Philip. Journ. Sci. 67 (1938) 47, as genus.

Epiphytes, with slender rhizome; frond pinnately compound, the axes bearing longitudinally attached laminar teeth, margin serrulate, cell-walls thin; involucre large, deeply cleft, receptacle included.

TYPE: *B. mirifica* (Morton) Copel., *Hymenophyllum mirificum* Morton.

A genus of five recognized species, in Ecuador and Peru. Apparently a local and natural group of species, related to *Hymenophyllum.* The receptacle is described as globose in *B. mirifica* and *B. cristata,* but is slender in *B. Sodiroi* and *B. megistocarpa.*

12. Leptocionium

Leptocionium Presl, Hymen. (1843) 118, Pl. 11 D.

Rhizome slender; frond small, pinnately compound, margin entire, but, like the surface, short-setose; involucre deeply cleft, receptacle in full development extruded.

TYPE, and sole species, *L. dicranotrichum* Presl, of southern Chile.

By a variety of errors, *Leptocionium* has been made to include, as a genus, the large group here called *Meringium,* and as a subgenus has included even typical *Hymenophyllum.* Properly construed, it is one of the considerable number of sub-antarctic species each of which is a genus because obviously not properly to be included in any larger genus. *Leptocionium* has single characters in common with *Meringium, Sphaerocionium,* and *Mecodium.*

13. Rosenstockia genus novum

Genus egregium, rhizomate filiforme ad truncos rupesque repente, sparse et decidue pilifero; frondibus remotis, stipitatis stipitibus gracilibus, anguste lanceolatis, pinnatis, pinnis dimidiatis, inferioribus late obovatis acroscopice plus minus adnatis, sursum decrescentibus latius adnatis, supremis ad undulas latas acuminis sinuati frondis diminutis, minute denticulatis, venis submarginalibus continuis vel ad apicem pinnulae interruptis, nigris, venulis infimis e vena basiscopica salientibus furcatis, medialibus iterum furcatis, ad apices conniventibus et interdum anastomosantibus, ita venam submarginalem efficientibus, rarius liberis, cellulis laminae parvis, parietibus tenuissimis non vittatis; "soris e pinnae latere versus rhachidem solitatim oriundis, ellipticis, 2-2.5 mm. long. 1-1.5 mm. lat., horum labiis duobus equalibus, dimidio superiore apertis, minute denticulatis, receptaculo incluso."

TYPE and sole species: R. Rolandi-principis (Ros.) Copel. — *Hymenophyllum Rolandi principis* Ros., Fedde's Repert. 9 (1910) 72, of New Caledonia.

The quotation describing the sori is from COMPTON, Journal Linn. Soc. Bot. 45 (1922) 438. I have not seen the sori, and overlooked Professor COMPTON's paper,

in twice publishing the statement that this is a generic entity which I preferred not to name without knowledge of the fructification. It is now named in memory of Professor E. ROSENSTOCK, of Gotha, describer of the species, and author of many valuable treatises on ferns during the earlier years of this century.

ROSENSTOCK's description of the species is excellent, evidently made from the specimen in the herbarium of the University of California.

Rosenstockia seems to be one of the several isolated genera in this family. If there is particular affinity to any other genus, it is probably *Meringium,* as indicated by the half-cleft involucre. The minute marginal teeth are single cells or outgrowths of single cells. The other genus with repeatedly forked or branched veins in undivided pinnae is *Polyphlebium,* but these genera are not intimately related.

14. Serpyllopsis

Serpyllopsis van den Bosch, Eerste Bijdrage (1861) 318.

Rhizome filamentous; fronds small but of indefinite length, simply pinnate, margin entire, axes reddish-hairy, cell-walls thin; involucre mostly immersed, more or less bivalvate, receptacle stout, somewhat extruded.

TYPE: *S. caespitosa* (Gaud.) C. Chr., as *S. antarctica* v. d. Bosch, a synonym.

RANGE: Antarctic America and neighboring islands. As construed by CHRISTENSEN, a single very variable species. This is another isolated plant of the far South, perhaps related to *Mecodium,* but not at all closely.

15. Hymenoglossum

Hymenoglossum Presl, Hymen. (1843) 35; Copel., Philip. Journ. Sci. 67 (1938) 50, Pl. 4.

Rhizome filamentous; frond simple, of appreciable size, with a short rounded tooth at the end of each of the simple veins, tangential cell-walls thin except for a thickened and pitted line under the superficial wall; involucre half-immersed, the outer half cleft, receptacle inflated, included.

TYPE: *H. cruentum* (Cav.) Presl, *Hymenophyllum cruentum* Cav.

A single species, in southern Chile and Juan Fernandez.

Without near affinity to any other known genus.

16. Cardiomanes

Cardiomanes Presl, Hymen. (1843) 12.

Terrestrial, with stout, wide-creeping rhizome; stipe elongate, erect, lamina simple, reniform, of some size, coriaceous, about four cells in thickness, veins flabellate-dichotomous; involucre cylindric, immersed, receptacle long-exserted.

TYPE: *C. reniforme* (Forster) Presl, *Trichomanes reniforme* Forster.

A single species, in New Zealand, as isolated as the preceding genus.

17. Vandenboschia

Vandenboschia Copeland, Philip. Journ. Sci. 67 (1938) 51.

Typically epiphytic, with elongate rhizome; frond pinnately compound, margin entire, cell-walls uniformly thin; involucre cylindric to cup-shaped, with entire mouth, receptacle long and slender, sporangia small for the family; gametophyte, so far as known, filamentous.

TYPE: *V. radicans* (Swartz) Copel., *Trichomanes radicans* Swartz.

RANGE: All tropical lands, Antarctic America, New Zealand, South Africa, Britain, Kentucky (reported from Ohio), Japan. More than 25 accepted species, many more if *V. radicans* be narrowly construed.

The argument that because a genus has spread over the earth, it may be presumed to be old and primitive, must be used with caution in this family, because all of the

genera believed to have migrated as such from Antarctica may be supposed to have done this at about the same time. However, as compared with a considerable number of the genera to follow, *Vandenboschia* seems primitive because it is unspecialized in structures which characterize them severally; and their limited range indicates that they did not migrate as such from the common source of the family.

As in the other large and relatively primitive genera, the notably aberrant species are subantarctic; such are *V. philippiana* (Sturm) Copel., and *V. exsecta* (Kunze) Copel., both in Juan Fernandez, the latter also in Chile.

18. Polyphlebium

Polyphlebium Copeland, Philip. Journ. Sci. 67 (1938) 55.
Phlebiophyllum v. d. Bosch, Eerste Bijdrage (1861) 321, *non* Nees (1822).

Epiphytic, with filiform rhizome; frond small, pinnatifid or bipinnatifid, diaphanous, veins pinnately and dichotomously branching in undivided segments of the frond; involucre long-urceolate with entire expanded mouth, receptacle very long and slender.

TYPE: *P. venosum* (R. Br.) Copel., *Trichomanes venosum* R. Br.

A single species, in New Zealand, Tasmania and Australia. This is still another rather isolated subantarctic genus, the only member of the family, except *Rosenstockia*, with several veinlets in each ultimate segment of a dissected frond.

19. Pleuromanes

Pleuromanes Presl, Epim. Bot. (1849 ?) 258.
Leucomanes Presl, *ibidem.*
Craspedoneuron v. d. Bosch, Synopsis (1859) 21, as *Sectio;* Hymen. Javan. (1861) 12, as genus.

Normally epiphytic, with filiform rhizome; frond pinnate, typically glaucous, margin entire, with a submarginal strand two cells in thickness, the costae enclosed by a dilated sclerenchymatous sheath and the frond hairy there; involucre urceolate with entire mouth, receptacle slender, extruded.

TYPE: *P. acutum* Presl, *Trichomanes acutum* Presl, of Luzon.

RANGE: Ceylon to Tahiti. Three recognized species, of which one, *P. pallidum* (Blume) Presl, has the range of the genus, is variable, and has several names.

Related to *Vandenboschia* and presumably a derived genus. *V. latifrons* (v. d. Bosch) Copel., Khasya to Formosa and Luzon, is a *Vandenboschia* in structure, a *Pleuromanes* in appearance, and probably illustrates the evolution of *Pleuromanes.*

20. Gonocormus

Gonocormus van den Bosch, Hymen. Javan. (1861) 7; Eerste Bijdrage (1861) 321.

Normally epiphytic, with freely branching filamentous rhizome, rhizome, stipe and rachis ill differentiated, all proliferous; frond very small, glabrous, sometimes pinnate, but it or its parts with flabellate venation and incised margin; cell-walls thin, not pitted; involucre immersed, elongate with dilated entire mouth, receptacle extruded.

TYPE: *G. minutus* (Blume) v. d. Bosch, *Trichomanes minutum* Blume, of Java, and wide-ranging.

RANGE: Africa to Japan, Queensland and Hawaii.

A natural genus, of remarkably ill defined species. The proliferation, from any axis of the plant, may be suppressed, may merely be indicated by buds, or may be free and repeated; and, occurring on stipe and rachis, may produce fronds of unlimited variety; some seven species have been more or less recognizably distinguished. *Vandenboschia philippiana* suggests *Gonocormus* by imperfect distinction of rhizome and stipe; it may indicate the ancestry of *Gonocormus,* but is itself not in the line of descent.

21. Crepidopteris

Crepidopteris Copeland, Philip. Journ. Sci. 67 (1938) 57.
Crepidium Presl, Hymen. (1843) 23, as sect. of *Didymoglossum;* Epim. Bot. (1849 ?) 258, as genus, *non* Blume.
Crepidomanes v. d. Bosch, Hymen. Javan. (1861) 16, *non* Presl.

Rhizome filiform; frond small, typically bipinnatifid, rachis winged, margin entire, one or two rows of marginal cells elongate and variously thickened, cell-walls elsewhere thin, false veinlets none; sori solitary on the lowest acropetal segments of the pinnae, involucre elongate, winged, with entire expanded mouth, receptacle extruded.

TYPE: *C. humilis* (Forster) Copel., *Trichomanes humile* Forster.
RANGE: Sumatra and Luzon to Tahiti, south to New Zealand.
A natural genus of five distinct species. *C. humilis* is wide-spread, and has more synonyms than its limited variability justifies.

22. Crepidomanes

Crepidomanes Presl, Epim. Bot. (1849 ?) 258.
Taschneria Presl, *ibidem.*
Didymoglossum Prantl, Hymen. (1875) 45, *non* Desv.

Normally epiphytic, rhizome filiform, often or always rootless; frond small, pinnately compound (rarely digitate by reduction), glabrous, margin entire, intramarginal or irregularly placed false veinlets (more properly, striae) always present; sori axillary or rarely epitact, involucre obconic to trumpet-shaped, winged, mouth bifid (except in *C. Christii*), receptacle extruded.

Type: C. *brevipes* (Presl) Copel., *Didymoglossum brevipes* Presl. The typification is obscured, because PRESL took the name of a dwarf Ceylon plant, which is *C. intramarginalis* (H. & G.) Presl, based his description on a dwarf Philippine specimen, which is *C. brevipes,* and cited also a Java plant which was probably *C. bilabiatum.* Fortunately the three are congeneric and nearly related. Because it was the chief basis of the description, *C. brevipes* seems to be the proper type. PRESL's confusion is another illustration of the difficulty in distinguishing the dwarfed representatives of species distinct enough in their normal development.

Taschneria was imperfectly published lower on the same page. Its type is *T. Filicula* (Bory) Presl, a synonym of *Crepidomanes bipunctatum* (Poiret) Copel.

RANGE: Madagascar to Japan and Tahiti. More than a dozen species — a great many more have been described. Synonyms are numerous, because of the repeated descriptions of dwarf specimens; also, because the best known species, *C. bipunctatum, C. brevipes,* and *C. bilabiatum,* are variable, and many forms have been named. A species or group ranging from India to Japan has a number of names which I have been unable to evaluate.

C. Christii is remarkable in the genus for having an entire flaring mouth of the involucre.

23. Microgonium

Microgonium Presl, Hymen. (1843) 19, Pl. 6; v. d. Bosch, Hymen. Javan. 5.
Hemiphlebium, sect. *Microgonium* Prantl, Hymen. (1875) 48.

Epiphytic, with filamentous rhizome, roots often or always wanting; frond minute, straight in vernation, simple or lobed, glabrous, venation pinnate or flabellate, false veinlets present; involucre elongate, mouth typically expanded and entire, receptacle extruded.

TYPE: *M. cuspidatum* (Willd.) Presl, *Trichomanes cuspidatum* Willd., of Mauritius.
RANGE: Africa to Tahiti; one species belonging here by definition in America.

A group of exceedingly reduced species, at least in major part derived from *Crepidomanes,* as shown by the false veins. Since the species of *Crepidomanes* are well known to be subject to reduction and simplification, and thereby to the loss of their specific characters, it is not unlikely that the derived species referred to *Microgonium* are of diverse origin in *Crepidomanes;* that is, *Microgonium* may not be a proper genus. But, until more intimate acquaintance may demonstrate independent descent, there is no reason for assuming it.

M. Hookeri Presl has the characteristic structure of the genus, but the geographic argument against its inclusion is very strong.

24. Callistopteris

Callistopteris Copeland, Philip. Journ. Sci. 67 (1938) 64.

Typically epiphytic, rhizome stout, ascending; fronds polystichous, large for the family, pinnately decompound, soft in texture, major axes soft-hairy, margin entire, cell-walls thin; involucre immersed, obconic or urceolate, mouth entire or cleft, receptacle extruded.

TYPE: *C. apiifolia* (Presl) Copel., *Trichomanes apiifolium* Presl, of the Philippines.

A very natural group of five species, ranging from Sumatra to Hawaii, south to Lord Howe Island and Rapa. Derived from *Vandenboschia,* and more particularly from the neighborhood of *V. aphlebioides.*

25. Nesopteris

Nesopteris Copeland, Philip. Journ. Sci. 67 (1938) 65.

Terrestrial, stem stout, becoming erect; fronds polystichous, pinnately decompound, the axes bearing minute, clavate hairs, margin entire, cell-walls thin, but texture fairly firm; involucre cylindric, winged, mouth entire but sometimes ciliate, receptacle extruded.

TYPE: *N. grandis* Copel., *Trichomanes grande* Copel., of the Philippines.

RANGE: Malaya to Loochoo and Samoa.

A clearly defined genus of four species, derived from *Vandenboschia,* and enough like *V. maxima* to suggest that species as a more particular relative of its ancestors. It differs from *Callistopteris* in habitat, texture, pubescence, and form of involucre, as well as in apparent origin. Old confusion with *Selenodesmium* (as *Trichomanes rigidum*) was never justified.

26. Cephalomanes

Cephalomanes Presl, Hymen. (1843) 17, Pl. 5.

Terrestrial, stem stout, becoming erect; fronds polystichous, setose, harsh, simply pinnate, pinnae unequal-sided, the acropetal side more or less incised or lacerate, veins coarse, cells large and with relatively thin wavy walls; involucre cylindric or rarely obconic, receptacle stout, long-extruded.

TYPE: *C. atrovirens* Presl, of the Philippines.

RANGE: India across Polynesia.

A most natural genus, of about 10 species, derived from *Vandenboschia,* the ancestry more particularly indicated by *V. auriculata.* With distinct parentage and in a different region, the evolution of *Trichomanes* has been roughly parallel.

27. Trichomanes

Trichomanes Linnaeus, Sp. Pl. (1753) 1097.
Trichomanes, sect. *Achomanes* Presl. Hymen. (1843) 15.
Ragatelus Presl, Hymen. (1843) 16.
Neurophyllum Presl, Hymen. (1843) 18, Pl. 4 C, *non* T. & G.
Odontomanes Presl, Epim. Bot. (1849 ?) 16.
Neuromanes Trev., (1851) : v. d. Bosch, Synopsis (1859) 7.
Ptilophyllum v. d. Bosch (1861) : Prantl, Hymen. (1875) 47, *nec aliorum.*
Lacostea v. d. Bosch (1861) : Prantl, Hymen. (1875) 50, *pro parte minore.*

Typically terrestrial, rhizome elongate or more typically short and becoming erect; fronds pinnatifid or pinnate or somewhat more dissected, typically uniform, false veinlets rarely present, lamina one cell in thickness except near veins and in the involucre; involucre obconic to cylindric, mouth truncate to expanded but always entire, receptacle slender and extruded; gametophyte, so far as known, filamentous but bearing archegonia on thalloid branches.

TYPE: *T. crispum* L., of Martinique. This species was LINNAEUS' genus *Trichomanes* prior to 1753, and the 10 others in the genus in Species Plantarum were obviously there because of some resemblance to *T. crispum*.

RANGE: Tropical America, and slightly beyond the Tropics.

Trichomanes is evidently derived from *Vandenboschia*, a stage in its evolution being illustrated by *T. rupestre* (Raddi) v. d. Bosch. A part of its later evolution has been parallel to that of *Cephalomanes*, and the resulting superficial resemblance led PRANTL to combine the two genera in his *Ptilophyllum*.

About 25 species are known to me, and the validity of others is not questioned. While not, as here construed, the largest genus in the family, *Trichomanes* remains easily the most diversified. It is a natural group. Its fragments, of any decent number, formally distinguished by the best of characters, are not so evidently natural. This is because characters which usually serve well as generic fail to do so here. Thus, an ascending and eventually radially symmetrical stem, as contrasted with a rhizome, is usually a convenient genus character among ferns; but in *Trichomanes* it does not uniformly characterize natural subgeneric groups; nor, as *T. crispum* is usually construed, is it constant for the species. The same is true of hairiness.

Dimorphism of the fronds almost always serves as a good generic character. In *Trichomanes*, as here construed and not including *Feea*, dimorphism occurs twice independently, and has been disputed as a good specific character in the case of *N. Vittaria* D. C. This was the first species listed by Presl under *Neurophyllum*, but he illustrated the genus by *N. pinnatum*, with uniform fronds. As his generic name was unavailable, its typification is unimportant. *Neuromanes* is possibly the available name for such a genus; or it may be *Odontomanes*. If one would feel constrained in this group to recognize genera on the basis of such conspicuous and usually significant characters as venation and dimorphism, at least four genera can be segregated from *Trichomanes*. This is an extraordinary case, in which I would not feel sure of the naturalness of all of the genera, even if each was composed of a single species.

Ragatelus was typified by *R. crinitus*, *Trichomanes crinitum* Swartz. PRESL knew the plant by a picture, and its supposed generic characteristic is not to be found in nature. It is very near to the type of *Trichomanes*. When PRANTL, following VAN DEN BOSCH, misconstrued *Trichomanes*, he should have used *Ragatelus* instead of *Ptilophyllum* as the name of the real *Trichomanes*.

28. Feea

Feea Bory, Dict. Class. d'Hist. Nat. VI (1824) 446.
Hymenostachys Bory, *ibid.*, p. 588; VIII (1825) 462.
Homoeotes Presl, Abh. böhm. Ges. Wiss. V 5 (1848) 331.

A genus derived from *Trichomanes*, and approximately from *T. crispum*, terrestrial, rhizome creeping or becoming erect; fronds dimorphic, the sterile lanceolate, subpinnate with entire segments, the fertile linear.

TYPE: *F. polypodina* Bory, from Guadeloupe, a synonym of *F. osmundoides* (D. C.) Copel.

RANGE: Bolivia to southern Mexico and the West Indies.

As here construed, a genus of five known species, all evidently nearly related to *Trichomanes crispum* and presumably derived from it, and in this sense a natural genus. But *T. crispum*, as here construed, is itself a diversified species, and the species of *Feea* may well represent independent lines of descent from it.

Typical *Feea* (*F. osmundoides* and *F. botryoides* (Kaulf.) v. d. Bosch) has an erect stem, and sori standing closely side by side on an almost wingless rachis;

F. diversifrons (Bory) Copel., the type of *Hymenostachys,* has closely placed sori sunk in the body of the linear fertile frond. The tissue between the sori is several cells in thickness; but it is more reasonable to say that the closeness of the sori leaves no room for normal lamina, than to say that the lamina is several cells in thickness. The veins of the sterile frond anastomose.

F. heterophylla (H. B. W.) Copel., the type of *Homoeotes,* has an elongate rhizome and seriate leaves, with pinnatifid fertile frond.

Both *Hymenostachys* and *Homoeotes* can be recognized as genera on the basis of their distinctive characters. If it is shown that these characters prove an independent origin in the group of *Trichomanes crispum,* they must be treated as independent genera — or else returned to *Trichomanes.* In the absence of such a demonstration, one natural genus is preferable to three, with a total of five species.

29. Didymoglossum

Didymoglossum Desvaux, Prod. (1827) 330.
Hemiphlebium Presl, Hymen. (1843) 25.

Epiphytic, with filiform velutinous rhizomes and (so far as known) without roots; frond small to minute, pinnatifid or more commonly entire, margin setiferous, veins pinnately or flabellately placed, with false veinlets between them; involucre elongate, the mouth bilabiate, receptacle extruded.

TYPE: *D. muscoides* (Swartz) Desv., a synonym of *D. hymenoides* (Hedwig) Copel.

Twenty or more species, mostly American, tropical and north to Georgia and Mississippi; a few in Africa, Madagascar and Ceylon.

Aberrant species are:

D. Petersii (Gray) Copel., with entire mouth.

D. lineolatum v. d. Bosch, without false veinlets.

Quite typical of the genus is *D. pusillum* (Swartz) Desv., the type of *Hemiphlebium.*

The bilabiate involucre and false veinlets suggest *Crepidomanes,* which has sometimes been combined with *Didymoglossum.* The setulose margin suggests *Sphaerocionium* and *Microtrichomanes.* I do not believe that either of these resemblances proves near relationship; but do suspect nearer affinity to the most primitive element in *Trichomanes.*

30. Lecanium

Lecanium Presl, Hymen. (1843) 11, Pl. 1.

Rhizome filamentous, velutinous, rootless when adult; frond simple, entire or incised, subcostate or veins everywhere flabellate-dichotomous, margin hairless but bearing unique paired scales on the apices of false veinlets between the true veinlets; lamina partly pluricellular in thickness; involucre elongate, immersed, with crenate or subbilabiate expanded mouth, receptacle extruded.

TYPE: *L. membranaceum* (L.) Presl, *Trichomanes membranaceum* L.

A single species, West Indies to Bolivia.

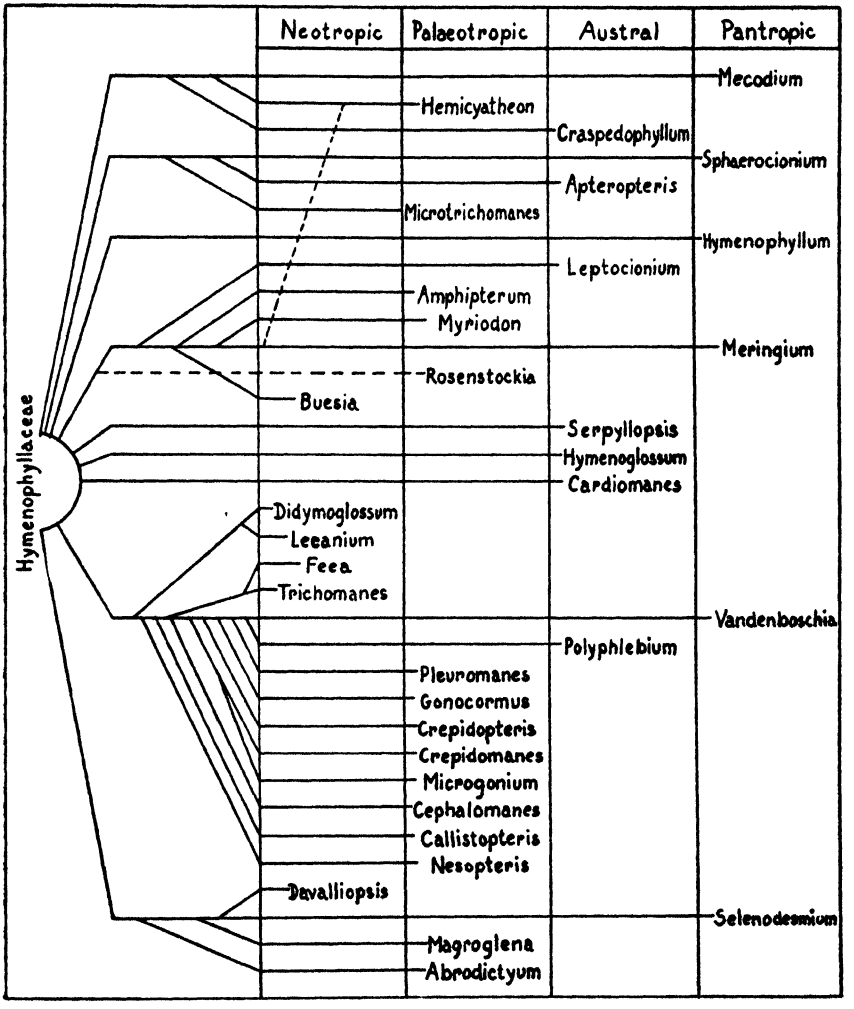
Evidently a relative of *Didymoglossum,* but fairly isolated.

31. Selenodesmium

Selenodesmium (Prantl, Hymen. (1875) 53, as sect. of *Trichomanes*) Copeland, Philip. Journ. Sci. 67 (1938) 80, as genus.

Terrestrial, stem stout, short-creeping to erect; stipe elongate, deciduously short-setose; lamina broad, pinnately compound, pinnules dissected but with an uncut medial portion, texture firm, cell-walls typically thick and coarsely pitted; involucre cylindric, with entire mouth, receptacle extruded.

TYPE: *S. rigidum* (Swartz) Copel., *Trichomanes rigidum* Swartz, of Jamaica.


Neotropic
Palaeotropic
Austral
Pantropic
Hymenophyllaceae
Hemicyatheon
Craspedophyllum
Mecodium
Sphaerocionium
Apteropteris
Microtrichomanes
Hymenophyllum
Leptocionium
Amphipterum
Myriodon
Meringium
Rosenstockia
Buesia
Serpyllopsis
Hymenoglossum
Cardiomanes
Didymoglossum
Leeanium
Feea
Trichomanes
Vandenboschia
Polyphlebium
Pleuromanes
Gonocormus
Crepidopteris
Crepidomanes
Microgonium
Cephalomanes
Callistopteris
Nesopteris
Davalliopsis
Selenodesmium
Magroglena
Abrodictyum

Pantropic, south to New Zealand. A clearly natural group of ten species, part of which are ill defined.

32. Davalliopsis

Davalliopsis van den Bosch, Eerste Bijdrage (1861) 323; Copel., Philip. Journ. Sci. 67 (1938) 82, Pl. 11.

Terrestrial, stem stout, becoming erect; frond large for the family, pinnately decompound, lamina three cells in thickness; involucre funnel-shaped, with expanded sinuate mouth, receptacle extruded.

TYPE: *D. elegans* (Rich.) Copel., *Trichomanes elegans* Rich.

A single species of tropical America, unless *Trichomanes pachyphlebium* of Madagascar, unknown to me, belongs here. Probably related to *Selenodesmium*, but distinct in structure of frond.

33. Macroglena

Macroglena (Presl, Abh. böhm. Ges. Wiss. V 5 (1848) 333, as sect. of *Trichomanes*) Copel., Philip. Journ. Sci. 67 (1938) 82, as genus.

Terrestrial and epiphytic, rhizome long or short, stout; frond pinnately decompound, finely dissected, lamina reduced to a narrow wing on the axes; involucre cup-shaped or rarely longer, mouth usually truncate, entire, receptacle extruded.

TYPE: *M. meifolia* (Bory) Copel., *Trichomanes meifolium* Bory.

RANGE: Madagascar to Tahiti, south to New Zealand.

A dozen species. As the genus is characterized chiefly by the reduction of the laminar expansion, which might make species of diverse ancestry look alike, there is a possibility that it is not a natural genus. There is sure affinity to *Selenodesmium*.

34. Abrodictyum

Abrodictyum Presl, Hymen. (1843) 20, Pl. 7.
Habrodictyon v. d. Bosch, Hymen. Javan. (1861) 17.

Epiphytic on tree-fern trunks, stem short, stipes crowded; frond small, pinnately compound with linear segments, margin entire, cells transversely elongate in obliquely longitudinal rows, walls conspicuously coarsely pitted, involucre funnel-shaped with expanded mouth, receptacle extruded.

TYPE: *A. Cumingii*, of the Philippines.

A single species, found also in New Guinea. Affinity unknown.

The foregoing treatment presents the *Hymenophyllaceae* as a family of 34 convenient genera, all of which may be natural, and nearly all of which are positively so. This number can be increased without violation of principles. The removal of *Ptychophyllum* from *Meringium* might be an improvement. The restoration of *Dermatophlebium, Hymenostachys* and *Homoeotes* is optional. With less convenience, because of uncertainty, several genera can be removed from *Trichomanes*. *Mecodium Levingei* can be made a genus; its affinity is clear, but it is conspicuously aberrant.

Then there are the species of the far South — *Hymenophyllum pectinatum* and *H. dentatum, Vandenboschia philippiana,* and the New Zealand species with "plurilaminate laminae," *Mecodium dilatatum* and *M. scabrum* — none of which fit well in any genus. Finally, there is a species which I have assigned to no genus because I do not know it well enough: *Trichomanes Hillebrandtii* Kuhn, of the Comores, apparently like *Microgonium* in some respects, but with thick lamina.

The relationships ascribed to the recognized genera are shown by the accompanying diagram, from Philip. Journ. Sci. 67 (1938) 2.

FAMILY 6 — PTERIDACEAE

Pteridaceae Gaudichaud, in Freycinet, Voyage (1826) 262, as "sous-division" of "Classe Gyratae."
Lindsaeaceae Presl, Tent. (1836) 130, as *Sectio.*
Dicksoniaceae Presl, Tent. (1836) 133, as *Tribus.*
Adiantaceae Presl, Tent. (1836) 139, as *Tribus.*
Culcitaceae, Dennstaedtiaceae, Hypolepidaceae, Gymnogrammaceae Ching, Sunyatsenia 5 (1940) 201-268.
Sinopteridaceae Koidzumi, cited by Ching, *l.c.*

Typically terrestrial ferns; stem a creeping rhizome, or ascending and becoming erect, rarely arborescent, vascular system solenostelic or becoming dictyostelic by congestion, rarely protostelic, indument of hairs or of paleae; fronds pinnate in plan, sometimes deltoid in form, decompound to simple and entire, not articulate to rhizome; sori typically marginal and protected by an indusium opening toward the margin, or by a reflexed margin, or naked, or borne on and protected by the reflexed margin (*Adiantum*), or elongate along veins anticlinal to the margin and exindusiate, or elongate parallel to the costa and exindusiate (*Taenitis*), or the sporangia covering the whole fertile surface; annulus oblique and uninterrupted in a few primitive genera, longitudinal and interrupted in all others, sporangium opening by a transverse slit through a definite stomium, spores almost always tetrahedral.

Obviously, the foregoing definition provides no satisfactory means of placing in this family an unknown member. This difficulty is inherent, and I do not believe it can be avoided. I do believe that the genera here included constitute one great phylum, a natural family.

For an ancestor of *Pteridaceae,* we look back beyond Miocene, perhaps to Cretaceous time, and to a type of fern represented now by *Schizaeaceae,* perhaps also by *Loxsomaceae.* If there is doubt about the naturalness of the family as here presented, it is due to the possibility that it includes more than one line of descent from the one assumed ancestral group.

Two smaller families are assigned this ultimate origin, — *Parkeriaceae* and *Davalliaceae.* They are more homogeneous and evidently younger. Conceivably, they are derived from *Pteridaceae.*

A discussion of the internal relationships of the family will follow the presentation of the genera.

Key to Genera of Pteridaceae: —

Sori with indusium opening on marginal side.
  Sorus served by a single veinlet.
    Tree-ferns.
      Fertile pinnae contracted.
        Indusium cup-shaped ..... **1. Thyrsopteris**
        Indusium bivalvate.
          Annulus conspicuously oblique ..... **2. Dicksonia**
          Annulus slightly oblique ..... **3. Cystodium**
      Fertile and sterile pinnae alike ..... **4. Cibotium**

Not arborescent, but stem erect.
Fertile pinnae contracted ..... **3. Cystodium**
Fertile and sterile pinnae alike ..... **7. Orthiopteris**
Rhizome creeping.
Rhizome dictyostelic.
Sorus marginal.
Hairs soft ..... **4. Cibotium**
Hairs stiff ..... **5. Culcita**
Sorus inframarginal ..... **6. Saccoloma**
Rhizome solenostelic.
Sorus marginal ..... **8. Dennstaedtia**
Sorus inframarginal.
Indusium half-cup-shaped ..... **9. Microlepia**
Sides of indusium free.
Lamina pubescent ..... **11. Oenotrichia**
Lamina glabrous ..... **22. Leptolepia**
Rhizome protostelic.
Pinnules dimidiate ..... **12. Lindsaea**
Pinnules not dimidiate ..... **13. Tapeinidium**
Sorus served by plural veinlets.
Margin not reflexed.
Pinnae articulate to rachis ..... **17. Isoloma**
Pinnae non-articulate.
Rhizome protostelic.
Fronds rampant ..... **15. Odontosoria**
Fronds not rampant.
Pinnules dimidiate ..... **12. Lindsaea**
Pinnules oblique, not dimidiate ..... **16. Ormoloma**
Pinnules cuneiform ..... **14. Sphenomeris**
Rhizome solenostelic, frond simple ..... **18. Schizoloma**
Margin reflexed.
Rachis zigzag, spores bilateral ..... **24. Paesia**
Rachis straight, spores tetrahedral ..... **28. Pteridium**
Sori not protected nor elongate.
Sori dorsal.
Frond membranaceous ..... **10. Monachosorum**
Frond herbaceous ..... **23. Hypolepis**
Sori marginal ..... **39. Cheilanthes**
Sori exindusiate, elongate.
Rhizome hairy or bristly, not paleate.
Venation, at least partly, reticulate.
Sori parallel to costa ..... **19. Taenitis**
Sori oblique to costa.
Frond simple or pinnate ..... **20. Syngramma**
Frond ternate or pedate ..... **21. Craspedodictyum**
Veins free.
Pinnae subdimidiate, simple ..... **62. Aspleniopsis**
Pinnae not subdimidiate.
Fronds simple or pinnae ample.
Veins parallel ..... **20. Syngramma**
Venation flabellate ..... **27. Pterozonium**
Pinnae or pinnules small.
Frond linear, simply pinnate ..... **26. Jamesonia**
Frond broader, more compound ..... **25. Eriosorus**
Rhizome paleate, with or without hairs.
Fronds glabrous or ceraceous.
Pinnae ample and entire ..... **36. Coniogramme**
Pinnae small or dissected.
Frond membranaceous ..... **60. Anogramma**
Frond herbaceous or firmer.

Pinnae pinnate ..... 58. Pityrogramma
Pinnae trifoliolate ..... 59. Trismeria
Fronds pubescent.
Frond membranaceous ..... 60. Anogramma
Frond herbaceous or firmer.
Frond deltoid ..... 53. Bommeria
Frond simple or pinnatifid ..... 52. Hemionitis
Frond at least pinnate.
Stipe and rachis castaneous ..... 57. Gymnopteris
Axes lighter.
Frond small ..... 61. Pleurosoriopsis
Frond ample ..... 36. Coniogramme
Fronds paleaceous.
Fronds uniform.
Frond pinnate ..... 56. Paraceterach
Frond pinnatifid ..... 55. Saffordia
Fronds dimorphic ..... 54. Trachypteris
Sori protected by reflexed margin, not borne on it.
Rhizome hairy, not paleate.
Sori not elongate along margin ..... 23. Hypolepis
Sori elongate along margin.
Rachis zigzag ..... 24. Paesia
Rachis straight ..... 28. Pteridium
Rhizome paleate, sometimes also hairy.
Veinlets anastomosing below sori.
Sorus single, on only one side of segment ..... 32. Hemipteris
Sori not so restricted.
Fertile margin much thickened ..... 33. Schizostege
Fertile margin not thick.
Sori on marginal connecting-veins.
Rhizome long-creeping ..... 29. Histiopteris
Rhizome short, fronds congested.
Fronds large or pinnate ..... 31. Pteris
Fronds small and pedate ..... 47. Doryopteris
Tips of veins not connected ..... 45. Pellaea
Veinlets free below sori but connected in them.
Rhizome scandent ..... 30. Lepidocaulon
Rhizome not scandent.
Frond pedate to tripartite.
Segments not again divided ..... 47. Doryopteris
Segments forked ..... 49. Actiniopteris
Frond at least once pinnate.
Fronds uniform.
Ultimate leaflets ample ..... 31. Pteris
Frond rather finely dissected.
Sori primarily terminal ..... 34. Ochropteris
Sori on sides of segments ..... 51. Onychium
Fronds somewhat dimorphic ..... 35. Anopteris
Veinlets everywhere free.
Fronds dimorphic ..... 50. Cryptogramma
Fronds uniform.
Frond deltoid to deltoid-ovate.
Frond ceraceous beneath ..... 41. Aleuritopteris
Frond not ceraceous.
Reflexed margin continuous ..... 44. Cheiloplecton
Sori separately protected ..... 42. Aspidotis
Base of frond not dilated.
Reflexed indusium inframarginal.
Indusium continuous ..... 43. Mildella
Indusia discrete, inconspicuous ..... 48. Ormopteris

Reflexed indusium marginal.
Indusium continuous ..... **45. Pellaea**
Indusium interrupted ..... **39. Cheilanthes**
Sori protected by and borne on reflexed margin ..... **63. Adiantum**
Sporangia covering fertile surface, whether or not borne everywhere.
Veins free; margin reflexed.
Fertile pinnae at apex of frond ..... **46. Llavea**
Frond everywhere fertile ..... **40. Neurosoria**
Veins anastomosing; margin flat.
Frond firm-herbaceous ..... **37. Neurocallis**
Frond thick-coriaceous ..... **38. Acrostichum**

1. Thyrsopteris

Thyrsopteris Kunze, Linnaea 9 (1834) 507; Hooker & Bauer, Genera, Pl. 44 A.
Panicularia Colla, Mem. Acad. Torino 39 (1836) 33, Pl. 64.

A small tree-fern, hairy but not scaly; frond pinnately decompound, dimorphic as to its parts, the upper pinnae sterile, the lower fertile and contracted to the axes; sori terminal, the indusium at first globose, opening as a cup with entire rim; sporangia on all sides of a short receptacle, maturing basipetally, short-stalked, with large oblique annulus, opening by a transverse slit, spores tetrahedral.

TYPE: *T. elegans* Kunze. A single species, endemic on Juan Fernandez.

The immediate ancestry of *Thyrsopteris* is presumably lost in Antarctica, but European Jurassic fossils have been ascribed to the genus. The position of the sorus, and the presence of hairs and the absence of paleae show affinity to the Dicksonioid genera, while the form of the sorus is Cyatheoid. It may well be a relic from the time when *Dicksonia* and *Cyathea* had a common ancestor. In the direction of less primitive ferns, its most probable affinity is to *Culcita.*

Like a very few other tree-ferns, *Thyrsopteris* spreads by means of runners.

2. Dicksonia

Dicksonia L'Héritier, Sertum Anglicum (1788 ?) 30.
Balantium Kaulfuss, Enum. (1824) 228.

Arborescent, clothed with coarse bristles; fronds large, harsh, tripinnate, somewhat narrowed at base, pinnules symmetrical or nearly so, dimorphic as to the pinnae or pinnules, the lamina of the fertile ones contracted or wanting; sori marginal, indusium bivalvate, the outer valve being a modified, concave tooth of the frond, the inner valve a special structure (the true indusium), also hard, sporangia on all sides of the short receptacle, maturing basipetally, annulus conspicuous, somewhat oblique, not interrupted by the pedicel, spores tetrahedral.

TYPE: *D. arborescens* L'Héritier, of St. Helena.

Twenty-five species, of Antarctic origin, eight species representing the American migration, and 14 that viâ New Zealand and Tasmania. One species reaches Mexico, and one Luzon.

Somewhat related to *Thyrsopteris* and to *Cibotium;* nearly so to *Cystodium;* less so to *Culcita.* With *Cystodium,* it is an offshoot from the main phyletic line of its group.

3. Cystodium

Cystodium J. Smith, in Hooker and Bauer, Genera Fil. (1841) Pl. 96.

Like *Dicksonia,* but doubtfully arborescent, the hairs weaker, the fronds bipinnate, less evidently dimorphic, the inner valve of the indusium smaller and weaker, the annulus only slightly oblique and usually interrupted by the pedicel.

TYPE: *C. sorbifolium* (Smith) J. Smith, *Dicksonia sorbifolia* Smith, of the Moluccas.
A single species, New Guinea to Borneo.
Nearly related to *Dicksonia,* and to nothing else.

4. Cibotium

Cibotium Kaulfuss, Jahrb. d. Pharm. (1820), not seen; Enum. (1824) 229.
Pinonia Gaud., Ann. Sci. Nat. 3 (1824) 507; Freyc. Voy. (1827) 96, 369, Pl. 21.

Stem stout, prostrate, or becoming erect in some species, densely soft-hairy; frond tripinnate or nearly so, with broad base; sori marginal, as in *Dicksonia,* but the outer valve less evidently a modified part of the lamina.

TYPE: *C. Chamissoi* Kaulf., of Hawaii.
Three or four Hawaiian species; four similar species in Central America and Mexico; one to three oriental — Java to China and Formosa.
Related to *Dicksonia,* but more so to *Culcita,* as shown by form and dissection of frond.

5. Culcita

Culcita Presl, Tent. (1836) 135, Pl. 5, f. 5; Maxon, Journ. Wash. Acad. Sci. 12 (1922) 454.
Balantium auct. plur. nec Kaulfuss.

Stem prostrate and ascending, not arborescent, densely bristly; fronds polystichous, pinnately decompound, uniform, the ultimate pinnules oblique; sori marginal, terminal on the veins, of which the tips become the receptacles, bearing sporangia on all sides, indusium of two valves, the outer formed from the tissue of the frond, the inner (true indusium) a special outgrowth, sporangia maturing basipetally, annulus slightly oblique and more or less interrupted by the pedicel, spores tetrahedral.

TYPE: *C. macrocarpa* Presl, a synonym (but with the tenable name) of *Dicksonia culcita* L'Héritier, of the Atlantic islands.
Other species are *C. coniifolia* (Hooker) Maxon, of tropical America; and seven too similar species from Australia to Samoa and Formosa. These oriental species have a section name, *Calochlaena* Maxon.
Culcita is related to *Thyrsopteris,* of more primitive ferns; to *Cibotium* rather than to *Dicksonia;* and most nearly to *Dennstaedtia,* thus being the most primitive member of a very large natural group of genera.

6. Saccoloma

Saccoloma Kaulfuss, Jahrb. d. Pharm. (1820) 51, not seen; Enum. (1824) 224.
Neuropteris Gaud., Prod. (1827) 292.

Rhizome stout, dictyostelic, prostrate, sparsely clothed with dark, firm paleae and with some hairs; fronds large, polystichous, simply pinnate, pinnae linear-lanceolate, entire or finely dentate; sori submarginal, terminal on the veins, indusium short and broad, drawn to a short point on the veins, receptacle short, being one side of the immersed vein tip, sporangia mixed in maturing, annulus of 16 to 23 thickened cells, straight or wavy, interrupted by the pedicel, stomium conspicuous, spores tetrahedral, sculptured.

TYPE: *S. elegans* Kaulf., of Brazil.
A single species, Brazil to Central America.

7. Orthiopteris

Orthiopteris Copeland, Bishop Mus. Bull. 59 (1929) 14.
Ithycaulon Copel., Univ. Calif. Publ. Bot. 16 (1929) 79.

Stem erect, dictyostelic, dark-paleate; fronds bipinnate to finely decompound, broad at base, glabrous, pinnae and pinnules oblique; sori marginal

or terminal on the segments, indusium obconic, drawn down to a point on the vein, the sides affixed, sporangia stalked, annulus of 15 to 19 thickened cells, interrupted, stomium well developed, spores tetrahedral, sculptured.

TYPE: *O. ferulacea* (Moore) Copel. *Davallia ferulacea* Moore, of Fiji.

Ithycaulon was typified by "*I. moluccanum* (Blume) Copel.," which is properly named **Orthiopteris minor** (Hooker) Copel., *Davallia inaequalis* var. *minor* Hooker, Sp. Fil. I (1846) 180, Pl. 58 A, the type being Philippine. This species ranges from Malacca to Fiji. Four other species are endemic in New Guinea. **O. Henriettae** (Baker), *Dicksonia Henriettae* Baker, Syn. Fil. (1874) 462, Icones Pl. 1606; *Saccoloma Henriettae* C. Chr., Dansk Bot. Arkiv 7 (1932) 75, Pl. 25, f. 12, 13, is endemic in Madagascar. Four species are known in the American tropics, of which the best known are **O. inaequalis** (Kunze), *Davallia inaequalis* Kunze, Linn. 9 (1834) 87; and **O. dominguensis** (Spr.), *Davallia dominguensis* Spr., Anleit. III (1804) 149, Pl. 4, f. 33.

Ithycaulon was to be distinguished from *Orthiopteris* by bearing paleae, of which the latter was supposed to be destitute; but recent better collections have shown that *Orthiopteris* bears a tuft of small, dark, firm paleae on the apex of the stem.

Orthiopteris and *Saccoloma* are near relatives. Neither is very near to *Cystodium* or *Ormoloma,* which were included in *Saccoloma* by DIELS, and in the original Index of CHRISTENSEN.

The distribution of the species of *Orthiopteris* implies Antarctic origin.

8. Dennstaedtia

Dennstaedtia Bernhardi, Schrader's Journ. "1800[2]" (1801) 124.
Sitolobium Desv., Prod. (1827) 263.
Patania Presl, Tent. (1836) 137.
Adectum Link, Fil. Hort. Berol. (1841) 41, 42.

Terrestrial, rhizome creeping, usually stout, solenostelic, hairy; fronds large to huge, pinnately decompound, broad at base, hairy or naked, the pinnules oblique, veins free; sori marginal, usually in sinuses, terminating the veins, indusium formed by the fusion of an indusium in the stricter sense and a minute tooth, to form a cup-shaped or slightly bivalvate structure, usually deflexed, receptacle short, sporangia slender-stalked, annulus interrupted.

TYPE: *D. flaccida* (Forster) Bernh., *Trichomanes flaccidum* Forster, from the islands of the Pacific Ocean. This fern was illustrated by BERNHARDI, and by SCHKUHR, Krypt. Gew. Pl. 129, and described in detail by SWARTZ, Schrader's Journ. (1803) 294, and Syn. Fil. 357, and by SCHKUHR, *l.c.,* 126; since which, it has been hardly more than a name. HOOKER, Sp. Fil. I 77, translated a description, and added "I have seen no specimen of this fern from the 'Pacific Isles,' save Forster's original ones in the Banksian herbarium . . ." BERNHARDI figured the indusium as an entire cup. SWARTZ disputed this, finding it bivalvate, and construed the species as a *Dicksonia.* SCHKUHR, also with FORSTER material, found it too immature for judgment. I have no doubt that BERNHARDI and SWARTZ had the same plant, and that each described what he saw; as to which saw it better, it may be observed that SPRENGEL, writing before BERNHARDI, called the plant a *Cyathea.*

I have tried diligently to relocate this species. *A priori,* this should have been easy. FORSTER naturally collected the commoner plants. Of Pacific isles, he collected most in Tahiti. But the only *Dennstaedtia* known now in Tahiti is *D. scandens,* with conspicuously aculeate axes; it can not be *D. flaccida.* With good material of every other *Dennstaedtia* over responsibly reported in Polynesia or Melanesia, I find only *D. samoensis* which may possibly be *D. flaccida.*

Dennstaedtia is a genus of about 70 species, nearly all tropical, ranging north to Japan and the United States, south to Chile and Tasmania, known fossil in the Upper Cretaceous of Patagonia.

Sitolobium, printed *Litolobium* by NEWMAN, and *Adectum* were both based on *D. punctilobula,* of the United States. *Patania* was typified by the tropical American

D. obtusifolia. Both are typical enough *Dennstaedtia;* in fact, PRESL would seem to have ignored BERNHARDI, distinguishing *Patania* by "indusio pateraeformi integro nec bivalvi."

There are in *Dennstaedtia* two easily distinguishable elements. The great majority of the species, including the type, have hairy stipes and rachises, stramineous to brownish, never polished. This element of the genus is related, among more primitive ferns, to *Culcita;* and is so near to *Microlepia* that the difference is not always certain.

The other element, which may be typified by *D. scandens,* has red or reddish-brown axes, slightly pubescent to glabrous, and aculeate. It is more nearly related to *Hypolepis* and to *Paesia.* This group of species is oriental, ranging from Malaya to Formosa and Tahiti. Related to it is a more isolated group with very shiny, naked, smooth axes, and articulate, commonly paired pinnae. These range from Celebes to Luzon and Fiji. CHRISTENSEN would perhaps combine what I regard as this group of species in a single one, *D. glabrata* (Cesati) C. Chr. This, the most aberrant group in the genus, has no outside relatives.

9. Microlepia

Microlepia Presl, Tent. (1836) 124.
Scypholepia J. Sm. Hist. Fil. (1875) 261.

Terrestrial, rhizome creeping, solenostelic, hairy; frond mediocre to large, pinnate to decompound, with obliquely incised ultimate pinnules, usually hairy, veins free; sorus intramarginal, terminal on its vein, indusium half-cup-shaped, fixed by the rounded base and sides, receptacle short, annulus of 16 to 20 thickened cells, straight and interrupted, spores tetrahedral, smooth or tuberculate, not sculptured.

TYPE, BY CONVENTION: *M. Speluncae* (L.) Moore, *Polypodium Speluncae* L., *M. polypodioides* Presl. The first species listed and first figured by PRESL are supposed to be species I include in *Orthiopteris,* which genus might therefore be called *Microlepia.* However, PRESL included species of both genera, and J. SMITH and CHRISTENSEN have agreed on *M. Speluncae* as the type. PRESL's figures, whatever their subject, depict the indusium of *Microlepia* as here construed, cup-shaped with a rounded base, not that of *Orthiopteris,* which is obconic with a pointed base. While both genera, like *Davallia,* have indusia fixed by base and sides, they are not very nearly related.

M. Speluncae, in countless slightly different forms, is pantropic and ranges south to New Zealand and Madagascar. The other species, about 45, are all in the Old World, in the tropics, south to New Zealand and Madagascar, and north to Japan.

The genus is distinguished from *Dennstaedtia* by the non-marginal sorus. The sorus may be very nearly marginal, and the indusium may then approach cup-shaped instead of half-cup-shaped. If the sorus has retreated from the margin in more than one phyletic line, the generic distinction should be abandoned.

Microlepia hookeriana (Wall.) Presl has simply pinnate fronds with non-incised pinnae, which I do not find to be articulate to the rachis. It constitutes J. SMITH's genus *Scypholepia.*

Another notably aberrant species is *M. platyphylla* (Don) J. Smith, with glabrous fronds of firm texture, not finely dissected, indusia broad and affixed by the lower part, the upper part free. It is common in cultivation.

10. Monachosorum

Monachosorum Kunze, Bot. Zeit. 6 (1848) 119.
Ptilopteris Hance, Journal of Bot. 22 (1884) 138.
Monachosorella Hayata, Bot. Mag. Tokyo 41 (1927) 573, 642.

Terrestrial, rhizome ascending, short and therefore dictyostelic, its apex protected by a mucilaginous excretion in which minute brown hairs are present; stipes clustered, elongate, naked, lamina mediocre to large, simply pinnate with oblique inciso-serrate pinnae, to quadripinnate with minute, lobed or incised ultimate pinnules, each lobe with one veinlet which falls

short of its tip, membranaceous, glabrous except for sparse cylindrical glandular trichomes on the axes, dark to black; sori terminal or nearly so on the veinlets, roundish, small, exindusiate, receptacle hardly raised, sporangia mixed with glandular trichomes, small, pedicel slender, annulus of 14-20 thickened cells, spores tetrahedral, muriculate.

TYPE: *M. davallioides* Kunze, of Java, a synonym of *M. subdigitatum* (Blume, *Polypodium*) Kuhn.

Five species, Papua to India and Japan.

Monachosorum was originally described as like *Acrophorus*, and in the past I have treated this as its affinity. Its proper place has been a puzzle to many botanists. CHRISTENSEN, in VERDOORN'S Manual (1938) 544, places it near *Thelypteris;* and CHING, Sunyatsenia 5 (1940) 241, says "Of uncertain systematic position, but in all probability . . . related to both *Thelypteridaceae* and the Athyrid ferns," and sets up a family *Monachosoraceae*. BOWER, Ferns II (1928) 13, 254, leaves it a *Genus incertae sedis,* but would relate it to *Dennstaedtia*. This is the position best supported by the evidence. The stelar structure of the rhizome is as nearly solenostelic as its congestion permits; the hairs are obsolescent, but still present; the spores are those of this group and unlike those of *Acrophorus;* and the sori are essentially terminal on the veins, though withdrawn from the margin, as happens also in *Microlepia* and many relatives. *M. subdigitatum* has the aspect of *Dennstaedtia*. That of *M. Maximowiczii* is different indeed, but is much like that of *Microlepia hookeriana*.

Ptilopteris, as I interpret it, and *Monachosorella* have the same type species, *Monachosorum Maximowiczii* (Baker, *Polypodium*) Hayata. *Ptilopteris* was evidently described with primary regard to this species, with one error, ascription of paleae; but HANCE included first a new species, *P. Hancockii*, which is a *Polystichum*, to which his generic description is inappropriate. Because of this essential inappropriateness, I construe *P. Maximowiczii* as his type.

HAYATA emphasized the anatomical structure, along with the difference in architecture of frond, in segregating *Monachosorella* from *Monachosorum*. But any such distinction lost its weight when, Flora 124 (1929) 50, he left, in *Monachosorum, M. flagellare* (Max.) Hayata, which on other grounds must be regarded as a nearer relative of *M. Maximowiczii*.

11. Oenotrichia

Oenotrichia Copeland, Univ. Calif. Publ. Bot. 16 (1929) 82.

Vegetatively like *Microlepia* except that the pubescence of the type species is reddish; sori submarginal, terminal on the veins, indusium reniform or semicircular, fixed by the sinus or a little more broadly, receptacle short, copiously paraphysate, annulus straight and interrupted, spores tetrahedral, obscurely tuberculate.

TYPE: *O. maxima* (Fourn.) Copel., *Leucostegia maxima* Fourn., of New Caledonia.

O. tripinnata (F. v. Mueller) Copel. is in Queensland; *O. Novae-Guineae* (Ros.) Copel., in New Guinea. At least one unnamed species is in New Caledonia.

The affinity is to *Dennstaedtia* and *Microlepia*.

The annulus of *O. maxima* has 12-14 thickened cells. That of *O. Novae-Guineae* has 24-28.

12. Lindsaea

Lindsaea Dryander *apud* Smith, Mém. Acad. Turin 5 (1793) 413; Trans. Linn. Soc. 3 (1797) 39.

Synaphlebium J. Sm., Journ. of Bot. 3 (1841) 415, *nomen;* London Journ. Bot. 1 (1842) 423; Hooker, Genera (1842) Pl. 101.

Odontoloma J. Sm., Journ. of Bot. 3 (1841) 415, *nomen;* Hooker, Genera (1842) Pl. 114 B; London Journ. Bot. 1 (1842) 424.

Schizoloma Fée, Genera (1850-52) 108, *non* Gaud.

Lindsaynium Fée, Genera (1850-52) 333, Pl. 27 bis C.

Terrestrial and epiphytic, rhizome creeping or very short, clothed with paleae shading into hairs, fibro-vascular bundle solid, of a type named for the genus; fronds of moderate size, rarely simple, typically pinnate or pinnately branched with pinnate branches, pinnules typically dimidiate, rarely almost symmetrical, usually thin, glabrous, veins free or laxly anastomosing; sori on the upper and outer margins, rarely also on the lower margin, intramarginal or apparently marginal, terminal on single veins and then roundish, or on an intramarginal connecting vein and then widened or even continuous along the margin, indusium round and attached to the single free vein, or widened indefinitely and attached along the base, sporangia slender-stalked, annulus straight, commonly of 12-15 thickened cells, spores oblong or tetrahedral.

TYPE: *L. guianensis* (Aubl.) Dry., *Adiantum guianense* Aubl., of the American tropics.

Nearly 200 species, pantropic, south to New Zealand, Tasmania and Natal.

Lindsaea, thus spelled, was the name given this genus, in honor of JOHN LINDSAY. It was accepted in this form by SWARTZ, ROBERT BROWN, WILLDENOW and others. In 1824, KAULFUSS, Enum. 218, changed it to *Lindsaya,* and most recent writers have so spelled it. As a matter of rule, and because the original spelling is fairly within the bounds of an author's discretion in the Latinization of a name, the original spelling is to be retained.

Typical *Lindsaea* has the sorus more or less extended along the margin and served by more than one vein, the veins free elsewhere.

Synaphlebium, typified by *S. recurvatum* (Wall.) J. Sm., construed now as a form of *Lindsaea decomposita* Willd., is characterized by veins confluent in the vegetative lamina.

Odontoloma, typified by *O. tenuifolium* (Blume, *Lindsaea*) J. Smith, has each sorus served by a single vein, being then roundish; this condition follows necessarily if the fertile margin, instead of being more or less entire, is cleft between the veins.

Lindsaynium was typified by *L. rigidum* (J. Sm., *Lindsaea*) Fée, of the Phillippines, Malaya and New Guinea, characterized by stout veins and consequently rigid texture, and one or two sori on a pinnule.

In *Lindsaea,* rather than in any other genus, belong *L. ensifolia* Sw., *L. Fraseri* Hooker, *L. heterophylla* Dry., and a number of other species with compound herbaceous fronds with sori extending around both sides of the pinnae. These constituted *Schizoloma* as misinterpreted by FÉE, and have been included in that genus by recent writers.

The affinities of *Lindsaea* can be discussed best after the presentation of its relatives. I credit it with Antarctic origin. Originally, it was terrestrial, and adaptation to epiphytic life, within the genus, is a most unusual phenomenon.

13. Tapeinidium

Tapeinidium Presl (Epim. (1849) 96, as section of *Microlepia*) Christensen, Index (1906) 631, as genus.
Wibelia Fée, Genera (1850-52) 331, *non* Bernhardi (1801).
Protolindsaya Copel., Philip. Journ. Sci. 5 Bot. (1910) 283.

Terrestrial, rhizome creeping, protostelic, bearing dark reddish bristles which shade into narrow paleae; fronds seriate but not usually remote, pinnate to tripinnate, firm, glabrous, veins free; sori submarginal or nearly marginal, terminal on the veins, indusium fixed by base and sides or free in the upper part, half-cup-shaped, firm, sporangium slender-stalked, annulus straight, of about 15 thickened cells, spores oblong.

TYPE: *T. pinnatum* (Cav.) C. Chr., *Davallia pinnata* Cav., of Luzon.
Fourteen species, ranging from Malaya to Indo-China, Luzon and Fiji.
Nearly related to *Sphenomeris* and *Lindsaea.*

Wibelia was also typified by *W. pinnata, T. pinnatum.* This generic name was retained by DIELS, in Natürlichen Pflanzenfamilien, but ascribed to BERNHARDI. *Wibelia* Bernh., was *Davallia.*

Protolindsaya, typified by *P. Brooksii,* is a very small Bornean fern. I now agree with CHRISTENSEN, that it is a reduced *Tapeinidium.*

14. Sphenomeris

Sphenomeris Maxon, Journ. Wash. Acad. Sci. 3 (1913) 144.
Stenoloma Farwell, Am. Midland Nat. 12 (1831) 237; Ching, Sinensia 3 (1933) 337; C. Chr., Suppl. III (1934) 173, *vix* Fée (1850-52), which is *Odontosoria.*

Terrestrial, rhizome creeping, clothed with dark narrow paleae shading into hairs, fibro-vascular bundle solid, of the *Lindsaea* type; fronds erect, of limited growth, glabrous, pinnately decompound, the ultimate pinnules or segments usually cuneate; sori marginal, terminal on the veins, each served by one vein, or fused and served by two or three veins, veins free; indusium fixed by the base and more or less of the sides, sporangia slender-stalked, annulus broad, of 14-18 thickened cells, spores oblong or globose-oblong, rarely globose-tetrahedral.

TYPE: *S. clavata* (L.) Maxon, *Adiantum clavatum* L.

Eighteen species, not all very distinct. Pantropic, south to New Zealand and Madagascar, north to Japan and Florida. The commonest is *S. chusana* (L.) Copel.

The affinity of *Sphenomeris* is to *Odontosoria,* in relation to which it may be ancestral or approximately so; and to *Lindsaea,* which is probably a cognate genus, but possibly parental.

The attempt of FARWELL and others to revive *Stenoloma* as the name of this genus is based on a perversion of the rule which provides that when a genus is divided the original name must be retained for one of its parts. I do not know just why MAXON rejected *Stenoloma* as the name of the genus to be typified by *S. clavata.* It may have been because the first species named and the first figured by FÉE are *Odontosoria.* It may have been because the largest of the three elements included by FÉE was *Odontosoria.* It might have been more or less arbitrary, and even then MAXON'S judgment was competent. What he decided was that the element which should typify *Stenoloma,* and bear that name if it could, was really *Odontosoria,* leaving the other element (ignoring now a third, minor one, which is *Lindsaea*) nameless. I can not believe that the rule referred to was intended to reestablish the old principle of residues, by which some plant included by the clear error of the author of a name was always likely to be the only species finally to bear the name. The effect of the rule, construed in that way, is demonstrated *ad nauseam* by FARWELL, who, at the same time that he revived *Stenoloma,* disinterred also *Aspidium,* to become now the name of *Nephrolepis.*

15. Odontosoria

Odontosoria Fée, Genera (1850-52) 325, Pl. 27 B, f. 1.
Stenoloma Fée, Genera (1850-52) 330, Pl. 27 B, f. 2, Pl. 27 bis A, f. 1, 4, 5.
Lindsayopsis Kuhn, Chaetopterides (1882) 347.

Terrestrial, rhizome creeping, densely clothed with narrow paleae shading into hairs; fronds mostly large and of indefinite growth, rampant, bipinnate or more compound, rachis usually aculeate, ultimate pinnules cuneate or oblique, thick, veins free, one or several in a pinnule; sori marginal, terminal on the veins, indusium fixed by base and sides, very firm, sporangia slender-stalked, annulus straight, of 18-22 (FÉE said 10-20) thickened cells, spores globose-oblong and globose-tetrahedral on the same plant. The fibro-vascular bundle of the rhizome seems to be of the *Lindsaea* type, but my material is poor.

TYPE: *O. uncinella* (Kunze) Fée, *Davallia uncinella* Kunze, of Cuba. There is no admissible question as to the type, since FÉE described the genus as monotypic. The

name *Odontosoria* was invented by PRESL, for a section of *Davallia;* its type might well have been *O. biflora* (Kaulfuss) C. Chr. But FÉE ignored PRESL completely, so that the genus is *Odontosoria* Fée, not *Odontosoria* (Presl) Fée, as it is cited by CHRISTENSEN, Index 464. This distinction is essential, because it determines the application of the generic name.

A tropical American genus of 11 species, related to *Sphenomeris* and to *Lindsaea.*

16. Ormoloma

Ormoloma Maxon, Proc. Biol. Soc. Washington 46 (1933) 143.

Rhizome slender, wide-creeping, protostelic, bearing thin, light-brown paleae; fronds remote, rather small, simply pinnate, pinnae lanceolate, oblique, crenate-serrate, veins free; sori at the bases of the teeth, on the ends of the veins, which may be curved so that the sori become lateral on their tips, indusium short and broad, attached by the broad base, and straight or retuse where the base crosses the vein; annulus of 10-14 thickened cells, spores tetrahedral, smooth.

TYPE: *O. imrayana* (Hooker) Maxon, *Saccoloma imrayana* Hooker, Genera (1839) Pl. 58 B, of Dominica.

Range of *O. imrayana,* West Indies and Guiana. A second similar species, *O. Standleyi* Maxon, is in Central America.

Although first named in *Saccoloma,* and kept there by most recent authors, *Ormoloma* has no near affinity to that genus. KUHN did better, in transferring it to *Schizoloma.* It is nearly related to *Lindsaya.*

17. Isoloma

Isoloma J. Smith, Journ. of Bot. 3 (1841) 414.

Terrestrial, rhizome creeping, clothed with dark bristles, fibro-vascular bundle apparently solid; fronds small, not articulate to rhizome, stipe and rachis dark and polished, simply pinnate, pinnae articulate to rachis, dark, coriaceous, glabrous, veins free or sparingly anastomosing; sori marginal, continuous, on both sides of pinnae, indusium firm, opening toward margin and conterminous with it, sporangia slender-stalked, annulus of about 15 thickened cells, spores tetrahedral.

TYPE: *I. divergens* (Roxb.) J. Sm., *Lindsaea divergens* Roxb.: H. & G., of Malacca, also in Borneo and Palawan.

About 8 species, Malaya to Ceylon, the Philippines and New Guinea.

Apparently related to *Lindsaea* and to *Schizoloma.*

18. Schizoloma

Schizoloma Gaudichaud, Ann. Sc. Nat. 3 (1824) 507; Freyc. Voy. (1829) 378, Pl. 16; C. Chr., in Verdoorn's Manual (1938) 535.
Schizolepton Fée, Genera (1850-52) 89, Pl. 8 B, f. 1.

Terrestrial, rhizome creeping, solenostelic, clothed with dark-chestnut bristles; fronds approximate, firm, glabrous, dimorphous, the sterile cordate-ovate, the fertile linear or trifid, veins anastomosing without free included veinlets; sorus continuous along the margin, indusium opening outward, conterminous with margin, sporangia slender-stalked, mixed with filamentous septate paraphyses, annulus broad, of 16-18 thickened cells, spores tetrahedral.

TYPE, and now the only recognized species: *S. cordatum* Gaud., of the Moluccas; also in Malaya, the southern Philippines, and reported in New Guinea.

Schizolepton was typified by the same species, FÉE misconstruing *Schizoloma.*

Related to *Taenitis,* in spite of being indusiate; perhaps, also to *Isoloma.* FÉE was particularly impressed by the resemblance to *Vittaria.*

19. Taenitis

Taenitis Willdenow: Sprengel, Anleit. III (1804) 374; Schkuhr, Krypt. Gew. (1804) 21, Pl. 6 b.
Platytaenia Kuhn, Chaetopterides (1882) 330.

Terrestrial, rhizome creeping, solenostelic, clothed with chestnut-black bristles; fronds seriate, non-articulate, of moderate size or small, simply pinnate or simple, pinnae normally entire, papyraceous to coriaceous, glabrous, venation reticulate without free veins; sorus dorsal, linear, nearly as long as the pinna, one on each side of the costa, medial between costa and margin or nearer the costa or submarginal, formed by longitudinal fusion, across the parenchyma, of sori on every vein, exindusiate, sporangia slender-stalked, mixed with peculiar paraphyses which suggest abortive sporangia, annulus straight, of about 15 thickened cells, spores tetrahedral.

TYPE: *T. blechnoides* (Willd.) Swartz, *Pteris blechnoides* Willd., a common and variable species, from Assam to Fiji, which is the range of the genus.

T. obtusa Hooker, a rare but variable little Bornean fern, has coriaceous simple, or abnormally trifid or trifoliate fronds.

T. requiniana (Gaud.) Copel., the type of *Platytaenia,* has normally dimorphous fronds, the fertile ones with the nether surface almost covered with sporangia. In this typical form, it has passed easily as generically distinct. But, by variation of both species or by hybridization, it blends so completely with *T. blechnoides* that specific discrimination becomes uncertain.

Less commonly, *T. blechnoides* blends also with *Syngramma pinnata* J. Smith, which might as well be regarded as a *Taenitis.* The affinity is manifest.

In spite of the naked sori, *Taenitis* is also surely a relative of *Schizoloma,* and thus, probably, of the group of *Lindsaea.* The vascular structure of the rhizome, however, is that of *Dennstaedtia.* And it may be observed that the bristles resemble those of *Dipteris,* to which any near affinity seems hard to imagine.

20. Syngramma

Syngramma J. Smith, London Journ. Bot. 4 (1846) 168, Pl. 7-8.
Callogramme Fée, Genera (1850-52) 169, Pl. 15 A, f. 1.
Austrogramme Fourn., Ann. Sc. Nat. V 18 (1873) 278.
Toxopteris Trev., Atti Ist. Veneto V 3 (1877) 591.
Trichiogramme Kuhn, Chaetopterides (1882) 325.

Terrestrial, rhizome short-creeping, solenostelic, clothed with dark bristles; frond simple or pinnate, entire, dark and commonly reddish, firm-papyraceous, glabrous, veins anastomosing or rarely free, without included veinlets; sporangia borne along the veins forming sori of indefinite length, paraphyses present on receptacle or as branches of the pedicel, filamentous or clavate, pedicel slender, annulus of 15-20 thickened cells, spores tetrahedral or globose-tetrahedral.

TYPE: *S. vittaeformis* J. Sm., of the Philippines. CHRISTENSEN, Index XXXVII, treats "S. alismifolia (Presl) J. Sm." as the type; if this is properly a *Syngramma,* it and *S. vittaeformis* are very nearly related. But SMITH stipulated that his plant was not *Diplazium alismifolium* Presl, Rel. Haenk. I 49, which is the source of the specific name. *S. vittaeformis* seems to have been described from juvenile material, and the two may be one species.

Twenty credited species, subject to reduction. Malay Peninsula to Fiji.

Typical *Syngramma* has simple fronds of moderate size, dark polished stipes, veins free or only casually branching and anastomosing for the greater part of their length, with one or two rows of areolae near the margin. *Callogramme* is a perfect synonym, its type, *C. Caeciliae* Fée being *S. alismifolia* as usually construed.

Austrogramme, typified by *A. marginata* Fourn. of New Caledonia, and *Toxopteris,* typified by *T. borneensis* (Hooker) Trev. of Borneo, are rather smaller plants, the

annulus of fewer (about 15 instead of 17-20) cells, and the veins free unless at their ends. *Austrogramme* had two species, the other being *Grammitis Deplanchei.*

S. pinnata J. Sm., New Guinea to Queensland and Fiji, is the only pinnate species, and is distinguished from *Taenitis* only by the sori and paraphyses. It is very near to *Taenitis,* and is the most primitive element in *Syngramma.*

21. Craspedodictyum

Craspedodictyum Copeland, Philip. Journ. Sci. 6 Bot. (1911) 84.

Terrestrial, rhizome short-creeping, solenostelic, bearing dark bristles; frond mediocre to large, ternate or pedate (rarely simple), entire, firm, glabrous, veins anastomosing to form marginal areolae, elsewhere free and parallel; sori continuous along the parallel veins, naked, not mixed with paraphyses, annulus of 14-17 thickened cells, spores globose-tetrahedral.

TYPE: *C. grande* Copel., of New Guinea.

Six supposed species, ranging from Sumatra to the New Hebrides, represented by too few collections to show their stability or variability.

A small, natural genus, nearly related to *Syngramma,* but so distinct in aspect that it is convenient to hold the two apart.

22. Leptolepia

Leptolepia Mettenius *apud* Kuhn, Chaetopterides (1882) 346; Diels, Nat. Pflanzenfam. 1 Pt. 4 (1899) 212.

Terrestrial, rhizome long-creeping, solenostelic, clothed with crinite ferruginous short hairs, not differentiated from base of stipe; frond pinnately decompound, finely dissected, leaflets of all orders oblique, ultimate segments acute, herbaceous, glabrous, veins free; sori terminal on veinlets, subterminal on teeth, indusium fixed by a point to the vein, or somewhat one-sided and attached to the vein (as in *Athyrium*), or rarely wholly on one side of the vein, the free end or side toothed, sporangium globose, slender-stalked, annulus usually of 13 thickened cells, spores tetrahedral (triangular in aspect), finely tuberculate.

TYPE: *L. Novae-Zelandiae* (Col.) Kuhn, *Davallia Novae-Zelandiae* Col., of New Zealand; also in Queensland; and this or a similar species in New Guinea. This is clearly the species for which Mettenius suggested the generic name; but KUHN'S illustrations apply, not to it, but to *Oenotrichia.*

I have treated *Leptolepia* as related to that element in *Dennstaedtia* to which are related also *Hypolepis* and *Paesia;* but this affinity is not intimate. *Leptolepia* is really more isolated, and I now regard it as one of the many relics of the old Antarctic flora, without surviving very near relatives. The lack of differentiation of stipe-base and rhizome is a remarkable character.

23. Hypolepis

Hypolepis Bernhardi, Schrader's Neues Journ., 1 (1806) 34.

Terrestrial, rhizome creeping, solenostelic, clothed with usually reddish hairs; frond mediocre to large, bipinnate or more compound, hairy or glabrous, herbaceous, veins free; sorus typically almost marginal and protected by a reflexed tooth, rarely inframarginal and naked, terminal on its vein, annulus of 13-15 thickened cells, spores oblong, spinulose or tuberculate, rarely smooth.

TYPE: *H. tenuifolia* (Forster) Bernhardi, *Lonchitis tenuifolia* Forster, of New Zealand, and ranging to China.

About 45 species, pantropic, south to South Africa and well represented in New Zealand where several natural hybrids occur, north to Japan.

The more primitive element in the genus has hispid stipes and, vegetatively, is

hardly distinguishable from a similar element in *Dennstaedtia*. *Hypolepis* is itself no new genus, but is probably less primitive than *Dennstaedtia*. It may be presumed to have lost a true indusium — one attached below the sorus and opening outward. Because it is like *Cheilanthes* in this respect, the two genera have been confused, but the affinity is not intimate. It is much nearer to *Paesia*, which retains an extrorse indusium.

24. Paesia

Paesia St. Hilaire, Voy. Dist. Diamans, I (1833) 381.

Terrestrial, rhizome long-creeping, solenostelic, clothed with castaneous hairs; frond pinnately decompound, finely dissected, axes dark, usually fibrillose and the major ones rough, rachis commonly zigzag, pinnae and pinnules oblique, firm, veins free except in the sori; sori marginal, in full fruit continuous along each side of the ultimate pinnule, borne on a marginal connecting-vein, indusium double, the outer (false) one being a scarious reflexed continuation of the upper epidermis, the inner (true) indusium less conspicuous but always evident, annulus narrow, of 17-20 thickened cells, spores oblong, smooth.

TYPE: *P. viscosa* St. Hilaire, of Brazil.

Twelve species; in tropical America, and from New Zealand to Tahiti, Luzon and Sumatra.

An evidently natural genus, old enough probably to have been antarctic, related in one direction to *Hypolepis* and *Dennstaedtia*, in another to *Pteridium*.

25. Eriosorus

Eriosorus Fée, Genera (1852) 152, Pl. 13, B, f. 1.
Psilogramme Kuhn, Chaetopterides (1882) 332; Underwood, Bull. Torrey Bot. Club 29 (1902) 628.
Gymnogramme auct. plur., non Desv.

Terrestrial, rhizome creeping or suberect, clothed with pluricellular ferruginous to castaneous hairs; fronds crowded, bipinnatifid to decompound, rachis often flexuous, pinnules usually cuneate, forked or lobed, herbaceous, pubescent, veins free; sporangia along the veins, unprotected, without paraphyses, annulus of 18 (-22) cells, spores tetrahedral.

TYPE: *E. scandens* Fée, of Peru. The same species was described in 1852 by HOOKER, Icones Pl. No. 820, as *Gymnogramme aureo-nitens*. As HOOKER's publication is believed to have priority, the proper name is **E. aureo-nitens** (Hooker).

A very natural genus of about 35 species, all tropical American, mostly Andean.

Psilogramme, as originally described, included *Jamesonia*, and should of course have borne that name. As revived by UNDERWOOD, restricting it to *Eupsilogramme* Kuhn, it is typified by *P. elongata* (H. & G., *Gymnogramme*, Journ. of Bot. 1 (1834) 61, Pl. 119) Kuhn, now to be **Eriosorus elongatus** (H. & G.) *Psilogramme* has always included *E. aureo-nitens*.

Among other species, I may mention:

E. chiapensis, *Psilogramme chiapensis* Maxon, Bull. Torrey Bot. Club 42 (1915) 81.

E. congestus, *Gymnogramme congesta* Christ, Bull. Herb. Boiss II 4 (1904) 1098.

E. flabellatus, *Gymnogramme flabellata* Hooker & Grev., Journ. of Bot. 1 (1834) 61, Pl. 120.

E. Feei *nomen novum*, *Neurogramme scandens* Fée, Crypt. Vasc. Bras. I (1869) 263; II 39, Pl. 92.

E. flexuosus, *Grammitis flexuosa* Humb. & Bonpland, Fl. Aequin. II (1809) 167.

E. Glaziovii, *Gymnogramma Glaziovii* C. Chr., Ark. f. Bot. 9^{11} (1910) 20.

E. hirtus, *Grammitis hirta* H.B.K., Nov. Gen. et Sp. (1815) 4.

E. myriophyllus, *Gymnogramma myriophylla* Sw., Vet. Ak. Handl. (1817) 58.

E. schomburgkianus, *Gymnogramme schomburgkiana* Kunze: Kl., Linnaea 20 (1847) 408.

E. schwackeanus, *Gymnogramme schwackeana* Christ, in Schwacke, Pl. Nov. Mineiras II (1900) 18; Bull. Boiss. II 2 (1902) 365.

E. sellowianus, *Cheilanthes sellowiana* Presl, *nomen; Gymnogramme,* Mett., Linnaea 36 (1869) 69.

E. Warscewiczii, *Gymnogramme Warscewiczii* Mett., Ann. Sci. Nat. V 2 (1864) 211.

E. elongatus, with linear frond, maintains its circinnate apex, in the manner characteristic of *Jamesonia.*

Eriosorus is most nearly related to *Jamesonia,* from which it is distinguished by form of frond and by texture.

26. Jamesonia

Jamesonia Hooker et Greville, Icones Fil. (1830) Pl. 178.

Terrestrial, rhizome creeping, solenostelic, clothed with dark bristles; fronds small or mediocre, erect, narrowly linear, the apex remaining circinnate, simply pinnate, hairy throughout, pinnae small, mostly cordate-rotund, coriaceous, bullate and the margin commonly recurved, veins flabellate, free; sporangia continuous along the veins, protected by copious hairs and the concavity of the pinnae, one species, *J. ceracea* Maxon, loosely ceraceous beneath, annulus of 18-20 thickened cells, spores tetrahedral, dark, smooth or nearly so.

TYPE: *J. imbricata* (Cav.) H. & G., as *J. pulchra* H. & G., of Equador, also in Peru and Colombia, and northward to Chiapas, *fide* MAXON.

Eighteen reported species, but the number is excessive, Peru to Costa Rica and Venezuela, one in south-eastern Brazil, all at considerable altitude. The rhizome was first reported in *Sphagnum.*

Jamesonia is sharply characterized by form of frond and indefinite apical growth. In other respects, it is like *Eriosorus,* to which it is manifestly related. Most species have been named in both *Gymnogramme* and *Psilogramme.*

27. Pterozonium

Pterozonium Fée, Genera (1852) 178, Pl. 16 A.

Small ferns, rhizome short, ascending, dictyostelic, bearing copious dark pluricellular bristles; fronds crowded, stipe long, brown, naked except near the base, lamina roundish and more or less cordate, entire or pinnate, glabrous, coriaceous, veins flabellate, free; sporangia along all veins, occupying a supramedial intramarginal zone, pedicels bearing clavate branches, annulus of 20-24 thickened cells, spores tetrahedral, dark, smooth.

TYPE: *P. reniforme* (Mart., *Gymnogramme*) Fée, of Brazil.

Three other species of northern South America, too little collected to permit judgment of variability. Originally described as an epiphyte, but terrestrial in appearance.

Pterozonium is sharply characterized by form of frond, and among immediate relatives by nakedness. Other significant characters show near affinity to *Jamesonia,* and thus to *Eriosorus.*

28. Pteridium

Pteridium Scopoli, Fl. Carniolica (1760) 169, conserved by Cong. Bot. Amsterdam, 1935, with rejection of:
Cincinalis Gled., Syst. Pl. (1764) 290, and
Eupteris Newman, Phytologist 2 (1845) 278.

Terrestrial, rhizome long-creeping, hypogaeous, solenostelic, clothed with hairs; frond pinnately compound, coriaceous, more or less densely hairy, veins free except for a marginal strand; sorus continuous along the margin, borne on the connecting-vein, indusium double, the outer (false) one formed by the reflexed margin, the inner (true) one developed or

obsolescent, paraphyses none, sporangium slender-stalked, annulus of about 13 thickened cells, spores tetrahedral or globose-tetrahedral, smooth.

TYPE: *P. aquilinum* (L.) Kuhn, *Pteris aquilina* L., the bracken fern.

As usually construed, a single variable species, in all tropical and temperate lands; better treated as six or more species, even though they blend in some places.

Related to *Paesia,* but not nearly enough to justify combining the two, as various authors have done.

29. Histiopteris

Histiopteris (Agardh, Rec. Spec. Gen. Pteridis (1839) 76, as Sect. of *Pteris*) J. Smith, Hist. Fil. (1875) 294, as genus.

Terrestrial, rhizome long-creeping, solenostelic, clothed with narrow castaneous paleae; frond commonly huge and of indefinite length, pinnae opposite, typically sessile and with stipule-like basal pinnules, firm to coriaceous, glabrous and often glaucous, veins anastomosing without included veinlets; sorus continuous along the margin, on a marginal connecting-vein, protected by a scarious reflexed false indusium, freely paraphysate, sporangium slender-stalked, annulus of about 18 thickened cells, spores oblong to reniform, tuberculate.

TYPE: *H. incisa* (Thunb., *Pteris*) J. Sm. Following AGARDH, the type would be *Pteris elegans* Sw.; SMITH stipulated *Pteris Vespertilionis* Lab.; both are regarded as synonyms of *H. incisa.*

H. incisa is pantropic, and south to the Cape of Good Hope, Tasmania, New Zealand, and several subantarctic islands. Seven local oriental species have been distinguished.

Histiopteris is a natural genus, evidently old enough to be a migrant from Antarctica, related to *Pteris;* probably related also to *Hypolepis.*

30. Lepidocaulon

Lepidocaulon Copeland, Univ. Calif. Publ. Bot. 18 (1942) 218.

Rhizome scandent, solenostelic, clothed with castaneous paleae; frond bi- tri-pinnate, axes dark-castaneous, polished, pinnae opposite, the lower ones stalked, pinnules narrow, firm, glabrous, veins free or casually confluent in the sori; sorus intramarginal, laterally elongate, on a vein parallel to the margin, more or less protected by a reflexed margin, paraphyses filamentous, sporangia slender-stalked, annulus of 14-16 thickened cells, spores reniform, tuberculate.

TYPE and sole species: *L. caudatum* Copel., of New Guinea.

Related to *Histiopteris,* but distinct in aspect, habit and venation. The fertile vein leaves the costa at an acute angle and curves to become parallel to the margin; it may or may not connect with another vein at its tip. The reflexed margin may partly protect the sorus, or may not be evident.

31. Pteris

Pteris Linnaeus, Sp. Pl. (1753) 1073.
Lonchitis L., Sp. Pl. (1753) 1078.
Campteria Presl, Tent. (1836) 146.
Litobrochia Presl, Tent. (1836) 148.
Pycnodoria Presl, Epim. Bot. (1849) 100.
Heterophlebium Fée, Genera (1850-52) 139, Pl. 11 A, f. 9-12.
Antiosorus Roemer: Kuhn, Chaetopterides (1882) 347.
Anisosorus Trev., Atti Ist. Veneto II 2 (1851) 166: Maxon, Pterid. Porto Rico (1926) 429.

Terrestrial; stem short and therefore dictyostelic, paleate and sometimes hairy; fronds clustered, pinnate to decompound, never very finely dissected,

herbaceous to coriaceous, glabrous or less commonly hairy, veins free except in the sori, or anastomosing without included veinlets; sorus continuous along the margin but avoiding the apices of the segments and usually the sinuses between them, borne on a marginal (except for the false indusium) connecting-vein, protected by the scarious reflexed margin, without other indusium, paraphysate, annulus of 16-34 thickened cells, spores tetrahedral or less commonly bilateral, smooth, tuberculate or sculptured.

TYPE: by convention, *P. longifolia* L. This is CHRISTENSEN'S selection among the Linnaean species. UNDERWOOD chose *P. arborea* L. But so many writers have regarded *Eupteris* as free-veined, and have provided other generic or subgeneric names for the many species with reticulate venation, that *P. longifolia* is the preferable choice.

A genus of about 280 species, almost all tropical, but reaching New Zealand, Tasmania and South Africa, and north to Japan and the United States. A genus of such size naturally includes groups of obviously inter-related species, but none of these seems conveniently susceptible of generic recognition.

Lonchitis was originally a genus of three species, *L. hirsuta, L. aurita* and *L. repens,* of which the last is *Hypolepis.* The typification of Linnaean genera is at best a matter of judgment. In this case, LINNAEUS knew his *L. hirsuta* by the living plant, *L. aurita* only by report and figures. Common sense seems to me to demand that we construe the genus by the plant he actually knew, *L. hirsuta.* A considerable number of writers have typified it by *L. aurita,* and some of them have then made another genus of *L. hirsuta.* The latter is the type of *Antiosorus* and *Anisosorus.* Perhaps ten other valid species, in the South African region and tropical America, are referred to *Lonchitis* in the Linnaean sense.

The diagnostic distinction from *Pteris* is the restriction of the sorus to the bottom of the sinus between the lobes or segments. This distinction will not hold, because the sori of so-called *Lonchitis* species may be separated at the sinus (commonly so in *L. occidentalis* Baker), and the sorus of species recognized as *Pteris* may continue around the sinus. Another distinction has been that *Lonchitis* bears hairs, and *Pteris* paleae on the rhizome. This likewise will not hold; the rhizome of *L. hirsuta* is hairy, but mixed with true hairs it bears dilated "hairs," which are paleae.

Anisosorus should be distinguished from *Lonchitis* if typified by *L. aurita* by free venation. This also is not constant — see CHRISTENSEN, Dansk Bot. Arkiv 7 (1932) 138-9, as to his *A. occidentalis;* and our specimens named *L. occidentalis* show a freer anastomosis. But, even if this distinction were constant, I would consider the splitting of *Lonchitis* artificial. *L. occidentalis, L. natalensis* and *L. glabra* are to me obviously congeneric. *L. hirsuta* is free-veined; but its nearest relatives in *Pteris* are all reticulate-veined. *Anisosorus,* or *Antiosorus,* is to be rejected, first because it is *Lonchitis* if anything is, and second because it is not tenably distinct from the group its advocates leave in *Lonchitis.*

Linnaean genera are so established in literature that one of them is not to be reduced casually. Nevertheless, typified by *L. hirsuta, Lonchitis* seems to me to be *Pteris.* Although free-veined, it is intimately related to the large *Pteris* species of the same region with pedate-deltoid fronds and reticulate venation. I have already pointed out that the venation is not a good generic character in this group, and that *L. hirsuta* itself has a paleate as well as hairy rhizome. WILLDENOW, Sp. Pl. V (1810) 397, described a small specimen of it as *Pteris laciniata,* and this is the name it must bear in *Pteris;* he noted the resemblance to *L. hirsuta,* but insisted that the sori of his specimen proved it to be *Pteris.* Except the most recently described, every currently accepted species of *Lonchitis* has also a name in *Pteris.*

Campteria should have been *C. biaurita, Pteris biaurita* L., of which *C. wightiana* Presl is a synonym. Its characteristic was a single series of costal areolae. Far from this being a good diagnostic character of a genus, the more reasonable question has been its validity as a specific distinction. In the Index, p. 593, CHRISTENSEN reduced *P. quadriaurita,* with free veins, to *P. biaurita;* but has since, Suppl. II 58, followed HIERONYMUS in treating them as specifically distinguishable.

Litobrochia may be typified by *Pteris grandifolia* L., as *L. ampla* Presl. As a type, this looks distinct enough from any free-veined *Pteris,* but all modern writers are

agreed that the genus as a whole does not break into two natural groups distinguished by the venation. As already remarked, the immediate affinity of *P. laciniata* is to species with reticulate venation.

Pycnodoria, typified by *Pteris opaca* J. Sm., was made a genus on the illusion that its indusium was fixed at the base, and free along the margin of the pinna, as in *Lindsaea.*

Heterophlebium, typified by *Pteris grandifolia* L., may be exactly synonymous with *Litobrochia.* Among species with reticulate venation, it is remarkable for having the veins free except near the margin. Further, FÉE stated its annulus to be composed of 26-28 thickened cells (the number may reach 31), and that of *Pteris* to be of 16-20 cells. This is correct as to most *Pteris* species, but I find the number usually above 30 in *P. vittata* L.

Most species of *Pteris* with fronds more than once pinnate have the pinnae or pinnules deeply divided near the base, shallowly or becoming entire toward the apex; FÉE emphasized this as a generic characteristic. One New Guinea species, *P. Montis-Wilhelminae* Alston, is peculiar in the genus in having pinnules everywhere contracted at the base.

Pteris is an old genus, rather sharply cut off from more primitive ferns. By diagnosis, it seems close to *Pteridium* and *Histiopteris,* and even to *Hypolepis;* but a common ancestor with these lived long ago. Still, in spite of such important distinctions as short and dictyostelic rhizome, and paleae, its ancestry was probably common with that of the genera just mentioned.

In the other direction, as an old and prosperous genus, it has naturally given rise to others, which follow.

32. Hemipteris

Hemipteris Rosenstock, Fedde's Repert. 5 (1908) 38.

Terrestrial, rhizome short, stout, dictyostelic, bearing sparse small paleae; frond huge, pedate, 2- 4-pinnatifid, pinnae of the axial portion deeply pinnatifid, lateral portions two or more times forked, the branches bipinnatifid, thin-herbaceous, minutely scurfy and glabrescent, veins anastomosing to form large costal and costular areolae, casually elsewhere, segments of the pinnules inciso-crenate, each short, broad tooth bearing one sorus on its lower and outer side; sorus short and broad, served by two or more veinlets, indusium short and thin, sporangia mixed with filamentous paraphyses, annulus of 18 thickened cells, spores tetrahedral, smooth, with epispore, rarely bilateral.

TYPE and sole species: *H. Werneri* Ros., of New Guinea. Known by two collections in New Guinea and two in the Solomon Islands.

An obvious derivative of the *Litobrochia* section of *Pteris,* distinguished chiefly by the discrete sori, a feature consequent on the crenate margin. The preservation of *Hemipteris* as a distinct genus is not compulsory, but is convenient. The thin frond and thin, short indusium are supplementary distinctions.

33. Schizostege

Schizostege Hillebrand, Fl. Hawaii (1888) 631.

Terrestrial, rhizome short, dictyostelic, paleate; frond pinnate or bipinnate, thick, glabrous, veins free or laxly anastomosing; sori marginal, where the frond is remarkably thick, on the end of a vein, or of plural veins more or less incompletely confluent in the broadened sorus, indusium formed by a very broad, sharply differentiated reflexed marginal outgrowth, annulus (in *S. calocarpa*) of 19 thickened cells, spores tetrahedral, smooth, with hyaline epispore.

TYPE: *S. Lydgatei* (Baker, *Cheilanthes*) Hillebrand, of Hawaii.

Two other species are known, in Mindanao. All three are rare and local ferns. *S. Lydgatei* seems not to have been collected for nearly fifty years, which raises the

suspicion that it may not exist. CHRISTENSEN has written, Bishop Mus. Bull. *25* (1925) 4: "I am inclined to believe that the obscure plant called *Schizostege Lydgatei* Hill. . . . is a mutant, derived from a species of Pteris (*P. excelsa* Gaud. ?)." A genus might originate in that way; or the mutant might be sterile or nearly so, and disappear. But it is the group of *P. quadriaurita* of which, in *Pteris, S. Lydgatei* might well be a mutant, and that group is, remarkably, not known in Hawaii.

The Mindanao species fit completely the generic description; but they do not suggest *P. quadriaurita,* nor do I recognize near affinity to any Mindanao neighbors. CHRIST proposed to make a new genus of *S. calocarpa,* but could not diagnose it in distinction to *Schizostege,* and assented to my publication under that genus. The Mindanao plants are established; they have not been collected in thirty years, because their locality has not been visited. Whether they are really congeneric with that of Hawaii, or merely fit the fairly detailed generic diagnosis, remains questionable. For the present, the generic status of *Schizostege* may be left thus questionable. Without reasonable doubt, it is (or they are) derived from *Pteris.*

34. Ochropteris

Ochropteris J. Smith, Hooker's Journ. Bot. 4 (1841) 158; Hooker and Bauer, Genera Pl. 106 A.

Terrestrial, rhizome short-creeping, bearing small paleae (*teste* DIELS); frond large, pinnately decompound, rather finely divided, coriaceous, glabrous, veins free except in the sori; sori terminal on ultimate pinnules or segments, or in fuller fruit extending down their sides, served by plural veins confluent in the sori, protected by firm, scarious broad reflexed false indusia, paraphysate, sporangia large, annulus of about 20 thickened cells, spores large, dark, tetrahedral and bilateral, smooth.

TYPE: *O. pallens* (Sw.) J. Sm., *Adiantum pallens* Sw.

A single variable species, of Bourbon, reported and perhaps present in Madagascar.

Presumably a derivative of *Pteris,* but isolated enough to have been named also in *Cheilanthes* and *Cryptogramme.*

35. Anopteris

Anopteris Prantl (Engler's Jahrb. 3 (1882) 414, as Sect. of *Cryptogramme*), in Diels, Nat. Pflanzenfam. I Part 4 (1899) 288, as genus.

Terrestrial, rhizome short, apparently erect, dictyostelic, bearing stiff short dark paleae; fronds clustered, of moderate size, bi- tri-pinnate, firm-herbaceous, glabrous, somewhat dimorphic, sterile pinnules oblong, serrate, fertile pinnules narrower, veins free except in the sori; sorus continuous along each side of the pinnule, slightly intramarginal, indusium fixed to the fertile vein, introrse, paraphyses filamentous, of short cells, annulus of about 19 thickened cells, spores tetrahedral or bilateral, smooth.

TYPE and sole species: *A. heterophylla* (L., *Adiantum*) Prantl, a synonym of *A. hexagona* (L.) C. Chr., *Adiantum hexagonum* L.; Jamaica to Brazil.

Probabaly a derivative of *Pteris,* from which it is supposed to differ diagnostically, aside from characters already stated, by having several fibro-vascular bundles in the stipe. Actually, the bundle is, at the base of the stipe, of the omega shape, common in *Pteris,* the two halves separating farther up, as occurs in *Pteris* also.

36. Coniogramme

Coniogramme Fée, Genera (1850-52) 167, Pl. 14, f. 1, 2.
Dictyogramme Fée, *ibid.,* p. 170.
Notogramme Presl, Epim. Bot. (1849) 263.
Neurosorus Trev. Atti Ist. Veneto II 2 (1851) 168, *nomen.*

Terrestrial, rhizome creeping, usually short and dictyostelic, paleate; fronds fairly large, pinnate to tripinnate, with few and large, entire or

serrulate leaflets, herbaceous or more firm, usually glabrous, veins free, or rarely anastomosing without included veinlets, ending in hydathodes; sori elongate along the veins except near the margin, or on the free part if the veins anastomose near the costa, exindusiate, annulus of 14-18 (or 14-24, *teste* FÉE) thickened cells, spores bilateral or tetrahedral, smooth, pale.

TYPE: *C. javanica* (Blume, *Gymnogramme*) Fée.

RANGE: Africa across Polynesia, north to Japan; one species in Mexico. About 20 species if the fine discrimination of HIERONYMOUS, Hedwigia 57 (1916) 266, be accepted.

I follow all recent writers in using *Coniogramme* as the name of this genus. FÉE's Genera bears on its title-page the dates 1850-1852, but it is not certain that it appeared before 1853. PRESL's Epimeliae is dated 1849, but HOOKER, Journal of Bot. 4 (1852) 286, states that it was not in the hands of dealers before 1852. At the end of it, in Addenda et Corrigenda, PRESL published the names of many undigested and mostly imperfectly described genera. Among these, p. 263, is found: "Syngrammati affine genus (D. japonica [Hemionitis japonica Thunb., Gymnogramma japonica Desv.]), quod venulis elongatis parallelis apice libero incrassatis differt." "Est Dyctiogramme" is blacked out by hand, and substituted in pencil by "est Notogramme," presumably because *Dictyogramma* had been proposed, p. 148 of the same volume, as a subgenus of *Colysis*. It is to be assumed that the correction was by the author — HOOKER, Sp. Fil. V 151, so states — before distribution; and that the name more or less effectively published was *Notogramme*, rather than *Dyctiogramme*. It is a circumstance remarkable enough to be suspicious, that FÉE published *Dictyogramme* Fée based on the same one species. This *Dictyogramme* was distinguished from *Coniogramme* by reticulate venation; it is agreed that they are properly one genus. PRESL's name must be granted priority, since the body of the Epimeliae (not the addenda) is referred to repeatedly in FÉE's Genera; but PRESL's publication was so imperfect that his name may well be rejected.

The single American species, *C. americana* Maxon, is near to *C. japonica*, not to the Hawaiian *C. pilosa*, nor to any other species. The genus being largely Malay-Asiatic, I suppose that it jumped the north Pacific Ocean from Japan, and found a landing place in north-western Mexico. Two other genera, *Plagiogyria* and *Loxogramme*, seem to have made the same jump.

Coniogramme is the gymnogrammoid derivative of *Pteris*. In the parent genus, its origin is in the group of *P. cretica*, in which such species as *P. insignis* and *P. pellucida*, in their juvenile stages, are effectively indistinguishable from neighboring young plants of *Coniogramme*.

37. Neurocallis

Neurocallis Fée, Acrost. (1845) 19, 89.

Terrestrial, rhizome said to be short and paleate; frond large, simply pinnate, firm-herbaceous, glabrous, dimorphic, pinnae of sterile frond broadly lanceolate, entire, venation rather coarsely reticulate without included veinlets; sori on linear pinnae, continuous along both sides, spreading over veins and parenchyma toward the costa, partly protected by a scarious reflexed false indusium, sporangia large, annulus of 20-22 thickened cells, spores mostly tetrahedral, smooth.

TYPE and only species: *N. praestantissima* (Bory, *Acrostichum*) Fée, a plant of mountain forests in the West Indies, Costa Rica and Colombia.

In view of the false indusium, and of the absence of characters making such affinity doubtful, *Neurocallis* may be regarded with confidence as an acrostichoid derivative of *Pteris*.

38. Acrostichum

Acrostichum Linnaeus, Sp. Pl. (1753) 1067.
Chrysodium Fée, Acrost. (1845) 22.

Terrestrial in brackish marsh, stem erect, short, stout, woody, dictyo-

stelic, paleate; frond very large, erect, simply pinnate with large entire pinnae, thick-coriaceous, glabrescent, venation closely and uniformly reticulate without included veinlets; sporangia borne on pinnae of the distal end or of distinct whole fronds, densely covering the dorsal surface without distinction of sori, mixed with capitate lobed paraphyses interpreted as abortive sporangia, large, annulus of 20-22 thickened cells, spores large, light, tetrahedral, minutely tuberculate.

TYPE: *A. aureum L.* On all tropical and some subtropical coasts.

Several more or less distinct species are sometimes recognized.

Affinity to *Pteris* is most probable. *Neurocallis* may hardly be regarded as intermediate in a phyletic sense between *Pteris* and *Acrostichum*, but illustrates perfectly the possible course of evolution.

39. Cheilanthes

Cheilanthes Swartz, Synopsis Fil. (1806) 5, 126.
Allosorus Bernh., Schrader's Neues Journal 1[2] (1806) 36, *pro parte.*
Notholaena R. Br., Prod. Fl. Nov. Holl. (1810) 145.
Cincinalis Desv., Berl. Mag. 5 (1811) 311, *non* Gled. (1764).
Adiantopsis Fée, Genera (1850-52) 145.
Myriopteris Fée, Genera (1850-52) 148, Pl. 12 A, f. 1-3.
Cosentinia Todaro, Syn. Pl. Sicil. (1866) 14.
Cheilosoria Trev., Atti Ist. Veneto V 3 (1877) 579.
Pomatophytum Jones, Cont. Western Bot. No. 16 (1930) 12.

Terrestrial, rhizome short-creeping or becoming erect, scaly; fronds small, usually clustered, pinnate to decompound, not usually at all deltoid, hairy or scaly or rarely smooth, veins free; sori marginal, on the tips of the veins, often in contact but not confluent laterally, indusium formed by the more or less modified reflexed margin, typically discrete but often more or less confluent, often obsolescent or wanting, sporangia with annulus of 14-24 thickened cells and many-celled stomium, spores globose-tetrahedral, smooth, granulose or sometimes corrugated.

TYPE: *C. micropteris* Sw., of Ecuador, ranging to Argentina.

A difficult and unsatisfactory genus, "genus arduum" — FÉE, of about 180 species, in all tropical and warm-temperate lands, characteristically ferns of dry places, but not confined to them.

The type is simply pinnate with roundish pinnae, but the type species in fuller development has pinnae more elongate and deeply lobed. Its pinnae are herbaceous, flat in full expansion, and hairy. Species with herbaceous hairy fronds must be regarded as typical *Cheilanthes. C. tenuifolia,* included in *Cheilosoria* by the author of that genus, is such a species. The type of *Cheilosoria, C. allosuroides* (Mett.), is treated as a *Pellaea* by CHRISTENSEN, but surely does not belong there. *Cosentinia vellea* (Ait.) Todaro, the type of *Cosentinia,* is an extremely hairy member of the same general group; it has passed improperly as *Notholaena vellea* Desv., a later homonym of *N. vellea* R. Br., which is *Cheilanthes vellea* F. v. M., with another needless name, *Notholaena Brownii* Desv. The few species with naked fronds belong also in this group.

Myriopteris, typified by *M. marsupianthes* Fée, which is *Cheilanthes lendigera* (Cav.) Sw., is a conspicuous but not sharply delimited American group, with minute, hard, cucullate ultimate pinnules, commonly hairy, and often scaly also. It can be maintained as a genus. *Pomatophytum* has the same type species, under the name, *P. pocellatum.*

Allosorus was published about simultaneously with *Cheilanthes,* before the Index to SWARTZ' Synopsis, which, p. 425, states "Allosorus Bernh. — est *Cheilanthes.*" As will be pointed out again under *Pellaea, Allosorus* should be discarded, to avoid confusion involving several genera.

Notholaena was described in a work on the plants of Australia and three Australian

species were named in it. One of these must be the type, and *N. distans,* the first listed, may properly be chosen. After diagnosing the genus, BROWN inserted an "Obs." ... "Huc, praeter sequentes Novae Hollandiae, pertinent *Acrostichum Marantae, Pteris trichomanoides L.* et aliae nonnullae ineditae." On the strength of this statement, BROWN has been credited by almost all writers with the combination *Notholaena Marantae,* which he did not make; and then this has of late, since types came into respect, been treated as the type of the genus. This seems contrary to common sense and to our rules. The typification of the genus may be important, because, while I regard *N. Marantae* as a *Cheilanthes,* it is far enough from a typical one so that METTENIUS could place it in *Gymnogramme;* while *N. distans* is by affinity a *Cheilanthes* in the strictest reasonable sense. From the time of its naming, *Notholaena* has been maintained by every eminent authority except METTENIUS, but has been as evidently an artificial genus as *Phegopteris.* The reflexed margin is a dependable characteristic of *Pteris, Adiantum, Pellaea, etc.,* but it is not so for *Cheilanthes,* nor *Hypolepis.*

Cincinalis Desv., independently described just after *Notholaena,* included the same group, but the name was invalid.

Adiantopsis is not clearly typified. FÉE did not illustrate it, and his text would make *A. capensis* (Thunb., *Adiantum*) Fée the most eligible selection; this appears now, C. CHR., Index Suppl. III (1934), as *Cheilanthes capensis* (Thunb.) Sw. FÉE emphasized the fact that the sori are of few sporangia — which is true of *Cheilanthes* in general. DIELS emphasized one-sided pinnules as a generic character; this applies to *A. radiata* (L.) Fée, the most distinct and striking species, but by no means to all species referred to *Adiantopsis.* Finally, *Adiantopsis* has been characterized by a separate indusium for each sorus; but this will ill distinguish it from the type itself of *Cheilanthes. A. madagascariensis* (Baker) Diels — see C. CHR., Pteridophyta of Madagascar (1932) Pl. 46 — seems to be a *Cheilanthes* in every respect supposed to be diagnostic. Even J. SMITH, who was not very cautious in the recognition of minor genera, rejected *Adiantopsis.*

As here construed, *Cheilanthes* is probably a natural genus. I am in no doubt as to the proper inclusion of *Notholaena,* and *Adiantopsis.* As to the latter, however, it is possible to typify it by *A. radiata,* and then to recognize it as a small genus. The inclusion or exclusion of *Myriopteris* and *Aleuritopteris* is a matter of judgment or choice. But there remain a number of species, some of which I remove, as *Aspidotis* and *Mildella,* and some of which I include, without confidence. When Fée called this a *genus arduum,* he referred apparently to questions of specific discrimination. With HOOKER, I find the generic boundary unsatisfactory, wherever it may be drawn.

Cheilanthes is an old genus. It and its obvious relatives have conspicuous characters in common with the *Pterideae,* but with phylogeny far from satisfactorily clear. By definition, it seems near to *Hypolepis.* As might be expected, it is in the far South that we find such a species as *Hypolepis bergiana* (Schlecht., *Cheilanthes*) Hooker, which illustrates the resemblance of the genera well enough to look like evidence of affinity. If this evidence is valid, *Cheilanthes* is one of the great group of Dennstaedtioid ferns. As an alternative possibility, BOWER has shown evidence of a more direct origin from *Schizaeaceae.* Whichever of these may be nearer the truth, there is no reason to doubt the Antarctic origin of *Cheilanthes,* as evidenced by its rich development in number of species and in diversity in southern regions.

40. Neurosoria

Neurosoria Mett.: Kuhn, Bot. Zeit. 27 (1869) 437.

A small terrestrial fern; rhizome short-creeping, essentially solenostelic but so congested that a section cuts more than one bundle, clothed with small, thin, narrow, ferruginous paleae; stipes crowded, black, fibrillose; fronds lanceolate-ovate, bipinnate at base, pinnules, and pinnae of upper part of frond, linear, thin but firm, glabrescent, veinlets numerous, forked, margin very thin, not penetrated by veinlets, reflexed; branches of veinlets completely beset with sporangia which cover the fertile surface, paraphyses wanting, annulus of 20-24 cells, spores tetrahedral, smooth.

TYPE and sole species: *N. pteroides* (R. Br., *Acrostichum*) Mett., of Northern Australia.

Although one of the early collections, this has remained a rare fern in herbaria. By the kindness of Miss MARY D. TINSDALE of Sydney, and of Director A. W. JESSUP of Melbourne, I have for study good material, from Stannery Hills, Queensland, and from Gilbert River, and can corroborate all of METTENIUS' description.

With the *Neurosoria*, Mr. JESSUP sent also a specimen of *Cheilanthes caudata* R. Br., also from Gilbert River, with the following note:

"For your consideration I am sending also another collection from the same region which BENTHAM cited under *Cheilanthes caudata*. Unfortunately we do not possess BROWN's co-types of either species, but they seem to me too close to be specifically (not to say generically) distinct. The dimensional, morphological, textural and sporangial characters are alike in the two entities forwarded, the only difference I can appreciate being a complete development of sporangia all over the ventral frond surface of 'Neurosoria,' whereas 'Cheilanthes' shows only a partial and marginal development; however, in view of the wide variations exhibited by fertile fronds within the common species *Cheilanthes tenuifolia* I would not attach much importance to this difference of sorial development." He refers also to the doubts of HOOKER, Sp. Fil. II, 111, and V, 279, as to both species.

I know *Cheilanthes caudata* only by Mr. JESSUP's specimen, but with it can endorse all that he says, except that I find no sporangia originating elsewhere than on the veinlets. Taking each by itself, nobody would question that *C. caudata* is a *Cheilanthes;* or would place *N. pteroides* in that genus. With the limited material, I hesitate to declare that they are one species. They may be; *C. caudata* may be an imperfectly fruiting *N. pteroides*. They are certainly nearly related. Evidently enough, *Neurosoria* is a local derivative of *Cheilanthes*, so different that it may not be conveniently included in that genus.

Classifying ferns by definitions, DESVAUX was justified in including *N. pteroides* in his genus *Phorobolus*, typified by *Cryptogramma crispa*. One can emphasize the more copious production of sporangia and the smooth spores, to discover distinctions between *Neurosoria* and *Cryptogramma*. The real objection to combining them is the improbability that *Cryptogramma* had the phyletic origin now ascribed to *Neurosoria*.

41. Aleuritopteris

Aleuritopteris Fée, Genera (1850-52) 153, Pl. 12 B, f. 1, 2.
Chrysochosma (J. Sm., Hist. Fil. (1875) 279, *nomen*, sect. of *Nothochlaena*) Kümmerle, Mag. Bot. lapok 13 (1914) 39, not seen.
Sinopteris C. Chr. et Ching, Bull. Fan Mem. Inst. 4 (1933) 359.

Terrestrial, small, rhizome short, ascending, clothed with black linear-setaceous paleae; stipes crowded, black and polished, naked or bearing brown paleae, lamina deltoid and bipinnatifid to ovate with large bipinnatifid basal pinnae, not finely dissected, nether surface more or less densely white- or yellow-ceraceous, veins free; sori marginal, on the vein tips, not laterally confluent but commonly in contact, protected by scarious reflexed margins which are individual and separate or more or less continuous, paraphyses wanting, sporangia few and large, annulus of 16-32 thickened cells, stomium large, spores globose or globose-tetrahedral, black or dark, usually with granular surface, rarely reticulate-spinulose.

TYPE: *A. farinosa* (Forsk., *Pteris*) Fée, Africa to Java, China, Mexico.

About 15 species. Ferns of dry places, mostly North Temperate, north to Siberia.

A genus segregated from *Cheilanthes* by FÉE, related to *Cheilanthes*, and not very sharply distinguished. The general distinctions are in form of frond, as *Doryopteris* differs from *Pellaea*, the ceraceous covering, and the few sporangia. It is because these three characteristics usually occur together that I follow FÉE in treating the group as a genus.

Chrysochosma should be typified by the Mexican *C. sulphureum* (Cav., *Pteris*) Kümm., *Aleuritopteris sulphurea* Fée, which is usually called *Notholaena*, in spite of having a distinctly reflexed margin.

Sinopteris, typified by *S. grevilleoides* (Christ, *Cheilanthes*) C. Chr. et Ching, of China, was regarded by its authors as a most extraordinary fern because it has only

1 or 2 sporangia in a sorus. As CHING has proposed to revive *Aleuritopteris*, he might have noted that FÉE diagnosed the genus as having "sporangiis 2-3 in eâdem nervillâ sedentibus." HOOKER too has noted and illustrated sori of 1 sporangium. Most of the species usually have a few more sporangia, up to about 5. But *A. candida* (Mart. et Gal.) Fée, has usually a single sporangium; and *A. sulphurea*, usually with 2, has many of them solitary. Even this distinction from *Cheilanthes* is not sharp, as *Cheilanthes* in general has few sporangia in a sorus, in comparison with ferns in other groups. The best single distinction of *Aleuritopteris* from *Cheilanthes* is provided by the architecture of the frond.

In *Aleuritopteris*, rather than in any other genus, belongs *Pellaea Tamburii* Hooker, but it is aberrant in having a commissure connecting the tips of the veins, and, correspondingly, an uninterrupted reflexed margin; by definition, it is a *Doryopteris*. I find 32 thickened cells in its annulus.

The distribution of *Aleuritopteris* does not indicate a direct antarctic origin. The appearance is rather that it is a more recent derivative of *Cheilanthes*, probably in Asia, and thence an immigrant to America. *A. argentea* is still found in Kamchatka.

42. Aspidotis

Aspidotis Nuttall *apud* Hooker, Sp. Fil. II (1852) 70.*

Small, terrestrial, rhizome short-creeping, clothed with blackish linear-setaceous paleae; fronds approximate, glabrous, subcoriaceous, stipe brown, polished, lamina deltoid-ovate, pinnately decompound, finely dissected with acute pinnules and teeth; sori small, in the sinuses of the teeth, with a scarious reflexed indusium, paraphyses none, sporangia few, annulus of 20 thickened cells, spores globose-tetrahedral, smooth or muriculate.

TYPE: *A. californica* Nutt., *Hypolepis californica* Hooker, a common California endemic of rocky, seasonally dry places.

Here belongs also *Hypolepis meifolia* (Eaton, *Cheilanthes*) Baker, of Mexico. *Cheilanthes* (*Hypolepis*) *Schimperi* Kunze, of Abyssinia, which I have not seen, is remarkably similar, but I do not suppose that it is congeneric.

Until now, *Aspidotis* has not been published quite properly as a generic name. It is a section of *Hypolepis* as published in Species Filicum, with a brief description and a single species fully named; but in synonymy, because HOOKER did not accept NUTTALL'S genus.

43. Mildella

Mildella Trevisan, Rend. Ist. Lombardo II 9 (1876) 810.

Terrestrial, stem short, ascending, clothed with setaceous black paleae with inconspicuous brown margins; stipes clustered, brown or black, naked unless pubescent in the groove, lamina deeply bipinnatifid, pinnae opposite, segments lanceolate, acute, minutely serrulate, subcoriaceous, glabrous, veins free, forked, evident; sori discrete, on the tips of the veins and not decurrent, protected by a continuous scarious reflexed intramarginal introrse indusium, without paraphyses, annulus of about 18 thickened cells, pedicel rather stout, spores tetragonal-globose, dark, smooth.

TYPE and sole species: *M. intramarginalis* (Kaulf., *Pteris*) Trev., of Mexico and Central America.

This species has of late been referred to *Pellaea*, which it resembles particularly in its discrete sori and continuous indusium. In aspect, it is very distinct, more like some species of *Pteris*. As to affinity, I rather suspect *Cheilanthes*.

Cheilanthes angustifolia H.B.K. should perhaps be transferred to *Mildella*. This may be true of several other species, but not in my not too competent opinion, of *Aspidotis*, nor of *Onychium densum*.

* Genus Cheilanthi affine, fronde decomposita pinnulis et dentibus acutis, soris in sinubus dentium margine scarioso reflexo protectis distinctum.

44. Cheiloplecton

Cheiloplecton (*errore,* Cheilopecton) Fée, 7me Mém. (1857) 33, Pl. 20, f. 4.

Terrestrial, rhizome short, ascending, bearing narrow brown paleae nigrescent with age; stipes crowded, black, paleate, lamina about 20 cm long, deltoid-ovate, tripinnate at base, pinnatifid at apex, coriaceous, bearing deciduous tapering bristles, veins conspicuous, free, repeatedly forked; sorus on the enlarged apex of a vein, protected by a continuous hard, strongly convex and corrugated reflexed introrse indusium, sporangia solitary or very few, large, without paraphyses, annulus broad, of 20-24 thickened cells, stomium very large, spores globose, smooth, large enough to be distinguished with the naked eye.

TYPE and sole species: *C. rigidum* (*Sw., Pteris*) Fée, of Mexico; reported from Peru, probably by collector's error.

This peculiar fern has been placed in *Cheilanthes, Doryopteris* and *Pellaea.* It would fit into CHING's genus *Sinopteris,* characterized by similar enough frond form, conspicuous veins, and solitary or few large sporangia, but may hardly be suspected of being an immediate relative of the species ascribed to that genus — else *Sinopteris* would become *Cheiloplecton.* As between *Cheilanthes* and *Pellaea,* I do not know to which *Cheiloplecton* is nearer.

45. Pellaea

Pellaea Link, Fil. Sp. Cultae (1841) 48, 59.
Allosorus Presl *et auct. pl., vix* Bernhardi.
Platyloma J. Sm., Journal of Bot. 4 (1841) 160.
Synochlamys Fée, 7me Mém. (1857) 35, Pl. 20, f. 4.
Pellaeopsis J. Sm., Hist. Fil. (1875) 289.
Choristosoria Mett.: Kuhn, in v. Decken, Reisen III3 Bot. (1879) 13.
Pteridella Mett.: Kuhn, *ibid.*

Terrestrial, rhizome creeping and solenostelic, or shortened even to globose, clothed with narrow, usually non-costate paleae; frond pinnate or more compound, rachis dark and commonly shining, leaflets uniform, commonly broad and entire, more or less coriaceous, glabrous or less commonly hairy or scaly, typically pedicellate, veins free or rarely anastomosing; sori approximately marginal, covering the vein-tips or ultimate veinlets, commonly in contact but not confluent laterally, protected (with one exception) by the continuous reflexed margin, usually without paraphyses, annulus of 14-20 (commonly 18) thickened cells, spores globose, reticulate-spinose to smooth.

TYPE: *P. atropurpurea* (L., *Pteris*) Link, of North America.

About 80 species. Mostly small ferns of dry places, most abundant in South America and South Africa and its islands; south to Chile and New Zealand, north to Canada.

In spite of the much-qualified description, *Pellaea* is a natural genus, typically characterized by pinnately compound fronds, entire, somewhat coriaceous, non-adnate, usually naked pinnules and free veins. *Platyloma,* typified by *P. Brownii* J. Sm., which is *Pellaea paradoxa* (R. Br.) Hooker, is substantially the same genus; the two genera were published independently, almost at the same time.

Pellaeopsis, typified by *P. articulata* J. Sm., which is *Pellaea angulosa* (Bory) Baker, has anastomosing veins; but, belonging naturally in the same group, may conveniently be retained in *Pellaea.*

Synochlamys, typified by *S. ambigua* Fée, *Pellaea ambigua* Baker, of Colombia, is peculiar in having indusia so broad that those of the two margins of the leaflet meet on the costa. It does not merit generic recognition.

Pteridella, as typified by *P. doniana,* a common African fern, is more aberrant. Its sori fuse laterally.

Choristosoria, typified by *C. pteroides, Pellaea pteroides* (L.) Prantl, is a South African species, with a discrete indusium for each sorus, as in typical *Cheilanthes.* It is evidently one of the *Pellaea* group, but critically different in this one respect. The notching of the margin, which would break up the indusium, would itself be unique in *Pellaea;* and the indusia remain discrete even where the margin is practically entire.

Allosorus Bernhardi was a genus which cannot be satisfactorily typified, and is best rejected as a source of confusion. I introduce it here because UNDERWOOD, Mem. Torr. Bot. Club 6 (1899) 266, would typify it by *A. viridis,* an aberrant *Pellaea.* In commoner modern use, it has been adopted improperly as the name of *Cryptogramma.*

Pellaea has most essential characteristics in common with *Doryopteris;* but the real affinities of the major genera of this group remain obscure.

The group placed under *Pellaea* in CHRISTENSEN'S Index, p. XL, as sect. *Argyrochosma,* typified by *P. nivea* (Poir.) Prantl, has no proper place in the genus. As a matter of purely formal definition, it might be included in *Notholaena,* under which name it has been studied by MAXON and WEATHERBY, Contrib. Gray Herb. CXXVII (1939) 3. It seems to be a proper generic entity, without a name as such.

46. Llavea

Llavea Lagasca, Gen. et Sp. (1816) 33.
Ceratodactylis J. Sm., Hooker, Genera (1839) Pl. 36.
Botryogramme Fée, Genera (1850-52) 166, Pl. 15 C.

Terrestrial on exposed banks and limestone cliffs, rhizome short, stout, dictyostelic, bearing large aciculate lemon-colored paleae nigrescent with age; frond large, tripinnate, subcoriaceous, glabrous, sterile pinnules mostly ovate, serrate, veins free, repeatedly forked, the distal part of the frond fertile, with linear pinnules; sporangia all along the once-forked veins, covering the dorsal surface (gymnogrammoid in reality, acrostichoid in appearance), partly protected by the reflexed margin, paraphyses none, annulus usually of 18 cells (extremes are 16 and 22), straight, pedicel rather stout, spores tetrahedral or sometimes bilateral, the free surface reticulate so finely that they are smooth in profile.

TYPE and sole species: *L. cordifolia* Lag.; central Mexico to Guatemala.

This peculiar and handsome fern has been classified variously. BOWER, Ferns III, 65, regards it as primitive in the gymnogrammoid group. Unless a measure of superficial resemblance to *Osmunda regalis* is acceptable evidence, which I do not at all believe, I cannot regard it as primitive. In the *Pteridaceae, Aspidiaceae* and *Polypodiaceae,* dimorphism and indefiniteness of sorus commonly characterize specialized genera at the ends of series. Instability of the sporangium being conceivably a mark of primitiveness, and imputed by BOWER to *Llavea,* I have examined an exceptional number of its sporangia, and find them as uniform as in other ferns — no single instance of obliquity or doubling of a cell. Such abnormalitites do occur in ferns, and are just abnormalities, but are not evident in my material of *Llavea.* Bilateral spores are commoner than in most ferns with typically tetrahedral spores, but this is a common variation in such ferns.

Llavea is a local fern. A primitive local plant must be the vestige of an old flora; but primitive local ferns are exceedingly few. Among gymnogrammoid ferns of wider but still limited distribution are *Coniogramme,* derived from *Pteris,* and *Hemigramma,* derived from *Tectaria. Llavea* ranges less widely and remains monotypic. It is presumably newer.

I regard *Llavea* as a gymnogrammoid, dimorphic derivative of *Pellaea.* The type species of *Pellaea, P. atropurpurea,* has always sporangia extending along its vein-branches; and I have a Guatemala specimen identified as this species, with sporangia running down the parent vein, almost to the costa, just as in *Llavea.* The peculiarity of *Llavea* is not limited to its dimorphism, but I feel confidently that it is here placed correctly.

47. Doryopteris

Doryopteris J. Smith, Journal of Bot. 3 (1841) 404; 4 (1841) 162; Tryon, Cont. Gray Herb. CXLIII (1942).
Cassebeera Kaulf. Enum. (1824) 216, *non* Dennst. (1818).
Heteropteris Fée, Crypt. Vasc. Bras. I (1869) 123, *non* Fée (1843).
Bakeriopteris. O. Kuntze, Rev. Gen. Pl. II (1891) 807.

Terrestrial, rhizome creeping and solenostelic or short and congested, bearing firm narrow paleae with black axes; stipes usually crowded, black and polished, scaly near the base, lamina rather small, simple and entire or usually pedate and incised or forked, rarely thus trifoliolate, glabrous, coriaceous, veins free except in the sori, or anastomosing without included veinlets; sori marginal or nearly so, continuous along the margin, or sometimes discrete, with a continuous indusium, or less commonly interrupted by incisions in the margin, protected by a firm introrse indusium, filamentous paraphyses typically present, annulus of 14-22 thickened cells, spores globose, smooth.

TYPE: *D. palmata* (Willd.) J. Sm., of Venezuela, ranging to Mexico and Bolivia. The choice of a type is not clear, and I am following MAXON's advice. *D. pedata* (L.) Fée, stipulated as type by SMITH, Hist. Fil. (1875) 288, and by TRYON, is impossible, not being included originally in the genus.

Pantropic; some 35 species, most numerous in Brazil.

D. ludens (Wall.) J. Sm. has reticulate venation, and is exceptional in the genus in having an elongate rhizome. Free venation characterizes *Doryopteridastrum* Fée, set up as a section of *Pellaea*, with the idea that reticulate venation distinguished *Doryopteris* from *Pellaea*. Including species with both types of venation, *Doryopteris* is a natural genus, more clearly so than are some of its relatives.

If it really belongs in *Doryopteris*, the most distinct component is that with incised margins, each tooth bearing a sorus — *Cassebeera* Kaulf., *non* Dennst. — for which *Bakeriopteris* was proposed as a substitute name. These are little ferns, almost wholly Brazilian. DIELS, Nat. Planzenfam. I, Pt. 4 (1899) 288, added absence of paraphyses as another distinction; but I can find none in the more nearly related species of *Doryopteridastrum*, for examples, *D. paradoxa* (Fée) Christ and *D. microphylla* (Fée) Christ, with which *Cassebeera* Kaulf. almost intergrades. That is, there are species with continuous sori but without paraphyses. The extreme retreat of the sorus from the margin, conspicuous in *D. triphylla* (Lam.) Christ, is also connected by intermediates with species of which the indusium springs from the margin.

Heteropteris, typified by *H. Doryopteris*, a synonym of *D. lonchophora* J. Sm., is a typical *Doryopteris*.

Doryopteris is related to *Pellaea*, which is pinnate in plan, and thus quite distinct in appearance. On the basis of a careful study of the group, PRANTL, Engler's Jahrb. 3 (1882) 403 *et seq.*, made *Doryopteris* a section of *Pellaea*, but subsequent writers have found it more convenient to maintain both genera.

With sympathetic endorsement, I quote here PRANTL's introductory statement: "Wohl für keine Farngruppe gehen die Meinungen über die Umgrenzung der Gattungen in solchem Maasse auseinander, als für jenen Formenreichthum, welcher sich an Pteris und Adiantum anschliessend die Gattungen Cheilanthes, Notochlaena, Pellaea, Allosorus und einige andere umfasst."

48. Ormopteris

Ormopteris J. Smith, Hist. Fil. (1875) 281.

Terrestrial, rhizome short-creeping, dictyostelic, densely clothed with narrow cinnamon non-costate paleae; fronds small, congested, stipe brown, not polished, lamina bipinnate, pinnae linear, pinnules mostly opposite, short and broad, adnate by the entire base, glabrous, coriaceous, revolute concealing the sori, veins free; sorus of a few large sporangia along the

vein, not confluent laterally, indusium inframarginal, introrse, short and inconspicuous, paraphyses apparently none, annulus of about 20 thickened cells, spores globose-tetrahedral.

TYPE: *O. glcichenioides* (Gardner, *Cassebeera*) J. Smith, a local fern of Minas Geraes, Brazil.

As represented by the type, *Ormopteris* seems nearer to *Pellaea*, where it was placed by CHRIST and left in the Index, than to *Doryopteris;* but it is too aberrant for easy inclusion in either genus.

A neighbor of *Ormopteris*, similar enough to be apparently a near relative, is *Pellaea pinnata* (Kaulf.) Prantl, which, with *Doryopteris triphylla* (Lam.) Christ (I use the names adopted in the Index) constituted KAULFUSS' genus *Cassebeera*. These look to me suspiciously like one species, and *D. triphylla* is connected with other *Doryopteris*, as is noted under that genus. These all have the paleae of *Doryopteris*.

49. Actiniopteris

Actiniopteris Link, Fil. Sp. Cultae (1841) 79.

Terrestrial, rhizome short-creeping, densely beset with stipe-bases, but also paleate, paleae brown, blackening first along the axes with age; fronds small, tripartite to the base and each part once or more dichotomous, the segments linear, glabrous, coriaceous, fertile fronds taller and longer than sterile, veins free except in the sori; sorus on a longitudinal vein connecting the vein-tips, uninterrupted for the length of the segment, protected by the continuous reflexed margin, paraphyses none, annulus of about 18 thickened cells, spores tetrahedral, smooth or nearly so.

TYPE and sole species: *A. australis* (L. f., *Acrostichum*) Link, South Africa and its islands, to Arabia and across India. More commonly called *A. radiata* Link.

A fern of arid places, remarkable for the crowding of the fronds and the narrowness of their segments.

As to probable affinity, *Actiniopteris* has more in common with *Doryopteris* than with any other genus.

50. Cryptogramma

Cryptogramma R. Brown, *apud* Richards in Franklin's Journey, (1823) 767.
Allosorus auct. plur., *vix* Bernh.
Phorobolus Desv. Prod. (1827) 291.

Terrestrial, rhizome solenostelic but in places congested and dictyostelic, clothed with thin, brown paleae; fronds crowded, small, herbaceous, glabrous, finely pinnately dissected, dimorphic, the fertile fronds usually having narrower and longer pinnules than the sterile, veins free; sorus submarginal, covering the branches of forked veins, protected by a typically continuous reflexed margin, without paraphyses, annulus of 20-24 thickened cells, spores tetrahedral or exceptionally bilateral, hyaline, tuberculate.

TYPE: *C. acrostichoides* R. Br., of northern North America.

A natural genus, including three other species, also northern, ranging south to the Himalayas. *C. crispa* (L.) R. Br., European and West-Asiatic, is the type of *Phorobolus*.

By definition, *Cryptogramma* seems like *Pellaea* and *Llavea*, but I mistrust any very near affinity. It seems nearer to *Onychium*. These two genera are alone among superficially similar ferns in seeming unlikely to have had a southern ancestry. BOWER, Ferns III 68, points out the likelihood that *Cryptogramma* is geologically ancient where it is still found. He also emphasizes the irregularity of the annulus as evidence of primitiveness; but, examining all species, I am not impressed by the unusual commonness of such irregularity.

51. Onychium

Onychium Kaulfuss, Jahrb. d. Pharm. (1820) 45 (not seen); Enum. (1824) 144.
Leptostegia Don, Prod. Fl. Nepal. (1825) 14.

Terrestrial, rhizome creeping and solenostelic, or more often short and compact, paleate; frond of moderate size, tripinnate or more compound, broad at base, ultimate pinnules small and narrow, glabrous, herbaceous or subcoriaceous, veins free except for a fertile commissure connecting the tips; sori continuous along both margins, protected by a scarious introrse marginal or submarginal indusium, so broad that the two on each pinnule meet on the costa, without paraphyses, annulus typically of about 20 thickened cells, spores tetrahedral, hyaline, typically with a thick, ribbed or tuberculate epispore.

TYPE: *O. auratum* Kaulf., a synonym of *O. siliculosum* (Desv.) C. Chr., common from Japan to India and New Guinea. There are 2 to 5 other old-world species.

Leptostegia was a genus of one Himalayan species, *L. lucida* Don, which, if not *O. japonicum*, is very near to that species.

O. strictum Kunze, of the West Indies, is in appearance a typical *Onychium*, but the paleae are different, and the spores want the remarkable epispore. It might about as well be placed in *Cryptogramma*.

O. densum Brack., of the Pacific United States, is more distinct as to paleae, and equally so as to the epispore, and is like *Pellaea* in having polished stipes. It has usually been treated as a *Pellaea*. MAXON, Am. Fern Journal 8 (1918) 116, regards it as a *Cheilanthes*, immediately related to *C. californica*, which I call *Aspidotis*, but suggests that *Mildella* may be their proper genus. There is affinity to *Aspidotis*, but I cannot see that it is appreciably more at home in any of these genera than where BRACKENRIDGE originally described it; but it is certainly a foreign element in *Onychium*. One peculiarity, however, the intramarginal indusium, is found also in *O. japonicum*, a typical *Onychium*.

52. Hemionitis

Hemionitis Linnaeus, Sp. Pl. (1753) 1077.

Terrestrial, rhizome short, dictyostelic, bearing thin brown paleae shading into hairs, the broader ones becoming dark-costate in age; fronds crowded, small or of moderate size, hairy, stipes maroon to black, long, lamina herbaceous, roundish or cordate or pinnatifid, never compound nor elongate, somewhat dimorphic, margin entire or broadly lobed, venation freely reticulate without included veinlets; sporangia along all veins of fertile fronds, without paraphyses, annulus of 14-20 thickened cells, stomium large, spores globose, everywhere reticulate-spinulose.

TYPE: *H. palmata* L., of northern tropical America.

Six other species are distinguished in the same region. One variable species, *H. arifolia* (Burm.) Moore, with entire fronds, the sterile forming basal rosettes and the fertile long stalked, ranges from India to the Philippines.

The discontinuity of distribution is remarkable, but there is no other evident basis for doubt that *H. palmata* and *H. arifolia* are congeneric. In America, there is apparent affinity to *Bommeria*, and less immediately to the *Cheilanthes* group as a whole. In the Orient, there is striking resemblance to *Syngramma*, particularly to *S. lusonica*, but this is probably purely fortuitous.

53. Bommeria

Bommeria Fournier, Dict. de Bot. I (1876) 448; Maxon, Cont. U. S. Nat. Herb. 17 (1913) 169.
Stegnogramma Fourn., Mex. Pl. I (1872) 71, *non* Blume (1828).

Small terrestrial ferns, rhizome short and dictyostelic, or elongate and solenostelic in *B. hispida*, clothed with brown paleae blackening with age

along the axis and finally throughout, hairy also in *B. hispida;* lamina deltoid, pinnatifid or pinnate or bipinnatifid, margin entire, herbaceous to coriaceous, hairy, veins free or anastomosing without included veinlets; sporangia seriate along all veins or only toward the margin, partly protected by the reflexed margin in *B. ehrenbergiana,* unprotected in other species, sporangium rather small, annulus of 14-18 thickened cells, spores globose or globose-tetrahedral, smooth or granular.

TYPE: *B. ehrenbergiana* (Kl., *Gymnogramme*) Underwood, as to the formal combination; FOURNIER merely said that *Gymnogramme ehrenbergiana* is a *Bommeria.*

Four species, all in Mexico; *B. hispida* also from Texas to California, and *B. pedata* in Guatemala.

The nearest affinity seems to be to *Hemionitis,* and there is no evident serious difficulty in combining the genera. Only *B. hispida* is discrepant in extreme hairiness and elongate rhizome, and looks more like neighboring species called *Notholaena.* The limited geographic range of *Bommeria* indicates local origin.

54. Trachypteris

Trachypteris André *apud* Christ, Monog. Elaphoglossum (1899) 150.

Terrestrial, rhizome short and becoming erect, paleate; fronds dimorphic, the sterile ones forming a basal rosette, broadly oblanceolate, rounded, entire, clothed densely beneath and deciduously above with ciliate paleae, firm, veins freely reticulate without included veinlets, fertile fronds long-stipitate, erect, trifid or pinnate; sporangia borne along all veins and covering the surface, annulus of about 26 thickened cells, spores reticulate-spinose.

TYPE: *T. aureo-nitens* (Hooker, *Acrostichum*) André: Christ, a synonym of *T. pinnata* (Hooker f.) C. Chr., of the Galapagos Islands, ranging east to Minas Geraes.

One other species, *T. drakeana,* occurs in Madagascar.

The sporangia are borne at first on the veins, abundantly enough to cover the surface; whether, later, some are borne between the veins, I can not be sure. CHRISTENSEN, Dansk Bot. Arkiv 7 (1932) 110, has had the same doubt.

Trachypteris is related to *Hemionitis,* from which it differs in its paleate fronds. The paleae are strikingly like those of the Australian *Paraceterach.*

55. Saffordia

Saffordia Maxon, Smithsonian Misc. Coll. 61[4] (1913) 1, Pl. 1, 2.

Terrestrial, rhizome ascending, short, bearing uniformly light-castaneous long-pointed paleae; stipes fascicled, atrocastaneous, polished, scaly; lamina uniform, deltoid-pentagonal, pinnatifid with few segments, the basal ones again pinnatifid on the lower side, segments broad, rounded, coriaceous, curled upward in drying, naked above (or more probably glabrescent), densely imbricate-paleaceous beneath, paleae erose-denticulate, veins immersed, closely reticulate without included veinlets; sporangia typically in a continuous intramarginal zone, on and immediately beyond the outermost row of areolae, exindusiate but well protected by the paleae, annulus of 16-18 thickened cells, spores globose-tetrahedral, reticulate-spinulose.

TYPE: *S. induta* Maxon, of Peru.

MAXON and BOWER, Ferns III, 86, have recognized the immediate affinity of *Saffordia* and *Trachypteris.* I cannot follow them in regarding *Saffordia* as intermediate between *Doryopteris* and *Trachypteris,* plausible as their sequence appears. To me, *Saffordia* seems nearer to *Hemionitis* than to *Doryopteris.* Also, the Australian *Paraceterach,* in spite of its pinnate frond and free veins, is a near relative of *Saffordia.* Collectively, these ferns give the impression of a group old enough to have originated

in Antarctica with fixed characters of texture, paleae, fructification and spores, just successful enough in more recent time for bare discontinuous survival.

Saffordia is known by a single collection, and its range of variation is thus uncertain. On one frond, I find the zone of sporangia widened toward the costa, approaching the condition in *Trachypteris*.

56. Paraceterach

Paraceterach F. v. Mueller, Fragmenta 5 (1866) 138, *nomen*, as Section of *Grammitis;* Copeland, Genera 75 as genus.

Rhizoma repens paleaceum; stipes rhachisque atrofusci paleacei; lamina pinnata, pinnis suboppositis, oblongis vel latioribus rotundatis integris, superne demum glabrescentibus inferne paleis ciliatis imbricatis densissime vestitis, venis occultis liberis; sporangia in lineam sat latam intramarginalem instructa, exindusiata paleis protecta.

TYPE: **P. Muelleri** (Hooker) Copel., *Gymnogramme Muelleri* Hooker, Sp. Fil. V (1864) 143, Pl. 295, of Queensland.

Here presumably belongs also *Nothochlaena Reynoldsii* F. v. M., collected once, but with four generic names, said to be distinguished by broader pinnae and narrower paleae.

Paraceterach is distinguished from *Gymnopteris* by its indument of scales instead of hairs; from *Saffordia*, by pinnate fornd and free veins. All are nearly related.

In my single imperfect specimen, the bundle seems to be solenostelic.

57. Gymnopteris

Gymnopteris Bernhardi, Schrader's Journal 1 (1799) 297.
Gymnogramma Desv., Berlin Mag. 5 (1811) 304.
Neurogramma Link, Fil. Sp. Cultae (1841) 138.

Terrestrial ferns of moderate size, rhizome short-creeping to erect, dictyostelic, clothed with linear tawny paleae blending with hairs; stipes crowded, castaneous, scaly and hairy at base, elsewhere hairy; lamina pinnate or more compound, not finely dissected, thin, hairy, veins free; sporangia along all veins, exindusiate, annulus of 16-24 thickened cells, spores globose-tetrahedral, conspicuously reticulate-spinose.

TYPE: *G. rufa* (L., *Pteris ruffa*) Bernh., of tropical America.

About 5 species, in tropical America and in India and China.

Gymnopteris is one of the *Cheilanthes* group, but its more immediate affinities are uncertain. The distribution is like that of *Hemionitis*.

Both *Gymnogramma* and *Neurogramma* have the same type species as *Gymnopteris*, and are thus synonyms. *Gymnogramma*, or *Gymnogramme* as the name was amended by KUNZE, has been used in the widest possible sense, to include all ferns with elongate naked sori; in which sense, as a genus-by-definition, it would better have been called *Grammitis*, if not *Hemionitis*.

Gymnopteris was imperfectly described by BERNHARDI: "Sporangia pedicellata lineatim aggregata. E. g. *Acrostichum rufum* L." Except as to the example, *Hemionitis* was described in exactly the same words, the difference, appearing in preceding brackets, being that *Hemionitis* was credited with an indusium, which it has not. PRESL, Tent. 242, used the name in a distinct, comprehensive sense.

58. Pityrogramma

Pityrogramma Link, Handb. d. Gewächs. 3 (1833) 19 (not seen); Maxon, Cont. U. S. Nat. Herb. 17 (1913) 173.
Ceropteris Link, Fil. Sp. Cult. (1841) 141.

Terrestrial, mediocre or small, rhizome ascending, short, dictyostelic, bearing tawny to brown, narrow, aciculate paleae; fronds crowded, stipe scaly at base, elsewhere naked, dark, polished, lamina typically ovate and

pinnately decompound, herbaceous to subcoriaceous, more or less densely ceraceous, veins free; sporangia borne along all veins, exindusiate, annulus of 20-24 thickened cells, spores globose-tetrahedral, dark, with irregularly reticulate-ribbed epispore.

TYPE: *P. chrysophylla* (Swartz, *Acrostichum*) Link, of the West Indies, ranging from Costa Rica to Argentina.

Perhaps 40 species, mostly in tropical America; a few in Africa and Madagascar. One, *P. Brackenridgei* (Carr.) Maxon, from Samoa, is open to grave suspicion, at least as to its nativity. Once the most popular cultivated ferns, these are still very common in culture, and in bewildering variety. They hybridize freely in cultivation, and presumably in nature, which makes their specific identification difficult or impossible. A study of the hybrids and forms was published by DOMIN in 1929. Some of them, notably *P. calomelanos* (L.) Link, have become naturalized in all warm lands.

Pityrogramme is near enough to *Anogramma* and *Trismeria* so that they have been combined by some authors.

In publishing *Ceropteris*, LINK ignored his own earlier name of the same genus.

58*a*. Cerosora

Cerosora (Baker, Journ. Linn. Soc. 24 (1887) 260, as sect. of *Gymnogramme*) Domin, Acta Bot. Bohem. 8 (1929) 3.

Distinguished from *Pityrogramme* by bearing elongate pluricellular hairs, instead of paleae, on the rhizome.

TYPE: *C. chrysosora* (Baker, *Gymnogramme*) Domin.

This genus is based on one specimen, from Sarawak, apparently without local relatives. It must be better known before its status can be appraised.

59. Trismeria

Trismeria Fée, Genera (1852) 164, Pl. 14 A.

Terrestrial, rhizome becoming erect, congested and dictyostelic, clothed with attenuate castaneous paleae; fronds clustered, glabrous except for paleate bases of the castaneous polished stipes; lamina elongate, pinnate, pinnae simple and linear toward the apex, elsewhere mostly trifid or trifoliolate, sterile and mostly serrate in the lower part of the frond, fertile, more entire and narrower, with ceraceous nether surface in the upper part, herbaceous to subcoriaceous, veins free; sporangia everywhere on the veins, and spreading somewhat to the space between them, unprotected except by the waxy indument, large, short-stalked, annulus of 18-24 thickened cells, spores tetrahedral, smooth.

TYPE: *T. argentea* Fée, of Brazil, a synonym of *T. trifoliata* (L., *Acrostichum*) Diels.

A single species, throughout tropical America, common on bars and in brush along streams. *T. longipes* (Baker) Diels, transferred to *Trismeria* by description, is more properly a *Pityrogramma*.

Trismeria is intimately related to *Pityrogramma*, but is so distinct in aspect that its recognition as a genus is convenient.

60. Anogramma

Anogramma Link, Fil. Sp. Cultae (1841) 137.

Terrestrial, rhizome rudimentary, bearing ferruginous paleae shading into hairs; fronds small, tufted, lamina in full development tripinnate with decurrent pinnules, incised, glabrous or slightly hairy, membranaceous, veins forked, free; sporangia seriate along the veins and "sori" forking

with the veins, unprotected, without paraphyses, annulus of about 22 thickened cells, spores tetrahedral, faintly ribbed.

TYPE: *A. leptophylla* (L., *Polypodium*) Link, of the Mediterranean region, and many remote areas.

Seven species are recognized, but the individuals vary greatly with the stage of development and the distinctions are not convincing. The frond can reach a height of 30 cm, and be 5-pinnatifid; or simple flabellate fronds 1 cm long can be fertile. It is unique among ferns in that the prothallium can be perennial, and the sporophyte ephemeral.

The genus seems to be characterized by reduction, perhaps involving degeneration, and this demands caution in appraising its origin. By its positive characters, *Anogramma* seems near to *Pityrogramma*. Some species have been moved back and forth, and Domin submerged *Anogramma* in *Pityrogramma*. But *Anogramma* is found in New Zealand, Madagascar and Argentina, and has a wide range elsewhere. This distribution is evidence of respectable age and an Antarctic origin. If *Pityrogramma* was also Antarctic, it seems to have had less range there, and not to have escaped by the New Zealand route. So far as a conclusion can be drawn, *Pityrogramma* seems to be the younger genus. But, once a genus suffers reduction, it is not likely to give rise to a genus or to species more typically developed.

The ease with which reduction can result in similarity is illustrated by the species described as *Anogramma Fauriei*, which is an *Asplenium*. The genus *Pleurosorus* also resembles *Anogramma* to a great extent, but its paleae prove its real affinity to *Asplenium*.

61. Pleurosoriopsis

Pleurosoriopsis Fomin, Bull. Jard. Bot. Kieff XI (1930) 8 (not seen); Fl. Siberia et Or. Extr. V (1930) 215.

Terrestrial, rhizome creeping, slender, bearing a few ferruginous paleae and many similar hairs; fronds remote, little, sparingly bipinnate, herbaceous, beset with short pluricellular hairs, veins free; sporangia along the lower and middle parts of the veins, unprotected, stalked, annulus of 14 (-16) cells.

TYPE and sole species: *P. Makinoi* (Maxim., *Gymnogramme*) Fomin, of Japan, North China and the Amur region.

Like *Anogramma* except for the elongate rhizome and pubescence; and probably related to that genus.

My material is somewhat imperfect; in particular, the spores have been shed almost completely. The few I find are globose-tetrahedral, but may be there by contamination. FOMIN describes them as reniform, and he figures them within the sporangium.

62. Aspleniopsis

Aspleniopsis Mettenius *apud* Kuhn, Chaetopterides (1882) 324.

Terrestrial, rhizome short-creeping, solenostelic ("tubo vasorum rhizomatis clauso," Kuhn), bearing very short dark hairs; fronds crowded, simply pinnate, herbaceous, glabrous, veins free; sori elongate on the distal parts of the veins, exindusiate, densely paraphysate, sporangium slender-stalked, annulus broad, of 17 or 18 cells, spores globose-tetrahedral, very minutely verruculose.

TYPE and sole species: *A. decipiens* Mett., of New Caledonia, also in New Ireland and the New Hebrides.

The genus was named to note the superficial resemblance to *Asplenium heterocarpum* Wall., *A. cheilosorum* Kunze: Mett., which is not regarded as evidence of affinity. The real affinity is unknown. Because of presumably more significant common characters, it is appended to the hairy gymnogrammoid ferns.

63. Adiantum

Adiantum Linnaeus, Sp. (1753) 1094.
Hewardia J. Smith, Journ. of Bot. 3 (1841) 432, Pl. 16-17; Hooker and Bauer, Genera, Pl. 89.

Terrestrial, rhizome long-creeping and solenostelic or short and ascending, paleate, paleae usually brown to black and narrow; stipes scaly at base only, dark and polished, lamina typically broad, and pinnately decompound with dimidiate or flabellate pinnules, sometimes simply pinnate, rarely pedate or simple, usually firm-herbaceous, rarely membranaceous or coriaceous, glabrous or less commonly hairy, rarely glaucous, veins free or rarely anastomosing; sporangia borne along the veins on the inner face of reflexed marginal outgrowths which thus serve as indusia and also bear the sporangia, these veins approximate, parallel, free, the sporangia sometimes spreading over the tissue between them, pedicel slender, of three rows of cells, annulus usually of about 18 thickened cells, spores tetrahedral (varying to bilateral), dark, smooth.

TYPE: *A. Capillus-Veneris* L., European and cosmopolitan.

At least 200 species, most numerous in South America.

Adiantum is a most natural genus, characterized by the extension of the veins into the reflexed margin, and fertile there only. Being thus borne, the sori are never unprotected, and cannot extend down the veins. With these exceptions, the species of *Adiantum* duplicate the range of evolution of *Cheilanthes* and the related genera, collectively distinguished by fertile veins which fall short of the reflexed margin, if there is one. The "sorus" of *Adiantum* is the group of sporangia borne by a unit of reflexed margin. It is always served by plural veins, but the number is usually not great. The indusium may be at the bottom of a notch in the margin, and roundish, or on the unbroken margin, or on the end of a tooth, and then be squarish or elongate along the margin; or this elongation may be uninterrupted along the side of a pinnule.

The genus has been divided into sections on the basis of the shape of the indusium and of its extension along the margin; on the restriction of the sporangia to the veins, or their spread between the veins; on the plan of the frond, as simple, pedate, or pinnate; and on the shape of the pinnules, as more or less dimidiate, or flabellate; but no attempt has been made to segregate genera on any of these bases. There is also a group of Malay-Asiatic species characterized by the rigidity of the small, round, flabellate-veined pinnules.

Hewardia, typified by *H. adiantoides* J. Sm., of Guiana, is distinguished by anastomosing veins. Three or four species of the same region, all with large pinnules and elongate sori, would constitute the genus. But the anastomosis is sometimes casual rather than well fixed, and it is not worth while to maintain the generic distinction.

As a group, the species of *Adiantum* are remarkably beautiful, and many are cultivated for this reason. The spores of many species germinate readily, and retain their vitality well, which fits the genus for both migration and culture.

On the basis of present distribution, I suppose that at least the most of the extant species are of Antarctic ancestry; but the genus is old, and may have lived elsewhere without interruption.

Adiantum has a common ancestry with *Cheilanthes*, more immediate than that with *Pteris*.

Summary on Pteridaceae: — Our knowledge of ferns has progressed far enough so that we can suppose, with a large measure of probability, that the preceding 63 genera constitute a natural group, and that no other known fern should be included in it. The general characteristics of this group are: 1) Solenostely, developing necessarily into dictyostely as the approximation of the fronds makes the foliar gaps in the original solenostele

overlap. 2) Indument of hairs rather than of paleae. 3) Marginal rather than dorsal sori. 4) Tetrahedral spores.

As to the origin of this phylum, we can only speculate. As a matter of some common characteristics, the most similar more primitive ferns are found in the *Schizaeaceae*. This is true also of the *Hymenophyllaceae*. But, in both cases, the gaps are so wide that any measure of affinity is suggested rather than established.

Near the bottom of the Dicksonioid phylum, we find considerable diversity among genera, distinct certainly since the Miocene, and probably still longer ago. Among these are:

Thyrsopteris, a relict genus, with a sorus which suggests some affinity to *Cyathea,* a genus regarded as primitive in another great phylum.

Dicksonia, an aberrant relict genus of tree-ferns. The annulus of *Thyrsopteris* and *Dicksonia,* like that of *Cyathea,* is uniformly oblique. The nearest relative of *Dicksonia* is *Cystodium.*

Cibotium, including arborescent species, and others of which the rhizome merely becomes erect; nearer to *Culcita* than to *Dicksonia.*

Culcita, resembling *Thyrsopteris* more than *Dicksonia,* and nearer to the line of evolution of the phylum as a whole. In *Culcita, Cibotium* and *Cystodium,* the annulus is shifting from oblique to vertical.

Saccoloma is aberrant in the phylum, in having paleae and a dictyostelic rhizome, due to the long foliar gaps in the bundle. *Orthiopteris* is still more divergent, in that the stem becomes erect. The two genera are certainly related; and the distribution of *Orthiopteris* is proof of considerable age. The position of the sorus, the indusium, and the shape of the spores show affinity to the phylum, but not to any particular genera. Tentatively, I place them near the base of the phylum.

Going back to *Culcita,* it seems nearly related, among less primitive ferns, to *Dennstaedtia,* in which the longitudinal annulus is firmly established. *Microlepia* is distinguished from *Dennstaedtia* solely by its intramarginal sorus, and in nature this distinction is a feeble one. Another genus hardly more distinct, but more recognizably so because it is a small genus, is *Oenotrichia.*

Tapeinidium was for a time included in *Microlepia.* This can not be justified, but the common characters do suggest some measure of affinity. The affinity of *Tapeinidium* to *Lindsaea* is positive. *Lindsaea* is a large and old genus. Its spores are sometimes tetrahedral, sometimes bilateral, but the naturalness of the genus is not questioned. The bilateral spores, being a feature of variation within the genus, throw no doubt on its place in this phylum, but do remove such spores, more uniformly present in related genera, as an objection to the inclusion of these genera also. The peculiar "solid" bundle of *Lindsaea* is perhaps a more significant peculiarity. It seems to me that it may have been evolved by simplification of a solenostele. Or, it may be valid evidence of primitiveness. It is not always found in apparent relatives of *Lindsaea.* At any rate, it is not necessary to question the place of *Lindsaea* in this phylum. The time and place (among the genera) of its differentiation are, however, uncertain. It may be derived from such ferns as *Dennstaedtia,* or *Culcita,* or its independent origin may be still more remote. *Tapeinidium* is more likely to be a derivative of

Lindsaea than a link between *Lindsaea* and *Microlepia*. *Sphenomeris* and *Odontosoria* are more certain derivatives.

I return to *Lindsaea* a few Oriental species with more or less equilateral pinnae, which have passed of late as *Schizoloma;* but find it convenient to maintain as distinct a small American genus, *Ormoloma,* which has evolved along a parallel line. *Isoloma* is a more distinct group of Oriental species. *Isoloma* has been included in *Schizoloma,* which more reasonably includes a single species.

The common features of *Schizoloma* and *Lindsaea* have almost always been regarded as proof of near affinity, and I recognize the apparent weight of this evidence. On other grounds, I feel sure of the affinity of *Schizoloma,* with the marginal sorus and extrorse indusium of *Lindsaea,* and *Taenitis,* with naked dorsal sori. Because of the intermediate position of *Schizoloma,* I append *Taenitis* to the *Lindsaea* group. *Syngramma* is very near to *Taenitis;* and *Craspedodictyum* is an offshoot of *Syngramma.* These are all comparatively recent genera, of restricted, common range.

Returning to the more primitive part of the phylum, *Leptolepia* has a fixed longitudinal annulus, and the general aspect of *Dennstaedtia,* and a sorus terminal on its vein, but an indusium more suggestive of *Athyrium.* It belongs clearly in the Dennstaedtioid group, but may be as old as *Dennstaedtia.*

Dennstaedtia is a natural genus, but includes at least three distinguishable elements. One of these has already been followed, through *Microlepia.* Another, with naked polished axes, may be without derivatives, or may possibly be related to *Histiopteris.* A third is certainly close to *Hypolepis,* and may well be regarded as the source of that genus. *Paesia* and *Pteridium* may be cognate with *Hypolepis,* but the last is more remote from *Dennstaedtia.* All are fairly old genera.

The place of *Histiopteris* is less certain. Possibly, it is Dennstaedtiid. Its affinity to *Pteris* is clear enough. If its direct affinity to any Dennstaedtioid ferns were established, it would fix the place of *Pteris,* but any such affinity is an assumption rather than an established fact. The fact, or as near to one as we can come in this matter, is that, if either *Histiopteris* or *Pteris* is ancestral to the other, *Pteris* is the older. *Lepidocaulon* is a relative of *Histiopteris,* known by two collections in New Guinea.

If a link between *Pteris* and *Dennstaedtia* survives, it is probably *Paesia,* and *Pteridium* helps to close the gap. *Paesia* has a well preserved extrorse indusium, which is one of the proofs of affinity to *Dennstaedtia.* It has also a reflexed margin, protecting the sorus more efficiently. In *Pteridium,* the extrorse indusium is vestigial. In *Pteris,* it has vanished. If the sorus be the only structure considered, the transition form that of *Dennstaedtia* to that of *Pteris* has enough surviving steps to establish the sequence. *Pteris* has dictyostelic stems, necessarily consequent on their shortness. For the great body of the genus, the character most conspicuously in contrast to *Paesia* is the presence of paleae. But, as to this feature, the gap is bridged within the genus by the element long held distinct as *Lonchitis,* mostly hairy but showing the transition to scales. However conspicuously aberrant *Pteris* is in some of its features, its descent from Dennstaedtioid ancestors may not well be doubted.

Being a very successful genus in the modern fern world, *Pteris* has

naturally its own descendants, the twigs on its branch of the genealogical tree. *Hemipteris* and *Schizostege* are among the less divergent of these. *Anopteris* and *Ochropteris* are, with less evident certainty, others.

We have already seen the dissolution of the sorus and loss of the indusium in *Taenitis* and *Syngramma,* probable derivatives of the *Lindsaea* group, as the sporangia spread down the veins, and eventually even onto the intervening lamina. Among presumable derivatives of *Pteris,* the sporangia are restricted to the veins in *Coniogramme,* and have spread over the surface in *Neurocallis* and *Acrostichum.*

The group to which we now come is, and has long been, one of the most puzzling among all those of ferns. Its origin is open to dispute, its homogeneity is still questionable, even after I remove several genera, and the boundaries of the larger genera are subjects of free disagreement. *Cheilanthes* may be taken as one of the oldest and most representative genera of the group. It is a fern of dry places, as ferns go; is therefore small, and has a short, dictyostelic rhizome; but a species like *C. Clevelandii,* with longer rhizome, has a solenostele, showing that in this respect it is not out of place in the Dicksonid phylum. Its indusium, if it has one, is a reflexed piece of the margin, protecting a single sorus or more commonly spreading along the margin and protecting several sori, each on the tip of a vein. When the indusium protects a single sorus, the sorus is altogether like that of *Hypolepis,* and I regard this as valid evidence of affinity. Both genera are of probably Antarctic origin, and they are now most alike in the far South. Bower presents evidence indicating a possible more remote origin of these ferns, from the *Schizaeaceae,* and the superficial resemblance to *Mohria* has long intrigued me; but a Dennstaedtioid descent remains more probable.

As I treat the group, *Aleuritopteris, Aspidotis, Mildella* and *Cheiloplecton* are probable derivatives of *Cheilanthes. Pellaea* and *Doryopteris* are presented as cognate relatives of *Cheilanthes; Llavea,* as a derivative of *Pellaea;* and *Ormopteris* and *Actiniopteris* as minor variants of the same general group. *Cryptogramma* and *Onychium* are mutually related, and together belong in a general group with *Pellaea;* but they are old ferns, and a common ancestor with the other Cheilanthoid ferns may be remote in time.

The preceding twelve genera are alike in having the sorus protected by a reflexed margin, except as this has been lost by a considerable number of species. The sporangia may be borne in definite sori on the tips of the veins, as in *Cheilanthes;* or on a commisure connecting these tips, as in *Onychium* (and *Pteris*); or they may descend along the veins, as in *Pellaea* and *Cryptogramma.* In *Llavea,* they descend past the forking of the fertile vein, thus finally covering the dorsal surface, though borne only on the veins.

We have seen that in the cases of *Syngramma* and *Coniogramme,* when the sporangia spread indefinitely along the veins, their protection by indusia becomes impracticable — although such protection persists in *Llavea,* and will be found as a novelty in *Belvisia.* Since ferns of any group can extend the fertile region in this manner, and many unrelated ferns have done so, the old genus *Gymnogramme,* supposed to be characterized by sporangia ranging indefinitely along the veins, is now recognized as artificial; and a tribe similarly named must either be similarly artificial or else indefinable. Among the Cheilanthoid ferns, such extension of the sorus

has been common, and the immediate affinities of the real genera characterized by such "sori" are still by no means all clear.

The Linnaen genus characterized by such fructification was *Hemionitis*. Its more immediate relatives are *Trachypteris* and *Bommeria*. These are manifestly of the Cheilanthoid group, resembling *Doryopteris* and *Aleuritopteris* in general form, but without clear particular affinities. *Gymnopteris* is not remote from them.

Pityrogramma, Trismeria, Anogramma and *Pleurosoriopsis* constitute another group, apparently independent of *Hemionitis* and its relatives, but also Cheilanthoid in affinity.

There remain three mutually related South American genera, which differ from all of those immediately preceding in having hairy, non-paleate rhizomes. It has been usual to associate these with the Gymnogrammoid-Cheilanthoid genera, but their hairy rhizomes make such classification untenable. Throughout the phylum, hairs betoken primitiveness, as compared with paleae. But these genera, *Eriosorus, Jamesonia* and *Pterozonium,* can hardly be old, as compared with *Cheilanthes* and *Pellaea,* or with *Cryptogramma,* or even with *Hemionitis* and *Gymnopteris.* I have postponed their consideration to the place where the contrast with the other Gymnogrammoid genera would be emphasized most effectively, but have little doubt that *Eriosorus* is an immediate derivative of *Paesia;* and that *Jamesonia* and *Pterozonium* have been evolved from *Eriosorus* by reduction of the lamina, in adjustment to the life of xerophytes.

Adiantum is an old and isolated genus. It is placed in this phylum with reasonable safety, but the assignment of any particular place would not be justified.

FAMILY 7—PARKERIACEAE

Parkeriaceae Hooker, Exotic Flora II (1825) Pl. 147, *Ordo.*
Ceratopteridaceae Maxon Pterid. Porto Rico (1926) 379.

The characters are those of the single genus.

Ceratopteris

Ceratopteris Brongniart, Bull. Soc. Philom. (1821) 186.
Ellebocarpus Kaulf. Enum. (1824) 147.
Parkeria Hooker, Exotic Flora (1825) Pl. 147.
Furcaria Desv. Prod. (1827) 292.

Aquatic or subaquatic annuals, rhizome short, becoming erect, bearing a few small fuscous paleae; fronds of moderate size, pinnately decompound, broad, glabrous, soft-herbaceous, dimorphous, the fertile fronds larger, more finely divided, and with longer and narrower pinnules than the sterile, proliferous in the axils, veins anastomosing without included veinlets; sporangia sessile, seriate along the veins, large and occupying the entire surface, protected by continuous reflexed margins, annulus of 30 to 70 broad thickened cells, with an evident stomium in *C. siliquosa* and *C. cornuta,* or obsolescent in *C. pteridoides,* spores 16 or 32, large, tetrahedral, with the free surface ribbed.

TYPE: *C. thalictroides* (L.) Brongn., which is *C. siliquosa* (L.) Copel., India to Polynesia and Japan. There are probably another species in the Orient, one in Africa, and two or three in tropical America, north into the United States. The type of the family is *Parkeria pteridoides,* of South America, described as without a trace of annulus, with the avowal that *P. thalictroides,* then unknown to HOOKER, must belong in the genus. When, later, HOOKER became acquainted with this species, he retracted his own family, genus and species. The consequent confusion of species, which, as to those of LINNAEUS, is not yet well cleared, makes it difficult to typify the several proposed genera; but there is no question as to the generic identity.

This is one of the very few annual, and very few aquatic ferns. *C. pteridoides* is a typical floating plant, with inflated stipes providing buoyancy, able to root and grow on mud. *C. siliquosa,* as known to me, lives on mud, and cannot survive elsewhere. Both produce roots freely from the lower part of the stipes. It is the only fern ever grown as a food crop.

The extraordinary instability of the wall of the sporangium has no parallel.

The most probable affinity of *Ceratopteris* is to the *Cheilanthes* group. The sporangium is then to be regarded as degenerate, to the point that in *C. pteridoides* it is a rather structure-less sack holding the spores together. I cannot imagine that it is primitive. The ribbed spores recall those of *Orthiopteris.*

I let the genus stand as a family because the degeneration of the sporangial structure has taken it beyond easy inclusion in any family description of *Pteridaceae;* but do not doubt that it is derived from that family as here construed.

FAMILY 8—HYMENOPHYLLOPSIDACEAE

Hymenophyllopsidaceae Christensen, Verdoorn's Manual (1938) 532.

Terrestrial, stem erect, scaly; fronds polystichous, bipinnatifid to tripinnate, finely dissected, about three cells thick, without stomata or intercellular spaces; sori terminal or subterminal on segment and vein, indusium like the lamina in texture, attached by the base or base and sides, the distal margin lobed; sporangia few, large, pedicel short and stout, annulus conspicuous, oblique and uninterrupted, irregular in detail, spores globose-tetrahedral.

A single genus, with the characters just stated.

Hymenophyllopsis

Hymenophyllopsis Goebel, Flora 124 (1929) 3, 21, f. 1-10.

TYPE: *H. dejecta* (Baker) Goebel, *Hymenophyllum dejectum* Baker, of Mt. Roraima, on the boundary of Brazil and British Guiana. The only other known species is *H. asplenioides* A. C. Smith, the receptacle of which is described as subhemispherical, usually terminating the vein.

With excellent material of *H. dejecta,* collected by v. LUETZELBURG and by TATE, I can add nothing to GOEBEL's remarkably complete description. He demonstrated that the simple structure of the frond is not good evidence of affinity to *Hymenophyllaceae.* He found some resemblance of the sporangia to those of *Alsophila,* but this seems to me equally fortuitous. The simplicity of structure is due to reduction. GOEBEL had previously observed similar structural simplification of *Asplenium obtusifolium.* It characterizes *Leptopteris,* but is not regarded as primitive. The annulus might be evidence of relative primitiveness, but my belief is that that too is regressive. As GOEBEL observed, the annulus is variable.

I regard *Hymenophyllopsis* as a fern of Pteridaceous ancestry, but am unable to place it more definitely. GOEBEL observed the resemblance of the indusium to that of *Lindsaya* and *Tapeinidium* (*Wibelia*). SMITH notes resemblance to an *Asplenium.* The plant as a whole suggests *Orthiopteris,* and I suspect that as its affinity. In ignorance of its proper position, I let the family stand—as *Parkeriaceae* has been regarded as a family. Whatever its ancestry, *Hymenophyllopsis* presents a combination of characters which makes easy its recognition as a family.

FAMILY 9—DAVALLIACEAE

Davalliaceae Reichenbach, Consp. (1828) 37, as subdivision of *Polypodiaceae.*
Oleandraceae Ching, Sunyatsenia 5 (1940) 201-268.

Typically epiphytic ferns; rhizome creeping or rarely suberect, dictyostelic, paleate; stipes typically remote and articulate to rhizome, rarely (*Nephrolepis*) approximate and non-articulate; frond pinnate in plan, simple to decompound, veins free; sori submarginal or dorsal on the frond, terminal or (*Oleandra*) dorsal on the vein, usually indusiate, annulus of 12-16 cells, spores bilateral.

As here construed, a family of twelve genera, two of which I have not seen, in three natural groups:

1) *Davallia* and its more immediate relatives, 8 genera.
2) *Oleandra.*
3) *Nephrolepis* and its apparent relatives, 3 genera.

The oldest genus is probably *Nephrolepis,* the origin of which is obscure. I treat it without confidence as Dicksonid; but it has also been associated with "Aspidium," and its biplanate spores support this suggestion. The group as a whole is a young one. A more complete discussion will follow the description of the more strictly Davallioid genera.

Key to Genera of Davalliaceae: —

Stipes articulate.
  Pinnae not articulate to rachis.
    Fronds pinnate to decompound.
      Fronds herbaceous.
        Fronds glabrous.
          Fronds mediocre, mostly lanceolate ..... **1. Araiostegia**
          Fronds small, with broad base ..... **4. Trogostolon**
          Fronds large, with broad base.
            Sori of moderate size ..... **1. Araiostegia**
            Sori large ..... **2. Leucostegia**
        Fronds hairy ..... **3. Davallodes**
      Fronds coriaceous.
        Indusium affixed by base and sides.
          Paleae ciliate, not black ..... **5. Davallia**
          Paleae hardly ciliate, blackish ..... **6. Scyphularia**
        Sides of indusium mostly free ..... **7. Humata**
    Fronds simple.
      Sori elongate along margin ..... **8. Parasorus**
      Sori roundish, dorsal.
        Sori terminal on veins ..... **7. Humata**
        Sori dorsal on veins ..... **9. Oleandra**
  Pinnae articulate to rachis.
    Pinnae equilateral ..... **12. Psammiosorus**
    Pinnae oblique at base ..... **11. Arthropteris**
Stipe not articulate ..... **10. Nephrolepis**

1. Araiostegia

Araiostegia Copeland, Philippine Journal Sci. 34 (1927) 240, Pl. 1, 2; Univ. Calif. Publ. Bot. 12 (1931) 397.
Gymnogrammitis Griffith, Icones Plant. Asiat. II (1849) Pl. 129, f. 1; Notulae 608—inadequate publication.

Epiphytes or on logs, rocks or ground; rhizome creeping, containing a ring (as seen in section) of small fibro-vascular bundles, covered with large, thin, entire, obtuse to acuminate brown paleae; stipes articulate (at least vestigially) to rhizome, paleate or naked, containing 2 to 5 bundles; frond broadly or narrowly ovate, large or small, pinnately decompound and finely dissected, thin, glabrous or (*A. multidentata*) with puberulent axes; sori dorsal on the lamina, terminal on veinlets so suppressed that the sori appear dorsal on the veins, small, indusium thin, round or round-triangular and fixed by the base, or attached also by part of the sides, or obsolete, pedicel of three rows of cells, annulus of 12-14 cells, spores bilateral, oblong-reniform, densely but very flatly tuberculate.

TYPE: *A. hymenophylloides* (Blume, *Aspidium*) Copel., Java to Luzon and Ceylon; a very handsome fern, the largest in the genus.

A genus of a dozen species, all except the type confined to the region from India to Formosa.

The indusium of most species is fixed by the base only, like that of *Humata* except for being small and thin. In *A. yunnanensis* it is attached by the sides too, far enough to suggest *Microlepia*. It is wanting (or apparently so) in *A. dareiformis* and *A. gymnocarpa*.

A. dareiformis was figured by GRIFFITH, with the name *Gymnogrammitis*, but the publication (posthumous) was of a merely tentative name, which does not appear in the index, nor in the corresponding text, Notulae, p. 608. CHING has revived the genus — his publication is not in my hands — to be characterized by naked sori. In this case, I do not regard this as a sufficient generic distinction; other writers have regarded it as not even specific. I have thought of validating *Gymnogrammitis* as the name of all continental species of *Araiostegia*, leaving the latter monotypic, but a careful study satisfies me now that the other species are properly congeneric with *A. hymenophylloides*.

BEDDOME and CHRISTENSEN have included *Araiostegia* in *Leucostegia*, but the two genera seem more natural each by itself than combined into one. The two species of *Leucostegia* are alike and peculiar in texture, color, dissection, and very large sori, and in these respects unlike all species of *Araiostegia*. It can hardly be doubted that the two genera constitute phyletic entities.

2. Leucostegia

Leucostegia Presl, Tent. (1836) 94, Pl. 4, f. 11.

Large ferns, terrestrial or epiphytic on trunks; rhizome creeping, fibro-vascular vessels in a ring (as seen in section) and scattered, clothed with entire, ovate, acuminate (not aciculate) brown paleae and pubescent; stipes remote, articulate to a phyllopodium, stramineous, glabrous; lamina ovate, pinnately decompound, pinnae and pinnules of every order oblique at base, anadromic, the ultimate pinnules incised with obovate segments, firm in texture, light-green, glabrous; sori dorsal on the segments, terminal on the fertile veins, large, impressed, indusium pale, fairly firm, very broad and fixed by the base in *L. immersa*, narrower and fixed by the lower half of the sides in *L. pallida*, pedicel very long and slender, of 3 rows of cells, annulus of 16 cells, spores oblong-reniform, hyaline, closely tuberculate.

TYPE: *L. immersa* (Wall., *Davallia*) Presl, India to New Guinea.

The only other species known to me is *L. pallida* (Mett.) Copel., Malacca to Polynesia. The two species are remarkably alike in everything except the shape and attachment of the indusium.

L. loxoscaphoides (Baker) C. Chr., Suppl. III 120, is unknown to me; its assignment to any genus by its description is guesswork. Various other ferns have been ascribed to *Leucostegia*. In particular, BEDDOME and CHRISTENSEN have included here all species of *Araiostegia*.

3. Davallodes

Davallodes Copeland, Philip. Journal Sci. 3 C (1908) 33; 34 (1927) 242, Pl. 3.

Epiphytes of moderate size; rhizome wide-creeping, bundles of various size, mostly in a cylinder (ring, in section), paleae black or rufescent-black, with small peltate bases and thence long-aciculate, rostrate, non-ciliate; lamina lanceolate, pinnate, the pinnae cut to winged rachises, pinnules incised, mostly thin-herbaceous, axes and sometimes the laminar surface covered with weak articulate hairs; sori dorsal on the segments, terminal on usually obsolescent veinlets, small, indusium of various forms, sporangia small, annulus usually of 12 cells, spores oblong to reniform, hyaline, flat-tuberculate or almost smooth.

TYPE: *D. hirsutum* (J. Sm., *Leucostegia, nomen;* Presl, *Microlepia*) Copel., Luzon, endemic in the Philippines.

Eleven species, in the Philippines, Malaya and New Guinea, and one in the Himalayas, Yunnan and Tonkin. The last, *D. membranulosum* (Wall.) Copel., is aberrant, in the direction of *Araiostegia,* as to the paleae.

The indusium varies from semi-cylindrical with the sides affixed, through half-cup-shaped as in *Microlepia,* to much wider than long and fixed by the base only, and may even be almost obsolete. Except as to the form and attachment of the indusium, the genus is remarkably uniform.

4. Trogostolon

Trogostolon Copeland, Philip. Journal Sci. 34 (1927) 251, Pl. 4.

A small epiphyte: rhizome wide-creeping, traversed by a few fibro-vascular bundles, clothed with blackish paleae with peltate bases and very long, squarrose, acicular, ciliate or glabrescent somewhat rufescent tips; stipes remote, articulate to almost obsolete phyllopodia, slender, sulcate, naked, with 2 bundles near the base, 1 in the upper part; frond deltoid, pinnately decompound, finely dissected with narrowly winged axes, sub-coriaceous, glabrous; sori on the acroscopic bases of horn-like segments, each terminating a very short branch of the vein of the segment, indusium roundish or broader, attached by the base, firm, pedicel slender, short, annulus of (12-) 14 cells, spores oblong-reniform, hyaline, tuberculate.

TYPE: *T. falcinellus* (Presl, *Davallia*) Copel., of the central and southern Philippines. This is the only species.

Evidently related to *Davallia;* less immediately, to *Araiostegia.*

5. Davallia

Davallia Smith, Mém. Acad. Turin 5 (1793) 414.
Wibelia Bernhardi, Schrader's Journal 2 of 1800 (1801) 122, Pl. 1, f. 2; non Fée.
Stenolobus Presl, Tent. (1836) 130, Pl. 4, f. 30.
Parestia Presl, Epim. (1849) 99.

Epiphytes of moderate size; rhizome elongate, dictyostelic, clothed with peltate-based, thence elongate and squarrose, ciliate paleae; stipe remote, articulate; lamina deltoid to narrowly ovate, uniform or subdimorphic, typically decompound and rather finely dissected with the minor axes decurrent-winged, firm to rigidly coriaceous, almost always glabrous, veins free but sometimes ending in a cartilaginous margin, recurrent pseudo-veins sometimes present; sori terminal on veinlets, indusium fixed by the base and sides, more or less elongate, the apex equalling or falling short of the margin, pedicel long, of three rows of cells, annulus of about 14 cells, spores oblong-reniform, hyaline, smooth.

TYPE: *D. canariensis* (L., *Trichomanes*) Smith, of the Atlantic Islands, Morocco and Iberia.

About 40 species, mostly of the Polynesia-Asiatic region, one species, the type, remote from the others; ranging South to the Kermadec Islands, Madagascar and Natal.

Wibelia was typified by *W. multifida* and *W. elata,* synonyms of *Davallia denticulata* (Burm.) Mett.

Stenolobus was typified by *Davallia solida* under three specific names.

Parestia was typified by *P. elegans* (Burm.) Presl, since regarded as a form of *Davallia denticulata;* characterized by the presence of recurrent pseudo-veins.

None of these genera merit separation from *Davallia,* which, including them, is a perfectly natural genus.

6. Scyphularia

Scyphularia Fée, Genera (1850-52) 324, Pl. 26 B, f. 1.

Like *Davallia,* except that the paleae are dark and not ciliate or not conspicuously so, and the fronds are usually pinnate with few ample, almost entire pinnae, rarely simple or with the basal pinnae forked; indusia usually large.

TYPE: *S. pentaphylla* (Blume, *Davallia*) Fée, of Java, ranging to New Guinea.

A most natural genus of eight distinguished species, ranging from New Guinea to Fiji and the Malay Peninsula, not reported from the Philippines.

7. Humata

Humata Cavanilles, Descr. Plant. (1802) 272.
Pachypleuria Presl (Tent. 128 as Sect. of *Davallia*) Epim. (1849) 98.
Pteroneuron Fée, Genera (1850-52) 320, Pl. 25 B, f. 1.

Small epiphytes; rhizome long-creeping, dictyostelic, paleae with appressed peltate bases, thence attenuate, not strongly ciliate nor usually rostrate; fronds remote, articulate to the rhizome, simple and lanceolate, or pinnatifid and broader, or more dissected and usually deltoid, uniform or more commonly dimorphic and the fertile fronds then the more dissected, coriaceous, glabrous, veins free, usually remarkably broad; sori terminal on veins or veinlets, usually submarginal, indusium coriaceous, round to broadly reniform, attached by the base and sometimes by the lower part of the sides, pedicel elongate, of three rows of cells, annulus of about 12 cells, spores bilateral, compactly but rather coarsely tuberculate.

TYPE: *H. ophioglossoides* Cav., ascribed to Guam, improperly regarded as a synonym of *H. heterophylla* (Smith) Desv., ranging throughout the Malay-Polynesian region. This, the type of the genus, has simple lanceolate fronds, the sterile entire, the fertile deeply pinnatifid.

A genus of about 50 known species, common in Malaya and into Polynesia, ranging to Japan, the Himalayas, and Madagascar.

H. angustata, of western Malaya, has fronds uniformly lanceolate and entire.

A small group of species, typified by *H. pectinata* (Smith) Desv., diversified in the Society Islands but ranging across Malaya, has broader fronds, pinnatifid or subpinnate, the sori dorsal on the frond, terminating almost obsolete branch-veinlets. These constitute FÉE's genus *Pteroneuron.*

The great majority of the species are deltoid in outline and varying from pinnatifid to decompound. The least dissected and one of the smallest of these is *H. repens* (L. f.) Diels, which, as *P. pedata* (Smith, *Davallia*) Presl, is the type of *Pachypleuria.* It is the most wide-spread species of the genus. Because of plasticity, and probably of variability, the discrimination of the species of this group is sometimes uncertain. Most of the species are somewhat dimorphic, and some are extremely so.

8. Parasorus

Parasorus van Alderwerelt van Rosenburg, Bull. Buit. III 4 (1922) 317, Pl. 14.

"Sori longe lineares, submarginales, apices venularum venularumque conjungentes; indusium *Schizolomae* more intramarginale, exterius liberum.

"Rhizoma repens, squamosum. Frondes cum rhizomate articulatae.

"The single species, up till now found, has the mode of growth and the aspect of a simple-leaved *Davallia* of the *Scyphularia* group, with which it is undoubtedly related."

TYPE: *P. undulatus* v.A.v.R., of Ternate.

I have not seen this fern, which is known by the single collection. CHRISTENSEN, Suppl. III, p. 8, and VERDOORN's Manual, p. 535, accepts the systematic position indicated by VAN ALDERWERELT. The author's apparently good illustration leaves me very doubtful that this fern is Davallioid.

Comment on the Davallioid Ferns: — The genera *Araiostegia, Leucostegia, Davallodes, Trogostolon, Davallia, Scyphularia* and *Humata* constitute an evidently natural group. Common characters are:

1) Epiphytic habitat. The few terrestrial species betray epiphytic ancestry by
2) Fronds articulate to the rhizome.
3) Dictyosteles.
4) Paleae with peltate bases; often attenuate or aciculate in the upper part.
5) Indusiate sori. The indusium is vestigial or wanting in three species, but indusiate ancestry may not be doubted.
6) Sori terminal on the veins, which may or may not make them apparently marginal.
7) Bilateral spores, tuberculate except in *Davallia* and *Scyphularia*. These common characters demonstrate the naturalness of the group.

While the homogeneity of the group is evident, the genera do not constitute a natural series. No element in the group can at present be fixed upon as primitive. And while this is so, it is impossible to place the group as a whole, by established affinity to any other group. The position of the sorus suggests a place in the Dicksonid series. When the form of the indusium was regarded as a most important character, *Microlepia* used to be included in *Davallia,* but it does not now appear that these two genera have any significant common character except the position of the sorus. The Davallioid ferns have no common indusial character. The terminal sorus and the presence of any indusium do, however, make it reasonable to associate the group with the Dicksonid series.

Acrophorus has been placed in this group, as *Davallia* (?) by HOOKER, in *Leucostegia* by BEDDOME, as a genus by CHING; but I do not believe that there is any near affinity.

There is one genus, *Oleandra,* which follows, which has so many characters in common with the *Davallieae* that affinity seems certain. But, since any other affinity of *Oleandra* is not discernible, this does nothing to place them in the general system.

There is also probable, but not very close affinity to *Nephrolepis* and *Arthropteris.* For several reasons, these two genera are to be regarded as more primitive. In turn, they may be related to other comparatively primitive paleate Dicksonid ferns, such as *Orthiopteris.* This suggests as well as is at present possible the phylogeny of the Davallioid ferns.

Attention must be invited here to the dissertation, Die Natürliche Gruppe der Davalliaceen, by E. PÉREZ ARBELÁEZ, Bot. Abhandlungen

herausgegeben von K. GOEBEL, Heft 14 (1928). The genera are very different from those I recognize; but the wealth of data as to the anatomy and morphology of the plants, and the copious illustration of these features merit the careful attention of every student of this family, as well as of the Lindsaeoid and Dennstaedtioid genera of *Pteridaceae*.

9. Oleandra

Oleandra Cavanilles, Ann. Hist. Nat. 1 (1799) 115; Descr. Plant. (1802) 252.
Ophiopteris Reinw., Syll. Plant. II (1824) 3.
Neuronia Don, Prod. Fl. Nepal. (1825) 6.

Epiphytic or terrestrial in origin, brushy or sprawling or subscandent in habit; rhizome long and branching, the major axes very hard and stiff, radially symmetrical, dictyostelic, beset with peltate paleae with attenuate, usually deciduous apices, producing very slender roots running toward or to the ground, and remote or approximately whorled pedicels (phyllopodia) to which the stipes are articulate; fronds simple and entire, usually lanceolate, small or of moderate size, usually firm in texture, with cartilaginous margin, glabrous or pubescent, the costa sometimes paleate, uniform or rarely dimorphic, the fertile fronds then linear, veins free, commonly forked; sori dorsal on the veins, usually in one row on each side of the costa, indusia reniform (rarely round-reniform or even peltate), persistent except in one species, affixed by the sinus, pedicel long, of three rows of cells, annulus of 12 or 14 cells, spores bilateral, angular by shrinkage of the epispore or apparently smooth.

TYPE: *O. neriiformis* (misspelled *neriformis*) Cav., from Mauban, Luzon, known to me from the Philippines only; for its full description, see CHRISTENSEN, Dansk Bot. Arkiv 9 No. 3 (1937) 17.

A genus of about 40 distinguished species — 3 in America, as many in Africa, the remainder from Asia to Polynesia. Conspicuously dimorphic species occur in New Guinea and the Solomon Islands.

Ophiopteris was typified by *O. verticillata* Reinw., which is perhaps a synonym of *O. pistillaris* (Sw.) C. Chr.

Neuronia was typified by *N. asplenioides* Don, regarded as a synonym of *O. Wallichii* (Hooker) Presl; but, as *Wallich No. 373*, the type collection of *O. Wallichii*, looks like a mixture, the exact identity is less than certain.

Oleandra is an old genus, as shown by its range. Its ancestry is unknown. The resemblance to some some species of *Humata* suggests affinity. The habit of growth is almost unique, only *Oleandropsis*, not nearly related, having some gross resemblance to it. It has been described as the only shrubby fern.

10. Nephrolepis

Nephrolepis Schott, Gen. Fil. (1834) Pl. 3.
Leptopleuria Presl, Tent. (1836) 136, Pl. 5, f. 9-11; Hooker, Genera, Pl. 60 B.
Isoloma J. Smith. Hooker's Genera (1842) Pl. 102, *non* Journ. of Bot. 3 (1841) 414.
Lepidoneuron Fée, Genera (1850-52) 301, Pl. 23 C.

Terrestrial and epiphytic, stem erect and condensed, commonly stoloniferous, rarely rampant, paleate; fronds polystichous, crowded, nonarticulate to the stem, paleate and often hairy, or glabrescent, simply pinnate, pinnae articulate to the rachis, veins free; sori terminal on veins, dorsal or marginal on the pinnae, roundish or elongate along the margin, indusium of corresponding form, fixed by a point or along the base, sporangia mixed in maturing, stalked, with conspicuous, usually bent or crooked but interrupted annulus, spores bilateral.

TYPE: *N. exaltata* (L.) Schott, *Polypodium exaltatum* L.
RANGE: Pantropic, New Zealand, Japan.

A clearly natural genus, as shown by the uniformity and uniqueness of its vegetative characters. The sori are various, and are responsible for the proposed generic segregates. *N. exaltata* has dorsal sori with broad indusia fixed by the width of the base. *N. biserrata* has dorsal sori with round indusia fixed by a point at the middle; it is the type of *Lepidoneuron,* distinguished in this respect only.

J. SMITH's first mention of *Isoloma,* Journ. of Bot. 3 (1841) 414, was just sufficient to constitute publication, and to fix the type as *I. divergens,* more recently regarded as *Schizoloma; I. lanuginosum,* which is *Nephrolepis acutifolia* (Desv.) Christ, was merely mentioned. The next year, in HOOKER's Genera but by SMITH himself, *I. lanuginosum* is described and well figured, and *I. divergens* is mentioned. The two species are not nearly related, but have a very conspicuous common character, a sorus continuous along both sides of the pinna. If any peculiarity of the sorus justifies the segregation of a genus, this should suffice. However, to justify it is one thing, and to require it is another. The intimate affinity of *N. acutifolia* and other species of *Nephrolepis* is perfectly clear, and I am not disposed to give the segregate a name. It may not properly be called *Isoloma.*

Leptopleuria is typified by *L. abrupta* (Bory) Presl, *Dicksonia abrupta* Bory, *Nephrolepis abrupta* Mett. Its sori are terminal on teeth, each served by one vein, with an indusium like that of *N. exaltata,* but with the tooth modified as a protective outer valve, the effect being as in *Dicksonia* and *Culcita. N. acuminata* (Houtt.) Kuhn, and the ill distinguished *N. floccigera* (Blume) Moore, have the sori on marginal teeth, each served by a single vein, but the fertile teeth not modified like valves of an indusium.

Nephrolepis nephrolepioides (Christ) Copel. — *Dicksonia nephrolepioides* Christ and *Nephrolepis dicksonioides* Christ — of Celebes and New Guinea, bridges the gaps between *N. acuminata,* which is an unquestioned *Nephrolepis,* and both *N. acutifolia* and *N. abrupta.* Its sori are on the ends of teeth or lobes, but each is served by several veins. Thus, it differs from *N. acutifolia* by having an incised margin — not a cogent generic distinction. The end of the broad tooth or lobe is distinctly modified in texture, thus suggesting *N. abrupta.* It is chiefly because both *N. acutifolia* and *N. abrupta* are thus connected with the body of *Nephrolepis* by this intermediate species, that I see no real demand for their generic separation.

What is called a rampant rhizome in a few species is rather homologous with the runners of others; it bears no fronds, the latter being crowded on short branches. Another vegetative character common in the genus is the presence of lime dots over the vein-tips.

The proper systematic position of *Nephrolepis* is not established. It has been associated with Dicksonioid, Davallioid and Aspidioid ferns. The sori, terminal on the veins even if dorsal on the pinnae, indicate affinity to the great group with originally marginal sori, the Dicksonid ferns. Its distribution, and the uniqueness of its vegetative features, indicate age and a measure of primitiveness; but its bilateral spores are unique among primitive Dicksonid genera.

Nephrolepis may be a genus of 30 species. Several, regarded as pantropic, are remarkably variable and ill definable; apparently, they hybridize freely in nature. For this reason, *N. exaltata, N. biserrata* and *N. hirsutula,* as names applied to specimens, are conventional rather than specific.

Because they are very hardy, and run into countless bizarre monstrosities, the forms of *Nephrolepis* are favorite cultivated ferns.

11. Arthropteris

Arthropteris J. Smith, in J. D. Hooker, Fl. New Zealand II (1854) 53, Pl. 82.

Epiphytic, rhizome scandent, solenostelic, scaly; stipes remote, articulate to or above the rhizome; frond simply pinnate, pinnae articulate to rachis, oblique, veins free; sori dorsal in one row on each side of the costa, terminal on the veins, round, indusium round-reniform or obsolete, sporangia mixed

in maturity, long-stalked, annulus of 10 to 13 thickened cells, straight, spores oblong, with epispore.

TYPE: *A. tenella* (Forster) J. Sm., *Polypodium tenellum* Forster, of New Zealand.

About 20 species, from Madagascar, New Zealand and Juan Fernandez north to Arabia, Luzon and Fiji, best developed in New Guinea, New Caledonia and Madagascar.

Like *Nephrolepis* in aspect of frond, articulation of pinnae, sori terminal on veins, and shape of spores, similarities which collectively are evidence of affinity. The distribution testifies to Antarctic origin, and considerable age. Because of the scaly rhizome, articulate stipe, and usually indusiate sorus, I have in the past tentatively appended *Arthropteris* to the *Oleandra-Davallia* series. As to *Nephrolepis* also this is generally agreed, but there is no evidence as to just how the groups are related *Nephrolepis* and *Arthropteris* seem to be older than the Davallioid ferns.

12. Psammiosorus

Psammiosorus Christensen, Dansk Bot. Arkiv 7 (1932) 73, Pl. 24.

Epiphytic, rhizome wide-creeping, bearing peltate paleae; fronds remote, uniform, articulate above the base of the stipe, pinnate, pinnae articulate to the rachis, veins pinnate, free or sparingly confluent, the lower veins ending in the parenchyma without enlarged tips, the upper ones reaching the margin; sori round, dorsal on the veins, exindusiate; receptacle small, slightly elevated, glabrous.

TYPE: *P. paucivenius* C. Chr. Endemic in Madagascar.

"The systematic position of the new genus is, I believe, in a small group of genera (*Oleandra, Arthropteris* and perhaps *Nephrolepis*), which combine the characters of the Dryopteroideae and Davallieae." — C. CHR., *l.c.*

I have not seen this fern and have no opinion as to its affinity. The resemblance to *Arthropteris* is most evident, but may be fortuitous. This seems to be one more isolated genus in a land populated largely from the south.

FAMILY 10 — PLAGIOGYRIACEAE

Plagiogyriaceae Bower, Ferns II (1926) 275 (Bower gives date as 1924).

The characters are those of the single genus.

Plagiogyria

Plagiogyria (Kunze, Bot. Zeit. 7 (1850) 867, as Sect. of *Lomaria*) Mettenius, Plagiogyria, Abh. Senkenb. Naturf. Ges. 2 (1858) 275.

Terrestrial, stem erect, short, radially symmetrical, dictyostelic, neither hairy nor scaly; stipes crowded, their bases enlarged, triangular in section, bearing a double row of gland-like protuberances construed as pneumathodes, lamina pinnatifid or pinnate, herbaceous or coriaceous, glabrous, somewhat dimorphic, the segments or pinnae of the fertile frond being contracted, veins forked, free unless in the sorus; sporangia seriate on the branches of the vein, protected by the revolute margin, pedicel of 4-6 rows of cells, elongate, annulus of 18-22 thickened cells and about 10 flattened (the stomium), oblique and not interrupted by the pedicel, spores tetrahedral, tuberculate or almost smooth.

TYPE: *P. biserrata* Mett, of Colombia, regarded as a synonym of *P. semicordata* (Presl) Christ.

More than two dozen Oriental species, ranging from New Guinea to the Himalayas and Japan, most abundant in China; and about 10 in America, Mexico to Rio de Janeiro. The Oriental species fall into groups, but the American are all nearly related, and in a group with the Japanese *P. matsumureana*. I have ascribed a Chinese origin to the genus, and supposed that it jumped the Pacific from Japan to Mexico. Knowing the genus now from New Guinea and Rio, I feel less sure of this history, but it is still plausible.

Plagiogyria has been included in *Lomaria*, placed in *Cyatheaceae* by METTENIUS, among the Gymnogrammoid (Pteridoid) ferns by DIELS, and in a family by itself by BOWER. BOWER went on to postulate its approximate or collateral descendants among other Gymnogrammoid ferns, for which I see no good evidence. So far as is known, *Plagiogyria* is without near relatives.

The young fronds are protected by a gelatinous secretion. Drying, this cover may become flaky, and has been responsible for the report of scales; and it has been reported to be secreted by hairs, which I have not seen. I have not seen very young sporophytes, but in my observation the mature plants are destitute of trichomes, which is not true of any other genus of typical ferns.

FAMILY 11 — CYATHEACEAE

Cyatheaceae Reichenbach, Consp. (1828) 37, as subdivision of *Polypodiaceae;* referred to as Familia by SCHOTT, Genera (1834) *obs. ad* Tab. 5.
Protocyatheaceae Bower, Ferns II (1926) 282.

Tree-ferns, with stout, erect, paleate, intricately dictyostelic trunk (except *Amphidesmium* and juvenile *Lophosoria,* hairy and solenostelic); fronds with few exceptions huge and pinnately decompound; sori dorsal, round, indusium globose and opening at top, or partial or wanting, pedicel short, of more than three rows of cells, annulus oblique and not interrupted by pedicel, spores tetrahedral.

Protocyatheaceae, probably typified by *Lophosoria,* and including *Amphidesmium,* can be recognized as a family if one so choose.

If we knew an ancestor of *Cyatheaceae* of the evolutionary level of *Gleicheniaceae,* it could probably be included in that family. On the evidence of their distribution, it seems highly probable that all extant *Cyatheaceae* are of Antarctic origin.

No other ferns are believed to be descendants of *Cyatheaceae.* A number of genera placed as rather primitive *Aspidiaceae* seem to be cognate in origin with *Cyatheaceae.*

Key to Genera of Cyatheaceae: —

Stems hairy.
  Frond decompound ..... **1. Lophosoria**
  Frond simply pinnate ..... **2. Amphidesmium**
Stems paleate.
  Indusium present.
    Pinnules pinnatifid or pinnate ..... **3. Cyathea**
    Pinnules, if present, entire or serrate.
      Pinnules, if present, articulate ..... **7. Schizocaena**
      Pinnules not jointed to rachis ..... **5. Cnemidaria**
  Indusium wanting.
    Axes dark and polished ..... **6. Gymnosphaera**
    Axes not dark and polished.
      Pinnules ample, entire or serrate ..... **4. Trichopteris**
      Pinnules small or more dissected ..... **3. Cyathea**

1. Lophosoria

Lophosoria Presl, Ahb. Böhm. Ges. V 5 (1848) 344; Bower, Ferns II (1926) 283, figs. 547-551.
Trichosorus Liebm., Vid. Selsk. Skr. V 1 (1849) 281 (Mexicos Bregner, p. 129).

Terrestrial, rhizome hairy and solenostelic, promptly growing into an erect, imperfectly dictyostelic trunk a meter or so tall; fronds clustered, very large, usually tripinnate with rather small, lanceolate, deeply pinnatifid secondary pinnules, axes naked or deciduously hairy, lamina glaucous beneath, coriaceous, veins free; sorus on the lowest acropetal veinlet of each segment, exindusiate, round, receptacle flat, sporangia 7-10, mixed with copious hairs, pedicel short, of about six rows of cells, annulus oblique enough to be uninterrupted, thickened cells 22-28, stomium ill developed, spores tetrahedral.

TYPE: *L. pruinata* (Sw.) Presl, a synonym of *L. quadripinnata* (Gmelin) C. Chr.

Usually regarded as a single variable species with many synonyms, ranging from Patagonia to Mexico.

Trichosorus was typified by a Mexican specimen of the same species.

Lophosoria is an isolated relict genus, with some probably significant resemblance to *Thyrsopteris*. BOWER has emphasized the items of resemblance to *Dicranopteris*, as suggestive of origin from *Gleicheniaceae*.

2. Amphidesmium

Amphidesmium Schott, Gen. Fil. (1834) Pl. 5 adn.
Metaxya Presl, Tent. (1836) 59, Pl. 1, f. 5; Bower, Ferns II (1926) 288, figs. 552-554.

Terrestrial, rhizome stout, creeping, solenostelic, hairy; frond large, pinnate, pinnae long-lanceolate, somewhat hairy but glabrescent, subcoriaceous, serrate toward the tip, elsewhere undulate, or abnormally lobed, veins free, closely parallel, rarely forked; sori dorsal, normally plural on the veins, round or rarely oblong, exindusiate, receptacle flat or nearly so, sporangia mixed with copious hairs, numerous, maturing together, pedicel short, of four rows of cells, annulus just oblique enough usually to be uninterupted by the pedicel, of about 14 thickened cells, stomium well developed, spores globose-tetrahedral, faintly tuberculate.

TYPE: *A. Parkeri* (H. & G.) Schott. That of *Metaxya* was *M. rostrata* (Willd.) Presl. Both are regarded as synonyms of *A. blechnoides* (Rich.: Hooker) Kl.

A single species, Brazil to British Honduras.

Amphidesmium is the only Cyatheoid fern with more than one sorus on a vein. As described by BOWER, it is more essentially peculiar in having a creeping rhizome, not shown by my specimens or notes. The solenostele and hairy indument are foreign to adult Cyatheoid ferns, but like Dicksonioid. BOWER combined this genus with *Lophosoria* to make a family, *Proto-Cyatheaceae* — a bad name, if the family were good. They have in common dorsal sori and hairs instead of paleae; but do not impress me as being near relatives. They seem rather to be independent offshoots, like *Thyrsopteris*, of a common ancestral stock of both *Cyathea* and *Dicksonia*. Attaching primary importance to the position of the sorus, I place them at the beginning of the Cyatheoid series.

3. Cyathea

Cyathea Smith, Mém. Acad. Turin 5 (1793) 416.
Sphaeropteris Bernhardi, Schrader's Journal (1800²) 122.
Alsophila R. Br., Prod. Fl. Nov.-Holl. (1810) 158.
Hemitelia R. Br., *ibid.*, Obs. 3.
Chnoophora Kaulf., Enum. (1824) 250.
Disphenia Presl, Tent. (1836) 55.
Amphicosmia Gardner, Journal of Bot. 1 (1842) 441.
Dichorexia Presl, Abh. Böhm. Ges. V 5 (1848) 344.
Fourniera Bommer, Bull. Soc. France 20 (1873) XIX; Ann. Sc. Nat. V 18 (1873) 349.

Tree-ferns, with erect, dictyostelic trunks, the apices protected by paleae; fronds large to huge, bipinnate or more compound, usually coriaceous, variously scaly and sometimes hairy, or glabrescent, veins free; sori dorsal on the veins or on their axils, receptacle elevated, hemispherical, globose or columnar, indusium subtending the sorus, complete and globose, or partial or wanting, filamentous paraphyses commonly present, pedicel short and stout, commonly of four rows of cells, annulus oblique enough to pass the pedicel, spores tetrahedral.

TYPE: *C. arborea* (L., *Polypodium*) Smith, of the West Indies and northern South America.

The typical tree-fern genus, some 800 known species, and the number increasing

constantly. In all humid tropical lands, south to Chile, New Zealand and South Africa, a few passing the Tropic of Cancer.

The tree-ferns are incompetent migrants, and most species are local, each tropical mountain having its own endemics, sometimes in considerable number. Because of this inability to migrate, there has been little if any mixing of the descendants of the original emigrants from Antarctica, by Tierra del Fuego, New Zealand and South Africa; and the three great geographic groups of species are essentially natural — incomparably more so than the usual three groups based on the preservation of the indusium. These three are *Cyathea,* with a complete indusium; *Alsophila,* with none or with a mere basal scale; and *Hemitelia,* with some sort of partial indusium.

Sphaeropteris was based on a single species, *S. medullaris* (Forster, *Polypodium*), *Cyathea medullaris* Sw., without any characteristic to distinguish it from *Cyathea.* It is a majestic New Zealand species, once important as a food plant.

Alsophila, typified by *A. australis,* was to be distinguished from *Cyathea* by "Involucrum . . . lacero-multifidum, quandoque obsoletum;" and the one species described was *A. australis,* with "involucris subdimidiatis."

Hemitelia was published in a note on the same page, its features being the position of the sori, dorsal instead of alar on the veins, and "involucro . . . fornicato, basi semicirculari infra receptaculum inserto, marginibus solutis, demùm reflexo et persistente." Three species were named — "Cyathea multiflora *Sm.*, horrida *Sm.*, Capensis *Sm.*" Of these, *C. horrida* could have been the type of a distinct genus, which is *Cnemidaria.* As I recognize this as a genus, the choice of a name must be explained. GARDNER, London Journal of Bot. I (1842) 438, chose *C. horrida* to typify BROWN's genus, and may be quoted: "PRESL . . . in his *Tentamen* divides the genus, retaining the name *Hemitelia* for the Cape plant alone, and giving that of *Cnemidaria* to the West Indian ones, excepting *H. multiflora,* which he refers to the genus *Alsophila.* In doing this, PRESL has certainly not acted in accordance with the rule which ought to guide botanists when they find it necessary to divide a genus; *viz.*, that the old name should be retained for the mass, and not for a single species, as is the case in this instance." If we consider only the species mentioned by BROWN, because the type must be one of these, PRESL could not have recognized any mass, since he referred the three to as many genera. And GARDNER proceeded to do what he blamed PRESL for doing, constituting a genus *Amphicosmia* with two species, the *C. capensis* and *C. multiflora* mentioned by BROWN, and retaining the remaining one species, *C. horrida,* as the type of *Hemitelia.* BROWN refused to sanction any division of his genus. Botanists generally have agreed that if the genus was to be divided, PRESL did this competently and reasonably. *H. multiflora* has usually and properly been regarded as the type of its genus. Since I cannot see any sufficient reason for its removal from *Cyathea, Hemitelia,* and *Amphicosmia* with it, are treated as synonyms of *Cyathea.*

Chnoophora was typified by *C. Humboldtii* Kaulf., published as a synonym of *Cyathea villosa* H. B. W., characterized by villosity, in the sorus and elsewhere. PRESL, FÉE and J. SMITH, all disposed to recognize many genera, have alike been unable to distinguish *Chnoophora* from *Alsophila.*

Disphenia, typified by *C. arborea* (L.) Smith of the West Indies, was segregated on the supposition that its receptacle is furcate.

Dichorexia was typified by *D. latebrosa* (Wall.) Presl, a *Cyathea,* and included also *D. gigantea* (Wall.) Presl, a *Gymnosphaera.*

Fourniera was characterized by an indusium composed of spreading laciniate fragments, and typified by *F. Novae-Caledoniae* (Mett.) Bommer. It has no claim to distinction.

At the same time, BOMMER proposed a genus *Eatoniopteris,* to be distinguished from *Cyathea* by the consistency of the indusium and its mode of rupture, but did not typify it. The proposed distinction would divide *Cyathea* into genera without geographic boundaries; but I do not believe that the indusium of *Cyathea* can be used by itself for the characterization of any natural segregates.

J. SMITH, Hist. Fil. 244, suggested that *Cyathea* might be divided into groups characterized by the abscission of the fronds from the trunk and the articulation of the pinnae. This may be so; but it is as impracticable now as when Smith wrote, because of our ignorance of the trunks of most species. The older species were always described from fragments of fronds, and too many of the later ones are as incom-

pletely known. It is now well understood that the base of the stipe, with its indument, very generally has peculiarities characteristic of species, and often of groups of species. By long effort, I have assembled a considerable collection of these bases, but have not approached the completeness necessary before it may be known that they may serve as a factor in classifying the species of the genus as a whole.

It is not improbable that *Cyathea* includes groups evolved as distinct long enough ago to be represented in the Orient and in America. If we some time know the tree-ferns well enough to recognize such groups, it may or may not seem expedient to recognize them as genera. For the present, however, it is impossible to break the great body of *Cyathea* into evidently natural groups. I do find it convenient to maintain as genera such minor groups as are clearly natural, can be defined, and have been named. These are *Trichopteris, Gymnosphaera, Cnemidaria* and *Schizocaena,* which follow. Several other such twigs on this giant branch of the family are distinguishable, and may eventually be named.

The need of more complete specimens of these magnificent ferns cannot be too strongly emphasized.

4. Trichopteris

Trichopteris Presl, Del. Prag. (1822) 172—*"Trichipteris;"* Schott, Genera (1834) Pl. 5; Presl, Tent. 58, Pl. 1, f. 10. Since PRESL accepted the revised spelling, the original one may be regarded as an error, subject to correction.

Large tree-ferns, trunks protected with brown paleae at the apex; fronds bipinnate, with pedicellate pinnae and pinnules, stipe scaly near base, spinose, rachis light-brown, naked, pinnules lanceolate, entire or serrate, glabrous or slightly scaly and hairy, coriaceous, veins trifid at base, veinlets simple or the middle one forked, running to the margin, free; sori dorsal on the veinlets, in a line parallel to the costa and about midway to the margin, or sometimes less regularly placed, exindusiate, receptacle globose, filamentous paraphyses very abundant and persistent, sporangium subsessile, annulus oblique, thickened cells about 24, spores tetrahedral, hyaline.

TYPE: *T. excelsa* Presl, a synonym of **T. corcovadensis** (Raddi, *Polypodium*) *comb. nova,* of south-eastern Brazil.

A single variable species, ranging from Minas Geraes to Sta. Catharina; or, more probably, a very few similar species. **T. feeana** (C. Chr., *Alsophila*) seems distinct, by its serrate margin; it is *Trichopteris elegans* Fée *nec* Presl. *T. elegans* Presl is *Alsophila elegans* Mart., described as pubescent and squamulose; my only specimen so named agrees with the description, but is a *Cyathea.*

Trichopteris is distinguished from *Cyathea* in general by undivided pinnules, sori seriate on the pinnule and dorsal on the veins, and the dense, persistent paraphyses. PRESL emphasized also the form and arrangement of the leaf-scars on the trunk. It is not very sharply cut off, but is so distinct in aspect that its segregation is convenient. There is superficial resemblance to *Amphidesmium,* but *Trichopteris* is a local derivative of *Cyathea,* while *Amphidesmium* is far more primitive.

5. Cnemidaria

Cnemidaria Presl, Tent. (1836) 56, Pl. 1, f. 16-18.
Hemitelia R. Br. (1810) *partim.*
Microstegnus Presl, Abh. Böhm. Ges. V 5 (1848) 353.
Hemistegia Presl, *ibid.,* p. 354.
Actinophlebia Presl, *ibid.,* p. 355.

Caudex, so far as known, ascending or subarboreous, scaly at apex and elsewhere covered by roots; fronds very large, pinnate or commonly bipinnatifid, bipinnate in **C. petiolata** (Hooker, *Hemitelia*), axes brown, naked or furfuraceous or sparsely paleolate, stipe commonly spinose, lamina usually glabrous, subcoriaceous (coriaceous in *C. petiolata*), veins typically forming a series of costal areolae, casually forming other areolae, or in

some species free, veinlets simple or forked; sori dorsal (not axillary) on the veinlets, indusium cup-shaped or saucer-shaped, paraphyses rudimentary, sporangia subsessile, angular-pyriform, annulus uninterrupted, of 18-20 thickened cells and about 8 thin-walled, stomium ill developed.

TYPE: *C. speciosa* Presl "(Hemitelia speciosa Kaulf. nec Willd.)" The synonymy is most obscure. According to MAXON, Cont. U. S. Nat. Herb. 16 (1912) 49, PRESL's actual type was probably the later-named *Hemitelia subincisa* Kunze, of Peru.

A natural genus of two dozen or so tropical American species, characterized by ill developed caudices, rather naked fronds and undissected lamina; the common anastomosis of the lowest veins is correlated with the lack of dissection. The synonymy of the older species is confused, but was well presented by MAXON. The best known species is *C. horrida* (L.) Presl, which is the type of *Actinophlebia*. *Microstegnus* was typified by *M. grandifolius* (Willd.) Presl; and, with another synonym, this was probably true of *Hemistegia*. There is no possible reason for maintaining these genera.

6. Gymnosphaera

Gymnosphaera Blume, Enum. (1828) 242.
Thysanobotrya v.A.v.R., Bull. Buit. II No. 28 (1918) 66.

Typically tree-ferns of moderate size, the trunk of a few species requiring support, the apex protected by castaneous paleae; fronds typically bipinnate, rarely simply pinnate or tripinnate, axes black or sometimes brown, commonly polished, naked or scaly, rarely hairy, pinnae and pinnules stalked or sessile, subcoriaceous, usually dark, naked or the veins finely scaly or hairy, veinlets typically simple, free (or the lowest confluent in *G. podophylla*); sori on normal or contracted pinnae, dorsal on the veins, exindusiate, variously paraphysate, sporangia pyriform, short-stalked, annulus oblique, of 14 or 16 thickened cells and 10 or 12 flattened cells including a broad stomium, spores tetrahedral, hyaline.

TYPE: *G. glabra* Blume, Java to Assam.

Gymnosphaera is characterized by dark axes and exindusiate sori dorsal on simple veinlets. It ranges from India to Fiji. Except for Sect. *Thysanobotrya*, which is well developed in New Guinea, its center of evolution is in Malaya. It includes three somewhat distinguishable elements or sections, which, with illustrative species, follow:

1) *Eugymnosphaera*, the group of *G. glabra*, axes blackish, naked or bearing small bullate paleae, not very dimorphic.

G. papuana (Ridley, *Alsophila*), of New Guinea.

G. vexans (Cesati, *Alsophila*), of Borneo.

G. podophylla (Hooker, *Alsophila*), Siam to China.

G. denticulata (Baker, *Alsophila*) and **G. formosana** (Baker, *Alsophila*), of Formosa.

G. melanorhachis (Copel., *Alsophila*), tripinnate; **G. obliqua** (Copel., *Cyathea*), pinnules oblique and merely serrate; and **G. atropurpurea** (Copel., *Cyathea*), subdimorphic, these three from the Philippines.

G. ramispina (Hooker, *Alsophila*), of Borneo; and **G. recommutata** (Copel., *Cyathea*), of Borneo and the Malay Peninsula; these, subdimorphic and with the basal pinnae becoming spine-like. CHRISTENSEN, Dansk Bot. Arkiv 7 (1932) 37, reports perhaps four species of this group in Madagascar, but his figures seem to show the sori on the axils of branched veinlets.

2) *Thysanobotrya*, conspicuously dimorphic.

Cyathea subdimorpha Copel. of Java belongs here. BACKER and POSTHUMUS, Varenflora voor Java 30, reduce this to *Alsophila lurida* (Blume) Hooker. There is nothing in its description to show that this is dimorphic, but I have not seen it and abstain from transfers of names. *Alsophila heterophylla* v.A.v.R. of Sumatra is treated in the same way by BACKER and POSTHUMUS.

G. Hewittii (Copel., *Cyathea*), of Borneo. Christensen reduces this to *C. recom-*

mutata. To me, the dimorphism seems quite too complete. However, the line between *Eugymnosphaera* and *Thysanobotrya* is not at all a sharp one, in any respect.

G. melanoclada (v.A.v.R., *Alsophila*), of New Guinea.

G. biformis (Ros., *Alsophila*), of New Guinea. As *Thysanobotrya arfakensis*, believed to be a synonym, this is the type of *Thysanobotrya*. The trunk is in a sense scandent, clinging to tree-trunks for support. *Alsophila scandens* Brause is a similar plant, which I have not seen.

G. Schlechteri (Brause, *Alsophila*), New Guinea.

G. gracillima (Copel., *Cyathea*), New Guinea, axes brown rather than black.

G. Hornei (Baker, *Alsophila*), Fiji, the basal pinnae filiform-dissected but not spine-like.

3) The group of *G. squamulata*, characterized by brown rather than black axes, more various paleae, and commoner hairiness. This group may connect *Gymnosphaera* with *Cyathea*. Without it, *Gymnosphaera* is clearly a natural genus; including this group, I believe it to be equally so.

G. squamulata Blume, W. Java to the Malay Peninsula, and perhaps to the southern Philippines.

G. Kingii (Clarke: Bedd., *Alsophila*), Malay Peninsula, freely tripinnate, but certainly a *Gymnosphaera*.

G. kemberangana (Copel., *Cyathea*), Borneo.

G. subbipinnata (Copel., *Cyathea*), Borneo; and **G. bipinnatifida** (Copel., *Cyathea*), of Basilan.

G. Burbidgei (Baker, *Alsophila*); **G. mollis** (Copel., *Cyathea*); **G. Holttumii** (Copel., *Cyathea*), all of Borneo.

G. pulchra (Copel., *Cyathea*), Sumatra.

G. trichophora (Copel., *Cyathea*), Philippines. The last five species are nearly related. Here belongs also *Cyathea elliptica* Copel., which CHRISTENSEN regards as *Alsophila Ridleyi* Baker.

G. sarawakensis (C. Chr., *Alsophila*), of Borneo.

7. Schizocaena

Schizocaena J. Smith, in Hooker's Genera (1838) Pl. 2.

Tree-ferns, with small and slender trunks, bearing firm, brown paleae; fronds simply pinnate, with functionally or vestigially articulate pinnae, or simple, axes brown, lamina thinly coriaceous, glabrous or with a few minute squamulae, veins branching freely, veinlets normally simple, running to the margin, the lowest veinlets from adjacent veins sometimes anastomosing; sori dorsal on the veins, indusium globose, splitting into large expanded fragments, sometimes obsolescent or obsolete, receptacle large, globose, paraphyses filamentous, sometimes branched, partly attached to the short, stout pedicel, sporangia very numerous, small (for tree-ferns), annulus oblique, of about 14 thickened cells and about 10 flattened ones forming an ill differentiated stomium, spores tetrahedral.

TYPE: *S. Brunonis* Wall.: J. Smith, which should be called **S. moluccana** (R. Brown: Desv., *Cyathea*) Copel., of the Malay Peninsula, Sumatra and Borneo.

Other species are: *S. sinuata* (H. & G.) J. Sm., and **S. Hookeri** (Thwaites, *Cyathea*), both of Ceylon; **S. capitata** (Copel., *Cyathea*); **S. pseudobrunonis** (Copel., *Cyathea*); **S. arthropoda** (Copel., *Cyathea*); and **S. kinabaluensis** (Copel., *Cyathea*), all of Borneo.

Schizocaena is a natural local segregate of *Cyathea*, distinguished by small and relatively simple fronds, articulate pinnae, and the branching of the veins and position of the sori.

FAMILY 12 — ASPIDIACEAE

Aspidiaceae S. F. Gray, Arr. Brit. Pl. II (1821) 6, as Division of Family *Filices.*
Peranemaceae Presl, Tent. (1836) 64, Tribus.
Dictyoxiphiaceae, Thelypteridaceae, Sphaerostephanaceae, Woodsiaceae, Hypoderriaceae, Didymochlaenaceae, Elaphoglossaceae Ching, Sunyatsenia 5 (1940) 201-268.

Typically terrestrial ferns, a few scandent or epiphytic; rhizome creeping, ascending or erect, rarely forming a short trunk or scandent, dictyostelic, paleate; stipe very rarely articulate and then above rather than to the stem; fronds pinnate in plan, simple to decompound, typically uniform but often dimorphic; sori typically dorsal, very rarely marginal or even extramarginal, typically round but sometimes elongate, or the sporangia extending indefinitely along the veins and even over the surface, typically indusiate with the indusium fixed beneath the sorus and opening around the margin, but sometimes peltate, or opening over the sorus, or elongate, or often wanting; annulus longitudinal and interrupted by pedicel, of ten to forty or more thickened cells, spores bilateral, epispore almost always present, often conspicuous.

The type-genus, *Aspidium,* has fallen into synonymy, but its name can survive in that of the family.

The description of *Aspidiaceae* is as useless as that of *Pteridaceae,* for those who might seek by it to place an unknown member.

No direct ancestors of *Aspidiaceae* are recognized. One supported opinion is that this phylum is cognate with *Cyatheaceae* — but very long ago. Various of the genera have been distinct since migration from Antarctica, and the family must be older than its plural genera. Indicating materially greater age, Cretaceous fossils have been reported, of a derived (not primitive) genus.

Blechnaceae and *Aspleniaceae* may be cognate families less remote than *Cyatheaceae.* There is probably some measure of validity in the opinion that *Athyrium* and *Blechnum* are related; both are very old genera.

No family is believed to be derived from *Aspidiaceae,* though this might be the case of the two just mentioned.

Key to the Genera of Aspidiaceae: —

Fronds dimorphic.
  Sori enclosed by laminar structure.
    Veins free ..... **1. Matteuccia**
    Veins anastomosing ..... **2. Onoclea**
  Sori not enclosed by lamina.
    Veins free.
      Frond simple and undivided ..... **26. Elaphoglossum**
      Frond flabellate to subentire ..... **28. Rhipidopteris**
      Frond pinnate to decompound.
        Terrestrial, not scandent.
          Sterile fronds pinnate.
            Larger sterile pinnae forked ..... **27. Microstaphyla**
            Pinnae not furcate ..... **20. Egenolfia**
          Sterile fronds bipinnate ..... **36. Atalopteris**
          Fronds finely dissected, decompound ..... **33. Psomiocarpa**

Scandent or epiphytic.
Pinnae not articulate to rachis.
Indusium wanting ..... **18. Polybotrya**
Indusium present ..... **17. Maxonia**
Lateral pinnae articulate.
Sori distinct ..... **22. Thysanosoria**
Sporangia covering fertile surface.
Terminal pinna not articulate ..... **21. Lomariopsis**
Distal pinna jointed or suppressed.
Stipes biseriate on rhizome ..... **23. Teratophyllum**
Stipes polyseriate ..... **24. Arthrobotrya**
Veins anastomosing.
Included veinlets wanting.
Frond simple ..... **26. Elaphoglossum**
Frond pinnate.
Scandent ferns.
Anastomoses few ..... **18. Polybotrya**
Areolae numerous ..... **25. Lomagramma**
Terrestrial ferns.
Indusium wanting.
Rhizome short, ascending ..... **38. Stenosemia**
Rhizome creeping ..... **19. Bolbitis**
Indusium present ..... **13. Cyclodium**
Included veinlets present.
Indusia present.
Fertile frond simple.
Some sterile fronds radicant ..... **45. Fadyenia**
Fronds never radicant ..... **42. Luerssenia**
Fertile frond bipinnate ..... **41. Tectaridium**
Indusium wanting.
Lamina hairy ..... **44. Quercifilix**
Lamina not hairy.
Rhizome ascending to erect ..... **43. Hemigramma**
Rhizome creeping ..... **19. Bolbitis**
Fronds uniform or nearly so.
Veins free.
Indusium wanting.
Sori round.
Lamina punctate ..... **30. Stigmatopteris**
Lamina not punctate.
Minor axes decurrent on major ones ..... **29. Dryopteris**
Axes not decurrent.
Axes hairy with jointed hairs ..... **32. Ctenitis**
Glabrous or hairs not jointed.
Pinnae crenate with toothed lobules ..... **63. Anisocampium**
Pinnae not crenate.
Segments sharp-pointed ..... **10. Polystichum**
Segments not mucronate ..... **51. Lastrea**
Sori elongate ..... **52. Currania**
Indusium elongate along vein.
Indusium hairy ..... **9. Hypodematium**
Indusium naked.
Pinnules articulate, subdimidiate ..... **15. Didymochlaena**
Pinnules not jointed or dimidiate ..... **62. Athyrium**
Indusium ovate or narrower.
Indusium fixed at side of sorus.
Lamina harsh and dark ..... **6. Stenolepia**
Lamina herbaceous, green ..... **61. Cystopteris**
Indusium derived from margin of frond ..... **8. Cheilanthopsis**
Indusium symmetrical, fixed under sorus, opening above.

Indusium stalked ..... **5. Peranema**
Indusium not stalked.
Frond pinnate or bipinnate ..... **3. Woodsia**
Frond about 4-times pinnate.
Indusium breaking from top ..... **4. Diacalpe**
Indusium breaking irregularly ..... **11. Lithostegia**
Indusium peltate.
Lamina punctate ..... **30. Stigmatopteris**
Lamina not punctate.
Lamina viscid-pubescent ..... **31. Adenoderris**
Lamina not viscid.
Pinnae articulate to rachis ..... **14. Cyclopeltis**
Pinnae not articulate.
Articulate hairs wanting.
Frond broadest at base ..... **16. Rumohra**
Frond not widened at base ..... **10. Polystichum**
Articulate hairs on rachis ..... **34. Dryopolystichum**
Indusium reniform, fixed at sinus.
Axes bearing articulate hairs.
Nodes of rachis enlarged ..... **7. Acrophorus**
Rachis not nodulose.
Frond at least bipinnatifid ..... **32. Ctenitis**
Frond pinnatisect, deltoid ..... **46. Camptodium**
Glabrous or hairs unicellular.
Base of stipe inflated and dark ..... **9. Hypodematium**
Base of stipe not inflated.
Each sinus occupied by a tooth ..... **35. Pteridrys**
Sinuses not tooth-bearing.
Minor axes decurrent on major ..... **29. Dryopteris**
Axes not decurrent.
Frond anadromic, base broad ..... **16. Rumohra**
Frond catadromic ..... **51. Lastrea**
Veins anastomosing.
Sori elongate.
Indusia wanting.
Sorus submarginal ..... **48. Amphiblestra**
Sori dorsal.
Articulate hairs present.
Areolae costular only ..... **37. Heterogonium**
Areolae numerous ..... **39. Tectaria**
Articulate hairs wanting.
Rhizome creeping, paleae naked.
Lamina of definite length ..... **60. Meniscium**
Growth of lamina indefinite ..... **54. Ampelopteris**
Rhizome ascending, paleae setulose.
Venation regularly Goniopteroid ..... **57. Stegnogramma**
Venation rather irregular ..... **58. Dictyocline**
Indusium present.
Sorus submarginal ..... **49. Dictyoxiphium**
Sori dorsal.
Venation Sagenioid.
Lamina regularly pinnate ..... **39. Tectaria**
Lamina pinnate at base if at all ..... **47. Pleuroderris**
Lamina simple and entire ..... **50. Hypoderris**
Venation Meniscioid ..... **65. Callipteris**
Anastomoses irregular.
Intramarginal vein present ..... **64. Hemidictyum**
Without intramarginal vein.
Indusium opening at side ..... **62. Athyrium**
Indusium opening on top ..... **66. Diplaziopsis**

Sori round or nearly so.
Sori extramarginal ..... **40. Cionidium**
Sori dorsal.
Venation Sagenioid or Pleocnemioid.
Indusium cup-shaped ..... **50. Hypoderris**
Indusium not cup-shaped.
Sori uniform ..... **39. Tectaria**
Sori variable on single frond ..... **47. Pleuroderris**
Venation Goniopteroid or Meniscioid.
Hairs on paleae branched or stellate ..... **59. Goniopteris**
Hairs simple if any.
Indusium fixed by median line ..... **56. Sphaerostephanos**
Indusium fixed by a point.
Areolae in two strict rows ..... **53. Cyclosorus**
Accessory areolae present ..... **55. Haplodictyum**
Areolae few, large, not regular.
Lamina herbaceous ..... **63. Anisocampium**
Lamina more firm ..... **12. Phanerophlebia**

1. Matteuccia

Matteuccia Todaro, Syn. Pl. Sicil. (1866) 30.
Struthiopteris Willd., (1809), *non* Weis (1770) *nec* Bernh. (1801).
Pteretis Raf., Amer. Monthly Mag. 2 (1818) 268.
Pterinodes Siegesb. (1736): O. Kuntze, Rev. Gen. Pl. II (1891) 819.
Pentarhizidium Hayata, Bot. Mag. Tokyo (41: 716, Japanese) 42 (1928) 345.

Terrestrial, rhizome stout, ascending to erect, dictyostelic, scaly; fronds of moderate size, clustered, dimorphic, the sterile pinnate with lobed or pinnatifid pinnae, herbaceous, veins free, fertile fronds smaller, longer-stalked, contracted, less divided; sori practically terminal on the veinlets, contiguous in a single or double row longitudinal on the pinna, protected by a closely revolute coriaceous margin, either continuous along the pinna or a lobe for each group of sori, and by a thin, scale-like sometimes obsolescent or obsolete indusium particular to each sorus, receptacle somewhat raised, paraphyses none, sporangium very large, subglobose but laterally compressed, pedicel slender, annulus commonly of about 40 thickened cells, usually exactly longitudinal, stomium ill developed, spores globose or bilateral, with epispore.

TYPE: *M. Struthiopteris* (L., *Osmunda*) Todaro, of Europe, E. Asia, and E. North America.

Another species, *M. orientalis* (Hooker) Trev., described from the Himalaya, ranges across China, where it has been called *M. cavaleriana,* to Japan, where I cannot distinguish *M. japonica* (Hayata) C. Chr. And I believe that *M. intermedia* C. Chr. is a form of it with obsolete indusium.

Matteuccia has been most known as *Struthiopteris,* but that name had earlier uses.

Pteretis was never tolerably published. RAFINESQUE, in a review of PURSH' North American Flora, said that *Pteris* ought to be called *Pteripteris,* a name I have ignored in discussing *Pteris,* and continued: "*Struthiopteris* Wild. is abominable, should *Pteris* stand, being formed of two coupled names, *Struthio* and *Pteris:* and at all events it is bad, therefore *Pteretis* may be substituted." NIEWLAND, Am. Midland Nat. 2 (1918) 268, resurrected the name, apparently curious as to which of the possible reasons would make botanists reject it. But now CHING, Sunyatsenia 5 (1940) 244, has adopted it; and is not alone.

Pterinodes is the revival of a name proposed before 1753, and not revived until the genus had a tenable name.

Pentarhizidium, typified by *P. japonicum* Hayata, differs from typical *Matteuccia* in having an interrupted recurved margin, but was apparently segregated chiefly because of its vascular anatomy.

2. Onoclea

Onoclea Linnaeus, Sp. Pl. (1753) 1062.
Calypterium Bernh., Schrader's Journal (1802) 22.
Riedlea Mirbel, Hist. nat. des Vég. V (1803) 71.
Ragiopteris Presl, Tent. (1836) 96.

Terrestrial, rhizome creeping, dictyostelic, scaly; fronds seasonal, dimorphic, the sterile pinnate but rachis mostly winged, pinnae sinuate or lobed, thin-herbaceous, glabrous, veins anastomosing freely without included veinlets, fertile fronds bipinnate, without laminar expansion, the pinnules lobed; sorus one on each lobe, the lobes of a pinnule recurved and collectively forming a globose structure enclosing a compact group of sori, each sorus enclosed also by a transient inferior indusium, receptacle prominent, paraphyses wanting, pedicel slender, sporangium globose but laterally compressed, annulus longitudinal, of 36-40 thickened cells and 10 or more flattened cells, spores bilateral, without evident epispore.

TYPE and sole species: *O. sensibilis* L., of eastern North America and eastern Asia.

Fronds intermediate between sterile and fertile, with deeply pinnatifid or pinnate pinnae and free veins, are not uncommon, but are mere abnormalities, produced on the same rhizomes as normal fronds. *Ragiopteris* was based in part on such fronds, and in part on a mixture including part of a frond of *Dryopteris* — see MILDE, Bot. Zeit. (1867) 57.

Calypterium and *Riedlea* were both based on *O. sensibilis.*

Onoclea and *Matteuccia* are near relatives, although, on the basis of their venation, CHRIST was disposed to derive *Onoclea* from *Tectaria,* and *Matteuccia* from *Dryopteris.* Their collective affinity has been the subject of wide, not to say wild, speculation. BOWER has overemphasized their resemblance to *Cyathea,* which, except for features common to Dryopteroid ferns as a whole, extends only to the elevated receptacle and consequently inferior indusium. If BOWER had known such Cyatheas as *C. gleichenioides,* with strongly bullate pinnules, he might have added another common feature. But this, like the absence of the indusium reported by CHRISTENSEN and BOWER in *Matteuccia intermedia,* is a matter of convergence (homoplasy), and is no evidence of affinity. BOWER's attempt to relate them to *Blechnum* seems to me to be at least equally misguided; although CHRISTENSEN, VERDOORN's Manual (1938) 540, but not Supplement III (1934) 6, has subscribed to it.

The commoner association of these two genera with *Woodsia, Diacalpe* and *Peranema* has more in its favor. Every item of resemblance to *Cyathea* recurs here, plus similarity of sporangia and spores. There is hardlly ground for doubt that in this case the affinity is real. These are among the minority of ferns for which an Antarctic origin may not be postulated, while *Cyathea* and *Blechnum* are most evidently austral. *Onoclea sensibilis* has been reported fossil, Miocene, in the United States.

2*a*. Onocleopsis

Onocleopsis F. Ballard, Am. Fern Journal 35 (1945) 1.

Distinguished from *Onoclea* by being much larger, exceeding a meter in height; by pinnate sterile frond with pinnatifid apex and otherwise wingless rachis; by tripinnate fertile frond, the lamina reduced to a narrow wing on secondary and tertiary rachises, the ultimate pinnules enclosing paired sori, but fragile and almost caducous, indusium described as reduced to a scale; annulus of about 24 cells; spores described as ellipsoid and green, but globose-tetrahedral and black in my observation.

TYPE and sole species: *O. Hintonii* F. Ballard, from Los Hornos, Distr. Temascaltepec, State of Mexico; known also from one locality in Guatemala.

Dr. MAXON has been good enough to send me advance-proof of the publication of this genus, and a complete specimen, received as this book goes to press. This speci-

men fits the description, except as to the spores, and that free veinlets run to the margin of the sterile frond; except near the margin, they anastomose copiously, as in *Onoclea*.

3. Woodsia

Woodsia (Woodia) R. Brown, Prod. Fl. Nov. Holl. (1810) 158, Obs. 4.
Physematium Kaulf., Flora 12 (1829) 341.
Hymenocystis C. A. Meyer, Verz. Pl. Cauc. (1831) 229.
Trichocyclus Dulac, Fl. Dépt. Hautes-Pyrénées (1867) 31.
Protowoodsia Ching, Sunyatsenia 5 (1940) 245.

Small terrestrial ferns, stem erect, dictyostelic, clothed with broad, thin paleae; fronds pinnate or bipinnate, hairy or hairy and scaly or glabrescent, herbaceous, veins branching freely, free; sori round, dorsal on the lamina, subterminal or dorsal on the veins, receptacle slightly raised, indusium basal, fragile, globose and enclosing the sorus and breaking irregularly from the top, or partial, or only a circumbasal scale running into many hairs which at first enclose the sorus, paraphyses none, pedicel slender, of three rows of cells, sporangia small, globose, annulus longitudinal and interrupted, of 18-20 thickened cells, spores bilateral, with more or less conspicuously reticulate epispore.

TYPE: *W. ilvensis* (L., *Acrostichum*) R. Br., of cold Europe and North America and the Altai Mountains.

About 40 species, in cold northern lands and southward on high mountains, to Argentina, the Himalayas, and one species in South Africa; best developed in China.

Physematium, typified by *P. molle* Kaulf., *Woodsia mollis* J. Sm., has its indusium at first complete, and may be presumed to be the more primitive element of the genus.

The type of *Woodsia*, *W. ilvensis*, has a low saucer-shaped indusium running out irregularly into many hairs. Also, its stipes dehisce regularly at some distance above the base.

Trichocyclus, typified by *T. hyperborcus*, a synonym of *Woodsia alpina* (Bolton) Gray, is typical *Woodsia*.

Hymenocystis, typified by *H. caucasica* Meyer, *Woodsia caucasica* J. Sm., has a partial indusium, being thus intermediate between *Physematium* and typical *Woodsia*.

Protowoodsia is typified by *P. manchuriensis* (Hooker, *Woodsia*) Ching. In these times, one may not be sure that the current literature is all seen, but the only place I have found this name is that cited above. Its characteristic appears to be "tetrahedral, smooth and translucent" spores. I have examined a number of collections believed to represent its one species, and find the spores bilateral, sometimes merely scurfy, sometimes faintly but unmistakably reticulate.

In assigning affinity to *Woodsia*, the controlling characteristic has always been the symmetrical basal indusium, like that of *Cyathea*. Probably nobody believes that *Woodsia* is derived from *Cyathea*, but the indusium seems to be good evidence of less direct affinity. It is interesting to observe that BROWN, after characterizing *Woodsia* by "Involucrum membranaceum, apertum, lacero-multifidum, . . . receptaculo communi elevato nullo," continued: "Huic aliquo modo approximatur Polypodium pruinatum Sw." This species is *Lophosoria*, now recognized as a more primitive relative of *Cyathea*. The evidence justifies the belief that *Woodsia* evolved from a common stock with *Cyathea*. Its nearest relative is *Diacalpe*. *Onoclea* and *Matteuccia* are less immediate relatives. And *Dryopteris* is a somewhat more aberrant derivative of ancestry in common with *Cyathea*.

Within the old *Polypodiaceae*, the gametophyte has been supposed to be so uniform that it furnishes little evidence useful in classification. As to *Woodsia* and *Diacalpe*, however, SCHLUMBERGER, Flora 102 (1911) 383, has shown that their prothallia bear superficial and marginal hairs, and their antheridia have plural cap-cells, and that in these two respects they resemble *Cyathea*.

4. Diacalpe

Diacalpe Blume, Enum. (1828) 241.

Terrestrial, rhizome short, ascending to erect, dictyostelic, clothed with broad castaneous paleae; fronds clustered, of moderate size, stipe long and scaly, lamina broad at base, about 4 times pinnate, axes scaly but the paleae degenerating to hairs on the minor axes, ultimate pinnules small, oblong, incised, firm-papyraceous, very dark, veins free; sori dorsal, usually near the base of the lowest acropetal veinlet, sometimes medial, receptacle elevated, hemispherical, indusium inferior, globose and enclosing the sorus, rupturing irregularly from the top, paraphyses none except as short hairs on the pedicel, pedicel slender, sporangium commonly slightly asymmetrical but the annulus interrupted, thickened cells 14-16, spores bilateral, with coarsely ribbed epispore.

TYPE and sole species: *D. aspidioides* Blume, Java to Assam, Luzon and Papua.

Diacalpe and *Peranema* occur together in Assam and Luzon. In Khasya, they are so alike as to have been confused in the distribution of as careful a collector as J. D. HOOKER.

5. Peranema

Peranema Don, Prod. Fl. Nepal. (1825) 12.
Sphaeropteris Wall., List (1828) No. 183, *nomen;* Pl. Asiat. Rar. I (1830) 42, Pl. 48; Hooker, Genera, Pl. 22; *non* Bernh. (1801).
Nematopera Kunze, Bot. Zeit. 3 (1845) 797.

Terrestrial, stem short, erect, dictyostelic, densely covered with broad castaneous paleae; stipes clustered, elongate, scaly, lamina of moderate size, deltoid-ovate, 3-4 times pinnate, harsh, axes bearing paleae shading into sparse hairs on the minor axes, veins free; sori dorsal on the veins, solitary, each borne on a slender pedicel, indusium globose, breaking irregularly, receptacle globose, paraphyses wanting, pedicel slender, of three rows of cells, annulus interrupted, of about 14 thickened cells, spores bilateral, with epispore.

TYPE: *P. cyatheoides* Don, of India, perhaps also in Formosa. One other species, in Luzon.

Nearly related to *Diacalpe*, the essential difference being the pedicellate sorus. BOWER, Ferns II 107, describes and figures the indusium as unilateral in origin, and thus strongly suggestive of *Dryopteris Filix-Mas*. This I can neither confirm nor deny; but can say positively that it ruptures irregularly, sometimes from an apical pore and practically always from the top downward, into two, several or many fragments, and that a saucer-shaped base is the usual remnant when it is far gone.

Sphaeropteris was WALLICH'S herbarium and distribution name, probably for the material source of both generic names — DON cited no collector; and WALLICH complained bitterly of the publication of a different name, instead of his. *Nematopera* was only a proposed orthographic improvement.

6. Stenolepia

Stenolepia van Alderwerelt van Rosenburg, Bull. Dept. Agric. Ind. Néerl. XXVII (1909) 45, Pl. 7.

Terrestrial, rhizome short, ascending or erect, dictyostelic, densely covered with lanceolate castaneous paleae; stipes clustered, long, reddish, sparsely beset with narrow, harsh paleae which leave them rough, minor axes bearing harsh hairs, lamina rather large, ovate and quadripinnatifid with opposite pinnae, or suppressed by exposure and only bipinnate, harsh and dark, ultimate segments small, veins free; sori dorsal on veins or some-

times on their axils, receptacle raised, hemispherical, indusium narrow, attached on basal side at base of receptacle, transient, paraphyses none, pedicel fairly slender, sporangium globose to pyriform, annulus longitudinal or somewhat asymmetrical but interrupted, of 12-14 thickened cells, spores bilateral (or reniform), with coarsely wrinkled epispore.

TYPE: *S. tristis* (Blume, *Aspidium*) v.A.v.R., of exposed mountain-tops in Java; also in Borneo and New Guinea.

I regard *Stenolepia* as a relative, even if not a close one, of *Diacalpe*. VAN ALDERWERELT described it as a relative of *Cystopteris*, which the indusium suggests. It has also been placed in *Davallia* by RACIBORSKI, *Athyrium* (?) by PRESL, and *Cyathea* by DOMIN, besides *Lastrea* and *Allantodia*.

7. Acrophorus

Acrophorus Presl, Tent. (1836) 93.

Terrestrial, stem short, ascending or erect, dictyostelic, clothed with broad, castaneous paleae; stipes clustered, long, paleate, left rough as the paleae fall, lamina mediocre to large, deltoid-ovate, quadripinnate, axes bearing paleae which dwindle upward to hairs, pinnae mostly opposite, ultimate pinnules small, herbaceous, veins free, bearing articulate hairs or linear paleae on the upper surface; sori dorsal on the pinnules or segments, terminal or dorsal on the veins, receptacle roundish, slightly elevated, indusium reniform, attached at its sinus on the basal side of the sorus, entire or erose or short-fimbriate, paraphyses wanting, pedicel slender, sporangium globose but somewhat compressed laterally, annulus of 14 (- 16) thickened cells, spores reniform, with coarsely wrinkled epispore.

TYPE: *A. nodosus* (Blume, *Aspidium*) Presl, a synonym of *A. stipellatus* (Wall.) Moore. Java to the Himalayas, Formosa and Fiji.

There are geographic races distinguishable in various respects. *A. Blumei* Ching, in CHRISTENSEN and HOLTTUM, Gardens' Bull. 7 (1934) 226, is a new name for *Aspidium nodosum* Blume *non* Willd., and must therefore be so typified; I am then unable to distinguish it from WALLICH's *Davallia stipellata*. But the first specimen cited by CHRISTENSEN and HOLTTUM, *Holttum 25499*, might well be distinguished by sori far below the vein-tips, and very large indusia.

Acrophorus is like *Diacalpe* in many respects, but essentially different in receptacle and indusium.

8. Cheilanthopsis

Cheilanthopsis Hieronymus, Notizbl. Berlin 7 (1920) 406.

Small, terrestrial, rhizome short, ascending, scaly; fronds clustered, stipe stramineous, deciduously scaly and hairy, lamina oblanceolate, bipinnatifid, pinnae pseudo-articulate to rachis, sessile, hairy, herbaceous, veins free; sori effectively terminal on the veinlets, and submarginal, on the sides of the lobes of the pinnae, receptacle slightly raised, indusium strictly writing none, but a thin, sharply differentiated marginal scale is reflexed and extends completely over each sorus, paraphyses none, pedicel slender, annulus of 18 (- 20) thickened cells, spores bilateral with reticulate epispore.

TYPE: *C. straminea* (Brause, *Cheilanthes*) Hieron., a synonym of *C. indusiosa* (Christ, *Woodsia*) Ching, Sinensia 3 (1932) 154, of Yunnan, reported also in Burma.

This fern was described as a new species in both *Woodsia* and *Cheilanthes*, and has been compared to *Dryopteris*. I was wrong, Univ. Calif. Publ. Bot. 12 (1931) 395, in identifying it with *Woodsia elongata* Hooker. I believe, however, that the affinity to *Woodsia* is real. The general aspect, various details, and particularly the spores, indicate this affinity. If this is the proper place of the genus, the degeneration of the indusium, which is complete in *Physematium*, mostly reduced to hairs in

Euwoodsia, and completely so reduced in the species to which CHING applied the section name *Eriosorus,* has gone on to apparent disappearance. There are indeed hairs present, but in the material in hand I can establish no relation to the sorus.

9. Hypodematium

Hypodematium Kunze, Flora 16 (1833) 690; Farrnkräuter 41, Pl. 21.

Ferns of moderate size, often on limestone; rhizome short-creeping, densely immersed in large, thin, entire paleae with narrow cells; stipes approximate, the base inflated and dark, scaly, slender above the base and setose; lamina deltoid-ovate, tripinnate at base, bipinnate in the middle, pinnate below the pinnatifid apex, pinnules incised, herbaceous, setose throughout with white setae, veins free; sori dorsal on the veins, receptacle prominent, indusium vaulted, setose especially on the margin, reniform and usually asymmetrical, or sometimes Athyrioid, or ovate (CHING), or obsolescent, annulus of 18 or 20 cells, spores bilateral, oblong or roundish, almost black, crudely tuberculate.

TYPE: *H. onustum* Kunze, regarded as a synonym of *H. crenatum* (Forsk., *Polypodium*) Kuhn. This species is credited with a range from Japan and Luzon to Abyssinia, and even the Cape Verde Islands. More reasonably, this is the range of the genus, and a number of species should be recognized.

While *Dryopteris* was treated as a voracious genus, it swallowed *Hy.podematium,* as *D. crenata* O. K.; but they are not nearly related. CHING, Sunyatsenia 3 (1935) 8, has revived *Hypodematium,* with three species, and there are others equally distinct.

As to the real affinity of *Hypodematium,* there have been a variety of suggestions. With some confidence, I place it near *Woodsia,* the general affinity being then that postulated by KUNZE.

10. Polystichum

Polystichum Roth, Röm. Arch. 2[1] (1799) 106, not seen; Tent. Fl. Germ. III (1800) 69; Bernhardi, Schrader's Journal "1799[1]," p. 298.
Hypopeltis Michaux, Fl. Bor. Am. II (1803) 266, *nomen;* Bory, Bél. Voy., Bot. II (1833) 63.
Plecosorus Fée, Genera (1850-52) 150, Pl. 13 A.
Sorolepidium Christ, Bot. Gaz. 51 (1911) 350, f. 1.
Hemesteum Lév., Fl. Kouy-tschéou (1915) 496.
Aetopteron Ehrh., Beitr. (1789) 148; House, Am. Fern Journal 10 (1920) 88.
Papuapteris Christensen, Brittonia 2 (1937) 300, f. 2.

Typically terrestrial ferns; rhizome usually short, ascending, paleate, paleae various, but in general lacerate; stipes densely clustered, paleate; lamina anadromic in plan, not dilated at base, pinnate to decompound, ultimate divisions or teeth usually mucronate, firm to harsh, usually paleate and the paleae fibroid with stellate-peltate bases; veins free; sori dorsal on the veins, round, indusium peltate or rarely wanting, annulus usually of 18 or more cells, spores bilateral, oblong to roundish, almost always echinulate or tuberculate.

TYPE: *P. aculeatum* (L., *Polypodium*) Roth, at least, in name, of Europe; as usually construed, cosmopolitan.

A genus of 175 or more species, the approximate number depending upon how many of those named are reduced to *P. aculeatum.* After the removal of *Rumohra,* it is a most evidently natural genus.

Hypopeltis Michaux was proposed, not adequately published; the species to be included were presumably *Polystichum.* As revived by BORY, it included *Nephrolepis* and some other strange elements, but can be regarded as typified by *P. aculeatum.*

Sorolepidium was typified by *S. glaciale,* which is reduced to *P. Duthiei* (Hope) C. Chr. — see CHRISTENSEN, Medd. Göteborgs Bot. Trädgard 1 (1924) 64. Its

generic distinction was based on the mistake of a palea for an inferior indusium.

Hemesteum was to include a number of species with pinnate fronds, the group of *P. Lonchitis* (L.) Roth. The name is probably invalidated by *Hemestheum* Newman (1851).

Aetopteron would have been typified by *Polypodium aculeatum* L., and thus have preceded *Polystichum*, if it had been tenably published. For a full statement as to its invalidity, see BARNHART, Am. Fern Journal 10 (1920) 111.

Plecosorus was typified by *P. mexicanum* Fée, an unjustified specific synonym of *Cheilanthes speciosissimus* A. Br.: Kunze, and characterized by scattered sporangia protected by the reflexed margins of the segments. FÉE referred the plant to the Cheilanthoid group of genera. His material was perhaps immature, as he described the spores as subdimorphous, and figured one of them as tetrahedral, some others as rather amorphous. In good specimens, they are uniform, broadly oblong, with an epispore which wrinkles to form a very lax reticulation, making them pauci-spinulose in optical section. FÉE described a second species from Peru, and later a doubtful third one from Colombia. I do not know these, but do know *Polystichum* species from that region with exindusiate sori and bullate segments or pinnules. *Plecosorus speciosissimus* is the end member of an evolutionary sequence leading through such species, from the typical *Polystichum* group of *P. aculeatum*. Its phylogeny seems clear enough; but this is not in itself any objection to treating it as a genus.

Papuapteris, typified by *P. linearis* C. Chr., of Alpine grasslands in New Guinea, seemed well worthy of generic distinction when brought in by the First Archbold Expedition. But the third of these expeditions collected a species, *Polystichum cheilanthoides* Copel., exactly between *Papuapteris* and typical *Polystichum*. It agrees with *Papuapteris* in scaliness and in variety of paleae, in vaulted pinnules, in annulus of about 18 cells, and dark, subglobose, spinulose spores; but it has an ample frond, and is in all essentials a *Polystichum*. To complete the transition, I have from the Rawlinson Range, *Clemens 12435*, old plants which I believe to be *P. linearis*, but with fronds broader and more ample than those of the type. *Papuapteris* would be a respectable genus, so defined as to include or to exclude *P. cheilanthoides*.

If *Plecosorus* and *Papuapteris* were symphyletic, they would constitute one acceptable genus. But it seems more probable that they are two independent, remarkably parallel series, and cannot be combined. This being so, it is better to reduce both to their common parent, rather than to try to maintain them, with distinctions convenient enough as against the parent, but too difficult to be expressed as between themselves. When we come to *Phyllitis*, we will meet this problem again, with several instead of only two potential daughter genera.

The great majority of *Polystichum* species fall into one or the other of two groups: that of *P. Lonchitis* and *P. auriculatum* (L.) Presl, with simply pinnate fronds; and that of *P. aculeatum*, with dissected pinnae. Both are rich in species, the former especially so in the region of China. The group of *P. aculeatum* is remarkably rich in forms which seem to blend, and are questionably recognizable species. A Jamaican dwarf, *P. plaschnickianum* (Kunze) Moore, has fronds entire, or lobed or subpinnate near the base; it is connected with a more normal form of the genus by a presumably parental West Indian species, *P. rhizophyllum* (Sw.) Presl.

The distribution of *Polystichum* testifies clearly to its Antarctic origin. The group of *P. aculeatum* is found in every far-southern land. *P. mohrioides* (Bory) Presl is found in isolated spots from Amsterdam Island eastward to the Falkland Islands, and ranges northward along the Andes. The free evolution of species in the China region has obviously been more recent.

11. Lithostegia

Lithostegia Ching, Sinensia 4 (1933) 1, Pl. 1.

Terrestrial; rhizome short, ascending, with broad, acuminate, short-fimbriate paleae; stipes clustered, with similar but smaller paleae; lamina typically deltoid-ovate, 4-5-pinnate, anadromic in branching, finely dissected, ultimate pinnules entire or forked, acute or aciculate, firm, axes bearing long, linear, twisted, thin paleae; veins solitary in pinnules or segments; sori dorsal (CHING says terminal) on the veins, indusium hard,

dark, enclosing the young sorus, forced toward the margin or in any direction and usually splitting into segments as the sorus matures, annulus usually of 14 (rarely more; CHING says about 17) cells, spores bilateral (with broad hyaline epispore, *teste* CHING).

TYPE: *L. foeniculacea* (Hooker *Aspidium*) Ching, of Sikkim and Yunnan, the only species ascribed to the genus.

In presuming to correct CHING as to details, I am guided by a single specimen, *Wang* (*Fan Mem. Inst.*) *67023*, as to which only I can affirm that the sori are, at least mostly, dorsal on their veins; that the indusium is sometimes forced straight upward, sometimes downward, more often toward the margin; and that the cells of the annulus are almost invariably 14.

As to the systematic place of this plant, CHING says: "As a genus, *Lithostegia* proves a very interesting addition to that natural group to which belong the genera *Diacalpe, Peranema, Acrophorus* and possibly *Monachosorum* . . ."; a statement which seemed to mean more before CHING, Sinensia 5 (1940) 201 *et seq.*, distributed these four genera into three families, and placed *Lithostegia* in a fourth, next to *Polystichum*. The last is its proper position. The form of the frond and the low count of annulus cells suggest *Rumohra* rather than *Polystichum*, and the paleae of rhizome and stipe are intermediate. However, *Lithostegia* has a near relative in the species known as *Polystichum alcicorne* (Baker) Diels, with the typical frond-form and indusia of *Polystichum*, but similar to (not identical with) *Lithostegia* in paleae of rhizome and lamina, fine dissection, sharp segments, and sporangia. This species is aberrant in *Polystichum;* no nearer to typical *Polystichum* than to *Lithostegia*. As to the general affinity, there is hardly ground for doubt.

12. Phanerophlebia

Phanerophlebia Presl, Tent. (1836) 84; Underwood, Bull. Torrey Bot. Club 26 (1899) 204.
Cyrtomium Presl, Tent. (1836) 86; C. Chr., Am. Fern Journal 20 (1930) 41.
Amblya (*Amblia*) Presl, Tent. (1836) 184.
Cyrtogonellum Ching, Bull. Fan 8 (1938) 327.
Cyrtomiphlebium Hooker, Sp. Fil. V (1863) 15, Sect. of *Polypodium*.

Terrestrial ferns of moderate size; rhizome, short, ascending to erect, densely scaly, paleae broad, at first entire but commonly becoming lacerate; lamina imparipinnate or with pinnatifid apex, firm in texture, more or less fibrillose-paleate, pinnae almost always acuminate, often falcate and auricled on the acroscopic side at base, ample, usually toothed with sharp teeth, anadromic in plan as shown by the sequence of veins; veins anastomosing to form rather large areolae with excurrent included fertile veinlets, sometimes only casually anastomosing or almost wholly free; sori dorsal, or sometimes terminal, on the veins, indusium peltate, persisent or caducous or apparently absent, annulus of about 16 thickened cells, spores bilateral, tuberculate.

TYPE: *P. nobilis* (S. & C., *Aspidium*) Presl, of Mexico.

A genus of about 20 species, ranging from Japan to South Africa (not in the Philippines or Malaya); Hawaii; Arizona to Venezuela, and ascribed to Ecuador and Brazil.

PRESL'S distinction between *Phanerophlebia* and *Cyrtomium* depends upon the degree of anastomosing of the veins, and cannot be maintained by those who still try to recognize both genera. *Amblya* was to be distinguished by naked sori. FÉE, Genera: 281, 283, 285, recognized *Amblya* as indusiate, but still distinguished the three genera — *Phanerophlebia* with free veins, *Amblya* with connivent veins, and *Cyrtomium* with anastomosing veins — distinctions without factual basis. Subsequent authors have abandoned *Amblya*, but have mostly been disposed to recognize the species of the Old World and Hawaii as *Cyrtomium*, and those of America as *Phanerophlebia*, regarding these as parallel derivatives of *Polystichum*. In general, the species of

Cyrtomium are more coriaceous, and more often have falcate and hastate pinnae. But, if *P. nobilis* were in China, it would not be questioned as a *Cyrtomium;* nor would *Cyrtomium hookerianum* be a doubtful *Phanerophlebia* if in Mexico. The geography may raise some measure of presumption in favor of independent derivation from *Polystichum.* But my belief is that the genus as here construed is natural, that it is of approximately Chinese origin; and that, like *Plagiogyria, Coniogramme* and *Loxogramme,* it managed to jump the Pacific.

Cyrtogonellum is typified by *C. fraxinellum* (Christ, *Aspidium* and *Cyrtomium*) Ching, which CHRISTENSEN, Am. Fern Journal 20 (1930) 42, had excluded from *Cyrtomium;* and includes three similar neighboring species of south-western China, with veins free or anastomosing. CHING says: "The genus is probably nearest to the tropical American *Phanerophlebia* Presl in habit, venation and leaf-texture, but differs in fimbriate scales, subentire or only crenate pinnae and the always uniseriate and medial sori terminating the anterior basal veinlet of each group." Of these differences, only the uniseriate sori may be a real one, and this will surely not serve to distinguish an immediately related genus. Toward the ends of the pinnae, the sori of all species of *Phanerophlebia* naturally become uniseriate, and the sori are then placed as in *Cyrtogonellum,* on the lowest veinlet, which is acroscopic in all cases.

The common Oriental species are ill defined, and probably hybridize. They are easy to cultivate, and popular in culture. They appear constantly as green-house weeds, and escape and subsist in many places like natives. The Andean *Polystichum dubium* (Karsten) Diels, the basis of *Cyrtomiphlebium,* is a *Cyrtomium,* whether or not it has an indusium, as was recognized by MOORE, Index: 276. I draw from it no conclusion as to the natural range of the genus, suspecting that it may not be an Andean native. In 1942, a collector brings *C. falcatum* in from an isolated California station, and is hard to convince that it is not native. The same species may have reached Hawaii at the hands of man.

New combinations required by the reduction of *Cyrtomium* are:

Phanerophlebia falcata; *Polypodium falcatum* L. f.

P. caryotidea; *Aspidium caryotideum* Wall.: H. & G.

P. Fortunei; *Cyrtominum Fortunei* J. Sm.

P. hookeriana; *Lastrea hookeriana* Presl; *Aspidium caducum* Wall., *non* H. B. K.

P. nephrolepioides; *Polystichum nephrolepioides* Christ.

P. tachiroana; *Polypodium tachiroanum* Luerss. This is the Japanese species best to be regarded as ancestral to the American species.

P. vittata; *Cyrtomium vittatum* Christ.

P. fraxinella; *Aspidium fraxinellum* Christ.

13. Cyclodium

Cyclodium Presl, Tent. Pterid. (1836) 85, Pl. 5, f. 20; Hooker and Bauer, Genera, Pl. 49 B (good).

Moderately large terrestrial ferns; rhizome short-creeping or ascending, stout, densely clothed with linear-attenuate castaneous paleae bearing marginal teeth toward their apices; stipes approximate, non-articulate, scaly in the lower part, brown; laminae moderately dimorphic, pinnate, glabrous, firm, sterile pinnae large, ovate-lanceolate, entire to crenate, venation anadromic, veinlets curved toward the margin, uniting in pairs at an acute angle, with an excurrent veinlet which is usually free; pinnae of fertile fronds smaller, lanceolate, veinlets running directly and anastomosing at a very obtuse angle; sori dorsal below the anastomoses, round, indusium peltate, annulus of about 14 cells, spores bilateral, sparsely tuberculate.

TYPE: *C. meniscioides* (Willd., *Aspidium*) Presl, Trinidad to Peru and Brazil, apparently common in Guiana. This was the third of three species listed by PRESL, and the first illustrated, the second being a synonym. The first listed is a *Cyclosorus,* but the description applies better to the species accepted as the type.

One other species is reported in Brazil.

Cyclodium is evidently near to *Phanerophlebia,* differing by its dimorphism, and

most strikingly by the venation of the fertile frond. There are species of *Bolbitis* which differ somewhat similarly in the venation of sterile and fertile fronds.

14. Cyclopeltis

Cyclopeltis J. Smith, Comp. to Bot. Mag. 72 (1846) 36.
Hemicardion Fée, Genera (1850-52) 282, Pl. 22, A.

Terrestrial ferns of moderate size; rhizome short and stout, ascending, immersed in linear, attenuate, castaneous, usually entire paleae; stipes clustered, short; lamina narrowed to both ends, pinnate with entire or lobed terminal segment, rachis bearing narrowly linear paleae, surface naked; pinnae numerous, articulate to rachis, sessile, lanceolate, entire or shallowly toothed with rounded teeth, base unequally cordate-auriculate, the basiscopic lobe usually the larger, overlying the rachis; veins free, several times forked or pinnate, anadromic in sequence of veinlets; sori in one to four rows on each side of the costa, dorsal on the veinlets, or often terminal in Oriental species, indusium peltate, sometimes fugacious, annulus of 14-16 cells, spores bilateral, oblong to globose, with thick epispore which wrinkles to make them tuberculate.

TYPE: *C. semicordata* (Sw., *Polypodium*) J. Sm., of Jamaica, and wide-spread in tropical America.

In America, the principal row of sori is costal; in all Oriental species, medial or extra-medial. There are at least five species in the Orient, ranging from the Solomon Islands to the Philippines and Burma. The Bornean *C. mirabilis* Copel. has the pinnae very strongly auricled on the acroscopic side. An undescribed Philippine species has ciliate paleae. The commonest Oriental species, *C. presliana* (J. Sm.) Berkeley, is much like the American *C. semicordata*.

The genus is conspicuously natural, but its distribution is unexplained. It is unknown south of the Solomon Islands and Peru; also in Japan, Africa and Polynesia; and I mistrust the label of our only specimen ascribed to Mexico. There is no good basis for an opinion as to the common source of the species of the two hemispheres.

The affinity of *Cyclopeltis* is also obscure. In some significant respects — indusia, and anadromic venation — it suggests *Polystichum*, but this affinity does not seem very close. Quoting HOOKER, Sp. Fil. V 17: "This species has no near affinity with any of the *Polystichum* group, but it is not therefore needful to constitute a genus;" so he placed it in that group. The articulate pinnae suggest *Nephrolepis*, but this is probably not evidence of affinity at all. *Cyclopeltis* has also been associated with *Didymochlaena*, but their most conspicuous common feature is their distribution.

15. Didymochlaena

Didymochlaena Desvaux, Berl. Mag. 5 (1811) 303, not seen.
Tegularia Reinw., Sylloge Pl. II (1824) 3, not seen.
Monochlaena Gaud., in Freycinet, Voyage (1827) 340.

Large terrestrial ferns; rhizome ascending to erect, short and stout, scaly; stipes fascicled, elongate, scaly, densely so at base with large, lanceolate-aciculate paleae, their margins becoming lacerate; lamina ovate, bipinnate with pinnate apex, axes bearing narrow paleae dwindling upward to hairs, pinnules close and numerous, articulate-subsessile, subdimidiate, rounded at apex, entire or obscurely toothed, subcoriaceous, glabrescent, veins free, forked, enlarged at submarginal apices; sori terminal on veinlets, elongate, somewhat impressed, indusium elliptic, rounded at distal end, cordate or sagittate at base, fixed to veinlet along medial line, annulus usually of 14 or 16 cells, spores bilateral, oblong to roundish, angular or irregularly tuberculate by shrinkage of epispore, dark.

TYPE: *D. sinuata* Desv., not regarded as distinct from *D. truncatula* (Sw.) J. Sm., as known to me a single pantropic species, ranging northward to Cuba, Assam and Luzon, southward to Natal. It is variable enough to have a number of specific names, but, considering its range, is remarkable for uniformity rather than for diversity. Because it is regarded as one species, the generic synonyms do not need discussion.

One of the most distinct forms is in Natal. KUNZE, Farrnkräuter 200, Pl. 84, while regarding all other described species as one, distinguished this as *D. dimidiata* Kunze. Its pinnules are more angular than is usual; its costa holds more strictly to the basiscopic margin, with the result that all sori are typically on the upper side; and the annulus described as of 20 cells. KUNZE was the most dependable of pteridologists; but it does occur in Natal specimens that the costa is oblique enough to leave room for a sorus below it, and I have been unable to find any annulus of more than 17 cells. CHRISTENSEN, Dansk Bot. Arkiv 7 (1932) 64, Pl. 19, figs. 6-8, describes and figures a more aberrant plant as a distinct species, *D. microphylla* (Bonaparte) C. Chr.; but, in VERDOORN's Manual, he still rates *Didymochlaena* as having a single species.

Didymochlaena has significant characters in common with *Dryopteris* and with *Polystichum*. Those with the latter genus carry more weight, and make it reasonable to suppose that *Polystichum* is its nearest relative. It must be an old genus, and may be related to *Polystichum* without being a descendant.

16. Rumohra

Rumohra Raddi, Opusc. scient. Bologn. 3 (1819) 290, not seen; Ching, Sinensia 5 (1934) 33.

Polystichopsis J. Sm., Hist. Fil. (1875) 217, as subsect. of *Lastrea;* C. Chr., Monog. II (1920) 101, as subgenus of *Dryopteris.*

Terrestrial ferns of moderate size; rhizome usually long-creeping, sometimes short and ascending, dictyostelic, paleae entire or subentire; stipe elongate; lamina deltoid or ovate with broad base, tripinnatifid or more compound, anadromic in plan, ultimate pinnules usually rhomboid and aristate; veins free; sori dorsal or subterminal on the veins, indusium peltate on the type but orbicular-reniform on most species, pedicel long and slender, of 3 rows of cells, annulus of about 14 (sometimes 12 or 16) cells, spores bilateral, with epispore which shrinks to make them variously verrucose, rarely smooth.

TYPE: *R. aspidioides* Raddi (of Brazil), a synonym of *R. adiantiformis* (Forster, *Polypodium*) Ching, Sinensia 5: 70, New Zealand to New Guinea, South Africa, and America from Chile to Brazil, and reported to Cuba; said frequently to be epiphytic in South Africa.

CHING accredits to the genus about 50 species, 35 of them in China and neighboring lands. A dozen species are recognized in America, ranging north to Mexico.

This genus has been singularly unrecognized, its species being assigned indiscriminately to *Dryopteris* and *Polystichum,* under these or such other names as *Aspidium* and *Nephrodium.* A careful examination of many species satisfies me of the naturalness of the genus.* The species are diverse enough superficially to make its definition with words somewhat hazy; but any difficulty thus created is less serious than has resulted from the misplacing of the species elsewhere.

Using the peltate indusium as the diagnostic character, *R. adiantiformis* has been regarded by all as a *Polystichum.* Authors have also agreed in referring to that genus the common and familiar *R. aristata* (Forster) Ching and *R. amabilis* (Blume) Ching; but most good specimens of these species bear some peltate indusia and others orbicular with a sinus. The species assigned to *Dryopteris* have been more out of place, though this has been less evident, because *Dryopteris* was so diverse without them. The

* CHING, who, following a suggestion by CHRISTENSEN, Monog. II: 102, has revived *Rumohra,* seems to disagree. He says, *l.c.,* p. 29, "It seems to me more than probable that the species listed above represent a synthetic group: they arrive at the present state along two quite distinct evolutional lines, namely *Eudryopteris* and *Polystichum* respectively." A "genus" so derived would not be a genus at all.

convenient formal distinction from *Dryopteris* is the anadromic plan of the frond, the lowest aroscropic pinnules (except as to the basal pinnae), segments and veins arising nearer to the parent axis than the lowest basiscopic pinnules, etc. The mucronate to aristate pinnules and segments usually but not invariably serve as distinctions from *Dryopteris*. From *Polystichum*, the form of the frond, dilated at base, is the most conspicuous distinction; the rhizome is elongate in most species of *Rumohra*, short in most species of *Polystichum;* and the paleae are commonly lacerate in *Polystichum*, entire in *Rumohra*.

Rumohra is most nearly related to *Polystichum*. There is probably nearer affinity to *Ctenitis* than to *Dryopteris*.

The distribution of *Rumohra*, particularly striking in the case of *R. adiantiformis*, indicates that it migrated from Antarctica in its present form. So far as we are now able to estimate age, it is thus coordinate with *Polystichum, Ctenitis, Dryopteris, Lastrea* and *Athyrium*.

Citation of the following species, with what have been mentioned, will sufficiently illustrate this genus: **R. hispida** (Swartz, *Aspidium*); **R. amplissima** (Presl. *Polystichum*); **R. pubescens** (L., *Polypodium*); **R. denticulata** (Swartz, *Polypodium*).

17. Maxonia

Maxonia Christensen, Smiths. Misc. Coll. 66 (1916) No. 9.

Large scandent ferns; rhizome stout, deeply immersed in long, linear-attenuate, entire castaneous paleae; stipes remote, elongate, naked except near base; fronds dimorphic, ovate, quadripinnate in the lower part, anadromic, firm, naked unless in axils and grooves, sterile pinnules of every order ample, the ultimate ones with toothed apices, veins free, the ultimate fertile pinnules much contracted, rounded, entire; sori dorsal on the veins, completely covering the nether surface without losing their identity, indusium large, persistent, round with a sinus or apparently peltate by overlapping of the basal lobes, annulus of 18-20 cells, spores bilateral, irregularly angular.

TYPE and sole species: *M. apiifolia* (Swartz, *Dicksonia*) C. Chr., of Jamaica, known also in Cuba, Guatemala and Panama.

The characteristic of the genus is conspicuous dimorphism without loss of the indusium. The dimorphism is somewhat unstable. As a rule, it applies to whole fronds, but the degree of elimination of the laminar area is variable; and a Panama specimen, *Killip No. 2610* in U. S. Nat. Herb., bears some sori on hardly altered parts of an elsewhere typical sterile frond.

Maxonia is to be regarded as a local derivative of *Rumohra*. This is true also of *Polybotrya*, and the most evident and immediate relative of *M. apiifolia* is *P. osmundacea*. *Maxonia* and *Polybotrya* may be cognate; or *Maxonia* may be a less perfectly dimorphic intermediate between *Polybotrya* and an ancestor in *Rumohra*.

18. Polybotrya

Polybotrya Humboldt & Bonpland, in Willd., Species Pl. V (1810), 99.
Olfersia Raddi, Opusc. Sci. Bologna 3 (1819) 283.
Soromanes Fée, Hist. d'Acrost. (1845) 16, 82, Pl. 43; Genera 50, Pl. 2 B.
Botryothallus Kunze, Bot. Zeit. 4 (1846) 104, *nomen*.
Dorcapteris Presl, Epim. Bot. (1849) 166.

Large scandent ferns; rhizome long and stout, immersed in linear-aciculate castaneous paleae, their margins toothed especially in the distal part; stipes remote, elongate, scaly at least at base, setose or glabrescent; fronds anadromic, dimorphic, pinnate to tripinnate, sterile leaflets entire to pinnatisect, ample, firm, naked or setose, veins typically free, but connected by a submarginal strand in one species and uniting in pairs in another; fertile fronds sometimes more compound than the sterile, leaflets very con-

tracted, sporangia covering the nether surface, sometimes spreading also to the upper, sporangia large, annulus of 12 to 24 cells (most commonly 14 or 16), spores bilateral, large, with thick, hyaline epispore, finally flaky or angular, or subtuberculate.

TYPE: *P. osmundacea* H. B. W., Cuba to Bolivia and Brazil.

A genus of 25 species, of the American tropics.

Olfersia was typified by *O. corcovadensis* Raddi, an unstable fern of the neighborhood of Rio de Janeiro. In its variation, it becomes indistinguishable from *Osmunda cervina* L., and is accordingly reduced to that species, as *Olfersia cervina* Kuhn and *Polybotrya cervina* Kaulf. This species has simply pinnate sterile, or sterile and fertile fronds, the vein-tips connected by a vascular strand, sporangia spread over both surfaces and the margin, and the annulus usually of 14 cells. It can be recognized as a genus if one please, and is so treated by CHRISTENSEN, VERDOORN'S Manual 543, but characterized there by free veins. Because of its extreme instability, and its sure affinity to *Polybotrya,* I prefer to include it in the latter genus, as CHRISTENSEN did in the Index and in Supplement III. *P. caudata* seems to bear sporangia regularly on the upper surface, and they encroach on it in other species.

Dorcapteris was typified by *D. cervina* (L.) Presl, the generic name derived from the specific, and was to be distinguished by the restriction of the sporangia to the nether surface. Since, in this case, the distinction is not regarded as specific, it is obviously not generic.

Soromanes, typified by *S. serratifolium* Fée, *Polybotrya serratifolia* Kl., is characterized by veins anastomosing in pairs at an acute angle and then excurrent. Otherwise it is a *Polybotrya* with simply pinnate sterile fronds. FÉE, Genera 50, Pl. 2 B, himself described and illustrated its instability in margin and venation; and I find the venation sometimes almost wholly free, even with the margin entire. The inclusion of *Soromanes* and *Olfersia* in *Polybotrya* makes difficult the definition of the last, but the difficulty is merely shifted if they are held distinct.

Polybotrya seems most nearly related to *Rumohra,* of the more primitive genera, and may accordingly be regarded as an American derivative of that genus. The venation of *P. serratifolia* is so like that of *Cyclodium* that sterile fronds are easily confused, and affinity seems hardly open to question. *Polybotrya* seems at present to be monophyletic. But increasing familiarity with details of resemblance and difference has required the breaking up of many Acrostichoid genera, and this process may eventually have to continue with *Polybotrya. P. lechleriana* Mett. looks out of place here.

The number of cells of the annulus is approximately uniform, most commonly 14, in most genera of this great group. I find 24, or sometimes 22, in *P. osmundacea* and *P. acuminata* (*P. scandens* Christ, *non* Fée); most of the species examined have 16 or 18.

19. Bolbitis

Bolbitis Schott, Genera (1834) Pl. 14; Ching, in C. Chr., Suppl. III (1934) 47.
Campium Presl, Tent. (1836) 238, Pl. 10, f. 22, 23; Hooker & Bauer, Genera, Pl. 80 A; Copel., Philippine Journal Sci. 37 (1928) 341 *p. p. majore,* with many plates and figures.
Poecilopteris (Eschw., *Poikilopteris,* Linnaea 2 (1827) 117) Presl, Tent. (1836) 241, Pl. 10, f. 18, 19, Pl. 11, f. 1, 2; Hooker & Bauer, Genera, Pl. 81 B.
Jenkinsia Hooker, in Hooker & Bauer, Genera (1840) Pl. 75 B.
Cyrtogonium J. Smith, Journal of Bot. 3 (1841) 402; 4 (1841) 154.
Heteroneuron Fée, Acrost. (1845) 20, 91, Pl. 54-57.

Terrestrial ferns, of moderate size or small; rhizome creeping, dictyostelic, bearing narrow, dark, entire paleae; stipes usually approximate, nonarticulate, elongate, sparsely paleate; fronds typically pinnate, rarely simple or bipinnatifid, herbaceous, glabrous, margin crenate to deeply lobed or incised, the sinuses sometimes obstructed by excurrent veins, venation evident, with regular areolae along costae and costules and regular or irregular ones beyond these, excurrent included veinlets usually present but other

included veinlets rare; fertile fronds long-stalked and contracted, sporangia covering the fertile surface, without indusia or paraphyses, annulus of (12-) 14-16 (-20) cells, spores globose or nearly so, brownish or hyaline, with thick epispore which shrinks to become reticulate-flaky or -spinulose or -angular, or rarely tuberculate.

TYPE: *B. serratifolia* (Mertens, *Acrostichum*) Schott, of Brazil. SCHOTT listed four other species, of which PRESL placed two in *Campium,* and two besides the type in *Poecilopteris.*

A genus of 85 recognized species, in all tropic lands, most numerous in the Indo-Malayan region.

Campium was typified by *C. punctulatum* Presl, "*Acrostichum punctulatum* Presl nec Lin." This name is apparently invalid, and is currently replaced by *Bolbitis presliana* (Fée, *Heteronuron*) Ching. This identification is full of confusion, but there is no question as to the nature of *Campium.*

The type of *Poecilopteris* was probably what is now *Bolbitis aliena* (Sw., *Acrostichum*) Alston, any doubt being because PRESL took the name (modified) but nothing else from ESCHWEILER. Again there is no doubt as to the genus, nor had PRESL any doubt, for he charged SCHOTT (Tent., 242) with the needless coining of a new name. Likewise as to *Cyrtogonium* and *Heteroneuron* (which he changed to *Heteroneurum*), PRESL, Epim., 169, complained: "Cur J. SMITH et FÉE nomen genericum (Campium) in novum mutaverunt et sine necessitate synoniam auxerunt, plane non intelligo." All of these genera were based on minor modifications of the pattern of venation.

Jenkinsia, typified by its one species, *J. undulata* Hooker, was an imperfectly fruiting individual; the species stands as *Bolbitis undulata* (Wall.: Hooker) Ching.

While fewer in number, the American species are more diverse than those of the Orient, especially as to venation, and in general they are larger. Among Oriental species, *B. cuspidata* (Presl) Ching, a dwarf, is remarkable because, with extreme loss of size ,the veins of the sterile frond sometimes become wholly free. By definition, the plant might then be *Polybotrya,* as suggested by PRESL, Epim., 169, or *Egenolfia.* It has no direct affinity to either genus, but illustrates the likely affinity of the genera as a whole.

The description and illustration of the Oriental and African species in my monographic study of *Campium* are good, but my misinterpretation of the genera was inexcusably bad. CHRISTENSEN and CHING have probably been correct in combining *Campium* with *Bolbitis,* and are certainly so in ascribing the origin of the whole of the genus thus formed to the Dryopteroid, not to the Polypodioid phylum.

Except *Elaphoglossum, Bolbitis* is the largest and most widely dispersed genus characterized by dimorphism. Its size and range are evidences of age, and time can obscure affinity. I can see no positive reason for looking to any one of the more primitive Dryopteroid genera for the ancestry of *Bolbitis.* There is no evident affinity to *Ctenitis,* which effectively negatives suggestions of Tectarid origin. There are some resemblances to simply pinnate species of *Polybotrya,* for which I tentatively suggest derivation form *Rumohra;* but I am not at all sure that *Polybotrya* as here presented is homogeneous, and see no other reason for suspecting affinity of *Rumohra* and *Bolbitis. Egenolfia* and *Bolbitis* are related, and *Egenolfia* has some resemblance to *Polystichum.* But *Bolbitis* is probably older than *Polybotrya* or *Egenolfia,* so that these genera are not to be regarded as connecting links to genera still more primitive.

20. Egenolfia

Egenolfia Schott, Genera (1834) Pl. 16; Fée, Acrost. (1845) Pl. 38-40; Genera, p. 48; Ching, Bull. Fan 2 (1931) 297.
Lacaussadia Gaud., Voy. Bonite, Bot. (1846) Pl. 118-120.

Normally mediocre terrestrial ferns; rhizome creeping, dictyostelic, woody, bearing small, lanceolate to ovate, entire or irregularly toothed, clathrate, fuscous paleae; stipes approximate, non-articulate, paleate; fronds lanceolate, pinnate, dimorphic, rachis scurfy-paleate, often winged, sterile pinnae herbaceous, glabrous, veins forked, free, salient from the margin as

sharp teeth; fertile fronds contracted, the pinnae typically entire, but sometimes elongate and the lamina reduced to connected or discrete fragments, sporangia spread over the fertile surface, indusia and paraphyses wanting, annulus of 12-18 cells, spores globose, with thick epispore which becomes angular- or spinulose-flaky.

TYPE: *E. hamiltoniana* Schott, which is properly *E. appendiculata* (Willd., *Acrostichum*) J. Smith; India to Java and Formosa.

A genus of ten species, within the range of the type, not reported from Celebes or Mindanao.

The affinity to *Bolbitis* is near and evident; that to *Polystichum* may be indirect, but is apparent.

21. Lomariopsis

Lomariopsis Fée, Acrost. (1845) 10, 66; Holttum, Gardens' Bull. 5 (1932) 264.

Large scandent ferns; rhizome dorsi-ventral, the roots produced on one side, but the fronds in plural rows, fibro-vascular bundles few and large, paleae dark as to walls and lumina, dense near apex of rhizome; fronds dimorphic, pinnate, lateral pinnae articulate, terminal one typically not so, sterile pinnae broadly or narrowly lanceolate, veins free, sometimes ending in a cartilaginous border, fertile pinnae contracted; sporangia covering the nether surface, notably large, annulus of 14-22 cells, spores bilateral, brownish, epispore evident, contracting variously, sometimes into small flakes.

TYPE: as chosen by Holttum, *L. cochinchinensis* Fée, Cochinchina to New Guinea. The first species described by FÉE was *L. prieuriana*, from French Guiana; but HOLTTUM's election of a type is final under Art. 51 and Recommendation IV, of the International Rules of Bot. Nomenclature, Ed. III (1935).

HOLTTUM has distinguished 11 species in the area from Hainan to Tahiti, and 9 in Africa and its islands.

There are also a score of species in the tropics of America, which nobody seems to have questioned as belonging in this genus. My material of these is insufficient for their discrimination as a group, but I do not believe that they are properly included in a genus with the species of the Orient, and suggest that they may not themselves be monophyletic.

Lomariopsis is related to *Teratophyllum* and *Arthrobotrya*, and is probably the most primitive of these three genera.

22. Thysanosoria

Thysanosoria Gepp, in Gibbs, Dutch N. W. New Guinea (1917) 19, Pl. 4.

Large ferns, scandent by the twining, deciduously scaly rhizome; fronds dimorphic, pinnate, lateral pinnae articulate to rachis, terminal one not so, sterile pinnae lanceolate, veins free; sporangia in distinct, round sori, one on each lobe of the narrowly linear fertile pinnae, exindusiate, spores (*teste* CHRISTENSEN) bilateral with a broad perispore.

TYPE: *T. dimorphophylla* Gepp, a synonym of *T. pteridiformis* (Ces., *Gymnogramme*) C. Chr., Dansk Bot. Arkiv 9 No. 3 (1937) 57. An unique species of the Arfak Peninsula of New Guinea, said to be common in the hills behind Manoekoeari.

I have not seen this fern, but locate it by CHRISTENSEN's conclusion, that it "is a *Lomariopsis* with retained individual sori."

23. Teratophyllum

Teratophyllum Mettenius: Kuhn, Ann. Lugd. Bat. 4 (1869) 296; Holttum, Gardens' Bull. 5 (1932) 277.

Large scandent ferns; rhizome dorsi-ventral, bearing roots on one side, and fronds in two rows on the other, with one, two, or three large fibro-

vascular bundles as seen in section, bearing small, irregularly ramified, dark paleae, finally glabrescent, usually spinose; fronds polymorphic, juvenile and basal ones (bathyphylls) small, usually bipinnate with narrow segments, fronds of adult plants (acrophylls) pinnate, dimorphic, subarticulate to rhizome, all pinnae articulate to rachis, herbaceous, veins free; fertile pinnae more or less contracted; sporangia covering the nether surface, large, annulus of (18-) 20-22 (-26) cells, spores large, with thick, pale epispore, which shrinks, usually to make the spore obtusely angular, or rarely becomes flaky or is lost.

TYPE: *T. aculeatum* (Blume, *Lomaria*) Mett., of Java, ranging from the Malay Peninsula to Luzon and New Guinea.

Eight species are distinguished by HOLTTUM, all within the geographic range of *T. aculeatum*.

Teratophyllum is distinguished from *Lomariopsis* by somewhat simpler vascular structure, articulate apical pinna, and most conspicuously by the formation of distinct bathyphylls. The two genera are nearly related. *Teratophyllum* was included in *Lomariopsis* by FÉE, and again by CHRISTENSEN in Index Suppl. III. The articulation of the pinna at the end of the rachis is explained by HOLTTUM as the result of suppression of the really terminal leaflet and its substitution by a lateral pinna.

24. Arthrobotrya

Arthrobotrya J. Smith, Hist. Fil. (1875) 141; *non Arthrobotrys* Wall., *nomen.*
Teratophyllum, Sect. *Polyseriatae* Holttum, Gardens' Bull. 9 (1938) 356.

Large, high-scandent ferns; rhizome woody, angular, dictyostelic, bearing sparse, minute, dark paleae, clinging to tree-trunks by roots on one side; stipes polyseriate on the rhizome, remote, elongate, with plural (up to 12) fibro-vascular bundles; lamina dimorphic, typically bipinnate, secondary rachises narrowly winged, lateral pinnae and pinnules articulate to rachises, pinnules many and small, oblique, obtuse, serrate, herbaceous, axes deciduously bullate-paleolate beneath, apical leaflet non-articulate but usually almost completely suppressed, veins free; fertile pinnae contracted, sporangia covering the nether surface, naked, paraphyses wanting, pedicel short and stout, annulus of about 20 cells, spores flaky-tuberculate.

TYPE: *A. articulata* J. Smith, of Leyte, ranging from Luzon to the Solomon Islands; *Lomagramma bipinnata* Copel. is a synonym. **A. wilkesiana** (Brack. *Polybotrya*) comb. nova, described from Tahiti and accredited also to New Caledonia, is similar.

Acrostichum Brightiae F. v. M., of Queensland, with simply pinnate fronds, is referred to this genus (as *Teratophyllum* sect. *Polyseriatae*) by HOLTTUM; I have not seen it. My specimen of *Franc n. 613, Lomariopsis Balansae* Fourn., bears HOLTTUM's annotation label of 1932: "This is not a Teratophyllum . . . It probably belongs in a new genus with Lomagramma Wilkesiana." Its terminal pinna is articulate. Fertile pinnae 5 mm wide; annulus of (22-) 26 cells; spores bilateral, sparsely spinulose or merely granular.

Correcting my former opinion, I do not now question the correctness of removing *Arthrobotrya* from *Lomagramma*. But I still see no sufficient reason to unite it with *Teratophyllum*.

25. Lomagramma

Lomagramma J. Smith, Journal of Bot. 3 (1841) 402; 4 (1841) 152; Hooker & Bauer, Genera (1841) Pl. 98; Holttum, Gardens' Bull. 9 (1937) 190.
Chorizopteris Moore, Gard. Chron. (1885) 854.

Large scandent ferns; rhizome dorsi-ventral, rooting on one side, fibro-vascular bundles numerous, the larger ones in a central cylinder, paleae with dark walls, the lumina hyaline or also dark; fronds usually remote and long-

stipitate with plural bundles in the stipe, pinnate or rarely bipinnate, dimorphic, pinnae articulate to rachis except sometimes the apical pinna of juvenile fronds, sterile pinnae serrate or entire, often but not always thin, veins branching and anastomosing to form plural rows of areolae without included veinlets; fertile fronds apparently seasonal, often wanting, pinnae much contracted, sporangia covering the nether surface, or sometimes wanting near the costa, mixed with paraphyses with expanded pluricellular heads, pedicel of three rows of cells, annulus of 14-20 cells, spores bilateral, hyaline, smooth or minutely granular.

TYPE: *L. pteroides* J. Smith, of Luzon, endemic in the Philippines.

A genus of about 15 species, not all fully known, ranging from Assam to Tahiti. Besides the fertile fronds, not known for quite all species, the fronds of juvenile plants are distinctive, and not positively known for a number of species. The fronds of sporeling plants of all ferns differ of course from those of adult plants, but it is not usual for the fronds of juvenile plants of a genus to be specifically distinct, as they seem to be in *Lomagramma*. Even here, though, they are by no means as distinctive as are the bathyphylls of *Teratophyllum*.

L. polyphylla Brack. has bipinnate fronds. Described from Tahiti, it is credited with a range from Aneitium to Tonga, but more than one species may be included.

I have guessed twice, in the past, at the origin of *Lomagramma*, and do not now respect either guess. I do not suppose that it is correctly placed here, but it has superficially similar neighbors.

As shown by HOLTTUM, *op. cit.*, p. 196, who does not exhaust the reasons for his action, and in spite of CHING, and of CHRISTENSEN, Koningl. Sv. Vet. Akad. Handl. 16 (1936) 43, *Lomagramma guianensis* (Aubl.) Ching is no *Lomagramma*.

26. Elaphoglossum

Elaphoglossum Schott, Genera (1834) Pl. 14 adn.; J. Smith, in Hooker & Bauer, Genera (1842) Pl. 105 A; Christ, Elaphoglossum (1899) (Monograph).
Olfersia Presl, Tent. (1836) 232 *p. p. majore, non* Raddi.
Aconiopteris Presl, Tent. (1836) 236, Pl. 10, f. 17.
Hymenodium Fée, Acrost. (1845) 20, 90, Pl. 58.
Dictyoglossum J. Smith, Bot. Mag. 72 (1846) Comp. 18.
Acrostichum Auct. mult. incl. Fée, Acrost. 8, 27, Pl. 1-24, Genera 41, *non* L.

Epiphytic and terrestrial ferns, of moderate size, or small, or rarely large; rhizome short-creeping, or rarely long and slender, or ascending, dictyostelic with few bundles, and no sclerenchyma strands, paleate; stipes mostly approximate or caespitose, rarely remote, articulate to enlarged phyllopodia or non-articulate; fronds simple and entire, sometimes with cartilaginous border, firm to hard-coriaceous, paleate or glabrescent, veins evident or more often immersed, mostly forked and then straight and parallel, typically free, sometimes connected at their tips, anastomosing elsewhere in three species; fertile fronds usually smaller and narrower than the sterile, often longer-stalked, sporangia occupying the whole fertile surface, paraphyses wanting, annulus of about 12 cells, spores elliptic, brownish, with thick epispore shrinking to reticulate-angular or -flaky or -tuberculate.

TYPE: *E. conforme* (Sw., *Acrostichum*) Schott, of St. Helena, reported from all tropical lands.

A genus of far over 400 species, in all warm countries, most numerous in the Andes. Because fertile fronds are likely to be rare, these ferns elude collectors, and the species still awaiting description are surely numerous.

Aconiopteris was characterized by veinlets forking just within the margin, and anastomosing, and was typified by *A. subdiaphana* (H. & G.) Presl, which is *Elaphoglossum nervosum* (Bory) Christ, of St. Helena. This might be a genus of one species; but several species not directly related to it nor to each other have marginal

commissures, and have therefore been put into *Aconiopteris* by FÉE and by J. SMITH. As these might with equal right constitute genera, it is preferable to include them all in *Elaphoglossum.*

The argument is the same as to *Hymenodium,* typified by *H. crinitum* (L.) Fée, of the West Indies, Mexico and Central America, characterized by forking and anastomosing veins. MAXON, Pterid. Porto Rico (1926) 400, and CHRISTENSEN, VERDOORN's Manual (1938) 549, maintain this as a genus of one species. But FÉE included in it *Elaphoglossum reticulatum* (Kaulfuss) Gaud., of Hawaii, and *E. pachyphyllum* (Kunze) C. Chr. (as *H. kunzeanum* Fée). With the same propriety as *E. crinitum,* each of these would be a genus; and again it is preferable to leave them all in *Elaphoglossum. Dictyoglossum* was typified by *D. crinitum* (L.) J. Smith, already the type of *Hymenodium.*

Elaphoglossum dimorphum (H. & G.) Moore, of St. Helena, is abnormal in the genus in having toothed to pinnatifid fronds, figured, as *Acrostichum dimorphum,* in HOOKER and GREVILLE, Icones Fil. Pl. 145, and in HOOKER's Second Century, Pl. 90. FÉE suspected confusion with *Microstaphyla furcata,* which HOOKER refuted. Still, the fact that both are confined to the little island of St. Helena may well be significant.

Elaphoglossum has never been satisfactorily placed in the classification of ferns. In the most recent schemes, CHRISTENSEN has created a subfamily, and CHING a family for it. Its distribution is good evidence of age, of time for the disappearance of ancestors. Its uniformity leaves us without such clues to affinity as are often presented by diversity. The articulation of the stipe of many species is characteristic, and unlike that of Polypodioid ferns. The paleae are more like those of Dryopteroid ferns, and the sporangia and spores indicate this general affinity. Accordingly, I place it, as well as *Bolbitis,* in this general group. But I recognize no near relatives, except the two little genera regarded as its offshoots.

27. Microstaphyla

Microstaphyla Presl, Epim. (1849) 160.

Small terrestrial ferns; rhizome creeping, dictyostelic, bearing small, dark, entire paleae; stipes crowded, elongate, slender, not (at least, not functionally) articulate; fronds lanceolate, pinnate, dimorphic, the larger sterile pinnae furcate to trifurcate, segments thin, glabrous, entire or subentire, one-veined; fertile pinnae congested, lobed instead of furcate, sporangia covering the fertile surface, without paraphyses, annulus of about 11 cells, spores globose-elliptic, brownish, with thick epispore shrinking to angular.

TYPE: *M. bifurcata* (Jacq., *Osmunda*) Presl, properly *M. furcata* (L.f., *Adiantum*) Fée, of St. Helena.

Two other species are reported: *M. Moorei* (E. Britton) Underwood, of Bolivia and Peru; and *M. columbiana* Maxon, of Colombia.

Microstaphyla is like *Elaphoglossum,* in which most writers have included it, in everything except the dissection of the frond. In view of the uniformity of *Elaphoglossum,* this distinction is sufficient.

Microstaphyla has been illustrated, badly by SCHKUHR, Krypt.-Gew., Pl. 2, and well by HOOKER, Second Century, Pl. 91.

28. Rhipidopteris

Rhipidopteris Schott, Genera (1834) Pl. 14 adn.; Fée, Acrost. (1845) 14, 78; Genera, 49, Pl. 2 A.

Peltapteris Link, Fil. Berol. Cult. (1841) 147.

Small epiphytes; rhizome wide-creeping, slender, branching, dictyostelic with few meristeles, clothed with lanceolate-ovate, acuminate, entire, brown paleae; fronds dimorphic, the sterile flabellate, more or less finely dissected, firm-herbaceous, glabrescent; fertile fronds smaller, roundish, cordate, crenate-dentate or lobed, sporangia covering the fertile surface, without para-

physes, annulus of about 11 cells, spores reniform-elliptic, epispore shrinking to angular.

TYPE: *R. peltata* (Sw., *Osmunda*) Schott; West Indies and Mexico to Northern South America.

A genus of four species, ranging across the equator.

Rhipidopteris is nearly related to *Elaphoglossum*, and sometimes included in that genus; but the flabellate fronds justify its separation.

Peltapteris had the same type species as *Rhipidopteris*.

29. Dryopteris

Dryopteris Adanson, Fam. des Plantes II (1763) 20, 551; Schott, Genera (1834) Pl. 9; C. Chr., Biol. Arb. til. E. Warming (1911) 76.
Psidopodium Necker, Elem. Bot. III (1790) 315.
Nephrodium Richard, Cat. Jard. Méd. Paris (1801) not seen; Michaux, Fl. Bor. Am. II (1803) 266.
Arthrobotrys Wall., List (1828) no. 395, *nomen.*
Dichasium A. Braun, Flora 24 (1841) 710, as sect. of *Aspidium;* Fée, Genera (1850-52) 302.
Lophodium Newman, Phytologist 4 (1851) 371, app. XVI.
Pycnopteris Moore, Gard. Chron. (1855) 468.
Diclisodon Moore, Index (1857) XCV.
Microchlaena Ching, Bull. Fan 8 (1938) 322.

Terrestrial ferns of moderate size or large; rhizome short and stout, ascending to erect, paleate, paleae broad, entire or glandular-margined, rarely lacerate, the cells elongate and commonly sinuate; stipes fascicled, elongate, commonly scaly; lamina bipinnatifid to decompound, catadromic in sequence of pinnules, usually broad at base, firm in texture, surfaces typically naked, axes sometimes scaly but not hairy, minor axes decurrent on major axes forming the sides of dorsal grooves, veins free, forked; sori normally dorsal on the veins, round, indusia round-reniform and attached by the inner end of the sinus, sometimes more broadly attached, very rarely wanting, annulus of 14 or more cells, spores bilateral, with epispore which shrinks to make them tuberculate or echinulate.

TYPE: *D. Filix mas* (L.) Schott. ADANSON, *l.c.*, p. 20, named no species, and his very defective description, in the form of an analytic key or table, applies to *Polystichum* and not to *Dryopteris*. As NAKAI, Bot. Mag. Tokyo 40 (1926) 59, the first pteridologist ever to see ADANSON's herbarium, found, the original *Dryopteris* included *Polystichum, Dryopteris,* and miscellaneous other genera of to-day. However, *Dryopteris* appears again in the same volume of ADANSON, p. 551, where references to pre-Linnaean writers fix *Filix mas* as the type, if one is demanded. NAKAI says it is by CHRISTENSEN's grace that the genus enjoys present respect. This is only partly true; SCHOTT (1834) and ASA GRAY (1848) preceded him in its recognition, and the genus might be upheld dating from 1834. One Congress recommended the conservation of *Nephrodium* as against *Dryopteris*. But the status of *Nephrodium* is at least equally dubious. I have not seen the first publication of *Nephrodium,* but from its presentation by MICHAUX any typification would be purely arbitrary; if it were a plant of this genus, it might be *D. cristata* (L.) A. Gray.

I have not listed among synonyms *Filix* Hill: Farwell, and *Filix mas* Hill. As to the former, FARWELL said it was a mistake, when he took up the other. As to the latter, it may have served to impress the clients of an apothecary, but it is not the name of a genus.

Psidopodium and *Arthrobotrys* were technically unpublished. The former never had a species, and the latter was undescribed. *Arthrobotrys macrocarpa* is *Dryopteris cochleata* (Don) C. Chr.

Dichasium was based on a misapprehension of the nature of the indusium and sorus. Its type, *D. parallelogrammum,* is *Dryopteris paleacea* (Sw.) C. Chr. — an invalid specific name unless it is *D. paleacea* Handel-Maz. (1908).

Lophodium had a dozen named species, among which a type need not be selected, as all are synonyms of species of *Dryopteris*.

Pycnopteris was a genus of one species, *P. Sieboldii*, and was immediately, Index (1857) LXXXVIII, reduced to *Lastrea* by its author. It represents a small group of species, characterized by undivided terminal leaflets, for which CHING, Bull. Fan 8 (1938) 371, retains the name as that of a subgenus. To this group, I refer **D. yunnanensis** (Christ, *Aspidium*), more commonly known as *D. khasiana* C. Chr., the type of *Microchlaena* Ching. In distinguishing this genus, CHING particularly emphasizes the catadromic sequence of the veins. Since the catadromic plan of the frond as a whole is characteristic of *Dryopteris*, its extension to the veins ought not to exclude a species. The venation of *D. hirtipes* is sometimes catadromic, more usually anadromic; and the angle of salience of the veins is not conspicuously or regularly different in the two species. The *Pycnopteris* group is remarkably similar to *Phanerophlebia*, and the resemblance may be evidence of real affinity.

Diclisodon has one species, *D. deparioides* Moore, characterized by bearing the sori near the ends of the teeth of the pinnules. This margin-ward migration of the sori parallels that of *Athyrium Macraei*, responsible for the genus *Deparia*, and of *Cionidium*, and led MOORE to associate the plant with *Dennstaedtia*. In this case, the aberrance is less extreme, and HOOKER and BEDDOME recognized confidently the proper place of the species.

As here construed, in strict and confident agreement with CHRISTENSEN, *Dryopteris* is a very natural genus, of about 150 species. It is represented in all regions, but is remarkable for the number of common species in Northern lands, and in the region of China. There are enough Austral species to support my belief that it is of Southern origin, where only it could have had a common origin with its evident relatives. It is most nearly related to *Ctenitis* among large genera; and to *Stigmatopteris*, which may be a derivative of it. There is also clear affinity to *Rumohra*, and less immediately to *Polystichum*. There are species which suggest *Athyrium*, and CHRISTENSEN has expressed the view that these two are near relatives; but I feel sure that the affinity between *Athyrium* and *Lastrea* is closer.

30. Stigmatopteris

Stigmatopteris Christensen, Bot. Tids. 29 (1909) 292; Vid. Selsk. Skr. VII 10 (1911) 73, as subgenus; Index Suppl. III (1934) 174.
Peltochlaena Fée, Genera (1850-52) 289.

Rhizome short, clothed with entire, thin, brown paleae with elongate cells; stipes fascicled, paleate with decrescent paleae; fronds of moderate size to large, pinnate to deeply bipinnatifid; veins salient at a wide angle, branched, ending in intramarginal hydathodes, or casually anastomosing in the less divided species; lamina glabrous, punctate with "internal glands"; sori dorsal or subterminal on veinlets, indusium peltate and caducous or more commonly wanting, annulus of 12 to 16 cells, spores oblong-bilateral, with spinescent epispore.

TYPE: *S. rotundata* (Willd., *Polypodium*) C. Chr.

A well defined and easily recognizable genus, of 26 known species in tropical America, from Brazil north to Mexico and Cuba; distinguished from *Dryopteris* by the punctate lamina, and veins salient at a wide angle and ending in hydathodes. While these distinctions are good, I see no reason to suspect such remoteness of affinity as is suggested by CHRISTENSEN's comment (1911) p. 74: "perhaps even not a member of the *Dryopterideae*."

The name *Stigmatopteris* was first proposed for the group of exindusiate species. With the inclusion of indusiate species, FÉE's name, *Peltochlaena*, does not have to be adopted, being published too tentatively to demand respect.

31. Adenoderris

Adenoderris J. Smith, Hist. Fil. (1875) 222; Maxon, Bot. Gaz. 39 (1905) 366, with two figures.

Small terrestrial ferns; rhizome short, immersed in broad but attenuate, thin, brown, entire paleae; stipes fascicled, short, sparsely paleate, and, like the entire frond including the indusium, viscid-pubescent with short, non-articulate hairs; lamina lanceolate, subpinnate to bipinnatifid, herbaceous, segments obtuse or acute, not mucronate, veins free, once or a few times forked, anadromic in sequence; sori dorsal or terminal on veinlets, round, indusium peltate, annulus of about 15 cells, spores oblong, black, subtuberculate.

TYPE: *A. glandulosa* (*Aspidium*, H. & G., *non* Blume) J. Smith, which is *A. viscidula* (Mett., *Aspidium*) Maxon, of Jamaica and Cuba. A second species, *A. sororia* Maxon is in Guatemala.

Adenoderris is not near to *Polystichum*, in which many writers have placed it because of its peltate indusium. Aside from the indusium, there is enough similarity to *Dryopteris* to suggest affinity. There is also some community of characters with *Woodsia*.

32. Ctenitis

Ctenitis Christensen, Biol. Arb. til. E. Warming (1911) 77, as subgenus; Verdoorn's Manual (1938) 544, as genus; or possibly, C. Chr. et Ching, Bull. Fan 8 (1938, November) 275, as genus.

Parapolystichum Keyserling, Pol. Cyath. Herb. Bung. (1873) 11, not seen, as section; C. Chr., Monog. Dryopteris II (1920) 93, as subgenus of *Dryopteris*.

Lastreopsis Ching, Bull. Fan 8 (1938) 157.

Ctenitopsis Ching, Bull. Fan 8 (1938) 304.

Terrestrial ferns of moderate size or larger; rhizome short, ascending to erect, or rarely creeping, scaly with broad paleae; fronds bipinnatifid to decompound, broad at base, typically catadromic in plan, usually herbaceous, the axes paleate beneath usually with toothed paleae, typically hairy above with articulate (pluricellular) hairs, ultimate divisions usually rounded or obtuse, costae not decurrent; veins free, simple or branched; sori dorsal on the veins, indusium round-reniform, sometimes wanting, sporangium non-setulose, annulus of 14 to 16 cells, spores bilateral, echinulate.

TYPE, implied by the name, and stipulated by CHING: *Aspidium Ctenitis* Link, which becomes *Ctenitis distans* (Brack.) Ching, of Brazil.

A genus of about 150 species, as estimated by CHRISTENSEN, *l.c.* (1938). In his Monograph, he lists 66 American species, besides 3 of *Parapolystichum*. CHING has named in this genus 30 Old-World species. As it has been CHRISTENSEN'S service to recognize this genus as a natural one, and thereby to contribute more than in any other single respect to the proper classification of the great aggregate of species known of late as *Dryopteris*, I would gladly have left it to him to make the combinations he indicated.

In making *Ctenitis* include *Parapolystichum*, I construe it more broadly than he has sometimes done. Therein, I agree with his earlier opinion, *l.c.* (1911) 78, when he stated that *Dryopteris effusa* Urban should probably be referred here. In his latest expression, VERDOORN'S Manual 544, he treats *Parapolystichum* as doubtful, but places it near *Lastrea*. To me, *D. effusa* seems near to typical *Ctenitis*, and not to *Lastrea*. I include it in *Ctenitis* partly because of its apparent affinity, and partly because there are in the Old World other aberrant species of *Ctenitis*, which I cannot refer to *Parapolystichum*, and it seems undesirable to set up a genus for each such aberrant line.

One such aberrant species is **C. boryana** (Willd., *Aspidium*), described from Bourbon, and ranging from Africa to Japan. CHRISTENSEN, Gardens' Bull. 7 (1934) 254, has been disposed to associate it with *Athyrium*, but its articulate trichomes seem to me to locate it in or with *Ctenitis*. Similar but almost glabrous is **C. Gordoni** (Baker, *Polypodium*), of Fiji.

Ctenitopsis, typified by *C. sagenioides* (Mett., *Aspidium*) Ching, and including *C. dissecta* (Forster, *Polypodium*) Ching, is proposed as a genus intermediate between

Ctenitis and *Tectaria*. I regard this as the position of the species, but prefer to call it **Ctenitis dissecta**. In this species, the fronds are less finely dissected than in most equally ample species of *Ctenitis*, and this want of dissection is correlated with casual anastomoses of the veins in most Polynesian specimens. I agree with CHING, that **Ctenitis ingens** (Atkinson: Clarke, *Nephrodium*), and **C. trichotoma** (Fée, *Aspidium*) are distinct species. **C. kusukusensis** (Hayata, *Dryopteris*) is in the same group, and includes *Ctenitopsis tamdaoensis* Ching. **Ctenitis sagenioides** (Mett., *Aspidium*) is more like *C. distans* than are any of its Oriental neighbors.

Lastreopsis is typified by *L. recedens* (J. Sm., *Polypodium* and *Lastrea*) Ching. To me, this is a typical *Ctenitis*, to be known as **C. recedens**; it was so placed by CHRISTENSEN, in the first publication of the name *Ctenitis*. CHING'S ascription of affinity to *Lastrea* is incomprehensible.

The present distribution of *Ctenitis* justifies the belief that it is of Antarctic origin. Most of its species are now tropical; but it is represented by *Dryopteris spectabilis* (Kaulf.) C. Chr. in Chile, even to Patagonia; by *D. inaequalifolia* (Colla) C. Chr. in Juan Fernandez; by **C. decomposita** (R. Br., *Nephrodium*), **C. glabella** (A Cunn. *Nephrodium*), and the aberrant **C. velutina** (A. Rich., *Aspidium*), in New Zealand; and by **C. lanuginosa** (Willd., *Aspidium*) in South Africa.

Of other similarly primitive genera, *Dryopteris* is most nearly related to *Ctenitis*. There is some apparent affinity to *Rumohra; "Dryopteris" amplissima* (Presl) O. K. occupies the gap between these two genera. Of the genera of its group, *Ctenitis* is probably nearest to *Cyathea*, but this statement does not imply near affinity. Of less primitive large genera, *Tectaria* is probably of Ctenitid origin.

Ctenitis species involved in this study, besides those already mentioned, are:

C. abundans (Ros., *Dryopteris*), Brazil; *C. aciculata* (Baker) Ching, Borneo; **C. acrosora** (Hieron., *Dryopteris*), Colombia, Costa Rica; **C. adenopteris** (C. Chr., *Dryopteris*), Brazil, Argentina; *C. adnata* (Blume) Ching, Malaya; **C. alpina** (Ros., *Dryopteris*), New Guinea; **C. ampla** (H.B.W., *Polypodium*), Ecuador - Florida; **C. amplissima** (Presl, *Polystichum*), S. America; **C. Anniesii** (Ros., *Dryopteris*), Brazil; *C. apiciflora* (Wall.) Ching, Himalayas-Formosa; **C. aspidioides** (Presl, *Polypodium*), Brazil; **C. atrogrisea** (C. Chr., *Dryopteris*), Costa Rica; **C. balabacensis** (Christ, *Dryopteris*), Philippines; **C. cirrhosa** (Schum., *Aspidium*), Africa; **C. connexa** (Kaulf., *Polypodium*), Brazil, Uruguay, Paraguay; **C. Copelandii** (Christ, *Dryopteris*), Luzon; **C. crenulans** (Fée, *Aspidium*), Brazil, Paraguay; *C. crinita* (Poir.) Ching, E. African ids.; *C. decurrenti-pinnata* Ching, Hainan; **C. deflexa** (Kaulf., *Polypodium*), Brazil; **C. dubia** (Copel., *Dryopteris*), Philippines; *C. Eatoni* (Baker) Ching, Liu Kiu, Formosa; **C. effusa** (Sw., *Polypodium*), Trop. America; **C. equestris** (Kunze, *Aspidium*), Panama-Mexico; **C. exculta** (Mett., *Aspidium*), Ecuador-Mexico; **C. falciculata** (Raddi, *Aspidium*), Brazil, Guiana; **C. fenestralis** (C. Chr., *Dryopteris*), Brazil; **C. fijiensis** (Hooker, *Nephrodium*), Fiji; **C. flexuosa** (Fée, *Aspidium*), Brazil; **C. grandis** (Kaulf., *Polypodium*), Brazil; **C. Griesebachii** (Baker, *Nephrodium*), W. Indies; **C. habbemensis** (Copel., *Dryopteris*), New Guinea; **C. hemsleyana** (Baker, *Polypodium*), Central America; **C. Hendersonii** (Bedd., *Lastrea*), Himalayas-Formosa; **C. hirta** (Sw., *Polypodium*), W. Indies; **C. honoluluensis** (Hooker, *Polypodium*), Hawaii; **C. hypolepioides** (Ros., *Dryopteris*), New Guinea; **C. inaequalifolia** (Colla, *Polypodium*), Juan Fernandez; **C. inaequalis** (Kaulf., *Polypodium*), Brazil; **C. Kawakamii** (Hayata), Ching, Formosa; **C. lasiernos** (Spr., *Polypodium*), Brazil; **C. latifrons** (Brack., *Lastrea*), Hawaii; **C. Lowei** *nomen novum* (*Dryopteris acuminata* (Lowe) Watts), Australia;

C. mariformis (Ros.) Ching, China; *C. Maximowicziana* (Miq.) Ching, China, Japan; **C. melanosticta** (Kunze, *Aspidium*), Mexico-Costa Rica; **C. meridionalis** (Poiret, *Polypodium*), W. Indies; **C. mesodon** (Copel., *Dryopteris*), Philippines; **C. microtricha** (Copel., *Dryopteris*), Fiji; **C. blanchetiana** (Kunze: Mett., *Phegopteris*), Brazil; **C. nemophila** (Kunze, *Aspidium*), S. America; **C. nemorosa** (Willd., *Aspidium*), W. Indies; **C. nigrovenia** (Christ, *Nephrodium*), Ecuador-Mexico; **C. obscura** (Fée, *Phegopteris*, Genera 243, *nomen nudum*), Philippines; *C. obtusiloba* (Baker) Ching, Ceylon; **C. oposita** (Kaulf, *Aspidium*), E. African Ids.; **C. paucisora** Copel., *Dryopteris*), Borneo; **C. pedicellata** (Christ, *Aspidium*), Brazil; **C. Preslii** (Baker, *Nephrodium*), Philippines; **C. protensa** (Afz., *Aspidium*), Trop. Africa and America; **C. pulchra** (Copel., *Dryopteris*), New Guinea; **C. pulverulenta** (Poiret, *Poly-*

podium), Ecuador-W. Indies; *C. rhodolepis* (Clarke) Ching, Oriental Tropics; **C. rizalensis** (Christ, *Dryopteris*), Philippines; **C. rubiginosa** (Brack., *Lastrea*), Hawaii; **C. rufescens** (Blume, *Aspidium*), Malaya, Ceylon;

C. Sanctae-Clarae (C. Chr., *Dryopteris*), Cuba; *C. scabrosa* (Kunze) Ching, S. India; **C. sciaphila** (Maxon, *Dryopteris*), Tahiti; **C. securidiformis** (Hooker: Mett., *Aspidium*), Africa; **C. setulosa** (Baker, *Nephrodium*), Tonkin, China; **C. speciosissima** (Copel., *Dryopteris*), New Guinea; **C. squamigera** (H. & A., *Nephrodium*), Hawaii; **C. squamosissima** (Sodiro, *Nephrodium*), Ecuador, Colombia; **C. stenosemioides** (Baker, *Acrostichum*), Borneo; **C. strigillosa** (Dav., *Aspidium*), Mexico; *C. subglandulosa* (Hance) Ching, Formosa, Japan; **C. subincisa** (Willd., *Polypodium*), Trop. America; **C. submarginalis** (L. & F., *Polypodium*), Trop. America; **C. subsericea** (Mett., *Aspidium*), N. Caledonia; **C. tenera** (R. Br., *Nephrodium*), Australia; **C. tenerifrons** (Christ, *Hypolepis*) (*Dryopteris dennstaedtioides* Copel.), Philippines, Borneo; **C. tenuifrons** (C. Chr., *Dryopteris*), Polynesia; **C. trichotoma** (Fée, *Aspidium*), Indo-China; **C. umbrina** (C. Chr., *Dryopteris*), Brazil, Paraguay; *C. vilis* (Kunze) Ching, Malaya, Philippines; **C. villosa** (L., *Polypodium*), W. Indies; **C. Vogelii** (Hooker, *Aspidium*), Africa; **C. Wacketii** (Ros., *Dryopteris*), Brazil.

33. Psomiocarpa

Psomiocarpa Presl, Epim. Bot. (1849) 161.
Amphisoria Trev., Atti Ist. Veneto II 2 (1851) 168—incomplete publication.

Small terrestrial ferns; rhizome ascending, bearing dark, narrow, entire paleae; stipes densely clustered, scaly near base, sparsely so upward, the short stipes of sterile fronds densely pilose; fronds catadromic, dimorphic, the sterile ones rosette-forming, ovate, bipinnate or tripinnate by enlargement of the lowest basiscopic pinnule, herbaceous, axes densely and upper surface sparingly beset with articulate hairs; fertile frond long-stalked, tripinnate at base only, contracted to wingless axes or with traces of a wing in the axils and with minute distal fertile laminar fragments; sporangia borne on both surfaces and margin of these pinnules, or with the upper surface imperfectly covered, a single globose or cylindrical sorus representing each pinnule, a transient vestigial round-reniform indusium sometimes evident, annulus of about 14 cells, spores oblong, reticulate-spinulose by contraction of the epispore.

TYPE: *P. apiifolia* (J. Smith: Kunze, *Polybotrya*) Presl, common throughout the Philippines. KUNZE, Farrnkräuter 142, Pl. 62, described and figured this fern very perfectly.

In every respect except its dimorphism, *Psomiocarpa* is a typical *Ctenitis;* its descent from *Ctenitis* is evident. Unlike its regular associate, *Hemigramma latifolia,* it does not revert, atavistic variants being unknown unless the indusia, not to be detected in most herbarium specimens, are so regarded. In *Ctenitis,* the species most suggestive of *Psomiocarpa* is *C. dubia,* like it in most vegetative characters but with no suggestion of dimorphism.

34. Dryopolystichum genus novum — PLATE IV

Filix terrestris, caudice erecto, dictyostelico, breve; stipitibus fasciculatis, elongatis, fuscis, praecipue deorsum paleis longis linearibus integris atrocastaneis, cellulis longis angustisque non sinuatis, dejectis tuberculas relinquentibus ornatis; lamina catadromica lanceolato-ovata, subbipinnata, basi truncata, apicem acutam versus gradatim decrescente, rhachi inferne glabrescente, ad latera pilis ctenitoideis subdeciduis ornata, in sulca pubescente; pinnis infimis et medialibus conformibus, infimis brevi-pedicellatis, lanceolatis, acuminatis, basi pinnatis pinnulis sessilibus, deinde pinnulis paucis adnatis, pro parte majore profunde pinnatisectis, segmentis basi decurrenti-dilatatis, acutis, integris vel apices versus serrulatis, subcoriaceis, superne

nigrescentibus inferne nigro-olivaceis, subcoriaceis, glabris, venis liberis furcatis; soris ad venulas acroscopicas dorsalibus, indusiis orbicularibus peltatis nigris, annulo plerumque 14-articulato, sporis oblongis episporio hyalino, tum demum inconspicue tuberculatis.

TYPE: **D. phaeostigma** (Cesati) Copel., *Aspidium phaeostigma* Cesati.

Endemic in New Guinea, apparently common throughout at low levels. For the nomenclatorial history of this plant, independently described by CESATI, myself, ROSENSTOCK, BRAUSE and VAN ALDERWERELT VAN ROSENBURGH, without any agreement as to its proper genus, see CHRISTENSEN, Dansk Bot. Arkiv 9 No. 3 (1937) 47. Out of several excellent specimens, *Brass n. 13855,* in my herbarium, is selected as generic type.

The affinity of *Dryopolystichum* to *Ctenitis* is positive. Its most aberrant feature is its peltate indusium, reminiscent of *Tectaria;* but I do not believe that it is Tectarid. As I once suggested, and as CHRISTENSEN agrees, there is some affinity to *Pteridrys;* also to *Ctenitis sagenioides.* But resemblance to these is explicable by the Ctenitid origin of all of them.

35. Pteridrys

Pteridrys (Christensen, Gardens' Bull. 7 (1934) 243, as "Group" of *Lastrea*) Christensen & Ching, Bull. Fan 5 (1935) 125.

Terrestrial ferns of moderate size or large; rhizome ascending, dictyostelic with several vascular strands, clothed, like the stipe-bases, with firm, dark, narrow, entire paleae; stipes clustered, elongate, naked upward, not blackish; lamina commonly ovate, bipinnatifid, lowest pinnae sometimes dilated, segments serrate, the lowest acroscopic tooth typically shifted to the sinus, glabrous, or, in one species, *P. australis* Ching, with costae setose especially beneath, veins free, forked once or several times; sori dorsal or terminal on veinlets, round, indusium orbicular-reniform, annulus of about 12 cells, spores bilateral, obscurely reticulate-tuberculate.

TYPE: *P. syrmatica* (Willd., *Aspidium*) C. Chr. & Ching, originally ascribed by error to Peru and Chile, actually of the Malay region.

CHRISTENSEN and CHING distinguish 7 species, from Java to the Himalayas, South China and Luzon. To these is to be added **P. olivacea** (Ros., *Dryopteris*) of New Guinea, typified by *Bamler 103,* sent to us as *Dryopteris sagenioides* (Mett.). It is distinguished from *Pteridrys microthecia* (Fée) C. Chr. & Ching by having very few sinuses occupied by teeth.

These teeth in the sinuses were noted in the original description of *P. syrmatica,* and are emphasized by CHRISTENSEN and CHING as characteristic of the genus. I long since, Philip. Journal Sci. 2 (1907) 36, pointed out their function, to prevent the passage of water to the nether surface.

As to the affinity of *Pteridrys,* CHRISTENSEN has doubtfully associated it with *Lastrea;* CHRISTENSEN and CHING say, *l.c.* 126, "Our new genus must be held as a close ally to *Dryopteris filix-mas* and other species of *Eudryopteris;*" again, p. 127, "The real affinity of the genus, however, is, in all probability, to be found in that group of *Dryopteris* as typified by *D. sagenioides* (Mett.)" — which is CHING's genus *Ctenitopsis;* I include it in *Ctenitis-;* and still again, p. 127, *"Pteridrys* is thus a very specialized group of the *Tectarid* ferns and related, particularly, to the simple or partially free veined species of the genus, such as *T. leuzeana . . . "* Since it does not seem nearly related to *Lastrea,* or *Eudryopteris,* or *Tectaria leuzeana,* I prefer the remaining speculation, that it is Ctenitoid. I suppose it to be Ctenitid. The usually glabrous fronds present an objection to this opinion, and the hairs of *P. australis* are not typical of *Ctenitis* in structure or in position; but they suggest this rather than any other affinity. *Lastrea spectabilis* J. Sm. should be *Ctenitis.* The specific name, from BLUME, should apply to *P. syrmatica,* but SMITH included also *P. microthecia.* More than this, he included also *Cuming 354,* which in my herbarium seems to be a juvenile specimen of some typical *Ctenitis.*

36. Atalopteris

Atalopteris Maxon and Christensen, Cont. U. S. Nat. Herb. 24 (1922) 55.

Rather small terrestrial ferns; rhizome short, ascending, paleate; stipes fascicled, elongate, fuscous, clothed throughout with squarrose, lanceolate-aciculate, subentire castaneous paleae; fronds dimorphic, the sterile oblong-ovate, slightly narrowed at base, bipinnate near base, elsewhere bipinnatifid, thin, axes bearing articulate hairs, surfaces setulose or naked, veins free, fertile frond more slender, laminar tissue reduced to just enough to bear the sori, or to this *plus* a very narrow wing; sori distinct, contiguous or confluent, exindusiate, elliptic-capitate paraphyses present, annulus of 14 (rarely 16) cells, spores bilateral, oblong, conspicuously spinose.

TYPE: *A. aspidioides* (Griseb., *Polybotrya*) Maxon & C. Chr., of Cuba. The other accredited species are *A. Maxoni* (Christ) C. Chr., of Jamaica, and *A. Ekmani* Maxon, of Haiti. As the three species are known by a total of four collections their real distinctness is hard to appraise.

The authors of *Atalopteris* recognized and demonstrated its affinity to *Ctenitis*. It is presumably derived from that *Ctenitis* group with bipinnatifid or barely bipinnate fronds. If it were true, as the authors stated, *l.c.*, p. 56, that "*Atalopteris* is most nearly related to *Psomiocarpa* Presl," then it would properly be *Psomiocarpa*, as CHRIST, Smiths. Misc. Coll. 56 (1911) No. 23, treated it. *Atalopteris* and *Psomiocarpa* are distinct genera because they are not immediately related, but have been derived independently from long-distinct groups in one parent genus, *Ctenitis*.

37. Heterogonium

Heterogonium Presl, Epim. Bot. (1849) 142; Copel., Univ. Calif. Publ. Bot. 16 1929) 61.

Terrestrial ferns of moderate size; rhizome short, stout, erect, paleae dark-castaneous, broad but attenuate, entire; stipes fascicled, elongate, fuscous, bearing sub-deciduous articulate hairs and a few small paleae; fronds catadromic in plan, subdimorphic, pinnate with inciso-lobate pinnae, herbaceous, margin, axes and upper surface bearing articulate hairs, venation typically Pleocnemioid; sori dorsal on the veins, typically elongate, exindusiate, sporangia globose, annulus of 13 or 14 cells, spores oblong, flaky-tuberculate.

TYPE: *H. aspidioides* Presl, of Leyte and Samar. A similar, more ample, possibly not distinct species is *H. profereoides* (Christ) Copel., from Mindanao and Borneo. Two other species are known in the same region. Plate 94 of HOOKER and BAUER'S Genera, excepting figs. 5 and 6, is an excellent illustration of *H. aspidioides*, misnamed *Stenosemia aurita*.

I incline to the opinion that this fern is derived directly from *Ctenitis*. The alternative belief is that it is Tectarid, the venation simplified, as in *Pleocnemia*, in correlation with the dissection of the frond. It is surely related to *Stenosemia*, but is not nearly enough identical to explain their confusion by J. SMITH and HOOKER.

38. Stenosemia

Stenosemia Presl, Tent. Pterid. (1836) 237.

Terrestrial ferns of moderate size; rhizome short, erect, scaly; fronds dimorphic, stipe of the sterile one about as long as the lamina, fuscous, paleate toward the base, minutely pubescent with articulate hairs, lamina deltoid or ovate, pinnate with one or more pairs of free pinnae, these and the terminal portion pinnatifid, often with a bud in an axil, herbaceous, margin (especially in the sinuses), axes and upper surface bearing sparse articulate hairs, veins lax, anastomosing along the axes or more extensively,

without included veinlets, sometimes almost wholly free; fertile frond long-stipitate, lamina reduced to a narrow wing along all axes, sporangia typically continuous along the veins, and finally spreading over the intervening tissue, annulus usually of 14 cells, spores oblong, reticulate-tuberculate by contraction of the epispore.

TYPE: *S. aurita* (Sw., *Acrostichum*) Presl; Solomon Islands across Malaya and the Philippines. Two other species are distinguished.

Stenosemia is unstable in venation and fructification. There may be several rows of areolae, or the veins may be almost wholly free in equally ample portions of the frond. Full fructification is Acrostichoid in type. But variant individuals, presumably to be regarded as atavistic, have the lamina less than typically contracted, with the sporangia restricted to the veins, or interrupted along the veins, tending then to form distinct sori. I have one specimen with the sporangia restricted to a continuous, apparently marginal line. This condition is typical of several unrelated genera; and occurs abnormally in that form of *Tectaria irregularis* named *Polypodium Brongniartii* Bory.

The affinity of *Stenosemia* and *Heterogonium* is sure, but the proper place of the two remains less so. My present belief is that they are derived directly from *Ctenitis*.

39. Tectaria

Tectaria Cavanilles, Ann. de Hist. Nat. 1 (1799) 115.
Aspidium Swartz, Schrader's Journal 2[1] (1801) 4, 29.
Sagenia Presl, Tent. (1836) 86, Pl. 2, f. 22-25.
Pleocnemia Presl, op. cit. 182, Pl. 7, f. 12.
Dictyopteris Presl, op. cit. 194, Pl. 8, f. 6, 7, 12, *partim, non* Lamouroux (1809).
Bathmium Link, Fil. Spec. cult. (1841) 99, 114.
Microbrochis Presl, Epim. Bot. (1849) 51.
Polydictyum Presl, Epim. Bot. (1849) 52.
? *Proferea* Presl, Epim. Bot. (1849) 259.
Dryomenis Fée, Genera (1850-52) 225.
Podopeltis Fée, Genera (1850-52) 286.
Phlebiogonium Fée, Genera (1850-52) 314, Pl. 24 A, f. 2.
Cardiochlaena Fée, Genera (1850-52) 314.
Grammatosorus Regel, Index Sem. Hort. Petr. (1866) 75; Milde, Bot. Zeit. 26 (1868) 614.
Arcypteris Underwood, Bull. Torrey Club 30 (1903) 678.

Terrestrial ferns of moderate size or large; rhizome stout, short-creeping to erect, paleate, usually with ample, thin, entire paleae; stipes clustered, elongate, scaly at base or throughout, often ebeneous; lamina commonly pinnate or more compound with dilated base, rarely simple, never finely dissected, pinnae or segments commonly entire, never aristate, naked or rarely hairy except on the axes which are typically pubescent above with articulate hairs, veins variously anastomosing, usually with free included veinlets; sori compital, dorsal or terminal on the veinlets, typically round, indusium peltate, or round-reniform or wanting, annulus of about 14 cells, spores oblong with thick epispore, becoming tuberculate or spinulose.

TYPE: *T. trifoliata* (L., *Polypodium*) Cav., of tropical America.

A genus of 212 accredited species, common in all moist tropical lands, and remarkably restricted to them, ranging north to the Himalayas, Formosa and Florida, south to Queensland and the Transvaal. The large, undissected fronds seem unable to endure other conditions; and in the tropics, these are ferns of low and middle altitudes, not of the mossy forest. Forty-three species are known in America, 17 in Africa and its islands, 150 from India to Polynesia, 28 in New Guinea.

The type species has short, deltoid fronds, finely reticulate veins with simple or hamate included veinlets, and compital sori with peltate indusia. This type of venation is called Sagenioid, and is found also in the *Phymatodes* group of Polypodioid ferns.

However narrowly *Tectaria* may be construed, as genus or as to subgenera, it occurs in both hemispheres; and no natural subdivision can be based on details of the pattern of venation, or on the form or presence of the indusium. There are of course natural groups of species, and these are likely to be recognizable by characters not usually regarded as of generic significance. Thus, *Pleocnemia* and *Arcypteris,* very different in venation, are related, as shown by size, color, and basal tufts of narrow paleae.

Most species bear typical ctenitoid hairs, but these are commonly shorter than they usually are in *Ctenitis.* In a few species, they spread over the lamina. In many species, they are contracted to a dense velvety pubescence, so short that they are necessarily unicellular. In a few species, they seem to be wanting. Among these is *T. decurrens* (Presl) Copel.; and in the related, very common *T. crenata* Cav., they are regularly present only in the axils. They are very nearly obsolete on *T. Menyanthidis,* typically a plant of water-courses, peculiar also in having an elongate rhizome clinging to stones. The species with few or no hairs do not constitute a natural group.

Among notably aberrant species may be mentioned *T. Godeffroyi* (Luerssen) Copel., of Fiji, with marginal, sometimes even extra-marginal sori; it is evidently related to, and therefore derived from, the common *T. latifolia* (Forster) Copel. *T. dolichosora* Copel. is remarkable for elongate indusiate sori. Among exindusiate species, elongation of the sorus is fairly common, and vestigial indusia can sometimes be detected.

Aspidium has been the name most used for this genus. As first published, it contained already 72 species, all ferns with round and indusiate sori. The first two, and only these, are *Oleandra.* The third is *A. trifoliatum* (L.) Sw., which Christensen, Index XXII, properly chose to typify the genus. The fact that *Aspidium* has been construed in an almost incredible variety of ways is irrelevant. As Christensen construed it, and as I do, *Aspidium* and *Tectaria* have the same type and are perfect synonyms. Misinformed as to the date of *Tectaria,* Christensen used *Aspidium* as the generic name in his Index, but corrected it in the Third Supplement.

Sagenia was based on supposed peculiarities of the vein-pattern and position of the sorus, and was said to have a peltate indusium. These peculiarities are not constant even within some species. The venation commonest in *Tectaria* is known as Sagenioid. In spite of Presl's clear definition, subsequent writers using the name *Sagenia* for a genus or subgenus have restricted it to species with orbicular-reniform indusia.

Pleocnemia, originally with the single species, *P. leuceana* (Gaud., *Polypodium*) Presl, is characterized by veinlets anastomosing to form areolae along the main veins, and elsewhere free, and was described as exindusiate. The venation is correlated with the dissection of the frond, which is much more deeply dissected in this species or group than is usual in *Tectaria,* thus leaving no room for copious formation of areolae. Like Sagenioid, Pleocnemioid has been adopted as descriptive of a type of venation.

Dictyopteris was used by Lamouroux in 1809 as the name of a genus of Algae, and thus was invalid as used by Presl. The fixing of a type for Presl's genus is superfluous; but if one were required, it could at least as reasonably be a Polypodioid fern as a *Tectaria.* The name is brought up here because a number of later writers have treated it as if typified by *D. irregularis* Presl, which is *Tectaria irregularis* (Presl) Copel.

Bathmium was a name first used by Presl as that of a section of *Aspidium;* as so used, it might be typified by *Tectaria singaporiana* (Wall.) Copel. (1917). As taken up as a generic name by Link, it could be typified by *B. trifoliatum,* and thus be exactly synonymous with *Tectaria* and *Aspidium.*

Microbrochis, type and sole species *M. apiifolia* (Schkuhr, *Aspidium*) Presl, is *Sagenia* as usually interpreted — that is, with round-reniform indusium. While *Aspidium apiifolium* Schkuhr provided a reference and the name, the description was made from the species now known as *Tectaria Gaudichaudii* (Mett.) Maxon.

Polydictyum, with one species, *P. Menyanthidis* (Presl) Presl, from Luzon, follows *Microbrochis* as published. Better than anywhere else, Presl shows here how a sufficiently detailed description of the venation can serve to raise any species to generic status. Even the two generic names have the same significance.

Proferea was typified by *P. excellens* (Blume, *Aspidium*) Presl, a species unknown to me. Hooker, Sp. Fil. IV 63, had from Blume a fragment, which he called *Nephrodium excellens* Blume. Under *Dryopteris megaphylla* (Mett.) C. Chr., which is *Cyclosorus megaphyllus* Ching, Backer and Posthumus, Varenflora voor Java

(1939) 337, state: "*Tectaria excellens* C. Chr. . . . schijnt slechts een afwijkend gevormd exemplaar dezer soort te zijn." If this be so, it suggests *Haplodictyum,* somewhat similarly divergent, but of independent origin in *Cyclosorus.* And in that case, *Proferea* is a synonym of *Cyclosorus;* or, if instead of a mere abnormality it is an established deviation, it may be restored to generic status.

Dryomenis is one of the too numerous genera proposed on speculation. FÉE says: "Nous indiquons, sans toutefois le proposer définitivement, le genre suivant, qui prendrait place à côté du *Meniscium.*" I do not regard this as valid publication, however complete the description; in this instance, the description and illustration are excellent. The plant is *Tectaria siifolia* (Willd.) Copel., a species with exindusiate and irregularly elongate sori.

Phlebiogonium, typified by *P. impressum,* is unknown to me by that name. In the Third Supplement to CHRISTENSEN'S Index, p. 186, it is indirectly referred to *Tectaria variolosa* (Wall.) C. Chr., which seems reasonable. FÉE'S illustration is poor, and HOOKER, Sp. Fil. IV 59, regarded the subject as an abnormality.

Cardiochlaena should probably be typified by *C. macrophylla,* which is now construed as *Tectaria incisa* Cav. It was to be distinguished from *Aspidium* by cordate indusia and free included veinlets. Its several listed species are *Tectaria,* but do not constitute a natural group within the genus. One of them is *Polydictyum Menyanthidis* Presl and is so cited by FÉE, who nevertheless presented a new generic name.

Podopeltis was typified by *P. singaporiana* (Wall., *Aspidium*) Fée, *Tectaria singaporiana* Copel. FÉE tried to distinguish it from *Bathmium* by the nerve-pattern and the position of the sori, neither of which is peculiar. The species is peculiar in *Tectaria* because of simple fronds contracted at the base, and the apparently complete absence of pubescence, but it is unnecessary to distinguish it as a genus.

Grammatosorus was a garden plant of uncertain origin. MILDE secured from REGEL one old frond, which suggested *Tectaria incisa.* After the most careful possible study, he concluded: "Ob uns aber in *Grammatosorus* ein Product der Cultur oder ein Bastard-Erzeugniss vorliegt, dürfte jetzt kaum zu entscheiden sein."

Arcypteris was proposed as a substitute name for *Dictyopteris,* with *Aspidium difforme* Blume, which is a form of *Tectaria irregularis* (Presl) Copel. as its type.

Tectaria varies conspicuously, but within definite limits, in frond-form, venation, position of sori, and indusium. The numerous synonyms result from the belief that difference in these respects ought to characterize genera, which is not true in this group. Within this genus, a polished stipe may be a better guide to affinity than any indusial character. So far as I can see, *Tectaria* is a natural genus. I emphasize this, because CHRISTENSEN has several times expressed the belief that *Tectaria* as here constituted is polyphyletic. This would be hard to disprove, but the more divergent species seem to me to be exactly that — due to divergence, not to convergence, in phylesis. The relation of the entire genus to *Ctenitis* is unquestionable. Plural origin in *Ctenitis* is possible, but not to be postulated without evidence in both genera. I am more ready to believe that *Ctenitis,* by definition, contains a few species of Tectarid origin than that *Tectaria* is polyphyletic; but this too is something not to be asserted without good evidence.

Ctenitis is more primitive than *Tectaria;* therefore, it is the probable parent genus. But *Tectaria* is itself old, probably old enough to have been differentiated, as a genus and within the genus, long enough ago so that its representatives in America and in the Orient had their common ancestor in the far South.

Nothing about *Tectaria* is more remarkable than the number of species and groups of species derived from it, so diverse that they demand recognition as little genera.

40. Cionidium

Cionidium Moore, Comp. to Gard. Mag. (1852) 143.
Trichiocarpa (Hooker, Journal of Bot. 4 (1852) 55, as sect. of *Deparia*) J. Smith, Cat. Kew Ferns (1856) 7.

Like *Tectaria* except that each sorus is terminal on a pedicel-like vein prolonged beyond the margin, indusium semi-orbicular, connected in the lower part of the sides with a strictly local laminar outgrowth of the vein, the indusium and this lamina forming a cup-like structure; stipe and rachis

ebeneous, lamina large, deltoid, bipinnate at base in full development, thin, naked except for finely velutinous upper side of axes.

SOLE SPECIES: *C. Moorei* (Hooker, *Deparia*) Moore, endemic in New Caledonia.

Too remarkably divergent for convenient inclusion in *Tectaria*, but manifestly derived from a local species, *T. Seemannii* (Fournier) Copel. I am unable to distinguish these two species except by the sori, which, in *T. Seemannii*, are scattered over the surface, sometimes compital, sometimes terminal on free included veinlets, the indusia large and round, whether peltate or with a deep, narrow sinus.

41. Tectaridium

Tectaridium Copeland, Philip. Journal Sci. 30 (1926) 329, Pl. 1.

Terrestrial ferns of moderate size; rhizome becoming erect, short and stout, paleate; stipes fascicled, blackish, bearing dark, linear-aciculate paleae and very short, dark, ctenitoid hairs; fronds dimorphic, the sterile lanceolate, entire, rounded or cordate at base, fuscous, opaque, glabrous or glabrescent, venation Sagenioid; fertile frond similar in outline, but the laminar tissue reduced to spots, usually paired, on the main veins, the effect being that the frond is bipinnate, each laminar fragment or pinnule just sufficing for the bearing of a sorus; sori round, indusium round, with a sinus which may or may not extend to the middle, dark, firm, persistent, annulus of 14 cells, spores oblong, with thick epispore, becoming sparingly echinulate.

TYPE: *T. MacLeanii* Copel., a local species in the damp mountains of eastern Luzon. A second species, in Leyte, with the laminar tissue reduced to a very narrow wing instead of completely wanting along the axes, is probably distinct, and illustrates the evolution of the genus.

Tectaridium is manifestly of Tectarid origin. The preservation of the indusia, during the evolution of complete dimorphism, is very unusual.

42. Luerssenia

Luerssenia Kuhn, Bot. Centralblatt 11 (1882) 77; Diels, Nat. Pflanzenfam. I, 4, 181, Fig. 93 A, B.

Terrestrial fern with erect, paleate rhizome; fronds simple, entire, lanceolate, subdimorphic, the fertile ones narrower, venation reticulate with free included veinlets; sori terminal on simple veinlets, one in each areola, in 4 to 6 longitudinal rows, indusium "elongate-hippocrepiform," entire, spores bilateral.

SOLE SPECIES: *L. kehdingiana* Kuhn, from Lankat, West-Sumatra.

Described from a single specimen. I have never seen this fern, nor any record of any except the original collection. KUHN stated that the sterile frond could be mistaken for *Tectaria singaporiana*. Nothing known about *Luerssenia* makes its Tectarid origin doubtful.

43. Hemigramma

Hemigramma Christ, Philip. Journal Sci. 2 C (1907) 170; Copel., Philip. Journal Sci. 3 C (1908) 31, Pl. 1-4; 37 (1928) 402.

Terrestrial plants, small or of moderate size; rhizome ascending to erect, scaly; stipes fascicled, scaly with narrow, crinite-attenuate brown paleae which are entire in age, but bear a few lateral and basal branches when young, also pubescent when young with caducous articulate hairs; fronds dimorphic, the sterile on young plants rosette-forming, ovate-lanceolate, entire, subsessile or short-stipitate, on adult plants longer-stipitate and ranging from the juvenile form through lobed and pinnatifid to pinnate with few pinnae, usually deltoid in form, fuscous, completely glabrescent, vena-

tion Sagenioid; fertile fronds longer-stipitate, linear on young plants, varying to pinnate with forked basal pinnae on adult plants, free included veinlets usually wanting; sporangia borne along the veins without interruption (Gymnogrammoid), eventually also on the laminar surface (Acrostichoid), indusia wanting, annulus of about 14 cells, spores reticulate-spinulose by contraction of the epispore.

TYPE: *H. Zollingeri* (Kurz, *Hemionitis*) Christ, which is *H. latifolia* (Meyen) Copel., an exceedingly variable fern of seasonally dry forest in the Philippines and Java.

A genus of half-a-dozen species, ranging from New Guinea to Java, China and Formosa. *H. latifolia* is the only species common enough and sufficiently collected so that its variability is dependably known; its collection of generic names is *Polybotrya* (Meyen, Goldmann, Mett.); *Gymnopteris* (Presl, Diels); *Dendroglossa* (Fée); *Leptochilus* (Fée, C. Chr.); *Acrostichum* (Hooker); *Hemionitis* (Kurz, Copel.); *Gymnogramme* (Salomon); *Syngramma* (Diels); and *Hemigramma.*

The derivation of *Hemigramma* from *Tectaria* is one of the most perfectly proved cases in generic phylogeny. Atavistic variation is fairly common in *H. latifolia,* fertile fronds being broader than typical, the venation, and with it the net-work of sporangia, then more lax. In more extreme cases, this net-work becomes interrupted, until finally the sporangia are in more or less definite sori. When these sori bear indusia, as I have photographed them, *l.c.* (1908), we may be dealing with hybridization instead of atavism, but the interpretation is the same. These possible hybrids suggest direct affinity to *Tectaria crenata.* Other common characters suggest rather *T. decurrens.* Since *T. crenata* and *T. decurrens* are nearly related, the general place of origin in *Tectaria* can be considered to be fixed.

NAKAI, Bot. Mag. Tokyo 47 (1933) 174, regards *Hemigramma* as exactly synonymous with *Anapausia* Presl, Epim. Bot. (1849) 185, and therefore to be known by the latter name. The condition here is what PFEFFER, who always spoke English with English-speaking students, used to describe with "It is possible, but it cannot be." *Anapausia* was first used in the *Tentamen,* p. 244, as the name of a Section of *Gymnopteris.* As there used, its type *might* be *G. latifolia* Presl, which is the type species of *Hemigramma.* In general, when the status of a group is changed, as from section to genus, its type goes with it. But in this particular case, in publishing *Anapausia* as a genus, PRESL cited "Gymnopteris § 2 Anapausia Presl (excl. speciebus);" and on page 187 he specifically excluded *G. latifolia.*

44. Quercifilix

Quercifilix Copeland, Philip. Journal Sci. 37 (1928) 408.

A small terrestrial fern; rhizome creeping or ascending, paleate with broad, dark paleae; stipes approximate, scaly at base with narrower, attenuate paleae, elsewhere densely pubescent with pale, articulate hairs; fronds dimorphic, the adult sterile lamina short-stalked, oblong or ovate, composed of a relatively large, broadly crenate, or lobed or incised main portion, and usually a single pair of opposite basal pinnae, herbaceous, fuscous, ciliate and the surface rather deciduously pubescent with articulate hairs, venation laxly Sagenioid; fertile frond long-stalked, lamina so contracted that the segments are few and linear, sporangia everywhere along the veins, and eventually spreading somewhat onto the laminar surface, annulus of about 13 cells, spores oblong, coarsely reticulate-tuberculate by shrinking of the epispore.

TYPE and sole species: *Q. zeilanica** (Houttuyn, *Ophioglossum*) Copel., described from Ceylon, common in South China, said to range from Mauritius to Formosa.

Quercifilix is intimately related to, and can therefore be said to be derived from, the group in *Tectaria* represented by *T. Labrusca* (Hooker) Copel. It bore eight generic names before being constituted a genus by itself.

* As to the spelling, see MERRILL, Journal Arnold Arb. 19 (1938) 315.

45. Fadyenia

Fadyenia Hooker, in Hooker and Bauer, Genera (1840) Pl. 53 B.

A small terrestrial fern; rhizome erect, short, paleate; stipes clustered, short, paleate at base with light-brown, thin, linear-aciculate scales, elsewhere, like young laminae, bearing minute, deciduous Ctenitoid hairs; laminae subdimorphic, the sterile ones oblanceolate with round apex or lanceolate with protracted radicant apex, decurrent at base, entire or shallowly lobed, herbaceous, glabrescent, veins laxly and rather irregularly anastomosing, the larger coastal areolae commonly with single free included veinlets; fertile fronds narrower and longer, non-radicant; sori mostly on the included veinlets, conspicuously large indusium round to oblong, fixed by a median line from the base to above the middle, the cordate base often unequal-sided, minutely pubescent, sporangia large, annulus of about 14 cells, spores bilateral, with thick epispore shrinking to make them spinulose.

TYPE: *F. prolifera* (*Aspidium* H. & G., *non* R. Br.) Hooker, which is F. *Fadyenii* (Mett.) C. Chr. A single West-Indian species.

Fadyenia is regarded as Tectarid, but is notably aberrant in venation. The shapes of the indusium suggest *Athyrium*, but the minute articulate hairs, along with complete agreement in sporangia and spores, mark it as Tectarid. In this group, the indusium does not provide a dependably significant character.

46. Camptodium

Camptodium Fée, Genera (1850-52) 298.

A small terrestrial fern; rhizome stout, ascending to erect, its paleae lanceolate, attenuate, entire, castaneous; stipes fascicled, as long as the lamina or longer, ebeneous, paleate at base only, deciduously pubescent with articulate hairs; lamina deltoid, coarsely pinnatisect, brownish, thick, glabrous at least at maturity, veins free, sparingly branched; sori terminal on the veins, submarginal or in full development scattered, indusium usually reniform, sometimes round-reniform, annulus of about 13 cells, spores oblong, tuberculate.

TYPE: *C. pedatum* (Desvaux, *Aspidium*) Fée, of the Lesser Antilles, Haiti and Jamaica.

Instead of figuring this genus, FÉE referred to a good illustration by KUNZE, Farrnkräuter (1845) 179, Pl. 75. Few spores remain on my specimens, but these are as here described, not tetrahedral, as stated and figured by KUNZE.

When CHRISTENSEN, VERDOORN'S Manual 544, places *Camptodium* intermediate between *Ctenitis* and *Tectaria*, he can hardly be writing with regard to phylesis, for it is improbable that a plant intermediate in that sense survives locally in the West Indies, or that its apparent affinity should be to that element in *Tectaria* with least dissected fronds. This is one of the ferns which seem to me to be Tectarid in spite of free venation.

47. Pleuroderris

Pleuroderris Maxon, Journal Washington Acad. Sci. 24 (1934) 550.

Terrestrial plants of moderate size; rhizome ascending to erect, stout, paleate; stipes fascicled, paleate, especially toward the base, with narrow, irregularly toothed or fibrillose scales, and with minute, deciduous articulate hairs; lamina usually narrowed at base, variable, from linear, sinuate in the upper part and pinnatifid downward, to pinnate in the lower part, the pinnae close or remote, decurrent or adnate or rarely sessile, ovate to linear, and the frond sometimes ovate, firm-herbaceous, rachis pubescent above, laminar

surface naked, venation Sagenioid; sori irregularly scattered or mostly near the margin, large, round or elongate, sometimes confluent, indusium conforming in shape to the sorus, sometimes cleft or in more than one part, the whole or each part attached to the vein by one side, broad and firm, the free margin minutely ciliate, developed sporangia with annulus of 13-15 cells, spores oblong, tuberculate or irregularly spinulose, but most sporangia more or less abortive, and very few spores seen.

TYPE: *P. michleriana* (Eaton, *Lindsaea*) Maxon, of Colombia.

A single species, named six times, ranging to Guatemala, apparently most common in Panama. MAXON's description and discussion are alike excellent.

The most striking feature of *Pleuroderris* is its extreme variability. This, and the common malformation or abortion of the sporangia and apparent paucity of spores, raise the suspicion that it is hybrid. *Tectaria rivalis* (Mett.) Maxon (or C. Chr.) is suggested as one possible parent, and *Dictyoxiphium* as the other. The range of *Pleuroderris*, and its local abundance in Panama, are sufficient evidence that it propagates itself — but so does also the hybrid and variable family cat. I leave this conjecture where MAXON did, and will not question the status of the genus because of its possible or probable hybrid origin.

Some of the various sori of *Pleuroderris* suggest other Tectarid genera of the same region. The elongate indusiate sori, and their sometimes conspicuous drift toward the margin, represent tendencies which jointly reach their limit in *Dictyoxiphium*. The broken or plural indusia, not always facing in the same direction, and their ciliate free margin, suggest *Hypoderris*.

48. Amphiblestra

Amphiblestra Presl, Tent. (1836) 150, Pl. 6, f. 1.

Rhizome and base of stipe unknown; frond rather large, pinnate with very few pinnae and large coadunate terminal leaflet, thin, glabrous except for minute pubescence in dorsal groove of costa, venation Sagenioid; sporangia in a more or less continuous line along the almost marginal fertile veinlet, exindusiate, annulus of 12 cells, spores probably oblong and irregularly angular (very few detected).

TYPE: *A. latifolia* (H. B. K., *Pteris*) Presl, of Venezuela.

This fern, so far as I know, has been collected twice — by HUMBOLDT and BONPLAND, and by FUNCK and SCHLIM, the latter as *Linden no. 201*. Part of a frond of the latter collection is in the U. S. Nat. Herbarium. *Amphiblestra* has been described and depicted oftener than it has been examined. Judging by the specimen just cited, the *indusium tenue membranaceum* of the original description is an illusion. DIELS found it hard to detect, but did not deny its presence. The margin is very thin, and, in the herbarium, may be slightly reflexed or perfectly plane, where there are no sporangia or where they are present. The general resemblance to *Tectaria* has been remarked by all authors.

The marginal sori, continuous or interrupted, can justify recognition of the genus, but its derivation from *Tectaria* is manifest. A similar drift of naked sori to the margin occurs exceptionally in *Tectaria*, and abnormally in *Stenosemia;* and the indusiate sorus of *Dictyoxiphium* is fixed in the same position.

49. Dictyoxiphium

Dictyoxiphium Hooker, in Hooker and Bauer, Genera (1840) Pl. 62.

A terrestrial fern of moderate size; rhizome erect, short, paleate; stipes fascicled, short, fuscous, bearing lanceolate, attenuate, entire, fuscous paleae and some deciduous hairs; fronds subdimorphic, the sterile linear-lanceolate, attenuate to both ends, entire, firm-herbaceous, glabrous (or glabrescent ?), venation Sagenioid, fertile fronds narrower; sorus marginal, uninterrupted, with a continuous extrorse indusium about equalling the margin, annulus

of 13 or 14 cells, spores oblong, flaky-tuberculate by collapse of the epispore.

TYPE and sole species: *D. panamense* Hooker, of Central America and Colombia; reported as the commonest of all ferns in British Honduras.

The statement that the sori are marginal describes the appearance; HOOKER's original statement that they are intramarginal is more accurate, applying to their insertion. The condition is the same as in *Lindsaya* and *Isoloma*. BAUER's illustration is excellent.

This fern is so aberrant that CHING has constituted a monotypic family for it. However, anybody unacquainted with it, but familiar with *Tectaria*, would mistake a sterile specimen for another species of the familiar genus. The sporangia and spores are as Tectarioid as the entire vegetative structure. Nothing about *Dictyoxiphium* is peculiar except the position, shape and protection of the sorus. To temper our appreciation of these peculiarities, we may recall the diversity of sori and indusia already familiar in *Tectaria* and its derivatives; that the sori are similarly marginal in *T. Godeffroyi*, sometimes abnormally so in *T. irregularis* and in *Stenosemia*, and even extra-marginal in *Cionidium;* that the sori are irregularly elongate in many species of *Tectaria*, and regularly so in *Hemigramma* and *Quercifilix;* that *T. dolichosora* has an indusium elongate like its line of attachment, and that elongate vestigial indusia can sometimes be detected on species with elongate sori, described as exindusiate. Finally, by changing the words but not the meaning, the indusium of *Tectaridium* can be described as conterminous with the margin, or eventually exceeding it — in this case, the margin of the fertile segment. In the case of *Dictyoxiphium*, we have in *Pleuroderris* a perfect intermediate between the ancestral condition in Tectaria, with round, scattered, dorsal sori, and the ultimate condition with completely coalesced marginal fructification. The Tectarid status of *Dictyoxiphium* is not open to doubt.

50. Hypoderris

Hypoderris R. Brown, in Wallich, Plant. Asiat. Rar. I (1830) 16; Hooker & Bauer, Genera Fil. (1838) Pl. 1.

A terrestrial fern of moderate size; rhizome creeping, dictyostelic, paleate; stipes remote, elongate, fuscous, bearing lanceolate-aciculate paleae and more deciduous articulate hairs; lamina simple, entire, acuminate, cordate or hastate, thin, glabrous except on the costa and main veins, venation Sagenioid; sori compital or dorsal or terminal, round or sometimes elongate along the vein, indusium apparently calyciform, probably never closed, soon expanded and hidden by the sporangia, thin, its margin toothed or fimbriate, annulus of about 14 cells, spores oblong, dark, spinulose.

TYPE and sole species: *H. Brownii* J. Sm., of Trinidad; also in the West Indies and Venezuela.

In everything unless the sorus, this is a *Tectaria*, in gross aspect much like several *Tectaria* species of the same region. Because of its indusium, *Hypoderris* has usually been associated with *Woodsia*, but this one feature, however interpreted, should not outweigh the many features in common with *Tectaria*. Moreover, I do not construe this indusium as indicating any affinity to *Woodsia*. The sorus of *Woodsia* is never elongate, and it is hardly imaginable that it become so. In my regard, the indusium of *Hypoderris* is like that of *Pleuroderris*, except that it is obsolescent, as usually occurs with elongation of the sorus. It seems to be true that it commonly surrounds the receptacle; but it usually does this in several parts, not in a continuous cup. The behavior of the indusium of *Pleuroderris* is sometimes identical, which is probably to be explained by regarding the sorus as composite. The likeness of the sori is responsible for the fact that the one species of *Pleuroderris* has been given three specific names in *Hypoderris*. The two genera are distinct, representing independent phyletic lines leading out of the parent genus, but they are alike Tectarid.

51. Lastrea

Lastrea Bory, Dict. Class. d'Hist. Nat. VI (1824) 588; IX (1826) 232.
Thelypteris Schmidel, Icon. Plant., ed. Keller (1762) 45, Pl. 11, invalid publication;

Schott, Genera (1834) ad Pl. 10; Nieuwland, Am. Midl. Nat. 1 (1910) 224; Ching, Bull. Fan (Bot.) 6 (1936) 238.
Leptogramma J. Smith, Journ. of Bot. 4 (1841) 51.
Amauropelta Kunze, Farnkr. I (1843) 86, 109, Pl. LI.
Glaphyropteris Presl, Abh. Böhm. Ges. Wiss. V 5 (1848) 344.
Phegopteris (Presl, Tent. (1836) 179, as Sect.) Fée, Genera 1850-52) 242.
Oochlamys Fée, Genera (1850-52) 297.
Gymnocarpium Newman, Phytologist 4 (1851) 371.
Hemesthium Newman, Phytologist 4 (1851) App. XXII; Hist. British Ferns (1854) 123.
Steiropteris C. Chr., Biol. Arb. tilegn. Warming (1911) 81; Monog. Dryopteris I (1913) 161, as subgenus; Verdoorn's Manual (1938) 544.
Cyclogramma Tagawa, Acta Phytotax. 7 (1938) 53.

Terrestrial ferns of moderate size, rarely large; rhizome short- or long-creeping, or ascending or erect, dictyostelic, paleate, paleae rarely dense, often pubescent; lamina typically bipinnatifid and usually narrowed toward both ends, rarely more compound, often hairy with simple, unicellular hairs; veins free, usually simple and reaching the margin; sori dorsal (rarely terminal) on the veins, small and round, or rarely elongate, indusium round-reniform if present, spores bilateral.

TYPE: *L. Oreopteris* (Ehrh., *Polypodium*) Bory, of Europe, and other North-Temperate lands.

A genus of fully five hundred species, in all lands habitable by ferns. The most cosmopolitan species is *L. Thelypteris* (L.) Bory. As must be true of a genus of such size, most of the species are tropical, but it is as well represented as other genera in temperate lands. The great majority of the species constitute an exceptionally uniform group, but a number of small aberrant groups are included.

As to the name, the recent tendency has been to adopt *Thelypteris*, and to ascribe it to SCHMIDEL. Resurrection of this name was by NIEUWLAND, whose confidence in it avowedly did not extend beyond its being as worthy of respect as *Dryopteris*, proposed a year later. Of still more recent authors who adopt the name, ALSTON, Kew Bull. (1932) 309, alone seems to have presented justification. ALSTON argues that SCHMIDEL intended to establish genera — which is not to say that he succeeded; and that he used binomial names. In the case of *Thelypteris*, he not only formed no binomial, but his plate represents *Thelypteris non ramosa*, an expression pre-Linnaean in form and fact, distinguishing it, not from *Acrostichum* of LINNAEUS, but from the older *Thelypteris*, which we know as *Pteridium*. The *Thelypteris* of SCHMIDEL was properly ignored, by botanists and by bibliographers, although there is no question that his plant was *Acrostichum Thelypteris* L.

The same species is the type of *Hemesthium*, of NEWMAN, who proposed a new name for *Thelypteris* Schott, in order to conserve LINNAEUS' specific name and avoid a duplicating binomial.

Leptogramma is typified by *L. totta* (Willd.) J. Smith, properly **Lastrea africana** (Desv.) characterized by elongate, naked sori and free veins. Comprising this species and a few immediate relatives, this would be a natural genus, but would be hard to define, especially against *Athyrium*, which includes species with similar venation and sori. The difficulty of definition becomes insuperable when we recognize the probability that *Lastrea* has several times independently undergone elongation of sorus and loss of indusium. Thus, *Dryopteris polypodioides* (Raddi) C. Chr., included by CHRISTENSEN, Monog. Dryopteris I, 198, in his subgenus *Leptogramma*, is hardly open to the suspicion of being a direct relative of *L. totta*. On the ground that it is impossible to distinguish by generic definition the several similar but independent gymnogrammoid derivatives of *Lastrea*, *Leptogramma* must be abandoned as a genus. *Currania* has other characters which permit it to be retained.

Amauropelta was described as a near relative of *Saccoloma*, with marginal sori, terminal on the veins. Type: *A. Breutelii*, which is a synonym of *Lastrea limbata* (Sw.) Moore. The indusia do indeed reach the margin. But examination of an excellent generic isotype shows that the veins — at least, many of them — are prolonged

beyond the receptacle of the sorus. The position of the sorus is unusual in *Lastrea*, but the place of the species in that genus is clear.

Glaphyropteris, typified by *G. decussata* (L., *Polypodium*) Presl, is characterized essentially by the formation of large aerophores at the bases of the pinnae, and small ones where the costa of each segment joins that of the pinna. The group is a small but natural one, endemic in tropical America. CHRISTENSEN has recently, VERDOORN'S Manual, p. 544, seemed to restore it to generic rank, but I prefer his earlier judgment, Monog. Dryopteris I, 157: "If one should prefer to treat *Lastrea* as a genus, which would be a very natural treatment, *Glaphyropteris* ought to be referred to it as a subgenus." Its type is *Lastrea decussata* (L.) Presl.

Phegopteris should be typified by *Polypodium Phegopteris* L., which provided its name. Its distinction from *Lastrea* is the absence of an indusium. It has been treated as a large generic entity, or combined with *Polypodium*, when naturalness was not demanded of genera. As *Lastrea* has lost its indusium along countless lines of evolution, *Phegopteris* is untenable as a large genus. As a natural genus, it would have less than a dozen species, and then would be hard to define in words.

Among the apparent nearer relatives of *L. Phegopteris* (L.) Bory, are *L. Dryopteris* (L.) Bory and *L. robertiana* (Hoffm.) Newman (*L. calcarea* Bory). These are the species named by NEWMAN in the publication of *Gymnocarpium*, followed by the statement that 30 exotic species should be included. By this statement, as well as by his definition, it is perfectly clear that he was proposing a genus typified by his *G. Phegopteris*, to include all species previously included in *Lastrea* but with naked sori. *Gymnocarpium* and *Phegopteris* are thus completely synonymous, and *Gymnocarpium* almost certainly had priority. CHING has tried to revive *Gymnocarpium*, including *Currania* in it, but leaving *L. Phegopteris* in *Lastrea* (*Thelypteris*), as does CHRISTENSEN. Because CHING mistypifies *Gymnocarpium*, because *L. Phegopteris* and *L. Dryopteris* seem too nearly related to demand generic separation, and because their separation by reasonable generic definition is hardly possible, I prefer to follow NEWMAN in keeping them together, and BORY in treating them as *Lastrea*.

Oochlamys was published with avowed doubt — "Les botanistes auront plus tard à statuer sur leur valeur générique," FÉE, *l.c.* — It was based on *O. Rivoirei* Fée, which is *L. contermina* (Willd.) Presl; it is a typical *Lastrea*, as was inadvertently emphasized by FÉE'S comment that it "est assez délicate et remarquable par ses frondes décroissantes du center au sommet et du centre à la base."

Steiropteris is a more or less definable and natural group of 11 or 13 American species, characterized by a keel or pseudo-vein recurrent from the sinus between lobes. A similar structure is found in various and *inter se* unrelated Oriental species, as noted for one by CHRISTENSEN, *l.c.* (1911) 81: "*D. crassifolia* (Bl.) O. Ktze. from tropical Asia seems to belong here." As to this species, see also Gardens' Bulletin *4* (1929) 381, where CHRISTENSEN misconstrues the recurrent strand as a true vein. Since these Oriental species are not immediate relatives of the American *Steiropteris*, the latter may stand as a local subgenus but is undefinable on a world scale.

Cyclogramma, typified by *Thelypteris simulans* Ching, Bull. Fan 6 (1936) 280 has no peculiarity of generic significance. It should be **Lastrea simulans** (Ching).

A genus of such size as *Lastrea* naturally includes many natural minor groups, some of which are easily recognizable and definable if the species of any limited region are considered. *Glaphyropteris* and *Steiropteris* are such groups. The occurrence of parallel evolutionary lines, of distinct origin in different regions, makes the definition of most such groups impossible when the species of the whole world are taken into account.

The inclusion in *Lastrea* of species with decompound fronds, except as the lowest lobe of the lower pinnae may be free, is of uncertain propriety. There are at least three phyletically independent groups of such species:

1) *Gymnocarpium*, as typified by *L. Dryopteris;* certainly related to *Lastrea.*

2) A group of Oriental species, represented by *L. setosa* Presl; included in *Lastrea* (or *Thelypteris*) by CHRISTENSEN and CHING, but real affinity not quite so clear.

3) A remarkable New Guinea fern described by ALSTON, Journ. of Bot. 78 (1940) 327, as *Dryopteris marattioides*, with huge fronds, bipinnate throughout, undivided lanceolate, acute pinnules several centimeters long, veinlets simple and free; peculiar

in several respects, without an evident immediate relative in *Lastrea,* and apparently better to be treated as a genus.

Another New Guinea species, aberrant but clearly a *Lastrea,* is **L. hunsteiniana** (Brause, *Dryopteris*), with one pair of incised or auricled basal pinnae, a second pair entire and adnate, and the rest of the frond pinnatifid not quite to the costa with entire segments. The venation is correspondingly modified. It is one of the Oriental species which might by definition be *Steiropteris.*

Lastrea is evidently of Antarctic origin, and must therefore be at least as old as Miocene. Its northern components, so far as they constitute any distinguishable group, *Gymnocarpium* or *Euphegopteris,* are comparatively recent in differentiation.

Among other similarly primitive ferns, *Lastrea* is most intimately related to *Athyrium,* and only less so to *Cystopteris.* In the other direction, it is doubtfully distinguishable from *Cyclosorus.*

No definition will distinguish perfectly between *Lastrea* and either *Athyrium* or *Cyclosorus.* In the case of *Athyrium,* doubtful species are assigned to the genus which seems to contain their relatives; thus a number with round sori are assigned to *Athyrium.* In the case of *Cyclosorus,* as treated here, the boundary is arbitrary, and probably not in every instance natural. Taking into consideration the Oriental species, I have drawn a somewhat different line from CHRISTENSEN's, and retain in *Lastrea* a number of species, of which the commonest is *L. patens* (Sw.) Presl, which CHRISTENSEN treated as *Cyclosorus.* With more experience, the same method used against *Athyrium* may be found useful here.

Species of *Lastrea* in hand are:

L. aequatorialis (Copel., *Dryopteris*), Ecuador; **L. africana** (Desv., *Polypodium*), Malaya-Azores-Japan; **L. Alfredii** (Ros., *Dryopteris*), Costa Rica; **L. argentina** (Hieron., *Aspidium*) S. America; **L. armata** *nomen novum* (*Dryopteris spinosa* Copel., *non Lastrea,* Newman), New Guinea; *L. augescens* (Link) J. Sm., Mexico, W. Indies; **L. aureo-viridis** (Ros., *Dryopteris*), Sumatra; **L. aurita** (Hooker, *Gymnogramme*), Sikkim-Tonkin; **L. badia** (v. A. v. R., *Dryopteris; D. lincaris* Copel.), Sumatra, Borneo; **L. Bangii** (C. Chr., *Dryopteris*), S. America; **L. beccariana** (Cesati, *Nephrodium*), Borneo; *L. Beddomei* (Baker) Bedd., S. India-Formosa; **L. belensis** (Copel., *Dryopteris*), New Guinea; *L. bergiana* (Schlecht.) Moore, Africa; **L. blanda** (Fée, *Phegopteris*), Mexico-Costa Rica; *L. Brackenridgei* (Mett.) Carr., Polynesia; **L. Bradei** (Christ, *Aspidium*), Costa Rica; *L. calcarata* (Blume) Moore, Oriental Tropics; **L. calva** (Copel., *Dryopteris*), Mindanao; **L. caucaensis** (Hieron., *Nephrodium*), Bolivia-Costa Rica; *L. cheilanthoides* (Kunze) Moore, Trop. America; **L. chlamydophora** (Ros., *Dryopteris*), Malaya, Burma; **L. Christensenii** (Christ, *Dryopteris*), Cent. America; *L. coarctata* (Kunze) Moore, Trop. America; **L. columbiana** (C. Chr., *Dryopteris*), Colombia, Panama; *L. concinna* (Willd.) Moore, Trop. America; *L. contermina* (Willd.) Presl, Trop. America; **L. costaricensis** *nomen novum* (*Dryopteris atrovirens* C. Chr. *non Lastrea,* J. Smith), Cent. America; **L. costulisora** *nomen novum* (*Dryopteris basisora* Copel., *non* Christ), New Guinea; **L. crassa** (Copel., *Dryopteris*), New Guinea; *L. crassifolia* (Blume) Moore, Malaya-Burma, Philippines; **L. cyctopteroides** (Eaton, *Athyrium*), Japan, Korea, Formosa;

L. dasyphylla (C. Chr., *Dryopteris*), Brazil; *L. decursive-pinnata* (van Hall) J. Sm., China, Japan; *L. decussata* (L., *Polypodium*) Presl, Trop. America; *L. deltoidea* (Sw.) Moore, West Indies; **L. densiloba** (C. Chr., *Dryopteris*) (*non Lastrea gardneriana* Moore), Brazil; **L. densisora** (C. Chr., *Dryopteris*), Venezuela-Costa Rica; **L. divergens** (Ros., *Dryopteris*), Sumatra; **L. diversisora** (Copel., *Dryopteris*), Rapa; *L. Dryopteris* (L.) Bory, N. Temperate zone; **L. dryopteroidea** (Brause, *Alsophila*) (*D. atrispora* C. Chr.), New Guinea; **L. Duclouxii** (Christ, *Dryopteris*), China; **L. dura** (Copel., *Dryopteris*), Mindanao; **L. echinata** (Mett., *Aspidium*), Malaya, New Guinea; **L. elegantula** (Sodiro, *Nephrodium*), Ecuador; **L. engleriana** (Brause, *Dryopteris*), New Guinea; **L. ensipinna** (Brause, *Dryopteris*), New Guinea; **L. erubescens** (Wall., *Polypodium*), Malaya-India-Formosa; **L. Esquirolii** (Christ, *Dryopteris*), China; **L. euaensis** Copel., *Dryopteris*), Tonga; **L. eugracilis** *nomen novum* (*D. gracilis* Copel., *non Lastrea,* Moore), Mindanao; *L. exigua* J. Sm., Philippines; **L. falcatipinnula** (Copel., *Dryopteris*), New Guinea; *L. falciloba* Hooker, Himalayas, China; **L. Finisterrae** (Brause, *Dryopteris*), New Guinea; *L. flaccida* (Blume) Moore, Malaya-India-China; **L. flavovirens** (Ros., *Dry-*

opteris), New Guinea; **L. flexilis** (Christ, *Aspidium*), China; **L. Funckii** (Mett., *Aspidium*), Venezuela-Costa Rica;

L. germaniana (Fée, *Phegopteris*), W. Indies; *L. glanduligera* (Kunze) Moore, Himalayas-Japan; **L. Glaziovii** (Christ, *Aspidium*), Brazil; *L. globulifera* Brack., Hawaii; **L. Goedenii** (Ros., *Dryopteris*), Brazil; *L. gracilescens* Hooker, *quoad nomen*, New Guinea, Malaya-Formosa; **L. Grantii** (Copel., *Dryopteris*), Society Ids.; *L. gueintziana* (Mett.) Moore, Africa and islands; **L. Guentheri** (Ros., *Dryopteris*), Bolivia; **L. gymnocarpa** (Copel., *Dryopteris*), Mindanao; **L. gymnopoda** (Baker, *Nephrodium*) (*D. athyriocarpa* Copel.), Borneo; **L. Hallierii** (Christ, *Aspidium*), Borneo; *L. Harveyi* (Mett.) Carr., Polynesia; **L. Herzogii** (Ros., *Dryopteris*), Bolivia; **L. heteroclita** (Desv., *Polypodium*), Jamaica; *L. hexagonoptera* (Mx.) Nieuwl., Eastern U. S.; **L. Hieronymusii** (C. Chr., *Dryopteris*), Colombia; **L. himalayensis** (C. Chr., *Dryopteris*), Himalayas, China; **L. hunsteiniana** Brause, *Dryopteris*), New Guinea; **L. illicita** (Christ, *Dryopteris*), Costa Rica; *L. immersa* (Blume) Moore, Malaya, Philippines; **L. japonica** (Baker, *Nephrodium*), Japan, Korea; **L. Juergensii** (Ros., *Nephrodium*), Brazil; **L. keysseriana** (Ros., *Dryopteris*), New Guinea; **L. kunzeana** (Hooker, *Nephrodium*) (*an D. oligophylla* Maxon?), Trop. America;

L. Lauterbachii (Brause, *Dryopteris*), New Guinea; **L. laxa** (F. & S., *Aspidium*), China, Japan; **L. Leprieurii** (Hooker, *Nephrodium*), Trop. America; *L. leucolepis* Presl, Philippines across Polynesia; **L. Levingei** (Clarke: Baker, *Gymnogramme*), Himalayas, China; *L. ligulata* J. Sm. (*D. Luersseni* C. Chr.), Philippines; **L. limaensis** (Copel., *Dryopteris*), Peru; *L. limbata* (Sw.) Moore, W. Indies; **L. Lindmanii** (C. Chr., *Dryopteris*), Brazil; **L. Linkiana** (Presl, *Grammitis*) (*D. diplazioides* Urban *non* O. K., *nec L. diplazioides* Moore), Trop. America; **L. Linnaeana** *nomen novum* (*D. sancta* O. K., *non L. sancta* Moore), W. Indies, Cent. America; **L. lomatosora** (Copel., *Dryopteris*), Peru; **L. loretensis** (Maxon, *Dryopteris*), Peru; **L. macradenia** (Sodiro, *Nephrodium*), Ecuador; **L. mapiriensis** (Ros., *Dryopteris*), Bolivia; **L. maranguensis** (Hieron., *Aspidium*), Africa; **L. Margaretae** (E. Brown, *Dryopteris*), Rapa; **L. Mettenii** *nomen novum* (*D. palustris* (Mett.) O. K., *non L. palustris* J. Sm.), Brazil; **L. Mexiae** (C. Chr., *Dryopteris*), Brazil; **L. Mosenii** (C. Chr., *Dryopteris*), Brazil; **L. motleyana** (Hooker, *Nephrodium*), Malaya; **L. multiformis** (C. Chr., *Dryopteris*), Ecuador; **L. multiseta** (Baker, *Nephrodium*), Borneo; **L. multisora** (C. Chr., *Dryopteris*), Borneo; **L. muzensis** (Hieron, *Dryopteris*), Ecuador; **L. myriosora** (Copel., *Dryopteris*), Solomon Ids.;

L. nephrolepioides (C. Chr., *Dryopteris*), New Guinea; **L. nipponica** (F. & S., *Aspidium*), China, Japan; **L. nitens** (Desv., *Polypodium*), Andes; **L. nockiana** (Jenman, *Nephrodium*), Jamaica; **L. normalis** (C. Chr., *Dryopteris*), W. Indies, Gulf States; **L. notabilis** (Brause, *Dryopteris*), New Guinea; *L. noveboracensis* (L.) Presl, New York region; **L. novoguineensis** (Brause, *Dryopteris*), New Guinea; **L. obliquata** (Mett., *Aspidium*), N. Caledonia; *L. ochthodes* (Kunze) Moore, S. India-Tonkin; *L. oligocarpa* (H. B. W.) Moore, Trop. America; **L. oligophlebia** (Baker, *Nephrodium*), China, Japan; **L. omeiensis** (Baker, *Polypodium*), China, Japan; **L. ophiura** (Copel., *Dryopteris*), New Guinea; **L. oregana** (C. Chr., *Dryopteris*), Oregon, California; *L. Oreopteris* (Ehrh.) Bory, N. Temp. zone; **L. ornata** (Wall., *Polypodium*), India, Burma; *L. pachyrachis* (Kunze) Moore, Trop. America; **L. paleata** (Copel., *Dryopteris*), Sumatra; *L. patens* (Sw.) Presl, Trop. America; **L. petrophila** (Copel., *Dryopteris*), New Guinea; **L. phacelothrix** (C. Chr. & Ros., *Dryopteris*), Bolivia; *L. Phegopteris* (L.) Bory, N. Temp. zone; **L. pilosa** (M. & G., *Gymnogramme*), Mexico; **L. piloso-hispida** (Hooker, *Nephrodium*), Bolivia-Mexico; *L. pilosula* (Kl. & Karsten) Moore, Peru-Mexico; **L. pinnata** (Copel., *Dryopteris*), Sumatra; **L. platyptera** (Copel., *Dryopteris*), New Guinea; **L. plumosa** (C. Chr., *Dryopteris*), Borneo; **L. polyphylla** (Copel., *Dryopteris*), Mexico; *L. Prenticei* Carr., Fiji; *L. prolixa* (Willd.) Presl, India, Africa; *L. ptarmica* (Kunze) Moore, Brazil; **L. ptarmiciformis** (C. Chr. & Ros., *Dryopteris*), Bolivia; **L. pubirachis** (Baker, *Nephrodium*), Fiji, Samoa; *L. setosa* Presl. (*Cheilanthes setigera* Blume, *non Lastrea*, Moore), Malaya, Philippines-Polynesia; **L. pyrrhorhachis** (Kunze, *Polypodium*) (*D. brunnea* C. Chr., *D. hirtirachis* C. Chr., *D. Moussetti* Ros.), Malaya-India-Formosa; **L. quadriaurita** (Christ, *Dryopteris*), New Guinea, Philippines; **L. quelpartensis** (Christ, *Dryopteris*), Korea-Aleutian Ids.;

L. recumbens (Ros., *Dryopteris*), Brazil; **L. Regis** (Copel., *Dryopteris*), New Guinea; **L. repens** (Hope, *Nephrodium*), Himalayas-Tonkin; **L. resinifera** (Desv., *Polypodium*), Panama-Mexico, W. Indies; **L. retusa** (Sw., *Polypodium*), Brazil; **L. Rimbachii** (Ros., *Dryopteris*), Ecuador; **L. riopardensis** (Ros., *Dryopteris*), Brazil; **L. rivulariformis** (Ros., *Dryopteris*), Bolivia; **L. rivularioides** (Fée, *Aspidium*), Brazil, Uruguay, Argentina; *L. robertiana* (Hoffm.) Newman, N. Temp. zone; **L. Rosenstockii** (C. Chr., *Dryopteris*), Ecuador; **L. rudis** (Kunze, *Polypodium*), Bolivia-Mexico; **L. Rusbyi** (C. Chr., *Dryopteris*), Bolivia;

L. saxicola (Sw., *Polypodium*), Peru-Costa Rica; **L. scalaris** (Christ, *Aspidium*), Costa Rica-Mexico; **L. scariosa** (Ros., *Dryopteris*), Brazil; *L. sericea* Scott: Bedd., India, China; **L. Serra** (Sw., *Polypodium*), West Indies; **L. simulans** (Ching, *Thelypteris*), Formosa; *L. simulata* Dav. (improperly published), Eastern U. S.; *L. singalanensis* (Baker) Bedd., Malaya; *L. Sprengelii* (Kaulf.) Presl, Trop. America; **L. Stierii** (Ros., *Gymnogramme*), Brazil; **L. subandina** (C. Chr. & Ros., *Dryopteris*), Bolivia; **L. subattenuata** (Ros., *Dryopteris*), New Guinea; **L. subdimorpha** (Copel., *Dryopteris*), New Guinea; **L. subnigra** (Brause, *Dryopteris*), New Guinea;

L. tablazensis (Christ, *Dryopteris*), Cent. America; *L. tenericaulis* (Wall.) Moore, Polynesia, India, Japan, naturalized in America; **L. tenerrima** (Fée, *Aspidium*), Brazil; **L. Teuscheri** (v.A.v.R., *Dryopteris*), Borneo; *L. Thelypteris* (L.) Bory, almost cosmopolitan; *L. tomentosa* (Thouars) Moore, Bourbon; **L. tonkinensis** (C. Chr. *Dryopteris*), Tonkin, Kwangsi; **L. tuberculata** (Cesati, *Nephrodium*), New Guinea; **L. tuberculifera** (C. Chr., *Dryopteris*), Assam, Yunnan; **L. Tuerckheimii** (Donn. Sm., *Nephrodium*), Guatemala; **L. uraiensis** (Ros., *Dryopteris*), Formosa; **L. urens** (Ros., *Dryopteris*), Uruguay; **L. varievestita** (C. Chr., *D. atrisporae* var.), New Guinea; *L. verrucosa* J. Sm.: Presl, Philippines, Malaya; *L. viscosa* (Blume) J. Sm., Malaya, Philippines-Fiji; **L. vulcanica** (Baker, *Nephrodium*), Java; **L. wantotensis** (Copel., *Dryopteris*), New Guinea; **L. wariensis** (Copel., *Dryopteris*), New Guinea; **L. Weberi** (Copel., *Dryopteris*), Philippines; **L. Williamsii** (Copel., *Dryopteris*), Mindanao; *L. xylodes* (Kunze) Moore, India, China; **L. yunkweiensis** (Ching, *Thelypteris*), Tonkin, China.

52. Currania

Currania Copeland, Philip. Journ. Sci. 4 C (1909) 112.

Small terrestrial ferns; rhizome long-creeping, slender, branched, open-dictyostelic, bearing naked castaneous paleae; stipes remote, slender, naked except at base; lamina sharply reflexed at base, deeply pinnatifid, segments opposite, serrate (abnormally, incised) or entire, glabrous; veins free, branched, mostly reaching the thin margin; sori oblong or longer, exindusiate, annulus usually of 14 cells, spores oblong, laxly tuberculate.

TYPE: *C. gracilipes* Copel., of Luzon, doubtfully distinct from *C. oyamensis* (Baker) Copel., known from Japan and North China, Formosa and New Guinea. In first reporting this species from New Guinea, ROSENSTOCK gave it the appropriate specific name, *Dryopteris genuflexa*.

Currania is very near to *Lastrea*, with which it can be combined if one prefer. In reviving *Gymnocarpium*, CHING, Cont. Biol. Lab. Sci. Soc. China, Bot. 9 (1933) 30, included *Currania* in that genus. They are certainly nearly related, but do not seem to me to belong in one phyletic line. If CHING's treatment were acceptable in other respects, I would still maintain *Currania* as the generic name, not perhaps appreciating CHING's argument that, by removing *Polypodium Phegopteris* to *Lastrea*, BORY left *P. Dryopteris* and *P. robertianum* as a potential genus. BORY treated the three species alike.

C. oyamensis (as *Gymnocarpium*) is well illustrated by CHING, l.c., p. 43.

53. Cyclosorus

Cyclosorus Link, Hort. Berol. II (1833) 128.
Abacopteris Fée, Cong. Sci. France (1843), not seen; Genera (1850-52) 309; Ching, Bull. Fan 8 (1938) 235.
Pronephrium Presl, Epim. Bot. (1849) 258.

Like *Lastrea* in every respect except that at least the lowest veins of adjacent segments meet and unite at or below the sinus. This definition agrees with CHING's. CHRISTENSEN's is "Veins simple and free, the basal ones running to the bottom of the sinus or more often united into an excurrent vein or two to several being united in pairs (venation goniopteroid or meniscioid)" — VERDOORN's Manual, p. 545.

TYPE: *C. gongylodes* (Schkuhr, *Aspidium*) Link, typified from the West Indies, but pantropic and extratropical.

A genus of probably 300 known species, tropical and subtropical, two in New Zealand, five in South Africa. In America, this is a uniform group, including a few common, ill defined species. In the Oriental tropics, it is a large and diversified genus, including a number of minor groups some of which have received generic names.

Abacopteris was typified by *A. Philippinarum* Fée, characterized by meniscioid venation and sori with orbicular-reniform indusia (depicted as peltate in FÉE's figure, but correctly described). The type species has been reduced to *Dryopteris glandulosa* Blume) O. K., and to *D. urophylla* (Wall.) C. Chr. CHING, Bull. Fan 8 (1938) 249, renames it *A. presliana,* in spite of avowing that "*A. philippinarum* is the same, in my mind;" they are identical, in fact. *Abacopteris* could be a natural genus, with imparipinnate fronds, few large undissected pinnae (or with simple fronds), meniscioid venation, round or elongate and indusiate or naked sori, including Oriental species which have been misplaced in the superficially similar but not immediately related American genus *Meniscium.* It is not admissible as a genus, for two reasons: It is not practically definable against *Cyclosorus,* from which it is derived, and into which it shades insensibly. And it is impracticable so to define it as to exclude a group of species, represented by **C. canescens** (Blume, *Polypodium*), of independent origin in *Cyclosorus.* Of such species, FÉE cited *Nephrodium simplicifolium.* CHING devotes a paragraph to this group, and cites their most aberrant element, *Haplodictyum,* in his synonymy.

Both *Abacopteris* and the group of *C. canescens* are of recent origin and limited range. And both are in active evolution, including, as one may choose to construe the cases, numerous local, hardly more than incipient species, or comparatively few polymorphic species. In treating the *canescens* group, CHRIST, Philip. Journ. Sci. 2 C (1907) 198-200, was driven to such expressions as *Dryopteris diversifolia* (Presl) n. subsp. (of *D. canescens*), var. *acrostichoides* (J. Sm.), subvar. *rhombea.* The group as a whole shades insensibly into its parent, typical *Cyclosorus.*

Pronephrium, typified by *P. lineatum* (Blume, *Aspidium*) Presl, belongs in the *Abacopteris* group, the latter name being presumably unknown to PRESL. The feature emphasized by PRESL was dimorphism of fronds, associated with progressive diffusion of the sporangia. Like FÉE and CHING, PRESL included a species, *P. acrostichoides* (J. Sm., *Nephrodium*), of the *canescens* group.

Cyclosorus is so intimately related to *Lastrea* that a line between them has to be provided by the terms of the definition. Chiefly because of its evident affinity to other genera, such as *Athyrium,* I suppose that *Lastrea* is more primitive than *Cyclosorus.* Still, the distribution of *Cyclosorus* indicates that it too is old enough to have migrated from Antarctica in its present form. If the distinction between the two could be known to have been natural twenty million years ago, it might have occurred subsequently that species of *Lastrea* evolved toward entireness of pinna and anastomosis of veins, and that pinnae of *Cyclosorus* became more deeply cut, freeing the veins. The genera as defined may thus not be wholly natural. With such a multitude of species, the single criterion distinguishing the genera may provide an artificial line. But the recognition of the two genera, as defined, is eminently convenient; and such a measure of convenience does not have to be sacrificed because the naturalness of the classification is open to some measure of doubt.

Only the lowest veins must unite to indicate the place of a species in *Cyclosorus.* With very few exceptions, the distal veins are free, running to the margin. Near the ends of pinnae, all veins are usually free, the contraction of the lamina leaving no room for anastomosis. In *C. extensus* (Blume) Ching, and **C. alatella** (Christ,

Nephrodium, Aspidium) the lowest veins are sometimes free, sometimes confluent. This occurs also in *Dryopteris roemeriana* Ros., which I believe to be, by affinity, a *Lastrea*.

Species of *Cyclosorus* in hand are:

C. abortivus (Blume) Ching, Malaya; **C. acanthocarpus** (Copel., *Dryopteris*), Borneo; *C. acuminatus* (Houtt.) Ching, Japan and southward; **C. adenophorus** (C. Chr. *Dryopteris*), Luzon-Celebes; **C. adenostegius** (Copel., *Dryopteris*), New Guinea; **C. afra** (Christ, *Dryopteris*), Africa; **C. alatellus** (Christ, *Nephrodium*) (*D. stenobasis* C. Chr., *D. pseudostenobasis* Copel. ?), New Guinea-Samar; **C. albociliatus** (Copel., *Dryopteris*), New Guinea; **C. albosetosus** (Copel., *Dryopteris*), New Guinea; **C. amboinensis** (Willd., *Aspidium*), Malaya; **C. angustipes** (Copel., *Dryopteris*), Borneo; **C. aoristisorus** (Harr., *Polypodium*), Panay; **C. appendiculatus** (Blume, *Gymnogramme*), Java; **C. aquatilis** (Copel., *Dryopteris*), New Guinea; **C. aquatiloides** (Copel., *Dryopteris*), Borneo; *C. arbuscula* (Willd.) Ching, Mascarenes, perhaps to Fiji; **C. Archboldii** (C. Chr., *Dryopteris*), New Guinea; **C. arfakianus** (Baker, *Polypodium*), New Guinea; *C. aridus* (Don) Ching, India-Formosa; **C. asymmetricus** (Fée, *Goniopteris*), Philippines; **C. Atasripii** (Ros., *Dryopteris*), New Guinea; **C. austro-philippinus** (Copel., *Dryopteris*), southern Philippines; **C. Bakeri** (Harr., *Nephrodium*), Philippines; **C. Bartlettii** (Copel., *Dryopteris*), Sumatra; **C. Batacorum** (Ros., *Dryopteris*), Sumatra; **C. beccarianus** (Cesati, *Meniscium*) (*D. cesatiana* C. Chr., *D. oblanceolata* Copel.), New Guinea-Fiji; *C. biauritus* (Bedd.) Ching, Assam; **C. Bordenii** (Christ, *Dryopteris*), Philippines; **C. borneensis** (Hooker, *Polypodium*) (*D. labuanensis* C. Chr.), Borneo; **C. Brooksii** (Copel., *Dryopteris*), Borneo;

C. callosus (Blume, *Aspidium*), Malaya; **C. canescens** (Blume, *Polypodium*), New Guinea, Malaya; **C. canlaonensis** (Copel., *Dryopteris*), Negros; **C. celebicus** (Baker, *Acrostichum*), Celebes; **C. chamaeotaria** (Christ, *Dryopteris*), Philippines; **C. Clemensiae** (Copel., *Dryopteris*), Luzon; **C. compactus** (Copel., *Dryopteris*), Borneo; **C. confertus** (Brause, *Dryopteris*), New Guinea; **C. contiguus** (Ros., *Dryopteris*), Borneo; **C. costatus** (Brack., *Goniopteris*), Polynesia; *C. crinipes* (Hooker) Ching, Malacca-Sikkim-China; **C. cuspidatus** (Blume, *Meniscium*), Malaya, Philippines; *C. cyatheoides* (Kaulf.) Farwell, Hawaii; *C. cylindrothrix* (Ros.) Ching, Sikkim-Siam; **C. debilis** (Mett., *Phegopteris*), Amboyna; **C. deltipterus** (Copel., *Dryopteris*), New Guinea; *C. dentatus* (Forsk.) Ching, Pantropic; **C. dichrotrichus** (Copel., *Dryopteris*), New Guinea; **C. diminutus** (Copel., *Dryopteris*), Mindanao; **C. distinctus** (Copel., *Dryopteris*), New Guinea; **C. diversilobus** (Presl, *Nephrodium*), Philippines; **C. doodioides** (Copel., *Dryopteris*), Solomon Ids.; **C. ellipticus** (Ros., *Dryopteris*), Mindanao; **C. Elmerorum** (Copel., *Dryopteris*), Mindanao; **C. epaleatus** (C. Chr., *Dryopteris*) (*D. Francii* Copel., *non* C. Chr.), New Caledonia; **C. euryphyllus** (Ros., *Dryopteris*), Sumatra; *C. evolutus* (Clarke) Ching, Burma, Assam; **C. excrescens** (Copel., *Dryopteris*), Sumatra; *C. extensus* (Blume) Ching, Malaya-India-Philippines; *C. ferox* (Blume) Ching, Malaya, Philippines; **C. firmulus** (Baker, *Polypodium*), Borneo;

C. glanduliferus (Brack., *Goniopteris*) (*D. subspinosa* C. Chr.), Samoa; *C. glandulosus* (Blume) Ching, Malaya, Philippines; *C. gongylodes* (Schkuhr) Link, Pantropic; *C. Gustavi* (Bedd.) Ching, Assam; *C. haenkeanus* (Presl) Ching, Mariannes; **C. hastato-pinnatus** (Brause, *Dryopteris*), New Guinea; *C. heterocarpus* (Blume) Ching, Malaya, Philippines, China; **C. Hewittii** (Copel., *Dryopteris*), Borneo; **C. hirto-pilosus** (Ros., *Dryopteris*), New Guinea, Philippines; **C. hispidulus** (Dec., *Aspidium*), Philippines-Samoa; **C. holophyllus** (Baker, *Polypodium*) (*D. mirabilis* Copel.), Borneo; **C. Hosei** (Baker, *Meniscium*), Borneo, Mindanao; **C. hudsonianus** (Brack., *Nephrodium*), Hawaii; **C. imponens** (Cesati, *Polypodium*) (*D. armata* Ros.), New Guinea; **C. inclusus** (Copel., *Dryopteris*), Sumatra; *C. interruptus* (Willd.) Ching (*D. pteroides* O. K.), Oriental tropics; **C. invisus** (Forster, *Polypodium*), Polynesia; **C. iridescens** (v.A.v.R., *Dryopteris*), Sumatra; **C. lakhimpurensis** (Ros., *Dryopteris*), Assam; **C. lanceola** (Christ: Copel., *Dryopteris*), Philippines, New Guinea; **C. lineatus** (Blume, *Aspidium*), Malaya; **C. lithophyllus** (Copel., *Dryopteris*), Borneo; **C. lobangensis** (C. Chr., *Dryopteris*), Borneo; **C. loherianus** (Christ, *Aspidium*) Philippines; **C. longipes** (Blume, *Aspidium*), Malaya; **C. longissimus** (Brack., *Goniopteris*), Tahiti; **C. luzonicus** (Christ, *Dryopteris*), Philippines;

C. macropterus (Copel., *Dryopteris*), Tonga; **C. magnificus** (Copel., *Dryopteris*), Fiji; **C. malodorus** (Copel., *Dryopteris*), Solomon Ids.; **C. matutumensis** (Copel., *Dryopteris*), Mindanao; *C. megaphyllus* (Mett.) Ching, Malaya, Philippines; **C. megaphylloides** (Ros., *Dryopteris*), New Guinea; **C. Merrillii** (Christ, *Dryopteris*), Philippines; **C. mesocarpus** (Copel., *Dryopteris*) Society Ids.; **C. micans** (Brause, *Dryopteris*), New Guinea; **C. microlonchus** (Christ, *Dryopteris*), Philippines; **C. microsorus** (Copel., *Dryopteris*), Fiji; **C. mindanaensis** (Christ, *Dryopteris*), Mindanao; *C. molliusculus* (Wall.) Ching, Burma, Sikkim; **C. morobensis** (Copel., *Dryopteris*), New Guinea; **C. moulmeinensis** (Bedd., *Nephrodium*), India-Polynesia; **C. multiauriculatus** (Copel., *Dryopteris*), New Guinea; **C. mutabilis** (Brause, *Dryopteris*), New Guinea; *C. namburensis* (Bedd.) Ching, Assam, Formosa; **C. obstructus** (Copel., *Dryopteris*), Rarotonga; **C. obtusifolius** (Ros., *Dryopteris*) New Guinea; **C. oxyourus** (Copel., *Dryopteris*), Solomon Ids.; *C. Papilio* (Hope) Ching, Himalayas, Ceylon; **C. paraphysatus** (Copel., *Dryopteris*), New Guinea; *C. parasiticus* (L.) Farwell, China, Malaya; **C. paripinnatus** (Copel., *Dryopteris*), New Guinea; **C. patens** (Fée, *Goniopteris*) (*D. silvatica* C. Chr.), Africa; **C. peltatus** (v.A.v.R., *Dryopteris*) (*D. Korthalsii* Ros.), Sumatra; **C. penangianus** (Hooker, *Polypodium*) (*D. rampans* C. Chr., *D. pseudocuspidata* Christ), Ceylon-China; **C. pennigerus** (Forster, *Polypodium*), New Zealand; **C. pentaphyllus** (Ros., *Dryopteris*), New Guinea; **C. philippinensis** (Baker, *Nephrodium*), Philippines; **C. pilosiusculus** (Zippel, *Nephrodium*), Java, Luzon; **C. porphyricola** (Copel., *Dryopteris*), Borneo; **C. protecta** (Copel., *Dryopteris*), New Guinea; **C. rhombeus** (Christ: Copel., *Dryopteris*), Philippines;

C. riparius (Copel., *Dryopteris*), New Guinea; **C. roemerianus** (Ros., *Dryopteris*), New Guinea; **C. rubidus** (J. Sm., *Goniopteris*), Philippines; **C. rubrinervis** (Mett., *Phegopteris*), Fiji; **C. rurutensis** (Copel., *Dryopteris*), Polynesia; **C. sagittifolius** (Blume, *Aspidium*), Malaya; **C. salicifolius** (Wall.: Hooker, *Meniscium*), Malaya; **C. sandwicensis** (Brack., *Stegnogramme*) (*D. stegnogrammoides* C. Chr.), Hawaii; **C. simplex** (Hooker, *Meniscium*), Annam-Formosa; **C. simplicifolius** (J. Sm., *Nephrodium*), Philippines; **C. sogerensis** (Gepp, *Dryopteris*), New Guinea; **C. Spenceri** (Copel.: Christ, *Dryopteris*), Mindanao; **C. stipitellus** (Blume, *Aspidium*), Java; **C. Stokesiae** (E. Brown, *Dryopteris*), Rapa; **C. striatus** (Schum., *Aspidium*), Africa; **C. strigosissimus** (Copel., *Dryopteris*), New Guinea; **C. subappendiculatus** (Copel., *Dryopteris*), New Guinea; **C. subpectinatus** (Copel., *Dryopteris*), Tahiti; C. subpubescens (Blume) Ching, Oriental Tropics; **C. sulphureus** (E. Brown, *Dryopteris*), Marquesas; **C. supraspinigerus** (Ros., *Dryopteris*), New Guinea; **D. suprastrigosus** (Ros., *Dryopteris*), New Guinea;

C. taiwanensis (C. Chr.) Ching, Formosa; **C. tephrophyllus** (Copel., *Dryopteris*), Mindanao; **C. terrestris** (Copel., *Dryopteris*), New Guinea; **C. todayensis** (Christ, *Dryopteris*), Philippines; *C. Toppingii* (Copel.) Ching, Borneo; **C. triphyllus** (Swartz, *Meniscium*), India-Japan-Queensland; *C. truncatus* (Poir.) Farwell, Oriental Tropics; **C. uniauriculatus** (Copel., *Dryopteris*), New Guinea; *C. unitus* (L.) Ching, Oriental Tropics; **C. urdanetensis** (Copel., *Dryopteris*), Mindanao; **C. urophyllus** (Wall., *Polypodium*), Malaya-Polynesia; **C. vestigiatus** (Copel., *Dryopteris*), New Guinea; **C. Wollastonii** (v.A.v.R., *Dryopteris*), New Guinea; **C. xiphioides** (Christ, *Dryopteris*), Mindanao.

Like so many other genera, *Cyclosorus* runs riot in New Guinea, with 65 accredited species.

54. Ampelopteris

Ampelopteris Kunze, Bot. Zeit. 6 (1848) 114.

A rather large fern of wet, open places; rhizome creeping, sparsely paleate when elongate; stipes usually approximate or fascicled; lamina growing indefinitely, pinnate, irregularly proliferous and producing smaller fronds or clusters of fronds in the axils of the pinnae, firm-herbaceous, rachis, costae and veins bearing simple deciduous setulae, veinlets anastomosing in many pairs with an excurrent secondary vein; sporangia in more or less definite sori elongate along the veinlets, exindusiate, mixed with globose-

capitate orange paraphyses, annulus usually of 16 cells, spores bilateral, granular.

TYPE: *A. elegans* Kunze, of Java, a synonym of **A. prolifera,** (Retz., *Hemionitis*), Africa across New Guinea. KUNZE was hesitant about the generic status of his *A. elegans,* but seemed more assured in describing a second species.

In his earlier attempt at a "natural classification of the species of Dryopteris" (1911), CHRISTENSEN assigned this species to *Goniopteris.* If that were its affinity, there would be no occasion for its generic separation. But I feel sure that his later judgment, Dansk Bot. Arkiv 7 (1932) 50, placing it in *Cyclosorus,* conforms better to nature. And in *Cyclosorus,* its remarkable proliferation and ramification is so out of order that KUNZE's old generic name may well be restored. The elongation of naked sori occurs repeatedly in *Cyclosorus,* in groups not immediately related.

The young frond-tips of *Ampelopteris* are edible, but inferior to those of *Athyrium esculentum.*

55. Haplodictyum

Haplodictyum Presl, Epim. Bot. (1849) 50; Copel., Univ. Calif. Publ. Bot. 16 (1929) 60.
Haplodictyon Fée, Genera (1850-52) 309.

Small terrestrial ferns, like *Cyclosorus* except that the lower veins are forked, the basiscopic branch anastomosing with a vein from the costa of the adjacent segment of the frond or with the secondary vein which runs to the sinus, the acroscopic branch anastomosing with the next higher vein from the same costa, the effect being that normally four rows of areolae are between adjacent costae, instead of two rows as in *Cyclosorus;* fronds pinnatifid almost throughout, pinnate at base only, surfaces hairy; indusium round-reniform, setose, transient.

TYPE: *H. heterophyllum* Presl.

Two similar species from the wet eastern mountains of the Philippines. Immediately related to the group of *Cyclosorus canescens,* which is polymorphous in the same region. In his Revision of Dryopteris, Bull. Fan (Bot.) 8 (1938) 231, CHING reduced *Haplodictyum* to *Abacopteris,* making that genus heterogeneous. Two years later, Sunyatsenia 5 (1940), he restored it, moved it to another family, and included several relatives which must remain in *Cyclosorus* if the genera are to be definable in words.

56. Sphaerostephanos

Sphaerostephanos J. Smith in Hooker & Bauer, Genera Fil. (1839) 21.
Mesochlaena R. Brown in Horsfield, Plant. Jav. Rar. (1838) 5, *nomen;* J. Smith, Journ. of Bot. 3 (1840) 18.

Like *Cyclosorus* except for somewhat elongate sorus, and oblong indusium fixed along the receptacle and fringed with globose golden glands; rather large, hispid-setose ferns.

TYPE: *S. asplenioides* J. Smith, a synonym of *S. polycarpa* (Blume) Copel.

Six species are credited to the genus, from the Solomon Islands across Malaya.

Sphaerostephanos and *Mesochlaena* are typified alike. SMITH bowed to BROWN's prestige, and withdrew his own, first properly published name, leaving *Mesochlaena* in use for nearly a century. However, an author's control over a name ceases with its publication, and SMITH was as unable as anybody else effectively to subordinate the name he had published.

Sphaerostephanos is derived from *Cyclosorus.* It can be included in the latter genus without making *Cyclosorus* unnatural, and with little change in the generic description. However, *Sphaerostephanos* seems to be a natural group of species, and its maintenance is convenient.

57. Stegnogramma

Stegnogramma Blume, Enum. (1828) 172; Ching, Sinensia 7 (1936) 90.

Terrestrial ferns of moderate size; rhizome short, ascending, paleae

narrow, dark, setulose; stipes fascicled; lamina pinnate with pinnatifid apex, hairy, pinnae crenate or more deeply incised; venation goniopteroid, one to seven pairs of veins anastomosing; sporangia in full development occupying the whole of the primary veins, without indusia, elongate-globose, sporangia setulose, annulus of 16 to 18 cells, spores bilateral, minutely spinulose.

TYPE: *S. aspidioides* Blume, which BLUME named also *Gymnogramme Stegnogramma;* described in Java, and ranging to Ceylon.

CHING includes three other species, extending the range of the genus to Khasya and Szechuan.

Stegnogramma is a derivative of *Cyclosorus.* Many botanists have included them in one genus. If this be done, *Stegnogramma* is the older name; but it is better to hold them distinct. It is very near to *Dictyocline,* the formal distinctions seeming trivial; but I doubt their phyletic unity.

58. Dictyocline

Dictyocline Moore, Gard. Chron. (1855) 854, not seen; Index Fil. (1857) LIX.

Terrestrial ferns of moderate size; rhizome short, ascending, dictyostelic, scaly like the lower parts of the stipes, paleae narrow, fuscous, setulose; stipes fascicled, elongate, short-setose; lamina deltoid-ovate and pinnatifid, or more elongate and pinnate with entire pinnae, dark, herbaceous, pubescent; venation somewhat irregularly goniopteroid to irregularly meniscioid, veins sometimes branching and anastomosing so as to form 3 or 4 rows of areolae between costae; sporangia everywhere on the veins, without indusia, globose, setuliferous, annulus of 16 cells, spores oblong-bilateral, minutely spinulose.

TYPE: *D. Griffithii* Moore, of Assam, ranging to Japan.

The type is pinnate. The broader, usually pinnatifid form is *D. Wilfordi* (Hooker) J. Smith. The two seem distinct to me, but have not usually been so regarded.

Dictyocline is derived from *Cyclosorus,* and CHING has suggested that it be reduced to *Stegnogramma.* They are much alike in hairiness, venation, and absence of definite sori, and their affinity cannot be remote. I doubt, though, that either is descended from the other.

59. Goniopteris

Goniopteris Presl, Tent. (1836) 181.
Monogonia Presl, Tent. (1836) 146 Pl. 5, f. 10, *partim.*

Terrestrial ferns of moderate size; rhizome usually short and ascending to erect, paleate, the paleae bearing branched or stellate unicellular hairs; stipe and rachis usually and other parts sometimes bearing similar hairs, rachis often proliferous at axils or apex; lamina simple to bipinnatifid; veins typically anastomosing in pairs with a secondary vein excurrent where they unite, rarely (in species with deeply pinnatifid pinnae) free; sori dorsal on the veins, round, indusium wanting or round-reniform, sporangia smooth or setulose, annulus of about 14 cells, spores bilateral, usually oblong, with epispore, tuberculate or spinulose.

TYPE: best choice is *G. vivipara* (Raddi, *Polypodium*) Brack., being typical and the first species illustrated by PRESL, who, however, misidentified it as *Polypodium fraxinifolium* Jacq.

Goniopteris is an apparently natural, exclusively American genus of about 70 known species, well characterized by the branched hairs; also by the proliferation, known in many species. *Eugoniopteris* has a terminal pinna more or less like the lateral ones, while sect. *Asterochlaena* C. Chr. has pinnae shading into the pinnatifid apex.

Monogonia has priority of position over *Goniopteris,* but was founded on confusion

and must be rejected. PRESL's figure of it represents *Goniopteris tetragona* (Sw.) Presl; but the more essential parts of his description, and the source ascribed to his plant apply to a *Pteris,* which provided also his specific name.

CHRISTENSEN is disposed to isolate *Goniopteris,* saying that it "is a very natural subgenus, or, as I firmly believe, a very natural genus, not nearly related to the other subgenera, *Meniscium* excepted." The resemblance to *Lastrea* and to *Cyclosorus* seems to me to be sufficient evidence of close affinity. He limited range of *Goniopteris* makes it probable that it is the youngest of the three genera, and likely that it is a descendant of *Lastrea.*

Goniopteris was originally defined by the venation, associated with want of an indusium. The latter criterion is valueless; and to make it a natural genus, some species with free veins must be included.

60. Meniscium

Meniscium Schreber, in Linnaeus' Genera Pl., 8th Ed. II (1791) 757.

Terrestrial ferns of moderate size to large; rhizome usually creeping, dictyostelic, bearing sparse, naked paleae; fronds imparipinnate, or in one species simple, pinnae rather broad, entire or serrate; venation similar to that of *Goniopteris,* but with many pairs of anastomosing veins, the secondary vein excurrent from each anastomosis usually ending free below the next higher anastomosis; sporangia in full fruit completely occupying the anastomosing veins, without indusia, annulus of about 18 cells, spores bilateral, oblong to globose, tuberculate or almost smooth.

TYPE: *M. reticulatum* (L., *Polypodium*) Swartz, of Martinique, ranging to Mexico, Central America, and (credited to) Brazil. The species was indicated by SCHREBER, but its formal naming was by SWARTZ.

A genus of a dozen or more species, all Tropical American. The Oriental species which have been called *Meniscium* belong in FÉE's genus *Abacopteris,* which I include in *Cyclosorus.*

Meniscium is very near to *Goniopteris,* from which it is presumably derived. It seems to have a single fixed disinction — that it is without branched hairs. CHRISTENSEN has expressed grave doubt as to the generic distinction of the two. *Meniscium* is by far the older name.

61. Cystopteris

Cystopteris Bernhardi, Schrader's Neues Journal 1^2 (1806) 5, 26; conserved by Internat. Bot. Congress, Cambridge (1930).
Filicula Séguier; Farwell, Am. Midland Nat. 12 (1931) 234, 251.
Filix Adanson, Fam. d. Pl. II (1763) 20; Underwood, Native Ferns Ed. 6 (1900) 119.
Cystea Smith, Engl. Flora IV (1828) 260, 284.
Cyste Dulac, Fl. Hautes-Pyrénées (1867) 33.

Small terrestrial ferns, rhizome short-creeping, dictyostelic, clothed with thin, brown, broad but attenuate paleae; stipes stramineous to castaneous, with two vascular bundles, lamina thin, bipinnate with incised pinnules or more compound, glabrous, veins free; sori dorsal on the veins, round receptacle hardly raised, indusium attached to the base of the receptacle on the basiscopic side, elsewhere free, thin, paraphyses none, pedicel slender, sporangium globose, annulus longitudinal, of 14-16 thickened cells, spores reniform, smooth or muriculate.

TYPE: *C. fragilis* (L., *Polypodium*) Bernhardi, cosmopolitan. For the nomenclature of this species, see MERRILL, Am. Fern Journal 25 (1935) 137; besides what is there published, Dr. MERRILL writes "LINNAEUS scratched the F. (of Polypodium F. fragile) in his personal copy of the Sp. Pl., clearly indicating that it was an error in ed."

Eighteen species are accreditated to *Cystopteris* in CHRISTENSEN's last accounting, VERDOORN's Manual (1938) 542; but, as he there states, most of them would better be

distributed in *Athyrium. C. tenuisecta* (Blume) Mett., including *Lastrea setosa* Bedd., is Dryopteroid; and, as the last term is usually understood, so is *C. japonica* Luerssen.

Filicula and *Filix* are both rejected by the conservation of *Cystopteris.*

The more recently proposed generic names are all based on *Cystopteris fragilis,* broadly construed.

Cystopteris is not as near to *Woodsia,* where DIELS placed it, as to *Athyrium* and *Lastrea.* These three genera are near enough together so that their more similar, and, judged by this similarity, most primitive representatives might belong to one genus. Their separate maintenance is of course demanded by the widely divergent development of *Athyrium* and *Lastrea. Cystopteris* is thus comparatively primitive in the group which includes more than one-fourth of all "*Polypodiaceae.*"

62. Athyrium

Athyrium Roth (Röm. Mag. 2^1 (1799) 105); Tent. Fl. Germ. III (1800) 58; Milde. Bot. Zeit. (1866) 373.
Diplazium Swartz, Schrader's Journ. "1800^2" (1801) 61.
Allantodia R. Br., Prod. Fl. Nov. Holl. (1810) 149.
Deparia H. & G. Icones Fil. (1829) Pl. 154.
Anisogonium Presl, Tent. (1836) 115.
Digrammaria Presl, Tent. (1836) 116; Hooker, Genera, Pl. 56 C.
Oxygonium Presl, Tent. (1836) 117.
Pteriglyphis Fée (1843); Genera (1850-52) 219.
Lotzea Kl. & Karst., Linnaea 20 (1847) 358.
Brachysorus Presl, Epim. (1849) 70.
Microstegia Presl, Epim. (1849) 90.
Ochlogramma Presl, Epim. (1849) 93.
Hypochlamys Fée, Genera (1850-52) 200, Pl. 17 C, f. 3.
Pseudathyrium Newman, The Phytologist 4 (1851) 370.
Monomelangium Hayata, Bot. Mag. Tokyo 42 (1928) 343.
Cornopteris Nakai, Bot. Mag. Tokyo 44 (1930) 7.
Lunathyrium Koidzumi, Acta Phytotax. 1 (1932) 30.
Homalosorus Small, Ferns Vicinity of N. Y. (1935) 80.

Terrestrial ferns, rhizome commonly erect, dictyostelic, rarely forming an epigaeic trunk, or elongate-creeping, paleate, the paleae with inconspicuous cell-walls, uniformly rather dark or black-marginate, sometimes harsh and black; roots in most species stout and black; stipe with two vascular strands, usually uniting upward to form one peripheral semi-cylindrical strand; fronds of moderate size or large, rarely very small, usually pinnately decompound, sometimes simply pinnate, rarely simple, commonly glabrous except on the axes, herbaceous to coriaceous, veins typically free, sometimes anastomosing without included veinlets; sori dorsal, typically elongate along one or both sides of the veins, very rarely short and roundish, indusium typically curved across the vein at the distal end of the sorus and more or less descending but shorter on the basiscopic side (Athyrioid), or else interrupted at the distal end and produced equally on both sides of the vein (Diplazioid), rarely rudimentary or absent, but on most sori above the lowest ones usually produced only on the acroscopic side of the vein (Asplenioid); sporangia with slender pedicels, of three rows of cells at least in the upper part, annulus of 12-20 (commonly 16) thickened cells, spores bilateral (commonly reniform).

TYPE: *A. Filix femina* (L., *Polypodium*) Roth, almost cosmopolitan. As to date and place of publication, Volume III of the Flora Germanica is dated 1800, but part of it appeared earlier, and this may well have been the first publication of the name. As to the specific type, the first two species listed by ROTH are *Asplenium. A. Filix femina* was sixth, and Nos. 3 to 5 are synonymous of it. As ROTH was describing a genus to be distinguished from *Asplenium* and *Polypodium,* the choice of *A. Filix*

femina as the type is only reasonable, and is accepted without question. The definition of the genus as it is here treated is due to MILDE, who distinguished it properly from *Asplenium,* and combined *Diplazium* with it.

So construed, *Athyrium* is a genus of about 600 known species, distributed over the world about as are ferns in general. It is an old genus. As would be expected of a genus of such size and age, it contains a number of recognizably natural groups; but these groups seem to me to shade into one another so insensibly that their definition is impracticable.

Euathyrium, containing the type of the genus, is characterized by thin-herbaceous texture, fine dissection of the frond, and rather short sori with the indusium crossing the vein. It is so close to the corresponding elements in *Lastrea* and *Dryopteris,* and to *Cystopteris,* that positive reference of species to one or another of these genera is sometimes impossible. Because they so blend, it is reasonable to regard these as the most primitive elements of the several genera. *Euathyrium* is most richly developed in the Northern hemisphere, and particularly in China; but it is present in all fern lands.

The element most diverse from *Euathyrium* is *Diplazium,* typified by ***A. plantaginifolium*** (L. *Asplenium*) Copel., (*Athyrium plantagineum* (L.) Milde), with simple fronds of firm texture, and very long, double sori. The type of *Diplazium* is tropical American, but it represents a small natural group, with fronds simple or simply pinnate, with few pinnae much like the simple fronds, the veins free or anastomosing casually or irregularly, in the tropics of both hemispheres. Although this is the group apparently most divergent from *Euathyrium, Diplazium* must be credited with Antarctic origin, and with having evolved in its present form at least as long ago as the Miocene period.

If we had to deal only with *Diplazium* (as just defined) and *Euathyrium,* nobody would combine them. But the genus as a whole, including both as extremes, is almost surely a phyletic entity. Working from either extreme, I have been unable to find any line where the genus can be divided, leaving distinguishable natural groups. Writers of the last half-century, except myself, have maintained both genera, and seem to have been guided now by the sori, now by the dissection of the frond, now by the texture, in assigning species to one or the other; and it is not practicable to use these criteria in combination. In dealing with the great number of species with decompound fronds, the contraction of the frond toward the base indicates the *Euathyrium* end of the series better than do texture and sori.

As to ultimate phylogeny, the problem is complicated by the facts that, besides the evident affinity of *Euathyrium* to *Lastrea,* etc., there is also affinity to another old and apparently primitive genus, *Blechnum,* and that it is the *Diplazium* end of the series which manifests this affinity. This will be mentioned again in discussing *Blechnum.*

Long confusion of *Athyrium* and *Asplenium,* and inclusion of *Athyrium* in *Asplenium* by METTENIUS, HOOKER and BAKER, have no justification except the elongation of indusiate sori along the veins. Like most of my colleagues, I have referred a species of one of these genera to the other, but this occurs only as the result of imperfect observation. The two are not to be distinguished by the sori alone, but can always be distinguished by the paleae; and so far as my observations go, the bundles in the stipe are equally diagnostic. There is no element in either genus which seems to be particularly related to the other. The affinity of the genera is therefore not clear, and the supposed affinity may rest entirely on one feature of superficial resemblance.

Allantodia, typified by *A. australis, Athyrium australe* (R. Br.) Presl, originally characterized by strongly convex indusia, is in that and other respects typical *Athyrium.* By BROWN'S advice, WALLICH, List (1829) *nomen;* Pl. Asiat. Rar. (1830) 44, Pl. 52, applied this generic name to a very different plant; and to this the name was thereafter restricted until CHRISTENSEN, Index (1905) 227, replaced it by *Diplaziopsis.*

Deparia, typified by *D. Macraei* H. & G., the name changed to *D. prolifera* (Kaulf.) Hooker in 1831, is one of the most variable Hawaiian ferns. In the extreme form named *Deparia,* the fertile veinlet is prolonged to or beyond the margin, and the indusium becomes cup-shaped, wherefore the plant was associated with *Dicksonia.* But no line can be found between sori of this type and those which just reach, and those which fall short of the margin, and bear typical Athyrioid and convex Asplenioid indusia. Plants of the latter type were named *Asplenium deparioides* Brack., *Athyrium*

deparioides C. Chr. All represent one species, and sori of both types occur on a single frond. A peculiarity, however remarkable, thus unstable from plant to plant and even on fronds and parts of fronds, not a valid specific characteristic, certainly is no proper criterion of a genus. The correct name of the species is **Athyrium Macraei** (H. & G., *Deparia*).

As a genus to be known by definition, *Deparia* has been made to include a number of unrelated plants, properly *Dennstaedtia* and *Tectaria,* and the Tectarid *Cionidium.* And these errors are maintained, contrary to the whole genius of his work, even by BOWER, Ferns III (1928) 257.

Anisogonium was a mixture as first described. The first species listed is *A. integrifolium* (Blume, *Diplazium*) Presl, *Athyrium integrifolium* Milde, a synonym of *A. cordifolium* (Blume) Copel. The second species listed, and the first figured, is *A. pinnatifidum* (Kunze, *Diplazium*) Presl. Both of these are immediate relatives of the type of *Diplazium,* distinguished by laxly, casually rather than regularly anastomosing veins. Casual anastomoses occur also, but less commonly, in *Athyrium* (*Diplazium*) *plantaginifolium. Anisogonium,* typified by either of the species mentioned, is not at all tenably distinct.

The same is true of *Oxygonium,* if it belongs in this group at all. This was set up as a genus of two species. *O. ovatum* (Wall., *Asplenium*) Presl is first listed and figured. The other is *O. alismaefolium* (Presl, *Diplazium*) Presl. Both may be *Syngramma.* But PRESL's figure shows conspicuous Diplazioid indusia. Except for the indusium, described and figured, *Oxygonium* might be the preferable name of *Syngramma.* Given the indusium, it is a synonym of *Athyrium.*

The case of *Digrammaria* is equally unclear, although it had a single species, appropriately called *D. ambigua. Asplenium ambiguum* Sw. and *Diplazium malabaricum* Spr. are cited as synonyms. These are *Athyrium esculentum* (Retz.) Copel.; and this may be the best guess as to PRESL's *Digrammaria;* it was so accepted by HOOKER, Genera Pl. 56 C, and by FÉE, Genera 217. The other guess, supported by the facts that PRESL listed *A. esculentum* as *Anisogonium* on the preceding page, and that his figures of *Digrammaria* do not approximately represent that species, is that he was describing here the same fern which he later, Epim. (1849) 142, described again as *Heterogonium;* CHRISTENSEN, Index 227, adopts this view.

Athyrium esculentum, in its typical development, with several pairs of anastomosing veinlets, seems almost as fit for generic segregation as does *Callipteris.* It has been afflicted with at least four specific names in *Callipteris* and two in *Digrammaria.* I do not treat it as typifying a distinct genus because in the eastern part of its range, in New Guinea and Fiji, it shades into forms (*Diplazium dietrichianum, Asplenium vitiense*) with a single pair of anastomosing veins, or even with all of them free. It is by far the most important of ferns, as human food.

Pteriglyphis, typified in FÉE's Genera by *P. elegans,* and *Ochlogramma,* typified by *O. Cumingii,* are actually typified by the same species and same Philippine collection by CUMING; it is *Athyrium Cumingii* (Presl) Milde. In FÉE's opinion, this was also *Oxygonium alismaefolium* Presl, a possible type of *Oxygonium.* The amazing confusion involving all of these supposed genera had several causes. Confusion with *Syngramma* is due to some similarity of venation, and the description of imperfect material. Within the *Diplazium* group, there were two sources of confusion. The anastomosis of the veins of *Athyrium cordifolium* (Blume) Copel., *A. Cumingii* (Presl) Milde, and *A. fraxinifolium* (Presl) Milde is casual in its nature, being irregular even if fairly common. At least of *A. fraxinifolium,* fronds occur with wholly free venation. Also, all of these ferns bear fertile simple fronds, though pinnate in full development. There was a further chance for confusion and doubt in the fact that all of these genera, as well as *Anisogonium* and *Digrammaria,* were based wholly or partly on CUMING's Philippine collections. These collections were arranged in sets and numbered in London, and thence distributed. Whether or not CUMING mixed species in the field, the numbers under which his ferns were distributed often included mixtures. Whether or not that happened in this group, all of the species involved, except as they are *Syngramma,* are near relatives of typical *Diplazium,* without distinctive characters which give the proposed genera any sound claim to recognition.

Lotsea, typified by *L. diplazioides* Kl. et Karsten, was distinguished from *Diplazium* by crenate-ciliate indusia, which do not provide a possible distinction from *Athyrium.*

Brachysorus, typified by *B. woodwardioides,* was characterized as indicated by the generic name, by short sori, with ciliate-lacerate indusia. It represents a considerable group of confused species in the Philippines and New Guinea, present elsewhere in Malaya, which cannot possibly be defined and recognized as a genus.

Microstegia may have been typified by its first species, *M. sylvatica, Callipteris sylvatica* Bory. It was characterized by "venae . . . oppositae in arcus plures triangulares supra-positos anastomosantes," but distinguished "ab Anisogonio venis venulisque liberis." *M. sylvatica,* which I have most recently called *Athyrium bulbiferum* — it is one of the worst name-encumbered ferns — has free veins. The second species was *M. esculenta, Athyrium esculentum* (Retz.) Copel., with anastomosing veins, already discussed. Another of the twelve supposed species was *M. aspera, Athyrium asperum* (Blume) Milde, with free veins. *A. esculentum* and *A. asperum,* in spite of the venation, are somewhat related, but *A. bulbiferum* is remote. Still, PRESL expressed his suspicion of all twelve as "forsitan varietates unius speciei." *Microstegia* has no faintest claim to generic recognition.

Hypochlamys, best typified by *H. pectinatum* Fée, was distinguished by an illusion as to the insertion of the indusium. FÉE later returned the species to *Athyrium.* Its acceptable name is *A. costale* (Desv.) C. Chr.

Monomelangium was typified by *M. Hancockii* (Maxim.) Hayata, revised to *M. Pullingeri* (Baker) Tagawa, Journ. Jap. Bot. 12 (1936) 529; it should be **Athyrium Pullingeri** (Baker). If there is anything to distinguish it generically, it may be presented in the Japanese discussion, for it does not appear in the Latin description.

Cornopteris was typified by *C. decurrenti-alata* Nakai — *Gymnogramma decurrenti-alata* Hooker, *Athyrium decurrenti-alatum* Copel., a relative of *Athyrium japonicum* (Thunb.) Milde, more nearly related to *Euathyrium* than to *Diplazium.* It is characterized by exindusiate sori. CHING, *Sunyatsenia* 5 (1940) recognizes the genus, and ascribes 13 species to it. I do not follow NAKAI and CHING, because there are exindusiate *Athyria* which do not seem nearly related to *A. decurrenti-alatum.* I am unwilling to set up a genus for each independent loss of the indusium, or to recognize one such genus which would be practically indefinable from *Athyrium* as a residual whole. It is worth observing that the indusium of *Athyrium* is unstable, even if less so than in the related *Lastrea;* while in *Asplenium,* with which *Athyrium* has always been associated, the indusium is absolutely constant.

Lunathyrium was typified by *L. pycnosorum* (Christ, *Athyrium*) Koidzumi, of dubious status as a species. It is not clear whether or not KOIDZUMI intended to include *Athyrium acrostichoides* (Sw.) Diels in his genus. In either case, the distinctions, as generic, seem trivial.

Homalosorus, typified by *H. pycnocarpus* (Spr.) Small, *Athyrium pycnocarpum* Tidstrom, more commonly but less correctly called *A. angustifolium* (Mx.) Milde, is likewise based on trivia. After mentioning these, SMALL continued: "If *Athyrium* may be held generically distinct from *Asplenium* there is no good reason why the present fern should not likewise be separated from both its former generic associates." Such statements as this completely ignore affinity as a factor in determining the status of a genus. Such pseudogenera as *Homalosorus* and *Lunathyrium* are proposed in comparisons involving species by the half-dozen or so, without consideration of more than a thousand species of *Asplenium* and *Athyrium,* a fair proportion of which would have to be known and considered, to justify such a statement as SMALL's; and then the statement would not be made.

Pseudathyrium is an older pseudogenus proposed under the same conditions, but based on a character not generally recognized as likewise trivial. Its type was *P. alpestre* (Hoppe, *Aspidium*) Newman, *Athyrium alpestre* Rylands, an immediate relative of *A. Filix-femina,* but commonly exindusiate. *Pseudathyrium* thus preceded *Cornopteris* as the name of an exindusiate *Athyrium.*

If it served convenience to remove single species and small groups from *Athyrium,* many better opportunities could be found where these ferns luxuriate than are afforded by their comparatively few and uniform representatives in northern lands. *Athyrium esculentum,* whether or not it ought to be called *Digrammaria,* is one of these. **Athyrium ceratolepis** (Christ, *Diplazium*), with the lowest pair of veinlets anastomosing uniformly in the lower and central part of the frond, is aberrant and definable; it has

also remarkable paleae, responsible for its specific name. The Philippine *A. vestitum* (Presl) Milde has still more bizarre paleae.

Particularly inviting segregation is a group of species in New Guinea, the Philippines and Borneo, represented by *Athyrium fuliginosum* (Hooker) Copel., *A. porphyrorachis* (Baker) Copel., *A. acrocarpum* (Ros.) Copel., *A. Merrillii, A. longissimum* and *A. altum,* with narrow blackish fronds and copious shining black paleae.

The genera to follow are ferns which I have hitherto included in *Athyrium,* but now remove, since they are recognizable and already provided with familiar names.

63. Anisocampium

Anisocampium Presl, Epim. Bot. (1849) 52.
Oligocampia Trev., Atti Ist. Veneto II 2 (1851) 165, *nomen.*

Rhizome short, clothed with small, entire, thin, pale-brown paleae; stipes clustered, scaly at base, elsewhere naked; lamina of moderate size, imparipinnate, pinnae few, short-stalked, obliquely lanceolate-ovate, acuminate, crenate with toothed lobules, herbaceous, glabrous; veinlets few, the lower ones anastomosing at an acute angle with an excurrent veinlet where they meet; sori dorsal on veinlets, round, indusia minute and deciduous or absent, sporangia long-stalked, annulus of 14-16 thickened cells, spores bilateral, with short-spinescent epispore.

TYPE: *A. cumingianum* Presl, of the Philippines; also, Southern India to Assam and Burma. This species, with four specific names based on CUMING's one collection of an abnormal individual with free basal auricles on the pinnae, has been known best of late as *Dryopteris otaria.* The lack of evident generic place is shown by its many generic names — *Goniopteris, Oligocampia, Aspidium, Cyclodium, Nephrodium, Dryopteris, Athyrium;* of which the last, see CHRISTENSEN, Index, Suppl. III: 40, best indicates its affinity. The auriculate form has never been collected again, and the normal form is rare in the Philippines.

A. paucijugum (v. A. v. R., *Phegopteris*) of eastern Java, has a more elongate rhizome, narrower pinnae with broader base, and more persistent (less caducous) indusia, ciliate, of unstable but unmistakably athyrioid form, as accurately depicted by BACKER and POSTHUMUS, Varenflora voor Java, p. 119.

The range of the genus is similar to that of *Egenolfia.* Until the inclusion of the Javan species, it seemed remarkable in a plant restricted to minor altitudes.

64. Hemidictyum

Hemidictyum Presl, Tent. (1836) 110, Pl. 3, f. 24; Hooker and Bower, Genera, Pl. 55 A.

Large terrestrial ferns, with erect caudex; stipes stout, with two vascular strands (PRESL said one strand, having had presumably only the upper end); frond pinnate, with very large opposite, cordate, entire, thinly herbaceous, glabrous pinnae; veins patent, parallel and occasionally forking halfway to the margin or farther, then branching and anastomosing freely without included veinlets, all ending in a conspicuous intramarginal vein; sori elongate between costae and first anastomoses, Asplenioid, annulus of 14-16 thickened cells, spores bilateral, with coarsely thickened epispore.

TYPE and sole species: *H. marginatum* (L., *Asplenium*) Presl; throughout the American tropics.

PRESL included in the genus *H. Douglasii* (H. & G.) Presl, which is *Phyllitis plantaginea* (Schrad.) O. K.; and, with doubt, *H. Brunonis,* which is *Diplaziopsis javanica* (Blume) C. Chr. *H. finlaysonianum* (Wall.) Moore is an *Asplenium,* as originally named.

Although its sori seem all to be Asplenioid, *Hemidictyum* is more probably an aberrant relative, presumably a derivative, of *Athyrium.*

65. Callipteris

Callipteris Bory, Voyage I (1804) 282.

Large terrestrial ferns, with stout, erect, scaly caudices, paleae uniformly brown, minutely ciliate-toothed; stipes clustered, stout, spinose; fronds typically pinnate with a few pinnae coadunate in the incised apex, rachis commonly proliferous in the upper axils; pinnae large, entire, serrate or lobed, the basal lobes of the lower pinnae sometimes free but adnate, herbaceous or subcoriaceous; veinlets uniting in pairs, typically with an excurrent veinlet running outward from each point of fusion; sori in full fruit occupying the whole of all veinlets, the lowest and the secondary excurrent veinlets bearing diplazioid indusia; sporangia with 16 thickened cells, spores bilateral.

TYPE: *C. prolifera* (Lam., *Asplenium*) Bory, which is *Athyrium accedens* (Blume) Milde. New Guinea to Samoa, Luzon, and across Africa to St. Thomas Island.

C. Ridleyi (Copel., *Athyrium*) is a much more luxuriant species of the Malay Peninsula, with long-stipitate pinnae more than a decimeter wide, with two veinlets running outward from each pair of veinlets, and thus producing a medial row of areolae, besides those touching the main veins.

Digrammaria robusta Fée, which I have not seen, may be a third species, likewise luxuriant, with more divided pinnae. *Diplazium Lastii* C. Chr., of Madagascar, may also belong here.

Restricted to the type species and its obvious derivatives, *Callipteris* is a natural and most easily recognizable genus. BORY included other and unrelated species. J. SMITH, Journ. of Bot. 3 (1841) 409, misconstrued it farther, but partly changed his mind in the same year, Journ. of Bot. 4 (1841) 179. When enlarged to include other or all Athyriid ferns with anastomosing veins, *Callipteris* is no longer a genus, but only an assemblage.

The vein-pattern of *Callipteris* is called Meniscioid; but *Meniscium* and *Callipteris* are descended from distinct genera with free veins.

66. Diplaziopsis

Diplaziopsis Christensen, Index (1905) 227.
Allantodia Wallich, Pl. Asiat. Rar. I (1830) 44, *non* R. Br. (1810).

Terrestrial in damp places, rhizome ascending, clothed with uniformly brown, entire paleae; fronds of moderate size, simply pinnate with terminal pinna similar to others, pinnae few, large, entire or nearly so, membranaceous or somewhat fleshy, glabrous; veins remote and free about half-way to the margin, then divaricately branching, and uniting to form areolae without included veinlets; sori on the acroscopic side of the veins and elongate from near the costa to the lowest anastomoses, indusium very thin, usually bursting to expose the sporangia, but sometimes dehiscing along the distal side, annulus of about 16 thickened cells, spores bilateral, coarsely rugose-reticulate.

TYPE: *D. javanica* (Blume, *Asplenium*) C. Chr., India to Formosa and Samoa. A second species, *D. cavaleriana* (Christ) C. Chr. is reported in China.

Diplaziopsis is distinguished from *Athyrium* by texture, venation and usual mode of opening of the indusium.

Several fern species have been described in Formosa, China and the Himalayas, all regarded by CHRISTENSEN as *Diplazium heterophlebium* (Mett.) Diels, better called *Athyrium heterophlebium* Copel. These are perfectly intermediate between *Athyrium* and *Diplaziopsis*, and may obviously represent the phylogeny of the latter. But, in view of the range of *D. javanica*, it seems equally possible that *A. heterophlebium* is a successful hybrid with *D. javanica* as one parent, or an established reversion toward the older genus, *Athyrium*.

- ***Polystichum***
  - *Lithostegia*
  - *Phanerophlebia*
  - *Cyclodium*
  - *Cyclopeltis*
  - *Didymochlaena*
- *Rumohra*
  - *Maxonia*
  - *Polybotrya*
  - *Bolbitis*
  - *Egenolfia*
  - *Lomariopsis*
  - *Thysanosoria*
  - *Teratophyllum*
  - *Arthrobotrya*
  - *?Lomagramma*
  - *?Elaphoglossum*
- *Dryopteris*
  - *Stigmatopteris*
  - *Adenoderris*
- *Ctenitis*
  - *Psomiocarpa*
  - *Dryopolystichum*
  - *Pteridrys*
  - *Atalopteris*
  - *Heterogonium*
  - *Stenosemia*
  - *Tectaria*
    - *Cionidium*
    - *Tectaridium*
    - *Luerssenia*
    - *Hemigramma*
    - *Quercifilix*
    - *Fadyenia*
    - *Camptodium*
    - *Pleuroderris*
    - *Amphiblestra*
    - *Dictyoxiphium*
    - *Hypoderris*
- *Lastrea*
  - *Currania*
  - *Cyclosorus*
    - *Ampelopteris*
    - *Haplodictyum*
    - *Sphaerostephanos*
    - *Stegnogramma*
    - *Dictyocline*
  - *Goniopteris*
    - *Meniscium*
- *Athyrium*
  - *Anisocampium*
  - *Hemidictyum*
  - *Callipteris*
  - *Diplaziopsis*

Summary on the Aspidiaceae: — We have now completed the description of the genera of the great natural group which included the *Dryopteris* of the Index Filicum. We may not follow CHRISTENSEN'S more recent practice, in calling that genus, as well as my *Microsorium,* unnatural. Except in surprisingly few details, it was natural, in a sense in which such predecessors in respect as *Aspidium, Nephrodium* and *Phegopteris* were never so. Its very naturalness made it more recognizable, and to that extent more convenient, than the component genera here presented, while the latter were too imperfectly understood for equally easy recognition. At the same time, it constituted a block of more than a thousand species, the largest block resisting our understanding of fern phylogeny. As in the case of the other such great block, *Polypodium,* the diversity of its components made it almost certain that it could and should be broken into equally natural and convenient genera of more reasonable size.

As a physical aid in such an attempt, I prepared a card-catalogue of its species, in 1909. It became evident immediately that CHRISTENSEN was already engaged in the same task, and was better prepared; and the press of more practical duties made me glad to await his success. It is rare that a work of such size and difficulty is so largely one man's achievement. In the foregoing presentation, I have ventured to disagree with CHRISTENSEN only in what are to be regarded as minor details. And I particularly regret that he has not lived to round out his work, by indexing the species in the genera he defined.

As far back as the evidence of various kinds permits us now to trace them in time, what was *Dryopteris* constitutes four principal genera — *Rumohra, Dryopteris, Ctenitis* and *Lastrea* — and some derived genera. Three other large genera, *Polystichum, Tectaria* and *Athyrium,* were never included in *Dryopteris,* but are as much a part of the same natural group as are the genera which were so included. *Rumohra* and *Polystichum* are more nearly related to one another than to any other similarly primitive genera. *Tectaria* appears to be derived from *Ctenitis,* but its evolution is lost in geologic antiquity, probably under the ice of Antarctica. *Athyrium* and *Lastrea* are cognate, so far as we may now judge. However old both genera are, extant species might represent a common ancestor. The postulated origin of the derived genera is indicated by the table on page 153.

FAMILY 13 — BLECHNACEAE

Blechnaceae Presl, Tent. (1836) 97, as Section of *Aspleniaceae;* Epim. (1849) 103, as Tribus; PRESL also used this as an ordinal name.

Terrestrial ferns, sometimes becoming scandent; rhizome creeping, or usually becoming erect, sometimes forming a trunk, dictyostelic, paleate with non-clathrate paleae; stipes not articulate; fronds commonly large and coarse, rarely simple, commonly pinnatifid or pinnate, sometimes more compound; veinlets branching and anastomosing to form a secondary vein enclosing a row of areolae on each side of the costa, or rarely several such veins; sori on these secondary veins, discrete or forming continuous coenosori; indusium opening on the costal side, very rarely wanting, sporangia large, annulus longitudinal and interrupted, spores bilateral, usually without epispore.

Two species, *Blechnum punctulatum* Sw., and *Sadleria polystichoides* (Brack.) Heller, vary not only beyond usual generic limits, but beyond the definition of the family. They are ignored in the key to the genera.

Blechnaceae are an old phylum, old enough so that *Blechnum* itself had evolved a number of subordinate groups before its Northward migration. The apparent affinity to *Athyrium* is shown in the discussion of the genus.

Key to the Genera of Blechnaceae: —

Indusium present.
- Rachis scandent ..... **2. Salpichlaena**
- Rachis not scandent.
  - Sori discrete, one to each areola.
    - Fronds uniform.
      - Pinnae harsh, sharply toothed ..... **3. Doodia**
      - Pinnae not harsh nor sharply toothed ..... **6. Woodwardia**
    - Fronds dimorphic ..... **7. Lorinseria**
  - Coenosori not interrupted.
    - Fronds simple to simply pinnate ..... **1. Blechnum**
    - Fronds bipinnatifid or bipinnate.
      - Trunk 1-2 cm. in diameter ..... **1. Blechnum**
      - Trunk stout ..... **5. Sadleria**

Indusium wanting .
- Stem an erect trunk ..... **4. Brainea**
- Stem scandent ..... **8. Stenochlaena**

1. Blechnum

Blechnum Linnaeus, Sp. Pl. (1753) 1077.
Struthiopteris Weiss, Plant. Crypt. Fl. Gott. (1770) 286, not seen.
Lomaria Willd., Mag. Ges. Naturfr. Berlin 3 (1809) 160; Sp. Pl. V (1810) 289.
Stegania R. Brown, Prod. Fl. Nov. Holl. (1810) 152.
Parablechnum Presl, Epim. Bot. (1849) 109.
Distaxia Presl, op. cit. 110.
Mesothema Presl, op. cit. 111.
Spicanta Presl, op. cit. 114.
Blechnopsis Presl, op. cit. 115.
Orthogramma Presl, op. cit. 121.
Lomaridium Presl, op. cit. 154.

Blechnopteris Trev., Atti Ist. Veneto II 2 (1851) 166.
Blechnidium Moore, Ferns Gt. Brit. Nat. Printed (1860) 210; Index (1860) 191.
Homophyllum Merino, Cont. Fl. Galic. Suppl. I (1909) 7.
Diploblechnum Hayata, Bot. Mag. Tokyo 41 (1928) 702.
Spicantopsis Nakai, Bot. Mag. Tokyo 47 (1933) 180.

Terrestrial ferns; rhizome usually stout and ascending to erect, rarely subarborescent, sometimes creeping or scandent, dictyostelic, scaly, paleae various, often harsh, linear, black or black-costate; fronds usually pinnate, sometimes pinnatifid, rarely simple or bipinnate, usually coriaceous and glabrous, margin entire or serrate, uniform or variously dimorphic, sterile veins free except in one species, their apices evidently free or ending in a cartilaginous marginal strand; sori borne on vascular commissures parallel to the costa, one on each side, normally uninterrupted and therefore long and linear, indusium attached to the fertile commissure and opening on the side toward the costa, firm, always present, sporangia usually crowded and rather large, annulus of 14-28 cells (twenty is the commonest number), spores bilateral, reniform to subglobose, usually smooth.

TYPE: *B. orientale* L. or *B. occidentale* L. LINNAEUS listed only the two species and reversed the names; this is regarded as an accident, subject to correction, and *B. orientale* is accordingly the species of the Orient, *B. occidentale* that of America.

An exceedingly diversified but altogether natural genus of more than 200 species, predominantly of the Southern Hemisphere. A single species, *B. spicant* (L.) With. has a wide range in northern lands.

Struthiopteris is typified by *S. spicant* (L., *Osmunda*) Weiss, the sole European species of *Blechnum*. The same species may be regarded as typical of *Lomaria* Willd., *Spicanta* Presl, *Homophyllum* Merino and *Spicantopsis* Nakai, although this was not always the intent. Differently typified but with mention of the same species, *Stegania* represented the same group. As a distinct genus, *Struthiopteris*, oftener known as *Lomaria*, has been characterized by dimorphism, and by the more or less complete absence of lamina outside the sorus, which is thus apparently marginal. Many recent as well as earlier writers have tried to maintain such a distinction. Among these was MOORE, Index XXIV and XXV, who said of *Lomaria:* "This genus is technically very nearly allied to *Blechnum*, its typical species differing in having the sori and indusia at the margin;" and of *Blechnum:* "This genus is only intelligibly distinguished from *Lomaria* by including in it all those species in which the indusia and sori are evidently intramarginal, irrespective of the contraction of the fronds."

Because the contraction of the fertile pinnae ranges from incipient and inconstant to apparently complete absence of sterile surface, with many and not immediately related species illustrating every degree of contraction, MOORE was right, that no generic line can be drawn on this basis. But his criterion, the marginal position of the sorus, is equally impractical, and for the same reason. A great many species seem to have marginal sori, but a more or less inconspicuous trace of lamina can usually be detected, beyond the fertile vein which bears the sorus. Such a trace of lamina is easily evident on *B. spicant*, the type of *Struthiopteris*.

The species with more or less contracted fertile pinnae, and consequently more or less nearly marginal sori, constitute a number of natural groups, but probably not one such group. I see no reason to doubt that the general rule, that uniformity of fronds is more primitive than dimorphism, applies to *Blechnum*. *Struthiopteris* is rejected as a genus, because it is not possible to define it, and also because, however defined, I believe it to be polyphyletic.

As to PRESL'S proposed genera, let us begin by quoting FÉE, Genera, 82, who was himself disposed to recognize genera on mild provocation: "M. PRESL vient tout récemment (*Epimeliae Botanicae*, 1848) de créer dans ce group un assez grand nombre de genres, sur la valeur desquels nous ne sommes pas parfaitement édifié." Besides *Blechnum*, and *Spicanta* which should be *Struthiopteris*, PRESL distinguished:

Blechnopsis*, type, *B. brasiliensis (Desv., *Blechnum*) Presl; like *Blechnum* except for marginal anastomoses, more imaginary than real.

Orthogramma, O. Gilliesii (H. & G. *Lomaria*) Presl; said to differ in the same manner from *Lomaria.*

Mesothema, M. plantagineum Presl, believed to be *Blechnum Lanccola* Sw., but said to be dimorphic, with sori midway between costa and margin.

Distaxia, D. fraxinea (Willd., *Blechnum*) Presl; like *Mesothema* but with uniform fronds.

Parablechnum, P. ciliatum (Presl, *Blechnum*) Presl, which may be *B. capense* (L.) Schlecht.; not distinguishable from *Mesothema* as described, but really dimorphic.

Lomaridium, L. Plumleri (Desv., *Lomaria*), alleged to be exindusiate; it has a conspicuous indusium.

Blechnidium was typified by *B. melanopus* (Hooker, *Blechnum*) Moore, just then described and figured by HOOKER, Sp. Fil. III, 64, Pl. 161, from Khasya. It is like typical *Blechnum* except that the veins anastomose fairly regularly in the sterile lamina. I have never seen it, nor apparently had BEDDOME, who twice copied HOOKER's description and figure. To receive generic recognition, it should be better known.

Diploblechnum, so far as I have ascertained, has never been described unless in Japanese; it is apparently characterized by details of its vascular system.

Spicantopsis, typified by *S. nipponica* (Kunze, *Lomaria*) Nakai, is characterized by the position of its stomata. It would seem more reasonable to reduce it specifically to *Blechnum spicant,* than to distinguish it generically.

Included in *Blechnum* are species more susceptible of generic distinction than any of those, except *B. melanopus,* which have been treated so. Perhaps the most remarkable is *B. Fraseri* (A. Cunn.) Luerssen, New Zealand to Sumatra and Luzon, with trunk fingerthick and a meter tall, bearing a crown of bipinnate fronds. In species with dimorphic fronds, the sterile is more divided than the fertile, if there is any difference in this respect. This is presumably consequent on the anastomosis of the fertile veinlets. In most genera, if there is a difference, the fertile frond is the more divided.

No group of ferns is more conspicuously austral in present distribution, and thus more evidently Antarctic in origin. Fourteen species, all more or less dimorphic, are credited to New Zealand, making *Blechnum* the largest local fern genus. New Caledonia is also rich in the genus; and 17 species are known in New Guinea. Not only the genus as a whole, but several groups of species within the genus, were evidently distinct long enough ago to migrate northward already differentiated.

In harmony with its age, *Blechnum* is regarded as one of the comparatively primitive genera. Except for genera which can be regarded as derived from it, its nearest relative seems to be *Athyrium.* An erect stem is probably more primitive in *Blechnum* than a permanently creeping rhizome. A considerable number of large species have the stout caudex supported by coarse, black prop-roots, and immersed in harsh, dark paleae borne on caudex and stipe-basis. Similar prop-roots characterize a large group of *Athyrium* (*Diplazium*) species; harsh, dark paleae are also common in this group, but the resemblance of the paleae is less complete and less striking than that of the roots.

In *Athyrium,* the lowest acropetal veinlet of each group is the one most regularly fertile. If there is any anastomosis of veinlets, it begins with these lowest ones. If, now, these lowest acropetal veinlets ran regularly, each directly to the next main vein or to a widely divaricate lowest basipetal veinlet thereof, they would produce the fertile vein of *Blechnum,* parallel to the costa; and it is difficult to imagine this peculiar fertile vein as originating in any other manner.

We have an ideally perfect demonstration of how this shift in pattern of fructification can take place, in the often described and figured *B. punctulatum* Sw. (1801). In 1836, KUNZE transferred this species to *Lomaria,* and at the same time described *Onychium Krebsii* as a new species. In 1845, Farrnkräuter I, 176, Pl. 74, he described and figured the latter in detail, as *Scolopendrium Krebsii.* As a *Scolopendrium,* the frond has uncontracted fertile pinnae, with widely divergent, once forked veins, both veinlets fertile, the sori facing each other in pairs — KUNZE, *l.c.,* fig. f; see also SIM, Ferns of South Africa, Pl. 81. In a series of figures, KUNZE showed veinlets shifting from patent to erecto-patent, anastomosis of the acropetal fertile veinlet, disappearance of sorus on the basiscopic veinlet, and finally a frond which in the lower part has a row of contiguous sori opening to each side of the costa, and in the upper part looks like a typical *Blechnum,* the pinnae gradually contracting through the series. This was too much for HOOKER, Bot. Mag. III 10 (1854) Pl. 4768, who, with material from KUNZE, illustrated the "Scolopendrium" form, but as to the others said: "The figure probably belongs to some very different fern." KUNZE remarked: "Der Farrn zeigt den Habitus

einer *Lomaria*, z. B. meiner *L. punctulata*," but seems not to have suspected identity. As the case is now known, the only alternative to identity is the possibility that some of the forms are so established that they may be regarded as species; in which case, the phyletic unity is still certain. SIM, *l.c.*, Plates 77-81, shows a complete series of forms, beginning at the *Blechnum* end.

In the sense of morphology, *B. punctulatum* shows us the transition from *Athyrium* to *Blechnum* — for *Scolopendrium Krebsii*, if it were a fixed species, would be an *Athyrium*. It is hardly imaginable that *B. punctulatum* stands between the two genera in the sense of phylesis. Also, it is hardly possible that it is an unstable hybrid, such as *Pleuroderris* may be; because no possible local *Athyrium* parent is known. Possibly, as a case of atavism, it shows us to-day the course of phylogeny long ago. However it be interpreted, it strengthens the judgment, reached without it, that *Blechnum* and *Athyrium* are related genera, and that *Athyrium* is the more primitive. But again, *Blechnum* is itself a very old genus.

2. Salpichlaena

Salpichlaena J. Smith, in Hooker & Bauer, Genera Fil. (1842) Pl. 93. The name has been written *Salpiglaena* by KUNZE, and *Salpinchlaena* by PRESL and others.

Terrestrial in origin, rhizome said to be creeping and scaly; stipe and rachis indefinitely long, twining and thus climbing through trees, lamina huge, bipinnate, pinnules linear, acuminate, entire unless near the apex, glabrous except for ovate paleae along nether face of costa, usually unequally rounded at base, veins parallel, connected by a marginal strand; sori elongate on a fertile connecting strand, parallel and usually very close to the costa, indusium attached to the outer side of this fertile vein, and vaulted over the sorus, so as to be tube-like, eventually breaking outward, sporangia so densely packed as to be compressed, annulus of about 24 cells, spores bilateral, oblong or reniform with a straight side, smooth or verruculose.

TYPE: *S. volubilis* (Kaulf., *Blechnum*) J. Sm., of Brazil.

A single species, ranging to Peru, Costa Rica and the West Indies.

Abnormally, the fertile commissure is remote from the costa, and the pinna is contracted; this form was described as *Lomaria volubilis* Hooker.

The derivation of *Salpichlaena* from *Blechnum* may not be doubted, but its habit of growth is extraordinary enough to justify its generic separation. The indusium and the marginal strand are other distinctions.

3. Doodia

Doodia R. Brown, Prod. Fl. Nov. Holl. (1810) 151.

Rather small terrestrial ferns; rhizome ascending, bearing stout, black roots, and harsh, dark, small or narrow paleae; stipes densely fascicled, dark to black, scaly at least toward the base, lamina pinnate with numerous close adnate pinnae, narrowed to both ends, pinnae harsh even if thin, sharply toothed, veins divaricately forking, so that the lower veinlets anastomose and form at least one row, and sometimes several rows of areolae on each side of the costa, the veinlet forming the outer wall of each areola typically parallel to the costa, and fertile; sori in at least one series on each side of the costa, typically not contiguous, oblong, the indusium firm, opening on the side toward the costa, annulus of 14 (or 16) cells, spores as in *Blechnum*.

TYPE: *D. aspera* R. Brown, of Australia. BROWN described *D. media* and *D. caudata* at the same time.

Eleven species are distinguished, but the common ones are variable, and seem least distinct when the material for study is most ample. Range: New Zealand and Juan Fernandez to Hawaii and Australia, one species ranging westward to Ceylon.

Although the discrete sori of *Doodia* appear more primitive in character than the

typically uninterrupted sori of *Blechnum*, it is probable that *Doodia* is not merely related to *Blechnum*, but derived from *Blechnum*. The sori of *D. media* are sometimes contiguous. In *D. gracilis*, of New Caledonia, the sori fuse where fructification is most perfect, but the characters as a whole of the species make it referable to *Doodia* rather than to *Blechnum*.

4. Brainea

Brainea J. Smith, Cat. Kew Ferns (1856) 5.
Bowringia Hooker, Journal of Bot. 5 (1853) 237, *non* Bentham.

A large terrestrial fern; rhizome very stout and woody, becoming erect, the larger bundles of old stems arranged in a ring, caudex and stipe-bases immersed in long, linear-aciculate, castaneous, eventually black-costate paleae; fronds densely clustered, short-stipitate, broadly lanceolate, attenuate to both ends, pinnate, pinnae subsessile, coriaceous, sterile ones linear-lanceolate, denticulate, fertile pinnae linear, veins branching, veinlets anastomosing to form a costal series of areolae with the outer side arcuate or angular; sporangia produced on the veinlets surrounding the areolae, and more sparingly on those running toward the margin, eventually covering the nether surface, exindusiate, annulus of about 16 cells, spores bilateral, reniform to globose, smooth.

Type and sole species: *B. insignis* Hooker, of Khasya; ranging to South China, Mindoro and Sumatra.

Usually a fern of burnt-over grasslands; but Christensen has published a photograph by Rock, showing it as a respectable tree-fern in a forest.

Obviously a near relative of *Blechnum*, but very distinct by the loss of definiteness of sori, and of the indusium.

As abnormalities, Beddome has mentioned fronds bipinnate in the lower part, and Smith reported subbipinnate fronds on cultivated plants at Kew.

Some recent writers, notably Bower and Hayata, regard *Brainea* as more primitive than I make it, and regard the stem-structure and annulus as indicating a more direct relation to *Cyathea*. The stem is indeed peculiar, but I know nothing like it in *Cyathea*. The annulus is somewhat irregular, rather than continuous; and it may be recalled that extreme instability of the annulus is associated with irregular expansion of the sorus in *Ceratopteris*. *Brainea* is found in a region where several archaic ferns survive, but I doubt its being one of them.

5. Sadleria

Sadleria Kaulfuss, Enum. (1824) 161.

Typically like typical *Blechnum*, except that the trunk is arborescent and the fronds are bipinnatifid or bipinnate; annulus of 14-24 (commonly 18 or 20) cells, spores bilateral, smooth or flocculose or angular.

Type: *S. cyatheoides* Kaulf.

A genus of 6 or 7 species, endemic in Hawaii. Five species conform to the generic description, and another, *S. polystichoides* (Brack.) Heller, does so in its typical form. But this species shades insensibly into dwarf forms, sometimes held specifically distinct, which are not arborescent, and which have short sori, or interrupted sori, and may even have the veins wholly free, and with the sori on veinlets running toward the margin. One of these extreme forms, named *S. unisora* (Baker, *Polypodium*) Robinson, may have only a vestigial indusium. This series of forms is so complete that I regard it as constituting a single species. When the range of variation extends to interruption of the sori, and even to freedom of venation, the forms are such as are assumed for ancestors of the *Blechnum* group of genera. These forms are surely not primitive, however, but illustrate rather a chance reversal of the old course of evolution.

Sadleria is clearly a relative of *Blechnum*, and is reasonably regarded as derived from that genus.

6. Woodwardia

Woodwardia Smith, Mém. Ac. Turin 5 (1793) 411.
Anchistea Presl, Epim. Bot. (1849) 71.

Rather large terrestrial ferns; rhizome typically ascending to erect and short, stout and densely paleate, but in some species creeping, dictyostelic; stipes fascicled if the stem is erect, remote if it is creeping, elongate, fronds uniform, typically bipinnatifid, firm in texture, margin entire or serrulate, veinlets anastomosing to form costal and costular areolae, and beyond that free or forming additional areolae; sori borne on the outer side of the costular (or costal, or both) areolae, superficial to deeply impressed, indusium opening along the costule, annulus of 18-24 cells, spores bilateral, smooth or flocculose.

TYPE: *W. radicans* (L., *Blechnum*) Smith, of Italy; also in the Atlantic Islands, Himalayas, China, and broadly construed, in the Philippines, Java, New Guinea, Japan, and from Oregon to Guatemala. It is usual to recognize several species in these several regions, but they are much alike. The range of the genus is that just indicated, *plus* Atlantic North America. Christensen seems to hold 12 specific names in respect, but this number is subject to reduction.

Anchistea, typified by *A. virginica* (L., *Blechnum*) Presl, a swamp fern, from Canada to the Gulf of Mexico, was distinguished by an imaginary marginal vein, and by more superficial sori and less vaulted indusium; also, it has a wide-creeping rhizome, and its veins are normally free beyond the costular areolae. The nearest relatives of *W. virginica* are *W. japonica* (L.f.) Smith, and *W. cochinchinensis* Ching. The discontinuous distribution of this group of species is explained as the result of boreal glaciation. The geographic discontinuity of the group of *W. radicans* can be explained in the same way; its absence from Atlantic North America is remarkable among plants with this history.

HOOKER, Sp. Fil. III 70, treated *Lorinseria* as a Section of *Woodwardia,* and included in it *W. Harlandii* Hooker, of South China and Indo-China. As this species is hardly dimorphic, and the venation is more free than that of *Lorinseria,* I prefer to leave it in *Woodwardia,* and regard it as indicating the place in that genus whence *Lorinseria* was evolved. Whichever view be preferred, the group presents a third case of the same kind of discontinuity.

Woodwardia is one of the comparatively few genera characterized by boreal distribution. Its affinity to *Blechnum* is less conspicuous than that of the small genera which have just been treated. However, there is no plausible alternative to the belief that it is Blechnid in origin.

7. Lorinseria

Lorinseria Presl, Epim. Bot. (1849) 72.

A terrestrial fern of moderate size; rhizome wide-creeping, slender, dictyostelic, bearing ovate brown paleae, the older parts naked and black; stipes remote, scaly at base, elsewhere, like costa and costulae, sparsely and deciduously so; fronds dimorphic, the sterile one pinnatifid or barely pinnate at base, segments broadly lanceolate, finely serrulate, herbaceous, veinlets anastomosing freely without included veinlets, marginal veinlets running free into the teeth; fertile frond with the segments contracted to linear, therefore remote, connected by a very narrow wing, margin entire, veinlets forming areolae in a single series along the axes; sori one to each areola, elongate, superficial or becoming slightly impressed, indusium firm, becoming vaulted, opening tardily along the costule, sporangia long-stalked, annulus broad, of about 24 cells, spores bilateral, oblong, smooth or flocculose.

TYPE and sole species: *L. areolata* (L., *Acrostichum*) Presl, a swamp fern, from Maine to Florida and Louisiana.

Lorinseria is evidently derived from *Woodwardia*. It is convenient, and in harmony with practice in other groups where the dimorphic species constitute a phyletic entity, to distinguish it generically on the ground of its dimorphism.

8. Stenochlaena

Stenochlaena J. Smith, Journal of Bot. 3 (1841) 401; 4 (1841) 149; Holttum, Gardens' Bull. 5 (1932) 251.
Lomariobotrys Fée, Genera (1851) 45, Pl. 5 A.

Large ferns; rhizome indefinitely scandent, radially symmetrical, with a few large central fibro-vascular bundles and indefinitely many (up to 40) smaller ones toward the outside, bearing sparse, dark, round or elongate deciduous paleae; stipes remote, corresponding in structure to the rhizome; fronds dimorphic, pinnate or the fertile ones in one species bipinnate, lateral pinnae usually articulate to the rachis and provided with basal glands, firm in texture, glabrous, margin sharply cartilaginous-serrate, veins forming a single row of narrow areolae on each side of the costa, elsewhere (in the sterile fronds) free; fertile fronds with linear, entire pinnae, margin sometimes reflexed, sporangia covering a zone extending from the outer side of the costal areolae toward or almost to the margin, this hymenial region supplied in part by a supplementary system of veinlets, paraphyses wanting, annulus of 12 to 20 cells, variable on single fronds, spores bilateral, hyaline, without epispore, but more or less tuberculate or spinulose and the tubercles sometimes in rows, forming ribs.

TYPE: "Acrostichum scandens, Linn. — var. α. Luzon: (*n.* 133) — var. β. Luzon; (*n.* 226.) — var. γ. Negros; (*n.* 347.)" This citation of *Acrostichum scandens* L. is repeated in HOOKER's Genera, Pl. 105 B., and SMITH, Hist. Fil. 313. The name is SMITH's invention, but is explained by reference to *Lomaria scandens* Willd., which is *Polypodium palustre* Burm., now known as *Stenochlaena palustris* (Burm.) Bedd., and regarded as the type of the genus. *Cuming n. 133,* SMITH's first cited specimen, may be this species. In establishing the genus, SMITH confused *Stenochlaena, Lomariopsis* and *Teratophyllum,* believing that his material represented a single species, and being most impressed by tripinnatifid fronds, which belong to *Teratophyllum.* In this confusion, he has been followed by HOOKER, CHRIST, CHRISTENSEN and myself. Although the other genera were described long ago, the first careful and convincing description and discrimination are HOLTTUM's.

S. palustris is a variable species, ranging from India into Polynesia. *S. laurifolia* Presl is usually distinguished, and *S. juglandifolia* Presl sometimes.

S. areolaris (Harr.) Copel., of Luzon and New Guinea, presents a remarkable case of specific adaptation to its habitat. Where first known, at Majaijai, Luzon, it is locally common in the crown of a single species of large pandan with very broad leaves holding water in their axils. The rhizomes of the *Stenochlaena* run from one of these water-brackets to another, branching freely, and developing great masses of the fern. With a single exception, said to be scandent on banana and betle in New Guinea, all of my specimens of this species are from the crowns of *Pandanus.*

Lomariobotrys, typified by *Lomaria tenuifolia* Desv., *Stenochlaena tenuifolia* (Desv.) Moore, of tropical and South Africa and the East African islands, has bipinnate fertile fronds. *Cafraria* Presl, Epim. (1849) 166, is an earlier name for it as a section of *Stenochlaena.*

My former judgment, that *Stenochlaena* was derived from *Asplenium,* was based on confusion, and is abandoned. HOLTTUM believes it to be related to *Acrostichum,* but this seems to me improbable; for one objection, *Acrostichum,* like other Pteridoid ferns, has tetrahedral spores. J. SMITH, in HOOKER's Genera, suggested affinity to *Blechnum.* BOWER supports this view most confidently, but it does not appear that he studied any species properly included in the genus. My present opinion, or guess, is that SMITH was right. The venation is the original support of this suggestion. The spores support it. The texture and margin are similar to those of some *Blechnum*

species. And some species of *Blechnum* have scandent rhizomes. Without approaching *Stenochlaena* in this respect, such species, *B. ensiforme* (Liebm.) C. Chr. for example, have numerous bundles in the rhizome. In *Brainea*, as in *Stenochlaena*, they are indefinitely numerous.

Remarks on the Blechnaceae: — *Blechnum* is an old genus, of Antarctic origin. Several phyletic lines within the genus were differentiated prior to the general migration and dispersal.

The other genera of the group may all have become distinguishable more recently, and where they now exist: *Doodia* in Polynesia or farther South; *Sadleria* in Hawaii; *Salpichlaena* in America; *Brainea* in the Malay-Asiatic region. In the characters which have served most constantly and conveniently for the recognition of genera, *Brainea*, with ill-defined and exindusiate sori, is the most divergent of these genera. An erratic form of one species of *Sadleria* also loses its indusium.

The genus which has evolved most freely in independence of *Blechnum* is *Woodwardia*. It only has spread around the World, become discontinuous in distribution, evolved recognizable subgeneric groups of species, and given rise to one of these which may conveniently be treated as a genus. The place (region) of origin of *Woodwardia* may be suggested, but is no more than suggested, by its presence in Java and its recent discovery in New Guinea.

Repeated emphasis may well be given to the fact that, while boreal discontinuity obviously betokens the passage of more time than has to be assumed for specific evolution and continuous expansion, this time may still be a small fraction of that indicated by austral discontinuity, resulting from the glaciation of Antarctica. Neither the distribution of *Woodwardia*, nor the evolution of its subordinate groups, is proof that it is an older genus than *Doodia*. We can say confidently that *Blechnum* is the oldest genus of the group, and may with some reason believe that *Lorinseria* is the youngest; but have no basis for an opinion as to the relative age of the other genera.

FAMILY 14 — ASPLENIACEAE

Aspleniaceae S. F. Gray, Ar. Brit. Pl. II (1821) 11, as division; Presl, Tent. (1836) 91, as Tribus.

Typically terrestrial but sometimes epiphytic ferns, never arborescent; rhizome creeping or suberect, dictyostelic, clothed with clathrate paleae; stipes non-articulate, normally with two fibro-vascular bundles uniting toward the top; fronds simple to decompound, very small to very large, usually firm in texture; veins forking, free or anastomosing without included veinlets; sori elongate along the veinlets, with indusia of the same shape attached to the veinlets, rarely exindusiate, pedicel in large part a single row of cells, annulus longitudinal and incomplete, commonly of about twenty cells, spores bilateral.

The family consists of one great and diversified genus, *Asplenium;* seven small genera the derivation of which from *Asplenium* is remarkably clear; and one small genus, *Pleurosorus,* apparently of the same affinity, but longer distinct and of less evident origin.

Asplenium seems to be of Antarctic origin, and to have evolved a number of minor groups prior to its dispersal. The other genera, except *Pleurosorus* and possibly *Loxoscaphe,* are more recent. There is no evident particular affinity to any other family with longitudinal annulus. Because of the similar shape of the indusiate sorus, *Athyrium* has been confused with *Asplenium* but affinity of the two genera is remote indeed.

Key to the Genera of Aspleniaceae: —

Indusium conspicuous.
- Indusium wide at right angle to vein ..... **2. Loxoscaphe** and 2 species of **Diellia**
- Indusium longer than wide.
  - Veins free or with marginal strand or anastomosing only casually ..... **1. Asplenium**
  - Venation reticulate, frond simple.
    - Apex of frond protracted, radicant ..... **7. Camptosorus**
    - Apex not radicant.
      - Frond elongate.
        - Areolae in four or more rows ..... **6. Holodictyum**
        - Areolae less numerous ..... **8. Antigramma**
      - Frond round-flabelliform ..... **9. Schaffneria**
  - Venation reticulate, frond not simple ..... **3. Diellia**

Indusium none or vestigial.
- Lamina paleate beneath ..... **4. Ceterach**
- Lamina hairy ..... **5. Pleurosorus**

1. Asplenium

Asplenium Linnaeus, Sp. Plant. (1753) 1078.
Phyllitis Ludwig, Instit. Hist. Phys. Regn. Veg. (1757) 142.
Scolopendrium Adanson, Fam. des Plantes II (1763) 20.
Caenopteris Berg., Acta Acad. Petrop. (1786) 249.
Darea Juss., Genera Pl. (1789) 15.
Glossopteris Raf., Journ. Phys. 89 (1819) 262.

Acropteris Link, Hort. Berol. (1833) 55; (1841) 80.
Neottopteris J. Smith, Journal of Bot. 3 (1841) 409; 4 (1841) 175.
Amesium Newman, Hist. Brit. Ferns, ed. II (1844) 10.
Thamnopteris Presl, Epim. Bot. (1849) 68.
Tarachia Presl, Epim. Bot. (1849) 74.
Micropodium Mett., Ann. Mus. Lugd. Bat. 2 (1866) 232.
Diplora Baker, Journal of Bot. 11 (1873) 235.
Asplenidictyum J. Smith, Hist. Fil. (1875) 333.
Eremopodium Trev., Atti Ist. Veneto V 3 (1877) 589.
Triphlebia Baker, Malesia 3 (1886) 46.
Arcasplenium Moore *apud* Baker, Kew Bull. (1901) 145; synonym.
Chamaefilix Hill (1756); Farwell, Amer. Midl. Nat. 12 (1931) 268.
Hymenasplenium Hayata, Bot. Mag. Tokyo 41 (1927) 712.
Boniniella Hayata, Bot. Mag. Tokyo 41 (1927) 709; 42 (1928) 337; Flora 124 (1929) 50.

Terrestrial and epiphytic ferns, small to large; rhizome usually short-creeping, but varying to erect, dictyostelic, clothed with clathrate (cell-walls colored, lumina hyaline) paleae; stipes approximate, non-articulate, usually with two fibro-vascular bundles which fuse into one; fronds ranging from simple and entire through pinnate to decompound, usually firm in texture, and glabrous or minutely scaly, veins usually forked, typically free, exceptionally casually anastomosing or connected by a marginal commissure; one sorus produced on the basiscopic (exterior) side of each fertile veinlet, elongate along the veinlet, with an indusium like the sorus in origin and size, pedicel of sporangium long and in part a single row of cells, annulus usually of 20-28 cells, spores bilateral, smooth or spinulose.

TYPE: *A. Trichomanes* L., of Europe, Asia, North America and New Guinea. This seems to be the most eligible Linnaean species for selection as the type of the genus. It is as representative as any one species, is European, was included in every Linnaean list of the species, and is not typical of any proposed segregate genus.

A genus of nearly 700 recognized species, well represented in all habitable lands. "Le genre *Asplenium*, le plus vaste de la famille des polypodiacées, renferme des plantes de toutes les formes et de toutes les dimensions" — FÉE, Genera, 189. Except *Lindsaea*, it is the only genus which is indifferently terrestrial and epiphytic, without any general adaptation to either habitat sufficient to unfit it for the other.

Phyllitis; *Scolopendrium* and *Glossopteris* were all based on *Asplenium Scolopendrium* L., and are therefore exactly synonymous. The oldest complete name for this species in any genus other than *Asplenium* is *Scolopendrium vulgare* Smith (1793), and if I were maintaining a genus typified by it and distinct from *Asplenium*, my preference would be to call it *Scolopendrium*. Almost all recent writers do recognize such a genus, and call it *Phyllitis*. There are two objections to the recognition of the genus, and if it is not recognized, argument as to the name is superfluous. Such a genus is superficially, rather than essentially, distinguishable from *Asplenium*. And, if there is one such genus, there are several, too much alike for practical distinction.

The fronds of *A. Scolopendrium* are simple. Its veins are usually and normally forked, once or several times. In consequence of the size of the undissected frond, its veins, being free, run parallel for a large part of the length. A forked vein of *Asplenium* bears a sorus on the outer side of the acroscopic veinlet. If the basiscopic veinlet is also fertile, which is not usual in the genus, it is borne on the basiscopic side. This sorus will then face, and its indusium will open on the side toward, the sorus on the acroscopic veinlet of the adjacent vein. In *A. Scolopendrium*, the basiscopic veinlet is regularly fertile, and the parallel sori facing one another are so close together that they look like one sorus, with two indusia meeting along its median line. This "double sorus" gains something in the protection of the sporangia, and has become fixed as a character of the species. Still, it is a natural consequence of the production of sori on both veinlets, instead of on one only; and this is not so remarkable a feature that it would have been regarded as of generic significance, except for the close and regular

pairing of the sori. Although the apparently double sorus is thus no more than a special case in *Asplenium*, I would agree with my colleagues in recognizing *Scolopendrium* or *Phyllitis* as a genus, if it were not for the second objection, that several hardly distinguishable genera would have to be recognized.

Thirty years ago, I studied a group of Papua-Malayan species, on which BAKER had based his genera *Diplora* and *Triphlebia*, and was able to show that their soral characters were identically those of *Phyllitis*. Therefore, I discarded BAKER's genera, and agreed with OTTO KUNZE in the transfer of the species to *Phyllitis*. But I was also able to show with approximate certainty whence, in *Asplenium*, these species had been derived, and to present a species, *A. epiphyticum*, representing a potential ancestor. Later, it occurred to me that *A. epiphyticum* was not a potential ancestor of *A. Scolopendrium*, which, therefore, could not be congeneric with such species as *Scolopendrium longifolium* Presl and *S. Durvillei* Bory, unless in the common ancestral genus, *Asplenium*. CHRISTENSEN, Suppl. III, 9, 78, respected my argument, and restored the genus *Diplora*. We then had two genera, *Phyllitis* and *Diplora*, perfectly alike in the usual terms of generic definition. This would not be a satisfactory condition, but would be endurable.

The condition becomes intolerable when we recognize the fact that the production of apparently double sori, consequent on the production of basiscopic sori by *Asplenium*, has been arrived at independently, not just twice, but at least six times.

These results of convergent evolution are:

1) *Asplenium Scolopendrium* L.

2) *Scolopendrium Durvillei Bory*, the valid name of which seems to be *Asplenium scolopendropsis* F.v.M. Its near relative, *S. longifolium* Presl, has no specific name valid in *Asplenium*; it may bear the name of its first collector, and be **A. Haenkei**, *nomen novum*. Less immediately related, but probably in the same phyletic group, is **Asplenium schizocarpum** (Copel., *Scolopendrium*).

3) **Asplenium Delavayi** (Franch., *Scolopendrium*), of South China, Tonkin and Burma.

4) *A. cardiophyllum* (Hance) Baker, of Hainan, Formosa and Bonin. This is HAYATA's genus *Boniniella*. There is some anastomosis of veins near the margin, but it is casual rather than regular.

5) *Antigramma* Presl.

6) *Schaffneria* Fée.

Antigramma and *Schaffneria* present peculiarities in venation, on the basis of which they can be distinguished as genera.

Somewhat related to *Diplora*, but very remotely so to *Scolopendrium*, is the showy group of "bird's nest ferns," common from Polynesia to India, typified by *Asplenium Nidus*. J. SMITH typified the genus *Neottopteris* by this species, and used an intramarginal vein, connecting the apices of the parallel and otherwise free veins, as the diagnostic generic character. PRESL had already, Tent. (1836) 105, founded a Section (of *Asplenium*) *Thamnopteris* on this species, characterizing it in the same way, and later he raised the section to a genus. As a genus, *Neottopteris* has priority. In this group, the sori are invariably on the side of the vein or veinlet toward the apex of the frond. The fronds of some of these ferns may reach a length of two meters and a width of 30 centimeters. The intramarginal vein has an obvious value, in protecting such great leaf areas from being torn, by wind or otherwise.

Neottopteris is not maintained as a genus because there are species in which the marginal anastomoses are casual or occasional, standing at least morphologically between species with wholly free veins and those with a continuous commissure. Also, it seems to me that, in at least two cases, species with the marginal vein are independently related to species without it.

Micropodium was a genus to be distinguished from *Asplenium* by articulation of the stipe, and had originally two species, *M. sundense* (Blume, *Asplenium*) Mett., and *M. longifolium* (Presl, *Scolopendrium*) Mett. J. SMITH, Hist. Fil. 323, retained the genus, but was evidently skeptical about the articulation, "The articulated vernation, if it really is so . . . " I do not know *A. sundense* Blume, by name. *S. longifolium* Presl is not articulate. I do not believe that any *Asplenium* or near relative of *Asplenium* has really articulate stipes. *A. sundense* and *A. vittaeforme* Cav. constituted the genus *Eremopodium*.

The *Asplenium* species of the oriental tropics with simple fronds and wholly free veins form two groups: 1) Those with fascicled or approximate, coriaceous, non-viviparous fronds, represented by *A. vittaeforme* Cav.; this group blends with *Neottopteris.* 2) Those with elongate rhizome, and thinner, often viviparous fronds, represented by *A. amboinense* Willd.; this group is related to *Diplora.* The American *A. serratum* is not evidently related to either oriental group.

At the other extreme from the groups of species just discussed, are the many species of *Asplenium,* with finely dissected fronds. Dissection reaches its extreme when each ultimate pinnule or segment has room for a single vein, bearing a single sorus, with the free side of the indusium more or less conterminous with the edge of the lamina. This is the condition in *Caenopteris,* originally based on three species of South Africa and the East African islands, reasonably typified by *A. rutaefolium* (Berg., *Caenopteris*) Kunze. This genus was adopted by SWARTZ, Syn. Fil. 87, with citation of *Darea* as a synonym. *Darea* postdated *Caenopteris,* and was not well established, but WILLDENOW, Sp. Plant. V, 295, took it up, and it has been held in some respect, as genus, subgenus or section, by many later writers. Neither *Caenopteris* nor *Darea* can be a genus, because it shades imperceptibly into *Asplenium,* and because any definition will include a most heterogeneous lot of species. In other words, dissection of the frond, and some contraction of the lamina, have taken place independently in many natural groups of species of *Asplenium. Caenopteris,* or *Darea,* is a convenient descriptive term, not the distinctive name of any natural group.

Acropteris, typified by *Asplenium septentrionale* (L., *Acrostichum*) Hoffm., is reduced rather than dissected, having an apparently dichotomous rather than pinnate frond, with one or very few pinnae perhaps 2 cm long and 1 mm wide. It differs from *Caenopteris* solely in the degree of reduction.

A. Ruta-muraria L. is a relative of *A. septentrionale,* likewise of wide distribution in northern lands, but less finely dissected than *Caenopteris.* Each of the little pinnules is entered by a vein which forks low down in the cuneate base, each veinlet usually forking again near the base. The effect is that the pinnules are ecostate. On the basis of this peculiarity, it typified the genus *Amesium.* As a result of the forking of the veins, the sori on the inner veinlets face away from the margin, facing one another. This fits them to the formal definition of *Scolopendrium,* to which the species was transferred by ROTH, although two species of *Asplenium* could not be more remotely related than are *A. Scolopendrium* and *A. Ruta-muraria.*

Tarachia was a heterogeneous as well as diverse assemblage of rather finely dissected species which seemed to PRESL to differ from *Asplenium* in the position of the sorus. The name of the proposed genus means disorder, "conditionem variam sori et indusii indicans."

Chamaefilix is FARWELL'S amendment of *Chamae Filix* Hill. When FARWELL was so disposed, an author's spelling was a law of the Persians; thus, Am. Midland Nat. 12: 264, as to *Lindsaea,* "Under the International Rules DRYANDER'S spelling cannot be changed." Chamae Filix, Adiantum nigrum and the like are not tolerable generic names. Their rejection is not a quibble; it is a matter of principle. Their author wrote after the publication of LINNAEUS' Species Plantarum, but before the general adoption of binomial nomenclature. His practice, or lack of any uniform practice, was pre-Linnaean. If such an author chanced occasionally to use a binomial, it was no more than chance. None of his names should be adopted.

The reason for a genus *Chamae Filix* was the belief — to express it in to-day's terms — that *Asplenium* should be typified by *A. Ceterach* L. A good argument could have been made for this proposition in HILL'S time, and a weak one is made now. But under no condition should Chamae Filix be the name, or be made over into the name, of our genus *Asplenium.*

Asplenidictyum was founded on two species, *A. finlaysonianum* (Wall.: Hooker, *Asplenium*) J. Smith, of India, and *A. purdieanum* (Hooker) J. Smith, of the Andes; the former is the eligible type. The distinctive character is the anastomosis of the veinlets toward the margin of the pinnae. While these anastomoses are copious, they are irregular, and may be regarded as casual; on small but fertile fronds, they may hardly occur. Partly for this reason, but more because it seems unlikely that the two species are directly related, I do not maintain the genus. *Asplenium finlaysonianum* is an aberrant species of the group of *A. falcatum* Lam.

Hymenasplenium seems to have been published in Japanese if at all, to be typified by *Asplenium unilaterale* Lam., and to be distinguished by some peculiarity of the stelar structure.

In the description of *Asplenium,* it was stated that the sorus is borne on the basiscopic side of its vein or veinlet. Since most of the proposed segregate genera are based on apparent exceptions to this rule, or on the consequences of apparent exceptions, the rule may well be clarified. Other terms synonymous with basiscopic are "catadromic" and "exterior." Reference is always to the immediate source of the veinlet, not to the frond as a whole. Thus, if a vein fork, each veinlet has an interior side looking toward the twin veinlet, and an outer, exterior or basiscopic side; the latter, if either, bears the sorus. In *Neottopteris,* the veins normally fork once, and only the veinlet toward the apex of the frond is fertile; therefore, all sori look toward the apex of the frond. In *Scolopendrium,* both veinlets are fertile, their sori opening in opposite directions. In species with highly dissected fronds, the rule must be interpreted by reference to the origin, below the leaflet, of its vein.

Asplenium is a most natural genus. No species or group of species is suspected of origin independent of the genus as a whole. In a genus so large, there are of course natural groups of species, some of them easily recognizable. *Asplenium Trichomanes* represents such a group. These groups are remarkably indefinable. Like HOOKER, Sp. Fil. III, 93, "I have endeavoured in vain to find tangible characters for the larger or even any groups, into which the genus *Asplenium* (§*Euasplenium*) can be conveniently divided. Others have met with the same difficulty. PRESL, who was the first to give a list of a really large number of species, has only two divisions: 1) *'frons coriacea;'* 2) *'frons herbacea;'* and nothing can be more unsatisfactory."

It is unsatisfactory; but the largest natural group I have been able to recognize is characterized by texture. A great number of species have distinctly fleshy fronds, and are potentially viviparous, producing one to many buds along their axes. Included are species with simple, pinnate and decompound fronds. I feel sure that this is a natural group.

A single species, *A. bipinnatifidum* Baker, with four or five names, New Guinea to Fiji, is proliferous by slender runners.

It must remain for a future monographer to determine what natural groups include the more numerous species with firmer, drier, non-proliferous fronds.

No group within *Asplenium* is recognizable as approaching any other genus — except, of course, the genera regarded as derived from *Asplenium.* In several unrelated cases, species of *Asplenium* and *Athyrium* are confusingly similar, but I believe that all of these result from evolutionary convergence, not divergence. The resemblance in form of sorus and indusium has led most pteridologists to associate these two great genera, has led not a few to include *Athyrium* in *Asplenium.* I see no good evidence that they are at all nearly related. When the old family *Polypodiaceae* is broken into any considerable number of families, *Asplenium* must typify one family, and this should not include *Athyrium.*

There is enough evidence that *Asplenium* is a member of the vast group of Cyatheoid ferns, in distinction to the Dicksonid and Matonid phyla. Because it must have some place, it may follow the *Athyrium* and *Blechnum* groups.

Asplenium is a very old genus. The period of its distinctive existence is more than is indicated by the presumption that it migrated in its present form from Antarctica.

2. Loxoscaphe

Loxoscaphe Moore, Journal of Bot. 5 (1853) 227.

Stem short and erect, scaly; stipes fascicled, elongate, sparsely scaly; lamina ovate, repeatedly pinnate and pinnatifid, so finely dissected that ultimate segments are one-veined, thin-herbaceous, light-green, sparsely squamulose with usually minute clathrate paleae; sori solitary, lateral or subterminal on the vein, receptacle short (along the vein), indusium broad (at right angle to receptacle), fixed by base and sides, pedicels long, mostly of one row of cells, annulus of 18-20 cells, spores oblong or oblong-reniform, sparsely spinulose by shrinkage of the epispore.

TYPE: *L. concinnum* (Schrad., *Davallia*) Moore, of Natal, regarded as a form of L. *theciferum* (H. B. W.) Moore, of tropical America and Africa.

Loxoscaphe is distinguished from *Caenopteris,* using this term as already explained in a purely descriptive sense, by the shortening of the sorus, and the widening of the indusium and attachment of its sides, giving it the appearance of *Davallia,* in which genus most of the older species were described; or even of *Trichomanes,* in which the first species known, *L. gibberosum,* was first named. No sharp line exists between *Loxoscaphe* and *Asplenium.* I maintain the genus, as CHRISTENSEN has recently done, Suppl. III: 125, because in typical development it looks very distinct, and because I feel satisfied that it is a natural group.

Species are:

L. theciferum (H. B. W.) Moore, the range already stated.

L. nigrescens (Hooker) Moore, tropical Africa, with large fronds and small lateral sori near the bases of the segments.

L. gibberosum (Forster) Moore, throughout Polynesia, common and variable, always large and showy. *L. brachycarpum* (Mett.) Kuhn, of the New Hebrides, is hardly distinct. *L. foeniculaceum* (Hooker) Moore, of Fiji, is also doubtfully distinguishable.

L. novoguineense (Ros.) C. Chr., and *L. Schultzei* (Brause) C. Chr., both of New Guinea; these are the most delicate species of the genus.

CHRISTENSEN includes here also *L. Mannii* (Eaton) Kuhn, which I prefer to treat as *Diellia.*

The geographic range of *Loxoscaphe* is proof of age, and makes it probable that it originated in Antarctica. Its nearest extant relative is the Polynesian *Asplenium shuttleworthianum* Kuhn. Since the affinity is manifest, it would be natural to include this species in *Loxoscaphe;* but, if the form of the sorus be not insisted upon for the definition of the genus, it becomes impossible to fix any line of separation from *Asplenium.*

3. Diellia

Diellia Brackenridge, U. S. Expl. Exped. XVI (1854) 217, Pl. 31.

Terrestrial ferns of small or moderate size; rhizome short, more or less erect, bearing dark, lanceolate, attenuate, clathrate paleae; stipes fascicled, black, variously paleate and minutely pubescent or glabrescent; lamina pinnate to decompound, herbaceous, glabrous, venation reticulate without included veinlets unless the dissection of the frond is too fine to permit anastomoses; sori terminal on enlarged or curved apices of free veins of dissected fronds, or on anastomosing veinlets and then somewhat elongate parallel to and close to the margin, indusium opening toward the margin, firm, pedicel of one row of cells, annulus of about 20 cells, spores dark, round-oblong, irregularly flaky-spinulose.

TYPE: *D. falcata* Brack.

A genus of 9 or less species, endemic in Hawaii. The species are variable, and some of them blend; the number that are really distinct is uncertain. The position of the sorus, whether on single free veins or on anastomosing veins, is as in *Lindsaea,* wherefore it has been usual to include *Diellia* in *Lindsaea* or to associate the two genera. They are not related.

Diellia is derived from *Loxoscaphe.* The most primitive species are *D. Mannii* (Eaton) Robinson and *D. Alexandri* (Hill.) Diels. CHRISTENSEN, Suppl. III, 126, treats the former as *L. Mannii* (Hill.) Kuhn, but it would be an isolated species in *Loxoscaphe,* and is part of a series in *Diellia. Loxoscaphe* was evolved by progressive dissection of the frond of *Asplenium,* the sorus becoming "apparently marginal because the size of the segments leaves no other possible position. The evolution of the species of *Diellia* has been by a progressive simplification of the frond, in which the sorus remained near the margin, and the veins, merely as in many other phyletic lines, united as the intact area of lamina became ample enough to let them unite." — Univ. Calif. Publ. Bot. 16 (1929) 75.

4. Ceterach

Ceterach Garsault, Explic. abrégée 2 (1765) 140, Pl. 212, *teste* v. Beck, Oest. Bot. Zeit. 67 (1918) 59; conserved.
Notolepeum Newman, Hist. Brit. Ferns Ed. II (1844) 9.

Small terrestrial or saxatile ferns; rhizome short, erect, bearing lanceolate, attenuate, entire or casually toothed, clathrate paleae; stipes fascicled, short; lamina lanceolate, pinnatifid or subpinnate, thick and opaque, glabrous above, densely scaly with broad clathrate paleae beneath, veins forked and typically anastomosing toward the margin; sori elongate, indusium obsolescent or obsolete, pedicel of one row of cells, annulus of 20-24 cells, spores bilateral, round-oblong, dark, tuberculate or flaky-tuberculate.

TYPE: *C. officinarum* D.C., of Europe, Asia and North Africa. It was already *C. officinarum* Bauhin, and *Asplenium Ceterach* L. As a common South-European plant of reputed medicinal virtue, it was well known, as *Ceterach* and as *Asplenium*. Because it was the *Asplenium* of TOURNEFORT, there was ground for regarding it as typifying that genus, before our rules for interpreting names were codified. ADANSON listed it as *Ceterac* in 1763, but his publication was not valid. *Ceterach* as a genus has usually been credited to DE CANDOLLE and dated 1805. Immediately afterward, WILLDENOW ascribed it to himself. *Notolepeum* had the same type.

A genus of three feebly differentiated species. *C. aureum* (Cav.) v. Buch, of the Atlantic Islands is much larger, with freely toothed golden scales, but is dwarfed to the stature and aspect of *C. officinarum* in exposed places. *C. cordatum* (Thunb.) Desv., of South Africa, has partly pinnate fronds, is less scaly, and the veins are typically free; but SIM, Ferns of South Africa Ed. II, p. 175, states that it is variable and not always distinguishable from *C. officinarum*. *C. officinarum* is credited to Madeira and to South Africa. My judgment is that both reports are wrong. *C. cordatum* and *C. aureum* are distinct species, because under their typical conditions they develop in ways impossible for *C. officinarum*. They are distinct species in spite of the fact that under other conditions they may be distinguishable with difficulty if at all.

Another species named as *Ceterach, C. phillipsianum* Kümmerle, of East Africa, is unknown to me.

The remaining one or two species called *Ceterach, C. Dalhousiae* (Hooker, *Asplenium*) C. Chr., and *C. paucivenosum* Ching, of the Himalayan region, are *Asplenium*. They have glabrescent fronds, free veins, and well developed persistent indusia. It is simply impossible to define *Asplenium* so as to exclude them, and difficult to define *Ceterach* so as to include them.

While I entertain no doubt as to the propriety of leaving *A. Dalhousiae* in *Asplenium*, its affinity to *Ceterach* is obvious, and makes evident the place in *Asplenium* (§*Ceterachopsis* J. Smith) from which *Ceterach* was evolved.

5. Pleurosorus

Pleurosorus Fée, Genera (1850-52) 179, Pl. 16 C.

Small terrestrial ferns; rhizome short, bearing narrow, aciculate, blackish, clathrate paleae; stipes fascicled, clothed like the lamina with long, pale hairs; lamina pinnate with lobed pinnae to subbipinnate, herbaceous, veins repeatedly forked and the segments therefore ecostate; sori elongate along the veinlets, exindusiate, pedicel of one row of cells, annulus of 18-22 cells, spores bilateral, round-oblong, black, obscurely and laxly reticulate-tuberculate.

TYPE: *P. immersus* Fée, which is *P. papaverifolius* (Kunze) Fée, of Chile.

There are two other ill distinguished species, *P. rutaefolius* (R. Br.) Fée, of Australia and New Zealand, and *P. Pozoi* (Lag.) Diels, of Spain and Morocco. The distribution is extraordinary, and suggests that the plant was possibly introduced to Spain.

"Les *pleurosorus* sont des *asplenium* sans indusium" — FÉE, Genera, p. 180. The

hairiness and the naked sori are remarkable in this group, but the resemblances to *Asplenium* are strong evidence of near affinity.

6. Holodictyum

Holodictyum Maxon, Cont. U. S. Nat. Herb. 10 (1908) 481, Pl. 56, f. 4.

Terrestrial ferns of moderate size; stem erect, bearing dark, linear-lanceolate, attenuate, finely clathrate paleae; stipes densely fascicled, short; lamina linear-oblanceolate, entire, firm-papyraceous, light-green, glabrous, strongly costate, veins forking freely and everywhere anastomosing with the effect that no main veins are distinguishable beyond the costal areolae, costal areolae large, elongate at an acute angle to the costa, other areolae spreading and decreasing in size to the margin, 4 to 6 rows of areolae where the frond is widest; sorus extending from the costa to near the end of each costal areola, indusium rather broad, annulus of 20-22 cells, spores black, oblong, obscurely reticulate-tuberculate by shrinking of the epispore.

TYPE: stipulated as *H. Ghiesbreghtii* (Fournier) Maxon, but the description based at least in part on *Palmer no. 336*, which MAXON identified as *H. Finckii* (Baker) Maxon; they may well be a single species. Endemic in Mexico.

Holodictyum is evidently derived from *Asplenium*, but its point of origin is not more definitely recognized. There is conspicuous but wholly superficial resemblance to the exindusiate *Loxogramme*, a Grammitid genus.

7. Camptosorus

Camptosorus Link, Hort. Berol. (1833) 69.

Small terrestrial ferns; rhizome short, paleae linear, attenuate, clathrate; stipes fascicled, dark at base, green or stramineous upward; lamina simple, lanceolate or linear, with long-attenuate radicant apex, cordate or subcordate at base, herbaceous, glabrous, veins forking and anastomosing freely; sori, when copious, may be on any veinlets, and are thus irregularly scattered, short because the areolae are small, often facing one another but rarely approximate enough to appear double, pedicel long, of one row of cells, annulus of about 19 cells, spores oblong, dark, spinulose-flaky by contraction of the epispore.

TYPE: *C. rhizophyllus* (L., *Asplenium*) Link; Toronto to Alabama. There is one other species, *C. sibiricus* Rupr., in Eastern Siberia, North China and Japan. This is a familiar case of discontinuous distribution, due to geologically recent glaciation.

Camptosorus is evidently derived from *Asplenium*. *A. pinnatifidum* Nutt. presents a more definite place of origin in the parent genus. *A. Scolopendrium* is probably a reasonably near relative.

C. rhizophyllus is not a very common fern, but is well known, as the walking fern, because of its radicant frond-tips.

8. Antigramma

Antigramma Presl, Tent. (1836) 120.

Terrestrial ferns of moderate size; stem short, erect, clothed with dark, lanceolate, attenuate, finely clathrate paleae; stipes fascicled, long or short; lamina simple, entire or sinuate, subcoriaceous, glabrous, veins usually forked near the base, and the veinlets forked again more or less half-way to the margin, their branches divaricate and anastomosing to form elongate areolae; sori commonly extending from near the costa to the forking of the veinlets, born on both veinlets and therefore facing one another as in *Scolopendrium*, sometimes contiguous and forming a "double sorus," sometimes more remote (Diplazioid sori also occur), pedicel slender, mostly of one

row of cells, annulus of about 19 cells, spores irregularly spinulose by shrinkage of the epispore.

TYPE: *A. repanda* Presl, a synonym of *A. brasiliensis* (Swartz) Moore, of Brazil.

There is probably only one other species, *A. plantaginea* (Schrad.) Presl, including *Scolopendrium Balansae* Baker, of Paraguay and Southern Brazil.

This local genus, confined to Brazil and Paraguay, is directly related to *Asplenium serratum*, commoner in the same region and of wide range in tropical America.

9. Schaffneria

Schaffneria Fée, 7me Mém. (1857) 56, Pl. 17, f. 1.

A small terrestrial fern; stem erect, short, bearing dark, linear-lanceolate, attenuate, clathrate paleae; stipes closely fascicled, short, black, minutely pubescent; lamina round-flabelliform, entire, fleshy, opaque, glabrescent, venation flabellate, veins forking freely and anastomosing to form elongate areolae which become shorter toward the margin; sori everywhere except at base of frond, elongate as far as a vein does not fork or anastomose, commonly facing one another because all veins can be fertile, but not usually approximate enough to form Scolopendrioid double sori, indusium narrow and firm, annulus of 20 or 22 cells, spores oblong, becoming sparsely spinulose as the epispore shrinks.

TYPE and sole species: *S. nigripes* Fée, of Mexico and Guatemala.

Much like *Antigramma* in technical characters, but probably not a direct relative.

No known *Asplenium* of the same region suggests a possible source of *Schaffneria*. There is a species in South-West China, *Asplenium Delavayi* (Franch., *Scolopendrium*) which is remarkably like it in stem, black stipes, and size and form of frond, but with free veins. The temptation is to regard *Schaffneria* as derived from *A. Delavayi*, and to add this to the few fairly established cases of migration across the Pacific.

FAMILY 15—MATONIACEAE

Matoniaceae Presl, Abh. Böhm. Ges. V, 5 (1848) 330, 340, as Ordo.

Rhizome elongate, hairy, with concentric solenosteles; fronds pseudo-dichotomous or dichotomous, whether scorpioid or sympodial; sori dorsal on the frond, indusiate, round, sporangia few and large, sessile or nearly so, maturing simultaneously, annulus oblique, incomplete, without differentiated stomium, spores tetrahedral.

Two extant genera, in Malacca, Sumatra, Borneo and near New Guinea.

An old group, including Cretaceous fossils referable to the surviving genus *Matonia,* and a considerable number of still older fossils referred here with more or less confidence.

The nearest affinity is to *Gleicheniaceae.* The sporangium is slightly suggestive of that of *Cyathea.* There are also unmistakable evidences of affinity to the less primitive *Dipteris,* and thus to *Polypodiaceae.* Trying to be as sure as possible that my *Polypodiaceae* constitute a natural group, I have included *Matonia* in that family. But, since it is essentially unlike every genus of the great group of genera to which its affinity is most apparent, in having indusiate sori, and can hardly be imagined to be directly ancestral to that group, I have decided that it is more reasonable to recognize the two genera, *Matonia* and *Phanerosorus,* as a distinct family, an early offshoot of the Polypodioid phylum.

In itself, this family is clearly natural, easily defined, and without very near relatitves.

1. Matonia

Matonia R. Brown, in Wallich, Plantae Rariores Asiaticae I (1829) 16, Pl. 16; Hooker, Genera, Pl. 43; Bower, Ferns II 220.

Terrestrial ferns, rather large; rhizome wide-creeping, densely clothed with brown hairs, vascular system of two concentric solenosteles and a solid central bundle; stipes remote, erect, tall, dark, polished; lamina flabellate in appearance, composed of a slender pectinate medial segment, and a lateral scorpioid one on each side, these being compactly unilaterally dichotomous, the acroscopic branches being like the median segment, linear, pectinate, coriaceous, naked; veins close, free toward the margin, sometimes anastomosing near the base, and numerous veinlets convergent to each sorus; sori single near the base and on each side of the ultimate segments, indusium flattened-globose, the central point of the top confluent with the axis of the sorus, sporangia in a ring, annulus variously oblique and often crooked.

TYPE: *M. pectinata* R. Brown, of Malacca; also, *teste* HOLTTUM, in Borneo and Sumatra. I have thought the plants of Borneo and Sumatra could be distinguished, but HOLTTUM, who has seen *M. pectinata* growing in abundance, states that it varies in Malacca enough to include its range in form elsewhere.

2. Phanerosorus

Phanerosorus Copeland, Philippine Journal Sci. 3 C (1909, dated 1908) 344, Pl. 3.

Cliff-dwelling on limestone, rhizome slender, with only two concentric bundles, hairs tawny; frond pendent, monopodial, long, the suppressed

branches most often immediately pseudodichotomous with a suppressed median bud and the paired segments laminate-margined throughout, linear, entire, or sometimes again dichotomous, or rarely the median bud developing sympodially, the frond ending with three linear pinnae as the axial bud develops like the lateral pinnae; veins all free; sori terminal on their veinlets, in a medial row on each side of the costa.

TYPE: *P. sarmantosus* (Baker, *Matonia*) Copel., local over caves at Niah, Sarawak.

A second species, *P. maior,* is described by DIELS, Notizblatt d. bot. Gartens Berlin 11 (1932) 311, from Waighiou Island off the N. W. coast of New Guinea.

The system of branching of the frond is duplicated in *Lygodium.*

The differences between *Matonia* and *Phanerosorus* are found in Mesozoic fossils referred to this family, suggesting that the two genera may have been distinct since that period.

FAMILY 16—POLYPODIACEAE

Polypodiaceae R. Brown, Prodromus (1810) 145, in synonymy; S. F. Gray, Brit. Pl. II (1821) 4, as unstated division of Family Filices; Ascherson, Flora . . . Brandenburg (1864) 909, as Familie.
Grammitaceae Presl, Tent. (1836) 205, as Tribus.
Dipteridaceae Seward & Dale, Phil. Trans. R. S. 194 (1907) 487; Bower, Ferns II (1926) 311.
Cheiropleuriaceae Nakai, Bot. Mag. Tokyo 42 (1928) 210.
Loxogrammaceae, Platyceriaceae, Ching, Sunyatsenia 5 (1940) 201-268.

Typically epiphytic ferns, rarely terrestrial; rhizome creeping or sometimes ascending, never trunk-forming, dictyostelic, often with accessory sclerenchyma strands, paleate, paleae usually broad and affixed above the base, very rarely setiform or hair-like, very rarely suppressed; stipes usually articulate; fronds usually simple to pinnate, very rarely more compound, or dichotomous, usually firm in texture, paleate or hairy or glabrous; venation free or variously reticulate, veinlets often ending in hydathodes; sori strictly exindusiate, typically round, sometimes elongate along the veins, and the sporangia sometimes spread over the laminar surface; pedicel usually of three rows of cells, annulus longitudinal, usually of about 12 or 14 thickened cells, stomium well developed, spores bilateral, or less commonly (*Grammitis* and derived genera) tetrahedral, with or without a thin epispore.

THE TYPE GENUS is *Polypodium,* typified in turn by *P. vulgare.*

This is the great epiphytic fern family, its terrestrial representatives being a few primitive members, and scattered derived species which have descended to the ground. Because epiphytic life is in general impossible elsewhere, the family is almost wholly tropical.

Except in the mossy forest, the epiphytic habitat requires specialization to restrict the loss of water. The family exhibits a great variety of such adaptations, the most common being small size, lack of dissection, and thick fronds. The few members with thin and dissected fronds, species of *Ctenopteris,* are plants of the mossy forest.

The only certainly comparatively primitive genus included in the family is *Dipteris.* Although it deviates in several ways from the description of the family as a whole, this genus must be included to establish the probability that the family is a phyletic unit. More remotely, the origin is believed to be from relatives of *Gleicheniaceae,* rather than from any other ferns of such primitiveness. There is also evidence of affinity to *Matoniaceae,* which is probably an aberrant group of similar origin.

As a family of extant ferns, I suppose that *Polypodiaceae* are of austral origin, but the evidence is less conclusive than that regarding the other great families. It does not apply to *Dipteris,* representing an ancestry more remote than the Antarctic episode in fern life. It is most conclusive as to *Grammitis;* reasonably so as to the groups typified by *Microsorium* and *Crypsinus.* As to the Pleopeltid genera, it is weakest, but is supported by their pantropic occurrence, and by the necessity of a common place of origin for these and for *Microsorium.* This might be stated similarly also for *Polypodium* and *Grammitis.* But *Grammitis* (with its derivatives) is the most aberrant element in the family. I include it, not because it has commonly been called *Eupolypodium,* but because, as well as I can now appraise its ancestry, it is the same as that of the rest of the family.

Key to the Genera of Polypodiaceae: —

Sporangia spread over the fertile surface.
Fertile and sterile fronds dimorphic as a whole.

Fronds simple and entire ..... 32. Dendroglossa
Sterile frond 2-pronged ..... 3. Cheiropleuria
Sterile frond trifid or pinnatifid ..... 4. Christiopteris
Parts of fronds specialized as fertile.
Fronds dichotomous ..... 5. Platycerium
Fronds simple with apical fertile segment ..... 24. Belvisia
Sporangia in elongate sori or coenosori.
Sori elongate parallel to axes.
Fronds furcate.
Free included veinlets present ..... 17. Eschatogramme
Included veinlets wanting ..... 51. Grammitis
Fronds pedate ..... 19. Neocheiropteris
Fronds pinnatifid or pinnate.
Sterile part of frond pinnatisect ..... 39. Merinthosorus
Sterile part of frond pinnate ..... 40. Photinopteris
Fronds simple and undivided.
Sporangia confined to an apical segment.
Peltate paraphyses present ..... 24. Belvisia
Paraphyses wanting ..... 33. Dendroconche
Sori on body of frond.
Sterile or all fronds rush-like.
Fertile fronds narrow throughout ..... 46. Holcosorus
Fronds with dilated fertile apex ..... 55. Nematopteris
Sterile fronds not rush-like.
Free included veinlets present.
Laminar paleae stellate.
Coenosori interrupted ..... 25. Pyrrosia
Coenosori continuous ..... 26. Pteropsis
Laminar paleae peltate, not stellate.
Fronds uniform or nearly so ..... 11. Pleopeltis
Fronds dimorphic ..... 13. Marginariopsis
Neither peltate nor stellate paleae.
Fronds uniform.
Fronds coriaceous.
Sori linear or oblong ..... 22. Paragramma
Coenosori continuous.
Coenosori costal ..... 21. Drymotaenium
Coenosori submarginal ..... 18. Paltonium
Fronds herbaceous ..... 29. Diblemma
Fronds dimorphic.
Sterile fronds herbaceous or fleshy.
Paraphyses peltate ..... 20. Lemmaphyllum
Paraphyses wanting.
Terrestrial ..... 32. Dendroglossa
Epiphytic ..... 30. Leptochilus
Sterile fronds coriaceous.
Stem radially symmetrical ..... 47. Oleandropsis
Stem dorsi-ventral.
Areolae pluriseriate ..... 45. Grammatopteridium
Areolae uniseriate ..... 44 Pycnoloma
Free included veinlets wanting.
Stipes articulate ..... 9. Dictymia
Stipes not articulate.
Sori simple ..... 51. Grammitis
Sori fused into coenosori.
Sterile veins typically free.
Fronds subsessile.
Coenosori costal ..... 53. Cochlidium
Coenosori remote from costa ..... 54. Scleroglossum
Stipe slender ..... 56. Oreogrammitis

Veins anastomosing freely ..... **60. Loxogramme**
Sori or coenosori oblique to axis.
Free included veinlets present.
Fronds herbaceous.
Sorus on single included veinlet ..... **10. Synammia**
Coenosori transgressing areolae ..... **31. Colysis**
Fronds coriaceous.
Frond pinnatifid, large ..... **35. Pseudodrynaria**
Fronds simple, small.
Main veins ill developed ..... **12. Microgramma**
Main veins conspicuous ..... **48. Selliguea**
Free included veinlets wanting.
Anastomoses none or casual ..... **51. Grammitis**
Areolae in one costal row ..... **52. Glyphotaenium**
Veins anastomosing freely ..... **60. Loxogramme**
Sori in general round, whether points or areas.
Frond flabellate in plan.
Large and deeply cleft ..... **1. Dipteris**
Very small, subentire ..... **2. Holttumiella**
Frond pinnate in plan.
Venation reticulate, with included veinlets.
Included veinlets excurrent and simple.
Fronds somewhat dimorphic, small ..... **12. Microgramma**
Fronds uniform, simple and entire ..... **14. Campyloneurum**
Fronds uniform, pinnatifid or pinnate.
Included veinlets strictly single.
Pinnae articulate to rachis ..... **7. Goniophlebium**
Without articulate pinnae ..... **6. Polypodium**
Included veinlets commonly plural.
Frond pinnate ..... **14. Campyloneurum**
Frond pinnatifid ..... **16. Phlebodium**
Included veinlets variously directed or branched.
Rhizome hollow, inhabited by ants ..... **42. Lecanopteris**
Rhizome not housing ants.
Frond pinnatifid, peltate-paleate ..... **11. Pleopeltis**
Pinnatifid or pinnate, not peltate-paleate.
Pinnae or segments jointed to rachis.
Humus-collecting ferns.
Scale-fronds wholly distinct ..... **41. Drynaria**
Frond-bases humus-collecting.
Sori minute and numerous ..... **34. Drynariopsis**
Sori (coenosori) large.
Fronds on special branches ..... **38. Thayeria**
Fronds on normal rhizome ..... **36. Aglaomorpha**
Not humus collectors.
Fronds dimorphic ..... **37. Holostachyum**
Fronds uniform.
Pinnae dimorphic ..... **36. Aglaomorpha**
Pinnae uniform ..... **49. Arthromeris**
Pinnae and segments non-articulate.
Cartilaginous margin notched ..... **43. Crypsinus**
Margin not notched ..... **28. Microsorium**
Frond simple with fertile distal segment ..... **33. Dendroconche**
Frond simple, not segmented.
Lamina paleate at least when young.
Paleae stellate ..... **25. Pyrrosia**
Paleae long-ciliate ..... **27. Niphidium**
Paleae not stellate nor ciliate.
Fronds small (hardly 10 cm.)
Sori on narrow apex ..... **23. Weatherbya**
Sori not restricted to apex ..... **12. Microgramma**

Fronds mediocre.
Coriaceous ..... 11. **Pleopeltis**
Herbaceous ..... 19. **Neocheiropteris**
Fronds large (over 30 cm.) ..... 15. **Pessopteris**
Lamina glabrous or pubescent.
Cartilaginous margin notched ..... 43. **Crypsinus**
Margin not notched ..... 28. **Microsorium**
Veins anastomosing without included veinlets.
Fronds pinnate ..... 50. **Polypodiopsis**
Fronds simple.
Areolae costal only.
Costal areolae fairly regular ..... 52. **Glyphotaenium**
Anastomoses only casual ..... 51. **Grammitis**
Areolae in several rows.
Paraphyses conspicuous ..... 61. **Anarthropteris**
Paraphyses wanting ..... 9. **Dictymia**
Veins free.
Fronds entire, crenate or crenate-lobed.
Sorus protected by folded tooth ..... 58. **Calymmodon**
Sorus not protected by fold ..... 51. **Grammitis**
Frond pinnatifid or compound.
Vein in segment or pinna simple or forked.
Sorus protected by folded segment.
Reflexed margin fused over sorus ..... 59. **Acrosorus**
Reflexed margin free ..... 58. **Calymmodon**
Sorus not protected by fold ..... 57. **Xiphopteris**
Veins in segment pinnately branched.
Sori immersed, marginal or nearly so ..... 64. **Prosaptia**
Sori dorsal.
Glandular paraphyses present ..... 63. **Amphoradenium**
Glandular paraphyses wanting.
Base of lamina contracted ..... 62. **Ctenopteris**
Frond base not contracted.
Frond membranaceous ..... 8. **Thylacopteris**
Frond herbaceous or more firm ..... 6. **Polypodium**

1. Dipteris

Dipteris Reinwardt, Sylloge II (1824) 3.

Terrestrial ferns of moderate size or rather large; rhizome wide-creeping, solenostelic, clothed with coarse dark bristles which on old plants are several cells wide in the lower part; stipes remote, erect, long, naked except at the base; lamina cut to the base into two parts (whence the generic name), each of these parts flabellate, more or less deeply incised, firm in texture, naked; main veins repeatedly dichotomous, veinlets branching at right angles and anastomosing to form a fine mesh, with included veinlets; sori solitary in the minor areolae, eventually spreading along and even from the included veinlets, exindusiate, sporangia maturing in a short sequence, mixed with some capitate paraphyses, pedicel short, of four rows of cells (*fide* Bower), annulus inconstant but usually longitudinal and straight, incomplete, of about 12 cells, stomium ill developed, spores bilateral, hyaline, smooth.

Type: *D. conjugata* Reinw., of Java, and from Fiji to Malacca.

Eight species are distinguished, extending the range to China and the Himalayas.

An isolated genus, given family status by Bower, but with probable affinity to *Matonia;* and in another direction to *Cheiropleuria,* and thus appropriately placed at the bottom of the Polypodioid phylum. Throughout this phylum, dichotomy as an abnormality, presumably atavistic, is far more common than in other phyla of Filicales.

2. Holttumiella

Holttumiella Copeland (*sphalma, Holttumia*) Philip. Journ. Sci. 74 (1941) 153, Pl. 1.

Rhizome creeping, solenostelic, clothed with atrocastaneous bristles; fronds seriate, non-articulate, very small, cordate-orbicular, thick, glabrous, venation sparingly reticulate without included veinlets; sori dorsal, on the last forking of the veins, round, exindusiate, sporangia apparently sessile.

TYPE: *H. flabellifolia* (Baker) Copel., *Polypodium flabellifolium* Baker, a little known Bornean fern.

I described this genus as a relative of *Dipteris*. It has since occurred to me that the structure and trichomes of the rhizome are suggestive also of *Tacnitis*. In fact, the paleae of adult *Dipteris* are different, but those of a juvenile plant seem to be hairs, not paleae. With good material, the question of affinity will be easy to decide.

3. Cheiropleuria

Cheiropleuria Presl, Epim. Bot. (1849) 189.

A terrestrial fern of moderate size; rhizome creeping, protostelic or solenostelic, bearing soft, tawny to ferruginous hairs; stipes approximate, erect, slender, non-articulate; laminae dimorphic, the sterile ovate to round in outline, 2 lobed with a broad sinus, glabrous, subcoriaceous, margin entire, main veins dichotomous at the base, veinlets forming a fine mesh with branched included veinlets; fertile frond simple and entire, broadly linear, sporangia covering the entire fertile surface, served by a secondary vascular system nearer the fertile surface than the vegetative bundles, capitate paraphyses present, pedicel rather short, of four rows of cells, annulus just oblique enough to permit unthickened cells of the same row to pass the pedicel, thickened cells about 18, stomium imperfectly differentiated, spores mostly tetrahedral, sometimes bilateral, hyaline, smooth.

TYPE and sole species: *C. bicuspis* (Blume, *Polypodium*) Presl, of Java, ranging to New Guinea, the Loo Choo Islands and Tonkin.

It is not rare for one lobe of the sterile frond, or both to fork again; and Formosa specimens have most fronds undivided. *Cheiropleuria* has been described as epiphytic (PRESL), and as sometimes scandent; I have seen it often and in abundance, always terrestrial.

Cheiropleuria is an isolated genus, raised to family status by NAKAI. There are evidences of affinity to *Gleicheniaceae* and to *Matoniaceae*, and to *Dipteris* and *Platycerium*.

4. Christiopteris

Christiopteris Copeland, Perkins' Fragmenta (1905) 188; Philippine Journal Sci. 1 Suppl. (1906) 157, Pl. 13; 12 C (1917) 331.

Epiphytic or casually terrestrial ferns of moderate size; rhizome long-creeping, dictyostelic, paleae with peltate bases, thence abruptly contracted to setaceous, or broadly lanceolate (*C. varians*); stipes remote, articulate to rhizome; fronds trilobate or pinnatifid, with entire margins, dimorphic, the sterile ample, coriaceous, glabrous, hypodermis under the upper epidermis hardly differentiated, venation reticulate with branched included veinlets; fertile frond similar in form but much contracted, sporangia occupying the fertile surface without distinction of sori, served by special vascular bundles underlying the fertile surface, paraphyses short, simple or short-branched, pedicel elongate, of three rows of cells, annulus of 14 cells, vertical and uniform, stomium well developed, spores bilateral, hyaline, smooth.

TYPE: *C. Sagitta* (Christ, *Polypodium*), of Luzon and Mindanao.

The other known species are *C. tricuspis* (Hooker, *Acrostichum*) Christ, of Sikkim, of which *C. Eberhardtii* Christ, of Annam, may be a more ample, pinnatifid form; and *C. varians* (Mett., *Acrostichum*) of New Caledonia.

C. varians, with broad paleae with entire margin, pinnatifid fronds, and relatively ill developed secondary (diplodesmic) vascular system, is less specialized than *C. Sagitta* and *C. tricuspis.* It may be more primitive. At any rate, it is more suggestive of the *Microsorium-Phymatodes* group of genera. The genus as a whole seems more likely to belong in the *Crypsinus* group.

5. Platycerium

Platycerium Desvaux, Mém. Linn. Soc. 6 (1827) 213.
Alcicornium Gaud., in Freycinet, Voyage, Bot. (1825) 48; Underwood, Mem. Torrey Club 6 (1899) 275.
Neuroplatyceros Plukenet: Fée, 2me Mém. (1845) 25, 102, Pl. 64.

Large epiphytes of bizarre aspect; rhizome, except at the tips, concealed by a mass of fronds and roots, creeping and branched, dictyostelic, bearing costate paleae; fronds approximate, in two rows on the rhizome, of two types: 1, normal fronds, short-stipitate with articulate stipes, erect and then pendent, typically repeatedly forked, subcoriaceous, stellate-pubescent, margin entire, main veins sparingly dichotomous and then parallel, veinlets obscure, anastomosing with branched included veinlets; 2, scale fronds, sessile, persistent, very broad and more or less entire, presently becoming dry and brown, imbricate, protecting a mass of stems, roots and decaying debris; sporangia on specialized areas of the normal fronds, in full production occupying these areas without distinction of sori, served by specialized vascular bundles underlying the fertile surface, mixed with copious stellate paraphyses, pedicel rather stout, of three rows of cells, annulus of 18-20 (-24) thickened cells, longitudinal but sometimes evidently continuous with a row of unthickened cells passing the pedicel, stomium conspicuous in direct vision (not in profile), spores bilateral, smooth, hyaline.

TYPE: *P. alcicorne* (Willemet, *Acrostichum*) Desv., of the East African islands and continent; this name seems to me valid, but CHRISTENSEN prefers to call it *P. stemaria* (Beauv.) Desv.

Possibly seventeen species, of which the commoner ones have been confused badly as to their names. Range: Queensland and New Caledonia across Africa, and one species reported in Peru.

The normal frond is broad, with short distal lobes, in two Madagascar species; forked with comparatively narrow segments in all others.

The fertile area is at or beside the last forking in *P. alcicorne;* on the distal segments, in *P. bifurcatum* (Cav.) C. Chr.; below the lowest forking, and very large, in *P. grande* J. Sm.; and on a roundish stalked segment representing one of the lower branches, in *P. coronarium* (König) Desv. The one species credited to the Western Hemisphere, *P. andinum* Baker, is much like *P. alcicorne,* and I cannot help suspecting that it was introduced by man.

Because of their strange but attractive appearance, and their ease of cultivation in greenhouses, several species are very popular in cultivation. Several other species have been described from greenhouse specimens.

Paleae were described by GAUDICHAUD and FÉE, and depicted by BLUME. The rhizomes are wanting on most herbarium specimens, but can be observed anywhere on living plants; which makes most surprising BOWER'S statement, Ferns III, 211, that "Scales are not described for any of the species," and CHRISTENSEN'S classification of the genus as chaetopterid, VERDOORN'S Manual, p. 546.

Platycerium is an isolated genus, raised to family status by CHING. There is some suggestion of affinity to *Dipteris, Cheiropleuria* and *Christiopteris;* but it is not intimate. There is more evident resemblance to *Pyrrosia.*

Alcicornium was proposed by GAUDICHAUD as the name of a genus which would be recognized after further study. Its publication was explicitly tentative. A year or so later, *Platycerium* was properly published, and GAUDICHAUD accepted the name. Except as UNDERWOOD, *l.c.* (1899), and Bull. Torrey Club 32 (1905) 587, undertook to revive *Alcicornium*, it has been recognized properly as an abortive publication.

Neuroplatyceros Plukenet was a pre-Linnaean name of *Platycerium alcicorne*, cited as a synonym, even in binomial form as *N. ethiopicus*, by many writers, and taken up by FÉE, as 'a matter of justice,' in avowed violation of rules already recognized.

6. Polypodium

Polypodium Linnaeus, Sp. Pl. (1753) 1082; C. Chr., Dansk Bot. Arkiv 5 No. 22 (1928).
Marginaria Bory, Dict. Class. d'Hist. Nat. VI (1824) 587; X (1826) 176.
Goniophlebium Presl, Tent. (1836) 185, *partim, non* (Blume).
Lepicystis J. Smith, in Hooker & Bauer, Genera (1840) Pl. 51, as section; Journal of Bot. 1 (1842) 195; Diels, Nat. Pfl.-Fam. I Pt. 4 (1898) 322, f. 167.
Schellolepis J. Smith, in Hooker & Bauer, Genera (1840) Pl. 51, as section; Ferns Brit. and For. (1866) 82, *partim.*

Epiphytes, or rarely terrestrial; rhizome creeping, dictyostelic, paleate; fronds stipitate with articulate stipes, uniform, pinnatifid or compound, glabrous or paleate, or rarely pubescent, veins forked or branching, free or anastomosing to form regular areolae each with one simple excurrent included veinlet; sori dorsal on the frond, terminal or nearly so on the lowest acroscopic veinlet (which is the included one if areolae are present), typically round and superficial, exindusiate, paraphyses none or filamentous, or rarely clathrate or stellate, annulus of 12-18 cells, spores bilateral, hyaline, tuberculate.

TYPE: *P. vulgare* L., of Europe, and the North Temperate zone in general, reported also from South Africa and Kerguelen.

About 75 species, mostly of the Northern hemisphere, most numerous in the American tropics.

While the type of the genus has free veins, the limitation of the genus to species with free venation is practically impossible. In Pacific North America and in Eastern Asia, freeness of venation serves badly for the definition of species, as has long been known, and as is well illustrated by CHRISTENSEN (1928). There is again no line of possible generic significance between species with common but casual anastomoses and those in which anastomosis is uniform wherever the width of the segments permits. The series of species, from free-veined to uniformly areolate, is continuous both in America and in Asia. The areolae usually form one row on each side of the costa, with always a single free vein in each areola. The sori are terminal on these free included veins. Exceptionally, in species with wide segments, there are plural rows of areolae and correspondingly plural rows of sori.

These species with areolae each including one excurrent veinlet constitute the genus *Goniophlebium* as known to PRESL, which, if really PRESL'S genus, would be typified by *G. Haenkei* Presl and *G. attenuatum* Presl, both being *Polypodium attenuatum* H. B. W. But PRESL took the name from BLUME, citing the source, and it is reasonable to hold that a Blumean type came with the name. On this ground, I maintain *Goniophlebium* as an Oriental genus, with pinnate fronds and articulate pinnae.

Marginaria and *Lepicystis* are both typified by *Polypodium polypodioides* (L., *Acrostichum*) Hitchcock, as *Marginaria ceteracina* Bory, and *Lepicystis incana* J. Smith. Such a genus has to be distinguished from *Polypodium* by the presence of peltate paleae on the lamina. In a number of evidently natural groups of species, such paleae are present on some species but not on others, wherefore they can hardly serve to identify a genus. When DIELS tried to recognize a genus *Lepicystis*, it included a range in venation wider than is here included in *Polypodium.*

Aside from *Goniophlebium* (Blume), the nearest equally or comparatively primitive genus seems to be *Pleopeltis.* Taking this view, it follows that the more primitive

element in *Polypodium* has anastomosing veins and is paleate, the legal type of the genus representing its most modern element. This use of the word modern does not overlook the fact that *P. vulgare* ranges widely, and has immediate relatives in both America and Asia.

The type genus of a vast family, *Polypodium* has been the largest genus of ferns in the books of conservative pteridologists. In LINNAEUS' Species Plantarum, it included 58 species; in SWARTZ' Synopsis, 101; in HOOKER and BAKER's Synopsis (2nd. Edition), 453; in CHRISTENSEN's Index, 784; in the Third Supplement to the Index, 1127, after the removal of *Loxogramme* and *Aglaomorpha*. Only in the last of these enumerations, it was exceeded by the likewise overgrown *Dryopteris*.

Reduced here to an estimated 75 species, it is still by no means uniform. Aside from the range in venation and scaliness already explained, and, I hope, justified, it contains species aberrant in various respects. There is a small group represented by *P. friedrichsthalianum* Kunze, with finely dissected fronds. *P. fallax* S. & C. has inequilaterally peltate paraphyses. *P. amoenum* Wall. has clathrate peltate paraphyses, indicating affinity to *Pleopeltis*. *P. lachnopus* Wall. has irregularly stellate paraphyses. These various paraphyses should be significant structures; but I have not been able to use them because they are so elusive (caducous) that my failure to detect them on a considerable number of herbarium specimens does not convince me that they do not occur.

7. Goniophlebium

Goniophlebium (Blume, Flora Javae (1828) 132, Pl. 82) Presl, Tent. (1836) 185, as to the name; Copel., Univ. Calif. Publ. Bot. 16 (1929) 109.

Schellolepis J. Smith (in Hooker & Bauer, Genera (1840 Pl. 51, with reference to Pl. 14, as section) Ferns, British and Foreign (1866) 82.

Epiphytes, of moderate size to large; rhizome long-creeping, dictyostelic, with black sclerenchyma strands, clothed with attenuate, clathrate paleae with peltate bases, finally glabrescent and usually glaucous; stipes remote, articulate to phyllopodia, elongate; fronds pinnate, pinnae articulate to rachis, lanceolate or linear, herbaceous, veins evident, forking and anastomosing to form a series of large costal areolae, each with one free included vein excurrent from the base of the inferior main vein, beyond these major areolae veins free or forming similar or smaller areolae; sori in one row on each side of costa, terminal on the included veinlets, usually more or less immersed, with clathrate, typically peltate and ciliate-dentate ephemeral paraphyses, annulus of about 14 cells, spores bilateral, hyaline, smooth.

TYPE: *Polypodium cuspidatum* Blume *ncc* Don, which is *Goniophlebium persicifolium* (Desv., *Polypodium*) Bedd.

A genus of twenty species. *G. subauriculatum* (Blume) Presl ranges from India to Fiji, and is common in cultivation, pendent and sometimes nearly three meters long. The other species range less widely within these limits.

Besides typical peltate paraphyses, there occur others, smaller, fixed by a marginal base or dwindling to vermiform; these are illustrated by HOOKER and BAUER.

The only considerably aberrant species in this otherwise uniform group is *G. Korthalsii* (Mett.) Bedd, with slender rhizome and broad pinnae, each with a row of sori, instead of one sorus, between consecutive main veins.

It is to be observed that PRESL had no personal acquaintance with this genus as here defined. He did avowedly take the name from BLUME, and could not do this without taking also whatever type of BLUME properly went with the name.

Goniophlebium is intimately related to the group of Asiatic species with pinnatifid fronds which I leave in *Polypodium*.

8. Thylacopteris

Thylacopteris Kunze, *apud* Mett., Pol. (1857) 50; J. Smith, Hist. Fil. (1875) 87.

Epiphytes of moderate size; rhizome long-creeping, slender, dictyostelic, with sclerenchyma strands in cortex and pith, paleae ovate, attenuate, thin

and thin-walled, entire; fronds remote, articulate to pedicels, long-stalked, pectinate, membranaceous, glabrous, segments obscurely serrate, veinlets once forked; sori terminal on the acroscopic branch, typically immersed but in one species superficial, without paraphyses, sporangia long-stalked, annulus of 12 (- 14) cells, spores bilateral, hyaline, smooth.

TYPE: *T. papillosa* (Blume, *Polypodium*) Kze.: J. Smith, Java to Luzon.

There should be little difficulty about the recognition of *Thylacopteris* as hitherto constituted, a genus of one species. The slender rhizome with very numerous strands of black sclerenchyma, remote membranaceous fronds, once-forked veins, sori immersed so deeply that they protrude as long papillae from the upper surface, and smooth spores distinguish it most sufficiently.

However, I cannot imagine it as other than congeneric with **T. diaphana** (Brause, *Polypodium*), of New Guinea, which is singularly like it in appearance, texture, etc., but with superficial sori on veinlets developed only enough to provide a place for them, and the sclerenchyma in the rhizome merely indicated. If this species were considered by itself, it could be left in *Polypodium.*

9. Dictymia

Dictymia J. Smith, Bot. Mag. 72 Comp. (1846) 16; Hist. Fil. (1875) 115; *non* J. Smith in Hooker, Fl. Novae-Zelandiae (1854) 42.
Dictyopteris Presl, Tent. (1836) 194 ?; *non* Lamoureux (1809).

Epiphytes of moderate size; rhizome wide-creeping, dictyostelic, bearing deciduous ovate paleae peltate at base; stipes remote, articulate; lamina simple, entire or sinuate, linear or lanceolate, glabrous, coriaceous, costa evident, main veins none, veins immersed, forking freely, anastomosing to form several series of irregular areolae without included veinlets; sori large, elliptic to round, somewhat impressed, without paraphyses, sporangia naked, annulus of 12-14 cells, spores reniform, hyaline, shallowly reticulate-tuberculate.

TYPE: *D. attenuata* (R. Br., *Polypodium*) J. Smith, a synonym of *D. Brownii* (Wikstr., *Polypodium*) Copel., of Australia.

A genus of two, or possibly four species, ranging to Fiji.

Dictymia is a member of the *Polypodium* (not the *Grammitis*) group, superficially much like *Paragramma* and sometimes confused with it, but distinguished by the series of cell-divisions producing the stoma, by the structure of the parenchyma, and by the absence of included veinlets and of paraphyses.

The report of *Dictymia* in New Zealand seems to be due to misidentification of *Dictyopteris attenuata* as *Polypodium attenuatum* R. Br. At any rate, the subject of HOOKER and BAUER, Genera, Plate 71 B, said to be *D. attenuata* Presl, is not a *Dictymia,* but is genus no. 61 as here presented.

10. Synammia

Synammia Presl, Tent. (1836) 212, Pl. 9, f. 11.

An epiphyte of moderate size; rhizome long-creeping, stout, dictyostelic, clothed with large, thin, ovate, attenuate paleae with peltate bases; stipes remote, elongate, stramineous, articulate to phyllopodia; lamina typically pinnate with few adnate, lanceolate pinnae, pinnae sometimes decurrent-confluent, and simple fronds sometimes fertile, herbaceous, glabrous, margin narrowly cartilagineous and notched, or the sterile serrulate, veins inconspicuous, more than once forked, anastomosing to form a single row of

costal areolae each with one excurrent included veinlet as in *Goniophlebium;* sori on the included veinlets, elongate, superficial, protected while young by dense filiform paraphyses, sporangia naked, annulus of 12-14 cells, stomium with 3 or 4 hyperstomial and as many hypostomial cells, spores reniform, hyaline, flat-tuberculate.

TYPE and sole species: *S. triloba* (Cav., *Polypodium*) Presl, more properly to be called **S. Feuillei** (Bertero, *Polypodium*), of Chile. PRESL listed first another species, *S. elongata* (Sw., *Grammitis*), a *Pleopeltis,* which does not fit well his generic description and is not illustrated.

Synammia seems near to *Polypodium,* but is distinguished by the pattern of frond, and the conspicuously elongate, densely paraphysate sori. It has probably been distinct for a very long time.

11. Pleopeltis

Pleopeltis Humboldt et Bonpland, in Willd., Sp. Plant. V (1810) 211.
Lepisorus (J. Smith, Bot. Mag. 12 Comp. (1846) 13; Hist. Fil. 113, as Section) Ching, Bull. Fan. 4 (1933) 47.

Epiphytes, usually small, with elongate, dictyostelic, paleate rhizome; fronds articulate to rhizome, simple or rarely pinnatifid, entire, firm to coriaceous, bearing peltate paleae or glabrescent, without specialized hypodermis, veins anastomosing freely and irregularly with included veinlets; sori borne at the union of several veinlets, typically round, rarely elongate or fusing parallel to the costa, protected at least at first by peltate paraphyses with flat, expanded heads, pedicel of three rows of cells, annulus of about 14 cells, spores bilateral, hyaline to orange, smooth or nearly so (without epispore).

TYPE: *P. angusta* H. & B., of Mexico, ranging to Uruguay and Chile. The type is peculiar in the genus in having other than simple and entire fronds. The genus was originally characterized by the paraphyses, each of which was regarded as an indusium.

A genus of some forty species, in tropical America and from Japan to Africa, reaching Sumatra, Luzon and Hawaii but otherwise wanting in the Malay-Polynesian region.

Lepisorus, typified by CHING by *Polypodium lineare* Thunb., which should be known as *Pleopeltis thunbergiana* Kaulf., might be distinguished by the paleae on the laminar surface; this is the key character used by CHRISTENSEN, Dansk Bot. Arkiv 7 (1932) 156, who ascribes numerous peltate scales to *Pleopeltis,* but ovate-lanceolate scales, if any, to *Lepisorus.* This is not a distinction, because the paleae of *Lepisorus* are peltate, at the same time that they are usually elongate but sometimes orbicular; while ovate paleae occur even on the *Pleopeltis* species, *P. lanceolata,* with which CHRISTENSEN was dealing — see GOEBEL, Ann. Buit. 36 (1926) 117, Pl. 9, f. 60. In VERDOORN'S Manual, p. 547, CHRISTENSEN agrees that the paleae of *Pleopeltis* may be elongate, but presents another distinction — that the paleae of *Pleopeltis* are non-clathrate, those of *Lepisorus* "often clathrate." The paleae are variable, and characteristic of accepted species, in both America (*Pleopeltis*) and China (*Lepisorus*), and the range of texture is largely the same in the two regions. They may be dark throughout, or dark with brown margins, or brown throughout, and toothed or entire. Clathrate means that the anticlinal (interior) walls are thickened and darkened, the superficial walls not so; and there is no such general distinction between the species of the two regions. Finally, CHING offers what would be the best of reasons for keeping the genera distinct, if it were tenable — that *Pleopeltis* belongs "to a distinct phyletic line of its own," *l.c.,* p. 57. But, for evidence, he cites BOWER, Ferns III, 231; and there is nothing to show that BOWER ever examined a specimen either of *Lepisorus* or of *Pleopeltis* as here construed, or intended to present any opinion regarding them. BOWER has a heading "Pleopeltis," p. 224, and mentions two species, *P. macrosphaera* and *P. angustata* which seem to represent this genus; but neither name exists in taxonomic literature. His treatment is an abridgment of GOEBEL'S, *l.c.,* 114 *et seq.,* and GOEBEL certainly did not propose any generic separation. GOEBEL'S *Pleopeltis*

macrosphaera seems to be *Polypodium macrosphaerum* Baker, Kew Bull. (1895) 55, and this citation can validate his change of name.

So far as they have been examined, the sori of all species of *Pleopeltis* are subtended by a more or less elaborate vascular network, without homologue in the vegetative area of the frond, and are thus spots rather than points; for details and illustration, see the work of GOEBEL already referred to. In some species the enlargement of the sorus goes farther, leading to fusion, and the production of linear sori parallel to the costa. Such a species in Mexico is *P. astrolepis* Fourn. Elongate sori are still more characteristic of the Chinese fern first named *Neurodium sinense* Christ, then *Paltonium sinense* C. Chr., *Lemmaphyllum sinense* C. Chr., *Polypodium neurodioides* C. Chr., and *Lepisorus sinensis* Ching. Accepting CHRISTENSEN'S latest opinion and CHING'S, as to the group it belongs in, its name becomes **Pleopeltis sinensis** (Christ) Copel.

As to the origin of *Pleopeltis*, the question presents the difficulties pertaining to the whole great group. If it has been distinct since Miocene time, which its wide range suggests, it can have migrated North *via* the Andes and South Africa, but not through New Zealand. Or it may have used the Andean route only, and reached the Old World across the South Atlantic — *P. lanceolata* is found in St. Helena and Tristan d'Acunha. But it evidently reached Hawaii from the West, and may have reached North America in the same direction. I regard the *Microsorium-Phymatodes* group as probably more primitive than *Pleopeltis*, and suppose that if its generic evolution was post-Miocene, it originated in the Orient.

In both hemispheres, *Pleopeltis* seems to have been the parent of more local groups distinct enough for generic recognition.

As *Pleopeltis* is best characterized by the peltate protective paraphyses responsible for its name, this seems a proper place for a summary on the occurrence of such structures. The most primitive fern bearing them is *Gleichenia cryptocarpa*. In this case, they occur on the lamina only, the sorus of *Gleichenia* affording no place for paraphyses. In general, they are found on the lamina and in the sori of the same ferns, their form not being peculiar to paraphyses. They are as characteristic of *Belvisia* as of *Pleopeltis*, and are responsible for its more familiar name, *Hymenolepis*. Their presence is one chief reason for the recognition of *Paragramma* as a genus.

The stellate paraphyses of *Platycerium* and *Pyrrhosia* differ from the disc-shaped ones of *Pleopeltis* only in depth of dissection. They too are peltate. *Platycerium*, *Belvisia*, *Pleopeltis*, *Pyrrhosia* and *Paragramma* are all Pleopeltid ferns, using the term to indicate some measure of affinity, rather than a detail of resemblance. Peltate, or sometimes stellate paraphyses are also characteristic of *Goniophlebium*. They also occur, on the lamina and as paraphyses, of many and various of the American ferns usually called *Polypodium*. DIELS, Nat. Pflanzen-familien I, 4, p. 322, made their presence the essential character of his genus *Lepicystis*. They do indicate affinity, mutual and to *Pleopeltis*. But they are found on some, but not on other members of a number of groups of species, groups more natural than can be identified by the one character of their presence.

12. Microgramma

Microgramma Presl, Tent. (1836) 213, Pl. 9, f. 7.
Craspedaria Link, Fil. Spec. Hort. Berol. (1841) 117.
Lopholepis J. Smith, in Hooker & Bauer, Genera (1840) Pl. 51, as Section; London Journal of Bot. 1 (1842) 195.
Anapeltis J. Smith, Bot. Mag. 72 Comp. (1846) 12, as Section; Cat. Cult. Ferns (1857) 5; Hist. Fil. 115.

Small epiphytes; rhizome-creeping, dictyostelic, clothed with attenuate to aciculate paleae with peltate bases; stipes remote, short, articulate to short phyllopodia; fronds simple, entire, usually more or less dimorphic the fertile being the narrower, firm to coriaceous, veins anastomosing in various patterns with some included veinlets; sori compital or terminal on veinlets, superficial or slightly impressed, paraphyses usually filiform and multicellular, rarely dilated below (not at) the apex, sporangia naked, annulus of 12-16 (-20) cells, spores reniform, hyaline, reticulate-tuberculate.

TYPE: *M. persicariaefolia* (Schrader, *Polypodium*) Presl, West Indies to Brazil. As established by PRESL, this genus was monotypic, and characterized among its relatives by elongate sori. As the genus is here defined, this is the only species with such sori.

A genus of about 20 species, in tropical America, with two species in Africa.

Craspedaria, typified by *C. vaccinifolia* (L. & F., *Polypodium*) Link, now made **Microgramma vaccinifolia,** is common in Brazil. The fronds are strongly dimorphic. The sorus is terminal on a single included veinlet, as in *Goniophlebium.*

Lopholepis was awkwardly published, first as a section of *Goniophlebium* (1840); then merely by listing a name, *L. ciliata* (1842); finally (1875), with a generic description, and with the naming of *L. piloselloides* (L., *Polypodium*) J. Smith as the type. This becomes **Microgramma piloselloides.** The group is the same named *Craspedaria* at about the same time.

Anapeltis, first published in the same manner, is typified by *A. lycopodioides* (L., *Polypodium*) J. Smith, now **Microgramma lycopodioides,** common and variable in America and ranging across Africa. The species may illustrate the impossibility of defining a pattern of venation for the genus. One may say that the pattern, of the sterile frond, is as follows: Along the costa is a row of narrow areolae, each with a hamate recurrent veinlet. Next outward is a row of large areolae, arched on the outer side, each with two long excurrent veinlets anastomosing at their tips to form an included arch. There follows a less regular row of small, perhaps pentagonal areolae, usually without included veinlets. Beyond these are short, free veinlets running to the margin. This makes a beautiful and very characteristic vein pattern. But, on the broad part of a single frond, the costal areola may have a simple recurrent veinlet, or no recurrent veinlet, or the vein bounding the areola may not be complete, the areola thus blending with the major one; in the major areolae, a veinlet is sometimes forked; and it is common for the excurrent veinlets to run free, instead of forming an arch. Some areolae of the outer minor row fail to be enclosed; and free veinlets are sometimes present in these areolae.

The fertile frond being narrower, the venation is simpler, the outer row of minor areolae usually being absent, and the minor costal areolae often so. A single large, impressed sorus occupies each major areola. Contrary to HOOKER'S statement, Sp. Fil. V, 34, that the sori are usually dorsal on the veins, I find them compital, as in *Phlebodium.* This is as METTENIUS, Fil. Hort. Lips., Pl. 25, f. 2, correctly figured the sori of *Phlebodium aureum.* Basically similar is the pattern of *Pleopeltis percussa* (Cav.) H. & G., METTENIUS' fig. 3 of the same plate. Because of its peltate (ciliate) paraphyses, I leave the latter species in *Pleopeltis,* but feel sure of its affinity to *M. lycopodioides.*

Microgramma as here amplified seems to me to be a definite phyletic entity, easily defined, and so easily recognized that it is best treated as one genus. It is true that the genus may be left monotypic, and all other species included in one genus, *Craspedaria;* but the sole difference will be in form of sorus. The statement of METTENIUS, Fil. Hort. Lips. 36, that the spores of *M. persicariaefolia* are tetrahedral, is incorrect — possibly taken from the incorrectly cited illustration of HOOKER and BAUER, Genera, Pl. 73 A. The spores of all species I have been able to examine are so uniform that no single specific or individual variation could be detected.

Microgramma can be accepted with confidence as a relative of *Pleopeltis.* The venation of *M. persicariaefolia* suggests that usual in *Pleopeltis* more than does that of *M. lycopodioides.* At the extreme of deviation from this, is a pattern with a single excurrent veinlet in each major areola, as in *Goniophlebium;* examples are *M. vacciniifolia* and *M. piloselloides.* I regard this as a matter of simplification, natural in fronds so small, and not as indicative of any direct affinity to *Polypodium.*

13. Marginariopsis

Marginariopsis Christensen, Dansk Bot. Arkiv 6 No. 3 (1929) 42.

A small epiphyte; rhizome long-creeping, slender, dictyostelic with filiform bundles, paleae ovate, thin, obscurely toothed; fronds remote, inconspicuously articulate, dimorphic, the sterile sessile, broadly lanceolate, entire,

papyraceous (dry), bearing sparse peltate paleae on both surfaces, venation evident, main veins weak, veinlets coarsely reticulate with some included veinlets ending in hydathodes; fertile fronds stalked, narrowly linear, sporangia in superficial continuous coenosori almost as long as the frond, paraphyses large, orbicular or irregular, toothed, transient, annulus of (12-) 14 cells, spores bilateral, smooth.

TYPE and sole species: *M. Wiesbaurii* (Sodiro, *Drymoglossum*) C. Chr., of Ecuador; also in Costa Rica; illustrated, as *Pteropsis Underwoodiana*, by MAXON, Cont. U. S. Nat. Herb. 16 (1912) 51, Pl. 28.

In the foregoing description, I have corrected CHRISTENSEN in one essential: The peltate paraphyses, typical of *Pleopeltis* and its relatives, are present *in* the coenosori. Some of them are large enough to cover the whole width of the young coenosorus. But, as in many related ferns, they are present only at the proper state of development, and are cast off before the sporangia are mature.

The resemblance of *Marginariopsis* to *Pteropsis* (*Drymoglossum*) is superficial, the latter genus being derived from *Pyrrosia*, not from *Pleopeltis*. It is *Lemmaphyllum* in the Orient, which is equally like *Marginariopsis* in aspect and in most characters, which is its real cousin. Both are Pleopeltid, but their independent descent may not be questioned.

The name *Marginariopsis* was previously used by MOORE, Index LXXIII, for a different fern, as that of a section.

14. Campyloneurum

Campyloneurum Presl, Tent. (1836) 189, Pl. 7, f. 15-21; Hooker & Bauer, Genera Pl. 71 A.

Cyrtophlebium (R. Br., in Horsfield, Plant. Jav. Rar. (1838) 4, as Section) J. Smith, Journal of Bot. 4 (1841) 58.

Campyloneuron Fée, Genera (1850-52) 257.

Epiphytes of moderate size or rather large; rhizome creeping, stout, dictyostelic, clothed with ovate, entire, brown paleae, usually immersed in a mass of roots, stipes approximate and often crowded, rarely remote, articulate to rhizome, lamina lanceolate and entire, or rarely pinnate, firm to coriaceous, glabrous, main veins connected by arched or straight veins forming a row of regular areolae extending from costa to margin between each pair of veins, the costal areola with one excurrent included veinlet, all others with two or more excurrent from the cross-vein, the middle one of three excurrent veinlets sometimes percurrent and dividing the areola; sori subterminal on the included veinlets, round, superficial, paraphyses wanting, sporangia smooth, annulus of 12-14 cells, spores bilateral, verruculose or apparently smooth.

TYPE, by convention: *C. Phyllitidis* (L., *Polypodium*) Presl, common throughout tropical America.

A very natural genus of about 25 American species, more or less related to *Polypodium*.

When *Cyrtophlebium* was published as a genus, *Campyloneurum* was cited as a synonym, in spite of its priority. *Cyrt. repens* happened to be the first species listed, this being also the species selected to illustrate *Campyloneurum* in HOOKER & BAUER'S Genera; the two generic names were intended to have exactly the same application.

Campyloneuron was intended merely as a correction, and FÉE cited PRESL as its author.

15. Pessopteris

Pessopteris Underwood et Maxon, Cont. U. S. Nat. Herb. 10 (1908) 485.

Anaxetum Schott, Gen. Fil. (1834) Pl. I; *non* Gaertner (1791).

Pleuridium (Presl, Tent. (1836) 196, Pl. 8, f. 9; Hooker & Bauer, Genera Pl. 29, as Section) Fée, Genera (1850-52) 273, *non* Bridel (1819).

A large epiphyte; rhizome short-creeping, dictyostelic, immersed in a mass of hairy roots and clothed with large, ovate, acuminate, brown paleae with lighter margins, affixed above the base; stipes approximate, (functionally ?) articulate to prominent phyllopodia; lamina narrowly oblanceolate with long-attenuate base, entire, glabrescent, coriaceous, main veins prominent, other venation immersed, main veins connected by rather irregular cross-veins forming inconspicuous major areolae which contain numerous irregularly anastomosing veinlets with excurrent and recurrent free veinlets in the minor areolae; sori solitary in the major areolae, in rows of 3 to 15 between the main veins, compital, large, round, superficial, paraphyses filamentous, fugitive, sporangia pubescent with short, deciduous hyaline hairs, annulus of 12 cells, spores bilateral, hyaline, smooth.

TYPE and sole species: *P. crassifolia* (L., *Polypodium*) Underw. & Maxon, common and variable throughout tropical America.

A few peltate-ovate ciliate paleae can be detected on young fronds, especially along the costae.

An isolated species; probably related to *Pleopeltis*.

16. Phlebodium

Phlebodium (R. Brown, in Horsfield, Plant. Jav. Rar. (1838) 4, as Section) J. Smith, Journal of Bot. 4 (1841) 58; Hooker and Bauer, Genera, Pl. 112.
Chrysopteris Link, Fil. Spec. Hort. Berol. (1841) 120; Fée, Genera 264.

Large epiphytes; rhizome creeping, stout, dictyostelic, clothed with large, lanceolate, aciculate-attenuate, irregularly ciliate brown paleae; stipes remote, elongate, articulate to very short phyllopodia; lamina ovate, pinnatisect to a broad wing with rounded sinuses, segments broad, entire, firm-papyraceous or chartaceous, usually glabrous and often glaucous, main veins fairly developed near the costa but forking freely, the typical venation pattern being: a row of narrow areolae along the costa each extending from one vein to the next, without included veinlets; next, a series of major areolae, each with two excurrent included veinlets which meet at their apex; beyond these, additional similar major areolae, or few or many minor areolae mostly without included veinlets; sori compital, one in each major areola, round, superficial, paraphyses wanting, sporangia naked, annulus of about 12 cells, spores oblong-reniform, hyaline, strongly tuberculate.

TYPE: *P. aureum* (L., *Polypodium*) J. Sm., common throughout the American tropics and in cultivation. *Chrysopteris* had the same type species, the two genera being in course of publication at the same time.

A small genus with the range of the type species, the number of species to be recognized depending on how broadly *P. aureum* is construed.

The venation is quite variable, even on individual plants. The pattern described as typical resembles that of *Microgramma lycopodioides*. In its variations, it also comes very near to that of *Pleopeltis percussa*.

Phlebodium is probably related to, and therefore probably derived from *Pleopeltis*, but its origin is not clear in detail.

17. Eschatogramme

Eschatogramme Trevisan, Atti Ist. Veneto II 2 (1851) 168; C. Chr. Dansk Bot. Arkiv 6 No. 3 (1929) 34.
Cuspidaria Fée, 3me Mém. (1851) 8, 25; Genera (1851) 88, Pl. 8 A, *non* D. C. (1838).
Dicranoglossum J. Sm., in Seemann, Bot. Voy. Herald (1854) 232.

Small epiphytes; rhizome short-creeping, dictyostelic, bearing small, entire, clathrate paleae and imbedded in a mass of fibrous roots; fronds

contiguous, sessile, not functionally articulate, once to several times forked, axes everywhere uniformly winged, segments lanceolate to linear, entire, subcoriaceous, bearing small, clathrate, peltate-ovate or attenuate paleae, veins free or forming a series of costal areolae without included veinlets; fertile (upper) parts of fronds usually somewhat contracted, veins forming a series of areolae along the outer side of which the sporangia form a typically uninterrupted coenosorus, paraphyses none, annulus of about 13 cells, spores bilateral, elliptic, almost smooth.

TYPE: "Pteris furcata L." — *Eschatogramme furcata* (L.) C. Chr. It is noted that TREVISAN made no binomial combination; and that *Pteris tricuspidata* L., which CHRISTENSEN interprets as a form of the same species, has priority of position. Both species are from Haiti, though LINNAEUS ascribed *P. furcata* to South America. Its range is from Cuba to Brazil.

Four other species, within this range, can be distinguished. *E. polypodioides* (Hooker) C. Chr. has the sori mostly round, terminal on free veins.

In agreement with J. SMITH, CHRISTENSEN says "Leaves tufted, distinctly articulated to the rhizome." I can not always detect the articulation, and doubt that it is ever functional.

CHRISTENSEN, *l.c.*, p. 39, says: "In my opinion *Eschatogramme* and *Pleopeltis* sens. propr. are sister genera, both developed from *Lepicystis*-like ancestors. The natural position of *Eschatogramme* must consequently be between *Lepicystis* and *Pleopeltis*." Except for the absence of paraphyses, I would feel safe in deriving it from *Pleopeltis*. The aspect is that of *Pleopeltis* and *Campyloneurum*, not of *Polypodium;* but no known species of any of these genera has its venation.

18. Paltonium

Paltonium Presl, Epim. (1849) 156.
Heteropteris Fée, Dix. Session Cong. Sci. France I (1843) 178; Diels, Nat. Pflanzenfam. I Pt. 4: 305, f. 161 E; *non* H. B. K. (1821).
Neurodium Fée, Genera (1850-52) 93, Pl. 8 C.

An epiphyte of moderate size; rhizome short-creeping, stout, dictyostelic, immersed in a mass of densely hairy roots, paleae small, dark, lanceolate, attenuate, entire, clathrate; fronds approximate, articulate to rhizome, short-stalked, uniform, lanceolate, entire, glabrous, coriaceous, main veins inconspicuous, venation immersed, reticulate with simple or hamate excurrent and recurrent included veinlets; sporangia in almost marginal, typically continuous coenosori confined to the upper part of the frond which is usually somewhat contracted, paraphyses none or filamentous, annulus of about 13 cells, spores bilateral, hyaline, minutely tuberculate.

TYPE and sole species: *P. lanceolatum* (L., *Pteris*) Presl, of the West Indies, Florida and Caribbean coast.

The synonyms cited are based on the same species. FÉE replaced *Heteropteris* with *Neurodium* because the former was inappropriate, citing but not adopting *Paltonium*. Subsequently, both FÉE and PRESL called other ferns *Heteropteris*, overlooking its earlier use for a flowering plant.

Paltonium is evidently a member of the group of *Polypodium* or *Pleopeltis*, not of that of *Grammitis;* its more immediate affinity has not been recognized.

Several Oriental ferns have been referred to this genus, but are without affinity to it. One of these, *P. dubium*, is Philippine, but I do not recognize it.

19. Neocheiropteris

Neocheiropteris Christ, Bull. Soc. Bot. France 62 Mém. I (1905) 21; Bower, Ferns III, 218, f. 727-730; Ching, Bull. Fan 4 (1933) 103.
Cheiropteris Christ, Bull. Boissier 6 (1898) 876; 7 (1899) 21, Pl. 1; *non* Kurr.

Terrestrial ferns of moderate size; rhizome long-creeping, dictyostelic, clothed with iridescent clathrate paleae, their thickened internal walls projecting from the margin as teeth; stipes remote, inconspicuously articulate; lamina typically pedatisect, the lateral divisions scorpioid-dichotomous with spreading, linear-lanceolate segments on the acroscopic side, but more commonly simple and entire, deciduously and sparsely paleate, without differentiated endodermis, thin, venation reticulate with branched included veinlets; sori typically elongate, close to and parallel to costae near the base, but more commonly round, on anastomosing veins, paraphyses peltate to laterally affixed, clathrate, freely toothed or dissected, pedicel long, of three rows of cells, annulus of about 16 thickened cells, spores bilateral, smooth, hyaline.

TYPE: *Cheiropteris Henryi* Christ, a synonym of *Neocheiropteris palmatopedata* (Baker, *Polypodium*) Christ, of Western China.

The genus passed as a single and supposedly isolated species, until CHING's study showed the affinity of some species with simple fronds, and the presence in Thibet of an intermediate species, *N. Waltoni* Ching. The other recognized species are *N. triglossa* (Baker, *Polypodium*) Ching, of Yunnan; *N. ensata* (Thunb., *Polypodium*) Ching, Yunnan to Japan; and *N. phyllomanes* (Christ, *Polypodium*) Ching, India to Luzon and Japan. To these, CHING adds *N. Lastii* (Baker, *Polypodium*) Ching, of Madagascar; I do not know this species, but do not see why CHRISTENSEN, Pterid. Madagascar (1932) 158, was not right in assigning it to *Microsorium*.

The range in form of *Neocheiropteris* is fairly duplicated by that of *Colysis*, and the digitate form is peculiar enough to suggest affinity. However, *Colysis* is regarded with confidence as derived from *Microsorium*, while *Neocheiropteris* is evidently related to *Pleopeltis;* and both *Colysis* and *Neocheiropteris* are apparently too recent to be possible connecting links between the two groups.

20. Lemmaphyllum

Lemmaphyllum Presl, Epim. (1849) 157; Goebel, Ann. Buit. 36 (1926) 144; C. Chr., Dansk Bot. Arkiv 6 No. 3 (1929) 44, Pl. 5, f, 12, *partim.*

Small epiphytes; rhizome long-creeping, with sclerenchyma strands in the cortex; paleae ovate-lanceolate, fixed above the base, entire or short-ciliate, fronds articulate to rhizome, dimorphic, the sterile obovate, ovate or elliptic, entire, somewhat fleshy, glabrous or glabrescent, or (*L. squamosum*) lanceolate-paleate, venation reticulate with free included veinlets mostly running toward the costa, main veins wanting; fertile frond linear or linear-oblanceolate, sporangia in mostly continuous coenosori not confluent around the apex, paraphyses peltate, clathrate, toothed, annulus of about 14 cells, spores bilateral, hyaline or nearly so, without epispore.

TYPE: *L. spathulatum* Presl, of Luzon.

A genus of four similar species, from the Himalayas and Siam to Japan.

CHRISTENSEN, *l.c.*, included in this genus a Section *Pseudovittaria*, of three species. I follow CHING in treating two of these as *Pleopeltis* (*Lepisorus*); and regard the third, *Lemmaphyllum novoguineense* (Ros.) C. Chr., as a *Belvisia*.

Lemmaphyllum is intimately related to *Pleopeltis*. CHRISTENSEN thought it probable that the species of *Lemmaphyllum* are independently derived from species of *Pleopeltis*, regarding *L. microphyllum* and *Polypodium drymoglossoides* as "sister-species;" and *L. carnosum* and *P. subrostratum* as another such pair. If this be so, it practically follows that *Lemmaphyllum* must be abandoned, as an artificial genus, since *L. spathulatum* and *L. carnosum* are surely congeneric. CHING tried to make *Lemmaphyllum* natural by transferring to it *P. drymoglossoides* and *P. subrostratum*, which made it unrecognizable rather than natural. Finally, Sunyatsenia 5 (1940)

201-268, he sets up a genus "Lepidogrammitis inter Lepisorum et Lemmaphyllum medium tenens," typified by *L. drymoglossoides* (Baker) Ching.

In my opinion, *Lemmaphyllum spathulatum, L. carnosum* and *L. microphyllum* are mutually directly related, and thus a proper genus. I do not know the fourth species, *L. squamosum.*

Lemmaphyllum and *Pteropsis* are so alike in appearance that most authors have confused them, and they can not be distinguished, as PRESL tried to do, by the position of the coenosorus. But, as shown by GOEBEL, the stomata of most species of *Pteropsis,* as of *Pyrrosia,* are surrounded by a single cell; those of *Lemmaphyllum,* as of *Pleopeltis,* not so; the paraphyses of *Pteropsis* are stellate, and those of *Lemmaphyllum* peltate, as in *Pyrrosia* and *Pleopeltis* respectively. And the structures of their rhizomes betray the same independent ancestry.

21. Drymotaenium

Drymotaenium Makino, Bot. Mag. Tokyo 15 (1901) 102; Ogata, Ic. Fil. Jap. I (1928) Pl. 19; C. Chr., Dansk Bot. Arkiv 6 No. 3 (1929) 52, Pl. 7, f. 4.

A rather small epiphyte; rhizome short-creeping, dictyostelic, with black sclerenchyma strands in the parenchyma, paleae dark, lanceolate, acuminate, toothed; fronds approximate, articulate to pedicels, uniform, narrowly linear, glabrous, coriaceous, veins concealed, anastomosing to form one or two rows of areolae with few included veinlets; coenosori uninterrupted, in a groove on each side of costa, paraphyses peltate, clathrate, transient, annulus of 14 (- 16) cells, spores bilateral, roundish, hyaline, smooth.

TYPE: *D. miyoshianum* (Makino, *Taenitis*) Makino, of Japan; also, in S. W. China.

HAYATA and CHRISTENSEN refer to this genus a second species, *D. Nakaii* Hayata, from Formosa. I have not seen it; but if it has, as described, filiform paraphyses, it is probably misplaced in this genus.

Drymotaenium is obviously related to and derived from *Pleopeltis.* Linear fronds and coenosori occur in *Pleopeltis,* and *Drymotaenium* might be included in that genus, but it looks so distinct that I prefer to hold it out. It looks like a *Vittaria,* or still more like an attenuate *Scleroglossum,* but is without affinity to either.

22. Paragramma

Paragramma (Blume, Enum. (1828) 114, as Section) Moore, Index (1857) XXXII.

An epiphyte of moderate size; rhizome creeping, dictyostelic, with black sclerotic strands in the cortex, bearing small, lanceolate, black, toothed paleae, immersed in a mass of hairy roots; fronds approximate, short-stipitate, articulate to rhizome, linear and entire, coriaceous, glabrous, with specialized hypodermis, costa conspicuous, dorsally grooved, venation completely immersed, reticulate, forming elongate areolae with freely branched included veinlets, main veins hardly present; sori oblong or linear-oblong, close and parallel to the margin, deeply immersed, receptacle linear, subtended by a plate of tracheides (GOEBEL), paraphyses peltate and also (*teste* GOEBEL, Ann. Buit. 36 (1926) 115 Pl. 8, f. 53) of intermediate forms ranging to simple hairs, pedicel elongate, of 3 rows of cells, annulus of 14 cells, spores bilateral, hyaline, smooth or nearly so.

TYPE: *P. longifolia* (Blume, *Grammitis*) Moore, of Java; ranging to the Peninsula and Luzon; reported from New Guinea and New Caledonia, but I mistrust the reports. **P. balteiformis** (Brause, *Polypodium*) is endemic in New Guinea.

Paragramma has usually been regarded as a member of the *Phymatodes* group, in *Polypodium,* to which it has only a general affinity. It is more intimately related to *Pyrrosia,* in spite of the different paraphyses. While I have seen no *Paragramma longifolia* from New Guinea, I have twice received *Pyrrosia* misidentified as *Polypodium longifolium* Mett.

23. Weatherbya genus novum — PLATE VI

Genus Pleopeltidi affine frondibus subdimorphis, fertilibus medio contractis parte superiore angustata protracta sorifera; soris orbicularibus, paraphysibus peltatis dentato-ciliatis mox deciduis protectis, sporis reticulato-asperulis.

Small epiphytes; rhizome long-creeping, slender, dictyostelic, with black sclerenchyma strands, paleae peltate-ovate or -lanceolate, clathrate, dentate-ciliate, eventually deciduous; fronds remote but numerous, decurrent on short, articulate stipes, moderately dimorphic, the sterile ovate or lanceolate, obtuse, the fertile contracted about the middle and thence attenuate, subcoriaceous, at first clothed with peltate ovate or rarely orbicular paleae which persist for a time on costa (beneath) and margin, becoming glabrous, main veins hardly evident, connected by irregular cross-veinlets which branch and form minor areolae with usually hamate and mostly recurrent included veinlets; sori on veinlets excurrent from the lowest cross-veinlets, forming one row on each side of costa, superficial or slightly impressed, at first completely protected by peltate, clathrate, dentate-ciliate paraphyses which presently disappear, annulus of 14 (- 16) cells, spores bilateral, hyaline, minutely reticulate-roughened.

TYPE: **W. accedens** (Blume, *Polypodium*), of Java, ranging to the Malay Peninsula, Luzon, Kusaie, Samoa and Queensland.

W. damunensis (Ros., *Polypodium*) is a very small, not very distinct New Guinea derivative.

Weatherbya is clearly related to *Pleopeltis*, as shown particularly by the paraphyses. These are to be seen well on perhaps one herbarium specimen in ten, and have been overlooked by most authors. METTENIUS, Polypodium (1857) No. 165, described them; and FÉE, who included the type species in *Craspedaria*, must have seen them. *W. accedens* has been illustrated by METTENIUS, *l.c.*, Pl. 3, f. 29-31, and by DOMIN, Bibl. Bot. 20 (1914) Pl. 7, without showing the paraphyses. It is distinguished from *Pleopeltis* by habit, the peculiar dimorphism, position of the sorus on its vein, and the spores. The two genera have no area in common, not quite meeting in Luzon. PRESL was disposed to place *W. accedens* in *Crypsinus*, to which it has superficial resemblance.

The genus is dedicated to the distinguished Harvard pteridologist, Doctor C. A. WEATHERBY, in appreciation of his most careful and dependable contributions to science.

24. Belvisia

Belvisia Mirbel, Hist. Nat. Veg. V (1803) 111; Underwood, Mém. Torrey Club 6 (1899) 276.

Hymenolepis Kaulf., Enum. (1824) 146; Christensen, Dansk Bot. Arkiv 6 No. 3 (1929) 142; *non* Cassini (1817).

Macroplethus Presl, Epim. (1849) 54.

Hyalolepis Kunze, Linnaea 23 (1850) 258, *non* D.C. (1837).

Epiphytes of moderate size; rhizome creeping, usually short and covered by a mass of roots, dictyostelic, with black sclerenchyma strands in the cortex, paleae broad, of various texture and with entire or toothed margins; stipes articulate, usually approximate, lamina simple and entire, firm to coriaceous, usually glabrous, venation reticulate, with included veinlets ending in hydathodes, main veins not well developed; sporangia restricted to a distal segment of the frond, which is usually sharply delimited and linear, occupying the entire nether laminar surface except at the margin, served by a specialized vascular plate (GOEBEL), paraphyses asymmetrically

peltate and sometimes also of other forms, pedicel of three rows of cells, annulus of 14 cells, spores bilateral, hyaline, without epispore.

TYPE: *Belvisia spicata* (L. f., *Acrostichum*) Mirbel, of Africa and its islands.

A genus of about 15 species, ranging from Africa across Polynesia.

B. spicata was the first of five remarkably unrelated species composing MIRBEL's genus. I would not feel obliged to adopt his name, if *Hymenolepis* were otherwise valid; but, since it is not valid, *Belvisia* seems to be the best alternative.

Macroplethus is the other possible name. Its type is *M. platyrrynchus*, **Belvisia platyrrynchos** (J. Sm., *nomen*: Kunze, *Hymenolepis*), of Luzon and Mindoro. PRESL characterized it by a broad single "sorus", and broad sterile margin. CHRISTENSEN, *l.c.*, p. 69, denies the extension of the hymenium over the costa, but I find paraphyses certainly and sporangia apparently there. The margin of the fertile segment protects the young hymenium in all species, but in this one is broader and remains hygroscopically motile, expanding to expose the sporangia and permit the ejection of spores when dry, folding in and preventing their emission when moist. Small, obliquely peltate paraphyses can be found over the first-maturing sporangia, but most paraphyses are of the various simpler forms found also on *Paragramma*. The peltate paraphyses would naturally be the first to be thrown off by the maturing sporangia.

A few species are aberrant in having elongate rhizomes and remote fronds. CHRISTENSEN emphasized this peculiarity, as well as exceptionally evident main veins and broad, uniformly thin paleae, in **Belvisia squamata** (Hieron.: C. Chr., *Hymenolepis*), Luzon to Borneo and New Guinea. He says, *l.c.*, p. 59, "By the wide-creeping rhizome and the scales this species recalls certain species of *Polypodium* § *Lepisorus* and *Lemmaphyllum* § *Pseudovittaria*." This Section, *l.c.*, p. 50, included three species. As to two of them, of continental Asia, I agree with CHING that they are *Lepisorus*, or as I prefer, *Pleopeltis*. The third, *Paltonium novoguineense* Ros., *Lemmaphyllum novoguineense* C. Chr., is unquestionably a near relative of *B. squamata*, and should be known as **Belvisia novoguineensis.** Its fertile segment is sometimes as narrow as in any *Belvisia*.

Other species are: **B. mucronata** (Fée, *Hymenolepis*), Luzon to Ceylon, Queensland and Rarotonga, the most wide-spread species; **B. revoluta** (Blume, *Hymenolepis*), Malaya to Luzon and Tahiti; **B. validinervis** (Kunze, *Hymenolepis*), Malaya to Mindanao and New Guinea; **B. glauca** (Copel.: C. Chr., *Hymenolepis*) Mindanao; **B. callifolia** (Christ, *Hymenolepis*), Malaya; **B. Vaupelii** (C. Chr., *Hymenolepis*), Samoa; **B. dura** (Copel., *Hymenolepis*), Rapa; and **B. minor** (Copel., *Hymenolepis*), Raivavae. *Hymenolepis Henryi* Hieron.: C. Chr., and *H. annamensis* are unknown to me.

Belvisia is evidently a member of the *Pleopeltis* group. In the extension and differentiation of its fertile area, it is the most specialized member of the group, and presumably therefore the farthest from primitive.

25. Pyrrosia

Pyrrosia Mirbel, Hist. Nat. Veg. V (1803) 91; Hist. Nat. Plant. IV (1803) 70 (I do not know which publication was prior, but the second cited named no species); Ching, Bull. Chinese Bot. Soc. 1 (1935) 36-72.

Candollea Mirbel, Hist. Nat. Veg. V (1803) 86; Hist. Nat. Plant. 69, *non* Labill. 1805).

Cyclophorus Desv., Berl. Mag. 5 (1811) 300.

Niphobolus Kaulf., Enum. (1824) 124; Giesenhagen, Die Farngattung Niphobolus (1901).

Galeoglossa Presl, Epim. (1849) 132.

Scytopteris Presl, Epim. (1849) 133.

Sphaerostichum Presl, Epim. (1849) 134.

Polycampium Presl, Epim. (1849) 135.

Apalophlebia Presl, Epim. (1849) 137.

Gyrosorium Presl, Epim. (1849) 139.

Niphopsis J. Smith, Cat. Cult. Ferns (1857) 6; Hist. Fil. 105.

Neoniphopsis Nakai, Bot. Mag. Tokyo 42 (1928) 217.

Epiphytes, mostly small; rhizome creeping, dictyostelic, paleate, with

a sclerenchyma cylinder in the cortex, and (at least in many species) dark sclerenchyma strands within this sheath; fronds articulate to rhizome, uniform or moderately dimorphic, usually simple and entire, coriaceous, clothed with more or less persistent stellate paleae, hypodermis usually differentiated, veins concealed, variously anastomosing with included veinlets; sori usually distal on the included veinlets, and round, sometimes elongate, and confluent, stellate paraphyses present, sporangia of round sori maturing in centripetal sequence, pedicel long, of three rows of cells, annulus of 14-18 cells, spores bilateral, smooth or rough, hyaline or discolored.

TYPE: *P. chinensis* Mirbel, a synonym of *P. Lingua* (Thunb., *Acrostichum*) Farwell, which, as construed by CHING, ranges from Tonkin to Japan.

A genus of about 100 species, many of them confused and hard to distinguish, ranging from New Zealand to the Maritime Province of Siberia and from Africa to Polynesia, most abundant in S. E. Asia. Two species have been described from Ecuador. I follow J. SMITH in distinguishing one of these as *Niphidium*. The other, *Niphobolus cuneatus* Kuhn, is unknown to me.

Of the major fern genera, *Pyrrosia* shows the most remarkable structural specialization for the control of water. Because of the uniformly small or moderate size, the almost uniformly lanceolate, entire, thick fronds and stalked, stellate paleae, the genus appears a most natural one. In the details of structure, it is variable. The paleae are characteristic of species, sometimes of groups of species, and a frond may bear more than one type. The stomata may be raised above the epidermal surface, or flush with it, or immersed in pits. In the majority of species, each stoma is surrounded by a single cell. Possibly all species have some layers of mesophyll which can collapse with loss of water, thus having a store which can be drawn on in need; but many species have one or more hypodermal layers under the upper epidermis which are guarded against collapse by form or structure.

The commonest venation pattern is more or less Camplyoneuroid; that is, the main (primary) veins are connected by cross-veinlets forming primary areolae into which plural free veinlets run toward the margin. None, or some or all of these may end in hydathodes. There is much irregularity of venation in single species, and a wide range from species to species. In a few species, the venation approaches that of *Phymatodes*.

The sori may be raised, or superficial, or deeply immersed. Paraphyses are present while needed, but are commonly thrown off as the sporangia mature.

GIESENHAGEN'S Monograph deals at length with the structural details.

Cyclophorus and *Niphobolus* are names of exactly the genus under consideration. Kaulfuss substituted *Niphobolus* for *Cyclophorus* because the latter had been used first in zoology; this does not preclude its use in botany. Accordingly, CHRISTENSEN, Index LI, restored *Cyclophorus,* but with the observation that *Candollea* would be the *nomen optimum*. *Candollea* has priority of place over *Pyrrosia,* and would better have been adopted when some unfamiliar name was necessary. The first "species" listed by MIRBEL under *Candollea* seems to have been a mixture, but its fertile component was in this genus, and so were the two following species. The adoption of this name now would conform to our rules. But practically all species bear names in *Cyclophorus,* a majority also in *Niphobolus,* and CHING has recently named nearly 60 in *Pyrrosia*. Practically all of these would require renaming in *Candollea,* the use of which would also displace *Candollea* Labill. A better course, since generic names are conserved to avoid such disturbance, will be to conserve *Candollea* Labill. For the present, I make no new combinations in either genus.

PRESL dissected the genus, recognizing both *Cyclophorus* and *Niphobolus,* and six new genera. He was particularly attentive to dimorphism, of which every shade except the extreme occurs in this genus, and took account also of the arrangement and immersion of the sori. The most distinct of these Preslian genera is *Galeoglossa,* typified by *G. nummularifolia* (Sw., *Acrostichum*) Presl. No subsequent writer has agreed with PRESL, except to the extent that FÉE presented a summary of his genera.

Niphopsis had a single species, *N. angustata* (Sw.) J. Sm., characterized by a single row of large sori on each side of the costa.

Neoniphopsis, typified by *N. linearifolia* (Hooker, *Niphobolus*) Nakai, has linear fronds with a single row of sori on each side of the costa.

Pyrrosia has become isolated in appearance by its specialization as a xerophyte. It is probably rather nearer to *Pleopeltis,* but the foliar hypodermis of many species indicates some affinity to *Phymatodes.*

Saxiglossum Ching, Contrib. Inst. Bot. Nat. Acad. Peiping 2 (1933) 1, is a single species, *S. taenioides* Ching, *Cyclophorus taeniodes* C. Chr., Index 201, Dansk Bot. Arkiv 6, No. 3 (1929) 90, *Niphobolus angustissimus* (Baker, *Polypodium*) Giesenhagen, Monog., p. 183, fig. 11 E, F, p. 62. It has uniform, narrowly linear fronds, with uninterrupted coenosori, and such foliar structure that with loss of water the nether part of the frond, but not the upper part, can shrink, thus causing the sides to roll backward. It is an aberrant *Pyrrosia,* and I do not see that its generic separation is called for; however, that is a matter of opinion.

FARWELL, Am. Midland Nat. 12 (1931) 245, 302, perhaps attempting an orthographic correction, wrote the name of this genus "Pyrrhosia." *Pyrosia* would be better, but *Pyrrosia* stands.

26. Pteropsis

Pteropsis Desvaux, Prod. (1827) 218: Maxon, Cont. U. S. Nat. Herb. 10 (1903) 486, *non* 16: 51; *nec* Presl, Tent. (1836) 225, Pl. 10, f. 3.

Drymoglossum Presl, Tent. (1836) 227, Pl. 10, f. 5, 6; Goebel, Ann. Buit. 36 (1926) 140; C. Chr., Dansk Bot. Arkiv 6 No. 3 (1929) 83, Pl., 12, 13.

Oetosis O. K., Rev. Gen. Plant. II (1891) 817, *partim, vix* Necker.

Small epiphytes; rhizome wide-creeping, dictyostelic, with cortical cylinder of sclerenchyma, paleate; fronds remote, articulate to rhizome, dimorphic, the sterile ovate to orbicular, entire, fleshy, sparsely stellate-paleate, venation immersed, rather irregularly reticulate with included veinlets, main veins hardly developed; fertile fronds linear-elliptic, sporangia in a continuous linear coenosorus, sometimes occupying the whole nether laminar surface, stellate paraphyses present, annulus of 14-18 cells, spores bilateral, coarsely tuberculate or spinose-tuberculate.

TYPE: *P. piloselloides* (L., *Pteris*) Desvaux, India to New Guinea.

A genus of six tentatively recognized species (CHRISTENSEN), ranging to Madagascar and the Solomons.

As to the name: DESVAUX included a strange mixture of ferns in his genus *Pteropsis,* but I do not see how it can be typified reasonably otherwise than will make it replace the familiar *Drymoglossum,* based on the same type. There is, indeed, a rule which would sanction PRESL'S action in dividing DESVAUX' genus as he might see fit, arbitrarily. In such a course, since PRESL acted in the same way again in establishing *Paltonium, Pteropsis* will displace *Ananthacorus.* Personally, I decline to be bound by a rule when it operates contrary to reason. CHRISTENSEN, Index XLVI, wrote correctly: *"Pteropsis* Desv. (pro parte max. certe nom. opt.)."

The affinity is manifestly to *Pyrrosia,* from which it is distinguished by the combination of continuous coenosori and dimorphic fronds. *Py. confluens* (R. Br.) Ching has uninterrupted coenosori but uniform fronds. The paraphyses of these two species are similar and unlike those of most species of either genus. As I see it, this is the point of contact of the two genera, and both have followed the standard direction of migration, from New Guinea (or even from New Zealand) to Asia.

CHRISTENSEN, l.c., 1929, p. 91, believes that the several species of "Drymoglossum" are independently related to species of "Cyclophorus," and therefore that the former genus is artificial. If so, it would be better to abandon it and return all the species to *Pyrrosia.* But I cannot accept his suggestion that *Pt. piloselloides* is as nearly related to *Py. adnascens* as it is to other species of *Pteropsis. Pt. niphoboloides* (Luerssen, *Taenitis*), of Madagascar, is isolated geographically, and somewhat aberrant in structure, but not in a way which suggests a separate origin in *Pyrrosia.*

27. Niphidium

Niphidium J. Smith, Hist. Fil. (1875) 99.

An epiphyte of moderate size; rhizome short-creeping, dictyostelic, clothed with copious large, ovate, acuminate, brown paleae toothed toward the apex; stipes approximate, articulate; lamina linear, entire, attenuate to both ends, coriaceous, clothed deciduously above, very densely beneath, with large, ovate, filiform-attenuate paleae, fixed above the base, brownish and clathrate near the point of attachment, elsewhere hyaline, freely ciliate with long, contorted, branching hairs, venation like that of *Pessopteris* ("venatio Anaxeti"), some of the included veinlets ending in hydathodes; sori large, in single rows of two to four between the main veins, superficial, centered at the base of free veinlets, annulus of 14 cells, spores bilateral, hyaline, smooth.

TYPE: *N. americanum* (Hooker, *Polypodium*) J. Sm., of Ecuador.

SMITH segregated this genus from *"Niphobolus"* because of the uniseriate sori between the main veins. This would not distinguish it from such a species as *Pyrrosia serpens* (Forster) *Ching* (*serpensis, errore Chingii*), of New Zealand, and would justify the suspicion that *Pyrrosia* had migrated Northward along the Andes, as well as by New Zealand. But the foliar paleae of *Niphidium* are not stellate, as described by HOOKER and SMITH. They are unlike those of any *Pyrrosia,* or of any other fern known to me. The paleae of the rhizome are also unlike those of *Pyrrosia.*

Niphidium may well be a relative of *Pyrrosia,* to be regarded then, as already suggested, as an independent migrant from the far South. It has the aspect, venation and soral arrangement of *Pessopteris,* as observed by SMITH, but *Pessopteris* is glabrous.

28. Microsorium

Microsorium Link, Hort. Berol. II (1833) 110; Fée, Genera 267, Pl. 20 B; Copel., Univ. Calif. Publ. Bot. 16 (1929) 111 *partim;* Ching, Bull. Fan 4 (1933) 293.
Phymatodes Presl, Tent. (1836) 195, Pl. 8, f. 12, 14, 15, 19, 20; Ching, Cont. Inst. Bot. Nat. Acad. Peiping 2 (1933) 53 *partim.*

Typically epiphytes, mediocre to large; rhizome creeping, dictyostelic, paleate, paleae clathrate, usually broad; stipes remote, articulate to phyllopodia; fronds simple and entire or pinnatifid, rarely pinnate, herbaceous to coriaceous, glabrous or rarely pubescent but not paleate, margin entire in detail, venation irregularly reticulate with copious forked included veinlets running in all directions, ending in hydathodes; sori compital, usually round, without paraphyses, annulus usually of 14-16 cells, spores bilateral, usually smooth.

TYPE: *M. irregulare* Link, which was a cultivated, abnormal form of *M. punctatum* (L., *Acrostichum*) Copel.; native from Polynesia to Africa.

Typical *Microsorium* is characterized by simple fronds, and numerous scattered, round, superficial sori. CHING has estimated the number of species at 40 and enumerated twenty.

Phymatodes was typified by *P. vulgaris* Presl, which was *Polypodium Phymatodes* L., now *M. Scolopendria* (Burm., *Polypodium*) Copel., with typically pinnatifid, coriaceous fronds, and very large, impressed, seriate sori subtended by a vascular network (dictyosori, of GOEBEL). CHING estimated the number of species at 100, but the majority of those he lists are in his section *Phymatopsis,* which I include in *Crypsinus.* He also states that there are American species; but he names none, and may be following SMITH, in error.

The types of *Microsorium* and *Phymatodes* look too unlike for inclusion in any natural genus, and I do not blame CHING, and CHRISTENSEN, VERDOORN's Manual, p. 547, for treating them as distinct. Expecting to find somewhere a line between them, I have left this as the last genus for final description, but am unable to separate them by any character, or to assign a considerable number of species with any con-

fidence to one rather than to the other. As a matter purely of convenience, *Microsorium* and *Phymatodes* can be retained as descriptive names of sections. Species of both sections occupy the longitudinal range of the genus, from Polynesia to Africa..

From the over-large *Microsorium* set up in 1929, *Lepisorus* is now transferred to *Pleopeltis*. *Colysis, Paragramma, Weatherbya,* and *Arthromeris* are now given generic status; of these, only *Colysis* is an immediate relative of *Microsorium*. *Microterus* and *Phymatopsis* are now *Crypsinus*. *Atactosia, Allothecium* and *Symplecium* are *Microsorium*, hardly worth retention as sections.

Microsorium has given rise to a wealth of derived genera — *Diblemma, Leptochilus, Colysis* and thence *Dendroglossa*, and the whole *Drynaria* group. The fact that all of these are derived from fairly typical *Microsorium*, while no daughter genus is recognized as Phymatodid, might seem to be a reason for regarding section *Microsorium* as the relatively primitive part of the genus.

However, a small group of austral species — **M. pustulatum** (Forster, *Polypodium*), *M. diversifolium* (Willd.) Copel., **M. Novae-Zelandiae** (Baker, *Polypodium*) — with typically pinnatifid fronds but simple fronds sometimes fertile, the thinner texture more usual in section *Microsorium*, and seriate but small sori, represent the most probable common ancestry of both sections. These species are among those I have felt unable to assign to either section rather than to the other. This group presents also the nearest approach to *Crypsinus*.

Showing the content of *Microsorium* as now constituted, a list of the species used in this study, and not already mentioned, follows:

M. pitcairnense (Copel., *Polypodium*)—Pitcairn Island.
M. alatum (Brack., *Drynaria*) (*P. Wilkesii* C. Chr.)—Fiji.
M. sylvaticum (Brack., *Drynaria*) (*P. vitiense* Baker)—Polynesia.
M. Powellii (Baker, *Polypodium*)—Samoa.
M. Parksii (Copel., *Polypodium*)—Fiji.
M. maximum (Brack., *Drynaria*)—Society Islands.
M. Vieillardii (Mett., *Polypodium*)—New Caledonia.
M. cinctum (Copel., *Polypodium*)—New Guinea.
M. commutatum (Blume, *Polypodium*)—N. G. to Java and Luzon.
M. multijugum (Copel., *Polypodium*)—New Guinea.
M. tenuinerve (Copel., *Polypodium*)—New Guinea.
M. tuanense (Copel., *Polypodium*)—New Guinea.
M. Kingii (Copel., *Polypodium*)—New Guinea.
M. sibomense (Ros., *Polypodium*)—New Guinea.
M. phanerophlebium (Copel., *Polypodium*)—Mindanao.
M. lucidum (Roxb., *Polypodium*) (*P. leiorhizum* Wall.)—India and China.
M. Hancockii (Baker) Ching—India to Formosa.
M. insigne (Blume) Copel.—Java to Negros.
M. pentaphyllum Baker, *Polypodium*), including *P. dolichopterum* Copel.—Philippines.
M. pteropus (Blume) Copel.—New Guinea to India.
M. zosteriforme (Wall.) Ching—India.
M. heterocarpum (Blume) Ching—Java to Luzon.
M. Zippelii (Blume) Ching—Java to India and Luzon.
M. heterolobum (C. Chr., *Polypodium*)—Luzon.
M. monstrosum (Copel., *Polypodium*)—Philippines.
M. mindanense (Christ, *Polypodium*)—Mindanao.
M. neoguineense (Copel., *Polypodium*)—New Guinea.
M. linguaeforme (Mett.) Copel.—New Guinea to Fiji and Luzon.
M. schumannianum (Diels, *Polypodium*)—New Guinea.
M. musifolium (Blume) Copel.—Solomon Ids. to Java and Luzon.
M. glossophyllum (Copel., *Polypodium*)—New Guinea.
M. membranaceum (Don) Ching—India to Formosa and Luzon.
M. longissimum (J. Sm.) Fée (*P. myriocarpum* Mett.)—Philippines.
M. tenuilore (J. Sm.) Copel.—Philippines.
M. sablanianum (Christ, *Polypodium*)—Philippines.
M. Curranii (Copel., *Polypodium*)—Luzon.
M. Bamleri (Ros., *Polypodium*)—New Guinea.

M. glossipes (Baker, *Polypodium*)—New Guinea.
M. wobbense (Brause, *Polypodium*)—New Guinea.
M. Brassii Copel.—New Guinea.
M. congregatum (C. Chr., *Polypodium*)—Sumatra.
M. validum (Copel.) Ching—Philippines.
M. subirideum (Christ, *Polypodium*)—Philippines.
M. Steerei (Harr.) Ching—Formosa.
M. superficiale (Blume) Ching—Java to India and Japan.
M. hymenodes (Kunze) Ching—India, China.
M. buergerianum (Miquel) Ching—Tonkin to Japan.
M. Fortunei (Moore) Ching—Himalayas to Formosa.
M. Spectrum (Kaulf., *Polypodium*)—Hawaii.
M. papyraceum (Copel., *Polypodium*)—New Guinea.
M. Cromwellii (Ros., *Polypodium*)—New Guinea.
M. alternifolium (Willd., *Polypodium*) (*P. nigrescens* Blume)—Polynesia to India.
M. rubidum (Kunze, *Polypodium*) (*P. longissimum* Blume)—range doubtful.
M. Schneideri (Christ, *Polypodium*)—Sumatra, Philippines.
M. subgeminatum (Christ, *Polypodium*)—New Guinea.
M. acutifolium (Brause, *Polypodium*)—New Guinea.
M. sarawakense (Baker) Ching—Sarawak.

M. normale (Don) Ching, and *M. subhastatum* (Baker) Ching, listed in this genus by CHING, and regarded as indicating a transition to *Pleopeltis*, seem to me to be *Pleopeltis*. I do not believe that they are intermediate in a phyletic sense.

29. Diblemma

Diblemma J. Smith, Hooker's Journal of Bot. 3 (1841) 399, *nomen;* 4 (1841) 65; Hooker & Bauer, Genera (1842) Pl. 109 B.

An epiphyte of moderate size; rhizome creeping, slender, dictyostelic, clothed with small, attenuate, fuscous, shining paleae finely toothed by projecting cell-walls; stipes remote, articulate; fronds linear, attenuate to both ends, minutely pubescent, herbaceous. main veins hardly present, branching and anastomosing to form one series of inconspicuous major areolae elongate along the costa, minor areolae with included veinlets; sporangia confined to a closely submarginal line, uninterrupted or more or less broken into shorter coenosori, paraphyses wanting, annulus of 13 or 14 cells, spores lunate-reniform, smooth.

TYPE and sole species: *D. samarensis* J. Smith, of Samar, common also in N.-E. Mindanao.

CHING, Sunyatsenia 5 (1940) 201-268, maintains this genus but renames its type as *D. tenuiloris* (J. Smith) Ching; in which, though he borrowed the confusion from CHRISTENSEN, he is doubly wrong; because *Polypodium tenuilore* was validly published long after *D. samarensis*, and *P. tenuilore* is a *Microsorium*. The two species are nearly related, but distinct. It is more interesting than surprising to find, as an example of atavism, some scattered sori on *Diblemma*. These were exceptionally evident on CUMING's original collection, and are mentioned by SMITH, and by METTENIUS, Fil. Hort. Lips., p. 27, and illustrated by HOOKER and BAUER. I find none of them on a Samar specimen collected by JAGOR, nor on most Mindanao specimens.

While *D. samarensis* and *M. tenuilore* are intimately related species, it is convenient to maintain *Diblemma* as a genus, because its inclusion in *Microsorium* would require a very inconvenient modification of the description of that genus.

30. Leptochilus

Leptochilus Kaulfuss, Enum. (1824) 147, Pl. 1, f. 10; Fée, Genera, 54, Pl. 3 B; Copel., Philippine Journal Sci. 37 (1928) 338, Pl. 1.

A rather small epiphyte; rhizome wide-creeping and freely branched, dictyostelic with numerous bundles and no sclerenchyma strands, paleae

small, acuminate, dark, clathrate, deciduous; stipes remote, inconspicuously but functionally articulate, elongate; fronds simple, dimorphic, the sterile lanceolate, entire, glabrous, herbaceous, main veins hardly developed, veinlets anastomosing to form numerous areolae with copious included simple and branched veinlets ending in hydathodes; fertile frond narrowly linear, sporangia covering the fertile surface, without paraphyses, annulus normally of 14 cells, spores reniform-elliptic, hyaline, smooth.

TYPE: *L. axillaris* (Cav., *Acrostichum*) Kaulfuss, of Luzon, ranging to India and New Guinea. Accepting the judgment of CHRISTENSEN and CHING, that *L. platyphyllus* Copel. is a local variant, I have again a genus of one species.

More than most dimorphic genera, *Leptochilus* has been made to include unrelated species and genera. Since I reduced it to its original unity, CHRISTENSEN, Suppl. III, 118, and CHING, Bull. Fan 4 (1933) 336, have amplified it to include *Dendroglossa*, which we recognize in common as derived from *Colysis*, a typically terrestrial genus. *Leptochilus* is epiphytic, and I cannot believe that its immediate forebears were terrestrial. The articulation of its stipes is inconspicuous, but is still able to function. There are several other differences in detail; but this one satisfies me that it can not be derived from *Colysis*.

In my opinion, it is derived directly from *Microsorium*, from the element in that genus represented by *M. longissimum* Fée, and is related fairly nearly to *Diblemma*.

31. **Paraleptochilus** genus novum — PLATE VII

Genus Leptochilo simillimum e grege Microsorii Zippelii evolutum, venis primariis rectis facile distinguendum; rhizomate repente, paleis parvis obscuris vix denticulatis vestito; frondibus dimorphis ad rhizoma inconspicue articulatis, sterilibus brevi-stipitatis oblanceolatis integris acuminatis deorsum attenuatis, venis primariis conspicuis, fertilibus longe stipitatis angustissimis ubique fructiferis.

TYPE: **P. decurrens** (Blume) Copel.; *Leptochilus decurrens* Blume, Enum. (1828) 206, C. Chr., Cont. U. S. Nat. Herb. 26 (1931) 325; *Campium decurrens* Copel., Philip. Journal of Sci. 37 (1928) 351. Described from Java; ranging to Mindanao and India.

Argument of CHRISTENSEN and CHING for the identity of *Leptochilus* and *Dendroglossa* has been based on resemblance of the latter to this "Leptochilus decurrens," rather than to real *Leptochilus*. Against any such argument, I agree with CHRISTENSEN, *l.c.*, that, whether or not all the forms referred to *P. decurrens* are a single species, it is a direct derivative of *Microsorium*, not of *Colysis*, but not from the same source in *Microsorium* as *Leptochilus*. This demands that it be given independent generic status. The resemblance of its sterile fronds and other vegetative structures to those of *Microsorium Zippelii* is so complete that derivation from the same group is hardly less than certain. I have collected it on tree trunks and about their bases.

In this genus belongs **P. ovatus**—*Campium ovatum* Copel., Philip. Journal Sci. 37 (1928) 354, f. 9 and Pl. 6. *Acrostichum Listeri* Baker is probably another member.

32. Colysis

Colysis Presl, Epim. (1849) 146; Fée, Genera, 175; Ching, Bull. Fan 4 (1933) 313. *Leptoselliguca* C. Chr., Gardens' Bull. 7 (1934) 309, as sect. of *Polypodium*.

Terrestrial ferns of moderate size; rhizome creeping, dictyostelic, clothed with small, thin, dark, entire or subentire paleae; stipes remote, vestigially or functionally articulate to rhizome, elongate, commonly decurrent-winged; fronds simple or digitate or pinnate with adnate pinnae, entire in detail, herbaceous or thin-herbaceous, glabrous, main veins usually falling short of margin, connected by regular or irregular cross-veinlets, which branch and anastomose to form two rows of areolae between main veins, included veinlets simple or hamate; sporangia forming one typically continuous but sometimes interrupted row on the veinlet parallel to the main veins, para-

physes wanting, pedicel of three rows of cells, annulus of 12-14 cells, spores bilateral, hyaline to light-brown, smooth, or minutely spinulose.

TYPE: *C. hemionitidea* (Wall., *Polypodium*) Presl, of India, ranging to the Philippines and Formosa. This is PRESL's first listed species, and is indicated as the type by CHRISTENSEN, Suppl. III, 12. CHING, *l.c.*, p. 316, writes: "Type: *Grammitis macrophylla* Blume, or *Polypodium ellipticum* Thunberg." *Colysis macrophylla* (Blume) Presl was the second species listed by PRESL, and if CHING had chosen it unequivocally I would follow him. But, by choosing two, CHING effectively named no type. It can not be *C. elliptica* (Thunb.) Ching, because PRESL described its variety, *C. pothifolia*, as "Species insignis et a genere recedens," and suggested a subgeneric name, *Dictyogramma*.

A genus of probably 30 species, ranging from Africa (CHING) to New Guinea and Queensland. Represented in Queensland by **C. ampla** (F. v. M.: Bentham, *Grammitis; Polypodium queenslandicum* C. Chr.); and **C. Sayeri** (F. v. M. & Baker, *Gymnogramma*). Its New Guinea representative is **C. polysora** (Brause, *Polypodium*). The Borneo species identified by CHRISTENSEN as this, Gardens' Bull. 7 (1934) 308, is distinct. **C. Hosei** (C. Chr., *Polypodium*) and at least three other species are in Borneo.

A most interesting species is *C. membranacea* (Blume) Presl, *Selliguea aliena* Brack, *Polypodium Selliguea* Mett., which may have approximately uniform fronds, or may have the fertile fronds contracted to narrowly linear.

The affinity of *Colysis* to *Microsorium* is unquestionable. It is not equally sure that the species included in *Colysis* are really a natural group, representing a single line of descent from *Microsorium*. *C. hemionitidea* is evidently related to *Microsorium Zippelii*. It will be observed that *Colysis* and *Paraleptochilus* are thus assigned a common ancestry. In spite of this, they are held generically distinct because of the extreme dimorphism of *Paraleptochilus*, a character so striking that from Blume to Ching *P. decurrens* has been assigned to *Leptochilus* by all authors who have recognized such a genus.

Because of the similarly oblique coenosori, mostly simple and entire fronds, and several other characters in common, *Colysis* has usually been included in *Selliguea*. CHRISTENSEN, in Gardens' Bull., *l.c.*, was, I believe, the first to point out correctly the distinct ancestry of *Selliguea* and *Colysis*.

As to *C. hemionitidea*, CHING, *l.c.*, p. 320, comments: "It seems to be not only a linking species between *Microsorium* and *Colysis* as indicated by its unstable soral conditions, but also, in my mind, a parental type of the genus *Leptochilus*, particularly of the Himalayan *L. decurrens*. . ." I have already pointed out that *L. decurrens* is not a *Leptochilus*. "A linking species" might be placed in either genus; in this case, it must be in *Colysis*, being the type of the genus.

33. Dendroglossa

Dendroglossa Presl, Epim. (1849) 149.
Myuropteris C. Chr., Dansk Bot. Arkiv 6 No. 3 (1929) 73, Pl. 9, f. 1, 2, Pl. 10, f. 3.
Campium Copel., Philippine Journal Sci. 37 (1928) 342, *p. p. minore*.

Small, normally terrestrial ferns; rhizome creeping, dictyostelic, with few bundles and few fine sclerenchyma strands, clothed with small, dark, clathrate paleae; stipes subapproximate, vestigially if at all articulate; fronds simple, dimorphic, the sterile lanceolate or broader, herbaceous, entire, usually glabrous, main veins hardly developed, venation reticulate, with mostly recurrent included veinlets; fertile fronds linear to filiform, sporangia typically occupying the whole area on each side of costa, paraphyses wanting, annulus of 14 (- 17) cells, spores elliptic-reniform, hyaline, smooth.

TYPE: *D. normalis* (J. Sm., *Gymnopteris, nomen*) Presl, which should be **D. minor** (Fée, *Leptochilus*), of the Philippines.

A small genus, ranging to S. China and S. India. Referable to it are: **D. cantoniensis** (Baker, *Gymnogramme*), of S. China, and probably including *Drymoglossum cordatum* Christ, of Annam; **D. minutula** (Fée, *Leptochilus*), of Assam; **D. zeylonica** (Fée,

Leptochilus), and **D. Wallii** (Baker, *Acrostichum*), of Ceylon; also, *Leptochilus lanceolatus* Fée, of S. India, which probably is not *Dendroglossa lanceolata* (L.) Presl.

Dendroglossa Fée, Genera (1850-52) 80, was composed chiefly of ferns now included in *Hemigramma.*

Myuropteris was based on *M. cordata* (Christ, *Drymoglossum*), C. Chr; its author later reduced it to *Leptochilus,* in which he included *Dendroglossa.* CHING and, long ago, FÉE have agreed in this interpretation of *Leptochilus.* For reasons stated in the discussion of that genus, I disagree.

CHRISTENSEN, CHING and myself are in agreement that the ferns here called *Dendroglossa* are derived from *Colysis.* At Los Baños, P. I., where these ferns were under my observation for years, fairly typical *Colysis membranacea* (Blume) Presl and *Dendroglossa minor* are rare, but intermediate forms are very common. These are in many herbaria by my distribution, as *Pterid. Philip. Exsiccata No. 44,* labelled *Leptochilus normalis,* and *No. 277,* labelled *Selliguea aliena* Brack., later corrected to *C. membranacea.* These may illustrate the origin of *Dendroglossa.* They may be freely self-perpetuating local hybrids. But intermediate forms are not unknown elsewhere; and some degree of dimorphism is not unknown otherwise in *Colysis.*

Dendroglossa is distinguished from *Colysis* by comparatively perfect dimorphism, and I know no other distinction. *Dendroglossa* appears to be a natural group. If other species than *D. minor* are found to be as intimately related to species of *Colysis,* making the group probably unnatural, *Dendroglossa* should be reduced to *Colysis.*

The generic name is inappropriate, all species so far as known, and the type certainly, being terrestrial.

34. Dendroconche

Dendroconche Copeland, Philip. Journal Sci. 6 C (1911) 96.

Epiphytes of moderate size; rhizome creeping, slender, dictyostelic, clothed with thin, appressed, lanceolate-attenuate, sparingly and irregularly toothed paleae; fronds vestigially articulate to rhizome, subsessile, imbricate, dimorphic, the sterile orbicular-cordate, entire, naked, subscarious, costa dissipated in middle of frond, main veins branching and becoming dissipated, all venation conspicuous, areolae rather large, with included veinlets; fertile fronds with base like the sterile fronds but costa procurrent and wingless or winged, then with a linear or lanceolate fertile lamina, sori compital, round or extending along the veinlets, in a row on each side of costa if the fertile segment is linear, scattered if it is broader, without paraphyses, annulus of about 13 cells, spores elliptic, hyaline, smooth.

TYPE: *D. Annabellae* (Forbes, *Polypodium*) Copel., of Papua, well illustrated by FORBES, Journal of Bot. 26 (1888) Pl. 280.

The one other species, *D. Kingii* Copel., also of Papua, may be only an atavistic form.

Dendroconche is derived from *Microsorium linguaeforme* (Mett.) Copel., of the same region. Its generic distinction is justified in part by its striking appearance, but essentially by the fact that, if left in *Microsorium,* it would make that genus hard to define from *Drynaria,* to which *Dendroconche* is not directly related.

35. Drynariopsis

Drynariopsis (Copeland, Univ. Calif. Publ. Bot. 16 (1929) 117, as Section of *Aglaomorpha*) Ching, Sunyatsenia 5 (1940) 201-268.

A huge epiphyte; rhizome very stout, fleshy, dictyostelic, covered with slender, castaneous, sparingly and irregularly toothed paleae and a mass of fibrous roots; frond sessile, not functionally articulate, broad and shallowly lobed at the base, hard-scarious and humus-collecting, the upper part much wider, pinnatifid with broad (even 10 cm) entire or undulate segments abscissile from the costa, chartaceous, veins conspicuous, forming a fine reticulation with included veinlets; sori exceedingly numerous, mostly com-

pital, impressed, round, paraphyses none, annulus of about 13 cells, spores reniform-elliptic, light-brown, smooth or nearly so.

TYPE and sole species: *D. heraclea* (Kunze, *Polypodium*) Ching, Java to Luzon and the Solomon Islands.

In establishing a section for this majestic fern, I remarked that it was susceptible of generic status; but the name *Aglaomorpha* is so particularly appropriate to it that I disliked to give it any other.

36. Pseudodrynaria

Pseudodrynaria (Christensen, Suppl. III (1934) 13, as Section); Verdoorn's Manual (1938) 548; Ching, Sunyatsenia 5 (1940) 201-268.

A large epiphyte; rhizome creeping, stout, dictyostelic, imbedded in slender, dark, ciliate paleae and fibrous roots; frond sessile, not functionally articulate, base moderately dilated, sinuate or shallowly lobed, scarious, upper part of frond much wider, pinnatisect with lanceolate entire segments, veins conspicuous, the main veins connected by fairly regular cross-veins, and these in turn by usually two (tertiary) veinlets parallel to the main veins, included veinlets present; sori compital, in one row between each pair of main veins, superficial, round or more often elongate along the tertiary veinlets, annulus of 11-16 cells, sometimes irregular, spores bilateral, hyaline, smooth.

TYPE and sole species: *P. coronans* (Wall.: Mett., *Polypodium*) Ching; India to Formosa, not known in the Philippines.

Since it is not evident that CHRISTENSEN intended to publish *Pseudodrynaria* as a genus, it should apparently be credited to CHING. However, CHING published it as "Pseudodrynaria C. Chr.;" and the relations of the two writers were so intimate that a correction without consultation would be unsafe.

37. Aglaomorpha

Aglaomorpha Schott, Gen. Fil. (1834) Pl. 20; Copel., Philippine Journal Sci. 6 C (1911) 40.

Psygmium Presl, Tent. (1836) 199, Pl. 8, f. 21, 22.

Dryostachyum J. Smith, Journal of Bot. 3 (1841) 399; in Hooker & Bauer, Genera (1841) Pl. 95.

Hemistachyum (Copel., Philippine Journal Sci. 9 C (1914) 8; Univ. Calif. Publ. Bot. 16 (1929) 117, as Section) Ching, Sunyatsenia 5 (1940) 201-268.

Large epiphytes; rhizome creeping, fleshy (except *A. pilosa*), dictyostelic, paleae slender, usually dark and ciliate; fronds usually sessile, not functionally articulate, base usually dilated, scarious, typically humus-collecting, larger part of frond normally vegetative, deeply pinnatifid with broadly lanceolate entire segments abscissile from costa, papyraceous, venation conspicuous, regularly doubly reticulate with included veinlets; upper part of frond fertile, pinnate with narrowly lanceolate or linear pinnae; sori compital in origin but spreading to form patches (pleosori, coenosori or dictyosori) occupying the whole of discrete pinnules (in the type), or the space between main veins (in *Dryostachyum*), or between major veinlets (in *Hemistachyum*), paraphyses none, annulus of 11-15 cells, spores bilateral, subhyaline, smooth or minutely tuberculate.

TYPE: *A. Meyeniana* Schott, Central Luzon to Formosa. As *P. elegans* Presl, the same species is the type of *Psygmium*. Within the genus as here enlarged, it is distinguished by having the fertile pinnae so contracted that the lamina consists of separate or narrowly connected bead-like segments, each occupied by a sorus. It is a most ornamental fern.

Dryostachyum was typified by *D. splendens* J. Smith — *Aglaomorpha splendens* Copel. — of Luzon, of which I regard *A. novoguineensis* (Brause) C. Chr. as a synonym. The fertile part of the frond is less contracted, leaving room for great masses of sporangia, "sori," each occupying the area between two main veins. If the sporangia be removed, it is sometimes but not always possible to observe the absence of sporangia on the cross-veins.

A definite break-up of the sporangial area, so that several sori are formed, separated by the cross-veins, is found in *Aglaomorpha Brooksii* Copel., of Sarawak, the type of *Hemistachyum*. This difference is surely not of generic significance.

The most aberrant species, but the only one which has never served as the type of a genus, is *A. pilosa* (J. Smith, *Dryostachyum*) Copel., well described and figured by Kunze, Farrnkr. (1847) 139, Pl. 91. It has a comparatively slender rhizome and stipitate frond without humus-collecting base, is pubescent, and has spinulose sporangia. It has some evident affinity to *Photinopteris*, and near affinity to *Holostachyum*. And yet, HOOKER has not been alone in reducing it to the status of a variety of *D. splendens*.

Aglaomorpha is presented here with the same four species I included in it in 1911. In the interim, I have included in it *Holostachyum, Drynariopsis* and *Pseudodrynaria*, but defer now to the judgment of my colleagues in treating these as distinct. My own preference would be still to include *Holostachyum*.

38. Holostachyum

Holostachyum (Copeland, Philippine Journal Sci. 9 C (1914) 8, as Section) Ching, Sunyatsenia 5 (1940) 201-268.

An epiphyte of moderate size; rhizome creeping, slender for this group, dictyostelic, clothed with lanceolate, castaneous, ciliate paleae; fronds stipitate, non-articulate, not humus-collecting, dimorphic, subpinnate, the segments or pinnae articulate to rachis, those of the sterile frond ovate, entire, coriaceous, venation conspicuous, main veins connected by fairly regular (secondary) cross-veins, and these by tertiary veins, branching and forming a fine reticulum with included veinlets; pinnae of fertile frond lanceolate, remote but mostly connected by wings, pubescent, main veins zigzag, secondary veins forming two to several major areolae each occupied by a large sorus, sporangia setulose, annulus of (11-) 12 cells, spores elliptic, subhyaline, smooth.

TYPE: *H. Buchanani* (Copel., *Aglaomorpha*) Ching, of British New Guinea. With four collections in hand, I am now convinced that *Dryostachyum Ledermanni* Brause is the same variable species. In 1914, I transferred to this section *D. Hieronymi* Brause, but suppose now that this is a *Merinthosorus*. *Holostachyum* thus seems probably to be a single species.

Holostachyum is nearly related to *Aglaomorpha pilosa*. The sole generic distinction is that the dimorphism is of fronds as a whole, not of the apical portions of fronds.

39. Thayeria

Thayeria Copeland, Philippine Journal Sci. 1 Suppl. (1906) 165, Pl. 28; 7 C (1912) 41, Pl. 1.

Like *Aglaomorpha Meyeniana*, except that the fronds are produced singly in specialized branches of the rhizome, these branches then ending with the production of a mass of roots, each frond sessile, non-articulate, with a very broad scarious base wrapped in the form of a cornucopia, enclosing the tip of the branch, the mass of roots, and a collection of detritus.

TYPE: *T. Cornucopia* Copel., of the Philippines.

Above the humus-collecting cornucopia, the normal frond and its fertile apex are like those of *A. Meyeniana*, but usually larger.

The extraordinary character of the specialized leaf-bearing branch is attested by

the inability of VAN ALDERWERELT and ROSENSTOCK to comprehend it, by CHRISTENSEN'S agreement that *Thayeria* is a section of *Drynaria,* though it is not nearly related to that genus, and best by GOEBEL, Ann. Jard. Buit. 39 (1928) 227, who included a plea for verification of the origin of the leaf in his summary of accomplishments in the study of the *Drynaria* group. I promptly sent him good material, but it was too near the end of his life.

Thayeria is locally common on a number of mountains of Luzon and Mindanao, but is rarely found fertile. In one area on Mt. Apo, I have found the ground buried under fragments of it, but could find no sterile frond on the ground nor detect one in the canopy overhead.

I have included in the genus a second species, *T. nectarifera* (Baker, *Polypodium*). This is possibly correct, but I have yet to see a specimen.

40. Merinthosorus

Merinthosorus Copeland, Philippine Journal Sci. 6 C (1911) 92.

Like typical *Aglaomorpha, A. meyeniana,* except that the fertile pinnae are linear and entire, each with an uninterrupted "sorus" on each side of the costa, typically occupying the entire half-lamina.

TYPE: *M. drynarioides* (Hooker, *Acrostichum*) Copel., of "Malayan Peninsula, *Sir Wm. Norris.* Salomon's Islands, South Pacific, *Milne.*" I have specimens from Penang, Sumatra and Dutch New Guinea, with costae pubescent on the upper side; also from British New Guinea (four collections) and Bougainville, with glabrous fronds. There is considerable variation in dilation of the scarious bases, and in the elongation of the fertile pinnae; however, all may represent one species.

M. Hieronymi Copel., which is probably *Dryostachyum Hieronymi* Brause, of New Guinea, has a slender rhizome and stipitate frond without humus-collecting base. It has thus some resemblance to *Aglaomorpha pilosa,* but its sporangia are naked.

41. Photinopteris

Photinopteris J. Smith, Journal of Bot. 3 (1841) 403; 4 (1841) 155; in Hooker & Bauer, Genera (1842) Pl. 92.

Typically an epiphyte, of moderate size; rhizome creeping, firm, dictyostelic, clothed with deciduous, narrow, castaneous, ciliate paleae with peltate bases, eventually naked and glaucous; fronds remote, stipitate, non-functionally articulate, pinnate, sterile pinnae short-stalked, articulate to rachis and each subtended by a glanduliferous auricle, ovate, acuminate, coriaceous, glabrous, venation evident, of the Drynarioid pattern; upper pinnae fertile, narrowly linear, elongate, each with an uninterrupted "sorus" on each side of the costa, sporangia naked, annulus of 12 cells, spores elliptic, subhyaline, smooth.

TYPE and only recognized species: *P. Horsfieldii* J. Smith, a synonym of *P. speciosa* (Blume, *Lomaria*) Presl; Java to Malacca and Luzon.

Although typically an epiphyte, *Photinopteris* is not rarely terrestrial.

While certainly a member of the *Aglaomorpha* group, *Photinopteris* is in appearance its most aberrant member. It agrees with *Merinthosorus* in soral character, but the affinity of the two may not be close. It is not a humus-collector.

42. Drynaria

Drynaria (Bory, Ann. Sc. Nat. 5 (1825) 464, as Section; Gaud., in Freycinet, Voyage (1828) 354) J. Smith, Journal of Bot. 4 (1841) 60; Copel., Univ. of Calif. Publ. Bot. 16 (1929) 117.

Large epiphytes; rhizome creeping, stout and fleshy, dictyostelic, densely clothed with slender, ciliate-dentate paleae; fronds of two kinds: scale leaves, sessile, short, shallowly lobed, harsh and scarious, serving for the collection of detritus for ultimate use as food; and normal fronds, commonly

stalked, pinnatisect with few, large, entire, pinna-like segments adnate and articulate to the rachis, rarely pinnate with deciduous pinnae, veins all conspicuous, branching and anastomosing to form a fine reticulation with included veinlets; sori compital, round, mostly superficial and without paraphyses, annulus of about 13 cells, spores bilateral, elliptic to reniform, hyaline or somewhat discolored, spinulose to smooth.

TYPE: *D. quercifolia* (L., *Polypodium*) J. Smith, India to New Britain, reported from Fiji by confusion with the likewise common *D. sparsisora* (Desv.) Moore.

A genus of about twenty species; three in Africa, the others from Asia to Queensland and Tonga.

I have already, *l.c.*, 1929, discussed the affinity of *Drynaria, Aglaomorpha,* and the several related potential genera. The fleshy, densely scaly rhizomes, the collection of forest detritus to form humus, the texture and venation, the abscission of segments or pinnae from the rachis but not of stipe from rhizome, are group characters. Within the group, *Drynaria* is distinguished by the metamorphosis of whole fronds for the collection of humus. This metamorphosis of entire fronds marks *Drynaria* as less primitive than, for example, *Drynariopsis,* in which the base of otherwise normal fronds is thus specialized.

Drynaria rigidula (Sw.) Bedd. has pinnate fronds, impressed sori in one row on each side of the costa, and is the only species known to have paraphyses. It constitutes the section *Poronema* J. Smith.

Comment on the Drynaria Group: — The preceding eight genera constitute a conspicuous and natural group known as that of *Drynaria,* named for its commonest and most familiar genus. To these eight, another will probably be added, *Polypodium nectariferum* Baker, which I have called a *Thayeria. Aglaomorpha pilosa* can also be segregated. Outside of *Drynaria* and excepting *Merinthosorus Hieronymi,* every known distinct species in the group will then have been proposed as the type of a genus. Such fine generic dissection does not appeal to me as necessary, but it does illustrate the probable newness and extreme plasticity of the group.

The group has received particular study because of its ecological peculiarity, the collection of detritus to supply the mineral food. The stout, fleshy, densely paleate rhizomes are evidently correlated with the humus-collecting habit; for the genera and species which have lost this habit. *Photinopteris, Holostachyum* and *Aglaomorpha pilosa,* have comparatively slender and more or less glabrescent rhizomes.

Characteristics of the group, aside from those evidently concerned or correlated with the collection and retention of detritus, are: fronds sometimes vestigially but never functionally articulate to the rhizome; pinnae or segments of the normal fronds (not of scarious fronds or bases) always abscissile from the axis of the frond; firm texture, provided chiefly by the mechanical structures reinforcing the veins; conspicuous venation, consisting of main veins, secondary or cross-veins enclosing major areolae, tertiary veins roughly parallel to the main veins, and these usually again connected, enclosing minor areolae with included veinlets; glands subtending the costae of segments or pinnae.

Through the group runs a tendency to dimorphism of vegetative and reproductive fronds or part-fronds; and with this, a tendency of the sori to expand from points to lines or areas. The dimorphism is shown by whole fronds of section *Poronema,* and *Holostachyum;* by specialization of the upper part of the frond, in *Aglaomorpha* and the genera which can be regarded as its derivatives, *Thayeria, Merinthosorus* and *Photinopteris.*

Drynariopsis and most species of *Drynaria* exhibit neither dimorphism nor extension of the sorus. These may therefore be regarded as relatively primitive members of the group.

The group is derived from *Microsorium*. Several species of this genus have a limited power to form nests or baskets for the collection of detritus. Among these is *M. linguaeforme*, the point of departure for *Dendroconche*. A point of origin for the *Drynaria* group is better represented by *M. musifolium*. GOEBEL has been at pains to demonstrate that this species is not a member of the *Drynaria* group. Certainly, it is not; it is a *Microsorium;* and as such, it represents in a parent genus the approximate source of a daughter group of genera, with a clearness not common even among ferns.

43. Lecanopteris

Lecanopteris Reinwardt, Flora (1825)[2], Beilage 3, 48, as suggested improvement in name; Blume, Enum. (1828) 120; Flora Javae, Pl. 94; Copel., Univ. Calif. Publ. Bot. 16 (1929) 122.
Onychium Reinw., Sylloge Plant. II (1824) 2, *non* Kaulfuss.

Epiphytes of moderate size; rhizome creeping or variously inflated, the interior excavated and inhabited by ants, clothed with persistent or caducous orbicular-peltate paleae; stipes elongate, articulate to prominent conical, inflated phyllopodia; fronds simple or subpinnate, glabrous, fleshy, main veins inconspicuous, veinlets branching and anastomosing to form numerous areolae with included veinlets; sori in a single regular row on each side of costa in Sect. *Myrmecophila,* or on reflexed, concave marginal lobes in typical *Lecanopteris,* borne on a vascular reticulum, paraphyses none, annulus of about 13 cells, spores elliptic, hyaline, smooth.

TYPE: *L. carnosa* (Reinw., *Onychium*) Blume, of the Moluccas, ranging to Luzon and Perak.

About 15 species, some of them doubtful; Malaya across New Guinea.

Myrmecophila Christ, as Section of *Polypodium,* represented by the common *L. sinuata* (Wall.) Copel., has simple fronds and impressed dorsal sori. Its elongate, very moderately inflated rhizome and persistent paleae mark it as probably the primitive element of the genus. *L. lomarioides* (J. Sm.: Kunze) Copel. is a rare Luzon fern, like *L. sinuosa* in other respects but with large, subpinnate fronds. *L. Sarcopus* (de Vries et Teysm.) Copel. is like *L. lomarioides* except for very inflated rhizome. *L. mirabilis* (C. Chr.) Copel., of Amboyna, is described as like *L. Sarcopus* except for the loss of paleae. We thus have a series of species leading from *L. sinuata* to *L. carnosa,* which has its sori on reflexed and twisted lobes; and the bending and torsion of these lobes is at least partly determined by dryness.

Lecanopteris as here construed is a thoroughly and evidently natural genus. The separation of *Myrmecophila* as a genus, recently proposed by CHING, in a paper I am unable to cite, is better than leaving the latter in *Polypodium* or *Pleopeltis;* but it separates it from its manifest relatives by one character, the position of the sori, which seems to me, in this case, relatively trivial.

Lecanopteris may be derived from either *Phymatodes* or *Pleopeltis.* The former seems to me more probable, although the paleae indicate the latter. With excellent series of young sori, I can detect no paraphyses.

44. Crypsinus

Crypsinus Presl, Epim. Bot. (1849) 123.
Microterus Presl, Epim. Bot. (1849) 124.
Phymatopsis J. Smith, Hist. Fil. (1875) 104.

Small or mediocre epiphytes; rhizome creeping, dictyostelic, with conspicuous black sclerenchyma strands, paleae lanceolate, attenuate to seta-

ceous, affixed above the base; stipes remote, articulate to phyllopodia; fronds usually dimorphic, simple to pinnate, firm to coriaceous, usually without specialized hypodermis, margin cartilaginous and minutely notched, main veins usually evident, connected by concealed cross-veins which branch and form a reticulum with some included veinlets; fertile fronds sometimes narrowly linear and venation correspondingly simplified, sori compital, typically in a single row on each side of costa and one between each pair of veins, impressed or superficial, often marked by protuberances from the upper surface, paraphyses none or filamentous, sporangia naked, annulus of about 14 cells, spores bilateral, elliptic to subglobose, somewhat obscure, microscopically reticulate-roughened or spinulose.

TYPES *C. nummularius* Presl, properly **C. pyrolifolius** (Goldm., *Polypodium*), common from the central Philippines to Mindanao.

Microterus was described on the following page, based on *Polypodium neglectum* Blume, but probably described from a collection by MEYEN at "Manila." As a Java fern, this is reduced by BACKER and POSTHUMOUS, Varenflora voor Java 196, to *P. stenophyllum* Blume, which may not be correct. At any rate, there is no reason for not including it in *Crypsinus*.

Phymatopsis was explicitly typified by *P. palmata* J. Sm., *Polypodium palmatum* Blume, now to be **Crypsinus taeniatus** (Sw., *Polypodium*). SMITH'S understanding of the genus is the same adopted here, including species with simple and with compound fronds.

A genus of forty or more recognizable species, best developed in New Guinea and the Malay region, ranging to India and Japan.

For its size, the genus is highly diversified. I do not with confidence select any element as the most primitive. Because it is relatively undifferentiated, and, at least superficially, resembles probable relatives in the *Phymatodes* section of *Microsorium*, *C. taeniatus* may be a point of departure. It is slightly dimorphic, sometimes not at all so. Typically pinnatisect with a winged rachis, it is sometimes pinnate (*Polypodium angustatum* Blume), and often has fertile simple and undivided fronds. The sori are superficial or slightly impressed. **C. macrochasmus** (Baker, *Polypodium*) is a near relative, with more impressed sori and ciliate paleae. **C. Moseleyi** (Baker, *Polypodium*) of Ternate also belongs here.

Likewise pinnatisect or simple, with beautifully glaucous fronds, and with aciculate blackish paleae, is the Philippine **C. glaucus** (J. Sm.; Brack., *Drynaria; Polypodium glauco-pruinatum* C. Chr.).

C. trilobus (Houtt., *Polypodium*) (*P. triphyllum* Jacq.; *P. Hemionitis* Cav.; *P. incurvatum* Bl.) of Malaya and the Philippines, has deeply impressed sori, and paleae broader than characterize the genus. It suggess *Selliguea* in texture.

C. hastatus (Thunb., *Polypodium*), Luzon to Korea and India, is trifid or hastate, or more often entire. Related are **C. Stewartii** (Bedd., *Pleopeltis*); **C. Engleri** (Luerss., *Polypodium*); **C. griffithianus** (Hooker, *Polypodium*); **C. crenato-pinnatus** (Clarke, *Polypodium*); **C. ebenipes** (Hooker, *Polypodium*); **C. malacodon** (Hooker, *Polypodium*); **C. quasidivaricatus** (Hayata, *Polypodium*); **C. Veitchii** (Baker, *Polypodium*).

Again ranging from pinnate to simple, is **C. Proteus** (Copel., *Polypodium*) of Luzon, apparently related to *C. hastatus*, but also strongly suggestive of *Arthromeris*.

C. lagunensis (Christ, *Polypodium*), of the Philippines, is a manifest intermediate between *C. taeniatus* and the legal type of genus, *C. pyrolifolius*. Its fronds are compound, with the upper pinnae contracted and fertile, sometimes so contracted as to be much like the whole fertile frond of the latter species.

The largest element of the genus is much like the type in having small, entire (except for the notches), more or less dimorphic fronds. Here may be named: **C. rhynchophyllus** (Hooker, *Polypodium*); **C. Whitfordii** (Copel., *Polypodium*), related to *C. rhynchophyllus*, but not in my opinion identical; **C. Hellwigii** (Diels, *Polypodium*), of New Guinea, similar to *C. Whitfordii;* **C. craspedosorus** (Copel., *Polypodium*), of Sumatra; **C. soridens** (Hooker, *Polypodium*), of Borneo, of which *Polypodium stenopteris* Baker may be only a more contracted form; **C. de Kockii** (v.A.v.R.,

Pleopeltis), of New Guinea, of which I suppose *Pleopeltis Gibbsiae* and *Polypodium argyropus* Ridley to be synonyms, very near to *P. stenopteris;* **C. gracilipes** (v.A.v.R., *Pleopeltis*), and **C. crassimarginatus** (Copel., *Polypodium*), also of New Guinea, and this group being the approximate source of *Pycnoloma.*

C. taeniophyllus (Copel., *Polypodium*), of Borneo, has uniformly linear fronds about 3 mm wide. Typically still narrower fronds, with elongate sori, characterize *Holcosorus.* **C. oodes** (Kunze, *Polypodium*) has fronds of the typically sterile form, sometimes with typically placed sori, but in fuller development with the sori in plural rows or scattered.

C. platyphyllus (Sw., *Polypodium*) is a very aberrant species, with harsh, dark, aciculate paleae, and large, uniform fronds, the round sori in single long rows extending from costa to margin between the main veins.

C. albido-squamatus (Blume, *Polypodium*) is likewise aberrant, with acicular red-black paleae and large, pinnate fronds, the cartilaginous margins not notched, the free veinlets ending within the margin in hydathodes which excrete conspicuous calcareous scales. **C. bellivenosus** (C. Chr., *Polypodium*) is a New Guinea relative with conspicuous venation, shorter paleae, and smooth spores.

I include in *Crypsinus* a group of species which have a row of sori on each side of the costa, with two sori between each pair of main veins, or, having more numerous sori, have them in double rows, oblique to the costa, between each pair of veins. These have been included in *Pleuridium* by Fée and J. Smith, but that genus is properly synonymous with *Pessopteris.* **C. subundulatus** (Ros., *Polypodium*) and **C. lamprophyllus** (C. Chr., *Polypodium*) are New Guinea species with elongate fronds and the sori normally in single longitudinal rows.

C. enervis (Cav., *Polypodium; P. rupestre* Blume) is the commonest member of this group. Others are: **C. triquetrus** (Blume, *Polypodium*), with broad paleae; **C. undulato-sinuatus** (Ros., *Polypodium*); **C. subsparsus** (Baker, *Polypodium*); **C. Wrayi** (Baker, *Polypodium*); **C. albidopaleatus** (Copel., *Polypodium*); **C. albulus** (Christ, *Polypodium*); **C. senescens** (Copel., *Polypodium*); and **C. occultivenius** (Copel., *Polypodium*).

I have dealt at length with the species of *Crypsinus,* to make clear its nature and scope and its relation to derived genera. In the same way that Christensen's recognition of *Ctenitis* and the segregation of its species made it comparatively easy to see the several genera left in the old *"Dryopteris,"* so the segregation of *Crypsinus* facilitates the recognition of the other reticulate-veined groups of oriental "Polypodium."

With reasonable confidence, all listed species belong to *Crypsinus* as a natural genus. Several species are aberrant enough to constitute potential minor genera, and no need of them is evident. Included are several species with smooth spores, several without notches in the cartilaginous margin, a very few with broad paleae; but their affinity is positive. A single species, *C. trilobus,* has a thick-walled hypodermis under the upper epidermis.

Crypsinus is related to those austral species of *Microsorium,* which are at the same time the most primitive element of the latter genus.

45. Pycnoloma

Pycnoloma Christensen, Dansk Bot. Arkiv 6 No. 3 (1929) 75, Pl. 8, f. 1-3, Pl. 9, f. 2, Pl. 10, f. 1, 2.

Frondibus valde dimorphis, sterilibus orbicularibus vel ovatis crasse coriaceis, areolis inter venas uniseriatis, frondibus fertilibus anguste linearibus, sporangiis in lineam unam utroque latere costae continuam instructis; aliter Crypsino conforme. (This use of Latin is to eliminate possible question as to the validity of Christensen's publication.)

Type: *P. rigidum* (Hooker, *Drymoglosum*) C. Chr., of Borneo.

Christensen included in the genus two other Bornean species.

The derivation of *Pycnoloma* from *Crypsinus,* and from that element of the genus with single sori between main veins, is obvious.

46. Grammatopteridium

Grammatopteridium van Alderwerelt van Rosenburgh, Nova Guinea 14 (1924) 24; C. Chr., Dansk Bot. Arkiv 6 No. 3 (1929) 80, Pl. 4, f. 13.
Grammatopteris v.A.v.R., Bull. Jard. Buit. III, 4 (1922) 318, Pl. 15.

Like *Pycnoloma,* except for larger, acute or acuminate sterile fronds, with two main veins between consecutive marginal notches, and numerous irregular areolae between consecutive main veins.

TYPE: *G. Brooksii* (v.A.v.R., *Drymoglossum*) v.A.v.R., of Sumatra, which CHRISTENSEN treats as a variety of *G. costulatum* (Cesati, *Acrostichum*) C. Chr., of New Guinea. As "quite identical with the type," CHRISTENSEN includes *Polypodium iboense* Brause; but this has interrupted soral lines, and could be included in *Crypsinus.*

As a matter of definition, *Pycnoloma* could easily be included in *Grammatopteridum.* But the venation of the latter shows it to be derived from that section of *Crypsinus,* illustrated by *C. enervis,* with two rows of sori between consecutive main veins. CHRISTENSEN, *l.c.,* p. 81, says: "If the Asiatic species referred by J. SMITH to (*Phymatopsis* and *Pleuridium*) after a detailed analysis of a large material should appear to belong to a single natural group, it would then be quite natural to unite also the two drymoglossoid genera." After a study of almost every known species of both groups, I include both in *Crypsinus.* But *Pycnoloma* and *Grammatopteridium* can not be combined in one genus because of evidently independent origin in the one parent genus. If they are united, it must be under *Crypsinus.*

47. Holcosorus

Holcosorus Moore, Index (1857) XXIX.

Like *Crypsinus,* but all fronds narrowly setaceous, the sori elongate but not continuous, in a deep groove on each side of the costa.

TYPE: *H. pentagonus* Moore, of Borneo, which must be **H. bisulcatus** (Hooker, *Polypodium,* Icones Plant. 10 (1854) Pl. 998) Copel.

Another and still more slender Bornean species is **H. setaceus** (Copel., *Polypodium*).

BRAUSE, Engler's Jahrb. 56 (1920) 180, reports *H. bisulcatus* in New Guinea as varying in width from 1.5 to 5 mm; it may well be a distinct species.

In the absence of fronds of the usual sterile form, it seems impossible to fix for *Holcosorus* a definite place of origin in *Crypsinus.* It is without marginal notches, which must naturally have been lost in the extreme attenuation of the fronds. So far as the fertile fronds are concerned, *Pycnoloma, Grammatopteridium* and *Holcosorus* might be one genus, including also *Oleandropsis;* but their other characters indicate separate, independent origin from *Crypsinus.* It is therefore impossible to combine them except in *Crypsinus.* That genus is diversified without them, and their distinctions from it are such as are usually held to justify generic separation.

48. Oleandropsis — PLATE IX

Oleandropsis Copeland, Univ. Calif. Publ. Bot. 18 (1942) 226.

An epiphyte with small fronds; caudex erect, dictyostelic, composed mostly of black sclerenchyma, densely scaly, the lanceolate paleae at first white in the mass but old stems covered with imbricate ovate black bases of paleae; fronds borne on all sides of the stem, articulate to short phyllopodia, dimorphic, the sterile short-stipitate, linear-lanceolate, glabrous, rigidly coriaceous, margin notched, with one or two veins between notches, but with so copious and irregular areolae between the veins that affinity must be to the group in *Crypsinus* with double rows of sori; fertile frond long stipitate, setaceous-linear, sporangia in a continuous or sometimes interrupted line on each side of costa, not immersed, paraphyses apparently none, annulus of 14 cells, spores bilateral, rough.

TYPE and sole species: *O. ferrea* (Brause, *Polypodium*), of New Guinea.

The origin of the genus has already been indicated.

The fertile fronds of both *Grammatopteridium* and *Oleandropsis* are so extremely contracted that they are practically alike; but the paleae and the sterile fronds are so different that it is most unlikely that the two genera are related except through the parent genus.

Oleandropsis is unique among ferns at all related, in its radially symmetrical stems.

49. Selliguea

Selliguea Bory, Dict. Class. d'Hist. Nat. VI (1824) 587; XV (1829) 344; XVII (1831) Pl. 41.

Rather small epiphytes; rhizome creeping, dictyostelic, with black sclerenchyma strands, variously paleate; stipes remote, elongate, articulate to short, stout phyllopodia; fronds simple, moderately dimorphic, the sterile broadly lanceolate or ovate, usually acuminate, glabrous, hard-coriaceous, margin cartilaginous and sometimes notched, main veins conspicuous, veinlets immersed, branching and anastomosing to form several irregular rows of areolae between the main veins with few included veinlets; fertile fronds narrower, sporangia typically on elongate, superficial or impressed receptacles oblique to costa, one midway between each pair of main veins, paraphyses wanting, annulus of about 14 cells, spores bilateral, finely spinulose.

TYPE: *S. Feei* Bory, of Java, ranging to Luzon and across Polynesia.

A small genus, derived from that element in *Crypsinus* which has numerous irregular areolae between the main veins.

While the "sori" are typically elongate, as described, it is common for them to be more or less interrupted, so that, along with the typical sori of the genus, a few, or many, or nearly all of them are round, as in *Crypsinus*. And there are related species in which only round sori, a few in each row, are known. I believe that *Selliguea* will best be made to include these species; but am leaving them in *Polypodium* until a more careful study can show the best boundary between *Selliguea* and *Crypsinus*. This is not intended to raise any doubt as to the propriety of maintaining *Crypsinus* as a genus.

50. Arthromeris

Arthromeris (Moore, Index (1857) LXXVIII, section) J. Smith, Hist. Fil. (1875) 110; Ching, Cont. Inst. Bot. Nat. Acad. Peiping 2 (1933) 87.

Terrestrial and epiphytic ferns of moderate size; rhizome long-creeping, stout, dictyostelic and with sclerenchyma strands, clothed with lanceolate, attenuate, entire, brownish paleae affixed above the base; stipes remote, articulate, long; fronds uniform, imparipinnate, lateral pinnae articulate to rachis, opposite, lanceolate, acuminate, naked or pubescent, subcoriaceous, margin cartilaginous and entire, main veins conspicuous, minor venation not so, areolae irregular, with simple or forked included veinlets running in any direction; sori solitary or plural between main veins, compital, round, superficial, without paraphyses, annulus of 14-16 cells, spores bilateral, brownish, obscurely tuberculate or spinulose.

TYPE: *A. juglandifolia* (Don, *Polypodium*) J. Smith, a synonym of *A. wallichiana* (Spr., *Polypodium*) Ching, of N. India and W. China.

CHING includes 9 species in the genus, extending the range to Formosa.

The affinity of *Arthromeris* to *Crypsinus is* unmistakable. It differs from a group of *Crypsinus* species in having pinnate fronds with articulate pinnae. It stands to this group in the same relation as *Goniophlebium* to *Polypodium*. No violence to nature, but only some inconvenience would result from combining *Arthromeris* and *Goniophlebium* with the respective parent genera just named.

51. **Polypodiopsis** genus novum — PLATE X

Instar Polypodii, paleis et venatione distinctum, rhizomate repente dictyostelico et fibris nigris lignosis percurso, paleis hic illuc pariete cellulare excurrente denticulatis, nigris vel nigro-rubidis setiformibus basibus peltatis persistentibus vestito; stipitibus remotis, articulatis, nudis; lamina mediocre vel majuscula, lanceolata, pinnata, rhachi fusca glabra, pinnis multis, basi late adnatis et supra basin frondis anguste confluentibus, more Crypsini incisulis vel serrulatis, tenuibus sed rigidis, venis inconspicuis seriem unam costalem areolarum includentibus, venulis inclusis carentibus; soris orbicularibus superficialibus, ad venas areolas includentes impositis, ideo subcostalibus et uniseriatis, rarissime ad venas breves excurrentes terminalibus, paraphysibus nullis, annulo 14-cellulare, sporis reniformi-ellipticis, brunneis, levibus.

TYPE: **P. proavita** Copel.—*Polypodium proavitum* Copel., Philippine Journal Sci. 3 C (1909) 347, of Borneo.

There are two other species, also Bornean:

P. colorata—*Polypodium coloratum* Copel., *ibid.*, Pl. 6.

P. brachypoda—*Polypodium brachypodium* Copel., Philippine Journal Sci. 12 C (1917) 62.

CHRISTENSEN, Dansk Bot. Arkiv 9 No. 3 (1937) 39, f. 2, suspects that these are all one species, which he would provisionally call *Polypodium coloratum*, and which is *P. papillosum* Cesati *non* Blume, *P. cesatianum* Baker *nomen nudum*, and *P. cesatianum* v.A.v.R. (1909). I cannot suspect that *P. proavita* and *P. colorata* are identical. It is possible that *P. colorata* and *P. brachypoda* are forms of one species, but I doubt it; and CHRISTENSEN has sometimes thought them distinct; I lent him types of all three.

The affinity of *Polypodiopsis* is to *Crypsinus*, as was suggested by CHRISTENSEN, *l.c.*, and Gardens' Bull. 7 (1934) 305. I do not include it in *Crypsinus* because ferns with pectinate fronds would be a strange element in that genus, and more essentially because no *Crypsinus* has nearly free venation. A common abnormality of *Polypodiopsis* is to have the vein which should enclose an areola fall short of anastomosing. Far more rarely, another areola, outside the costal series, is enclosed; no free included veinlet has been seen.

52. Grammitis

Grammitis Swartz, Schrader's Journal (1801) 17; Syn. Fil. (1806) 3, 21.
Mecosorus Kl., Linnaea 20 (1847) 404, *partim.*
Austrogramme Fourn., Ann. Sc. Nat. V, 18 (1873) 278, *partim.*
Lomaphlebia J. Smith, Hist. Fil. (1875) 182.

Small or minute epiphytes, a few terrestrial; stem erect or short-creeping, rarely elongate, dictyostelic, paleate; stipes approximate or congested, rarely remote, non-articulate or rarely pseudo-articulate; lamina simple, lanceolate or linear, entire or rarely crenate or shallowly lobed, hairy or glabrescent, never paleate, membranaceous to fleshy or coriaceous, costa usually prominent, veins typically free, typically forked, sometimes several times, not rarely casually anastomosing without included veinlets; sori typically on the lowest acropetal veinlet of forked veins, thus forming a single row on each side of the costa, rarely with other fertile veinlets and the sori thus in plural rows or in part scattered, superficial or sometimes impressed or immersed, exindusiate, paraphyses filamentous if present but usually wanting, pedicel of one row of cells except near the top, annulus of 8 to 16 cells, commonly about 12, spores globose-tetrahedral, without epispore.

TYPE: *G. linearis* Sw., which should be called **G. graminea** (Sw., Polypodium), of Jamaica.

A genus of 150 species, remarkably alike in aspect, but easily distinguished by a variety of details. I have prepared a monograph of the genus, having for study typical material of almost all species. Proof was sent to Manila shortly before the outbreak of war; its fate is not known. Awaiting its publication, I omit here numerous necessary changes of name from *Polypodium*. Diagnoses of 26 new species are in Univ. Calif. Publ. Bot. 18 (1942) 222.

The distribution of the species establishes the Antarctic origin of the genus, and indicates that it migrated Northward by all three of the practicable routes — by the South Pacific, South Africa and South America. One species, *G. Billardieri* Willd., broadly construed, is found in Australia, Tasmania, New Zealand, Auckland Island (South of New Zealand), Amsterdam, St. Paul and Kerguelen Islands, South Chile and the Falkland Islands, surrounding Antarctica more closely and completely than does any other fern. Northward, the genus reaches the Bonin Islands but not Japan, the West Indies but not Mexico. The richest development of species is in New Guinea, followed by Malaya and the Philippines.

Grammitis species are ferns of high mountains, where they grow mixed together and with mosses and *Hepaticae* on the trees of the mossy forest. This environment is unfavorable to the wide dissemination of spores, and most species are local. For this reason, many are probably still to be discovered.

Within the limits of the generic definition, there is great diversity. Some species have rings at the bases of the stipes, which look like articulations, but none seem to be functional. Construing them as vestigial articulations, they indicate an epiphytic ancestry with active abscission structures.

Paleae are entire or toothed or ciliate. Typical *G. fasciculata* Blume of Java has large and conspicuous paleae. The form of this species which I once described as *Polypodium heanophyllum*, with much denser hairy stipes, has inconspicuous paleae not more than half as large; they are suppressed by the mass of hairy stipes. **G. Havilandii** (Baker, *Polypodium*), of Borneo, has paleae 2-3 mm long on lax plants with few fronds; but on plants with congested stipes no paleae can be detected. *P. Pseudo-Poolei* Reimers was described as without paleae, but I suppose it to be a form of **G. Poolei** (Baker, *Polypodium*), which has vestigial paleae among the crowded stipe-bases. **G. jungermannioides** (Kl., *Polypodium*) of the American tropics, and **G. parva** (Brause, *Polypodium*) of New Guinea are without paleae, but have relative neighbors in which this suppression is incomplete. Thus, in America, New Guinea, Borneo and Madagascar, species unrelated except as they are congeneric have independently lost a character as fundamental as the production of paleae.

Another transgression of the generic description occurs when occasional veins narrowly bordered by laminar tissue grow abnormally, sometimes even to three times the normal width of the frond, making the outline as a whole altogether irregular. **G. ludens** (Baker, *Polypodium*) is a freak of this kind, of a species long before described in its normal form as *Polypodium alpestre* Blume *non* Spann. *P. Pseudo-Poolei* is regarded as a similar freak of *G. Poolei*. Such monstrosities occur in a considerable number of species, but are without evolutionary significance.

Forking of the fronds is far commoner in *Grammitis* than in ferns of most tribes, and may reasonably be ascribed to remote ancestral influence. *G. furcata* H. & G. and **G. trifurcata** (L., *Polypodium*) owe their names to the occurrence of dichotomy, common in the case of the former. *Polypodium subdichotomum* Racib., *P. dichotomum* Brause, *P. fuciforme* Ros. and *P. alcicorne* Ridley all owe their names to similar abnormalities, and their types may all be individual freaks.

Mecosorus would most reasonably be typified by *M. nudus* Kl., a synonym of *Grammitis graminea*, the two genera being then based on the same type.

Austrogramme was briefly defined in terms exactly applicable to *Grammitis*. These apply ill to the first of the two species, *A. marginata* Fourn., which is *Syngramma*, but fit the second, which is **Grammitis Deplanchei** (Baker, *Polypodium*), named by FOURNIER in this genus also, as *G. athroosperma*.

Lomaphlebia was based on the species which I regard as the type of *Grammitis, G. linearis* Sw., SMITH'S idea being evidently that the old generic name should be reserved for the numerous species with free veins. *G. graminea* has the veins connected by a marginal strand, as does a single other species, **G. turquina** (Maxon, *Polypodium*), of Cuba. The importance which SMITH attached to differences of venation justified

him in making it the basis of generic separation; but it also led him to naming, as the "type" of *Grammitis, G. australis* R. Br., better called *G. Billardieri* Willd., a species unknown to SWARTZ. The most convenient course is certainly to regard this connecting strand as of less than generic significance, although it is not casual, but regular in the two species.

Casual anastomosis of veinlets is almost common in *Grammitis,* to be expected here and there on broad fronds with veinlets forked more than once. More regular anastomosis characterizes two genera regarded as derived from *Grammitis — Loxogramme* and *Glyphotaenium.*

Other derived generae are *Cochlidium, Scleroglossum* and *Oreogrammitis,* distinguished by coenosori parallel to the costa. As is usually, and in the nature of the case, true when the derivation of one genus from another is really clear, the recognition of the derived genus as distinct is a matter of judgment. This is so of all the genera just named except *Loxogramme,* the exception being because no place of origin of *Loxogramme* in *Grammitis* has become apparent.

The affinity of *Grammitis* and *Ctenopteris* is clear beyond question. There is no objection in principle to CHING's recent action in including both in *Grammitis.* However, *Grammitis* and *Ctenopteris* as here defined are natural genera, more apparently natural and more convenient than is a more inclusive genus. Recognizing both, the difficulty is in drawing a line between them; and, at least as far as convenience of definition and recognition is concerned, it is better to draw two lines than one, thus leaving an intermediate genus, *Xiphopteris.*

The commonness of dichotomy is a reason for regarding *Grammitis* and *Ctenopteris* as ultimately Matonid in origin. Alone among the many genera regarded as Matonid, *Grammitis* and its relatives retain the triplanate spores of the two surviving genera of *Matoniaceae.* I postulate with confidence the Antarctic origin of all Grammitoid ferns. This affirms the distinctness of the group since Miocene time. Farther back, we know nothing about them, and the open gap presumed to have been crossed still longer ago is a very wide one.

Since there is no evident nearer common ancestor of *Grammitis* and ferns with bilateral spores, we can write *finis* to any treatment of this group as *Eupolypodium,* or *Polypodium,* or as at all nearly related to *Polypodium.*

53. Glyphotaenium

Glyphotaenium J. Smith, in Seemann, Bot. Voy. Herald (1854) 227, Pl. 48.
Enterosora Baker, Timehri V (1886) 218; Trans. Linn. Soc. Bot. II 2 (1886) 294, Pl. 58.

Small epiphytes; rhizome short, ascending, clothed with brown, deciduously ciliate and setulose paleae; stipes crowded, hairy; lamina lanceolate, lobed ¼ to ¾ of the way to the costa, ciliate and sparsely setose, spongiose, venation immersed, main veins repeatedly branched, lower veinlets forked, anastomosing to form a fairly regular row of costal areolae, without included veinlets; sori scattered, impressed or immersed, pedicel of one row of cells toward the base, sporangia naked, annulus of 12 cells, spores globose-tetrahedral.

TYPE: *G. crispatum* (J. Smith, *Ctenopteris*) J. Smith, of Panama, South to Ecuador. *Polypodium ecostatum* Sodiro is a synonym.

A genus of probably four species.

Enterosora typified by *E. Campbellii* Baker, of British Guiana, is distinguished by sori immersed in long, deep slits, instead of merely impressed as in *G. crispatum.* BAKER ignored *Glyphotaenium* in publishing *Enterosora,* and the difference is not of generic significance. The name of the species becomes **G. Campbellii. G. percrassum** (Baker, *Polypodium*), and **G. spongiosum** (Maxon, *Enterosora*), both of Costa Rica, seem to be distinct species.

Glyphotaenium is derived from the group of *Grammitis trifurcata* (L., *Polypodium*); more strictly, it may be regarded as derived from that species. The intimate affinity is shown by the ciliate, brown paleae, and the aspect, dissection, pubescence,

texture and freely branched venation of the frond. The distinction is provided by the fairly regular areolae of the broader part of the frond, and the impression or immersion of the sori. Occasional, casual anastomoses occur in *G. trifurcata.*

54. Cochlidium

Cochlidium Kaulfuss, Berl. Mag. 5 (1820), not seen; Enum. Fil. (1824) 86; C. Chr., Dansk Bot. Arkiv 6 No. 3 (1929) 17, Pl. 1, Pl. 3, f. 1-3.

Pleurogramme Presl, Tent. (1836) *223*; Goebel, Flora 117 (1924) 91, *partim.* The name originated with BLUME.

Very small epiphytes; rhizome ascending, dictyostelic, clothed with linear, brown, entire paleae and covered with persistent stipe-bases and roots; fronds densely fascicled, subsessile, non-articulate, linear, entire or sometimes furcate, firm but hardly coriaceous, veins short, simple or forked and rarely anastomosing, sometimes almost suppressed; sori on or beside the costa, fused into coenosori, superficial or immersed, paraphyses wanting, sporangia naked, annulus of 10 cells, spores globose-tetrahedral, without epispore.

TYPE: *C. graminoides* (Sw., *Acrostichum*) Kaulf., a little known species of Jamaica.

A genus of perhaps 7 species, from the West Indies and Guatemala to Brazil.

Cochlidium is a genus derived from *Grammitis.* With the limited measure of uncertainty implicit in statements so definite, it is immediately related to *G. furcata* H. & G. Recognizing this fact, CHRISTENSEN has transferred *G. furcata* to *Cochlidium.* If this is done, it becomes impossible to define *Cochlidium* as a distinct genus. *Cochlidium* can be included in *Grammitis,* with appropriate change in the definition of the latter. As a matter of convenience, it is better to maintain both genera, distinguishing *Cochlidium* by its coenosori. It seems then to be a small, natural genus, of exceptionally definite ancestry.

55. Scleroglossum

Scleroglossum v. Alderwerelt v. Rosenburgh, Bull. J. B. Buit. II No. 7 (1912) 37, Pl. 5; C. Chr., Dansk Bot. Arkiv 6 No. 3 (1929) 25, Pl. 2, Pl. 4, f. 1-3.

Very small epiphytes; rhizome ascending, dictyostelic, covered with wiry roots, appressed stipes and minute, brown, entire paleae; fronds densely congested, subsessile, non-articulate, linear and entire but sometimes forked, thick and coriaceous, bearing single, binate or clustered caducous setulae, veins immersed, casually anastomosing; coenosori in deep, marginal or medial grooves, one on each side of costa, elongate but confined to upper part of frond and not reaching the apex, paraphyses none or utterly inconspicuous, sporangium naked, pedicel of one row of cells except near top, annulus of about 12 cells, spores globose-tetrahedral.

TYPE: *S. pusillum* (Blume, *Vittaria*) v.A.v.R., of Java, and to Ceylon, Luzon, New Guinea and Ponape.

A genus of six or more not very distinct species, extending the range to Queensland.

The affinity is to *Grammitis,* of which *Scleroglossum* is a derived genus. *G. pleurogrammoides* (Ros., *Polypodium*) of New Guinea, and *G. scleroglossoides* Copel. of Ponape suggest a point of origin in the parent genus.

The resemblance of *Cochlidium* and *Scleroglossum* is so nearly complete that GOEBEL, Flora 117 (1924) 91, and I, Univ. Calif. Publ. Bot. 16 (1929) 107, and others have doubted, or not even suspected the possibility of holding them distinct. There are differences, in position of sori, and perhaps in paraphyses. But the detection of clustered hairs by CHRISTENSEN, and my recognition of these as evidence of immediate affinity to certain species of *Grammitis,* make the independent origin of the two genera certain. Their geographic isolation is strong additional evidence, but valid and conclusive only after their independence is established on other grounds.

56. Nematopteris

Nematopteris van Alderwerelt van Rosenburgh, Bull. Jard. Buit. II No. 28 (1918) 65; C. Chr., Dansk Bot. Arkiv 6 No. 3 (1929) 31, Pl. 4, f. 4-7.

"Scleroglosso affinis. — Frondes cum rhizomate non articulatae, rigidae, proportione crassae, steriles (cum parte sterili frondium fertilium) non applanatae; venae laterales desunt. Sori lineares, utrinque I, costae paralleli, in sulcis dorsalibus immersi, parenchymate costali producto separati; paraphyses desunt."—v.A.v.R.

"like *Scleroglossum* in mode of growth, scales and the hard fronds, differing by the very numerous, terete or angular, rush-like leaves, the fertile ones with an apical widened fertile portion. Veins nearly obsolete without sclerenchyma. Sporangia borne in deep vertical grooves on both sides of the midrib, continuous." — C. Chr.

Type: *N. pyxidata* v.A.v.R.; *Scleroglossum pyxidatum* v.A.v.R., Bull. Jard. Buit. II No. 16 (1914) 37, Pl. 9, from Dutch Borneo.

"This is certainly a very distinct species, in habit resembling the type of *Cochlidium rostratum*, but it is not certain that it is generically different from *Scleroglossum*" — C. Chr. The genus is apparently known by a single collection, which I have not seen.

Christensen placed here a second species, as *N. interrupta* (Baker) C. Chr., with the comment: "Because of its close resemblance to *N. pyxidata* in general habit and structure I place it in this genus, but it is scarcely closely related to it." This is a New Guinea species. The sporangia are in definite sori, not coenosori, which brings it within the definition of *Grammitis;* it is **G. interrupta** (Baker, *Monogramme*). It is an evident relative of several species of *Grammitis*, among them *G. pleurogrammoides*, already mentioned as a possible source of *Scleroglossum*. This disposal of *N. interrupta* C. Chr. does not impair the status of *Nematopteris* as a monotypic genus.

57. Oreogrammitis

Oreogrammitis Copeland, Philippine Journal Sci. 12 C (1917) 64; C. Chr., Dansk Bot. Arkiv 6 No. 3 (1929) 30, Pl. 3, f. 7.

A minute epiphyte or petrophyte; rhizome short, ascending, dictyostelic, clothed with broadly lanceolate, acuminate, thin, entire, brown paleae; stipes fasciculate, non-articulate, long, dark, wiry; lamina linear-oblanceolate, decurrent, entire, sparsely setose, subcoriaceous, veins immersed, forked where the width of the fronds permits, the sterile ones free; sporangia in elongate coenosori, one on each side of the costa in the upper part of the frond, with round or elliptic sori on elongate receptacles sometimes present lower down, receptacle superficial or slightly elevated, paraphyses wanting, pedicel of one row of cells in the lower part, sporangia bearing caducous atropurpureous setae, annulus of 12 cells, spores globose-tetrahedral.

Type: *O. Clemensiae* Copel., a still little known fern of the Alpine summit of Mt. Kinabalu, in Borneo. Since the original collection of two plants, it has been collected by Holttum and again by Mrs. Clemens. Christensen comments that, while the species is distinct, "I should prefer to drop the genus and place the species in *Polypodium*" — meaning *Grammitis*.

Oreogrammitis is unquestionably derived from *Grammitis*. But, unless better local collection may show it to be a form of some more typical *Grammitis* species, it seems better to avoid the addition of so aberrant a species to that genus. It is not directly related to the other local derivative of *Grammitis* with coenosori, *Scleroglossum*.

58. Xiphopteris

Xiphopteris Kaulfuss, Jahrb. f. Pharm. (1820) 35, not seen; Enum. (1824) 85.
Micropteris Desv., Prodromus (1827) 217.
Micropolypodium Hayata, Bot. Mag. Tokyo, 42 (1928) 341; Flora 124: 55.

Small epiphytes; rhizome ascending to erect, paleate with brown, mostly narrow paleae; stipes crowded, non-articulate; lamina linear, pinnatifid to pinnate, mostly thin and herbaceous, hairy or glabrescent, veins solitary in the segments or pinnae, simple or once forked; sori dorsal or terminal on the veins, on the acropetal branch if the vein is forked, receptacle usually elongate, sorus usually becoming round, superficial, without paraphyses, pedicel of one row of cells except near top, annulus of 8 to 16 (most commonly, 12) cells, spores globose, tetrahedral in origin, subhyaline, without epispore.

TYPE: *X. serrulata* (Sw., *Acrostichum*) Kaulf., of the West Indies, ranging to Peru, S. Brazil, Africa, reported from the Mascarenes and Amsterdam. *Micropteris* is most reasonably typified by the same species.

As here and now construed, a genus of about 50 species, in the tropics of both hemispheres, North to Japan and Sikkim.

Xiphopteris was originally characterized by the restriction of the sori to the specialized upper part of the frond, where they become confluent, this part of the frond being entire, while the lower part is inciso-serrate. Thus restricted, the genus would comprise three other American species—see MAXON, Cont. U. S. Nat. Herb. 17 (1914) 398,—**X. Saffordii** (Maxon, *Polypodium*), of Hawaii, and *X. antipodalis* Copel., of New Guinea. It was treated in this sense by FÉE, Genera 100, Pl. 10 B, and by various other authors.

As MAXON and others have shown, it is hardly possible to maintain any line between such a genus and what he and most others have called *Polypodium*, meaning in this case *Grammitis* or *Ctenopteris*. To quote MAXON: "This group of species is not so recognized[as a genus, *Xiphopteris*] at present and can not be maintained as a valid genus, since there is nearly every gradation in form between its type species "*Polypodium serrulatum*," and several small members of Polypodium (section Eupolypodium) related to *P. trichomanoides*." In a later paper, Cont. U. S. Nat. Herb. 17 (1916) 642, MAXON has distinguished 26 American species of the latter group.

Sharing MAXON's opinion, but not caring to leave *X. serrulata* in *Grammitis*, nor *P. trichomanoides* in *Ctenopteris*, where it was placed by J. SMITH, I regard the latter species as **X. trichomanoides** (Sw., *Polypodium*). As the majority of the American species are unknown to me, I abstain from transfer of their names.

The commonest Oriental species is **X. subpinnatifida** (Blume, *Grammitis*), Java to Luzon and New Guinea. Others are **X. alternidens** (Cesati, *Polypodium*) of Borneo, reported from Celebes; **X. murudensis** (Copel., *Polypodium*) and **X. hecistophylla** (Copel., *Polypodium*) both of Borneo; **X. cornigera** (Baker, *Polypodium*), of Ceylon and Malacca; **X. govidjoaensis** (Brause, *Polypodium*), of New Guinea; **X. subcoriacea** (Copel., *Polypodium*), of Tahiti; **X. glanduloso-pilosa** (Brause, *Polypodium*), of New Guinea, with gibbous pinnae; **X. apoensis** (Copel., *Polypodium*), of Mindanao; **X. pulogensis** (Copel., *Polypodium*), of Luzon; **X. okuboi** (Yatabe, *Polypodium*,) the type of *Micropolypodium*, of Japan and Formosa; and **X. sikkimensis** (Hieron., *Polypodium*), of Sikkim and Yunnan.

As here construed, *Xiphopteris* is a definable and easily recognizable genus. It is equally natural, whether the half-dozen species conforming to KAULFUSS's definition are directly related, or represent two or more independent specializations of the upper part of the frond. This does not prove that it is natural as related to *Grammitis* or *Ctenopteris*, but I have been unable to recognize groups of related species which would demand its inclusion in either of these more obviously natural genera.

59. Calymmodon

Calymmodon Presl, Tent. (1836) 203, Pl. 9, f. 1; Copel., Philippine Journal Sci. 34 (1927) 259, Pl. 1-6.

Plectopteris Fée, Cong. scient. de France X.e session, t. 1, p. 178, as cited by Fée, Genera (1850-52) 230, Pl. 19 B.

Small epiphytes; rhizome ascending, distyostelic, covered with lanceolate or ovate, entire, brown paleae and very persistent roots and appressed

stipes; stipes densely crowded, short, non-articulate, lamina linear, pinnatisect or pinnate, or freely forked in *C. ramifer,* or only inciso-serrate in *C. grammitidiphyllus,* usually delicate in texture and soft-hairy or glabrescent, veins solitary in segments or pinnae or rarely forked; fertile in the upper part of the frond, the basiscopic half of each segment or pinna folded backward and protecting the sorus, sorus dorsal or terminal on the vein, round or elliptic, without paraphyses, sporangium naked, pedicel of one row of cells except at top, annulus of 12 cells, spores globose, without epispore.

TYPE: *C. cucullatus* (Nees et Blume, *Polypodium*) Presl, of Java, ranging to Malacca, Luzon and New Guinea.

A genus of 25 species, ranging to Ceylon, Tahiti and Rapa, represented in Queensland by **C. luerssenianus** (Domin, *Polypodium*). New Guinea is the richest area, in species and in diversity.

Calymmodon is evidently Xiphopterid; in describing *C. cucullatus,* BLUME, Flora Javae II, 119, wrote "Pertinet reverâ ad genus *Xiphopteris* Kaulf." The diagnostic distinction is the folding of the fertile segment, protecting the sorus.

C. kaniensis (Brause, *Polypodium*) has forked veinlets, and bears dark, often clustered or forked setae. C. *grammitidiphyllus* Copel. has forked veinlets, bears such setae, and is merely inciso-serrate, with thick fronds. It is very abnormal in the genus, and except for the reduplicate tooth-like segments could be a *Grammitis.* These two species are surely related, and connected by local intermediates, such as **C. atrichus** Copel. — *Polypodium pendens* C. Chr., *non* Ros. — and others, with the body of the genus. I believe that they represent a line of divergence from *Calymmodon,* not a line of descent from *Grammitis.*

Plectopteris, typified by *P. gracilis* Fée, which is *Calymmodon gracilis* (Fée) Copel., was in effect substituted for *Calymmodon* because the latter was based only on a picture, and too little known to be respectable. This was fairly true, but is not so since *C. cucullatus* has become well known. *C. gracilis* is a common Philippine fern. It has been described also as *Calymmodon hirtus* Brack., and *Polypodium consociatum* v.A.v.R., always from Mt. Banajao as the type locality.

60. Acrosorus

Acrosorus Copeland, Philippine Journal Sci. 1 Suppl. (1906) 158.

Epiphytes of moderate size; rhizome ascending, short, clothed with long, linear castaneous paleae; fronds densely clustered, sessile or nearly so, non-articulate to rhizome, narrowly linear, coriaceous, glabrescent, subpinnate, the segments obliquely deltoid, each with a simple or forked immersed vein; sori solitary, terminal on the vein, protected by the reflexed and typically fused basiscopic or both sides of the fertile tooth, the long-pedicelled sporangia thus protruding from the end of the tooth, paraphyses none, annulus of 12 cells, spores globose-tetrahedral.

TYPE: *A. exaltatus* Copel., of Mindanao.

A genus of perhaps five species, ranging to Mindoro, Malacca and Samoa.

Not respecting this genus nor some of its species, CHRISTENSEN, Suppl. III, p. 159, combines three of the latter as *Polypodium streptophyllum* Baker. In Suppl. I, he had transferred them to *Davallia.*

I have regarded *Acrosorus* as derived, independently of *Calymmodon,* from the group I now treat as *Xiphopteris;* but the recent discovery in New Guinea of *Calymmodon* species more like *Acrosorus* in size, form and texture than any species previously known throws some doubt on the degree of independence of their origin.

Acrosorus is a conspicuous fern. The paucity of collections must therefore be because it is rare. It is distinguished from *Calymmodon* by the fusion of the sides of the fertile segment, affording more perfect protection to the sorus. This fusion may be complete except at the apex, or may be only partial, at the base; or, in one speci-

men of *A. streptophyllus* (Baker) Copel. annotated by CHRISTENSEN as typical, both sides are reflexed but not fused. On other specimens believed to be this species, the fusion is partial. In my present opinion, the specimens from Mindanao, Mindoro, Samoa, and Borneo and Malacca represent four very intimately related species — a small, clear-cut, natural genus. I have no specimen from New Guinea.

61. Loxogramme

Loxogramme (Blume, Flora Javae II (1828) 73, as Section) Presl, Tent. (1836) 214, Pl. 9, f. 8; Copel., Philippine Journal Sci. 11 C (1916) 43.

Small or mediocre epiphytes, often with masses of hairy roots; rhizome creeping, dictyostelic, clothed with ovate, acuminate, slate to fuscous, entire, thin paleae; fronds fasciculate or more or less remote, non-articulate, sessile or short-stipitate, simple and entire, almost always lanceolate, oblanceolate or linear, uniform or dimorphic, thick, glabrous, main veins hardly present, veins immersed, forking and anastomosing freely without included veinlets; sori elongate, oblique to costa, in one row on each side of costa, commonly overlapping, superficial or slightly impressed, without paraphyses, annulus of 12 to 16 (commonly 14) thickened cells, with 4 wide, thin-walled cells above the stomium, spores usually globose and sometimes certainly tetrahedral, rarely broad-elliptic and bilateral, without epispore.

TYPE: *L. lanceolata* (Sw., *Grammitis*) Presl, of Bourbon, also in Madagascar and Africa.

A genus of about 40 species, ranging to Polynesia, Northward to Japan, with one species in Mexico and Central America.

Some contraction of the fertile fronds is common in the genus. In *L. antrophyoides*, of Borneo and Celebes, this contraction may be so pronounced that the sori are necessarily parallel to the costa, fusing into a single long coenosorus. *L. ensiformis* v.A.v.R. and *L. iridifolia* (Christ) Copel. are probably atavistic forms of this species, with fertile fronds broad enough to let the sori be free. *L. vittariiformis* (Ros.) C. Chr., of New Guinea is a stouter plant with a single long coenosorus parallel to the costa. The most extreme dimorphism is shown by two Philippine species, *L. dimorpha* Copel., with very narrowly linear fertile fronds, and *L. conferta* Copel., with round-elliptic, cordate sterile fronds.

The spores are globose in most species, and in some I have been able to detect the three converging lines showing their tetrad origin. *L. lanceolata* has broadly elliptic spores with a single line. The most of the spores of *L. salicifolia* Makino, of Japan and China, seem to be of this type.

L. mexicana (Fée) C. Chr., Mexico to Costa Rica, is the sole American species. It is enough like *L. salicifolia* to justify the belief that *Loxogramme*, like *Plagiogyria* and *Coniogramme*, has reached America across the North Pacific.

The New Zealand fern which I once so confidently named *Loxogramme Dictyopteris* (Mett.) is too aberrant for proper inclusion in the genus, and is now made the type of the genus to follow.

The resemblance of *Loxogramme* to *Grammitis* is so close that I have long been convinced of their near affinity, and still see no reason to doubt that *Loxogramme* is derived from *Grammitis*. The distinctions are the larger, broader fronds of *Loxogramme*, and the consequent uniform presence of many areolae. Being larger ferns, most species of *Loxogramme* can develop masses of hairy roots, and are thus adapted to a distinct environment, below instead of in the mossy forest. This drier environment facilitates the dispersal of the spores; in contrast to the general local character of *Grammitis* species, those of *Loxogramme* have in general wide ranges.

62. Anarthropteris genus novum

Filix mediocris epiphytica v. saxicola; rhizomate brevi-repente et frondigero seu late repente et prolifero, dictyostelico, paleis brunneis magnis lanceolato-ovatis acuminatis integris vestito; frondibus approximatis, brevi-stipi-

tatis, haud ad rhizoma articulatis, oblanceolatis, utrinque attenuatis, integris, glabris, coriaceis, venis ocultis, iterum furcatis et anastomosantibus, venulis in areolis inclusis nullis; soris utroque latere costae uniseriatis, inframedialibus, leviter impressis, orbicularibus vel breviter ellipticis, paraphysibus longis e seriebus tres cellularum confectis multis persistentibus, sporangiis nudis, annulo ca. 16-cellulare, sporis globoso-ellipticis linea una praeditis.

TYPE: **A. Dictyopteris** (Mett.) Copl., *Polypodium Dictyopteris* Mett., Ann. Sc. Nat. IV 15 (1861) 77.

Polypodium attenuatum Rich., Flora N. Zealand (1832) 62; Hooker, Icones Pl. (1842) Pl. 409, *non* R. Br., *nec* Willd.

Dictyopteris attenuata Hooker, Genera (1841) Pl. 71, B, *non* Presl.

Dictyopteris lanceolata J. Sm., Journal of Bot. 4 (1841) 64; this specific name may be rejected because based on an unpublished *Grammitis lanceolata* Cunn., *non* Swartz.

Dictymia lanceolata J. Sm. *apud* Hooker f., Flora N. Zealand II (1854) 43.

Polypodium Cunninghamii Hooker, Sp. Fil. V (1864) 58.

Loxogramme Dictyopteris Copel., Univ. Calif. Publ. Bot. 14 (1929) 369.

The multiplicity of names is due to repeated confusion with the superficially similar but not nearly related *Dictymia Brownii*, originally *Polypodium attenuatum* R. Br., Australia.

This is a common New Zealand fern and has been reported from Vanikoro. The generic name refers to the absence of articulation of stipe to rhizome, and is given in spite of the fact that it has been classed repeatedly with articulate ferns.

Anarthropteris seems most nearly related to *Loxogramme*, from which it is distinguished by the paraphyses, and in general by the position and shape of the sori and by the spores. The paraphyses are remarkable structures, consisting of three rows of cells, like the pedicel of the sporangium. They may be metamorphosed, rather than abortive, sporangia, but are formed in advance of the sporangia, as protective structures need to be, and exceed the mature sporangia in length.

63. Ctenopteris

Ctenopteris Blume, Flora Javae II (1828) 132; Kunze, Bot. Zeit. 4 (1846) 425; J. Smith, Hist. Fil. 184.

Cryptosorus Fée, Cong. scient. de France X.e session, t. I, p. 178, as cited by Fée, Genera (1850-52) 231, Pl. 19 C.; J. Smith, Hist. Fil. 86.

Epiphytes, small or of moderate size; rhizome short-creeping or erect, rarely elongate, dictyostelic, densely paleate, paleae entire or ciliate and even setulose on the surface; stipes congested, non-articulate or less commonly articulate to the rhizome; fronds usually lanceolate, contracted to both ends, typically pectinate (whence the name) whether pinnatisect or pinnate, rarely more compound, herbaceous to fleshy or coriaceous, setose or glabrescent but not paleate, veins plural or many in each segment, almost always simple, sori dorsal or terminal on the veins, round or elliptic, superficial to deeply immersed, without paraphyses, sporangia rarely setulose, pedicel of one row of cells except near the top, annulus of 8-14 (usually 12) cells, spores globose-tetrahedral, without epispore.

TYPE: preferably *C. venulosa* (Blume) Kunze, of Java, ranging to Malacca and Luzon. This is the second species listed by BLUME and the first by KUNZE, the first formally named in the genus. It is also the type of *Cryptosorus*, as *C. Dionaea* Fée.

The choice of this generic name is a border-line case. BLUME described *Ctenopteris*, explicity as a genus, but deferred a more complete treatment and never returned to it. He listed species of *Polypodium* belonging to it, but made no transfer of name. KUNZE used it formally, with transfer of name, but treated it as a genus established by BLUME. In his last work, in VERDOORN'S Manual, CHRISTENSEN cites it in the same manner, as "Ctenopteris Blume." FÉE'S first publication of *Cryptosorus* is unknown to me, but he

seems, like BLUME, to have left it without a formally named species; and before he remedied the deficiency, in his Genera, KUNZE had already done this for *Ctenopteris*. BLUME's first listed species, *Polypodium celebicum*, remains even now to be transferred, as **Ctenopteris celebica**; it is intimately related to *C. venulosa*.

Ctenopteris is a large genus, probably more than 200 species, common throughout the tropics, ranging South to New Zealand where it is represented by *C. Grammitidis* (R. Br.) J. Smith, and North to just beyond the Tropic of Cancer.

It has been included in *Polypodium* by most authors, even by those who, like CHRISTENSEN, recognized the unnaturalness of the genus thus maintained. It has constituted the largest element of the section or subgenus *Eupolypodium* of those using that term. Formal distinctions are that the stipe of *Polypodium* is articulate, that of *Ctenopteris* usually not so; the fronds of *Polypodium* are paleate or naked, those of *Ctenopteris* hairy or glabrescent; fronds of *Polypodium* have usually a broad base, those of *Ctenopteris* always a contracted one; the veins of *Polypodium* are forked at least once, those of *Ctenopteris* typically and almost always simple; the pedicel of *Polypodium* consists mostly of three rows of cells, that of *Ctenopteris* mostly of one row; and the spores of *Polypodium* are bilateral with epispore, those of *Ctenopteris* globose-tetrahedral without epispore. The spores distinguish the genera most perfectly. Actual affinity seems to be remote, though both are placed in the great phylum of Matonid ferns.

The affinity of *Ctenopteris* and *Grammitis* is so intimate that there is no objection in principle to Ching's recent action in combining them; but the genus thus set up seems quite too inconvenient. *Ctenopteris* and *Grammitis* were differentiated before their Northward migration. There is no recognized evidence as to which is the more primitive. Because such genera as *Phyllitis*, and such species as *Humata angustata* and *Tectaria singaporeana* are evidently descended from ancestors with compound fronds, and ferns in general have dissected leaves, there is a temptation to regard *Ctenopteris* as the older and parent form, but such an argument has no real validity.

Elongate rhizomes are found on **C. allocota** (v.A.v.R., *Polypodium*), **C. taxodioides** (Baker, *Polypodium*) and **C. Yoderi** (Copel., *Polypodium*) of the Old World, and the American *C. rigescens* (Bory) J. Smith. The paleae of the type species and a considerable number of its relatives are conspicuously ciliate, but those of a majority of all species are not so. As in *Grammitis*, congestion of hairy stipes may effect a suppression of the paleae, which exist only as ciliated vestiges in **C. micropaleata** Copel. (*Polypodium rufescens* Brause, *non Ctenopteris rufescens* Kunze). *C. venulosa* has vestigially articulate stipes. Its near relative, *C. celebica*, has them functionally articulate, as have many other species. A majority of the species have densely crowded stipes and no trace of articulation.

A few oriental species have forked veins. These are most conspicuous in two New Guinea species, *C. Clemensiae* Copel. and *C. schizophylla* Copel. BLUME excluded such species from the genus, but is not to be followed if all other criteria demand their inclusion. Among such species he included his *Polypodium tenuisectum*, *C. tenuisecta* J. Smith; but I do not find its veins ever forked, nor does he so show them on his illustration, Flora Javae *Pl. 68A;* this species constitutes MOORE's section *Thymelium*, A frond can be bipinnate without forking of the veins. If it be still more dissected, as in **C. millefolia** (Blume, *Polypodium*), a corresponding branching of the veins is of course inevitable.

The type species and its near relatives have the sori sunk in deep craters. In some species—**C. circumvallata** (Ros., *Polypodium*), **C. Ledermanni** (Brause, *Davallia*), *C. Brassii* Copel.—these craters are deepened by chimney-like elevated rims. Throughout the genus, more or less impressed sori occur, but superficial sori are probably still commoner.

Setose or setulose sporangia, common in *Grammitis*, are rare in *Ctenopteris*. Among species having them are **C. subulatipinna** (v.A.v.R., *Polypodium*), *C. Clemensiae* and *C. schizophylla* in New Guinea, and **C. asplenifolia** (L., *Polypodium*), **C. cultrata** (Willd., *Polypodium*) and **C. suspensa** (L., *Polypodium*) in America.

Most essentially aberrant, if they belong here at all, are a number of American species which look like *Ctenopteris*, but have biplanate, reniform to broadly elliptic spores, sometimes evidently with an epispore. Among such species are *Polypodium curvans* Mett., *P. Paradiseae* L. & F., *P. pectinatum* L., *P. Plumula* M. & G., *P. taxi-*

folium L., *P. Truncorum* Lindm. Most such species have furcate veins; and at least *P. Plumula* has a conspicuously paleate (as well as pubescent) rachis. Whether or not correctly, I leave all such species in *Polypodium*.

Like so many other genera, *Ctenopteris* reaches its richest evolution in New Guinea where 51 species are known. So far as it has not already been done, these are given names in the genus in a paper just ready for publication when war held it up.

64. Amphoradenium

Amphoradenium Desvaux, Prodromus (1827) 335.
Adenophorus Gaud., Ann. Sc. Nat. 3 (1824) 508, *non* Desv. (1808).

Epiphytes, or eventually terrestrial, mostly small; rhizome creeping or ascending, sometimes long, ramose and proliferous, dictyostelic, paleae castaneous, narrow, entire or glandular; stipes crowded or remote, non-articulate; fronds varying from simple and entire to subtripinnate, bearing unicellular or pluricellular hairs of which the terminal cell is clavate and glandular, veins simple or forked; sori terminal or dorsal on the veins, round but the receptacle usually elongate, clavate glandular paraphyses present, pedicel of one row of cells except near the top, annulus of 8-14 (commonly 10) cells, spores globose-tetrahedral, without epispore.

TYPE: *A. Gaudichaudii* Desv. Because DESVAUX merely provided another generic name for the invalid *Adenophorus*, and provided a new specific name to conserve GAUDICHAUD's honor, the typification by GAUDICHAUD must stand. The type of *Adenophorus* was *A. tripinnatifidus*, which is regarded as a form of *Polypodium tamariscinum* Kaulf., published the same year (1824) but granted priority. The correct name seems to be **Amphoradenium tamariscinum.**

An endemic Hawaiian genus, of which HILLEBRAND, Flora of the Hawaiian Islands (1888) 554, as Section *Adenophori* of *Polypodium*, distinguishes six species:

1) *Polypodium haalilioanum* Brack, with small, simple, entire or lobed fronds. Because of its rarity and the variability of the few collections, I mistrust its status as a proper species.

2) *P. sarmentosum* Brack.; to be **Amphoradenium sarmentosum.**

3) *P. Adenophorus* H. & A.; to be **Amphoradenium bipinnatifidum** (Gaud., *Adenophorus*). This and the preceding species have subpinnate fronds of the form typical of *Ctenopteris*.

4) *P. hymenophylloides* Kaulf.; **Amphoradenium hymenophylloides.**

5) *P. tamariscinum* Kaulf., the type species.

6) *P. Hillebrandii* Hooker, Sp. Fil. IV, 228, Pl. 279 A; **Amphoradenium Hillebrandii.** The last three species are bipinnatifid to almost tripinnate, and include several varieties regarded as species by some authors.

Amphoradenium thus includes a range of forms of frond enbracing those of both *Grammitis* and *Ctenopteris*. In this case, the *Ctenopteris* form may be regarded confidently as the more primitive, and *Amphoradenium* may be accepted as a genus derived from *Ctenopteris*.

Clavate, glandular trichomes are rare but not unknown on the lamina of *Ctenopteris*, but I have never been able to find them in the sori — that is, as paraphyses. With this single diagnostic character, the evident homogeneity and strict localization of the group of species justify well the recognition of *Amphoradenium* as a distinct genus. It may be noted that it bears an older name than *Ctenopteris*.

In the difficulty of distinguishing and evaluating the species, *Amphoradenium* exemplifies a famous feature of the Hawaiian flora. *Diellia* and *Sadleria* are local genera of similar character. *Schizostege* is dubious as a single species.

65. Prosaptia

Prosaptia Presl, Tent. (1836) 165.

Like *Ctenopteris* except that the deeply immersed sori open in the margin or adjacent to and toward the margin.

Paleae narrow, dark, ciliate; stipes articulate; fronds pinnatifid to pin-

nate; annulus of about 11 cells. These are not distinctions from *Ctenopteris,* but show the lack of diversity in a smaller and more uniform genus.

TYPE: *P. pinnatifida* Presl, a Philippine species, intermediate between the more familiar *P. contigua* (Forster) Presl and *P. alata* (Blume) Christ.

A genus of approximately 20 species, ranging from S. India to Polynesia; 8 species in New Guinea.

Prosaptia is derived from, and not sharply distinct from *Ctenopteris.* In its typical form, with the soral pit opening in the margin of the segment or in the apex of a tooth, and lying almost in the plane of the frond, the genus looks very distinct, so distinct that many authors have treated it as a section of *Davallia.* But this type of sorus-position passes, species by species, into that of the type of *Ctenopteris,* in which the likewise deep soral pits open from the nether surface of the frond, at a right angle to its plane. For this reason, CHRISTENSEN, who once treated it insistently as a section of *Davallia,* made it a subgenus of *Polypodium* in his Third Supplement; but in VERDOORN'S Manual, he has restored it as a genus.

The most aberrant species are the similar *P. davalliacea* (M. & B.) Copel., of New Guinea and reported from Borneo, and *P. linearis* Copel. of Luzon. In these, each segment bears a single large sorus in its acroscopic margin.

Comment on Grammitid Ferns: — The Grammitid or Grammitoid ferns are a homogeneous group consisting of three rather arbitrarily distinguished genera regarded as comparatively primitive and of a number of smaller genera regarded as derived from these three.

The more primitive genera, *Grammitis, Xiphopteris* and *Ctenopteris,* are found in all tropic lands, and are believed to have migrated from Antarctica after their differentiation. They are ascribed to the *Matonia-Dipteris-Polypodium phylum,* are like all but their most primitive associates in this phylum in the absence of indusia, and in a tendency to dichotomy; but, excepting the *Matoniaceae* themselves, and sometimes *Cheiropleuria,* are the only members of the phylum with globose-tetrahedral spores, without epispore.

From *Grammitis* are descended *Cochlidium, Glyphotaenium, Scleroglossum* and *Oreogrammitis;* from *Xiphopteris, Calymmodon* and *Acrosorus;* from *Ctenopteris, Prosaptia* and *Amphoradenium.* The derivation of these eight genera is exceptionally clear — so clear that all of them could be combined with their parent genera without possible violence to nature. But they are severally distinguished by features so conspicuous that their recognition as distinct genera is well justified on the ground of convenience. The completeness of the record of their phylogeny indicates that none of them are very old. Each derived genus inhabits a part of the range of its parent, or in the case of *Amphoradenium* it is on the edge of the parental range.

Loxogramme is almost as certainly derived from *Grammitis,* but its exact source in the parent genus and the details of its evolution are not established. It is older than the eight genera just listed, and has had time to spread more widely.

Every long known species of these genera has at some time been included in *Polypodium.* The clear demonstration of the distinctness of this group, and the elucidation of the lines of evolution within the group, are grounds of particular satisfaction.

Comment on Polypodiaceae: — As here constituted, this family includes:

1) An apparently primitive genus, *Dipteris,* with one questionable relative, *Holttumiella.*

2) Three genera which are sometimes regarded as primitive — *Cheiropleuria, Christiopteris* and *Platycerium.* I do not believe that these are really primitive, but have found no satisfactory place for them.

Four mutually related phyla, typified by:

3) *Polypodium* — *Polypodieae.*

4) *Pleopeltis* — *Pleopeltideae.*

5) *Microsorium* — *Microsorieae* (*Phymatodeae*).

6) *Crypsinus* — *Crypsineae.*

One more isolated phylum, typified by

7) *Grammitis* — *Grammitideae.*

While the evidence is less conclusive than in the case of most leptosporangiate fern families, a part of the *Polypodiaceae* are evidently of Antarctic origin, and all of them may be so. The evidence is most perfect in the case of the *Grammitideae;* least so for *Polypodieae* and *Pleopeltideae.*

The last two phyla are nearer to each other than to the other phyla. The most striking feature of their distribution is the paucity of representatives in the whole area from New Zealand to Java and the central Philippines. Of the genera of that area, *Dictymia* is assigned its place in the system with some doubt. *Paragramma* and *Weatherbya* are scant representation of a great phylum. Only *Belvisia* and *Pyrrosia,* with *Pteropsis* as a derivative, have the present distribution expected of successful genera once migrant through New Zealand. Speculatively, one may suggest that *Polypodium* and *Pleopeltis* migrated from Antarctica when local conditions there, perhaps merely of distribution, made the New Zealand avenue unavailable. Neither *Belvisia* nor *Pyrrosia* is regarded as primitive. The time since any fern lived in Antarctica must be recognized as sufficient to permit *Polypodium* and *Pleopeltis* to reach their present range. They have not reached New Guinea from India because the sun rises in the East — in more complete expression, because the tropic air, which bears the spores, drifts westward against the rotation of the Earth.

Microsorieae and *Crypsineae* are cognate phyla, with the distribution typically indicative of New Zealand origin. They are unknown in America, and scantily present in Africa. As shown in the discussion of *Microsorium,* its apparently most primitive element survives in the New Zealand region, and is a possible ancestor of *Crypsinus.* Thus it may be that *Crypsinus,* as such, is not of Antarctic origin, but is an early offshoot, and thus younger than *Microsorium.* Although it is a large and successful genus, and the parent of seven other recognized genera, ranging as far as Japan along easy paths of migration, the single report of it in Madagascar is open to suspicion — see CHRISTENSEN, Pterid. Madagascar (1932) 158. *Microsorium punctatum* and *M. Scolopendria* range across Africa.

For a common source of *Microsorium* and of *Polypodium* and *Pleopeltis,* it is more reasonable to refer to the lost flora of old Antarctica, than to imagine that it is found to-day, in China or anywhere else, in species like *Pleopeltis normalis* Moore, which happen to suggest the other phylum.

The remaining phylum of the family, *Grammitideae,* is so distinct that comment on it has been presented separately.

The family as a whole is believed to have originated long before the fern history of Antarctica, in ferns related to *Matoniaceae,* and among still more primitive ferns, from the group now represented by the *Gleicheniaceae.*

FAMILY 17 — VITTARIACEAE

Vittariaceae Presl, Tent. (1836) 164, as Tribus.
Antrophyaceae Link, Fil. Hort. Berol. Cult. (1841) 140, as Subordo.

Epiphytic ferns, or rarely terrestrial; rhizome creeping to suberect, protostelic or siphonostelic, bearing clathrate paleae; fronds simple, entire or rarely cleft from the apex, glabrous, with long idioblasts in the epidermis, venation recticulate unless prevented by extreme narrowness of frond, without included veinlets; sori elongate along the veins, or small, round and on the epidermal cells in one genus, exindusiate, paraphyses usually present, annulus longitudinal and interrupted, spores tetrahedral or biplanate, without epispore; prothallium elongate, ecostate, not cordate. A more complete discussion of the peculiarities of the family follows the presentation of the genera.

Key to the Genera of Vittariaceae: —

Ferns of moderate size.
- Costa wanting or partial ..... **1. Anthrophyum**
- Costa reaching apex of frond.
  - Sori round, small, scattered ..... **2. Pteridanetium**
  - Sori elongate.
    - Sori several or many.
      - Paraphyses none, spores tetrahedral ..... **3. Polytaenium**
      - Paraphyses present, spores bilateral ..... **4. Scoliosorus**
    - Sori solitary on each side of frond.
      - Areolae in 1 row between costa and sorus ..... **6. Vittaria**
      - Areolae in several rows or irregular ..... **7. Ananthacorus**

Minute ferns even if elongate.
- Fronds widening upward and cleft ..... **5. Hecistopteris**
- Fronds linear.
  - Fronds veinless except for costa ..... **9. Monogramma**
  - Sori on short lateral veins ..... **8. Vaginularia**

1. Antrophyum

Antrophyum Kaulfuss, Enum. (1824) 197.

Normally epiphytes; rhizome creeping, short, with single solid axial vascular strand, clothed with narrow, dark, clathrate paleae, and immersed in a dense mass of hairy roots; fronds approximate and caespitose, small or mediocre, sessile or stalked, non-articulate to rhizome, lamina simple and entire, glabrous, firm but without sclerenchyma, epidermis usually with copious peculiar spicular cells, costa wanting or partial, veins repeatedly dichotomous and typically anastomosing to form large, elongate areolae, without included veinlets; sori elongate along the veins and sometimes similarly reticulate, superficial or more often immersed, exindusiate, paraphyses present, annulus of about 14 cells, spores typically globose-tetrahedral (triplanate), but biplanate in some African species, smooth, hyaline.

TYPE, selected by BENEDICT: *A. reticulatum* (Forster, *Hemionitis*) Kaulfuss, from Upolu; wide-spread in the Old World tropics.

Nearly forty species have been described and not reduced, but a considerable part of them are ill distinguished; common from Polynesia to Africa.

The species are mostly really ecostate. The veins come from the base or petiole, and fork repeatedly, the areolae becoming more numerous to above the middle of the lamina, which is therefore oblanceolate. It varies to linear, and in two large species is as wide as long. In these two species, *A. latifolium* Blume and *A. mannianum* Hooker, the spicular idioblasts are few or wanting. *A. latifolium*, as I have found it, is peculiar also in being terrestrial.

The paraphyses are characteristic of the species, filiform, or capitate with globose or pyriform heads. As in all related genera, the stomium is of four cells, with accessory cells above and below it.

Antrophyopsis Benedict, Bull. Torrey Club 34 (1907) 447, as subgenus, typified by *Antrophyum boryanum* (Willd.) Presl, and including a few African species, has biplanate (elliptic-reniform) spores. *Antrophyopsis* may be treated as a genus.

Bathia C. Chr., Notes Pteridologiques XVI (1925) 110, as subgenus, as typified by *Antrophyum bivittatum* C. Chr., is a very small Madagascar fern, with only two, simple free veins. Related, if distinct, is *A. trivittatum* C. Chr., with three veins and sori. This in turn may shade into *A. perricrianum* C. Chr., with three or four rows of areolae. Because these form a local series which at one end is typical *Antrophyum* (or *Antrophyopsis;* the spores are not described), it is not practicable to treat *Bathia* as a genus.

The gametophyte of *Antrophyum* seems to remain unknown.

2. Pteridanetium nomen novum

Anetium (Kunze) Splitgerber, Tiijds. Nat. Ges. 7 (1840) 395; *non Anetia* Endl. (1839). *Anetium* Kunze was an unpublished section name under *Acrostichum*.

An epiphyte of moderate size; rhizome long-creeping, siphonostelic, clothed with fuscous clathrate paleae; fronds remote, entire, oblanceolate, with decurrent base, percurrent costa, and divergent veins forming several or many rows of areolae; sporangia in very small groups scattered over the nether epidermal cells without vascular supply, paraphyses wanting, pedicel very short, annulus of 10-12 cells, spores globose-tetrahedral, smooth, hyaline.

Type and sole species: **P. citrifolium** (*L., Acrostichum*), Guatemala to southern Brazil.

A fern unique in the distribution of its sporangia, surely related to *Polytaenium*, which it resembles particularly in costa and venation. Fée showed unusual appreciation of other characters than the sori, when, Genera, p. 174, without noting the idioblasts, he treated this fern as an *Antrophyum*.

Benedict, Bull. Torrey Club 38 (1911) 173, Pl. 2, f. 1, has described and illustrated an abormal, presumably atavistic frond, with the sporangia restricted, in the lower part of the frond, to the veins.

3. Polytaenium

Polytaenium Desvaux, Prodrome (1827) 174; Benedict, Bull. Torrey Club 38 (1911) 169.

Dictyogramme Trev., Atti Ist. Veneto V, 3 (1877) 592, *partim, non* Fée.

Like *Antrophyum*, but with percurrent costa, from which the veins diverge, and without paraphyses.

Type: *P. lanceolatum* (Sw., *Vittaria*) Desv., a synonym of *P. lineatum* (Sw., *Hemionitis*) J. Sm., of Jamaica, and throughout the American tropics.

A genus of about ten species, of the American tropics. It has usually been included in *Antrophyum*, but the costate lamina and the absence of paraphyses, together with the geographic isolation of the two genera, make their separation advisable. The resemblance to *Vittaria* is fully as close as that to *Antrophyum*, and this is probably true of the affinity.

Benedict, *l.c.*, p. 183, reports the gametophyte of *P. Feei* Maxon as of the type believed to characterize this whole group of genera.

Dictyogramme Fée is a synonym of *Coniogramme*, but TREVISAN included in it representatives of various genera not nearly related, including *Antrophyum*, *Polytaenium* and *Scoliosorus*.

4. Scoliosorus

Scoliosorus Moore, Index Fil. (1857) XXIX.

Like *Antrophyum*, but with percurrent costa, and diplanate (elliptic-reniform) spores.

TYPE: *S. ensiformis* (Hooker, *Antrophyum*) Moore, of Mexico, ranging to Costa Rica.

A single species, included in *Antrophyum* by HOOKER and several later authorities, and in *Polytaenium* by BENEDICT, Bull. Torrey Club 38 (1911) 169. MOORE based this genus on a mistaken idea of its venation, but it is maintained for other and real reasons. It is like *Polytaenium* in its percurrent costa, and in the consequent venation and soriation, but unlike it in bearing paraphyses. In its diplanate spores, it is unlike both *Antrophyum* and *Polytaenium*, except as to the African subgenus *Antrophyopsis*.

5. Hecistopteris

Hecistopteris J. Smith, London Journal of Bot. 1 (1842) 193; Goebel, Flora 82 (1896) 67.

A very small epiphyte; rhizome (?) short-creeping, slender, with a small central vascular bundle, clothed at the bases of tufts of fronds with clathrate paleae except as some are so small that all cells are marginal; fronds seriate or tufted, simple with attenuate base, widening upward and variously cleft at and near the apex, thin-herbaceous, glabrous, veins dichotomously branched, free; sori elongate along veins in the upper part of the frond, superficial, with filiform paraphyses, annulus of 14-22 cells, spores tetrahedral (or biplanate ?).

TYPE and sole species: *H. pumila* (Sprengel, *Grammitis*) J. Smith, from Surinam, ranging from Guatemala to Southern Brazil.

FÉE, Genera, says that the annulus is of 12-14 cells, but figures it with 22; I have found both extremes; 18 and 20 are commoner. FÉE says the spores are globose, and figures them as tri- and biplanate. BENEDICT, Bull. Torrey Club 38 (1911) 163, says they are biplanate. I have seen but few, and these triplanate.

GOEBEL reported the gametophyte as like that of *Vittaria*. He also maintained that the structure passing as a rhizome is really a root, bearing adventitious buds which become the plants.

6. Vittaria

Vittaria Smith, Mém. Acad. Turin 5 (1793) 413, Pl. 9, f. 5.
Haplopteris Presl, Tent. (1836) 141, Pl. 5, f. 21.
Taeniopsis J. Smith, Journal of Bot. 4 (1841) 67.
Taeniopteris Hooker, Genera (1842) Pl. 76 B.
Oetosis Greene, Pittonia 4 (1900), 103, *non* Necker *nec* O. K.

Epiphytes, with condensed rhizome immersed in water-absorbing and -holding roots, and bearing dark, often iridescent, narrow and attenuate clathrate paleae; fronds crowded, narrowly linear, entire, with or without distinguishable stipe, firm, glabrous, costate, veins forming a single row of areolae between the costa and the submarginal fertile vein; sori continuous along the latter and thus, in full fruit, one subtending each margin, immersed or almost superficial, paraphyses present, annulus of 14-18 (-20) cells, spores elliptic-reniform, or rarely globose-tetrahedral, smooth, hyaline.

TYPE: *V. lineata* (L., *Pteris*) Smith, of Santo Domingo, and throughout the American tropics.

Up to 80 described and accepted species, in all warm regions, but very many of these ill distinguishable.

Both *Haplopteris* and *Taeniopteris* were typified by *Vittaria scolopendrina,* the latter under a synonym, *T. Forbesii* Hooker.

Taeniopsis, typified by *T. revoluta* (Don, *Vittaria*) J. Smith, but including also the type species of *Vittaria,* was to be distinguished by intramarginal sori, marginal sori being ascribed to *Vittaria.* The distinction is apparent rather than essential. GOEBEL's interpretation is that no *Vittaria* has really marginal sori; however, no *Vittaria* has any veins outside the fertile one.

The veins may run more or less directly from the costa to the point of anastomosis, in which case the areolae are numerous; or they may curve and become more or less parallel to the costa, forming only a few areolae, even a single one on each side in *V. sikkimensis* Kuhn, — BENEDICT, Bull. Torrey Club 38 (1911) 164, Pl. 3, f. 13.

Tetrahedral spores are reported only for a couple of American species; I have not seen any.

7. Ananthacorus

Ananthacorus Underwood & Maxon, Cont. U. S. Nat. Herb. 10 (1908) 487; sometimes misspelled *Ananthocorus.*

Pteropsis Presl, Tent. (1836) 225, Pl. 10, f. 3; Hooker & Bauer, Genera, Pl. 77; J. Smith, Hist. Fil. 173, Pl. 10 C; Goebel, Flora 117 (1924) 99, f. 2; *vix* Desvaux (1824).

Like *Vittaria,* but with several rows of areolae; sori submarginal and hardly immersed, paraphyses clavate-capitate, annulus of 16 cells, spores elliptic-reniform (biplanate), smooth, hyaline.

TYPE and sole species: *A. angustifolius* (Sw., *Pteris*) Underwood & Maxon, of Jamaica, and throughout tropical America.

Reasonably segregated from its nearest relative, *Vittaria;* related also to *Polytaenium.*

8. Vaginularia

Vaginularia Fée, (Dix. Sess. d. congr. sci. France I (1843) 178); 3 Mém. (1851-52) 50; Goebel, Flora 117 (1924) 110.

Diclidopteris Brack., U. S. Expl. Exped. XVI (1854) 135, Pl. 17.

Like *Monogramma,* but costa emitting short alternate lateral veins which run parallel to it; sporangia borne along these veins, in a groove which opens along the costa, paraphyses non-capitate, annulus of 14-16 cells, spores globose-tetrahedral.

TYPE: *V. trichoidea* (J. Smith, *Monogramma*) Fée, of the Philippines, also in Borneo and the Malay Peninsula.

Five other species are recognized, extending the range to Fiji and Ceylon.

Diclidopteris was typified by *D. angustissima* Brack., *Vaginularia angustissima* Mett., a notably large Fiji species, sometimes reduced to *V. paradoxa* (Fée) Mett.

The stomata of *V. trichoidea* are at the ends of epidermal cells, and occur on all surfaces of the frond.

9. Monogramma

Monogramma Schkuhr, Krypt. Gewächse (1809) 82, Pl. 87.

Minute epiphytes; rhizome creeping, intricate, slender, protostelic, clothed with minute clathrate paleae; fronds remote but patch-forming because of the numerous rhizomes, linear or oblanceolate-linear, herbaceous, with a costa and no other veins; sporangia borne along the costa in a groove opening along one side of the frond, paraphyses capitate, annulus of about 20 cells, spores globose-tetrahedral.

TYPE: *M. graminea* (Poiret, *Pteris*) Schkuhr, of the East African islands. SCHKUHR attributed the generic name to COMMERSON.

The only other known species is *M. dareicarpa* Hooker, described from the Philippines, found also in Borneo, the Malay Peninsula and New Guinea.

M. dareicarpa is about as small as a fern can be, 2 cm long and 1 mm wide, and *M. graminea* is like it but longer.

The stoma of *M. dareicarpa* is normally surrounded by a single epidermal cell.

Comment on the Vittariaceae: — *Vittaria* and its relatives constitute an exceptionally clear-cut and certainly natural group. Group characters are:

1) Prothallia elongate, never cordiform or reniform, everywhere one cell in thickness, irregularly lobed, long-lived, multiplying by the abscission of lobes. Such prothallia are known for several species of *Vittaria,* for *Hecistopteris,* and for one species each of *Vaginularia* and *Polytaenium.* No member of the group is known to have a different prothallium, as GOEBEL later doubted his own statement that an *Antrophyum* had a prothallium typical of the *Polypodiaceae.* No other ferns with longitudinal annulus have prothallia of the *Vittaria* type.

2) Presence in the epidermis of conspicuous elongate cells with very thick outer walls with runcinate sides; these are commonly referred to as spicular idioblasts. They are known in all genera and most species of the group; are doubtful as to only two species of *Antrophyum,* which are aberrant also in habitat and form of frond. Structures at all similar are very rare in the higher ferns.

3) Total absence of sclerenchyma in any part of the plant.

4) Simple, but not uniform, vascular systems.

5) Clathrate paleae; that is, paleae with the internal lateral walls of the cells thickened and darkened, and all other walls thin.

6) Masses of hairy roots, which absorb and hold water.

7) Entire fronds. The only normal exception is the cleft apex of *Hecistopteris.*

8) Reticulate venation without included veinlets; found in all species except those — *Monogramma, Vaginularia, Hecistopteris,* and two species of *Antrophyum* — too small to afford occasion for reticulation.

9) Pedicels of one row of cells at the base, three rows in the upper part.

10) Stomium of four cells, with specialized cells above and below it.

11) Spores without epispore, always smooth and hyaline.

This is a remarkable assemblage of distinctive features. The first is the most important. Characters of the gametophyte are regarded as of primary importance in large-scale classification. Within *Polypodiaceae* and other related families, the gametophyte is very uniform.

As to the origin of the group, I am completely in doubt. Because of the extension of the sori along the veins, and the absence of indusia, it has been associated vaguely with the gymnogrammoid ferns, but the resemblance may well be wholly casual. The prothallium suggests that of some *Hymenophyllaceae,* but there is nothing like identity. It may be observed further that *Crepidomanes* and *Didymoglossum* produce idioblasts suggestive of those of *Vittaria.* These resemblances may have some significance, or may not. I am not ready to do more than suggest the possibility that common origin may be responsible for the somewhat similar gametophytes and idioblasts of *Hymenophyllaceae* and *Vittariaceae.*

The composition of the *Vittariaceae* is probably definite; that is, there is no evident reason to suspect that any species should be removed from it, or any known species added. Several Grammitid ferns, *Cochlidium, Sclero-*

glossum and *Loxogramma,* have been included in it, but are now correctly placed elsewhere.

As to the internal phylogeny of the group, any opinion depends upon what is regarded as the most primitive element. One view, of which Benedict is the most recent exponent, is that the vegetative simplicity of *Monogramma* is evidence of primitiveness; that *Monogramma, Vaginularia* and *Hecistopteris* are the more primitive part of the group. If the group be regarded as related to *Hymenophyllaceae,* then these minute ferns may indeed be comparatively primitive.

For the present, the more tenable opinion seems to me to be that the minute genera and species are simple in structure as an inevitable consequence of extreme reduction in size. Such simplification is no isolated phenomenon; I have repeatedly called attention to it in *Hymenophyllaceae.* According to this view, the more primitive element of the group is more typically fern-like — *Antrophyum,* for example.

The group has received more careful study than have many. It was the subject of Fée's Third Mémoire. Comparatively recent studies are by Benedict (1911), and Goebel (1924), both referring to earlier work of the same authors. Goebel was evidently ignorant of Benedict's work.

HYDROPTERIDES

The heterosporous leptosporangiate ferns. Small or minute ferns, floating or rooting in mud; spores of two kinds: megaspores, which produce prothallia bearing archegonia; and microspores, which produce prothallia bearing antheridia; prothallia exceedingly reduced, and transient.

This is a classic group in fern classification, but is not now regarded as natural. It has several names which remain useful only as descriptive terms. Because the included genera seem all to be descended from homosporous leptosporangiate ferns, I am including them in *Filicales*. On the basis of their extreme distinctness, they may with equal propriety be treated as constituting two orders, *Marsileales* and *Salviniales*. When their descent shall be better understood, they will probably be regarded as orders, but I dislike a classification which gives more expression to our ignorance than to our knowledge.

FAMILY 18 — MARSILEACEAE

Marsileaceae R. Brown, Prodromus (1810) 166, as Ordo; S. F. Gray, Brit. Pl. II (1821) 24, as Family.
Pilulariaceae Dumort., Anal. Fam. (1829) 67.

Small, typically subaquatic ferns, growing on mud, but commonly through water, rarely floating, or enduring desiccation, but not then active; rhizome creeping, solenostelic, hairy; fronds simple and linear, or with two or four opposite leaflets at the end of long stipes, veins forking freely if the laminar area permits, and anastomosing at their apices; sporangia in hard structures called sporocarps, borne on the stipes or at their bases, and construed as pinnae; sori consisting of megasporangia and microsporangia, megaspores solitary, microspores numerous.

The *Marsileaceae* have been shown by CAMPBELL (1904) and several successors to be probable relatives of *Schizaeaceae,* and not improbably derived from that family.

Fronds filiform or grasslike ..... **1. Pilularia**
Fronds with two opposite leaflets ..... **2. Regnellidium**
Fronds cruciform—with four leaflets ..... **3. Marsilea**

1. Pilularia

Pilularia Linnaeus, Sp. Plant. (1753) 1100.
Calamistrum O. Kuntze, Rev. Gen. Plant. II (1891) 822.

Rhizome very slender, wide-creeping; fronds filiform, with solitary basal globose sporocarps, each containing four loculi (sori), the sporangia on parietal receptacles.

TYPE: *P. globulifera* L., of Europe.

A genus of 6 widely scattered species, the range including Chile, New Zealand and Australia.

Calamistrum was published by KUNTZE in an attempt to revive an earlier and therefore invalid name.

2. Regnellidium

Regnellidium Lindmann, Arkiv f. Bot. 3 Pt. 6 (1904) 2.

Whole plant rather fleshy; leaflets two, apparently opposite. For a very complete account of this plant, see JOHNSON and CHRYSLER, Am. Journal Bot. 25 (1938) 141, and CHRYSLER and JOHNSON, Bull. Torrey Bot. Club 66 (1939) 263.

TYPE and sole species: *R. diphyllum* Lindm., known in three localities in Southern Brazil.

3. Marsilea

Marsilea Linnaeus, Sp. Plant. (1753) 1099.
Lemma (Jussieu, 1740) Adanson, Fam. d. Plantes II (1763) 21; Desr. in Lamarck, Enc. III (1789) 720.
Zalusianskya Necker, Acta Theod. Palat. Phys. 3 (1775) 303, not seen; O. Kuntze, Rev. Gen. Plant. II (1891) 823.
Spheroidea Dulac, Fl. Dépt. Hautes-Pyr. (1867) 39.

Leaves cruciform, consisting of two contiguous pairs of opposite leaflets;

sori numerous on a gelatinous receptacle attached to wall of sporocarp by its ends, and extruded in the form of a ring.

TYPE: *M. quadrifolia* L., of Europe; also in Asia and locally in Connecticut.

A genus of nearly 70 species, in all parts of the world, notably numerous in Australia (12-15 species) and South Africa.

All of the synonyms can properly be based on the same type species. The only question of name goes back then to the typification of *Marsilea* Linnaeus by *M. quadrifolia* (not by *M. natans*, which is *Salvinia*); and this is accepted by convention.

While affinity to *Schizaeceae* is fairly established, the gap is a very wide one, and *Marsileaceae* are so old that the surviving genera preserve little evidence of the course of their evolution. Judging by frond form, *Marsilea* has been regarded as the most primitive, and *Pilularia* as the least primitive genus. Judged by the sori, which seems more reasonable, the sequence is reversed. Really, the surviving genera do not represent a series, but are ends or fragments of related series.

FAMILY 19 — SALVINIACEAE

Salviniaceae Dumort., Anal. Fam. (1829) 27, not seen.
Azollaceae C. Chr., Verdoorn's Manual (1938) 550.

Minute floating plants; rhizome horizontal, branching freely; fronds straight in vernation.

Rootless; one leaf in three dissected, serving as root ..... 1. Salvinia
Roots present; leaves consisting of upper and lower lobe ..... 2. Azolla

1. Salvinia

Salvinia (Micheli, 1729) Adanson, Fam. d. Plantes II (1763) 15.

Very small floating plants; fronds in whorls of three, of which two are green, entire, flat, floating, the third being finely dissected, pendent in the water, substituting for a root; sori borne on the water leaves, each surrounded by a basifixed indusium; microsporangia numerous, each producing 64 microspores; megasporangia few, each maturing only one megaspore.

TYPE: *S. natans* (L., *Marsilea*) All., of Europe and Asia.

A genus of 10 species, mostly of tropical America and Africa, including Madagascar.

2. Azolla

Azolla Lamarck, Enc. Méth. I (1783) 343.
Carpanthus Raf., N. Y. Med. Repository II 5 (1808) 356; Journal de Bot. 1 (1808) 221.

Minute floating plants; fronds in two rows, each consisting of a floating upper lobe and a submersed lower lobe, always harboring *Anabaena;* sori borne on the lower lobe, in pairs, each enclosed by its indusium.

TYPE: *A. filiculoides* Lam., of S. Chile; ranging to Brazil and California.

Six species, ranging well over the world.

Carpanthus was presumably typified by *A. caroliniana* Willd.

CHRISTENSEN, in VERDOORN'S Manual (1938) 550, treats *Azolla* as constituting a distinct family, *Azollaceae,* which, with *Salviniaceae,* make an Order, *Salviniales.*

The terminal position of the sori, sometimes evident sequence of maturing of sporangia, and the basal but inclusive indusium, collectively suggest affinity to *Hymenophyllaceae.* For what it is worth, this suggestion applies to both genera; but there is no accepted opinion as to the origin of either genus or both. While this is so, the assignment of rank, as family or order, is arbitrary.

Θηλυπτέρις
Filix fœmina
Fougiere femelle
Felce femina
Weibsfarn Buetsle

INDEX

INDEX TO PLANT NAMES

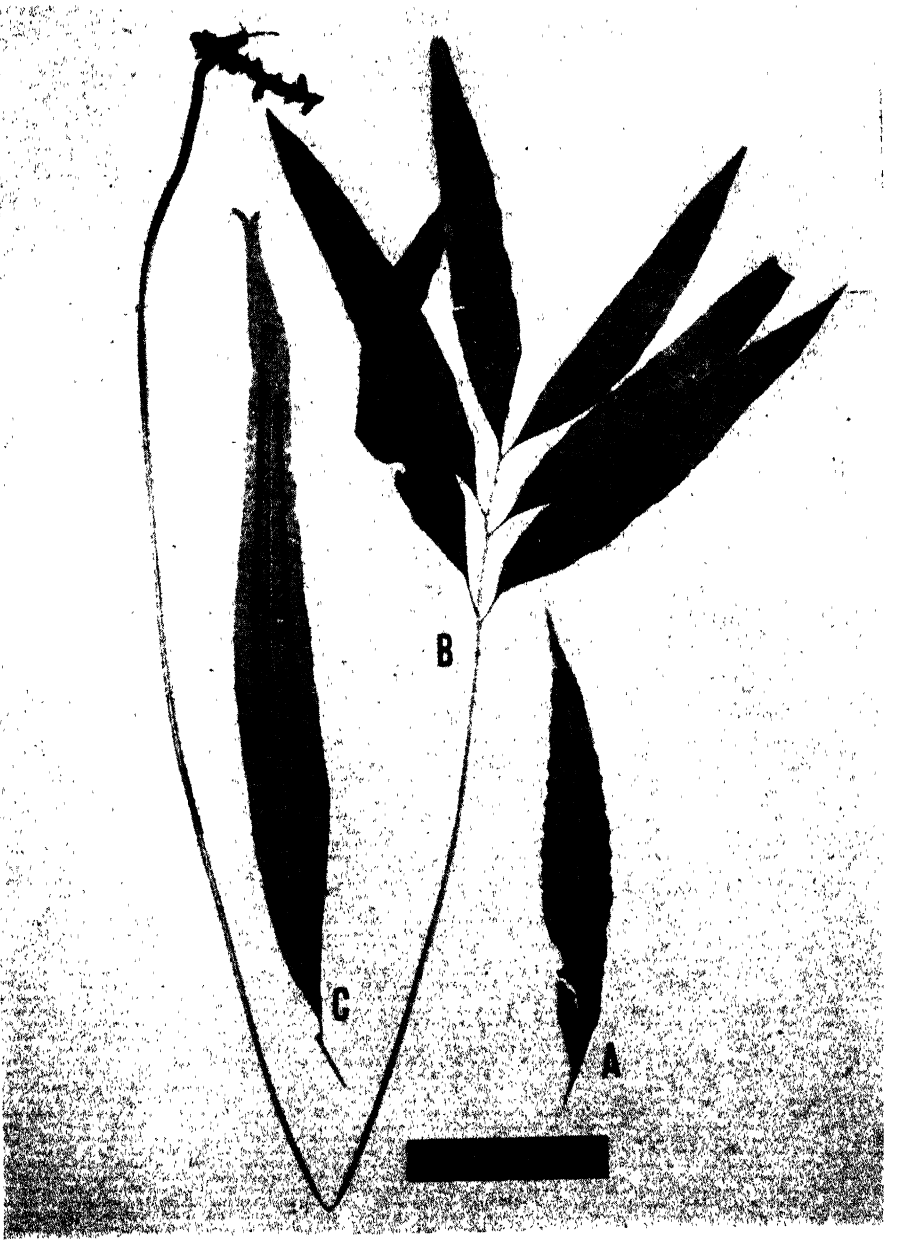
Names in use are in Roman type.
Synonyms are in *italics.*
New names and combinations are in bold face type.

Πτέρις ἡ πτέρις
Filix mas
Feuchiere
Felce maſchio
Dualöfary mennle

PLATES

— PLATE I —

A. — **Syngramma pinnata** J. Sm. — Typical. Fiji
B. — **Syngramma pinnata,** approaching Taenitis, Fiji: Gillispie no. 2008
C. — **Taenitis blechnoides** (Willd.) Sw. — Singapore


B
C
A

— PLATE II —

Lepidocaulon caudatum Copeland, Type

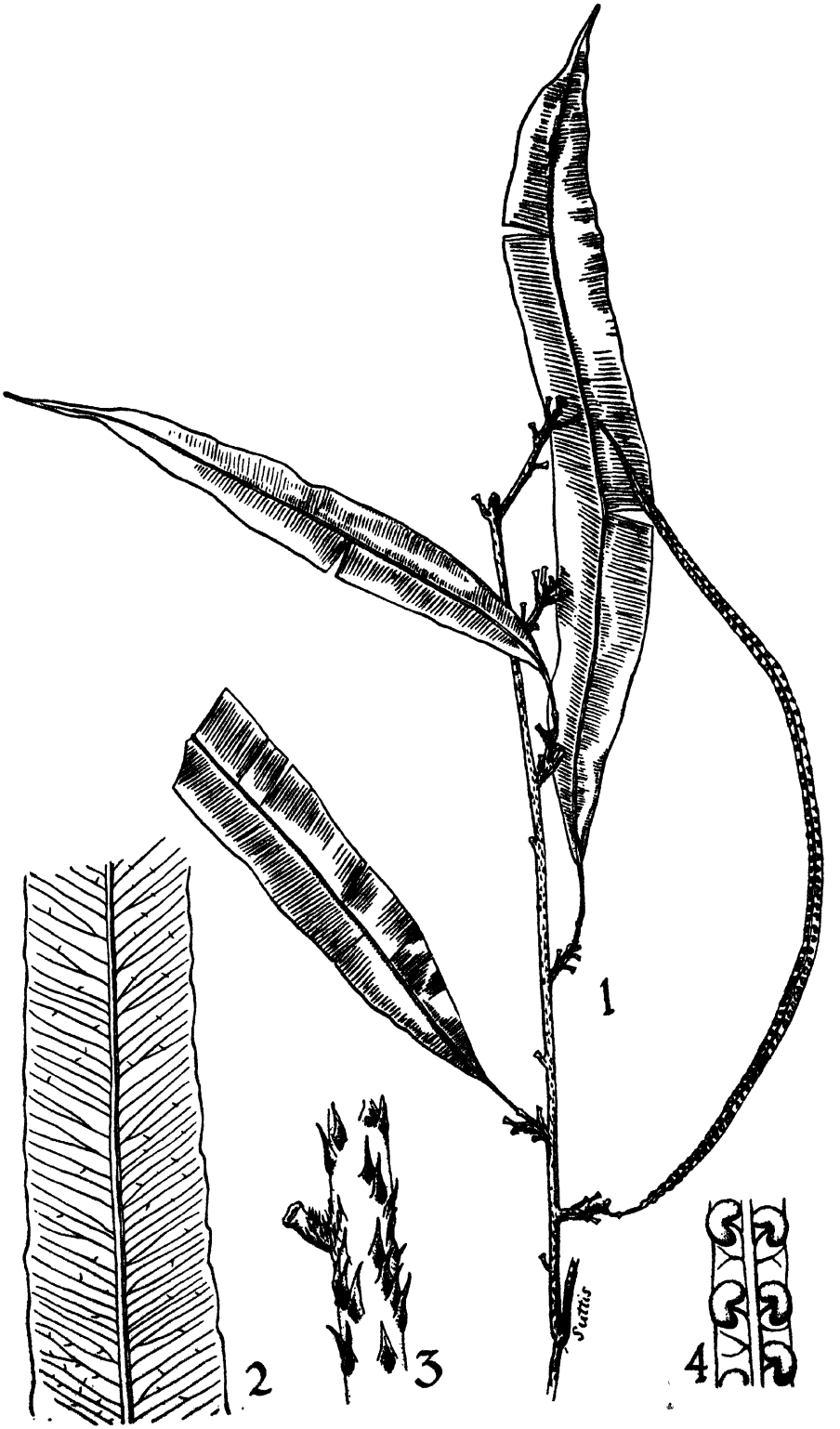
FIGURE 1 — Plant, × 0.5
FIGURE 2 — Venation, × 1.5
FIGURE 3 — End of fertile pinna, × 1.5
FIGURE 4 — Paleae, × 3


2
3
1
4

— PLATE III —

Oleandra Werneri Rosenstock

FIGURE 1 — Portion of Plant, × 0.5
FIGURE 2 — Portion of Sterile Frond, × 1.0
FIGURE 3 — Stem and Paleae, × 3
FIGURE 4 — Sori, × 3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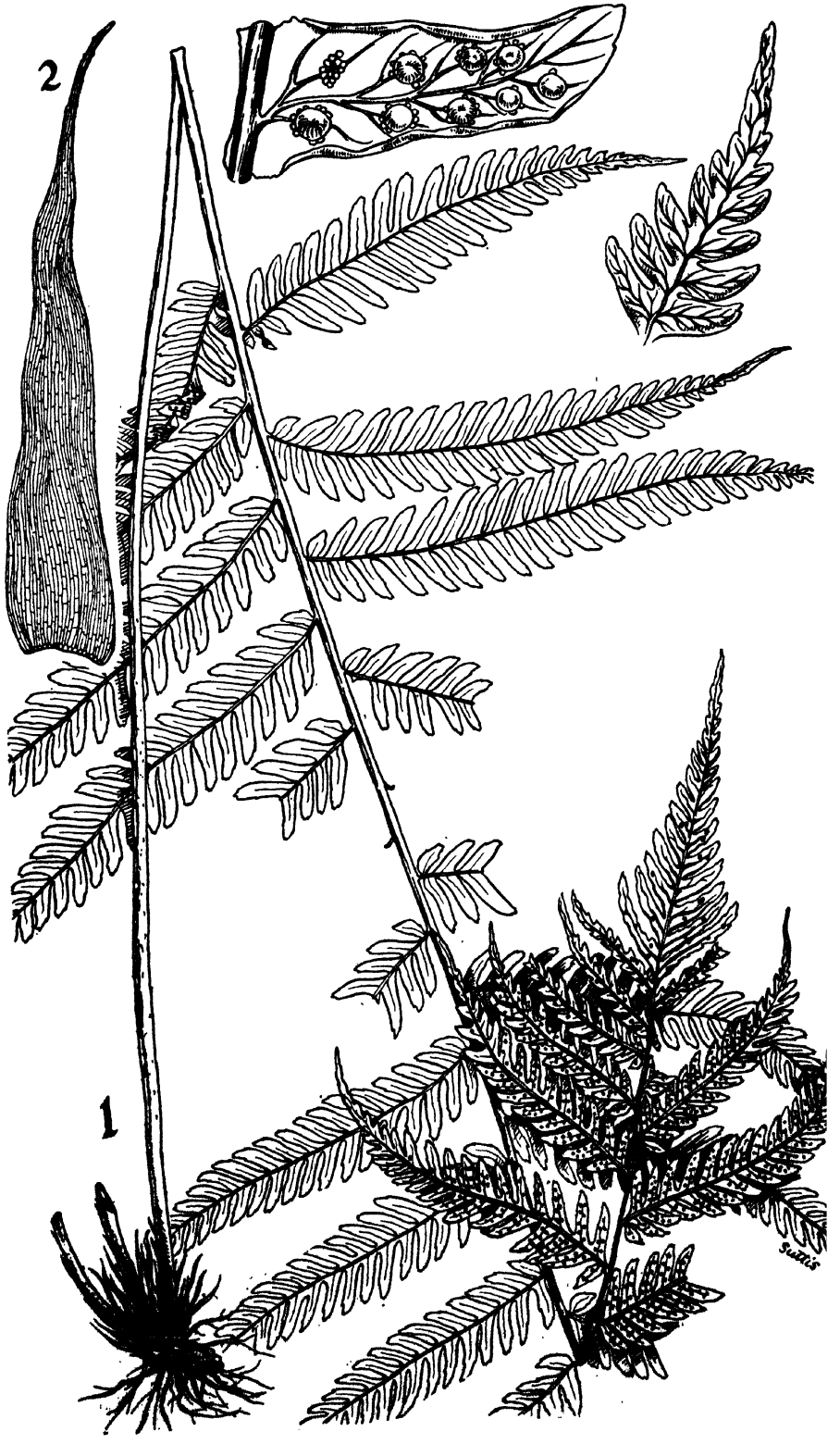
— PLATE IV —

Dryopolystichum phaeostigma (Cesati) Copel.

FIGURE 1 — Plant, × 0.5
FIGURE 2 — Palea, × 10
AT TOP — Fertile Segment, × 5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1

— PLATE V —

Currania gracilipes Copel.

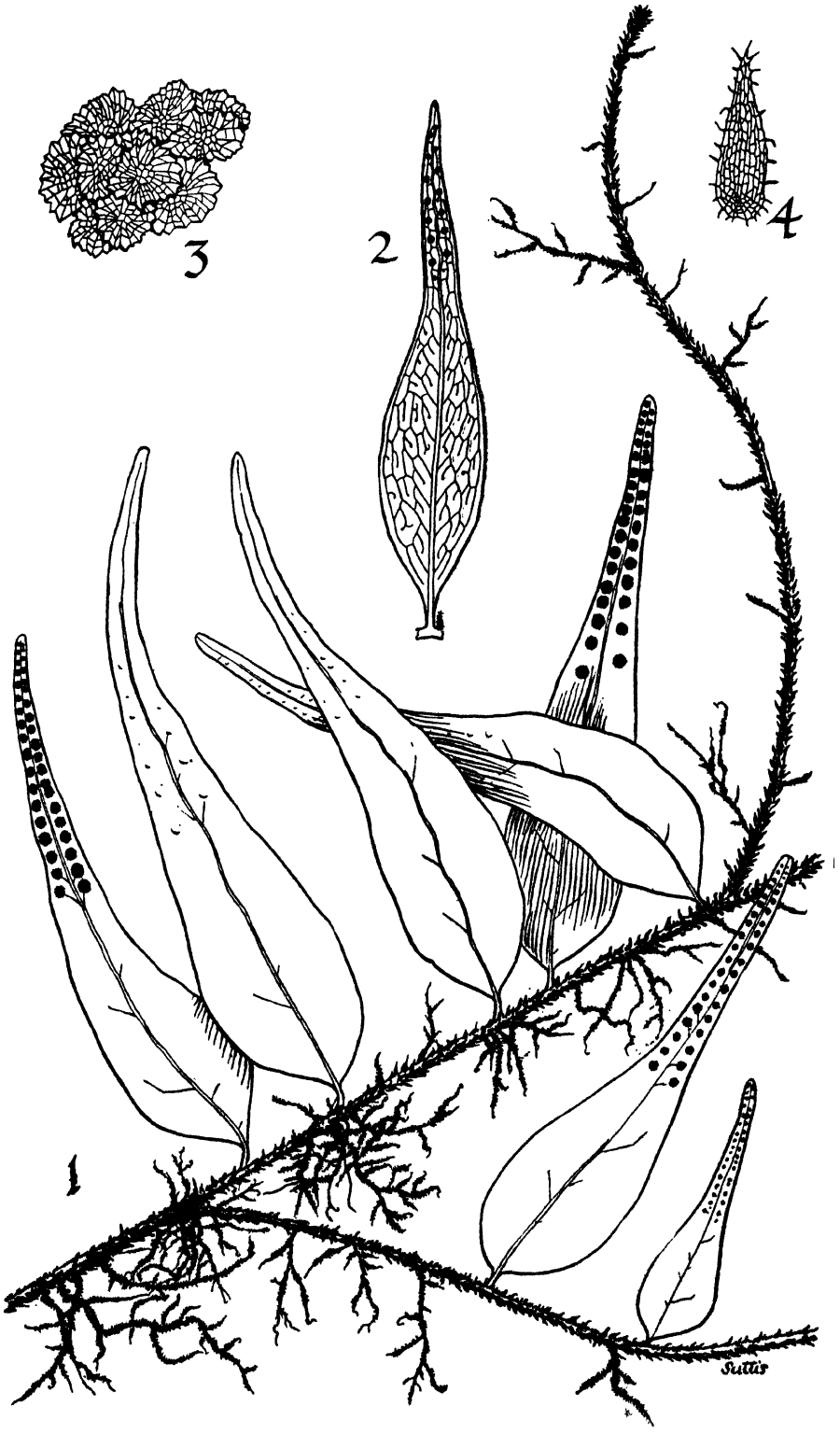
FIGURE 1 — Plant, × 1
FIGURE 2 — Segment, × 2.5


1
2
Suttis

— PLATE VI —

Weatherbya accedens (Blume) Copel.

FIGURE 1 — Plant, × 1
FIGURE 2 — Venation, × 1
FIGURE 3 — Sorus, Paraphyses in Place, × 20
FIGURE 4 — Palea, × 15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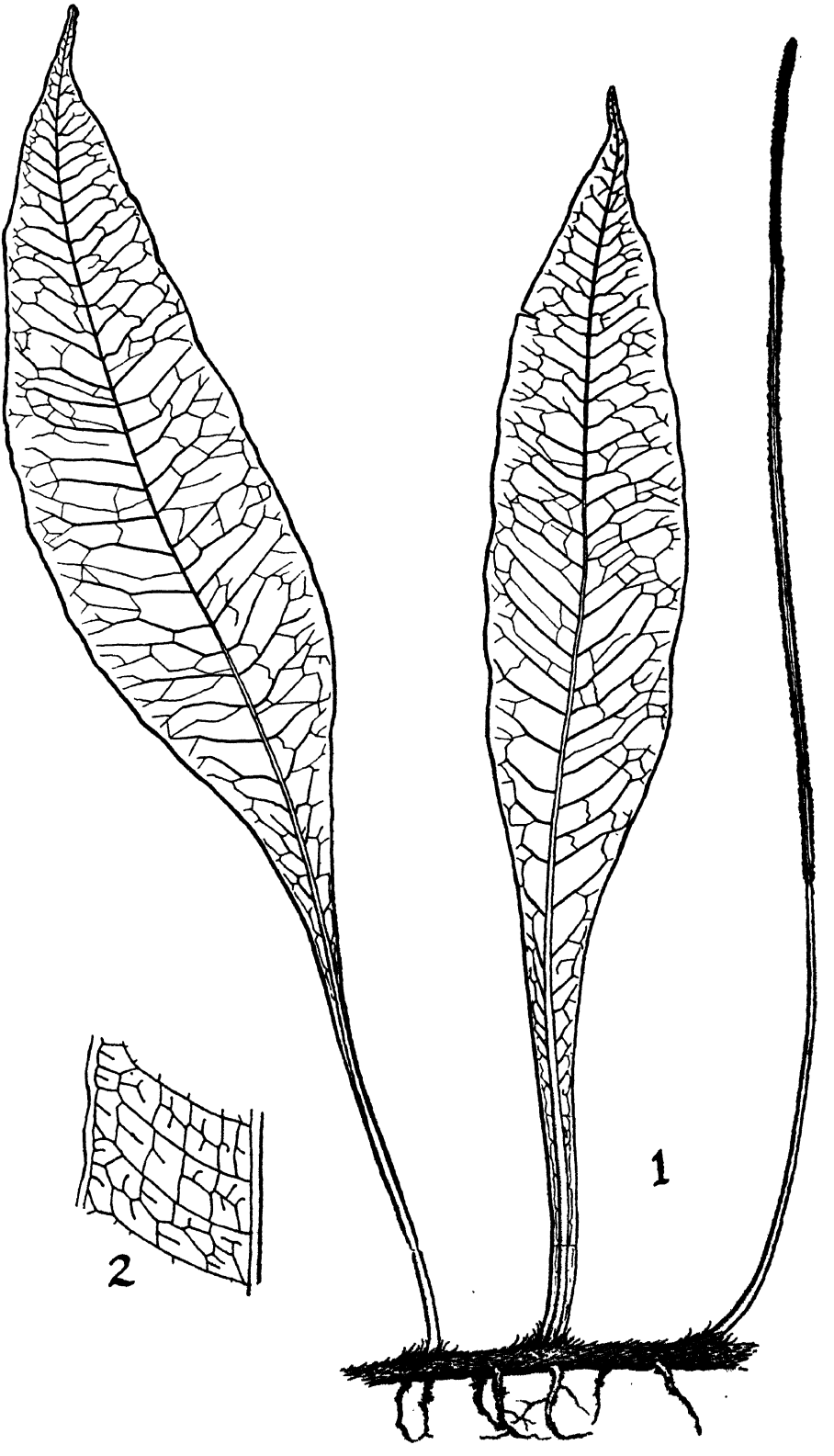
Suttis

— PLATE VII —

Paraleptochilus decurrens (Blume) Copel.

FIGURE 1 — Plant, × 0.4
FIGURE 2 — Venation, × 0.5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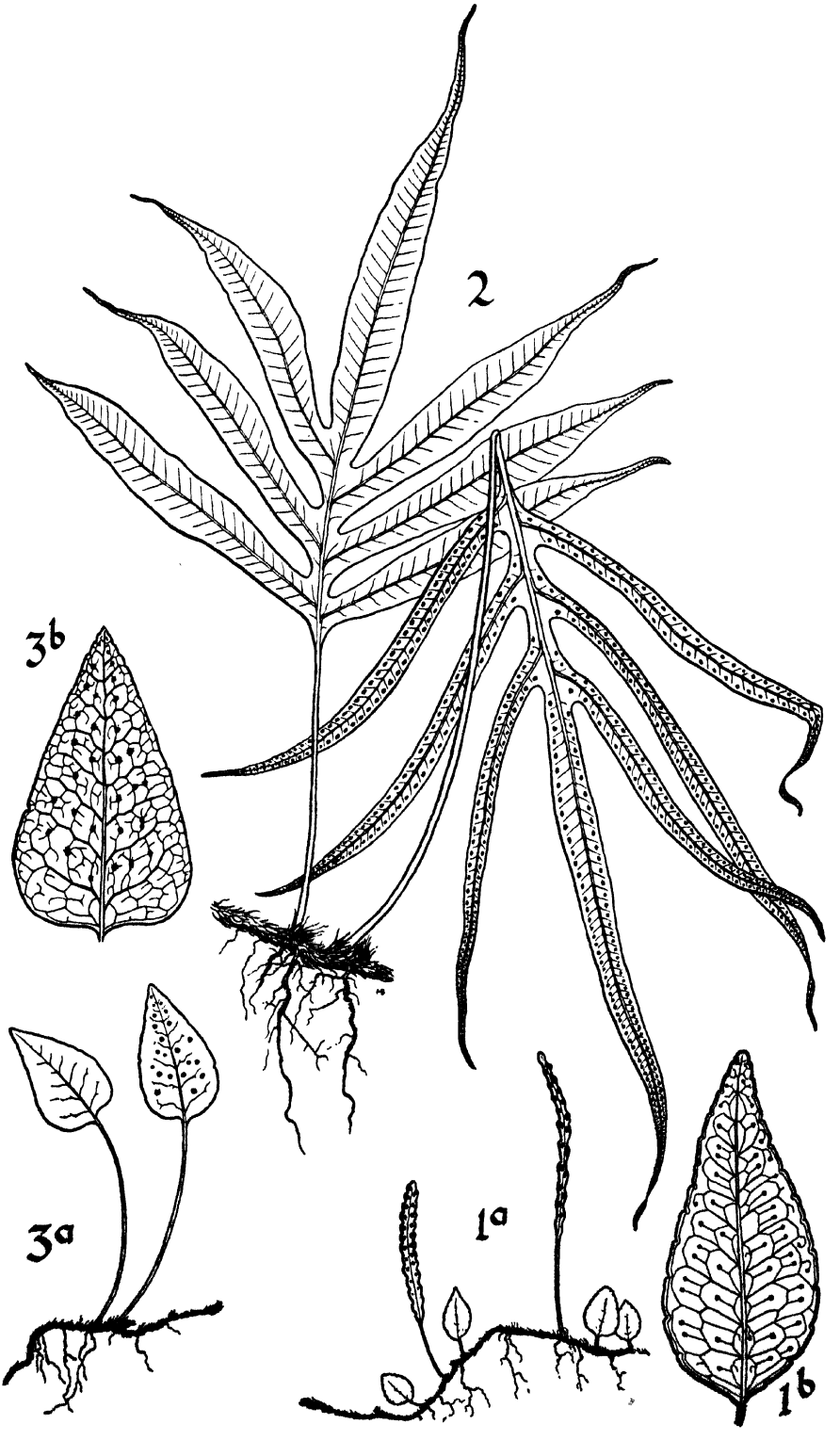
— PLATE VIII —

Crypsinus

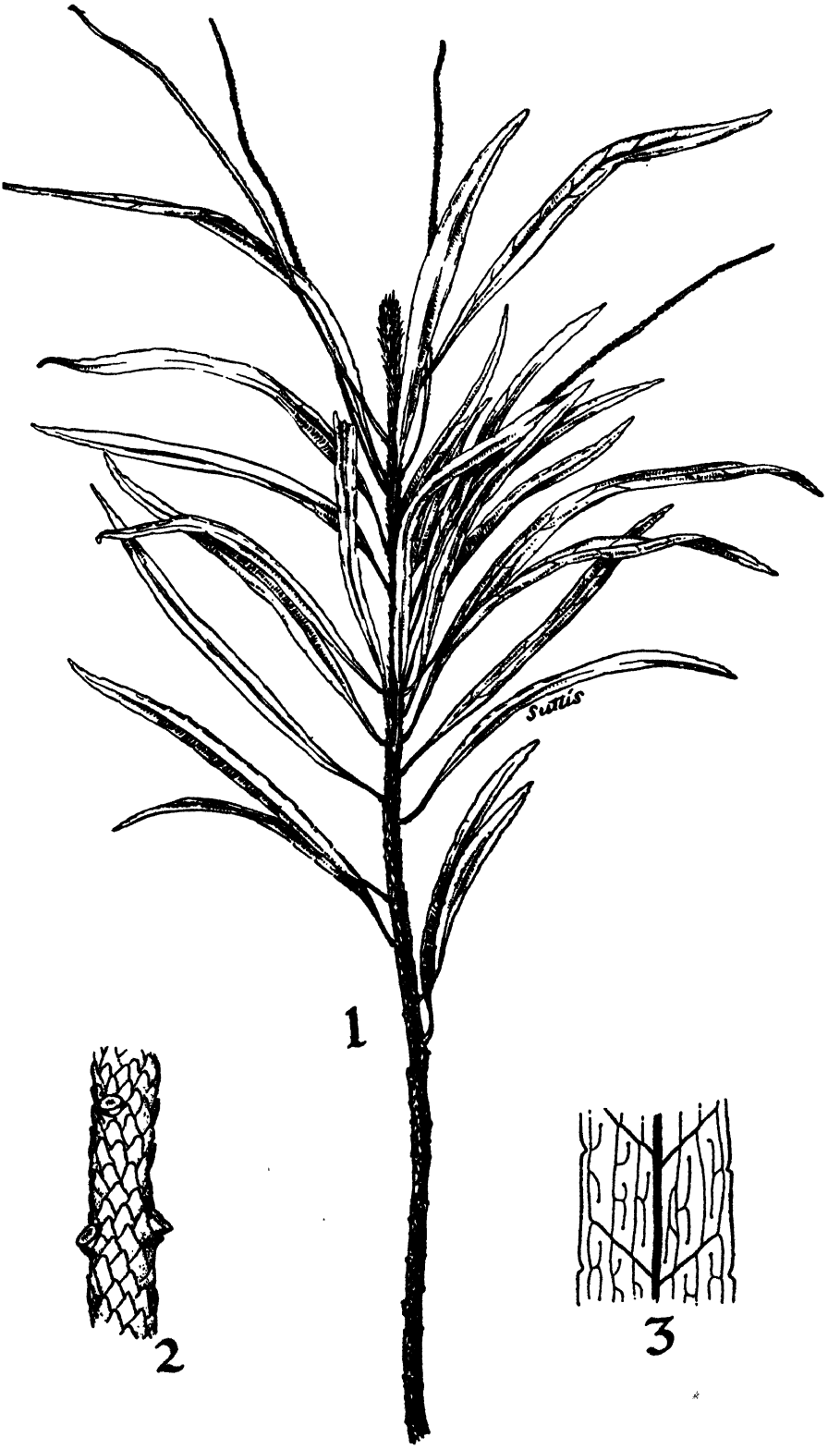
FIGURE 1 — **C. pyrolifolius** (Goldm.) Copel.
FIGURE 1a — Plant, × 0.35
FIGURE 1b — Sterile frond, × 2.0
FIGURE 2 — **C. taeniatus** (Sw.) Copel.
Plant, × 0.35
FIGURE 3 — **C. oodes** (Kunze) Copel.
FIGURE 3a — Plant, × 0.35
FIGURE 3b — Frond, × 1


2
3b
3a
1a
1b

— PLATE IX —

Oleandropsis ferrea (Brause) Copel.

FIGURE 1 — Plant, × 0.5
FIGURE 2 — Stem, × 2
FIGURE 3 — Venation, × 3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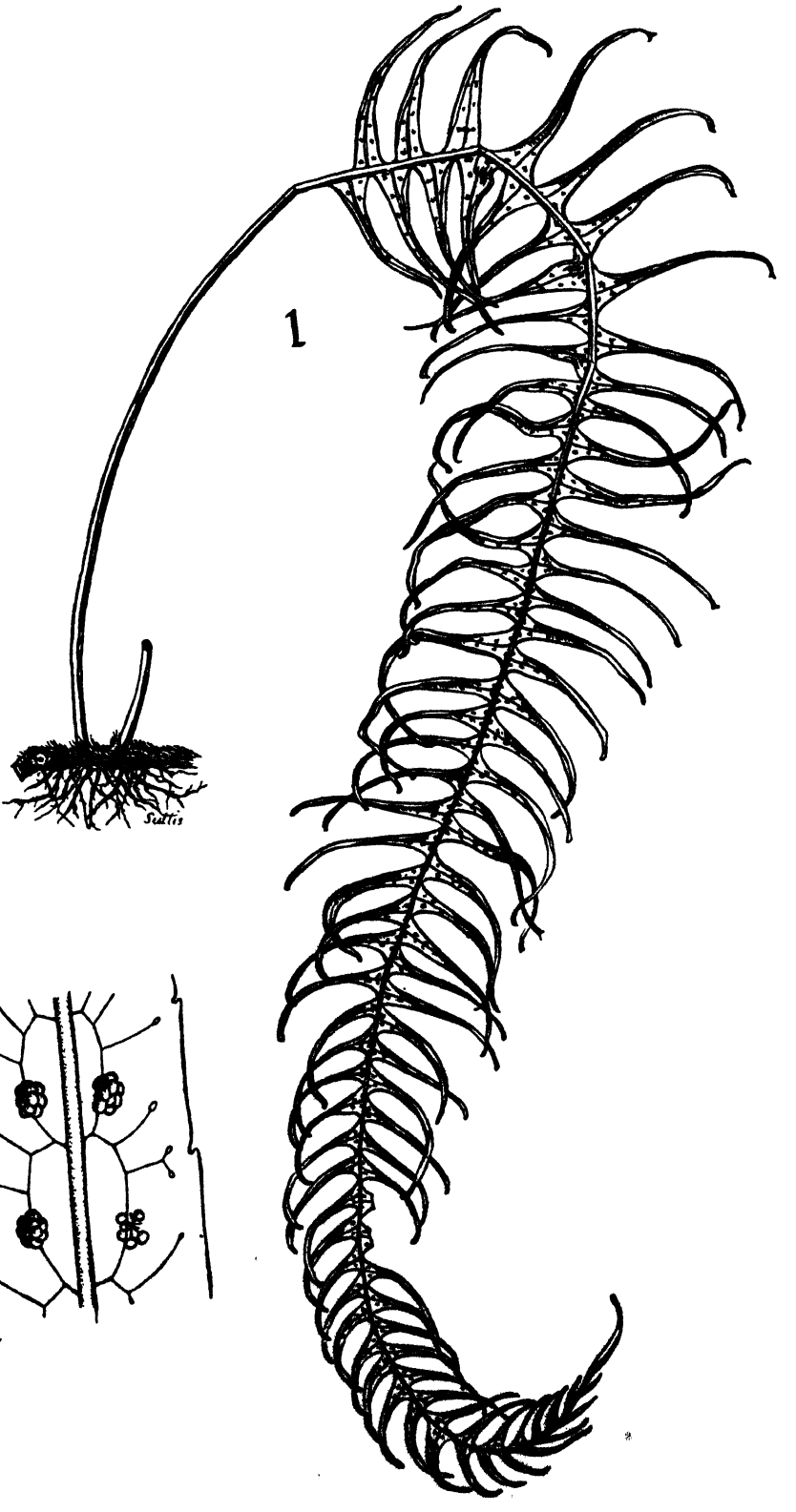
— PLATE X —

Polypodiopsis proavita Copel.

FIGURE 1 — Plant, × 0.5
FIGURE 2 — Venation and Sori, × 6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