

Notes on the Classification, History, and Geographical Distribution of Compositæ. By GEORGE BENTHAM, F.R.S., P.L.S.

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I. INTRODUCTION.

THE Compositæ are at once the largest, the most distinct, and the most uniform, and therefore the most natural, of all orders of Phænogamous plants. Nearly ten thousand known species are separated from each other by characters most of which are usually considered as only of secondary importance; and I cannot recall a single ambiguous species as to which there can be any hesitation in pronouncing whether it does or does not belong to the order. The very few cases where species have been erroneously referred to or excluded from it have been the result of conjectural determinations of imperfect specimens, or of gross ignorance on the part of the observer. The andrœcium, gynœcium, and fruit, as to all the essential characters of number of parts and relative position, the seed and its embryo in every particular, are absolutely uniform throughout the order; or in the very few cases of a slight variation (as, for instance, in the shape of the cotyledons) the differences are no more than specific, varying in one and the same small genus. To distribute, therefore, these ten thousand species into thirteen tribes and above seven hundred

and sixty genera, we are compelled to derive our characters from inflorescence and its rhachis and bracts, from the pappus or abnormal development of the rudimentary calyx, from the shape of the corolla, from sexual abortions, from appendages to the anthers, from the external form or appendages of the style-branches, and from very slight variations in the external form of the fruit, many of which, in other orders, are scarcely reckoned of more than specific value.

In Linnæus's artificial sexual system the sexual characters were necessarily taken as of primary importance, and the Compositæ, forming the chief portion of the class *Syngenesia*, are divided into four orders:—*Polygamia æqualis*, with all the flowers (or, as it is more convenient to call them, the florets) of each head hermaphrodite and fertile; *Polygamia superflua*, with the florets of the circumference female, those of the disk hermaphrodite, and all fertile; *Polygamia frustranea*, with the florets of the circumference barren, those of the disk hermaphrodite and fertile; and *Polygamia necessaria*, with the florets of the circumference female and fertile, those of the disk hermaphrodite but barren. To these Linnæus added a fifth order, which, notwithstanding its analogous name *Polygamia segregata*, is not founded on any sexual distinction, but on inflorescence only, being characterized by the numerous uniflorous heads crowded on a common receptacle.

Such an arrangement proved, however, to be purely artificial; the strikingly different groups, for instance, of the Hawkweeds and Thistles, are amalgamated with a few others with which they have evidently no other connexion than as members of the same family, into the first Linnean order; and notwithstanding the endeavours of most subsequent synantherologists to maintain as much as possible the value originally attached to these sexual distinctions, they have felt repeatedly compelled to unite into single or closely allied genera, species which would, on these Linnean principles, be distributed over most or all of his orders.

Jussieu and Ventenat, following up the ideas broached by Vaillant, considered the *Syngenesia polygamia* of Linnæus as a class, under the name of COMPOSITÆ, dividing it into three families or natural orders—*Cichoriaceæ*, *Cynarocephalæ*, and *Corymbiferæ*,—an arrangement which, up to the date of De Candolle's 'Prodromus,' was generally followed by the latter, as well as by most other French botanists—considering, however, the class as a natural order

under the Jussieuan name of *Compositæ*, and his three families as so many suborders, to which Lagasca and De Candolle added a fourth under the name of *Labiatifloræ*. Of these suborders the *Cichoriaceæ*, with the corollas all ligulate, have ever since maintained their ground as the most natural as well as the most accurately defined group in the whole order; the three others have been very variously modified or subdivided into tribes, none of which can as yet be considered as separated by any absolute characters.

Henri Cassini was the first who undertook a general revision and redistribution of *Compositæ*. Leaving the *Cichoriaceæ* undisturbed as a distinct tribe (changing the name, however, to *Lactuceæ*), he rearranged the great mass of tubuliflorous *Compositæ* upon new principles. His long series of articles, some of them first sketched out in the 'Bulletin des Sciences de la Société Philomathique,' were distributed over the sixty volumes of the 'Dictionnaire des Sciences Naturelles;' some of the more general ones collected in his 'Opuscules Botaniques;' the whole published between the years 1816 and 1834. These papers include a large number of very valuable observations, the result of the study of as many species as he could obtain in a living state, or could examine in the herbaria of Jussieu and others. He was the first to make use of the modifications of the style and anthers in the general systematic arrangement of the order; and he clearly exhibited the functions of the *collecting*, or, as he not inaptly terms them, *sweeping* hairs and papillæ (*poils collecteurs, poils balayeurs, papilles balayeuses* of Cassini, *Fegehaare* of Hildebrand). His table, or, rather, map, of the tribes (plate 1 of the 'Opuscules') shows a just appreciation of the natural affinities of the order, and of the principal groups of which it is composed, and in some respects, as in the tribe of *Inuleæ*, gives a better arrangement than those of Lessing and De Candolle. Unfortunately, however, in working out the details of the genera in the 'Dictionnaire,' he indulged in an enormous and useless multiplication of generic names, which only tended to throw the nomenclature into confusion, and cast a slur upon all his labours. Wherever he observed a slight difference in the involucre, pappus, or general aspect, or could not readily identify an imperfect specimen, an engraved figure, or a description often incorrect, he at once set it down as a new genus, and has thus, more than any other botanist of equal ability, overloaded the science with useless synonyms. So recklessly, indeed, did he give way to this mania of coining new names, that

he on many occasions proposed two, or even three, for the same genus, leaving future botanists to take their choice.

Robert Brown, in his memoir in the twelfth volume of our Transactions, with his usual accuracy, elucidated many obscure points in the structure and affinities of several genera of the order, here as elsewhere indicating even much more than he expressed in detail, but did not touch upon the general arrangement or distribution of the genera.

David Don, in the years 1828 to 1832, published in the Edinburgh New Philosophical Journal and other periodicals, as well as in our own Transactions, various monographic papers on Compositæ, chiefly on Cichoriaceæ and on South-American Mutisiaceæ and a few others. In his new genera he made use of some neglected characters derived from the venation of the corolla &c. but he seems to have consulted but very little the works of his predecessors, and to have been quite unaware of the important peculiarities of the style pointed out by Cassini.

Lessing, after some preliminary papers in the 'Linnæa,' published, in his 'Synopsis Generum Compositarum,' a new arrangement of the order, founded, still more than Cassini's, upon the modifications of the style, proposing many alterations in Cassini's groups, which cannot always be considered as improvements, except in so far as they resulted from a command of more ample materials. Cassini's tribes and subtribes are generally natural, although his genera are often species only. Lessing's tribes and subtribes are very technical, whilst the main characters are not always sufficiently absolute to give them the advantages of an artificial classification; and in his genera he often relies too much on the pappus, the variations of which are less in conformity with general differences than those of almost any other organ.

De Candolle, when he arrived at the Compositæ for the 'Prodromus,' had before him far more extensive collections than any of his predecessors. He had in former years worked out monographs of some portions of the order; and he now set to work, with his usual ardour and methodical mind, to the diagnosis and systematic arrangement of a mass of species nearly equal in number to those of the whole vegetable kingdom known in the days of Linnæus. But a severe attack of illness came on shortly after he had commenced; and on resuming work after the lapse of a couple of years, although his ardour and perseverance remained, he was no longer so well able to grapple with complicated difficulties.

He followed Lessing too closely where his own more perfect specimens might have shown errors; and in the numerous new genera he proposed, he, in too many cases, neglected the verification of the tribal characters which from their aspect he presumed them to possess. Thus it is that identical species, for instance, are not unfrequently repeated in different tribes, and that the most closely allied genera are often widely separated without cross references to indicate their connexion, the general result being that further researches have occasioned greater changes in proportion in this than in any other part of the 'Prodrômus.'

C. H. Schultz Bipontinus, devoting many years of his life exclusively to this order, considered himself, and was regarded by many others as the great synantherologist of his day; but he did not live to work out any general system. In his numerous detached papers he modified the circumscription of many genera, corrected errors, and consigned to print many valuable observations; but he seemed always too much in haste to bring out something new, to divide or to consolidate old genera, changing long lists of names of species of which he had only examined one or two, to alter upon slight grounds the scale of relative value previously given to generic characters, without, however, relinquishing the idea that there exists in nature such a scale possessing a high degree of fixity, and in general to affix his own stamp upon all future synantherological labours. Where he has taken time to work out his monographs in detail his observations have appeared to me reliable for their accuracy; but where he has proceeded hastily it is difficult to follow him. His determinations, for instance, of Mandon's Bolivian, of Riedel's and Langsdorff's Brazilian, of Liebmann's Mexican Compositæ are replete with misnomers. There are other points also in which either I cannot quite agree with him, or from which I should differ widely. His multiplication of species is sometimes carried very far. His reliance chiefly upon the form of the achene for generic distinctions is in some cases a great improvement, in others carried so far as to become purely artificial. I must agree with him in his high estimation of the labours of Cassini; but that does not appear a sufficient reason for adding one more to the numerous names already given to the order. Even for those who maintain that all natural orders must be named after some one of their genera, with the affix of *aceæ*, there is Lindley's name of *Asteraceæ*, which has the right of priority over that of *Cassiniaceæ* proposed by Schultz, besides that

the genus *Aster*, being so much better known and (slightly modified) so much more universally distributed than the little-known local genus *Cassinia*, is much better suited for a so-called ordinal type.

Of all the modern contributions to the study of Compositæ none are more important for the accuracy of observation and the due appreciation of characters and affinities than those of Asa Gray. His views (first exemplified in the 2nd volume of the 'Flora of North America,' further carried out in a long series of memoirs or detached papers on the Compositæ of various collections published in the 'Smithsonian Contributions,' in the reports of various American exploring or surveying expeditions, in the Proceedings of the American Academy, of the Boston Society, in Hooker's Journals of Botany, and other periodicals) may always be implicitly followed without any danger of being led into error, although sometimes a difference of opinion may exist upon such minor points as the generic or subgeneric value to be given to a group. The only real difficulty in his case arises from the dispersion of his papers in such a large number of publications, not always within reach of the generality of botanists, and some of which it is scarcely possible not to overlook.

There are many others whom I might mention as having contributed more or less beneficially or prejudicially to our knowledge of Compositæ; but that would require the enumeration of the greater number of modern systematic botanists. Compositæ are so easy to examine, that botanists of very little experience are readily led into the belief that they have mastered every thing relating to a specimen they are examining; and if they discover some point not quite agreeing with the technical characters of the genus it is presumed to belong to, they are at once ready to establish a new one; and there are few orders which have been so universally dabbled with, or where there have been so many repetitions of species, of genera, or of observations. The literature of *Hieracium* and of *Aster*, for instance, is almost, if not quite, as bulky as that of *Rubus* and of *Rosa*; and generally the synonyms of this part of our 'Genera Plantarum' are nearly twice as numerous as the adopted generic names.

There are, however, among the numerous more speculative naturalists whom the promulgation of the Darwinian theories have called into action, two who require notice as having specially taken up the subject of Compositæ with reference to those pro-

visions for cross fertilization originally pointed out by Cassini, and with more or less of recognition forming the basis of the systems of classification of Lessing and De Candolle, but more or less neglected or ignored by Don, by Schultz Bipontinus, and by most of the minor more specific synantherologists. Of the two theorists I allude to, Prof. F. Hildebrand, of Bonn, and Federigo Delpino, of Florence, the former has published, in the last volume of the 'Nova Acta Naturæ Curiosorum,' elaborate observations, accompanied by excellent illustrations, of the fecundating apparatus of thirty species of Compositæ belonging to most of the principal groups of the order. In the general considerations which follow, he endeavours to show that in Compositæ, at least, all observations indicate that unisexuality where it exists has proceeded from hermaphroditism, and that the primitive parent of the order had capitula consisting entirely of protandrous hermaphrodite florets—a conclusion which may be a correct one, but for which the data at hand are wonderfully few. The same writer has a paper in the last number of the 'Botanische Zeitung' on the means of dispersion supplied by the fruits of Compositæ, upon which I may have to make some observations when speaking of geographical distribution.

Delpino, in his 'Studi sopra un legnaggio anemofilo delle Composte,' amidst many shrewd and instructive observations on the dichogamic arrangements of Compositæ in the comparatively few species he has had the opportunity of studying, supplements them rather largely from the sources of imagination. Attaching the greatest importance to the Darwinian distinction he has on various occasions worked out, between *anemophilous* and *zoidiophilous* plants (those which effect cross fertilization by the agency of winds or by the agency of insects), he considers that evidence derived from this character alone is sufficient to prove descent and affinity, without taking into account the numerous cases alluded to by Darwin, and some of which are mentioned by Delpino himself in this very paper, where important variations in this respect occur in different species of one and the same genus. His genealogical tree of Artemisiaceæ, from Campanulaceæ down to *Xanthium spinosum*, his statements, as proved facts, that Campanulaceæ transmitted hermaphroditism through Lobeliaceæ to their descendants the Compositæ, that Compositæ inherited proterandry from Lobeliaceæ, but acquired in many cases unisexuality during subsequent generations, are mere conjectures. So in pro-

posing his tribe of *Artemisiaceæ* to include *Ambrosiæ* and exclude *Tanaceteæ*, a tribe which he characterizes as irrefutably natural, it appears to me that by relying for it solely on one character (the anemophilous fertilization) his classification becomes as artificial as when Linnæus relies solely on the repartition of the sexes, Lessing on the shape of the style-branches, Schultz Bipontinus on the shape of the achene, or others on the pappus alone. As to his idea that heterogamous capitula with fertile female ray-florets and sterile disk-florets may be regarded as simple hermaphrodite proterogynous flowers descended from inflorescences of proterandrous flowers, this is surely but little more than a play upon words.

With regard to the part I have myself taken in the elaboration of this great order, I may observe that, long before I was called upon to undertake it for our 'Genera Plantarum,' I had had repeated occasion to test the value of the labours of my predecessors, and for various publications had examined in detail the *Compositæ* of Europe, of British Guiana, of tropical Africa, of China and allied Indian forms, and especially of Australia; and I have now, with the aid of the rich stores and extensive library collected together at Kew, and liberal assistance in the way of loan of specimens or notes on typical specimens in Continental herbaria, communicated by my friends M. Decaisne and M. Cosson of Paris, Dr. Ascherson of Berlin, and Dr. Fenzl of Vienna, been enabled to examine specimens and compare the original descriptions of an immense majority of the published genera, subgenera, or sections, as well as of numerous species which have been supposed to present some anomaly, or which by their aspect seemed to suggest some peculiarities which might affect the generic character. Notwithstanding, however, the lengthened period which I have devoted to this tedious labour, I feel that there is yet much left to be done to future synantherologists who can undertake throughout a specific monograph, such as I have only been able to do with regard to the *Compositæ* of some countries or of a limited number of genera. There are also certain characters, and some of them evidently important, which our herbarium specimens often do not supply. Perfectly ripe achenes are often wanting in whole genera; and microscopical characters, such as the form of the pollen, upon which much stress has been laid of late years, have been observed in too small a number of species to ascertain their real connexion with general affinity. In

general my chief labour has been the testing and verifying or reconciling the observations of others, although this has always been preceded by the examination of specimens and drawing up my own generic character, afterwards modifying it when necessary in points elicited by others which I had at first overlooked. The principal changes I have proposed in the general methods of Lessing and De Candolle were determined upon and worked out long before I was aware that they were in a great measure a return to that of Cassini. The confusion which his multiplication of names had produced, and the unusual terminology of his descriptions, had excited in my mind a prejudice against him, until, after completing my work of detail, I came to study his generalizations, which showed how much better his views of affinities coincided with mine than those of his successors; and I have since had the satisfaction to learn that the principal of these changes I have made have also met with the approval of such careful observers as Asa Gray and Ed. Boissier. It is scarcely necessary to add that in this, as in other parts of our 'Genera Plantarum,' any important changes which either Dr. Hooker or myself have proposed in the orders we have respectively undertaken, have always been after consultation and in concert with the other.

II. COMPARATIVE VALUE OF GENERIC CHARACTERS.

Before entering into a general outline of the main divisions we have adopted, some explanation is required of the principles upon which we have conformed to or departed from the systems of our predecessors; we must form to ourselves some idea of the comparative value of the various characters put forward by different synantherologists; and for this purpose it will be necessary severally to consider them in some detail. We may take them in the following order:—1. Sexual differences; 2. Di- and trimorphism; 3. differences in the Pistil, 4. in the Fruit, 5. in the Andrœcium, 6. in the Corolla, 7. in the Calyx, 8. in the ultimate Inflorescence and bracts (*i. e.* in the capitulum and its receptacle, involucre, and paleæ), 9. in Foliage, 10. in Habit, stature, and general inflorescence, and, 11. in Geographical distribution.

1. *Sexual Differences.*

Characters derived from this source were, as already observed, considered of the highest importance by Linnæus, who founded on them his primary divisions of the order. Subsequent systematists have gradually placed them lower in the scale, but yet

have, generally speaking, regarded them as absolute for the distinction of genera. Schultz Bipontinus, however, in some of his later generic changes, has shown a disposition to neglect them, apparently from having observed their little accordance in certain cases with generic groups he was disposed to form on other grounds. But I have been unable to ascertain how far he generalized this degradation of the character. My own observations would lead me to conclude that, like other characters, sexuality varies in value in different tribes and in different genera, in a few cases absolute even in tribes, often of considerable importance in genera, but often also specific only, or at most available for sections or artificial groups of species.

These sexual differences relate to those of the individual flowers or florets within the head, and those of the flower-heads taken generally.

With regard to the individual florets, it is usual to distinguish four kinds—hermaphrodite, male, female, and neuter; but the sterility of the pistil is often so uncertain or variable in the anther-bearing flowers, in which it is never absolutely deficient, that I have found it much more convenient to designate as *hermaphrodite* all florets having perfect anthers, whether their pistil be susceptible of fertilization or not, distinguishing them as fertile or sterile—and as *female* all florets in which the anthers are abortive or deficient and the style is present; the neuter florets, reduced to a corolla with a rudimentary scarcely distinct ovary, might be classed in the same category as the females, as the abortion of the style is sometimes gradual or uncertain. Thus reducing the kinds of florets to two when both occur in the same head, the hermaphrodite ones invariably occupy the centre, the females being placed in one or more concentric rows in the circumference. Nuttall had indeed published a genus which he characterized from the supposed singular inversion of this position, the females being, as he believed, in the centre, surrounded by males, and gave it, therefore, the name of *Parastrephia*; but upon inspecting the original specimen in Nuttall's herbarium (a mere fragment gathered by Curson near Arequipa) it appeared to me that he had been deceived by some degree of unisexuality in the flower-heads, some having nearly or perhaps all the florets female and therefore central as well as circumferential, whilst one of the heads appeared to be entirely hermaphrodite. There are not heads enough on the specimen to verify the fact; but I at

once recognized the plant as one of which we have good specimens from the same locality, and which Meyen placed in *Baccharis* (*B. phyllicæformis*, Meyen) on account of its general affinity, but which Walpers *invita natura* transferred to *Vernonia* on account of the pappus. In these specimens the relative position of the hermaphrodite and female flowers is normal, although Nuttall's genus can be sustained as distinct from *Baccharis* on other grounds. Sterility may be more or less perfect either in the central florets, extending outwards more or less to the greater portion or to the whole of the hermaphrodite ones, or in the female florets, but extending never, as far as I am aware, within the outermost row; or, in one and the same head, both the outer female and the innermost of the hermaphrodite florets may be sterile.

In three of the principal tribes, Vernoniaceæ, Eupatoriaceæ, and Cichoriaceæ, uniform hermaphroditism of the florets is, I believe, quite constant, and the sterility of any of them (other than accidental) very rare and exceptional. So far, therefore, Linnæus's order of Polygamia æqualis is maintainable, the presence of any female florets at once excluding from either of these tribes any plant supposed to belong to them; but the character goes no further as a tribal one. In Cynaroideæ an outer row of female or neutral florets occurs in a few genera, but is not constant even in the same genus; in Mutisiaceæ it is more frequent and more constant. In the remaining eight orders the presence of one or more rows of female florets is the rule, but with exceptions, sometimes in single species of large genera where it is usually constant, sometimes in the majority of species or in whole genera, and in two subtribes of Inuloideæ very prevalent or quite constant. In all these cases we are therefore obliged to be very cautious in making use of the homogamous or heterogamous flower-heads as an absolute generic distinction. Still less value can usually be attached to the sterility of the inner or outer florets, although in some cases it appears to be positively generic or even subtribual. The central hermaphrodite and outermost female row of florets are constantly sterile in some Calendulaceæ, all the hermaphrodite florets constantly sterile in the subtribes Milleriæ, Melampodiæ, and Ambrosiæ, of Helianthoideæ, and in some genera of other subtribes or tribes; in other genera the greater or less sterility of the central florets is of no more than specific value. The sterility of the circumferential florets (reduced in that case

to a corolla with a rudimentary or small abortive ovary without style or stamens, and therefore called neuter) has been considered by many synantherologists an absolute generic indication; and although now generally abandoned in the case of the enlarged neutral florets of some Cynaroideæ, it has been strictly adhered to by Lessing, De Candolle, and others in the case of Asteroideæ, Helianthoideæ, and others with radiate flower-heads. But in many genera it appears to establish a purely artificial distinction; it separates from large and natural genera a few species or a single one without any other peculiarity but what every one admits is purely specific; and besides it is in these cases not always strictly constant. I would therefore, with Schultz Bipontinus, reunite *Galatella* with *Aster*, *Delucia* with *Bidens*, *Leptosyne* and others with *Coreopsis*. In some Helianthoideæ, however, it prevails through so large a number of species, otherwise evidently congeners, that I have adopted it among the essential generic characters of *Helianthus*, *Viguiera*, *Tithonia*, *Oyedæa*, *Gymnolomia*, *Rudbeckia*, &c.—and even as the sole generic distinction between *Aspilia* and *Wedelia*, *Actinomeris* and *Verbesina*—but more as a matter of convenience than of conformity to nature, in large groups of species where no better principle of subdivision has yet been proposed. This sterility of the ray-florets is yet more constant in the majority of the genera of the tribe Arctotideæ, though here, again, there are a few, such as *Arctotis* itself, where they are fertile.

Unisexuality of flower-heads is sometimes a constant generic or subtribual character; the heads are, for instance, constantly monœcious in Ambrosiæ, constantly diœcious in Petrobiæ, Tarchonantheæ, *Baccharis*, *Lycoseris*, *Moquinia*, &c. In these cases the male heads always consist of hermaphrodite sterile florets, with the anthers perfect, the style always present, but the ovary abortive and usually reduced to a mere rudiment; in the female heads the pistil is perfect, the anthers often present, but free and without pollen, or reduced to small rudiments or entirely deficient. In several Inuloideæ (Plucheineæ or Gnaphalieæ) the unisexuality of the flower-heads is less perfect and more inconstant, the male heads having occasionally a few female fertile florets in the circumference, the females one, two, or more hermaphrodite and sterile ones in the centre, and the proportions varying sometimes from species to species or from individual to individual.

2. *Di- and Trimorphism.*

Di- and trimorphism in individual florets is usually connected with unisexuality, the female corollas being either more slender than the hermaphrodite, or with a more expanded irregular or ligulate limb, or those of the outer rows ligulate and of the inner rows slender; or they may be reduced to a mere rudiment or entirely wanting; and the pappus may also differ, that of the female florets being often reduced from that of the hermaphrodites or entirely wanting; but the value of these differences is usually no greater than as an indication of sexuality. The reduction or alteration of the pappus in the female florets, so often taken advantage of as a generic distinction, very frequently produces a purely artificial separation of a very few or of a single species from a genus otherwise natural, and is now generally abandoned by A. Gray and others. On the other hand, with regard to dimorphism in the corollas, although the presence or absence of female florets is often not even of generic value, the form they assume when present, whether tubular like the hermaphrodites but more slender, or ligulate, is sometimes of subtribual importance, as in the case of the separation of the last four subtribes of Inuloideæ from the first six, of which this is one of the principal characters. In unisexual flower-heads the female corollas are always more or less reduced, never having the expanded or ligulate limbs so frequently observed in heterogamous heads.

Dimorphism in the flower-heads independent of the sexes is very rare in Compositæ, and, as far as hitherto observed, only of specific value. Linnæus had already informed us that in *Gerbera (Anandria) bellidiastrum* the vernal flower-heads are heterogamous and radiate, and the autumnal ones homogamous and discoid; and analogous dimorphisms have since been observed in a very few scattered species. Delpino has also observed a certain degree of dimorphism in the female flower-heads of two species of *Franseria*, which on that account he establishes as two distinct genera—a separation in which it is very difficult to concur.

3. *Differences in the Pistil.*

The ovary and ovule, as to their structure, insertion, position, and other relations to other parts of the flower, are absolutely uniform throughout the order, and afford no clue to generic or tribual distinctions. Nor is the style itself more available in the case of the female florets, where its sole functions are those de-

volving upon it as a portion of the female organ—the receiving the pollen and conveying it to the ovary. These styles of the female florets are uniformly divided into two equal more or less stigmatic branches, glabrous without and papillose inside, which may occasionally vary in length or thickness, but only slightly so, and very rarely, as far as I have been able to observe, so as to give any but a very slight generic clue. It is the style of the hermaphrodite florets, in its usually principal and often sole function of sweeping the pollen out of the antheral tube, that presents those external differences which by Lessing and De Candolle have been taken as absolute tribal characters, and which are in fact, generally speaking, important and useful, but which are also liable to numerous exceptions. As an instance of the confusion resulting from the use made of this character, I may point out that in the illustrations of the styles of eight of the principal tribes given in Lindley's 'Vegetable Kingdom,' p. 703, two (n. 2 and 3) have not the forms characteristic of the tribes they represent, and, indeed, are taken from genera which, although included by De Candolle in Eupatoriaceæ and Asteroideæ respectively, have been erroneously there placed, whilst three others (n. 5, 6, and 7) are far from being typical of the majority of their cotribuals.

Referring to the diagrams which I have here given, Plate X., there is no doubt that the styles of the large genera *Vernonia* (fig. 2), *Eupatorium* (fig. 3), *Aster* (fig. 4), *Senecio* (fig. 6), and *Carduus* (fig. 8) are prevalent also in a considerable number of genera closely connected with them on other accounts; but, on the other hand, some of these forms are to be met with in genera naturally far removed from them, or are not in closely allied genera, or, again, are so connected with each other by intermediate forms as to render them in some cases useless even as artificial characters.

The *Vernonia* style (fig. 2), with its long, slender, almost acute branches, nearly equally hirsute throughout, with the stigmatic series scarcely prominent on the inner surface towards the base, is, I believe, constant in the 35 genera and near 500 species of the tribe; but it is also to be met with in a few genera which on every other account must be placed either in Asteroideæ (e. g. *Chrysopsis*), in Inuloideæ, or in Senecionideæ (e. g. *Liabum* and *Gynura*). The *Eupatorium* style (fig. 3), with long, obtuse or club-shaped branches only minutely papillose instead of being hirsute, but with the slightly conspicuous stigmatic series of

Vernoniaceæ, is not only constant in the tribe of 33 genera and above 700 species (although slightly modified in *Mikania*, where it is less obtuse and more slender), but is also, I believe, exclusive, or there is only a slight approach to it in a few Inuloideæ or Mutisiaceæ. The *Asteroid* style (fig. 4), with flattened branches, the marginal stigmatic series very prominent but not reaching the extremity, which consists of a so-called appendage, long or short, broad or narrow, acute or obtuse, and papillose or shortly hirsute all over, is very prevalent in the tribe as now limited; but occasionally the appendage is so short as to bring the style nearly to that of the Senecionideæ or of the Inuloideæ, and sometimes a truly *Asteroid* style, as well as numerous approaches to it, may be observed in various genera of Helianthoideæ, Helenioideæ, and Senecionideæ. The *Inula* style (fig. 7), with the stigmatic series reaching to the end of the branches, or nearly so, without appendages as in *Senecio*, but the branches rounded, not truncate, at the end, prevails in several subtribes of Inuloideæ, but in others passes into the true *Senecio* style. It is also to be occasionally met with in Arctotideæ and Mutisiaceæ, as well as in genera closely allied to *Senecio*. The *Senecio* style (fig. 6) has flattened branches like that of *Aster*, but narrower and usually recurved; and the stigmatic series reach the extremity, which is truncate and fringed with hairs. This style is uniform in nearly the whole of the 900 species of *Senecio* and in several allied genera; but even in *Senecio* itself the extremities of the branches are occasionally rounded, or form an exceedingly short appendage (in this tribe called cone), which, in other genera very closely allied to *Senecio*, lengthens out (as in fig. 5) even into the *Vernonia* form (fig. 2), the stigmatic series also gradually becoming less conspicuous; and the true *Senecio* style is observable in numerous genera which on other accounts must be placed in Inuloideæ, Helianthoideæ, Helenioideæ, Anthemideæ, or Mutisiaceæ (Nassavieæ). The *Carduus* style (fig. 8), with a so-called articulation or change of texture, and abrupt thickening or ring of hairs, above the middle, at or usually much below the branching, the branches, if long, erect, but usually very short and erect or spreading, is general, but not universal, in Cynaroideæ, and is also observable in some genera of Mutisiaceæ and Arctotideæ. In all tribes which admit of central sterile hermaphrodite florets (Asteroideæ, Inuloideæ, Helianthoideæ, Helenioideæ, Anthemideæ, Senecionideæ, Calendulaceæ, and Arctotideæ) the styles of these sterile florets are for the most part filiform or slightly clavate,

undivided or with slender erect branches, very papillose or hirsute outside, without stigmatic series inside, and very similar in all the different tribes where they occur. The Cichoriaceous style (fig. 1), with slender, almost filiform, papillose branches, varying but slightly in being more or less acute or obtuse, and very rarely somewhat shortened and flattened, is uniform in the tribe, but is also precisely the one most general in the female florets of the order.

To recapitulate, the style-branches of the hermaphrodite florets afford one of the most useful characters for the determination of genera and some tribes; but all attempts to take it as absolute have hitherto miserably failed, and it must always be considered in combination with other characters.

An increase in the number of style-branches from two to three has been occasionally observed, but appears never to be even of specific importance; for I have met with it in genera otherwise far removed from each other, and never found it to be constant in all the flowers of the same specimen.

The epigynous disk has been much made use of for the distinction of genera, by a few botanists who have specially studied a small number of Composite forms. When present it varies much in form: generally speaking, it is a fleshy or glandular, thick, annular projection round the base of the style, either free from it or more or less connected with it, and passing, as it were, into a bulbiform base to the style itself, besides other modifications. In some *Centaureæ*, for instance, it forms a membranous or paleaceous 5-toothed cup or tube, having the appearance of an inner pappus; in many genera there is no trace of it. I had formerly, in concurrence with Steetz, Schultz Bipontinus, and others, thought that these differences might be useful at least for generic distinction; but when I came to observe it in several large natural genera, I found it so variable, that I felt compelled to omit it from the generic characters whilst unable to verify it in every species. Delpino connects the presence or absence of the epigynous disk with the entomophilous or anemophilous character of the fertilization; and he may be right, although the observations hitherto made are far too few to assume such to be the case; and even if it be so, the character seems of comparatively inferior systematic value, entomophilous and anemophilous fertilization occurring sometimes, in Compositæ as in other orders, in plants otherwise closely allied—as well stated by Delpino in the above-quoted pamphlet, p. 34, almost in contradiction to the generic and even tribal importance he attaches to the character in the same memoir.

4. *Differences in the Fruit, i. e. in the Achene and its Pappus.*

The fruit, which in many large and natural orders, such as Leguminosæ, Umbelliferæ, Rubiaceæ, Myrtaceæ, &c., has furnished many valuable characters for the distinction of genera or tribes, has naturally been looked to for similar purposes in Compositæ; and Schultz Bipontinus, for instance, has prided himself on establishing his genera on carpological principles. But throughout this vast order, so far as the achene itself is concerned, the structure is absolutely the same; there remain only outward form and consistence, which, however useful in the case of many genera, are, if too closely relied upon, apt in Compositæ, as in Leguminosæ and others, to break up very natural genera, especially when the modifications are the result of development in the course of growth from the ovary, and not discernible at the period of fertilization of the flower. The achene (always without its pappus) is very rarely of any use in determining the tribe of a Composite plant, beyond a few vague forms appreciable perhaps to the eye, though difficult to describe, which are only to be found in some one or two of the thirteen tribes; and, moreover, there are so large a number of species in which the ripe fully formed achene is as yet unknown, that its absolute value in large genera where it is usually so uniform, such as *Vernonia*, *Aster*, *Senecio*, &c., is as yet very doubtful. Outward form, however, when ripe achenes are obtainable, is so prominent a character that much use has been made of it, and often to great advantage, in the definition of genera otherwise natural, and sometimes for that of subtribes or smaller groups of genera.

The principal modifications are:—(1) the shape acquired in lateral development, (2) in longitudinal development, (3) the development of the ribs, (4) the consistence, (5) the surface and indumentum.

In lateral development the achene as it ripens becomes angular, terete, or flattened, with a considerable degree of constancy in genera or even in subtribes, although in some cases, where it has been the most relied upon for the separation of large nearly allied genera (as in Asteroideæ, for instance), there are usually a few exceptional or intermediate species which forbid any absolute reliance upon it. When flattened it becomes important, as in Umbelliferæ, to consider whether the flattening is lateral (that is, in the direction of the radius of the flower-head) or dorsal (that is, at right angles to the radius); this forms a good distinction, for instance, between the subtribes Verbesineæ and Coreopsidæ of Helianthoideæ. This character, however, applies only to the achenes of the disk; those of the outer row, even when the others are laterally

flattened, are often dorsally so, or, if the inner edge protrudes, they become triquetrous.

In longitudinal development the achene is either equally grown at both ends, so as (if terete) to form a regular cylinder, or tapers at the upper end beyond the seed into what was formerly called a stipes to the pappus, but is now recognized as a neck or beak to the achene, or tapers at the lower end into more or less of a stipes, all which forms variously combined, being readily observed (if ripe achenes are obtained), have been made great use of in the fixation of genera or even of subtribes, especially in Cichoriaceæ; but one of the most prominent differences, between the achene merely contracted at the top, and the distinctly beaked achene, has now been generally abandoned in such genera as *Crepis*, *Leontodon*, &c., where there occurs every grade from the one to the other; and in many genera, of which it is still the most marked character, it is necessary to be very cautious in its use.

The development of the ribs of the achene would at first sight seem to hold the same position in the classification of Compositæ as in that of Umbelliferæ, the ribs being precisely of the same nature; they represent the ribs or nerves of the calycine leaves which form the adnate calyx-tube; their systematic value, however, is more varied in Compositæ than in Umbelliferæ. These ribs are equal to the number of the calycine leaves (usually 5, or sometimes 4) when the primary nerve alone or midrib of each leaf is prominent, double that number when an intermediate rib is formed between each two by the combination of the lateral nerves of each two adjoining calycine leaves, three times (15-12) if these lateral nerves are separately developed, four or more times if four or more parallel veins are developed from each leaf. This distinction between the development and non-development of the secondary ribs has been found constant, as far as hitherto observed, for the separation of the two principal subtribes of Eupatoriaceæ, but has quite failed, even for genera, in Vernoniaceæ. In other cases the reduction of the ribs to the two marginal ones of flattened achenes, the protrusion of one, two, three, or more of the primary ribs into acute angles, or their expansion into wings, or their regular equidistance, or the contraction of some of the intervals between them, are often the characters of good genera, but have in many instances (as in *Chrysanthemum*) been too much relied upon, producing generic combinations or disseverances far from natural.

The consistence of the ripe achene is occasionally, but rarely,

useful as a generic character. The thick achene, whether hard and bony or fleshy, is only to be met with in Cynaroideæ, Arctotideæ, Calendulaceæ (*Osteospermum*), and a few Helianthoideæ; but even there, although pretty constant in genera, is unavailable for tribal or even subtribal distinctions. The pericarp is never, I believe, truly crustaceous and fragile, but from the ordinary consistence it passes in a few genera into thinly membranous. The smooth pitted or muricate surface has been made use of in the case of some Cichoriaceæ especially, but cannot be implicitly relied on. In some genera of Helianthoideæ, for instance, as also in *Villanova*, *Adenostemma*, *Brachycome*, and some others, strongly muricate and perfectly smooth achenes are met with in different capitula of the same specimen, or proceeding from different florets of one and the same capitulum. The difference between the densely silky-hairy and the glabrous or slightly hirsute achene, and in some cases the woolly indumentum, has been found a good generic character in some Helenioideæ, Cynaroideæ, Arctotideæ, Mutisiaceæ, and Cichoriaceæ.

The pappus may be best considered under the head of the fruit; for although homologically it is generally admitted to be an altered or semiabortive calyx-limb, and although when present it is always already to be met with at the time of flowering, yet it is on the ripe achene that it has attained its fullest development in those innumerable variations which strike the eye of the most superficial observer, and which have been eagerly seized upon to characterize a large proportion of the thousand and one petty genera with which synantherology has been encumbered. Constant or nearly so in each species, with very few exceptions, the pappus will often, in a most natural genus, so vary from species to species, as to make it a most difficult task to decide whether it should be neglected altogether, or, if taken into account, what modifications may be taken as generic, subtribal, or tribal.

The presence or absence of a pappus or its degree of development is always of much less importance than its nature when present; for there are frequently exceptional species or varieties where it is wanting in genera or species where it is usually present; and therefore it is, that where we have a specimen with no pappus, we must be very careful to determine its affinities by other characters. In some cases, however, the absence of pappus has proved a really constant generic character, and is often a clue at least to the tribe of a Composite. It is, for instance, almost

always present in Senecionidæ, and very frequently deficient in Anthemideæ. There is not, however, a single tribe in which there is not at least one genus deprived of all pappus.

Among the various peculiarities by which the pappus is diversified, it is a very difficult question to determine which are and which are not of importance in classification, whether we reason *à priori* from the presumed homology and functions of the organ, or whether we confine ourselves to the experience of its conformity or non-conformity to variations of other organs. As a general rule, the greater the consolidation and contraction of the inner and more important floral organs, and the more the outer comparatively vegetative organs are called in to assist in some part of the reproductive functions, the more constant and important in classification are the latter. In Compositæ we have alluded to the great condensation of the floral organs; and, amongst other reductions, the calyx-limb, in the form of a pappus, appears to have its functions annihilated or confined to the sole purpose of assisting in the dissemination of the seed, whilst its ordinary part of protecting the young flower is here supplied by the bracts collected in an involucre. The modifications under which this pappus is acted on by wind, or adheres to extraneous substances, ought therefore to be systematically important, as well as those which are indications of its homologies. On the other hand, the pappus being in so many cases a very much reduced or rudimentary organ, those differences depending on the degree of development must, as in the case of other rudimentary organs, be very little relied on.

Of these modifications, we may first consider the indications of homologies. If the pappus is a reduced calyx-limb, then in all cases where it consists of a single ring of bristles or paleæ it is easy to suppose that these may represent the parallel veins, nerves, or ribs of the calyx-lobes or calycine leaves—more especially as they, or at least the most valid among their number, often correspond in number, and are even in direct continuation of the ribs of the achene; but where these bristles are very numerous and crowded in a dense tuft, scarcely separable into series, or where they form several concentric series, very distinct from each other and often differing in nature, their homology is not so easy to settle. Most probably the longest or principal series represent the calyx-ribs, which may sometimes, owing to their great number and crowded state, become forced, as it were, into two or

three apparent series, when they are organically in a single one ; and these, therefore, should be taken chiefly into account in using the pappus as a systematic character. The gradually diminishing outer rows, so much less constant in their presence, absence, shape, or degree of development than the principal row, may be analogous only to those extra teeth or appendages of some *Melastomaceæ*, *Verbenaceæ*, &c., which have been called epicalyces. The occasionally present reduced innermost row (as in some *Centaureas*), which, as above mentioned, may be only a modification of the epigynous disk, is of scarcely more than specific value.

The four principal modifications of the pappus which may be made available in the tribal characters are:—1, the *setose* pappus, where the ring consists of a number, often indefinite, of bristle-like rays, sometimes very slender and hair-like, sometimes thicker or flattened and passing into paleæ; 2, the *paleaceous* pappus, consisting of a usually smaller and often definite number of flattened chaff-like or transparent scales; 3, the *aristiform* pappus, where one, two, three, or more of the ribs of the achene are produced into rigid awns or teeth; and, 4, the *coroniform* pappus, where the very short paleæ are united in a ring or cup. These different forms give very useful and general characters without being absolute; for in every tribe there are exceptions to the normal pappus, besides that the different forms may pass so gradually one into the other as to make it difficult to decide to which class a given pappus should be referred. The paleæ may be very obtuse or produced into a point which may lengthen into an awn, whilst the flattened base may gradually shorten or be obliterated, or the paleæ may gradually increase in number and diminish in breadth, till they come better under the designation of setæ, or they may gradually shorten and unite more or less into a corona. Generally speaking, the pappus may be said to be setose or slightly paleaceous in *Vernoniaceæ*, *Eupatoriaceæ*, *Asteroideæ*, and most subtribes of *Inuloideæ*; aristiform or truly paleaceous in the subtribe *Buphthalmeæ* of *Inuloideæ* and in *Helianthoideæ*, paleaceous in *Helenioideæ*, coroniform or none in *Anthemideæ*, setose again in *Senecionideæ*, none in *Calendulaceæ*, paleaceous or none in *Arctotideæ*, setose or slightly paleaceous and usually very copious in *Cynaroideæ*, setose or paleaceous in *Mutisiaceæ* and *Cichoriaceæ*. In all tribes there are a few genera or species, and in *Asteroideæ*, *Inuloideæ*, *Helianthoideæ*, and *Helenioideæ* several genera without any pappus; and in almost all tribes there are a

very few striking exceptions to the normal form, although perhaps specific only.

Of the further modifications of the pappus, there is one upon which great stress is often laid, as being of supposed absolute generic importance—the difference between the simply setose (where the setæ are denticulate or scabrous only) and the plumose (where the setæ are bordered by fine cilia like the plumes of a feather). But the value of this character has been much overrated. The plumose pappus occurs most frequently in Cichoriaceæ, Mutisiaceæ, and Cynaroideæ; in the two former tribes it is often constant in otherwise good genera; in Cynaroideæ it is also not uncommon, but rarely accompanied by other marked differences; it is little more than a specific character in *Onopordon*, *Jurinea*, *Tricholepis*, *Centaurea*, &c.; and if we have maintained it for the technical separation of *Cnicus* from *Carduus*, it is partly from convenience, on account of the large number of species it separates—partly on geographical grounds; for the American species, which are now numerous and pass into a distinct type in other respects, have always the pappus plumose. In the other tribes the plumose pappus is rare, occasionally constant in small but natural genera, in other instances passing gradually through allied species into the simply setose. The difference is indeed but one of degree; the lateral denticulations or cilia are always the same in relative position. When they are shorter than the diameter of the pappus-ray or main seta, the latter is termed simply scabrous or denticulate, when they shortly exceed that diameter it is said to be barbellate, and plumose only when they are considerably longer. The intermediate barbellate stage, however, is much more rare than the simply denticulate or the decidedly plumose state.

Another distinction often of some importance, and much insisted upon of late, especially by Weddell, is, in those very frequent cases where the setose pappus parts with its achene—whether it falls off altogether, the setæ being united in a ring at the base, or whether each seta falls off separately. This character is often of much avail in several genera of Cichoriaceæ; and Weddell made use of it chiefly in aid of the difficult discrimination of some Gnaphalioid genera or subgenera, and at first sight very successfully; but a closer investigation of a much larger number of species than he had at his command has in some measure lowered again the supposed value of the character.

Generally speaking, the modifications of the pappus, however inconstant in genera or even sections, are very constant in species; the exceptions are chiefly in the coroniform and other very much reduced pappi, which may be present or absent in different individuals or varieties of one and the same species—as, for instance, in those forms of *Chrysanthemum leucanthemum* so elaborately worked out by Fenzl, as well as in several *Matricariæ* and some species of *Centaurea*, several *Helenioideæ*, &c.

5. Differences in the Androecium.

In all essential points the androecium of Compositæ is as uniform throughout the order as the pistil; it offers none of those differences in number, symmetry, position, direction, or structure which in so many orders are called in aid of the discrimination of genera. The anthers, equal in number to the corolla-lobes, are united, or perhaps, in a few cases, only closely connivent in a cylinder round the style, and their cells open inwardly and longitudinally without any variation; so also in regard to the filaments, they are always inserted in (adnate to) the corolla-tube, and attached to the base of the connective. These filaments vary slightly in the height to which they are adnate to the corolla-tube (a question of degree affording no available characters), and also in their being free or monadelphous after quitting the tube, and glabrous or papillose-hairy. Both the latter characters have been made use of in *Cynaroideæ* as generic—the former to separate rather too artificially three monotypic genera from *Carduus* and *Cnicus*, the hairy or non-hairy filaments rather more successfully applied to the distinction of a few large genera where it proves constant. There is also, in many *Senecionideæ*, for instance, an abrupt dilatation or change of texture, and almost an articulation at some little distance below the insertion of the anther. But it remains to be ascertained how far this is constant even in the genus *Senecio*; and my own observations are insufficient to establish it as a generic character.

The anthers, however, are sometimes provided with certain appendages apparently of little or no functional or homological importance, but which nevertheless, from the remarkable constancy of their presence or absence in whole tribes, supply one of the most valuable characters in Compositæ if applied with proper caution. These appendages are either apical or basal. At the top of the anther-tube each connective is produced into a thinly cartilaginous erect or incurved membrane or point, which may

possibly act some part in influencing the dissemination of the pollen, although nothing in that respect has as yet been ascertained. These appendages are uniform throughout the order, except as to length or breadth, and except as to two subtribes which they assist in characterizing. In the subtribe *Piqueriæ* of Eupatoriaceæ they are deficient, the anthers being truncate on the top; and in the subtribe *Ambrosiæ* of Helianthoideæ they taper into an incurved point. In one or perhaps a very few species of Helianthoideæ, they are reduced to a small point or possibly deficient.

At the base of the anthers the appendages usually called tails are much more systematically valuable, as affording by their presence or absence almost absolute tests of several of the largest tribes. The difficulty is, in a few cases, to decide whether the anthers are or are not to be properly designated as tailed; and allowance must be made for a few, although rare, real exceptions.

First, as to determining what is a tail to an anther, the accompanying figures (Plate IX.) will readily explain the principal differences. In figs. 1 and 2 the anthers are truncate at the base; in fig. 3 produced into obtuse auricles; in fig. 4 sagittate with the auricles of adjoining anthers connate to the point, in fig. 5 sagittate with the auricles free; and in all these they are inappendiculate or tailless, although the auricles in figs. 4 and 5 may be very acute, for the points are not produced beyond the pollen-bearing cells; in figs. 6 and 7 these auricles, united in fig. 6, distinct in fig. 7, are very shortly produced into what may be termed rudimentary tails, and occasion one of the great difficulties, as different botanists have described them as tailed or tailless; in figs. 8 and 9 the tails are decidedly setiform, those of adjoining anthers united so as to show five setæ to the pentamerous andrœcium in fig. 8; setiform but distinct in fig. 9, showing ten setæ either approximate in pairs or equidistant as represented in the plate, or lying close to the filament; the tails are ciliate at the end or ciliate fringed in figs. 9 and 10, dilated and fringed in fig. 11. But the observation of some of these differences requires considerable care and some experience. If not well soaked out, the acute auricles of figs. 4 and 5 may be mistaken for the really pointed ones of figs. 6 and 7; and the tails of fig. 7, and even of fig. 9, sometimes lie so close to the filament, that when very fine they are frequently overlooked. To show the degree of constancy of these various forms we may take the thir-

teen tribes in succession, as far as known; and I may state that there are very few genera in which I have not examined the anthers, and usually verified them in a considerable number of species of the larger genera.

Vernoniaceæ (near 500 species in 35 genera) have normally the anthers of figs. 3, 4, or 5, and strictly so in the great majority of species. They are, therefore, usually characterized as tailless; but there are some four or five genera, one of at least twenty species, the others monotypic or nearly so, which pass into fig. 7, and have therefore been described as exceptionally tailed, although they never, as far as I am aware, have the elongated setiform or fringed appendages of figs. 8, 9, and 10. Several species of *Vernonia* itself have also been described as having shortly tailed anthers; but that is owing to careless observation of the acute auricles not sufficiently soaked out so as to show that they are polliniferous to the end. Vernoniaceæ, therefore, may be safely characterized as having the anthers sagittate at the base, with the auricles obtuse, acute, or rarely produced into short points.

Eupatoriaceæ (above 700 species in 35 genera) have the anthers of fig. 1 and 2, passing occasionally into fig. 3, but never, as far as I am aware, beyond that, and are therefore characterized as having the anthers truncate, emarginate, or rarely sagittate at the base, and strictly tailless.

Asteroideæ (nearly 1500 species in 88 genera) have the anthers as strictly tailless (varying only from truncate to sagittate) as in Eupatoriaceæ, with the exception of some very few, perhaps not above a dozen, species of Australasian *Olearias* and *Celmisias*, in which the auricles have been observed to have minute very fine points, similar to the tails of figs. 7 and 8 when in a reduced form. In these rare cases the other tribal characters are so decided as to leave no doubt as to the tribe to which the plant should be referred.

Inuloideæ (above 1100 species in 138 genera) have the tailed anthers of figs. 6 to 10, not absolutely without exception; but having myself examined all the genera, except six monotypic ones unknown to me, and by far the greatest number of species, I have only found the few species of *Laggera*, three or four of *Phagnalon*, and perhaps as many more scattered over other genera in which these tails are wanting. There are, however, many species, especially among the Gnaphalioid genera, in which they are so fine, and so apt when wet to lie close to the filament,

as to be difficult to observe, besides that they have been neglected or carelessly overlooked in the characters given by authors to various genera, which have therefore been placed in wrong tribes. In all these doubtful cases there are characters derived from the style and other organs ready to be called in aid.

Helianthoideæ (nearly 1100 species in 140 genera) vary in their anthers as in their styles. Like the Vernoniaceæ, the base of the anthers passes from fig. 2 to fig. 7, but never beyond that; they are usually sagittate with obtuse, acute, or more or less pointed-acuminate auricles, but not properly speaking tailed, although they are on some occasions so described by Grisebach and some others. They are often also as obtusely truncate at the base as the Eupatoriaceæ.

Helenioideæ (nearly 300 species in 60 genera) are, in respect of anther-bases, like Helianthoideæ, but with less variation, ranging from fig. 2 to fig. 5, rarely if ever passing into figs. 6 or 7.

Anthemideæ (about 650 species in 41 genera) appear to be always quite tailless, and show more frequently fig. 2 than figs. 3, 4, or 5, and never, as far as I am aware, go beyond that.

Senecionidæ (about 1350 species in 42 genera) have again the range of Helianthoideæ in their anther-bases, which are almost always sagittate from fig. 3 to fig. 5, rarely truncate as in fig. 2, or shortly pointed as in figs. 6 or 7, never, properly speaking, tailed as in figs. 8 to 10; but, as in the case of Helianthoideæ, some of them are occasionally described as tailed.

Calendulaceæ, the smallest of all the tribes (not quite 120 species in 8 genera), is less definite than any in respect of the anther-tails, which are more or less decided from fig. 6 to fig. 8, rarely so obsolete as to show figs. 4 or 5, nor yet so prominent or fringed as to represent figs. 9 or 10.

Arctotideæ (about 250 species in 16 genera), usually connected with Cynaroideæ on account of their styles, but more nearly allied to Anthemideæ in their involucre and flowers, show an approach to the latter tribe in their anther-bases, which are never more tailed than in figs. 6 and 7, and usually ranging from figs. 2 to 5.

Cynaroideæ (nearly 900 species in 36 genera) belong essentially to the tailed-anthered division. Their tails are usually long and fringed, as in figs. 9 and 10, or dilated as in fig. 11; but there are exceptions. In most *Serratulas*, and in some species of *Xeranthemum*, *Centaurea*, and a few others, the tails are more and more

shortened or quite obsolete ; but these exceptional species have other characters which leave no doubt as to their affinities, and after all they are but very few in proportion to the number of species in the tribe.

Mutisiaceæ (about 450 species in 49 genera) belong also to the tailed class, showing the anther-bases of figs. 8 to 10, without any gradual reduction of the tails as in Cynaroideæ, but with two remarkable exceptions. *Schlechtendahlia* and *Barnadesia* have no tails at all, even rudimentary, to their anthers. The former, a single anomalous species, may possibly hereafter be connected with some other tribe ; but the ten species of *Barnadesia* are so decidedly Mutisiaceous in every other respect, that they must be accepted as a striking exception.

Lastly, Cichoriaceæ (above 700 species in 56 genera) are as uniform in their anthers as in their styles and corollas, although there may be some ambiguity as to the class of anther-bases to which they should be referred. They have been described as tailed and as tailless ; and after examining hundreds of species either in the dry or in the fresh state, I have been left in doubt as to which is the best designation. The anthers are always sagittate at the base with pointed auricles ; but how far the fine point is produced beyond the end of the cells is a matter of uncertainty ; it is generally so produced, although never to any considerable length, and seems to vary in that respect (within very narrow limits) in one and the same species ; but these niceties are difficult to appreciate, and I may not always have been sufficiently careful in my dissections.

There are some other differences in the anthers, such as the proportion occupied by the polliniferous portion, the degree in which the anther-tube is exerted from or included in the corolla-tube, &c., in which I have been hitherto unable to discover any good generic indications. Steetz and some others have also established genera on characters derived solely from the shape of the pollen-grains ; but this character has been accurately observed in by far too small a number of species to be as yet made available for systematic purposes. It would require the close observation and study of years to decide upon its value ; and if really sufficiently connected with other characters to establish it as a natural one, it never would practically be very useful, as requiring a high microscopical power to verify it. It has been generally said that the pollen is angular (usually dodecaedrous) and scabrous in Cichoriaceæ, globular or elliptical and smooth in Mutisiaceæ,

globular and echinulate in the remaining tribes ; but several exceptional genera or species have already been noted, which, if they had been confined to genera otherwise anomalous, such as *Stokesia*, might have tended to establish the value of the character. But Steetz has also separated, on this character alone, plants which are, on every other account, evidently congeners ; and it remains to be observed whether some of the differences noted may not be individual only or even dependent on age or degree of development.

The presence or absence of staminodia, or abortive or imperfect stamens in the female florets, has been regarded as a character of some importance ; and it is, in a few cases, perhaps generic, but never much to be relied on. These staminodia are frequently to be met with, and perhaps constant in some genera, in Mutisiaceæ, in Petrobieæ, and a few other Helianthoideæ, and a very few Senecionideæ, rare, if ever observed, in Asteroideæ, Inuloideæ (except one or two species of Bupthalmæ), Helenioideæ, and Anthemideæ.

6. *Differences in the Corolla.*

The corolla of Compositæ is superior and gamopetalous, with a valvate æstivation throughout the order with as much uniformity as has been observed in the essential characters of the androecium and pistil. It is usually pentamerous, but not unfrequently tetramerous, and occasionally trimerous—differences which are sometimes generic, frequently specific or sexual only, or variable in the same species, never tribal. The available differences consist in the varied development of the limb, whether regular or irregular.

The first and most obvious distinction which strikes the eye of the most careless observer is that between the tubular and the ligulate limb, giving three principal forms of flower-heads—the discoid (where the corollas of all the florets are tubular), the radiate (where the external ones are ligulate and the central ones tubular), and the liguliform (where all the corollas are ligulate). But on further investigation this distribution requires to be modified. The ligulate corollas of the Cichoriaceæ do not correspond to those of the ray in other tribes. In the Cichoriaceæ, or true Ligulifloræ, the ligula is 5-merous ; it consists of the whole of the five united petals forming a flattened lamina, truncate and shortly 5-toothed at the end (Plate VIII. fig. 1), and this with the utmost uniformity throughout the tribe ; whilst in all other Compositæ, collectively distinguished by Weddell and others as Tubulifloræ, when the

florets of the circumference, or, in a few cases, all or nearly all are ligulate, the ligula is trimerous only, consisting of three only of the united petals, the two inner ones being reduced to minute teeth, or, more generally, entirely deficient (fig. 7). The only instances among Tubulifloræ of an approach to the Cichoriaceous corolla are in *Stokesia*, a monotypic genus of Vernoniaceæ, where the corollas are irregularly expanded into a 5-lobed lamina, and in a very few Mutisiaceæ and two or three species of Cynaroideæ, where the lamina is 4-merous, or even, in a few species, 5-merous, almost as equally so as in Cichoriaceæ. In Cichoriaceæ, therefore, the corolla gives us an absolute tribal character, but no generic ones within the tribe, beyond a few indications derived from size or colour. It is the diversity in the corolla of Tubulifloræ alone that we have further to consider.

The corollas of the female florets always differ from the hermaphrodite ones of the same species, sometimes only in being more slender, very frequently in the shape of the limb; and, in so far as the difference is owing to sex alone, the characters to be derived from the presence or absence and relative number and position of these diverging forms have been already considered under the head of sexual differences; but there are other diversities of form to which some importance is attached. The most remarkable is the so-called bilabiate form of most Mutisiaceæ, which had induced many to class that tribe as a distinct suborder, under the name of Labiatifloræ. In that tribe there is in the same head, or in different species or genera, a gradual passage from the regular 5-lobed to the ligulate limb:—first, a slight irregularity, owing to the innermost lobe being more deeply separated than the others; then two of the inner ones are more deeply separated or more erect than the three outer ones (Plate VIII. fig. 5); then, again, the two inner ones shorten, whilst the three outer lengthen and become gradually consolidated into a ligula; sometimes the two inner and three outer ones are respectively united, the former into a short inner lip, the latter into a longer outer one (fig. 6), or the inner lobes disappear altogether, leaving the truly ligulate trimerous female corolla of ordinary radiate heads (fig. 7). All these forms are to be met with in Mutisiaceæ, which can therefore no longer be absolutely characterized by their corollas. In the subtribe *Gochnatieæ*, for instance, they are all tubuliform, and as regular as in any discoid genus or tribe; and although the well-developed bilabiate form is almost limited to Mutisiaceæ, yet there are a

few genera among radiate Senecionideæ or Inuloideæ, and perhaps some others, where the ray-florets have at the base of their lamina one or two small inner lobes.

In other respects the form of the florets may afford some slight indication of the genera or tribes. Long narrow corolla-lobes to the hermaphrodite regular floret (fig. 4) are characteristic of most Vernoniaceæ and Cynaroideæ, rare in Asteroideæ, Inuloideæ, Helianthoideæ, and Senecionideæ. The female florets when present are almost always slender, but regular or nearly so (fig. 8) in some genera or subtribes of Asteroideæ, Inuloideæ, Anthemideæ, and Senecionideæ, always ligulate (fig. 7) in others. In a few genera or sections of genera of Asteroideæ, and in one of Mutisiaceæ, the outer rows of female florets are ligulate, the inner filiform; and in some genera or subgenera of Helianthoideæ or Anthemideæ the female florets have only a rudimentary corolla, or are absolutely without any. In all these respects differences in form of the corolla are more important than its absolute presence or absence, or than the degree of development when present.

The general shape of the limb (that is, of the dilated portion above the insertion of the stamens) of the regular corolla, whether campanulate (fig. 3) or gradually dilated, or scarcely thicker than the tube and cylindrical (fig. 2), is sometimes characteristic of genera, but very frequently specific only. Colour is also, in some measure, characteristic of some tribes. The corollas are, I believe, never yellow in Vernoniaceæ or Eupatoriaceæ, and not very frequently so in Cynaroideæ, in all of which the prevailing colour is purplish, varying from pink to blue, although pure blue is not frequent. In Cichoriaceæ yellow is the common colour, although some species, groups of species, or even genera are blue; pink and purple rare. In all the other tribes yellow is the prevailing and, in some tribes, the constant colour in the hermaphrodite florets; pink, purple, and blue exceptional, the latter very rare. The female florets when expanded into a ray are either of the colour of the disk, or pink, purple, blue, or white, with a yellow disk. This distinction between homochromous and heterochromous flower-heads, although specific only in some genera, *e. g.* *Senecio*, is generic in Asteroideæ, where it has served indeed to characterize two of the subdivisions of the tribe—somewhat artificial ones it is true, but yet the best that have been proposed. White flowers are not common in the order, but are to be met with in all the tribes, whether the normal colour be yellow or not; they have even been made to serve as a generic

character to distinguish *Cacalia* from *Senecio*, and *Nabalus* from *Prenanthes*. This, however, only holds good for North-American species.

The constancy of the venation of the corolla-lobes in Compositæ pointed out by Brown has since been frequently alluded to, and is, as it were, the natural consequence of the equally constant valvate æstivation. The chief minor difference observable in venation is in the undivided part of the limb, and results from the prominence of the central vein alone of each petal, or from the more or less conspicuousness of the lateral veins, those of two adjoining petals combined into one, or distinct, and all similar to the central vein. The latter arrangement is conspicuous, for instance, in the ligulæ of *Trichocline*, and comes in aid of the generic character.

7. *Differences in the Calyx.*

The calyx in Compositæ is so absolutely deprived of its ordinary function (the protection of the young flower), so completely absorbed in the ovary, or so absolutely rudimentary at the time of flowering, that the only available distinctive characters it affords result from the varied impress it gives to the external surface of the fruit, or from the forms it acquires as a portion of that fruit. These characters, therefore, have been considered under the head of the fruit, as those of its ribs and pappus.

8. *Differences in the Ultimate Inflorescence and Bracts (the Capitulum, its Receptacle, Involucre, and Paleæ).*

Inflorescence and its bracts are most frequently classed among the vegetative organs, and consequently assigned a low grade in the scale of generic characters, too low a one, probably, in many cases. In Compositæ, however, where they are called upon to take a part as accessories to the reproductive operation, to supply in some respects, the place of some of the reproductive class that have been disabled by consolidation, they acquire an unwonted degree of fixity, and thence of generic value. Thus it is, that the diversities in the flower-head or capitulum, its involucre, receptacle, and paleæ, are properly taken account of in the essential character of every genus of the order.

Whatever be the primary inflorescence of Compositæ (solitary, cymose, paniculate, capitate, or any other form), the ultimate ramification is invariably a capitulum—several flowers (often very many, sometimes very few, or a single one) sessile, or nearly so, on a com-

mon receptacle, within an involucre of several, often very many, rarely only two or three, closely packed bracts, which act more or less the part of the suppressed calyces in protecting the buds or the young fruits. Notwithstanding the special names given to these organs by various synantherologists, there is nothing to distinguish them from the corresponding organs in divers genera of Dipsacæ, Umbelliferæ, Cornacæ, Myrtacæ (*Darwinia*), Proteacæ, Thymeleæ, and many others—nothing whatever except their constancy. In order correctly to understand the minor modifications to which these organs are subject, it is necessary to keep their homology in view; and therefore it is that we have thought it better to retain the intelligible terminology of *involucral bracts* and *receptacle*, than to encumber it with such special terms as *periclinium*, *phyllaries*, *clinanthium*, &c., which only serve to give unnecessary trouble and convey false notions.

The capitulum characterized by the involucre exists throughout the order; the involucre may in some compact compound inflorescences be reduced to two or three bracts only, never, I believe, to a single one, even when uniflorous. The number (taken generally within certain limits, rarely as absolutely precise) and arrangement of the bracts, their general form and consistency, and the general form the involucre itself or the capitulum (including the florets) assumes, afford generic characters in most cases excellent from their constancy, although, from their ready perceptibility and the aspect they give to the plant, they are apt to be too hastily observed and too implicitly relied upon. They are also far from absolute as tribal characters, although they may give good general indications. Thus the single row of inner equal erect involucral bracts, with or without much smaller or differently shaped or much looser outer ones, so common in Senecionideæ, Helenioideæ, and Helianthoideæ, are seldom, if ever, to be met with in Vernoniaceæ, Eupatoriaceæ, Asteroideæ, Inuloideæ, Anthemideæ, Arctotideæ, or Cynaroideæ. The ovoid or globular involucre with many rows of closely imbricate bracts is chiefly characteristic of Vernoniaceæ, Cynaroideæ, the subtribe Gorterieæ of Arctotideæ, a portion of Mutisiaceæ, and exists only in isolated genera in other tribes. The broadly hemispherical involucre with scarious-tipped or bordered inner bracts is general in Anthemideæ, in the subtribe Euarctoteæ of Arctotideæ, and in some Asteroideæ. Involucres, however, are sometimes deceptive, and precisely the same forms may be occasionally met with in two genera belonging to widely distant tribes.

The receptacle, which is homologically the dilated apex of the peduncle, has in its general shape (concave, flat, convex, conical, or elongated) occasionally supplied generic characters, rarely of much value, and sometimes deceptive. Where the involucral bracts have been in many rows and very deciduous, they leave after falling off an apparently ovoid, obovoid, turbinate, or obconical receptacle, which has been used generically to separate species from their allies described as having flat or convex receptacles, when really there has been no difference at all, except that in the one case the portion of the peduncle on which the bracts had rested is taken into account, and in the other the apex only within the bracts has been considered. The extreme forms of the receptacle, either concave or elongated into the rhachis of a cylindrical spike, have been on some rare occasions observed in single species, which have on that account been at once raised into monotypic genera; but I do not believe that these differences have ever been found accompanied by other peculiarities, or to be prevalent through two or more otherwise allied species, and must therefore be regarded as specific only.

The so-called paleæ of the receptacle within the involucre have been made great use of, by their presence or absence, for characterizing genera, subtribes, or even tribes. But this use, however appropriately adopted in some cases, has in others degenerated into abuse. Homologically, these paleæ are the same as the involucral bracts. There is not even the difference that lies between ordinary bracts and bracteoles, for both are on the same axis, but is solely that which distinguishes the lower empty bracts of an ordinary spike or other simple inflorescence from those which subtend the individual flowers. In Compositæ, however, these inner subtending bracts amongst the florets are so frequently different from the outer empty or involucral ones in form, size, consistence, constancy, &c., that their designation by the distinct name of *paleæ* is of great convenience in systematic descriptions.

There is sometimes, however, a difficulty in regard to the innermost row of outer bracts, either when these are gradually modified so as to pass, as it were, into the flowering bracts or paleæ, or when each one of that innermost row of outer bracts exactly subtends one of the florets of the outermost row, or even embraces or encloses it, and is then different in form &c. both from the outer involucral bracts and from the inner paleæ; and some controversy has been carried on as to whether this is an inner row of involucral bracts

or an outer row of receptacular paleæ. But this is a mere war of words. Homologically the two are one and the same thing; but, as a matter of convenience in description, it has been a general, and ought to be an universal, rule to call all that are outside of all the florets involucre bracts, and those only which are within the outer rows of florets receptacular paleæ.

With regard to the use made of the presence or absence of these paleæ not only as a generic but as a subtribal or even tribal character, it proves with certain restrictions to be a good one, although in some cases it is very artificial or uncertain. Thus the rigid, usually persistent, receptacular paleæ are constant, or nearly so, in Helianthoideæ and the subtribe Buphthalmeæ of Inuloideæ, and never occur in Helenioideæ; whilst the thinner more deciduous ones of a very few small genera of Vernoniaceæ, Eupatoriaceæ, Asteroideæ, and Senecionideæ are sometimes inconstant in the same genus. In Anthemideæ this character conveniently, although somewhat artificially, separates the Euanthemæ from the Chrysanthemæ. In Cichoriaceæ, where, from the absolute uniformity of the florets, there is such a dearth of distinctive characters, these paleæ have been eagerly seized upon for the separation of some subtribes or other divisions; but a very little examination will show that they are at most of generic value for the separation of such closely allied groups as *Hypochaeris* from *Leontodon*, *Rodigia* from *Crepis*, &c. The peculiar shape assumed by the paleæ is often of much more absolute generic importance, as, for instance, those of *Scolymus*, which are accompanied by so many other characters in habit, involucre, receptacle, &c., although still with the uniform florets of Cichoriaceæ.

There is a state of the receptacle which has been variously described as paleaceous or naked, or neither, and which certainly sometimes passes from one to the other. On the naked receptacle each floret, after the fruit has fallen off, leaves a more or less marked scar, either on a small protuberance which may be said to be a rudimentary pedicel, or in a depression in which the achene was seated. In the former case the receptacle is said to be *scrobiculate* or furrowed by the depressions round the protuberances; in the latter it is described as *foveolate* or pitted. When there is neither much protuberance nor depression, but the area of each achene is marked by a more or less distinctly raised line round its circumference, the receptacle is said to be *areolate*. When this line is more raised and jagged on the edge, or broken into short setæ or

paleæ, the receptacle is *fimbriate*, *setiferous* when these setæ are elongated; and if the margins of the pits rise considerably (sometimes enclosing the whole achene) it is termed *alveolate* or honey-combed. All these varieties in the non-paleaceous receptacle are usually noticed in generic characters, and they are sometimes constant in good genera; but in general they have been too much insisted on, and have produced purely artificial combinations. The Cynaroideæ, however, are remarkable for the setose character of the receptacle throughout the tribe, with the exception of *Onopordon* and very few other species rather than genera, where the setæ become very short or disappear altogether, and a few others where the setæ are more or less combined into true paleæ. The alveolate receptacle is most remarkable in some small or monotypic genera belonging to very different tribes, *e. g.* *Albertinia* in Vernoniaceæ, and *Baldnina* in Helianthoideæ. It is also characteristic of several genera of Arctotideæ.

When the involucreal bracts of the innermost row precisely subtend the florets of the outermost row, and more or less enclose or become adnate to them, or assume more or less of the character of receptacular paleæ, they often acquire a generic or even a subtribual importance, as in several Helianthoideæ, Helenioideæ, or Cichoriaceæ, although occasionally the difference may be little more than specific.

9. *Differences in the Foliage.*

The foliage in Compositæ is, within certain limits, as variable as in other large orders. It has no one peculiar character which cannot be matched in many other orders; and the only two features of importance which it does not possess are (1) that there are no stipules (for the auricular expansions at the base of the petiole in some species of *Liabum*, a very few Helianthoideæ, &c. cannot be properly designated as such), and (2) that the leaves, though often much divided, are never compound with articulate leaflets. Amongst all variations to which it is liable, there is one only of any systematic importance—the difference between the opposite (including the rare instances of strictly verticillate) and the alternate leaves, which sometimes constitutes a good, though not quite absolute, tribual character, although also in other instances it is not even generic. Thus the leaves are alternate, with few exceptions, in Vernoniaceæ, Asteroideæ, Inuloideæ, Anthemideæ, Calendulaceæ, Arctotideæ, Cynaroideæ, Mutisiaceæ, and

Cichoriaceæ—the exceptions being 2 species in 465 in Vernoniaceæ, 1 genus and some 10 or 12 stray species out of 1470 in Asteroideæ, about 20 species out of 1150 in Inuloideæ, about 6 in 650 in Anthemideæ, 10 in 115 in Calendulaceæ, 2 in 450 in Mutisiaceæ, and no exceptional opposite leaves known in Arctotideæ 250 species, Cynaroideæ 880, or Cichoriaceæ 720 species. Alternate leaves are also prevalent in Senecionideæ, but with nearly 10 per cent. exceptional opposite ones (usually in distinct genera). In Helenioideæ the opposite and alternate are rather more equally divided, the former being the more frequent; and opposite leaves, at least in the lower part of the stem, are the rule in Eupatoriaceæ and Helianthoideæ, although with several striking exceptions. Entire, toothed, or divided leaves may be respectively prevalent in tribes or genera, but rarely in a degree to be much relied on for a general character. The much-divided leaves, for instance, so common in Anthemideæ are exceedingly rare in Vernoniaceæ, Eupatoriaceæ, and Inuloideæ. The prickly-lobed foliage of so many Cynaroideæ is scarcely to be met with elsewhere, except in a few Arctotideæ (Gorterieæ), one small genus of Cichoriaceæ (*Scolymus*), and here and there in monotypic genera scattered through other tribes.

10. *Differences in Habit, Stature, and General Inflorescence.*

In habit and stature, Compositæ are as variable as other large orders, without these differences being often even of generic importance, although they may sometimes give useful indications. Arborescent Compositæ are rare; and frutescent ones prevail only in comparatively few genera; but in some cases these habits may assist in the discrimination of groups where more absolute characters fail, especially when the differences are connected with geographical distribution. Thus in the great mass of Heterochromous Asteroideæ and Conyreaæ, including the large genera *Aster*, *Erigeron*, and *Conyza*, taken in their widest sense with a multitude of smaller genera around them, there is no one positive character to separate the groups, large or small, into which the six or seven hundred species have been distributed,—nothing absolute to separate *Aster* from *Conyza*, which nevertheless no experienced synantherologist would dream of uniting. Here, therefore, stature, combined with geographical distribution, have been appropriately called in aid by Weddell, excluding all the southern, usually frutescent, species from the northern, constantly

herbaceous, *Asters*; and there are many instances in other tribes where a shrubby or herbaceous habit may similarly assist in distinguishing natural genera. Beyond this, habit is systematically as vague a character in Compositæ as in other orders, acquiring importance only in geographical botany for the distinction of those plant-forms of which Grisebach has made so much use in his studies of geographical distribution with reference to climatology.

The general inflorescence in Compositæ (that is, the successive development of the flower-heads) is invariably centrifugal, whilst the ultimate inflorescence (the successive development of the florets within the head) is as constantly centripetal; and this circumstance is very important in characterizing the compound inflorescence of the subtribes *Lychnophoræ* in *Vernoniaceæ*, *Lagasceæ* in *Helianthoideæ*, *Angiantheæ* in *Inuloideæ*, and of several genera of *Filagineæ*, *Relhanieæ*, *Bupthalmææ*, *Cynaroideæ*, &c. In these cases numerous capitula, closely sessile on a common receptacle, are collected into a globular, oblong, or depressed cluster often surrounded by a common involucre, the whole assuming the appearance of a single flower-head. This is more especially the case when each individual head is reduced to a single floret with two, three, or very few involucre bracts. Such compound clusters have been sometimes confounded with single flower-heads like those of *Albertinia*, where the very deep and fringed alveoli of the receptacle resemble the separate involucre of the compound cluster. In such cases the difference between the centripetal inflorescence of *Albertinia* and the centrifugal one of *Eremanthus* has been well pointed out by Schultz Bipontinus. I am not aware of any other very marked generic character to be derived from the inflorescence of Compositæ. If in a few instances the heads are apparently axillary and sessile, it is from the abbreviation of the flowering branch. In *Liatris* the inflorescence is spicate or racemose, but always with the terminal head first developed. In this case the genera *Trilisa* and *Carphephorus* are chiefly distinguished by the corymbose inflorescence, accompanied, however, by some other characters.

Among miscellaneous vegetative characters must be included indumentum, to which we have not perhaps paid sufficient attention. Mr. Archer, in a paper published in the fifth volume of our Journal, has shown its value in the classification of the numerous species of *Olearia*. The stellate hairs have also been shown to be a good generic character for the separation of *Hieracium* and

Andryala from *Crepis*, of *Bedfordia* from *Senecio*, &c.; a certain glandular odoriferous indumentum is characteristic of most *Madieæ*, *Buphthalmeæ*, and a few others; and many other instances of the generic value of differences in the nature of hairs might be adduced, although the subject has not as yet been sufficiently worked out. The presence or absence, abundance or paucity, greater or less development of any description of indumentum appears never to be of more than specific value.

11. *Differences in Geographical Distribution.*

I purpose entering into the geographical distribution of *Compositæ* under a separate head. I only mention it now to show the importance of taking it into consideration in the demarcation of generic groups. If the two theories be admitted, that allied species and genera have a common origin, and that the descendants of a common stock placed in different regions having no intercommunication will vary in these different regions with different combinations of characters, it will be seen how much geographical distribution may be made to check the value given to generic or other groups founded upon technical distinctions. But the use of geographical distribution as a generic character is liable to many errors. There are especially two great difficulties to overcome:—first to determine upon how far geographical distribution is due to origin, and how far to climatological influences; and, secondly, to decide upon the all-important distinctions between what we may, with Hewett Watson, designate as true *denizens* of a country, *colonists*, and *aliens*: and even among the denizens a still more difficult, although important, point for consideration is the remoteness of the period at which the common stock has been connected with the flora of other countries. For instance, the *Helichryseæ*, as well as the *Arctotideæ* (*Cymbonotus*), of Australia are closely allied to the corresponding South-African groups without having a single species in common, excepting such as are known to be modern colonists. In the case of *Helichryseæ* the forms have multiplied exceedingly in both regions in the same or in different directions, and have every right to be designated as true native races. But *Arctotideæ*, numerous in South Africa, have assumed only one form in Australia. Is that form to be regarded as of contemporaneous origin with others common to the two regions, but modified into a local generic type, or is it some old colonist still to be found, or perhaps now extinct, in South Africa? is a question which remains undecided.

III. SKETCH OF THE PRIMARY DIVISIONS OF THE ORDER.

In determining upon the sequence of tribes and subtribes to be adopted in our 'Genera Plantarum,' we have here, as elsewhere, endeavoured to avoid all useless changes in the Candollean method so generally followed; and we have abandoned some transpositions which I had proposed in the 'Flora Hongkongensis' and 'Flora Australiensis.' I had there, for instance, commenced with the Cynaroideæ in order to place them in juxtaposition with Vernoniaceæ; but on working out all the allied genera which I had not previously examined, I have found that they were as well, if not better, placed in the position De Candolle had assigned them. As, however, there are a few other important alterations above alluded to which appeared to me absolutely essential in order to give more definiteness, as well as a more natural character, to some of the great divisions of the order, it may be useful to review shortly the modified characters I would now assign to the thirteen tribes we have adopted, referring for the technical synopsis to our 'Genera Plantarum.'

1. *Vernoniaceæ*.

We have reduced the Vernoniaceæ to those which have uniformly homogamous capitula with hermaphrodite florets never yellow. This removes several genera which in minor characters also were very exceptional in the tribe. The Pectideæ, which have not even the style of Vernoniaceæ, resume their place with the Tagetineæ under Inuloideæ; the Liabeæ are transferred to Senecionideæ, notwithstanding their style, which, however, is not absolutely without example in other genera of that tribe; and *Gundelia* and *Platycarpha* form a small subtribe of Arctotideæ next to Cynaroideæ.

Vernoniaceæ thus modified are usually perennial herbs or shrubs, rarely trees, or very rarely annuals. Their leaves are, with the exception of two or perhaps three species, alternate, entire, toothed, or very rarely lyrate-pinnatifid; the involucre bracts imbricate in several rows, except in a very few small anomalous genera, where they are reduced to two equal rows or to a small definite number. The capitula are uniformly homogamous, with the florets all hermaphrodite, and equally fertile or rarely slightly dioecious; they are sometimes reduced to a single floret; and in several genera they are closely clustered, forming a dense globular or oblong compound head with or without a common invo-

lucre. The receptacle is naked or slightly fimbriate, except in two monotypic genera where it bears paleæ subtending the florets, and one where it is deeply alveolate. The corollas are tubular, regular, with five narrow lobes to the limb, and varying from a reddish purple to nearly white, except in one monotypic genus where they are blue and expand into a five-lobed ligula, approaching that of Cichoriaceæ, in one small genus in which they are more deeply split on the inner side, nearly as in some Mutisiaceæ, in one species of *Veronia* where they are somewhat bilabiate, and in two monotypic genera where they are very small with the lobes reduced to short teeth; their colour is never yellow. The anthers are never without the terminal appendage to the connective; they are more or less emarginate or sagittate at the base; the auricles of contiguous anthers are usually connate to the end, obtuse or acute, or very rarely produced into short combined or distinct points or rudimentary tails. The style-branches are slender, acute, or scarcely obtuse, uniformly and shortly hirsute, the stigmatic series towards the base on their inner surface not very conspicuous; and in two monotypic (otherwise anomalous) genera the style is exceptionally almost entire. The achenes are usually terete or slightly flattened and equally ten-ribbed; but in some genera or species they are five- or four-angled, occasionally also with more than ten ribs, and in one monotypic genus perfectly smooth and shining. The pappus is usually setose and copious; the setæ in some genera flattened into paleæ, and in a very few others very much reduced or absolutely wanting.

2. *Eupatoriaceæ*.

We have reduced De Candolle's Eupatoriaceæ, as we have done his Vernoniaceæ, by withdrawing the genera with heterogamous capitula, which we have referred to Senecionideæ, leaving the tribe one of the best-defined by its style, as well as by several secondary characters.

Eupatoriaceæ are herbs or shrubs, rarely trees, very rarely annuals. The leaves, as a rule, at least the lower ones, are opposite and entire or toothed; but in a few genera they are all alternate, and exceptionally so in several others; and in very few species they are divided. The involucreal bracts are imbricate in several rows or nearly equal in about two rows, in some genera reduced to four, five, or six. The capitula are always homogamous, with all the flowers hermaphrodite and fertile, and are very rarely re-

duced to a single floret. The receptacle is without paleæ, except in three or four genera where deciduous paleæ subtend the florets in some or all of the species. The corollas are tubular and regular, the limb variously shaped, with five or rarely four short teeth, very rarely (in *Liatris* and its allies) with the longer lobes of Vernoniaceæ; they vary in colour from pink or purplish to white or pale yellowish, never truly yellow. The anthers in one subtribe are truncate at the top without the normal appendages which are present in the other subtribes, as in the generality of Compositæ; they are uniformly obtuse at the base, without prominent pointed auricles or tails. The style-branches are elongated, terete or somewhat flattened, obtuse or club-shaped towards the end, minutely papillose, but not hairy, with the stigmatic series rather obscure on the inner surface towards their base. The achenes in the first two subtribes are four- or five-angled, or rarely flat; in the third subtribe more terete and ten-ribbed: the pappus usually of fine but rigid setæ in one or two rows, in a few small genera plumose or nearly so, in some others reduced to a small definite number, or intermixed with short scales or paleæ, or the whole pappus reduced to these small paleæ or entirely deficient.

3. *Asteroideæ*.

We limit the *Asteroideæ* to the genera with tailless anthers and with appendages to the style-branches. The subtribes or divisions Sphærantheæ, Tarchonantheæ, Plucheineæ, Inuleæ, and Buphthalmeæ of De Candolle form part of our great tribe of Inuloideæ; and the Eclipteæ pass into the Helianthoideæ, most of the genera enumerated by De Candolle under the former name having nearly related or identical genera among the latter. The *Asteroideæ* thus limited are for the most part readily distinguished, by the above characters of the style and anthers, from all other tribes; but there are a few Inuloideæ and Senecionideæ where the involucre and other secondary characters must be called in aid.

Asteroideæ are mostly herbaceous perennials, or sometimes annuals; but a few southern or insular genera are shrubby, rarely growing into small trees. The leaves are, with very few exceptions, alternate, entire or toothed or occasionally divided, but much less frequently so than in Anthemideæ. The involucre bracts are usually imbricate in several rows, in a few genera all nearly equal in about two rows. The capitula are usually heterogamous,

with one or more outer rows of female florets rarely sterile; the disk-florets also most frequently fertile, although in a few genera constantly sterile, and in a few others the capitula are homogamous from the deficiency of the female florets. The receptacle is usually naked, pitted, or shortly fimbriate, rarely bearing deciduous paleæ subtending the florets. The corollas of the female florets are sometimes produced into a trimerous entire or toothed ligula, the two inner lobes of the limb entirely deficient; or the corollas are slender, shorter than the style and truncate at the end, or with a small two- or three-toothed limb; those of the disk are regular, the limb more or less dilated or campanulate, with five, rarely four, teeth or short lobes; they are usually yellow, whilst those of the ray are in some genera homochromous, in others heterochromous, and white or variously coloured. The anthers are never without the normal terminal appendages to the connective, and either obtuse at the base or rarely sagittate with acute auricles, in a very few species mucronate, or almost produced into minute fine tails. The style-branches of the fertile disk-florets are more or less flattened, the marginal stigmatic series usually conspicuous, and beyond them a terminal papillose or hirsute appendage, sometimes very short and obtuse, more frequently triangular or lanceolate, occasionally narrow and elongated, almost as in *Vernoniaceæ*. Where the disk-florets are sterile, the style-branches are very narrow, or the style remains undivided. The achenes are usually small, flat, with nerve-like margins, or more or less five- or more ribbed, and becoming terete; rarely produced into a beak, still more rarely, if ever, winged. The pappus is usually setose and copious in one or more rows; in a few genera the setæ are plumose, in others much reduced or very few, or absolutely none, rarely replaced or accompanied by small thin paleæ.

4. *Inuloideæ*.

The tribe of *Inuloideæ*, as we propose to restore them, are nearly the same as the *Inulées* of Cassini. They consist of De Candolle's subtribes *Sphærantheæ*, *Tarchonanthæ*, *Pluchei-næ*, *Inuleæ*, *Cæsulineæ*, and *Buphthalmæ* taken from his tribe of *Asteroideæ*, and of the *Angiantheæ*, *Cassinieæ*, *Helichryseæ*, *Seriphieæ*, *Antennarieæ*, *Leysserieæ*, and *Relhanieæ* subtracted from the *Senecionideæ*. Their chief distinction from the two tribes they are thus withdrawn from consists in the basal appendages of the anthers, and in the absence of those terminal appendages to

the style-branches of the fertile disk-florets which are almost universal in Asteroideæ, and occasionally, if not very frequently, observable in Senecionideæ.

The leaves of Inuloideæ are, with very few exceptions, alternate and entire, occasionally decurrent, very rarely opposite or lobed, the involucral bracts usually imbricate in several rows, scarcely ever showing that equality of a single or inner row, with or without small outer ones, so frequent in Senecionideæ and Helenioideæ. The capitula are most frequently heterogamous, with one or more rows of female florets almost, if not quite, universally fertile, the disk-florets sometimes also fertile, but in not a few genera sterile; in some genera, however, the capitula are dioecious; and in a considerable number of the *Helichrysum* group of the subtribe Gnaphalieæ, in all Angiantheæ, and in a few genera of other subtribes they are homogamous from the total absence of female florets. The receptacle is generally without paleæ, except in the subtribes Bupthalmæ and Filagineæ, and a very few scattered genera of other subtribes, where it is wholly or partially paleaceous. The corollas of the female florets are either short, slender, and minutely toothed at the summit without any expanded limb, or produced into a trimerous entire or toothed ligula, the two inner lobes of the limb either entirely deficient or very rarely appearing in the shape of one or two short slender appendages at the base of the ligula. The corollas of the disk are generally those of Asteroideæ, Senecionideæ, and allied tribes, with four or five short teeth or lobes, very rarely more deeply lobed, those of both sexes almost, though not quite, universally homochromous and usually some shade of yellow. The anthers are never without the terminal appendage to the connective, which is normal in its shape; they are always more or less sagittate at the base; the auricles of adjoining anthers usually connate to the end and produced beyond the polliniferous part into tails or fine hair-like appendages, either simple or fringed with long hair-like branches. These appendages or tails may be all free, or those of adjoining anthers connate, so as to form ten or five only to the whole andrœcium. In the former case they are sometimes (*e. g.* in many Gnaphalieæ) so fine and short, and lie so close to the filament, that they may be readily, and have been frequently, overlooked; and they are, as above mentioned, absolutely wanting in some twelve to twenty species out of 1100. The style-branches of the fertile disk-florets may be more or less flattened, slender, or

somewhat dilated towards the end, rounded at the tip, or truncate and penicillate, as in *Senecio*, but always without terminal appendages, the stigmatic lines reaching quite, or very nearly, to the end. Where the disk-florets are sterile, their styles are almost always undivided and strongly papillose or hirsute. The achenes are various, usually very small, flat, terete, or angular in the subtribes with filiform female florets, longer in the radiate subtribes, very rarely rather large and black, as in so many Helianthoideæ, rarely produced into a beak, and never either winged or thick and hard or fleshy. The pappus is usually setose with simple or plumose setæ, but in the subtribe Buphthalmeæ more frequently paleaceous, and in a few genera or species of various subtribes reduced to a corona or very scanty or wholly deficient.

5. *Helianthoideæ*.

Our Helianthoideæ consist chiefly of De Candolle's subtribes Melampodineæ and Heliantheæ, and of his subdivisions Eugalinsogeæ and Madieæ, to which we have added the Eclipteæ, placed by De Candolle under Asteroideæ on account of a supposed conformity of the style to that of the latter and not of the former tribe. But a closer examination has entirely put an end to this artificial distinction, and the Eclipteæ do not even remain a distinct group of Helianthoideæ. De Candolle's nine genera have to be distributed into different subdivisions. Thus *Blainvillea* cannot be removed from its closely allied *Wedelia*; *Salmea* is very near *Verbesina*; *Dahlia* comes next to *Coreopsis*, *Siegesbeckia* to *Jægeria*, *Sabazia* to *Gymnolomia*; and *Cryphiospermum* is identical with *Enhydra*. The Helianthoideæ thus modified differ from Asteroideæ in their usually combining opposite leaves, a rigidly paleaceous receptacle, and a rigid pappus of few awns or paleæ. All these characters, however, have exceptions, and many minor circumstances must be taken into account in fixing the limits of the tribe.

Helianthoideæ are usually rather coarse herbs or shrubs, their indumentum generally more or less scabrous or hirsute, or sometimes silky with simple hairs, rarely intricately tomentose or woolly. The leaves, at least the lower ones, are most frequently opposite and entire or toothed; in some genera the upper ones, and in a few the whole of them are alternate; and much divided leaves occur in some of the subtribes. The involucrel bracts are very often biseriate, with a difference between the outer and inner rows,

but sometimes imbricate in several rows, very generally more or less herbaceous, but sometimes dry and rigid or membranous, very rarely the inner ones scarious. The capitula are most frequently heterogamous, with a single row of female and fertile or neutral and sterile florets in the circumference, the disk-florets fertile or in some subtribes uniformly sterile. In some genera also the capitula are (by the imperfection rather than by the absence of the male or female organs) strictly unisexual, either monœcious or diœcious; and sometimes the capitula are homogamous from the deficiency of the ray-florets. The fertile florets are uniformly subtended, and sometimes embraced by or enclosed in the paleæ of the receptacle or innermost bracts of the involucre. These paleæ are deficient only in the centre of the capitulum in the subtribe *Milleriæ*, where the disk-florets are always sterile, and in some *Madiæ*, where they are frequently so. The corollas of the outer female or neutral florets are usually ligulate and trimerous, very rarely with an irregularly campanulate limb, or shortly tubular; in the subtribe *Ambrosiæ* they are reduced to a short conical tube or entirely deficient; the corollas of the disk with five, or rarely four, short lobes or teeth; in a very few small genera there is a slight tendency to the bilabiate form, either by the development of one or two small fine upper lobes to the ray-florets, or by an irregularity in the disk-florets. These disk-florets are generally yellow, sometimes white, rarely purple; the rays usually homochromous. The anthers have the normal terminal appendage, except in *Eleutheranthera* and possibly a few species of allied genera; and in the *Ambrosiæ* these appendages terminate in inflected points; the basal auricles sometimes very short and obtuse, are more frequently acute, and sometimes produced into short points, which have been termed tails. The anther-tube, as a whole, is in many genera much exserted and black. The styles of the fertile disk-florets vary in different genera, from the truncate tips of *Senecio* to the appendiculate branches of *Asteroideæ*, or the subulate hispid branches of *Vernoniaceæ*. As in other tribes, the style remains undivided in the disk-florets of most genera where they are constantly sterile. The achenes are often rather large, either thick and hard or sometimes even succulent, or laterally or dorsally flattened and sometimes winged. The pappus most frequently consists of two or three rigid awns or scales corresponding, and often continuous, with the principal ribs or angles of the achene, with or without smaller interme-

diate scales; in most Galinsogæ the scales are more numerous and often equal, as in Helenioideæ, and in a considerable number of genera the pappus is entirely wanting; any tendency towards the setose pappus of Senecionideæ is exceedingly rare, the nearest approach to it being in some species of *Calea*.

6. *Helenioideæ*.

Our Helenioideæ, as we propose to circumscribe them, may perhaps not be so readily admitted as a distinct tribe as most of the others; for the genera we have grouped under that name pass respectively into Helianthoideæ, from which they differ chiefly in the absence of paleæ to the receptacle, or into Anthemideæ, from which they are separated by the involucre, habit, and in great measure by geographical distribution; and some species or small genera have almost the pappus, as well as other characters, of Senecionideæ. Yet we believe the tribe to be not unnatural, and that in thus uniting the groups of genera it consists of we leave the tribes from which they are withdrawn much better defined. These groups are De Candolle's division Gaillardieæ of his subtribe Helenieæ, his subtribe Tagetineæ, the few-flowered epaleaceous genera of his Flaverieæ, all included by him in his large tribe of Senecionideæ, with his Pectideæ, taken from Vernoniaceæ, of which, as above observed, they have neither the style nor the habit, involucre, or pappus.

Helenioideæ are all herbaceous or very shortly shrubby at the base, with the exception of the somewhat anomalous small genus *Cacosmia*. They are not so coarse nor so roughly hirsute as the majority of Helianthoideæ, often glabrous; the indumentum, when present, is usually cottony or soft, sometimes glandular or viscid. The leaves are often opposite, but in some genera even the lower ones are alternate, and vary from entire or toothed to the divided form so prevalent in Anthemideæ. The involucreal bracts are generally either in about two rows and more or less herbaceous, as in Helianthoideæ, but usually thinner, or in a single row with or without a calyculus, as in most Senecionideæ; but in a very few genera they are imbricate in several rows, or approach those of Anthemideæ, with the inner ones scarious. The capitula are heterogamous in most genera, with a single row of female or rarely neutral florets in the circumference; the disk-florets fertile or rarely sterile, homogamous in some genera by the absence of the female florets. The receptacle is uniformly naked or slightly pitted, except in *Gail-*

lardia, where it is fimbriate. The corollas of the female or neutral florets are ligulate and trimerous, usually forming a prominent ray, but sometimes small; those of the disk-florets with five, or rarely four, short lobes or teeth; all usually yellow and homochromous, or those of the disk purple, and the same colour extending sometimes to the base of the ray. The anthers are like those of Helianthoideæ with the normal terminal appendage, the basal auricles obtuse or acute, but scarcely pointed; the style-branches vary in different genera as much as in Helianthoideæ, from the truncate tips of *Senecio* and of the Anthemideæ to the appendiculate branches of Asteroideæ or the subulate hispid branches of Vernoniaceæ. The undivided style has been only observed in the sterile disk-florets of *Blennosperma*. The achenes are frequently longer and narrower than in the adjoining tribes, angular or terete, rarely flattened or winged, but in the Euheleniæ usually turbinate and hairy or woolly. The pappus is normally paleaceous; the scales definite or indefinite, obtuse or acute, or, when numerous, occasionally attenuated into setæ, almost like those of Senecionideæ; in some genera very short, rarely united in a cup, and in many genera liable to disappear altogether in one or more species.

7. *Anthemideæ*.

Our tribe of Anthemideæ is the same as De Candolle's subtribe of that name, after deducting two or three small genera which had been inadvertently placed there. It is closely connected as to a few genera with the subtribe Euheleniæ of Helenioideæ, as to one or two others with Senecionideæ; and the group of Cotuleæ almost pass into some of the epappose Asteroideæ; but, generally speaking, the involucre, the habit, the styles, and the want of any setose or aristiform pappus readily distinguish the tribe.

Anthemideæ are often odoriferous in their herbage; the great majority are herbaceous; but they also include shrubby species or genera; their indumentum is rather woolly, glutinous, or soft than coarsely hispid. Their leaves are, with very few exceptions, alternate, and most frequently lobed, much divided, or at least toothed; in a very few small genera opposite and entire. The involucreal bracts are usually imbricate in several rows, dry or, the inner ones at least, scarious at the end; in several genera, however, of the *Cotula* group they are nearly equal in about two rows and thinly herbaceous. The capitula are most frequently

heterogamous, with one or, in some *Cotuleæ*, several rows of female fertile, or rarely neutral and sterile, florets in the circumference; the disk-florets fertile, or in a few small genera sterile; but there are also several genera in which the capitula are quite homogamous, the ray-florets being deficient. The receptacle is with or without paleæ; when present, they are usually deciduous. The corollas of the outer florets are either short, slender, and minutely toothed at the summit, without any expanded limb, or more frequently produced into a trimerous, entire, or toothed ligula; the two inner lobes entirely deficient, or the whole corolla of the female florets reduced in some *Cotuleæ* to a small rudiment or entirely wanting: those of the disk are generally those of *Asteroideæ* and *Senecionideæ*, with four or five, rarely three, short teeth or lobes; these disk-florets almost always yellow, the rays either homochromous or heterochromous (white or pink) in one and the same genus. The anthers have the normal terminal appendage, and are usually obtuse at the base, always without tails or distinct points. The style-branches of the disk-florets are more constant in their shape than in most tribes, truncate and usually penicillate at the end, except in the sterile florets of two or three somewhat anomalous monotypic genera, where they are slender; and whether truncate or not, they remain connate to the end in the sterile florets of a few genera. The achenes are usually rather small, often angular and truncate at the top, or those especially of the ray dorsally flattened or triquetrous and sometimes winged. The pappus is very commonly deficient; when present, reduced to a paleaceous ring or cup or oblique auricle, very rarely consisting of small distinct paleæ, passing, in one genus, almost into the setæ of *Senecionideæ*.

8. *Senecionideæ*.

Our tribe of *Senecionideæ* consists of the subtribe *Senecioneæ* of De Candolle, with the addition, first, of the *Liabeæ* and *Tussilagineæ*, taken from his *Vernoniaceæ* and *Eupatoriaceæ* respectively, on account of their heterogamous capitula with the florets most frequently yellow; and, secondly, of the *Othonneæ*, removed from *Cynareæ* as not having the habit or characters of that tribe, the undivided style of the disk-florets being that of similarly sterile florets of most tribes. The anthers distinguish them from *Inuloideæ*, the pappus and habit from *Helianthoideæ* and *Helenioideæ*, the pappus and involucre from *Anthemideæ*.

The leaves of *Senecionideæ* are very various—alternate in the

great majority, but strictly opposite in a few genera, entire or variously toothed or divided. The indumentum is usually cottony and whitish or soft, sometimes glutinous, rarely coarsely hirsute, in one genus stellate. The involucre very generally consists of a single or almost simple inner row of equal, more or less herbaceous or membranous, rarely almost fleshy, bracts, united or free, with or without more or less of smaller outer ones, commonly called a calyculus; in a few genera, however, they gradually increase from the outer to the inner ones; they are never pungent, and rarely appendiculate. The capitula are usually heterogamous; the female florets in a single row almost always fertile; the disk-florets fertile in most genera, but all, or mostly, sterile in some others; and in a few genera, and several species of others, the female florets are deficient, leaving the capitula homogamous. The receptacle is usually without paleæ; these, however, are present, subtending the florets and usually deciduous, in two small genera (one of them monotypic). The corollas of the female florets are usually ligulate, with a trimerous spreading lamina, entire or toothed, the two inner lobes entirely wanting, or rarely present in the shape of one or two fine teeth or short filiform lobes; the disk-florets regular, with five, or rarely four, short lobes or teeth, the latter yellow or rarely white or purple; the ray-florets homochromous or, in a few species only, heterochromous. The anthers have the normal terminal appendage, and are usually sagittate at the base, with the auricles usually acute and sometimes produced into small points, but never into the hair-like tails of most Inuloideæ. The ordinary form of the style-branches of the disk-florets is with dilated truncate penicillate tips, as in Anthemideæ; but these in some genera bear obtuse or acute terminal appendages, hairy, as in Asteroideæ, but perhaps rather less flattened, and therefore called cones, and their hairs usually shorter than those which surround the base of these appendages; but in a few cases the styles pass into those of Asteroideæ, and in others the branches are so narrow and so much more equally hairy or papillose that they become in some genera almost, in others quite, like those of Vernoniaceæ or Eupatoriaceæ. Where the disk-florets are sterile, the style-branches are usually filiform and connate to the end. The achenes are various, usually angular or terete and striate, truncate or shortly contracted at the end, not beaked, flattened only in two or three small genera, and never winged. The pappus almost always setose and copious; the setæ usually fine

and soft, simple or rarely plumose, in a few small genera rigid, in a very few small genera or species of larger ones deficient on the achenes of the ray, and in *Gamolepis* on all the achenes.

9. *Calendulaceæ*.

Our small tribe of *Calendulaceæ* consists of De Candolle's subtribes *Calenduleæ* and *Osteospermeæ*, which he classes under *Cynaroideæ*, but which we consider much more closely connected with *Senecionideæ*. They have the style of the latter tribe, and differ from it chiefly in their involucre, the constant deficiency of pappus, and usually by the forms assumed by the ripe achenes of the outer, or of the next to the outer, row of florets.

Calendulaceæ are herbs or small shrubs, usually much branched or spreading from the base; the leaves are alternate or very rarely opposite, entire or toothed or lobed, very rarely much divided. The involucreal bracts are usually narrow, more open than in *Senecionideæ*, in one, two, or rarely three rows, herbaceous or membranous, often with scarious margins. The capitula are heterogamous, with the female florets in a single row, either fertile or sterile; the central disk-florets almost always, and sometimes the whole of them, sterile; the outer row of disk-florets often the most perfect of the capitulum. The receptacle is naked, or rarely bears a few setæ amongst the florets. The corollas of the female florets are ligulate, with a trimerous spreading or sometimes reduced lamina, entire or toothed; the two inner lobes entirely deficient; the disk-florets regular and usually with five short lobes or teeth, usually yellow. The corollas of the ray homochromous. The anthers have the normal terminal appendage, and are sagittate at the base, with acute, or rarely obtuse, auricles, often produced into small points, which might be regarded as short tails. The styles of the disk-florets, when these are fertile, have their branches usually truncate and penicillate at the tips, as in *Senecionideæ*; in the sterile florets the style is often undivided, as in many other tribes. The fertile achenes, or at least the outer row, often acquire an unusual development and various irregular shapes, much curved or arched or winged, or sometimes thick and hard, and they have never any pappus.

10. *Arctotideæ*.

Our tribe of *Arctotideæ* comprises, first, the subtribes *Arctoteæ*

and Gorterieæ of De Candolle's Cynaroideæ, differing from those we leave in the latter tribe in their heterogamous usually radiate capitula, in the absence of anther-tails, and, in some measure, in their styles; and, secondly, of the genera *Gundelia* and *Platycarpha*, withdrawn from Vernoniaceæ, of which they have neither the habit nor the styles nor any other important characters. Thus constituted, the Arctotideæ appear to form a connexion between Anthemideæ and Calendulaceæ on the one hand and Cynaroideæ on the other.

Arctotideæ are sometimes stemless or spreading herbs, more or less cottony-white or glabrous and *Anthemis*-like, sometimes with the prickly aspect of many Cynaroideæ, occasionally assuming the common South-African small shrubby form. The leaves are always alternate or radical, often much lobed and sometimes prickly-toothed. The involucral bracts are imbricate in several series, free with the inner ones often scarious at the end in the subtribe Euarctoteæ, usually connate at the base, and hardening after flowering in the Gorterieæ, pungent or prickly-toothed in many Gorterieæ and in Gundeliæ. The capitula are (with very few exceptions where the ray-florets are wanting) heterogamous and radiate, the florets of the ray in a single row and often sterile, and the disk-florets either all fertile or the inner ones, rarely all, sterile. In Gundeliæ the ray-florets are wanting and the capitula collected in close clusters or compound heads, with more or less of a common leafy involucre. The receptacle is usually without paleæ, but in several genera very deeply honeycombed, the raised cells almost or quite enclosing the achenes, or, in one genus, truly paleaceous. The corollas of the female florets are always ligulate, with a trimerous spreading lamina, entire or toothed, the two inner lobes usually deficient, but occasionally appearing as two short or slender teeth; the disk-florets regular, with five or rarely four short lobes or teeth (as in Anthemideæ); in most Euarctoteæ the limb deeply divided into narrow, often erect, lobes (as in Cynaroideæ); in most Gorterieæ and Gundeliæ the disk-florets yellow, the rays homochromous or reddish or purple, especially outside. The anthers have the normal terminal appendage; they are more or less sagittate at the base; the auricles sometimes obtuse, more frequently acute or produced into short points, without the distinct tails of most Cynaroideæ. The style-branches of the perfect disk-florets are linear or oblong, long or short, usually obtuse and papillose outside, the papillæ

extending frequently below the ramification, but not ending in an abrupt ring of hairs or swelling as in most Cynaroideæ. In the sterile disk-florets the style is usually undivided. The achenes are usually rather thick, often angular, and sometimes winged, and never beaked, occasionally densely hairy or woolly, without any or with a coroniform or paleaceous pappus.

11. *Cynaroideæ*.

We reduce the Cynaroideæ to the last nine of De Candolle's subtribes, which never have the capitula normally radiate, and in which the styles have usually an abrupt thickening or change of texture or ring of hairs below the ramification, at a point where the external papillæ commence; the branches are also usually very short or reduced to mere teeth. These characters, however, are not quite constant; and it is not easy to express in words any definite limitation of the tribe. Some Mutisiaceæ (Gochnatieæ), indeed, approach it very nearly; but otherwise I believe, there is never any ground for hesitation as to including or excluding any genus in or from it.

The Cynaroideæ are, with very few exceptions, herbaceous, and often assume that peculiar prickly habit which gives them the common name of Thistles. Their indumentum is usually loosely cottony or woolly, rarely silky or hispid. The leaves are always alternate, often sinuate or lobed or divided and prickly-toothed, but sometimes entire and rigidly ciliate or quite unarmed and soft. The involucreal bracts are always imbricate, in several, often numerous, rows. The capitula are usually homogamous, but have occasionally an external row (sometimes only a very few) of sterile or female florets. The receptacle, often thick and hard or fleshy, is usually densely covered with rigid, almost paleaceous, setæ, longer or shorter than the achenes, sometimes more or less united into paleæ at the base, in a very few small genera reduced to mere fimbriæ or minute teeth bordering the slight pits or areoles of the receptacle. The corollas of the circumferential, neutral or rarely female, florets have the limb usually enlarged and regular or slightly irregular, sometimes small and distinctly bilabiate; or if expanded into a ligula, it is pentamerous, as in Cichoriaceæ, only more deeply lobed, like that of *Stokesia* in Vernoniaceæ, never showing the trimerous ligula of the normally radiate tribes. The corollas of the hermaphrodite florets have the deeply and narrowly lobed limb of Vernoniaceæ, but often

oblique, still longer and narrower, and more abruptly dilated from the tube. The anthers, with the normal terminal appendages, are sagittate at the base; and, with very few exceptions, the auricles are produced into fringed appendages or tails. The style is usually, as above mentioned, an abrupt thickening or change of texture or ring of hairs (called by Cassini an articulation) at a greater or less distance below the ramification, and is more or less papillose (not hairy) from that to the end: the branches are most frequently short, rather obtuse, and erect or at length spreading, sometimes reduced to a scarcely perceptible notch, sometimes longer and linear; and in a few cases the external ring disappears and the branches are elongated and slightly dilated upwards so as to bring the style nearer to that of the *Arctotideæ* and of some *Inuloideæ*. The achenes are usually thick and often hard, rarely flat or winged, and never beaked. The pappus most frequently consists of several, often numerous, rows of rigid setæ, increasing in length from the outer to the inner, or to the next to the inner, row, with sometimes an innermost row more definite in numbers and more paleaceous; or the whole pappus may consist of this single row of definite or indefinite paleæ or setæ, with very few or none at all of the outer setæ; or the pappus may be reduced to short deciduous setæ or paleæ or be entirely deficient.

12. *Mutisiaceæ*.

Our *Mutisiaceæ* correspond to the *Labiatifloræ*, considered a suborder by several synantherologists, and comprise the *Mutisiaceæ* and *Nassauviaceæ* of De Candolle, excepting, however, from the former the small group of *Facelidæ*, which had been inserted by Lessing and retained by De Candolle for reasons not very intelligible, and since correctly referred by Weddell to *Gnaphalieæ*. They differ generally from *Cynaroideæ* in the corolla of some or all the florets being more or less bilabiate, and the want of the rigid setæ of the receptacle characteristic of most *Cynaroideæ*; but both characters have exceptions, and the precise limits of the tribe are difficult to fix in general terms.

The habit of *Mutisiaceæ* is most variable, but very frequently shrubby, or almost stemless except the radical scapes; the leaves alternate or radical, except in two monotypic genera, entire or toothed or pinnatifid, very rarely much divided or prickly. The involucreal bracts usually imbricate in several rows, rarely forming a single row of equal bracts, with or without small outer ones, as

in Senecionideæ. The capitula are homogamous, heterogamous, or sometimes dioecious; when heterogamous, often more or less radiate, but not always in the contrasted manner of the preceding tribes, the corollas being gradually modified or enlarged from the centre to the circumference, as in some Cichoriaceæ, or the ray-florets are irregular or 4-5-merous. The receptacle is naked or shortly alveolate or fimbriiferous, not rigidly setose as in Cynaroideæ, but in a few small genera bearing simple paleæ subtending the florets. The corollas exhibit every variation of the 5-merous limb, regular, bilabiate in various proportions, or expanded into a ligula, in a very few exceptional species becoming trimerous by the suppression of the inner lobes. The colour is very various; but the capitula appear to be always homochromous. The anthers have the normal terminal appendage; and the basal auricles have conspicuous, usually fringed, appendages or tails, except in two genera, where there is no trace of them. The style-branches when long are nearly those of Inuloideæ; but they are more frequently short or erect and connivent, or very shortly spreading at the tips, usually obtuse or truncate, always without terminal appendages, and papillose outside or penicillate at the tip in a few genera. The achenes vary much in form; their pappus is usually setose, simple or plumose, or formed of narrow paleæ, very rarely deficient.

13. *Cichoriaceæ*.

The Cichoriaceæ remain within the same definite limits originally assigned to them by Jussieu; they are at once known by their homogamous capitula, with the corollas all expanded into a 5-merous, truncate, 5-toothed ligula; and the only approach to them is traceable in the Vernoniaceous genus *Stokesia*, or in the Mutisiaceous genus *Catamixis*.

Cichoriaceæ are usually herbs, very rarely growing into shrubs or small trees, and are as rarely thistle-like and prickly. The leaves are always alternate or radical, entire or toothed or pinnatifid, rarely much divided. The involucrel bracts are imbricate in several rows, or equal in a single row, with or without external smaller ones, and are usually membranous or herbaceous, rarely scarious or rigid and prickly. The capitula are always homogamous, the outer row of florets sometimes rather longer, forming a sort of ray. The receptacle is naked, or in a few genera bears paleæ or setæ subtending the florets. The corollas are uniformly

ligulate, with a pentamerous spreading lamina, truncate and 5-toothed at the end. The anthers have the normal terminal appendage, and are sagittate at the base, with acute auricles often produced into a short point. The style-branches are those of the female florets of other tribes, slender, acute or almost obtuse, papillose but not hirsute, sometimes rather broader and slightly flattened. The achenes are various, usually narrow or flat, and sometimes produced into a slender beak. The pappus usually with one or more rows of simple or plumose setæ; but sometimes it consists of thin paleæ or of few setæ or awns, or is entirely wanting.

IV. HISTORY AND GEOGRAPHICAL DISTRIBUTION.

The ancient history of Compositæ must be more purely conjectural than that of many other large groups of plants. The geological record is remarkably scanty; but in the case of the members of this order, the absence of their remains is no proof of their non-existence at various geological periods. They are very rarely aquatic; and a comparatively small number only are to be met with on the borders of such waters as are wont to accumulate stores of organic remains; nor yet do they shed a profusion of leaves likely to be carried to any such hoarding-places. The great mass of them live, die, and are thoroughly consumed, without leaving a single fragment to serve as evidence or indication to future generations. It is only here and there that the winds appear to have carried an achene, by means of its pappus, to some place of deposit; and thus it is that Oswald Heer found in the upper miocene tertiary deposits of central Europe various impressions which he refers, on plausible grounds, to Compositæ. He is also probably justified in his conjecture that the great majority of them belong to Cichoriaceæ, two or three to Cynaroideæ, and that one is probably the achene of an aquatic *Bidens*. All this, if well founded, would show that at that tertiary epoch Compositæ existed in Europe of the same general character as those which are now to be met with. It would seem to prove that they had then already attained that highly differentiated character they now possess, and consequently must have been already of very old date, although they had left no previous record of their existence which has as yet been exposed to our observation. I can find no further reliable notice of fossil Compositæ; for I say nothing of Massalonghi's *Silphidium*-leaves; their reference

to Compositæ is only a wild guess without a particle of evidence in support of it; large herbaceous Compositæ are not in the habit of casting their leaves unwithered, so as to have become encased in mud unaltered in shape. Still less need I take notice of Martius's *Lychnophorites*, which have since been more plausibly referred to large monocotyledons of the *Vellozia* type. And even Heer's above-mentioned Miocene Composite achenes are doubted by some palæontologists, who contend that they are seeds of Apocynæ. Some, indeed, of Heer's figures show the pappus not to be strictly terminal, but to proceed from an oblique or somewhat lateral notch, which is unusual though not unknown in Compositæ (*e. g.* *Tourneuxia*); but many of the figures might be identified with more than one recent achene and pappus.

In the absence of all direct evidence we are left to judge of the antiquity and origin of Compositæ from their comparative structure and from their geographical distribution, as to both of which we have still much to learn, and in both which respects several of the boldest of modern hypothesisists have neglected or been ignorant of much that is known.

A general notion is prevalent, especially among French botanists, that Compositæ are at the summit of the scale of progression in the vegetable kingdom—that De Candolle's idea that the greatest perfection was to be sought for where, as in some Thalamifloræ, the essential parts of the flower, the petals, stamens, and carpels are the most distinct from each other, is altogether erroneous—that these Thalamifloræ are, in fact, the nearest to the Monochlamydeæ, which commence from the base of the Dicotyledonous scale—and that the high degree of consolidation in the floral organs of Compositæ is a strong proof of perfection and thence of a comparatively recent origin. It seems very probable that these views may be correct; yet, on the other hand, we must bear in mind that the numerous monotypic or oligotypic highly distinct genera confined respectively to the widely distant centres of preservation of the Mediterranean region, tropical and Southern Africa, Southern and Western Australia, Chili, the Mexican region, &c., point to a very wide dispersion of the original stock of the order at a very early period, when the physical configuration of the surface of the globe must have been very different from what it is now,—that this dispersion appears, indeed, to have been so early as to give time for the absolute fixation of secondary characters, which in most orders are very inconstant—and that, moreover,

previously to this dispersion the stock must have existed long enough to give absolute permanence and an otherwise unexampled constancy to those essential characters of primary importance which I shall recur to in detail. The presence of an involucre, the symmetry of the floral organs, the abortion of the calyx-limb, the æstivation of the corolla-lobes, the syngenesy of the anthers, and, above all, the structure of the pistil, fruit, and seed are not known to offer a single exception throughout the ten thousand species of the order.

But although Compositæ must thus have existed, in some shape or other, but yet with all these essential characters, at an early geological period, the differentiation of the larger groups probably took place after the isolation of the actual centres of preservation. Of the thirteen tribes adopted, two only, Asteroideæ and Senecionideæ, may be said to be cosmopolitan or nearly so. Cichoriaceæ, Cynaroideæ, and Anthemideæ belong to the northern hemisphere with chief centres in the Mediterranean and Central Asiatic regions; a few, but those (except some Cichoriaceæ) either forming part of or closely allied to Europæo-Asiatic genera, have spread over North America and even down the Andes to extra-tropical South America. Calendulaceæ and Arctotideæ are African, extending sparingly into Europe. Vernoniaceæ, Eupatoriaceæ, Helianthoideæ, Helenioideæ, and Mutisiaceæ are essentially American, but with a few types which may have arisen in the tropical and subtropical regions of Africa and Asia. The great tribe of Inuloideæ is for the most part Old-World, although the subtribes Plucheineæ and Gnaphalieæ have been long enough in America to have there formed a very few generic types. Before, however, drawing any further general hypothetical conclusions as to the early history of the order, and the course of its present distribution, it will be necessary to recapitulate successively the data hitherto supplied to us by the several tribes, subtribes, and principal genera it is composed of. For this purpose I propose taking the several tribes successively in their systematic order, although in the further details under each tribe I shall endeavour to take genera and subordinate races as much as possible in their natural rather than in their technical limits. I shall then proceed to consider the chief centres or regions occupied by the present races of Compositæ, the limits to be assigned to them, their distinctive characters and mutual connexions. I must now, however, observe, to prevent misunderstand-

ings in the following detailed notes, that these regions are founded solely on the distribution of Compositæ, and would require much modification as to those orders of plants especially which take a part in forest vegetation. I must also explain that the Mexican region, here often referred to, includes California, W. Texas, and a portion of Central America, and that the Mediterranean region, in the Composite sense, must include the Levant and Persia.

A. DISTRIBUTION OF THE TRIBES AND PRINCIPAL GENERA.

1. *Vernoniaceæ*.

This tribe, as limited for systematic purposes, consists principally of one large genus with a number of smaller ones closely connected with it, forming altogether one subtribual or generic group of a higher order; and to this are added a few small genera so distinct as to leave some doubts as to their real affinities. I shall here, therefore, commence with the principal genus.

Vernonia, a genus, as we now propose to limit it, of nearly 400 species, and closely connected with about 25 smaller genera comprising above 120 more species, has its chief centres in tropical America and tropical Africa, forming in both countries more or less divergent groups, but in different directions, the species more numerous in America, the forms more varied in Africa. From tropical America it spreads more sparingly into North America and extratropical South America, and from tropical into Southern Africa, and eastward into tropical and subtropical Asia, forming in each of these outlying districts more or less local groups. More than three fourths of the genus belong to the section *Lepidaploa*, which, rather from its wide geographical range and connexions than from its happening to include the species first taken as the type, may be conjectured to be nearest to the original form. At least four fifths of its species are tropical American; but it includes also the North-American ones, a portion of those from Africa, and five or six Asiatic species. In this section the achenes are equally 10-ribbed, with the inner setæ of the pappus long and fine, rarely slightly dilated, the outer numerous and short, more frequently flattened and almost scale-like than fine. This great multitude of species has to be methodized and distinguished by foliage, general inflorescence, size, and shape of the capitula, and by the obtuse, acute, or aristate, appressed, or squarrose invo-

lucral bracts; but even these secondary characters are most frequently differently combined in the New and in the Old World and in the different regions of each. No other section or group of *Vernonia* can be strictly said to be common to the New and the Old World. Aberrant modifications of some one of the more important characters may indeed be observed in both the regions, but differently combined in the two with other characters.

1. In the two Brazilian species of *Hololepis* and the single Mexican *Leiboldia* there is not the usual disproportion in the pappus, the outer setæ being but little distinguishable from the inner in length, numbers, or rigidity. The Brazilian *Hololepis* is, moreover, remarkable for the large involucre, of which the outer foliaceous bracts conceal the inner ones. The Mexican *Leiboldia* has also rather large involucre; but its bracts are all acute and normally accrescent from the outer to the inner. In the Old World we have in the *Vernonia calycina*, Wall., from Prome, a close representative of the Brazilian *Hololepis* as to habit and involucre, and the pappus also abnormal, but in a direction peculiar to the Old World; the outer setæ, though longer than in *Lepidaploa*, are fewer and shorter than the inner ones. In the tropical-African *V. purpurea*, Sch. Bip., the outer bracts are sometimes enlarged and foliaceous as in *V. calycina*; but the pappus is normal, and the plant is in other respects a true *Lepidaploa*.

2. The tropical-American *Critoniopsis*, containing five or six species, with a normal pappus, is distinguished by its ample panicles of small few-flowered capitula, the involucre bracts obtuse, the inner ones frequently very deciduous, as in the allied genus *Piptocarpha*. This section is not identically present in the Old World, but is there represented by the section *Strobocalyx* of about a dozen species, with similar inflorescence and capitula; but the pappus has the tendency, so frequent in Old-World *Vernoniæ*, to the attenuation, reduction, or almost total disappearance of the small outer setæ of the pappus.

The aberrant forms peculiar either to the New or to the Old World, which, however, we have thought not sufficiently distinct to retain as separate genera, are the following:—

1. In tropical America the three small sections *Stenocephalum*, *Trianthæa*, and *Eremosis* have the normal pappus and other essential characters of the original *Vernonia*; but the narrow involucre contains but very few florets. In *Stenocephalum* the

inflorescence approaches that of the *Lychnophoreæ*, a truly American type; but the section is closely connected with the ordinary *Lepidaploæ* through *V. obtusata*, Less., and others. *Trianthæa* is more normal in general inflorescence as well as in the involucre, except that it contains usually only three florets; and *Eremosis* only differs in these florets being reduced to a single one. Triana's *Lherasia*, from the mountains of Columbia, must be included in the section *Trianthæa*, with a habit still nearer to that of *Oliganthes*. In the Old World when the *Vernonia*-capitulum becomes 3-flowered or only single-flowered (*Monosis Wightiana*, DC.) the species assume the habit, inflorescence, and involucre of *Strobocalyx* above referred to.

Vernonia complicata, *V. bahamensis*, and *V. lepidota*, Griseb., from Cuba or the Bahamas, are insular aberrant forms which require further study and comparison with the S.-American genus *Piptolepis*, or the San-Domingo *Piptocoma*, of which last I have seen no specimen.

2. In the Old World the section *Stengelia*, including *Ascaricida*, with the inflorescence, pappus, &c. of *Lepidaploa*, diverges in the involucre, of which the inner bracts end more or less in membranous coloured appendages, a character not carried further in any allied genera. In some species the setæ of the pappus become flattened and more rigid, showing a tendency towards the paleaceous pappus of the American *Stilpnopappus* and its allies—a tendency which, however, does not appear to be carried any further in any Old-World genus allied to *Vernonia*; for *Herderia* is probably more nearly connected with *Ethulia*.

The sections *Gymnanthemum* and *Xipholepis* are chiefly characterized by the reduction of the outer pappus to fine setæ, few in number, of variable length, and sometimes disappearing altogether—a circumstance towards which American forms show no tendency, except in *Lachnorhiza*, a Cuban species, which, on account chiefly of its peculiar habit and the form of its involucre, very different from those of the Old-World *Gymnanthema*, has been admitted as a distinct insular genus.

The sections *Cyanopis*, *Lepidella*, and *Tephrodes* exhibit a divergence which would at first sight appear important enough to raise them into a distinct genus, but that the main character, the 4- or 5-angled, or almost terete and nerveless, not equally 10-ribbed achene, is so variously combined with others in species which in other respects would belong to *Lepidaploa*, and is, moreover, so

vague in some species where the secondary ribs are present but much less prominent than the primary ones, that no tolerably fair line of demarcation can be drawn between the groups. The pappus in the three sections is very nearly the normal one of *Vernonia*: that of *Tephrodes* usually white, copious, and rather soft; that of *Cyanopsis* more fragile, approaching that of *Centratherum*; that of *Lepidella* with the outer short row more paleaceous, as in many American *Lepidaploæ*. No American species, as far as I am aware, shows the 4- or 5-angled or the nerveless achenes of these Old-World groups.

The Mascarene section *Distephanus* (two species), with a somewhat different habit, a compact inflorescence, and a remarkably fimbriate receptacle, might perhaps be maintained as a distinct genus; but the extreme vagueness of the character derived from the receptacle (a tendency to which is observable in several African species) will probably justify its reduction to a section, chiefly geographical, of *Vernonia*. Another supposed Mascarene genus, *Bechium* (a single species), appears to me to be a true *Lepidaploa*, with a slight tendency to the coloured tips to the bracts of the involucre of *Stengelia*, and a somewhat peculiar habit, the leaves being almost radical.

The numerous Vernonioid genera, most of them small or monotypic, which have been maintained around *Vernonia*, partly from habit, but chiefly on account of more or less marked divergences in characters regarded as essential, but which are yet connected with the main group by small gradations, may be classed as follows according to the nature of those divergences:—

1st. In the mucronate or subcaudate anther-auricles.—This is exhibited in one American and three Old-World genera.

The American *Piptocarpha*, with nearly twenty species, is closely connected in involucre, and in one species in inflorescence, with the American section *Critoniopsis* and the Old-World *Strobocalyx*; most species, however, have a peculiar inflorescence of a character much more American than Asiatic or African. The pappus is sometimes the normal Vernonian double one; sometimes the outer series is reduced to a few fine setæ, or disappears altogether, as in the Old-World *Strobocalyx*.

In the Old World the few cases of Vernoniaceæ with subcaudate anthers show a different combination of other characters. The three genera *Centauroopsis* from Madagascar with two species, *Adenoon* from the E.-Indian peninsula, and *Pleurocarpæa* from N. Aus-

tralia, both monotypic, have each a much reduced pappus; in *Centauropsis* it is copious, but shorter than the achene, in *Pleurocarpæa* reduced to the few exceedingly caducous setæ of the American *Centratheræ*, in *Adenoon* entirely deficient. In all three the involucre bracts are very persistent, quite different from those of the American *Piptocarpha*.

2nd. Divergences in the receptacle.—In the Old World the receptacle rather deeply foveolate and fimbriiferous, which has served to distinguish the above-mentioned Mascarene section *Distephanus* and the genus *Bothriocline*, a single tropical African species, is but little more than may be observed occasionally in several Vernoniaceæ of other genera, both in the Old and the New World, and even in *Vernonia* itself; in *Distephanus* it seems to be accompanied by some slight difference in habit, in *Bothriocline* by a peculiar involucre, as also by opposite or whorled leaves, a circumstance otherwise unknown in the whole tribe of Vernoniaceæ except in a single Brazilian, otherwise normal, *Vernonia*. In America, among the genera otherwise closely allied to *Vernonia*, the Brazilian monotypic *Albertinia* has the receptacle so deeply alveolate as completely to envelop the achenes; and the Mexican *Bolanosa*, also monotypic, has separate caducous paleæ embracing each floret, with the habit, involucre, and other characters quite those of a *Vernonia* (*Lepidaploa*). Neither of the above characters, however, is of more than generic value, occurring in groups otherwise very far distant from each other. The deeply alveolate receptacle is met with, for instance, in the Helianthoid *Balduina* from North America, and in several South-African Arctotideæ. The deciduous paleæ of *Bolanosa* occur here and there in species or genera of Eupatoriaceæ, Asteroideæ, Senecionideæ, and other tribes usually deprived of them.

3rd. Divergences in the pappus.—The indefinite setæ of the inner or principal pappus of *Vernonia* assume a paleaceous character in several tropical American genera, otherwise nearly connected with *Vernonia* (*Stilpnopappus* and others); whilst in the Old World there is only a slight tendency in this direction, as already observed in some species of the section *Stengelia*, without being there carried further. On the other hand, the same paleaceous pappus prevails generally, though not universally, through the strictly American genera with glomerate capitula to be mentioned presently. This is, therefore, a type much developed in America, but early arrested in the Old World, or an old type

which has retained more permanency in the former than in the latter region.

The reduced pappus is common to the New and the Old World, but more frequent and more regularly connected with that of *Vernonia* in the latter than in the former. *Centratherum*, with the setæ exceedingly caducous and usually a peculiar involucre, is common to both regions, but much more marked in America, where it is limited also to one or two species passing into *Oiospermum* without any pappus at all, and never having any near approach to the ordinary pappus of *Vernonia*; whilst in Asia and Africa it is connected by various gradations with *Vernonia*, especially with the section *Cyanopis*, in which also the pappus is frequently deciduous, and does not seem to pass gradually into the African pappusless genera *Ethulia* and *Gutenbergia*. The latter, indeed, especially *Ethulia*, seem to be more nearly connected with *Herderia*, also African, in which the developed pappus has a very different character from that of *Vernonia* and its modifications.

4th. Divergences in the involucre.—These are so great within the genus *Vernonia* itself, that they are scarcely admissible as distinctive generic marks, except when combined with other characters as in the above-mentioned *Centratherum* and *Oiospermum*, or with habit and geographical isolation, as in the Cuban *Lachnorhiza*, to which also I have already referred.

5th. Divergence in the general inflorescence.—A large group of American Vernoniaceæ diverge gradually from the typical *Vernoniæ* in their compound inflorescence—the flower-heads, either 1- or few-flowered, being closely sessile several or many together on a common receptacle, so as to give the whole mass the general appearance of a single capitulum. In *Lychnophora* and most of its allies this change is accompanied by an alteration in the pappus, which is paleaceous as in *Stilpnopappus*; but in *Eremanthus* it passes sometimes almost into that of *Vernonia*, and in *Vanillosmopsis* into that of *Centratherum*, whilst in some *Vernoniæ* and *Piptocarphæ* the few-flowered capitula, sessile in small clusters, further connect the true *Vernoniæ* with the *Lychnophoreæ*. All these modifications are American; the Old-World *Vernoniæ* and groups immediately connected with them show no tendency to the compound inflorescence, although it is there exhibited in several genera belonging to other tribes.

The mere reduction of the number of florets to very few or to a single one, which induced the establishment of the separate genus

Monosis, is now found to take place in so many and so various genera of Compositæ, that it is no longer held to be more than a specific character.

The tribe of Vernoniaceæ is made to include several small groups or isolated species, which, although they have the general characters of the tribe, are not, as far as at present known, connected with the central *Vernonia* group by any gradation of intermediate forms; these are:—

1. *Elephantopus*, somewhat related to Lychnophoreæ, will be further mentioned under the head of American genera with one cosmopolitan species.

2. *Sparganophorus*, *Pacourina*, and *Heterocoma*, three monotypic tropical American genera, connected with each other in inflorescence and in the development on the top of the achene of a prominent ring or cup, either alone constituting the pappus or encircling a pappus of small caducous bristles. The essential characters are truly Vernonian; and some approach to their peculiar inflorescence may be seen in a few species of *Vernonia*, *Piptocarpha*, *Stilpnopappus* &c.; but of the terminal cartilaginous ring the only trace I have observed is in the Old-World *Ethulia*, very different in general character.

3. *Stokesia*, a monotypic North-American genus, stands alone without any near relations. Its remoter affinities are on the one hand with Vernoniaceæ, of which it has the style and anthers, and under which it is therefore classed, and on the other with Cichoriaceæ, which it approaches in its blue almost ligulate and 5-merous although deeply lobed corollas. It is the only genus not Mutisiaceous which shows any such connexion with that very marked tribe.

4. *Corymbium*, a small South-African genus with the Vernonian style; but the habit, involucre, silky-villous achenes, and the pappus are very different from any thing else known in the tribe. No other nearer connexion, however, has occurred to me.

5. *Rolandra* and *Spiracantha*, two monotypic tropical American genera, with very numerous minute 1-flowered capitula, collected in globular head-like axillary clusters, as in some Lychnophoreæ, and perhaps on the whole best placed, as hitherto, amongst Vernoniaceæ, although they have neither the characteristic style nor the corolla of the tribe, showing possibly some connexion, although a distant one, with some American small-flowered Helianthoideæ or Helenioideæ.

2. *Eupatoriaceæ*.

Eupatoriaceæ may be regarded as one large and natural essentially American group or genus in an extended sense of the term; for, multifarious and distinct as it is, some of the last mentioned small groups or monotypic genera of *Vernoniaceæ* rank as high in the latter respect. *Eupatoriaceæ* must, therefore, either not be so ancient as some other groups of *Compositæ*, or some other reason must have interfered with their early dispersion; for although abundant and evidently early established over the whole of temperate and tropical America, from California to Chili and Buenos Ayres, as evidenced by the distinct local generic groups they have formed in North America, in the Mexican region, in the tropical Andes, in Brazil, and in Chili, they are either wholly absent or have not, with the single possible exception to be presently mentioned, produced any distinct species in tropical or transtropical Africa, Asia, or Australia. They are indeed entirely absent from the Australian flora, and would be also wanting in the floras of tropical and southern Africa and tropical Asia, but for three essentially American genera, *Adenostemma*, *Ageratum*, and *Mikania*, which have each one cosmopolitan species, and will be considered hereafter, and for one or two species of *Eupatorium* itself, which from Northern Asia may have penetrated within the tropical limits.

This leads us to the northern and sole connexion of *Eupatoriaceæ* with the Old World, which may be observed in two genera:—1st, in the wide-spread American genus *Eupatorium* itself, which has in that continent above 400 species, and is represented in the Old World by about 8 or 10 rather variable species, all of one North-American type, although not exactly identical with any one species of that country, most of them from Eastern Asia, one of which extends over the whole of Europe, another (by some considered an extreme variety of an Asiatic one) is scattered over the Mediterranean region, and reappears almost in the same form in the Canary Islands, and another, also near the Asiatic ones, has been found on the Zambesi in south tropical Africa. There is, indeed, such a general family likeness between these Old-World forms and some of their E. North-American congeners, that they may well be imagined to have sprung from some parent race that may have passed over from America, and in the various vicissitudes of their career through the lapse of ages, spreading gradually over a vast extent of territory, disappear-

ing in some places and flourishing and further migrating in others, have become gradually differentiated into species which may scarcely yet be taken as perfected. 2nd, in the genus *Adenostyles*, which has one Californian and two European species, without any known representative in the vast intervening regions of Asia on the one side, or of central and eastern North America on the other. There is no doubt of the generic identity; the Californian species, though quite distinct from either of our European ones, is yet more nearly allied to one of them (*A. alpina*) than the two European ones are to each other. Like many others now confined to America, the genus probably once ranged over a great part of the temperate northern hemisphere, and instead of disappearing from the whole of the Old World, has kept its ground in Europe, becoming extinct in Asia.

It is this same genus *Adenostyles* which alone supplies some sort of link connecting Eupatoriaceæ with any other tribe; for in habit and involucre it shows some approach to some species of *Senecio* (*Cacalia*), although the style and other characters leave no doubt as to its being a true Eupatoriacea.

Eupatoriaceæ, within American limits, have formed a number of genera, groups of genera, or subgenera, more or less local or general, but most of them passing so nearly one into the other as to require little notice for the present purpose. The most remarkable is perhaps the group or subtribe of Piquerieæ, characterized by the anthers truncate at the top, without that appendage to the connectivum so universal in the rest of Compositæ. It comprises 7 genera, with about 30 species, chiefly Western, ranging from Chili to Mexico, with two or three South-Brazilian and three Cuban species; it includes also the above-mentioned *Adenostemma*, to which I shall refer under the head of genera with one cosmopolitan species. This remarkable deviation from the almost absolute uniformity of Compositæ is probably, therefore, of West-American origin, and not ancient enough to have spread into other continents now severed from America. I have not observed it in any other group of Compositæ, although the appendage may be very much reduced in a very few tropical American Helianthoideæ.

The other deviation I would mention is not so important, nor very strictly defined, but purely local. The three genera (or subgenera) *Liatris*, *Trilisa*, and *Carphephorus* form a little North-American group, almost limited to the regions east of the Andes or

Rocky Mountains. Their constantly alternate leaves, their general habit, and, to a certain degree, their corollas, may indicate some approach to the Vernoniaceæ; but their styles and other most important characters are essentially Eupatoriaceous.

3. *Asteroideæ*.

The vast tribe of *Asteroideæ* is neither so well marked as a whole as *Vernoniaceæ* and *Eupatoriaceæ*, nor yet is it well divisible into distinct groups. Nearly the whole of the 90 genera, comprising above 1400 species, pass into each other through exceptional or intermediate forms; and there are species if not genera closely connecting *Asteroideæ* with *Inuloideæ*, with *Anthemideæ*, and with *Senecionideæ*. Of these four intimately connected tribes, comprising about half the known *Compositæ*, two, *Asteroideæ* and *Senecionideæ*, are cosmopolitan, the two others chiefly Old-World.

The *Asteroideæ* not being divisible into distinct subtribes, we may for geographical purposes consider a certain number of types with the various divergences from them, and then take up a few comparatively isolated forms. The principal of these types are *Grangea*, *Bellis*, *Solidago*, *Aster*, *Erigeron*, *Conyza*, and *Baccharis*. Six of them are common to the New and the Old World, the first two chiefly belonging to the Old World, the next four more numerous in the New, and *Baccharis* entirely American. The whole tribe affects chiefly temperate or mountain regions of both hemispheres, tropical *Asteroideæ* being comparatively rare.

1. The *Aster* type.—*Aster*, taken in its most extended sense, ranges over the whole area of the tribe; but isolation has been ancient enough to admit of its having established special forms in different countries, which are now admitted as genera by most botanists. *Aster* itself, as we have limited it, forms a group of about 250 species belonging to the temperate regions of the northern hemisphere, chiefly North American, a very few species rather abnormal descending along the western regions into South America, and a mountain form connected with a European and Asiatic one crossing the equator in Eastern Africa. These true *Asters* are herbaceous, usually perennial, often tall, though some mountain species are quite dwarfed or almost stemless; the involucre are usually broad, the heads heterochromous, the achenes flat, and the pappus copious. Among the modifications observed within the genus as we now retain it which some asterologists

have considered to be in themselves of generic importance, the following are more or less connected with geographical distribution:—

(1) The section *Alpigenia*, ranging over the mountain-regions of the northern hemisphere, and including the above-mentioned transtropical African species, with the achenes and pappus of the typical *Asters*, acquires the habit and involucre and, in some measure, the increased numbers of ray-florets of a corresponding mountain group of *Erigeron* inhabiting the same regions, and thus to a certain degree connects the two genera.

(2) The Andine section *Noticastrum*, consisting, as far as known, of two species only, with a slight modification in the ribs of the achenes, but with the pappus and other essential characters of *Aster*, closely connects the genus with the Andine group of *Erigeron*; whilst the nearly related section *Heterastrum*, also South American and chiefly extratropical, approaches another South-American set of *Erigeron*, even in the pappus, and has been alternately placed in both genera. So, also, the section *Oxytripolium*, with very few species dispersed over North and South America, connects the same set of *Erigerons* with the section *Orthomeris* of *Aster*. This latter section, chiefly differing in the involucre, although present in North America, has been much more developed and become much more varied in Asia.

(3) *Tripolium* and *Galatella* are Europæo-Asiatic forms characterized chiefly by the reduction, sterility, or disappearance of the florets of the ray, towards which there is very little tendency in N. America, although *Galatella* itself is there represented by one species. *Tripolium* is a single very variable species with a peculiar involucre, the ray-florets sometimes abundant and conspicuous, sometimes very few or absolutely none. *Galatella* has the involucre of the section *Orthomeris* (the one most abundant in Asia); but the female florets are usually sterile or have not even a rudimentary style, or in some species are usually entirely deficient. For the latter case the genus *Linosyris* was established; but it has been proved that the Old-World species sometimes acquire the ray and become true *Asters* of the section *Galatella*. The American species associated with *Linosyris* on account of the absence of ray-florets belong rather to the *Solidago* group to be presently referred to.

Close around *Aster* are two small genera belonging geographically to parts of the main region of that genus, and which, even

on structural grounds, might perhaps be restored to it as sections,—the N.-American *Sericocarpus* of 5 species, and the Asiatic monotypic *Callistephus*.

Six other genera, not diverging more or perhaps even so much as the above two in essential characters, but with a very different geographical range and apparent origin as well as a distinct habit, have been by several botanists reunited with *Aster*, because they have no distinct character which is not liable to exception. But the species are numerous and the exceptions few; and, geographical considerations coming in aid, it would seem to be more in conformity with the evidences of affinities thus obtained to maintain them as distinct genera. These are:—

(1) The South-African genus *Felicia* (including the greater portion of *Agathea*), about 45 species, much branched shrubs, or, if herbaceous, small annuals branching from the base, all very unlike any American true *Asters*, retaining the achenes but not the pappus of that genus, which is more like that of *Erigeron*, but different from either in its fragility. The very few exceptions in their case consist in one or two eastern species approaching in some respects the alpigenous *Asters* represented in the same country by *A. natalensis*. Closely connected with these *Felicias*, and perhaps not separable, is the monotypic extratropical S.-American *Sommerfeltia*.

(2) The Australian genus *Olearia*, about 85 species, mostly shrubby, like the S.-African *Felicias*, but larger and retaining, not the achene but the pappus of the American *Asters*. This achene is no longer flattened, but terete or nearly so. There is also an occasional tendency to extreme acuteness or even fine points to the auricles of the anthers, never observable in any true *Aster*, but traceable sometimes in another Antarctic or Australasian genus, *Celmisia*, to be presently referred to. The exceptions in this case are a very few Australian herbaceous *Oleariæ*, but with a very different habit from any American *Asters*, and a very few N. American *Asters* (*Biotiæ*) with subterete achenes, but accompanied by a typical American involucre and other characters not to be met with in *Olearia*. These circumstances taken together constitute a much greater difference between *Aster* and *Olearia* than is observable between the alpine *Asters* and *Erigerons*.

(3) The antarctic or subantarctic American genus *Chiliotrichium*, a genus of three species, one of the numerous connecting links between the Australian and the extratropical or Andine S.-American

floras. It is closely allied as well to *Olearia* of the former as to *Diplostephium* of the latter region, differing slightly from both in the presence of a few paleæ on the receptacle.

(4) The South-American Andine genus *Diplostephium*, of about 18 shrubby species, more nearly connected, perhaps, with the Australian *Olearia* than with the American *Asters*, but with a habit and foliage of their own. The achenes are terete or nearly so, not flattened as in *Aster*; and the pappus tends much more than in that genus to the shortening of an outer row of setæ.

(5) & (6) *Commidendron* and *Melanodendron*, two insular genera, the former of three, the latter of a single species, all confined to the island of St. Helena, where they may have been originally differentiated from the ancient type of the group, and, like a few others of the most ancient St.-Helena plants, appear to have retained more of a S.-American (Andine or Western) than of a South-African character. Their nearest connexion is with *Diplostephium*, not with *Felicia*.

2. The *Erigeron* type.—*Erigeron*, taken in an extended sense, has nearly the same geographical range as *Aster*, but without so great a tendency to develop local forms, geographical subgenera, sections, or species. It is also, in point of structural characters, very closely allied to and blending in with *Aster*, touching it at various points, and passing into it more gradually than the above-mentioned semi-geographical genera *Felicia*, *Olearia*, &c.; and yet synantherologists are unanimous in its admission into the ranks of genera of the first order. It passes, indeed, quite as gradually into *Conyza*, and thence into other equally large groups, which, unless we give up all idea of methodizing, must be admitted as very different, although they cannot be strictly defined. This greater blending into allied forms may also not be due to any nearer genealogical affinities, but possibly to greater inherent facilities for propagation, dispersion, and original intercrossing of breeds.

The species of *Erigeron* are in general less distinct from each other than those of the *Aster* type; and most of them are far more widely dispersed; a few also as annual weeds multiply exceedingly wherever they are carried with cultivation, in this respect also agreeing more with *Conyza* than with *Aster*. To distinguish, however, *Conyza* and *Erigeron* from *Aster*, we have but little besides the increase in number and reduction in size of the female florets, which in *Erigeron*, although they have still the corollas produced into a ligula, have that ligula always very narrow, and

often short ; whilst in *Conyza* these corollas are still further reduced to a filiform tube, shorter than the style, toothed or truncate at the top, the ligula remaining undeveloped. The achenes, also, both in *Erigeron* and *Conyza*, are usually much smaller than in *Aster*, with the pappus much less copious, of finer setæ, usually but not always in a single row.

The same great facilities enjoyed by many species of *Erigeron* for propagation and dispersion increase the difficulty of fixing the geographical origin of some of the sections of which it is composed. *Euerigeron*, ranging from *E. uniflorus* and *E. alpinus* to *E. acris*, belongs to the northern hemisphere, and is chiefly mountainous, passing into the section *Alpigenia* of *Aster*, and may be as much, or nearly as much, of Old-World as of American extraction. *Cœnotus*, the section which passes into *Conyza*, is now pretty nearly cosmopolitan, and, like *Conyza*, overruns tropical as well as temperate regions, the preponderance of local species being African as well as American. The other sections appear to be chiefly or entirely American, and perhaps all of American origin. *Phænactis*, however, belonging to the northern hemisphere, has two genuine Asiatic species. *Phalacroloma* consists of American annuals, two of which have overrun a great part of the Old World as weeds, like the well-known *E. canadensis*, which is almost intermediate between *Cœnotus* and *Euerigeron*. *Erigeridium* is a single N.-American species of *Euerigeron*, somewhat aberrant in the form of the achene, a deviation which does not appear to go further in any genera of the *Erigeron* group. The South-American sections are rather more distinct and local. *Leptostelma* is a purely Brazilian form, resembling some of the large-flowered North-American species of *Phænactis*, but with an exceptionally fimbriiferous receptacle. This also does not connect itself with neighbouring genera. *Oritrophium*, from the Andes, aberrant both from *Aster* and *Erigeron* in the form of the style-branches, in other respects approaches the Andine section *Noticastrum* of *Aster* nearly as much as the northern *Euerigeron* approaches *Alpigenia*; *Oritrophium* assumes also often the habit of the more southern *Celmisia*, but differs in the achene and other characters. *Terranea* (*E. fruticosus*, DC.), from the island of Juan Fernandez, approaches *Aster* in a third direction, being closely connected in many respects with the South-American chiefly maritime *Oxytripolia*.

Around *Erigeron* may be grouped the following slightly divergent genera, designated as much by their geographical areas as by

any structural characters, and yet natural enough to be readily recognized:—1. The Antarctic and Australian genera *Pleurophyllum* and *Celmisia*, closely connected with the Andine section *Oritropium* of *Erigeron*, differ from it chiefly in the shape of the achene, which is more that of *Olearia*, a genus bearing the same geographical relation to *Aster* that *Celmisia* does to *Erigeron*. 2. The Hawaiian *Tetramolopium*, an insular group of about half a dozen species, which during its long isolation has, like so many other insular forms, assumed more or less of a shrubby habit. In this respect it is still connected with *Erigeron* through the similarly insular (Juan Fernandez) *Terranea* above mentioned. As to structural characters, *Tetramolopium* has, on account of its subulate style-appendages, been connected by A. Gray with *Vittadinia*; but the latter genus appears to me to be further removed from *Erigeron*. A similar style is observable in the Andine section *Oritropium* of *Erigeron*. 3 & 4. The small Asiatic extratropical genera *Brachyactis* and *Lachnophyllum*, the former with one species extending into North America, both nearly allied to *Aster*, *Erigeron*, and *Conyza*, the species banded about from the one to the other, difficult technically to distinguish from them, but with a peculiar habit justifying their maintenance as distinct genera, unless the three great types be reunited into a single one. 5. The Asiatic and African *Microglossa*, which, however, may be best considered, with its other relations, under the *Conyza* type.

There are yet two genera connected with *Aster* and *Erigeron*, but rather more clearly distinguished on structural grounds, and to a certain degree supported geographically, both with elongated although still flattened achenes, with the pappus almost that of *Aster*, but with a habit more approaching *Erigeron*: one is *Podocoma*, with five South-American and one Australian species in which the achene is attenuated into a beak, whilst the style is that of *Aster*, but the ligulæ more numerous, like those of the *Aster*-like *Erigerons*; the other, *Vittadinia*, has the flowers of *Erigeron*, or almost of *Conyza*, elongated but beakless achenes, the pappus nearly of *Aster*, and the subulate style-appendages of the section *Oritropium* of *Erigeron*; and with these characters we find species scattered over South America and Australia, as in the case of *Podocoma*, but with the addition of one from the Sandwich Islands.

There are, again, a number of small or monotypic genera ranging geographically around the *Aster* or *Erigeron* groups, which have

been in a great measure technically distinguished by slight structural differences, and which in other respects generally correspond to the Asteroid sections or diverging genera of the same respective regions. Thus we have the Asiatic and North-American *Boltonia*, the Asiatic *Heteropappus*, and the N.-American *Townsendia*, *Monoptilon*, and *Psilactis* differing from the typical Asters of the same regions in scarcely any thing but the pappus. The Californian *Corethrogyne* differs rather more in the style and other characters, and may possibly have other connexions. *Eremiastrum* is nearer to *Erigeron*. The Andine *Hinterhubera*, with remarkable irregular corollas to the external female florets, approaches in other respects the South-American *Vittadinia*. The same peculiarity in the corollas characterizes also the genus *Lessingia*, referred, perhaps erroneously, to the homochromous subtribe, and also West-American, though limited to the northern hemisphere. In South Africa, *Amellus*, characterized by the paleæ of the receptacle, and *Mairia* and *Gymnostephium*, by the plumose or reduced pappus, partake in other respects of the Asteroid form characteristic of that region, that of *Felicia*; so also does the monotypic *Charieis*, which in some respects connects the tribe with the Senecionideæ. Finally, three small genera, *Distasis*, *Chætopappa*, and *Minuria*, the two former from W. North America, the latter from Australia, have an abnormal pappus nearly similar in the three, but not much else in common, except as members of the heterochromous group of Asteroideæ; but each will be found to be nearly allied to Asteroid genera of its own country, *Distasis* being comparable with the section *Orthomeris* of *Aster*, *Minuria* approaching in many respects the Australian *Calotis*.

3. The *Bellis* type has a somewhat unusual geographical distribution. It belongs to extratropical western regions of the Old World and to Australia, with one or two representatives in North America; but its principal seat is in Australia. Indeed the European and North-African *Bellis*, with four or five species, the American *Astranthium*, one, or perhaps two, species, the Azorean *Seubertia*, one species, and the South-African *Steirodiscus*, two species, are but very imperfectly distinguished as genera from the Australian *Brachycome*, which has forty species; and amongst slightly diverging genera the European *Bellium* has three species, the North-American (Mexican) *Keerlia* two, the South-African *Garuleum* three, whilst the Australian *Calotis* has fifteen. All these genera may be regarded as more nearly allied to each

other than to any other ones of their own respective countries, although in some respects *Calotis* may be compared to *Minuria*, and *Bellis* itself may be said to approach some Anthemideæ in the Old World, and in the New World, through *Aphanostephus*, to pass into *Egletes* and the more tropical *Grangea* type.

The distinct genus *Lagenophora*, allied on the one hand to the *Bellis* type of Asteroideæ, on the other to the *Cotula* group of Anthemideæ, has a more normal extratropical geographical area, having its chief seat in Australia, but one species extending here and there into S.E. Asia, and allied but distinct representatives being found in Antarctic America and the Sandwich Islands.

The scattered distribution of the *Bellis* type of Asteroideæ and of the closely allied *Cotula* type of Anthemideæ, and the local endemic generic as well as sectional or specific types or races they have both or one of them left in each of the great centres of preservation of Compositæ, the Mediterranean, South-African, Australian, Chilian, and Mexican regions, might suggest the idea of comparative antiquity; and if so, combining its consideration with that of the Helianthoideæ, we might conjecture that in Compositæ the annihilation of the calyx-limb, or its reduction to a small cup or to a definite number of teeth or awns continuous with the ribs of the tube, preceded its development into a setose pappus. Under this view the parent type of the Bellideæ and Cotuleæ would in the Old World have become further differentiated into the tribe of Anthemideæ, whilst in America its development would have been limited to the few nearly allied Grangeoid genera, being otherwise replaced by the more anciently separated Helenioid genera.

4. The *Grangea* type, with usually more numerous and smaller female florets, less compressed achenes, &c. than the *Bellis* type, is much more tropical. It spreads over the warmer regions of Asia and Africa with a few American forms, which latter connect it more immediately with the preceding types. In the Old World it remains as distinct in geographical range as in structural character. A few of the genera, especially *Myriactis* and *Rhynchospermum*, both of which extend rather further north than the others, have the achenes flattened, with nerve-like borders so common in the preceding types, but with the beak of *Lagenophora*. In the remaining genera the achenes are more like those of the Anthemideæ of the *Cotula* type; and, still more than the Bellieæ, the Grangeæ, by their pappus reduced to a small cup or corona or entirely de-

ficient, connect the Asteroideæ with the Anthemideæ. The genera are all small; seven are from the Old World, of which three (*Myriactis* 5 species, *Grangea* 4 species, and *Dichrocephala* 5 species) have a wide range over Asia and Africa; whilst four monotypic ones are local, or nearly so, *Rhynchospermum* and *Cyathocline* being exclusively Asiatic, and *Ceruana* and *Microtrichia* limited to Africa. The two American genera *Aphanostephus*, 3 species, and *Egletes*, 5 species, have not thrown out any immediately divergent genera around them; the connexion of the former with the *Bellis* group and thence with typical *Asters* has been already mentioned. *Egletes* is remarkable in its close resemblance in every respect to the African and Asiatic *Grangeas*, excepting in the single generic character the presence of the ray-flowers, which in Africa are always deficient—a character which in other genera is frequently variable even in one species, but here apparently constant and geographical.

5. The *Solidago* type.—We have here about 320 species in 24 genera, all nearly allied to each other and only distinguished technically from *Aster* and its immediate allies by the homochromous florets, the ray-florets, when present, being yellow, like the disk—a character in general of so little value that it cannot, in *Senecio* for instance, be admitted as of more than specific importance, and yet is here accompanied by so much of habit and certain prevalent, although not absolute, peculiarities, that it is universally acquiesced in, notwithstanding the frequent difficulty in ascertaining it. The erroneous appreciation of colour in dried specimens has led to many mistakes, and there are several groups where the rays are deficient; in these cases it is only by complicated affinities in other respects that the place of a plant can be determined. In general, the rayless species and genera belong to the *Solidago* group; but this absence of ray occurs sometimes even in *Aster* itself; and experience has now shown that the European *Linosyris* and American *Bigelovia*, united by some of the most eminent synantherologists, belong, the one to the *Aster*, the other to the *Solidago* group. And here geographical distribution may be called in aid. The great seat of the group is extratropical America, North and South, with a few intermediate Andine species. The large genus *Solidago* itself is almost entirely North American and extratropical, but represented by one variable species in extratropical South America, and by another at least as variable in the north temperate regions of the Old World,

both these outlying species being identical with, or closely allied to, genuine North-American ones. The other genera (excepting 5 to be presently mentioned) range from California to Chili and Patagonia, with a North-American and chiefly western preponderance, and in South America scarcely extending eastward of the great mountain-chain until the continent narrows in the extreme south. Not one of the group is to be met with in tropical Brazil, Guiana, or the West Indies; not one, besides *Solidago virga aurea*, in Europe, Asia, Northern or Tropical Africa, or in Australia.

The 5 excepted genera comprise 58 South-African species. Of these, 2 continental genera, *Pteronia* with 51 and *Fresenia* with 3 species, are rayless; and one might therefore at first suspect that they may not be correctly associated with a group so different geographically. But the involucre and general aspect are much nearer those of many homochromous than of any heterochromous genera (excepting in respect of the shrubby character so frequently assumed in the region by most Asteroid genera); and there is one monotypic continental genus, *Homochroma*, and two Mascarene ones, *Glycideras* of one and *Rochonia* of two species, in which the ray is, according to all accounts, homochromous and yellow. Moreover the geographical connexion between South Africa, extratropical South America, and the Mexican region is not so anomalous as would at first appear. I shall have to quote instances of it under the general head of extratropical southern connexions between America and the Old World.

With regard to the distribution of the American genera within the general limits assigned to the group, *Solidago*, including its offset *Brachychæta*, with about 80 species, has, as I have already mentioned, only one immediate southern representative. The large shrubby *Bigelowiæ*, which might make a good genus of 4 species, are exclusively Andine. The remaining *Bigelowiæ*, 16 species, *Haplopappus*, about 60 species, *Grindelia* and *Guttierrezia*, about 20 species each, range from Chili to California, but all with more diversified, as well as more numerous, forms in the north than in the south. *Hysterionica*, 5 species, may be considered the southern representative of the northern *Chrysopsis*, 21 species; *Nardophyllum* and *Lepidophyllum*, each of 5 or 6 species, representing the northern *Ericameria* of 4 species, are the only ones which show any southern preponderance. *Xanthocephalum*, with 7 Mexican species, has one in the Andes of Columbia. *Heterotheca*, 5 species, *Pentachæta*, 2 species, and the monotypic genera

Bradburia, *Aphantochæte*, and *Xanthisma*, are exclusively North-American. Philippi's two monotypic Chilean genera, *Steriphe* and *Chiliophyllum*, are unknown to me; and without having examined them I cannot feel certain that they are really forms of the *Solidago* group distinct from any of the above.

6. The *Conyza* type.—This is as intimately blended with the *Erigeron* series as that is with the *Asters*, preserving generally the small flat or narrow achenes and slender uniseriate pappus of *Erigeron*, but with a great reduction in size and increase in number of the female florets, these being shorter than the style, filiform, and truncate, or two- or three-toothed, rarely producing a small scarcely spreading ligula. But all these characters are vague. *Conyza* itself passes, on the one hand, into *Erigeron*, on the other into *Laggera* and *Blumea*, and in a third direction comes very near to *Baccharis*.

The geographical range of the *Conyza* type, however, is somewhat different from that of *Erigeron*; it is much more tropical and chiefly Old-World. *Conyza* itself, with 50 species, ranges over the warmer regions of Asia, Africa, and America; and one or two species, as ready colonizers or weeds of cultivation, extend over the whole area. The allied more local species of this, which may be called the typical form of the genus, are some of them African, some American, without any particular local physiognomy; but amongst the more divergent species in America, *C. triplinervia* and its allies assume a form approaching that of some species of the American *Baccharides*, and *C. gnaphalodes* (*Lænnecia*, Cass.) has the pappus of an American *Erigeron*. In the Old World the principal divergent forms are *Fimbrillaria* and *Dimorphanthus*, each with several species, the former tending towards the Old-World genus *Nidorella*, the latter with an abnormal involucre unknown in this group in the New World.

None of the genera closely diverging from *Conyza* are American. *Haastia*, with 3 species, is its New-Zealand representative. *Thespis* is a monotypic East-Indian. *Nidorella*, *Heteromma*, *Chrysocoma*, and *Nolletia*, comprising together about 28 species, are chiefly extratropical, but South-African, *Nolletia* alone having a representative in North Africa; and *Nidorella* passes into some tropical African and Asiatic species which may almost equally well be placed in *Conyza*.

There remain three or four genera connected in many respects with the *Conyza* group, but also giving indications of other affini-

ties; these are:—1. *Psiadia*, an African and Mascarene genus of about 14 species, with something of the involucre and yellow ray-florets of some of the *Solidago* group; but the ligulæ are as numerous and almost as small as in some of the Conyzoid genera. The glutinous inflorescence of several species recalls some of the South-American homochromous genera, whilst the shrubby habit brings it nearer to an African type; and the constant sterility of the hermaphrodite florets is also chiefly to be found in some South-African and Australian genera of the tribe. 2. *Microglossa*, a tropical African and Asiatic genus, as to which it still remains a doubtful point whether it should be associated with the *Erigeron* or the *Conyza* type. 3. *Adelostigma*, one, or perhaps two, tropical species of a truly African character, but seemingly connecting the *Conyza* type of Asteroideæ, of which it has the tailless anthers, numerous filiform female florets, small achenes, &c., with the true *Inuleæ*, which it approaches in habit and involucre. 4. *Parastrephia*, a single Peruvian species which has been described as a *Baccharis* and as a *Vernonia*, and which Nuttall considered to be anomalous in the whole order in having the female florets in the centre of the head surrounded by the hermaphrodite ones. But in this he was misled by insufficient specimens; and the examination of more perfect ones shows it to be a connexion, as it were, between *Conyza* and *Baccharis*, technically belonging to the former group, but in habit, geographical station, and probably in real relationship much more closely allied to *Baccharis*, where Meyen first placed it.

7 (and lastly). The *Baccharis* type.—This consists of two genera, including above 250 species, which may be loosely defined as more or less dioecious *Conyzas*. Although the florets in the capitula of Asteroideæ show so frequently sexual differences in the same capitulum, it is only in these two Baccharoid genera that there is any unisexuality in the capitula or the individual plants. In this respect they correspond with several Inuloideæ (*Plucheineæ*, *Gnaphalieæ*, &c.), but have not the anther-appendages of that tribe; and their geographical position is different. *Baccharis* and *Heterothalamus* are exclusively American and chiefly South-American, where they accommodate themselves to every soil and climate, ranging over the tropical plains, dispersed over the mountain-regions in great abundance, and extending to the extreme south, although not accompanying other Andine and Magellanic genera over to the Antarctic or the Australasian region. They

extend also into North America, but in somewhat diminished numbers and varieties of form, and have not there diffused themselves generally enough, or far enough northward, or early enough, to have spread into temperate Asia. The species are in general comparatively local; and none have shown any of the *Conyza* disposition to become introduced into foreign lands.

There is a small oriental plant, the *Gymnarrhena* of Desfontaines, which technically, from its anthers and style, might be referred to the *Baccharis* group of Asteroideæ; but in habit and natural affinities, as well as in geographical station, it is so near to *Geigeria*, that we are compelled, as it were, to place it among Buphthalmeæ, although exceptional in what we reckon the most essential characters of Inuloideæ.

4. *Inuloideæ*.

The tribe Inuloideæ, not quite so numerous as Asteroideæ, is more varied, the 1150 to 1200 species being easily distributed into 138 genera, or, according to some botanists, nearly double that number; and these again may be collected into 9 fairly distinct subtribes—*Tarchonantheæ*, *Plucheineæ*, *Filagineæ*, *Gnaphalieæ*, *Angiantheæ*, *Relhanieæ*, *Athrixieæ*, *Euinuleæ*, and *Buphthalmeæ*, all more or less geographical as well as structural. As a whole, Inuloideæ belong for the most part to the Old World, and several of the subtribes exclusively so; and the tribe is fairly limited (among heterogamous tribes) by the double character of style-branches without terminal appendages, and anthers with appendiculate or so-called tailed auricles. The exceptional species are very few, and the frontier-lines not very difficult to trace, although in some measure the subtribe Plucheineæ may be said to pass into Asteroideæ of the *Conyza* group, Gnaphalieæ into Senecionideæ, Euinuleæ into Mutisiaceæ, and Buphthalmeæ into Helianthoideæ.

Of the above subtribes, the second, third, and fourth, though most numerous in the Old World, range also over the New; the other six are limited to the Old World. The first and sixth are exclusively South-African, the fifth almost exclusively Australian, the seventh South-African with one or two more northern species, the eighth and ninth African, European, and rather more sparingly Asiatic. We will take the subtribes, however, rather in their systematic than in their geographical sequence, commencing with the tribes

in which the female florets, when present, are filiform, not ligulate.

1. The TARCHONANTHÆ are placed first, as having their diceious character in common with the Baccharideæ (the last subtribe of Asteroideæ), which they may in that respect be said to represent in South Africa; and the hermaphrodite florets being constantly sterile, their styles are the same in both cases; but there is no direct connexion between the two. The habit and the anthers are as absolutely different as the geographical situation, besides that, in Tarchonanthæ, the form of the style-branches of the female florets is a greater departure in shortness and breadth from the almost uniform slender shape than I have met with elsewhere in the order. The subtribe consists of two genera and nine species, all strictly South-African, to which should probably be added the Mascarene *Synchodendron*, of which the sterile flowers alone are known.

2. PLUCHEINÆ. The genus *Pluchea* in an extended sense might include *Blumea*, *Sachsia*, *Rhodogeron*, and *Tessaria*; and, indeed, the whole subtribe show the filiform female florets, small achenes, and slender pappus of the *Conyza* group of Asteroideæ, but with the Inuloid anther-tails, the styles without terminal appendages, and usually drier involucral bracts, and a few other features rather different from those of *Conyza*. The various genera proposed or adopted depend chiefly upon differences in the pappus and other individual characters, and are more or less artificial and not always geographical. The nearest to *Conyza* is *Blumea*, strictly confined to the tropical and subtropical regions of the Old World and mainly Asiatic. It consists of about 60 species of varied habit, ranging from that of *Conyza* to *Pluchea* itself. Several species, widely diffused tropical Asiatic weeds, very difficult to distinguish from each other, only differ from *Conyza* in their anthers, whilst in the closely allied African and Asiatic genus *Laggera*, of about ten species, these anthers even lose their tails; but these species are in their styles and other respects quite removed from *Conyza*, and belong to a group intermediate, as it were, between *Blumea* and *Pluchea*. Notwithstanding, therefore, any such exceptional forms which interfere with accurate technical characters, I believe there is never any difficulty in distinguishing at once any Inuloid *Laggera*, *Blumea*, or other Plucheinea from any Asteroid of the *Conyza* group.

Pluchea, less varied in form than *Blumea*, and far less numerous

in species, is yet far more extended in geographical range; and as it has established endemic species in different parts of its area, several of these have been raised into monotypic genera, sometimes with so much of the common habit and character that we have thought it illogical to adopt them; others are retained with some hesitation. The genus, as a whole (about twenty-five species), differs from *Blumea* in the corymbose inflorescence, in the disk-florets generally (though not always) sterile with undivided styles, and usually in the broader more coriaceous involucreal bracts. It is nearly equally distributed over America, Africa, and Asia, chiefly within the tropics, but extending somewhat northwards both in America and Asia, and sparingly to the south of the tropic in Australia. No one species is common to the New and the Old World; but the commonest species of the two hemispheres are about as near to each other as each is to the other species of its own region.

The Old-World genera, chiefly monotypic, separated by characters which we would consider as no more than specific, are:—1. *Berthelotia*, an East-Indian species which had been removed from the neighbourhood of *Pluchea*, chiefly on the mistaken supposition that the anthers were not tailed. It has also been characterized by the setæ of the pappus being more or less connate at the base; but that is also observable, though in a less degree, in the common *Pluchea indica*. 2. *Karelinia*, a Caspian species with a narrower involucre and a long white pappus, the setæ of the disk-florets mostly thickened at the apex, as is so often the case where the florets are sterile. This also had been erroneously presumed to have tailless anthers. 3. *Oligocephalum* may be given as a sectional name for *P. pinnatifida*, Hook. f., from tropical Africa, and *P. frutescens*, Benth., from Scinde, small shrubby species which in some respects form, as it were, a passage into *Blumea*, but are, on the whole, nearest allied to *Pluchea*; whilst the *Laggeras* above mentioned, intermediate in another direction, have the inflorescence and chief characters of *Blumea*, with the involucre rather of *Pluchea*—and having, in addition, no tails to the anthers, are retained as a distinct genus. 4. *Spiropodium* is an Australian species with the capitula generally, but not quite constantly, diœcious, a tendency to which arrangement is also observable occasionally in the African *P. Dioscoridis* and some others. The Australian *P. tetranthera*, which is also nearly diœcious, diverges further in its tetramerous sterile florets and

in the inflorescence tending towards that of *Monarrhenes*. 5. *Eyrea*, with three species, all Australian, is a form diverging in another direction, in its broader or hemispherical, often solitary, capitula and narrower involueral bracts, but apparently better placed as a section of *Pluchea* than as a distinct genus.

In America three small genera, scarcely more divergent from *Pluchea* than some of the foregoing, but each with a very special geographical range, may still be kept up as distinct; these are:— 1, *Sachsia*, three Cuban species more distinct from *Pluchea* in habit than in character; 2, *Rhodogeron*, a single species, also from Cuba, with the female florets almost ligulate, an exception to the whole subtribe; and, 3, *Tessaria*, five species limited to western temperate or Andine America from Chili to California, has not the tropical geographical character of *Pluchea*, but is closely allied to the less tropical Asiatic forms of *Pluchea* both in habit and in character, whilst in indumentum and in the consistence of the involueral bracts it shows some approach to the Gnaphalieæ. *Stenachænium*, consisting of two or three Brazilian species, although hitherto included in *Pluchea*, is much more distinct than any of the foregoing, especially in its long achenes, exceptional in the subtribe.

Two Old-World forms of limited geographical range diverge rather more prominently from *Pluchea*, to which they bear, nevertheless, much general resemblance—*Pterigeron*, five Australian species, and *Nanothamnus*, one East-Indian species, both with anomalous corollas, the former showing an approach to those of some Athrixieæ, the latter to those of Mutisiaceæ. This Asiatic monotypic genus, with two equally monotypic Australian genera, *Thespidium* and *Coleocoma*, unite the Pluchean involucre and flowers with a much modified, reduced, or evanescent pappus; and the latter two Australian plants have, moreover, a very peculiar habit and inflorescence.

Epaltes, a genus of about nine species, is spread over the same wide tropical and subtropical area as *Pluchea* itself. With the essential characters of the subtribe Plucheineæ, it bears a general resemblance, in habit and pappusless achenes, to the Vernoniaceous *Ethulia*, with which genus it has often been confounded through a total neglect of the principal floral characters. The genus as a whole is a very natural one, although the species of each region have been raised into separate genera upon characters which scarcely deserve more than a specific rank. Thus *Pachy-*

thelia, Steetz, comprises two American species (of which one, *E. brasiliensis*, is also African), *Litogyne* four African species, the original *Epaltes* a single Asiatic one, and *Sphæromorphæa* (*S. petiolaris*, DC.) and *Ethuliopsis* (*Gynophanes*, Steetz) each a single Australian species. In the last-named species the capitula, as has been observed as to some Australian *Pluchææ*, are almost or quite diœcious.

Denekia is a curious little South-African genus of two, or perhaps three, closely allied species, with the anthers of *Pluchæineæ*, but in habit and some other characters approaching rather *Nidorella* amongst Conyzoid Asteroideæ, and forming one of the strongest links between the two tribes. The pappus is unlike that of any genus of either subtribe.

Sphæranthus, *Pterocaulon*, and *Monarrhenus* form a small tropical or subtropical group with the main characters of *Pluchæineæ*, but with the small glomerate capitula so prevalent in *Filagineæ*, *Angiantheæ*, and *Relhanieæ*. *Sphæranthus* (ten species) belongs exclusively to the Old World; *Pterocaulon* (eleven species) is also American; both are more prevalent in Asia and tropical Australasia than in Africa; *Monarrhenus* (three species) is exclusively Mascarene. The three genera, though closely allied, are fairly distinguishable. From the American *Pterocaulon* the Australasian species have been usually considered generically distinct, under the name of *Monenteles*, characterized by the solitary disk-florets; but the two genera, established without reference to each other at about the same time, had never been fairly compared, and the supposed differential character is now no longer in accord with geographical distribution; for the Brazilian *P. spicatus* has the solitary disk-florets and glabrous receptacle of *Monenteles*, whilst the Australian *M. sphacelata* has two or three disk-florets, as in the majority of American *Pterocaulons*.

3. **FILAGINEÆ.** The majority of the genera here included form a very natural group closely allied to *Gnaphalieæ* as to the principal characters, but with the disk-florets most frequently sterile with undivided styles as in so many *Pluchæineæ*, and specially distinguished from both by their capitula usually small and glomerate almost as in *Angiantheæ*, and by the paleæ subtending or enclosing the female florets, or at least the outer ones. The seven genera we have adopted, comprising about forty species, range over the temperate regions of the northern hemisphere, scarcely penetrating within the tropics, several of them common

weeds in the Old World; the American species chiefly western and extratropical both in North and South America. The three principal genera, *Evax*, *Micropus*, and *Filago*, are chiefly Old-World, but represented also by a few species in Western America; the sections *Acantholæna* and *Bombycilæna* of *Micropus* belong, however, exclusively to the Old World; and the section *Stylocline* of *Micropus*, with the nearly allied genera *Psilocarphus*, *Diaperia*, and *Micropus*, are limited to California or Chili, or both. The somewhat more divergent genus *Ifloga* (*Trichogyne*, DC.) has a very different geographical area, being chiefly South-African, with one representative in the Mediterranean region.

Three genera with many of the technical characters of Filagineæ, but with a very different habit and geographical range, are not, perhaps, properly included in the subtribe, or at the most should only be considered its tropical considerably modified representative. These are *Cylindrocline*, with one Mauritian species, and *Blepharispermum* and *Athroisma*, which together include four from tropical Asia or Africa. Their larger black achenes and reduced paleaceous or deficient pappus seem to bring them nearer to the Bupthalmæ; but the receptacular paleæ covering the filiform female florets are characteristic of Filagineæ. They thus form an isolated group which would be still more out of place in any other tribe or subtribe with which they might be compared.

Petalacte, a single South-African species, is another ambiguous genus which, technically, would be placed among Filagineæ, but, from its habit, geographical, and some other characters, may be better considered as an exceptional Helichrysea next to *Anaxeton*, which it so closely resembles.

4. GNAPHALIEÆ, a very large subtribe, distinguished from Plucheineæ chiefly by the scarious, or coloured, and radiating involucre, may be divided into two groups or large natural genera, *Eugnaphalieæ* and *Helichryseæ*, the one of about 200, the other of about 400 species, closely allied to and, as it were, passing into each other, insomuch that some botanists have united into one the two typical genera *Gnaphalium* and *Helichrysum*, but distinguished with few exceptions (chiefly tropical African) by a general character of some importance, the female florets outnumbering the others and usually exceedingly numerous in the *Eugnaphalieæ*, few, or disappearing altogether, in the *Helichryseæ*; and the geographical distribution is different. *Eugnaphalieæ* range over the whole world, forming only small distinct groups in

local areas; Helichryseæ are, with few exceptions, limited to South Africa, Australia, and the Mediterranean region of the Old World.

The delimitation and subdivision of the genus *Gnaphalium* has much puzzled all synantherologists, and is still in a very unsatisfactory state. Among the species now generally admitted to belong to it are some which by Lessing and De Candolle were established as a genus of Mutisiaceæ; and the differences observable, whether in habit or structure, are not much in accord with the geographical distribution. The genus as a whole is cosmopolitan, though rather more temperate or mountainous than tropical; and the two principal groups into which it might be divided as to habit inflorescence and involucre, represented, for example, by *G. polycephalum* and *G. uliginosum* respectively, are both to be found over the same area; whilst *G. luteo-album*, which closely connects the two groups, is ubiquitous. Weddell proposed the division into two genera founded on the pappus, of which the setæ are quite free and separately caducous in *Gnaphalium*, united at the base in a ring and falling off altogether in *Gamochæta*: and this appears at first sight very plausible, and accompanied by some difference in the involucre; but upon further investigation it is found to separate species like *G. purpureum* and *G. indicum*, so closely allied that they are found mixed together in most collections, whilst it unites into one genus *G. polycephalum*, *G. lavandulaceum*, and *G. uliginosum*, species evidently the most remote in affinity of the whole series. It would seem, therefore, that Weddell's divisions can only be taken as somewhat artificial sections, and that if we attempt any more natural although vaguely characterized groups we must recognize three as very generally diffused, those above-mentioned as typified by *G. polycephalum* and *G. uliginosum* with the intermediate *G. luteo-album* under *Eugnaphalium*, and that exemplified by *G. purpureum* and *G. sylvaticum* under *Gamochæta*, and about five other groups confined to special geographical areas:—1, two or three Andine species (Mexican or South-American) belonging to *Eugnaphalium*, but remarkable for their involucre bracts radiating as in *Chionolæna*, which they also resemble in habit; 2, *Lucilia* (including *Belloa*), a Chilean or south Andine group, differing from other *Gamochætæ* chiefly in their longer narrow involucre; 3, *Merope*, dwarf tufted or prostrate Andine plants, with the involucre bracts more spreading after flowering than in *Lucilia*, to which A. Gray unites them; 4, *Omatotheca*, a Europæo-Asiatic and North-American Alpine plant, dwarf like the *Meropes*,

with the involucre of a *Gamochæta*, but the pappus of a *Eugnaphalium*; and, 5, *Anaphalioides*, a remarkable New-Zealand group of two or three species, with the spreading involucre of *Anaphalis*, and in sexual arrangements connecting that genus with *Gnaphalium*.

With regard to the groups so much further divergent from *Gnaphalium* as to have been retained as distinct genera, one, *Achyrocline* (fifteen species), is common to the New and the Old World; like many tropical-American (chiefly Brazilian) genera it has two or three representatives in tropical Africa. It is nearest, on the one hand, to the corymbose group of the section *Eugnaphalium*, but with narrow few-flowered capitula more densely corymbose, a *Helichrysum*-like involucre, &c.; and, on the other hand, to *Stenocline* among Helichryseæ, of which it has the aspect, but with the Gnaphalioid sexual proportions. Nearly allied to it is the monotypic tropical-African *Chiliocephalum* without any pappus.

Chevreulia and *Facelis* are two small South-American Andine or extratropical genera connected with the *Lucilia* series of *Gnaphalium* of the same region, but differing, the one in the long beak into which the achene is produced, the other in the plumose pappus. *Lasiopogon*, from extratropical Africa south and north, and from the latter extending into the Levant, is another small genus, differing from some of the smaller *Eugnaphalieæ* and *Filagines* of the same region in the plumose pappus. *Phagnalon* has a dozen species from the Mediterranean region more isolated in character. The anthers are often almost or quite tailless; and the species were indeed formerly included in *Conyza*; but their involucre, habit, styles, and the anther-tails of some of the species justify their having been removed to Gnaphalieæ.

All the above genera have the disk-florets usually fertile as well as the females; in the following eight or nine genera, so nearly connected with *Gnaphalium* that they have most of them been united with it by some authors, the disk-florets are almost universally sterile and often with undivided styles. *Chionolæna* is Brazilian, allied in other respects to the American *Gnaphalia* with radiate involucre. *Luciliopsis* is Andine, near the Andine *Gnaphalia* of the section *Lucilia*. *Tafalla* is also Andine, but more tropical, and in its habit and diœcious capitula connected with some species of *Baccharis* of the same country, but with the Gnaphalioid involucre, anthers, &c. *Mniodes*, again, another high-

Andine small genus with diœcious capitula, corresponds in other respects with *Merope*, also high-Andine. *Antennaria* and *Leontopodon* are mountain genera connected with the smaller *Eugnaphalia*, dispersed over Europe, Asia, North America, and the Andes of South America. *Anaphalis*, allied on the one hand to *Antennaria*, on the other to the corymbose *Eugnaphalia*, is intermediate between the two as to sexual characters, and differs from both in the usually radiating involucre. It is more Asiatic than any of the other genera, being represented in North America by only a single species out of about twenty-five. *Stuartina*, *Demi-dium*, and *Amphidoxa*, three monotypic genera from Australia, Madagascar, and South Africa respectively, are allied in habit to the small glomerate *Eugnaphalia*; but, besides the frequent sterility of the disk-florets, they differ in the pappus reduced to a very few setæ in *Amphidoxa*, entirely deficient in the other two.

There remains only *Raoulia*, an Australasian mountain genus of fourteen species, chiefly from New Zealand, which may be said to be almost strictly intermediate between *Eugnaphalieæ* and *Helichryseæ*, the proportion of the female and disk-florets being variable and often nearly equal, but certainly with a *Eugnaphalioid* tendency both in that and in habit.

Helichryseæ present one of those instances (such as *Proteaceæ*, *Restiaceæ*, &c.) in which a large very natural group of plants had spread over two regions, South Africa and Australia, now quite isolated, but then possibly in connexion with each other, in times sufficiently remote for them to have diverged in each region into different forms, and have multiplied greatly in both, without having preserved a single species in common. The *Helichryseæ*, however, have retained a closer affinity than the larger groups above mentioned. The South-African *Ericaceæ* have only a representative order or suborder in Australia (*Epacrideæ*); *Proteaceæ* and *Restiaceæ* have tribes but no genera in common; among *Helichryseæ* there are common genera and even sections, but no species.

Helichrysum itself, the largest genus of the subtribe, has, out of about 260 species, 137 South-African and about 60 Australasian (chiefly Australian with a few from New Zealand), and in each country has established distinct sectional races. The subgenus *Lepicline* is wholly South-African, as are also several sections of *Euhelichrysum*; others of these are exclusively Australian; but the sections *Xerochlæna* and *Ozothamnus*, although chiefly Australian,

have a few African representatives ; for many groups of the former have been found in South Africa, and a few species referable to the latter in Madagascar. The genus extends also into North Africa, Europe, and Central Asia—that is, into the Mediterranean region taken in a very extended sense. All these northern species belong to the section *Stæchas*, also represented in South Africa, with two monotypic exceptions : one is *Cladochæta*, which, however, might well be included in *Stæchas*, although De Candolle generically removed it on account of the setæ of the pappus being more or less united in bundles ; but the little value of this character is shown by its occurrence likewise in other species, as, for instance, in the Australian monotypic section *Acanthocladium*, which has the habit of the tropical-African *H. spinosum* and *H. horridum*, neither of which has the same pappus. The other exception includes *H. frigidum*, Willd., and *H. virgineum*, DC., dwarf alpine species, only known, the one from the mountains of Corsica, and perhaps of Lebanon, the other from Mount Athos in Greece, both very unlike any other species growing north of the equator. The radiating involucre are those of the southern *Xerochlænæ*; and the whole plant has much outward resemblance to the New-Zealand *H. (Gnaphalium, Hook. f.) prostratum* and *bellidioides*, but with the densely silky-villous achenes of several *Heliptera*.

Helipterum cannot well be called a good natural genus, but rather a collection of local South-African or Australian subgenera or sections, retained as a distinct group rather for convenience's sake, and solely founded on the artificial character of a plumose pappus ; and even that fails to draw a distinct line separating it from some species of *Helichrysum*. It is much more Australian than African ; for of 42 species, 30 belong to the former region, and 12 to South Africa ; it is in Australia also that it blends most with *Helichrysum* ; in South Africa the two genera are more distinct. We have, in the 'Genera Plantarum,' characterized four sections, of which one small one, *Syncarpha*, with two species, is South African, two, *Pteropogon* ten species and *Monencyanthes* seven species, are Australian ; the principal one, *Euhelipterum*, is common to both regions, although even here there is a slight difference ; the majority of the Australian *Euheliptera* have radiating involucre, which are exhibited only by very few of the South-African species.

Stenocline is a small genus of a more tropical character than any others of the Helichryseæ, and the only one common to the New and the Old World. It has eight species, of which six are Mascarene

and two Brazilian. It is very nearly allied to *Helichrysum* itself, but still nearer, in many respects, to the tropical African ~~and~~ American *Achyrocline*, although the sexual relations place the two in different divisions of *Gnaphalium*. Gardner's genus *Leucopholis* has two Brazilian species very closely allied to *Stenocline*, with the habit, however, of the American *Chionolæna*, and differing from both chiefly in inflorescence, the few-flowered heads being closely sessile, and collected in a globular cluster or compound head, as in the Angiantheæ.

The remaining genera of Helichryseæ require but little notice to their geographical distribution; they are all limited to South Africa or to Australia, without any of the forms sufficiently similar in their divergences in both countries to be considered representatives; for the diverging characters are differently combined in the two regions. They are chiefly characterized by the involucre and pappus. South Africa has six of these genera, comprising sixteen species; South Australia sixteen genera, comprising forty-eight species. Among the latter I may particularly mention *Millotia* and *Quinetia*, both monotypic, as connecting in some measure the Helichryseæ with the Senecionideæ, having the peculiar almost uniseriate involucre so rare in Inuloideæ, generally so frequent in Senecionideæ. Among the South-African genera the monotypic *Phænocoma* is remarkable for the foliage, which is that characteristic of the *Relhaniæ*; but the filiform female florets and the broadly radiating involucre are rather those of Helichryseæ.

5. The ANGIANTHÆ proper constitute a group of eight genera and about sixty-four species, exclusively Australian, and, with the exception of two New-Zealand species of *Craspedia*, limited to Australia itself. With a Gnaphalioid habit and connexion, they are further removed from *Gnaphalium* itself than the Helichryseæ, the capitula being always homogamous without any female florets whatever; the small closely aggregate capitula are also to be met with in some Filagineæ; but in the latter tribe there are always female florets embraced by the receptacular or involucreal paleæ. And, geographically, the Filagineæ are entirely wanting in Australia, the fatherland of the Angiantheæ.

Cæsulia, a monotypic East-Indian genus, stands alone. Its essential characters are indeed those of Angiantheæ; but its habit, its country, and several points of structure show but a remote affinity with any Australian genus of that subtribe.

Eriosphæra, a monotypic South-African genus which I only know from Harvey's figure and description, might also be technically referred to Angiantheæ, where, indeed, it may be regarded as a South-African representative of the Australian *Gnaphalodes*. It also bears much resemblance in outward aspect to the South-African *Lasiopogon*, but has no female florets and a very different pappus.

6. RELHANIÆ. The Inuloideæ have now taken leave of America; the remaining subtribes with the capitula radiate (when heterogamous) are all African, European, or Asiatic, very sparingly and anomalously represented in Australia. We have seen that the Inuloid genera with the greatest profusion of filiform female florets with exserted styles, Plucheineæ and Eugnaphalieæ, supply not only the most widely diffused genera and species, but also those which have most readily established local subgenera or diverging genera in both the New and the Old World. The Helichryseæ with few female florets have scarcely spread into or maintained themselves in America, whilst the Angiantheæ, without any, have remained within their own limited areas. Nor do the tribes with ligulate female florets appear to have been more successful than those which are strictly homogamous. Possibly the greater facilities enjoyed by the disciform over the radiate races for fertilization and for dispersion, resulting from the peculiar structure and mutual arrangement of the male and female florets and fruits, may have had some effect on their extended distribution; but it is difficult to appreciate the effects of each one of the numerous more or less counteracting influences which have at various times acted on the dispersion, establishment, restriction, or extinction of genera and species in different regions. Strictly diœcious Inuloideæ and other Compositæ certainly appear to have been less successful in spreading than those with androgynous capitula, where structure &c. is otherwise similar. The African Tarchonantheæ cannot well be considered close representatives of the American Baccharideæ; the smaller diœcious genera have not a wide range, with the exception of *Antennaria*, where other influences, resulting from alpine station, may have come into play.

Whatever, therefore, may have been the cause, these three Inuloid subtribes, in which the female florets, when present, are always ligulate, are absent from America, and are mostly, although not entirely, extratropical, and, generally speaking, of very

limited areas. The Relhanieæ (fourteen genera and near one hundred species) are exclusively South African, or sparingly represented in the Mascarene Islands. They are in many respects so closely connected with the *Helichryseæ* of the same region as to make it sometimes difficult to determine to which subtribe a genus should belong. Thus *Metalasia* and *Lachnospermum*, having no female florets in any of the species known, might equally well belong to either subtribe, but that they have the peculiar foliage of Relhanieæ, concave or tomentose on the upper instead of the under side, unknown in any other subtribe of Inuloideæ, excepting perhaps *Phænocoma*, another genus, like *Metalasia*, rendered ambiguous by the absence of female florets, but which, notwithstanding its Relhanieous foliage, seems, in involucre and other characters, to have more affinity with Helichryseæ.

Some Relhanieæ have the one- or few-flowered aggregate capitula of the Australian Angiantheæ, but accompanied by a strictly South-African, not Australian, combination of habit, foliage, and other characters, showing the affinity between the two subtribes to be distant.

The individual genera of Relhanieæ, distinguished chiefly by the aggregate or separate flower-heads, or by the various pappus-forms, afford nothing special to remark upon, as far as hitherto observed, in respect of geographical distribution, all being confined to the same limited area.

7. *ATHRIXIÆ*. This subtribe, although still chiefly South-African, is not so local in geographical distribution, and more varied in structure than the Relhanieæ. The Athrixieæ are at once distinguished from the Relhanieæ by the foliage, from Euinuleæ by the style, and generally from both in habit. The genera, however, require separate consideration; for they are not so blended into each other as most of those of the preceding subtribes.

Athrixia itself, with fourteen species, is represented in South Africa, Madagascar, Abyssinia, and Australia, although in no case by identical species in any two of these regions. Four of the five Australian species form a local section distinct from the African ones, and which has indeed been raised into two genera, but properly reduced to *Athrixia* by Asa Gray. The fifth Australian species, however (*A. aculeata*, Steetz, or *Asteridia*, Lindl.), is nearer in structure and habit to the typical *A. capensis* than to any of its own fellow-citizens; and the single Madagascar species

seems in some measure to connect the two Australian types. *Antithrixia* and *Arrowsmithia* may be considered as somewhat divergent forms or offsets from *Athrixia*, both of them South-African—*Antithrixia* represented also by one species in Abyssinia, *Arrowsmithia* monotypic and local.

Leyssera, with three South-African species, is the only genus of Athrixieæ which has a representative (not, however, specifically identical) in North Africa. Although of a perfectly distinct structural type from that of *Athrixia*, it is not, nevertheless, at all more intimately connected with any other Inuloid genera, whether Euinuleæ or Buphthalmeæ, which have a similar geographical distribution.

Macowania, of a single species, and *Heterolepis*, with three species, are both limited to South Africa, and form very distinct genera, although generally connected with Athrixieæ. The last-mentioned, *Heterolepis*, has hitherto been referred to Arctotideæ, of which it has neither the habit nor the achenes, pappus, or style, perhaps from an undue appreciation of the value of the scarious involucre bracts, which, however, is more or less observable in *Leyssera* and other truly Athrixious genera.

Podolepis is a very distinct Australian genus of a dozen species, remarkable for the irregular and varied development of the corolla of the female florets. It establishes in this respect, as also in the habit and involucre of some of its species, a connexion between some Australian forms of *Athrixia* and *Helichrysum* respectively. We have here a relationship, established by structural peculiarities and confirmed by origin as presumed from geographical distribution, between species such as *Athrixia australis* and *Podolepis rutidochlamys*, which might readily, on a hasty inspection, be referred the one to *Asteroideæ*, the other to *Helichrysum*.

8. EUINULEÆ, 19 genera and about 120 species, are so nearly connected with each other, that, with the exception of two or three rather more distinct monotypic forms, they might be considered as constituting a single large genus. Nearly half the species are still retained in the genus *Inula*; and the genus *Pulicaria*, for instance, including one half of the remaining species, although constant in its character derived from the pappus, is probably really less distant from some *Inulæ* than are the two sections *Bubonium* and *Cappa* from each other, although these are regarded by all botanists as congeners.

Taken, therefore, as a whole, Euinuleæ differ from Athrixieæ

in the style, and generally in habit, involucre, and other minor characters, and in a more northern geographical distribution. They have some outward resemblance to some American Asteroideæ of the *Solidago* group (*Haplopappus inuloides*, *Chrysopsis*, &c.), but with very different styles and anthers and a wide geographical severance, and are rather more nearly connected in structure and station with a few genera of Mutisiaceæ, amongst which one genus (*Printzia*) has been recently placed; but their real affinity, structural and geographical, and therefore presumedly genetic, is with Athrixieæ on the one hand and Buphthalmeæ on the other. They belong exclusively to Europe, Asia, and Africa; their chief centre appears to be the great Mediterranean and Oriental region; but they extend southward into South Africa, where they have established a few small local genera, and eastward to the tropical and subtropical extreme east of Asia, although not enough to the north-east to have passed into North America. In Asia they may be said to be partially replaced by allied Mutisiaceous genera; and the South-African genus *Printzia*, five species, has been, as above-mentioned, hitherto actually referred to Mutisiaceæ, although without the essential characters of that tribe, and to our eyes having a close affinity with the Inuloid genus *Iphiona*. Neither in Australia nor in America is there any genus of Euinuleæ, nor yet of any nearly allied Mutisiaceæ. The North-west American *Luina*, with a deceptive aspect of some species of *Inula*, proves, when examined, to be as different in structure as the *Inula*-like Asteroideæ above mentioned, but in this instance to belong to Senecionideæ.

Of the separate genera, the two principal ones above mentioned, *Inula* and *Pulicaria*, range generally over the greater part of the area of the subtribe, and are, besides the two species of the Mediterranean *Jasonia*, which may almost be regarded as a section of *Inula*, the only ones which extend to Europe. The next numerous genus, *Iphiona* (12 species), has still a wide range from the Levant to east tropical and South Africa. *Codonocephalum* and *Amblyocarpum*, two nearly allied monotypic genera, are limited to the Levant; *Grantia*, with four species, is in that region and in Algeria. *Allagopappus* and *Vieræa*, both monotypic, belong to the Canary Islands, where are also some rather peculiar species of *Inula*. *Vicoa*, with five species, is more tropical both in Asia and Africa. *Calostephane* and *Porphyrostemma*, both monotypic, are also tropical, but African only. *Pegolettia* has one tropical and

two South-African species; *Bojeria* one Mascarene and one South-African; and, lastly, *Printzia*, with five species, *Homo-chæte*, with one species, and the two monotypic genera unknown to me, *Minurothamnus* and *Cypselodontia*, are South-African. Among all the above forms *Porphyrostemma* is the most exceptional, having the purple, narrow, linear, very numerous ligulate corollas of *Erigeron*, with all the essential characters of *Euinuleæ*. All the other genera are homochromous.

There remains the somewhat anomalous genus *Carpesium*, with four or five species, which in its tubular female florets connects *Euinuleæ* with *Plucheineæ*, but, upon the whole, is best placed in the former subtribe. Its geographical area is within the chief range of *Euinuleæ*, South Europe and temperate and tropical Asia.

9. BUPHTHALMÆ. The subtribe Bupthalmæ, sixteen genera, but scarcely above fifty species, allied to *Euinuleæ*, has a nearly similar geographical distribution, somewhat more restricted eastward, and offers some exceptions. Bupthalmæ are chiefly African, European, and Oriental. Their structural connexions are more general than those of the other subtribes of *Inuloideæ*, their styles the same as in *Euinuleæ* in the North-African and European genera, like those of the *Athrixieæ* in some exclusively South-African forms; and their tailed anthers and alternate leaves leave no doubt as to their place in this tribe; but in their rigidly paleaceous receptacle, the nature of the pappus in several genera, and some other respects they point to some connexion with *Helianthoideæ*. The supposed affinity to *Asteroideæ* appears more remote, and can only have been suggested by the numerous narrow yellow ligulæ of some genera. Amongst themselves, the genera, although small, are more distinct than most of those of the preceding subtribes. Of the seven most nearly connected with each other, three were long united under *Bupthalmum*; but two of the others have been hitherto placed in very different tribes, owing to inattention to the anther-tails, and also to the supposition that there were no Bupthalmæ in South Africa. As it now stands, *Bupthalmum* is reduced to four species exclusively European: *Odontospermum* seven species, and *Pallonis* one species, formerly included in *Bupthalmum*, belong to the Mediterranean region generally, the former extending to the Canarian and Cape-Verd Islands; but *Callilepis*, two South-African species, *Sphacophyllum*, one Mascarene species, and *Anisopappus*, two

tropical species, appear to me to be quite as near, if not nearer, to *Buphthalmum* than *Odontospermum* or *Pallenis*, although *Callilepis*, for the reasons above stated, had been placed by De Candolle in his subtribe Heleniæ of Senecionideæ, and *Sphacophyllum*, included by him in the Helianthoid genus *Epallage*, referred by him to Anthemideæ. The two species of *Anisopappus* are both tropical African—one from western Africa, published by J. D. Hooker as a *Buphthalmum*; the other, only recently found by Colonel Grant in east tropical Africa, and undoubtedly indigenous, proves to be identical with a long-known South-Chinese plant published under the present generic name by Hooker and Arnott. It has never been found in any intervening district, and the most careful examination can detect no difference in the specimens from those widely distant regions—a case analogous to, but more remarkable than, that of the *Eupatorium* which connects east tropical Africa with north-eastern India.

The monotypic Oriental *Chrysophthalmum* is also very near *Buphthalmum*; but the female florets are deficient, and the habit is more that of *Amblyocarpum* among Euinuleæ.

Rhanterium, an Algerian genus of two species, and *Anvillea*, also of two species, one Algerian the other Oriental, are remarkable for their involucre becoming subglobose and often spinescent, like those of so many Cynaroideæ; but their other characters, and even the habit, on a closer investigation point out their close connexion with Buphthalmeæ. *Ondetia*, one species, from southern subtropical Africa, is another form of Buphthalmeæ, divergent in its involucre; but whilst the two previously named Mediterranean genera assume in that respect the Mediterranean Cynaroid type, the southern *Ondetia* takes the scariose involucre of the southern Arctotideæ.

Geigeria, with eight South-African and two Arabico-Nubian species, is an anomalous genus, rather puzzling as to its affinities; the styles, the anthers, the colour of the flowers, and, to a certain degree, the habit are those of Buphthalmeæ, whilst the densely setose receptacle points to Cynaroideæ, and the deeply lobed corollas to that tribe or to Mutisiaceæ; but upon the whole its nearest affinity seems to remain with Buphthalmeæ. Geographical distribution does not here afford much assistance; but at least it is as much in favour of the Buphthalmoid affinity as of any other.

Gymnarrhena, a single Oriental species, is still more puzzling as

to its affinities. It has the peculiar habit of the dwarf species of *Geigeria* and similarly deeply lobed yellow corollas; the receptacle, paleaceous under the female florets, but not under the sterile florets of the centre, is that of *Rhanterium*; but the female florets are in many rows, with short tubular corollas, as in the Conyzoid and many Grangeoid Asteroideæ, and as in the Plucheineæ amongst Inuloideæ. The tailless anthers would exclude it from all Inuloid subtribes and place it technically, as proposed by De Candolle, among Asteroideæ, where we might insert it after *Heterothalamus* in the *Baccharis* group. But it is in all other characters, as well as in a geographical point of view, so perfect a stranger there that it seems preferable to class it next to *Geigeria*, as an exceptional form, such as is *Barnadesia* amongst Mutisiaceæ. The style does not help us; for, the disk-florets being sterile, it is undivided, as is the case so generally in all tribes when similarly circumstanced.

Two South-African genera, *Osmites*, with six species, and *Osmitopsis*, with a single one, take their place among Buphthalmeæ in respect of almost all their general characters, as well as in habit (of *Odontospermum*) and the peculiar odour of the foliage; but the style is rather that of the South-African Athrixieæ than of the more northern typical Buphthalmeæ.

There remains a small anomalous plant from a very different region, which, after being attached to various tribes, must perhaps find its resting-place next to Buphthalmeæ. This is the *Nablonium* of Tasmania. Cassini placed it amongst Anthemideæ. In working up the Australian flora, I had trusted perhaps rather too much to Bauer's and Fitch's elaborate drawings and analysis, and referred it, after some hesitation, to Helianthoideæ. A more careful examination shows that we had all overlooked the long setiform appendages or tails to the anther-auricles. This places it technically among Buphthalmeæ, with which also, notwithstanding its reduced size, the foliage and indumentum agree better than with Helianthoideæ. Anthemideæ are quite out of the question.

5. *Helianthoideæ*.

The tribe Helianthoideæ is, again, one of the large ones. Not quite so numerous as Inuloideæ, it is still more varied. The species, rather under 1100, are distributed into about 140 genera not so easily classed into distinct subtribes as Inuloideæ, rather more scattered geographically, and many of the smaller genera

remarkably distinct. As a whole the tribe is essentially American, and chiefly tropical or subtropical; but some genera have been early enough in the warmer regions of the Old World to have there established distinct species or sections, a very few small or monotypic ones from Africa or Madagascar or East India sufficiently differentiated to be maintained as genera (*Micractis*, *Epallage*, *Guizotia*, *Glossocardia*, *Microlecanne*, *Glossogyne*). The development and usual persistence of the paleæ of the receptacle or bracts subtending the individual florets, the tailless anthers, and the pappus, when present, consisting of few rigid awns or paleæ, some of them more directly corresponding to the primary ribs of the achenes, are its principal characters. The style is very variable. The order is slightly connected through *Lagascea* with Vernoniaceæ, through Ambrosiæ with Anthemideæ, through Madiæ with Heleniæ, and through a few Verbesinæ with Inuloideæ (Bupthalmæ); but the delimitation is rarely doubtful. Some of the structural characters, as well as the dispersion of several genera over the warmer regions of both the New and the Old World, seem to point this out as containing some of the most ancient forms of the order.

Among the numerous subdivisions which have been proposed, we have thought that ten might be maintained as subtribes, although very unequal in point of numbers and geographical range. As in the Inuloideæ, we will take them in detail in their systematic sequence.

1. *Lagascea*, a small genus of about seven species, is so distinct from all others as to require separation as a subtribe, and even the tribe it should be classed under is uncertain. Its style is that of Vernoniaceæ, where it has been technically associated with *Elephantopus* amongst genera with glomerate uniflorous capitula; but the habit, the mostly opposite leaves, the indumentum, and especially the corolla and pappus are so different from any thing observable in that tribe, that it has appeared to me to be better placed as a somewhat anomalous Helianthoid. Its geographical area is that of a large proportion of the American anomalous oligotypic genera, the Mexican region, to which all its species are limited except one, which, apparently as a weed of cultivation, has spread over many parts of South America, and has been also carried into the tropical regions of the Old World.

2. Under the name of MILLERIEÆ are collected a number of small or monotypic genera, some of which may not really prove to have

claims to consanguinity sufficient to be thus associated, and may possibly be, like *Lagascea*, isolated remnants of old, almost extinguished races or local divergent forms, whose connexions have not been properly appreciated. In the mean time they are somewhat technically associated by their mostly Helianthoid habit, foliage, and involucre, by their usually small capitula with a few female fertile florets; the disk-florets always sterile with undivided styles; the achenes of the fertile florets Helianthoid, rather large, often dorsally flattened or thick, subtended by or enclosed in the inner involucre bracts (or outer receptacular paleæ), without any or with a short coroniform or Helianthoid pappus; the abortive disk-achenes without any pappus, their florets crowded in the centre of the capitulum without intervening paleæ, or, at most, with a few reduced subtending setæ. Geographically they are somewhat scattered; the majority are American and tropical. *Heptanthus*, three species, *Pinillosia*, three species, and the monotypic *Lantanopsis*, are restricted to Cuba; *Tetranthus*, two species, is also insular, restricted to San Domingo; *Elvira* has three species, which some may regard as so many distinct monotypic genera, of which two are insular, limited to the Galapagos, the third dispersed from Central over many parts of tropical South America, as is also the monotypic *Milleria*; *Stachycephalum*, also monotypic, is limited to Mexico,—the above seven (or nine) genera having, perhaps, sufficient characters in common to be united into one genus of a higher grade; all have opposite or radical leaves and few-flowered small capitula. Technically allied to them, with small few-flowered capitula and radical or alternate leaves, and, perhaps, really of very distant affinities, is a genus of a much wider geographical distribution. *Adenocaulon*, with five species, belongs to the temperate or mountain W.-American region, two species being Chilian, one N.W.-American, and two, possibly varieties of the N.-American one, inhabitants respectively of Japan and the Himalaya. This genus had hitherto been classed with *Tussilago*, where, to my mind, it would be a more perfect stranger than amongst *Milleriæ*.

The three remaining genera, *Riencourtia*, five or six species, from eastern tropical South America, *Desmanthodium*, two Mexican species, and *Clibadium*, with fourteen species more generally dispersed over tropical and subtropical America, establish the connecting link between *Milleriæ* and *Melampodineæ* and the still more normal Helianthoid subtribe *Verbesinæ*.

3. MELAMPODINEÆ, nineteen or twenty genera and nearly 100 species, constitute a more definite subtribe, intermediate between Milleriæ and the great mass of Helianthoideæ (Verbesineæ), differing from the former in their completely paleaceous receptacle, from the latter in the constant sterility and undivided styles of the disk-florets. They are, with two exceptions, exclusively American and chiefly tropical, but occasionally extending further both northward and, in a less degree, southward. Most of them require here but a very short mention. *Ichthyothere*, eight species, *Baltimora*, two species, and *Acanthospermum*, two species, are strictly tropical and chiefly eastern; *Melampodium*, eighteen species, is also tropical, but with a much wider range, extending northwards over the Mexicano-Texan region, with one species (probably introduced) found also in various parts of the warmer regions of the Old World, and another, to all appearance really indigenous, in the Philippine Islands. *Espeletia*, eleven species, *Philoglossa*, one or two species, and *Schizoptera*, one species, are also South-American and tropical, but limited to the Andes; *Parthenium*, six species, and *Polymnia*, twelve species, are tropical, but also extratropical and chiefly, but not entirely, western, the former extending from Chili to the Mexican region, the latter from the Argentine Republic to Canada. Eight genera are limited to the Mexican region,—*Berlandiera*, with five species, *Guardiola*, with four, *Trigonospermum*, with two species, and the monotypic *Lindheimera*, *Engelmannia*, *Dicranocarpus*, *Aiolotheca*, and *Parthenice*. Another monotypic genus, *Lecocarpus*, is limited to the Galapagos Islands; *Silphium*, with eleven species, is exclusively North-American. This geographical arrangement is, however, not in conformity to structural affinities; the natural divisions of the subtribe have generally a wide range. The northern *Silphium*, the Andine *Schizoptera*, and the intermediate *Berlandiera*, *Lindheimera*, and *Engelmannia* might form one genus, which would then have as extended an area as *Polymnia*. The east tropical *Acanthospermum* and the Galapagian *Lecocarpus* might be included in the widely spread *Melampodium*.

There remains the genus *Chrysogonum*, which, although it is undoubtedly nearly related to *Silphium*, and has even one species belonging to the same area in North America, is yet more strongly represented in a widely distant region; two species are East-Indian and three are tropical-Australian. These Old-World species have been hitherto known under the name of *Moonia*; but, on attempting to draw up comparative characters in the subtribe,

I could find nothing in habit or structure to distinguish the American from the East-Indian genera. The species are distinct enough; but one of those of the Old World is more nearly allied to the American one than to its co-citizens.

4. AMBROSIEÆ, ten genera and about forty species, form so distinct and natural a subtribe that it has been repeatedly proposed to raise them to the rank of an independent tribe, suborder, or even of a distinct order; and regarding the characters of *Xanthium* and *Ambrosia* alone, as they are usually expressed with a slight exaggeration, the separation would seem justified; I have, I believe, myself somewhere assented to it; but after a detailed examination of all the surrounding genera, I have felt compelled to admit that the majority of synantherologists are correct in placing them under the Helianthoideæ. They are, without doubt, connected with *Artemisia* as well as with Melampodineæ, having much of the habit of the former and passing into the latter through *Parthenice*; but geographically, as well as structurally, the relationship to Melampodineæ appears to me to be the closest. The Ambrosiæ are strictly American, although three or four species, as in the case of *Elephantopus*, *Eclipta*, &c., may be widely dispersed also over the Old World, whereas the *Artemisiæ* belong to an Old-World series, and are themselves of the Old World, although they may have some identical or representative species in the extratropical or mountain-regions of America. Delpino, however, in his above-mentioned memoir, as well as in his private letters, insists on the close connexion of *Artemisia* with Ambrosiæ, forming his subfamily of Artemisiaceæ, which he thinks he has established on irrefutable grounds. But to me it appears this is only a very natural attaching of undue importance to a class of characters the study of which he has specially carried out with so much success. He proposes two distinct "families," Senecionidæ and Helianthaceæ, the one with the style truncate at the end with a terminal tuft or marginal ring of hairs destined to scrape or *push* the pollen out of the anther-tube, the other with the hairs descending along the outside of the style so as to *sweep* out the pollen. This is an old distinction which experience has prevented from being made generally available. If Delpino had not confined himself to the examination of so small a proportion of the varied style-forms, if he had gone through any considerable number of our Senecionideæ and Helianthoideæ, he would soon have been stopped in his endeavours to class them according to his

views. To go no further than the few figured by Hildebrand in his above-mentioned memoir in the 'Nov. Act. Nat. Cur.,' what would he have done with the series *Doronicum*, t. 2. f. 23-26 (an undoubted truncate penicillate Senecionida), *Bidens*, t. 1. f. 30, 31, *Emilia*, t. 1. f. 11-13, *Dahlia*, t. 1. f. 26, 27, and *Gaillardia*, t. 3. f. 1, 2, which last is as undoubted a Helianthaceous style according to his views, and passes into the Asteroid *Solidago* style, t. 2. f. 7-9? Where would he, where could he draw the line? And if he had gone through many of the common tropical genera, he would have been obliged to remove *Gynura* far from *Senecio*, *Dahlia* from *Coreopsis*, *Spilanthes* from *Verbesina*, &c.

Delpino next divides Senecionidæ into two subfamilies, *Senecioneæ*, with zoidiophilous, and *Artemisiaceæ*, with anemophilous fertilization—according to him, a very remarkable and constant distinction, accompanied also by a difference in the position of the capitula, erect in one case, nodding in the other. As to the two modes of cross fertilization, or rather of the conveyance of pollen, it has hitherto been observed in so very small a number of species, that I must refrain from expressing any opinion as to their constancy as generic characters; but I would only refer to his own note, p. 34, as to the occurrence of the two modes in different species of one and the same genus. Erect and nodding capitula occur not unfrequently (e. g. *Lactuca* and *Prenanthes*) in different species of the same genus; they are not constantly nodding in *Artemisia*; and the Melampodineous genus *Parthenice*, too closely allied to *Parthenium* to be widely separated from it, has the habit and nodding capitula of the Ambrosieous genus *Cyclachæna*.

Ambrosiæ are remarkable for their anthers less perfectly connate than in any other Compositæ, although closely approximate, forming the usual cylinder and often slightly cohering; they are also distinguished by their terminal appendages inflected or hooked at the end, as observed by A. Gray*. The anther-bearing florets are as constantly sterile as in Melampodineæ and Milleriæ, and the styles of these sterile florets as constantly

* In a recent part of the 'Proceedings of the Academy of Natural Sciences of Philadelphia,' 1869, p. 189, Mr. T. Meehan observes that in *Ambrosia artemisiæfolia* this inflexed setiform appendage is only to be found on anthers which do not present perfect pollen; the abundantly polliniferous anthers are broad, without horns.

undivided, but with the different termination pointed out by various synantherologists and insisted on by Delpino. The genera may be distributed into two groups. In the first, the Ivaë, the capitula are heterogamous, as in Melampodineæ, with female florets in the circumference and sterile antheriferous ones in the disk. In *Iva* itself, with seven or eight Northern or Central American species, the corollas of the female florets are much reduced; in the two species of *Cyclachæna* and in the monotypic genera *Euphrosyne*, *Dicoria*, and *Oxytænia*, all Mexican or Californian, the female corollas entirely disappear, the style proceeding from the summit of the naked ovary, or at most surrounded by a rudimentary ring. In the second group the capitula are strictly monœcious, the males usually placed in a different part of the plant from the females. The female florets are again apetalous; but each one is completely enclosed in an involucre bract consolidated with more or less of the outer ones in a close utricle, from the beaked apex of which issues the style. These female capitula are sometimes one-flowered and distinct; sometimes there are two to four female flowers, each in a separate beaked and closed division of a common mass. Whether this mass is an aggregate of two to four consolidated one-flowered capitula or a single capitulum with the inner involucre bracts closed round the achenes, as in *Sclerocarpus* or *Melampodium*, and connate with each other as well as with the outer bracts, is a disputed point, the advocates of each side of the question being certain that they are right. To me it appears that the inflorescence may be explained either way, the florets not being numerous enough to supply any such proof as we have in the case of *Albertinia*. The four genera of this second group are all American, or, at least, as it would appear, of American and probably western origin. *Hymenoclea*, two species, is Mexican or Californian; *Franseria*, ten species, ranges from Chili to California, extending also eastward in North America; *Ambrosia*, twelve species, belongs to the same regions, but one or two of its species are also spread over a great part of the Old World, as in the above-mentioned cases of *Elephantopus* &c. *Xanthium* has two or three species, but too well known over almost all warm or temperate regions of the globe. The genus is probably of American origin, although the common species *X. strumarium* had evidently made its way into the Old World long before the discovery of America, and has established both in Asia and Europe many so-called species, none

of which, however, appears to have acquired much of a local character, and some are repeated in America. *X. macrocarpum*, DC., first described as a Mediterranean plant, is believed to be a more modern introduction from America; *X. spinosum*, Linn., which has quite recently extended its range over new countries (*e. g.* Australia), was originally said to be Chilian.

5. PETROBIEÆ form a small subtribe of three genera comprising 4 species, very distinct, by their strictly dioecious capitula, and remarkable for the flowers of the two sexes being more nearly similar than in most heterogamous Compositæ. The corollas of both sexes are regular, though still different in proportions; the stamens in the females are more developed than usual, having well-formed anthers, although small, free, and without pollen; the styles of the males are undivided in one genus, branched in the two others. They are trees or shrubs, with the other characters of Helianthoideæ. Geographically they are all of limited range. *Podanthus*, with two species (or varieties?), is Chilian; *Astemma*, a single species as yet only known from Humboldt's original specimen with female capitula, is from the Andes of Quito; the third, *Petrobium*, also monotypic, is insular, being limited to the island of St. Helena. Several of the above circumstances suggest the probability of these genera exhibiting the nearest approach to the primitive form of Compositæ.

6. ZINNIEÆ are a group of five or six genera, comprising twenty-five species, only separated from the great mass of Verbesineæ by the ligulate corollas of the female florets sessile or nearly so, and persistent on the ripe achene, without any external pappus or border at the base, and so deceptively continuous with the achene as in some instances to have given rise to a query whether this corolla did not really stand in the place of the pappus and represent the calyx-limb—a query, however, to which a careful examination will at once give a negative answer. These genera are all West-American and chiefly of the Mexican region; *Tragoceros* four species, *Zinnia* twelve species, *Sanvitalia* three or four species, and *Aganippea* two species limited to that region; *Heliopsis* has three species, of which one extends southwards along the Andes and the two others eastwards in North America. One or two species of *Zinnia*, long in cultivation for ornament, have established themselves as colonists in some parts of the Old World. *Philactis*, a single species, also Mexican, is unknown to me, but probably belongs to the *Zinnia* group.

7. The main subtribe of VERBESINEÆ comprises about 570 species distributed amongst 57 genera, many of them natural enough, but distinguished by characters of comparatively small importance, sometimes passing into each other, and often very technical and very difficult to group together except into very artificial series. The great majority are American, many of them restricted to that continent or to limited areas within it; but some are well represented in tropical Africa, or in a less degree in Asia or Australia, and two small genera are exclusively Mascarene. The geographical distribution of the two following subtribes (8. COREOPSIDEÆ, 17 genera with 150 species; and 9. GALINSOGEÆ, 7 genera with 80 species) is nearly the same, the one comprising also 4 small exclusively Old-World tropical genera, and the latter 1 small Sandwich-Island endemic genus. As the differences which distinguish them from Verbesineæ are also of somewhat minor importance (chiefly the shape of the achene in the one case, the nature of the pappus in the other), and as the real value of the generic distinctions is often as yet uncertain in all three subtribes, we may consider the whole as one group, taking the principal genera rather in the order of their geographical distribution, commencing with those American ones which are also represented in the Old World by distinct species.

Wedelia, about forty species, *Blainvillea*, ten species, slightly differing in the pappus, and *Aspilia*, thirty species, with neutral ray-florets, may be regarded as one large genus, chiefly American, of which each of these divisions includes several Old-World species, the whole group also scarcely distinct from several other purely American genera. *Wedelia* itself, as now limited, comprises three tolerably well-marked sections: (1) *Stemmodon* has three or four tropical-American species and one in tropical Asia, *W. calendulacea*, a maritime plant very closely allied to the similarly maritime West-Indian *W. gracilis*, although not identical; (2) *Cyathophora*, with numerous tropical American, has one insular (Galapagos) species, *W. frutescens*, Hook. f., which appears quite distinct from Jacquin's plant of that name, one East-Indian species, *W. urticifolia*, and one in east tropical Africa; (3) *Wollastonia*, with the pappus very much reduced or disappearing altogether, appears to be an Old-World deviation, and is limited to tropical and subtropical Asia and Australia. Although usually regarded as a genus, there is really nothing but this reduced pappus to separate it from *Cyathophora*; one species, indeed, so

closely resembles the above-mentioned Asiatic *W.* (*Cyathophora*) *urticifolia*, as to be frequently mixed with it in collections. *Blainvillea* is represented in tropical Africa and Asia by three or four species, one of them proposed as a distinct genus, but which are all closely allied to a common east tropical American weed, the typical *B. rhomboidea*, Cass.; they seem, however, to be rather representative than identical species. Two other common American weeds (both nearly allied to, but sectionally or, according to some, generically diverging from *B. rhomboidea*), *Blainvillea biaristata*, DC., and *Eleutheranthera ruderalis*, Sch. Bip., are not represented in Africa. *Aspilia* was the generic name originally given to a Madagascar plant, which, on a comparative examination, has appeared to me to be strictly congener as well with the African *Coronocarpus* as with a number of American, chiefly Brazilian, plants, referred by different botanists to various genera, including the whole of the genus *Anomostephium*, DC. Amidst these several names, Dupetit Thouars's *Aspilia* has the right of priority. The genus thus formed is divisible into three not very well-defined series, of which two are exclusively Brazilian; the third, extending in America from Brazil to Mexico, also includes some of the African species, though no one species is identical in the two continents; the Mascarene and one or two African ones cannot be exactly included in either of the American series. The tropical American genera *Zexmenia*, twenty species, and *Oyedæa*, twenty-two species, neither of them represented in Africa, are very closely allied to *Wedelia*, as is also the insular *Lipochæta*, consisting of ten Sandwich-Island and one Galapagos species (*Macræa*, Hook. f., united with *Lipochæta* by A. Gray).

Sclerocarpus was originally established for a tropical African plant now known to extend into tropical Asia, remarkable for the receptacular paleæ completely enclosing the disk-achenes and hardened round them, so as to appear to form part of them. Precisely the same structure was observed in some tropical American species, never compared with the African one, but distributed into various genera, although one of them (*Gymnopsis uniserialis*, Hook.), if not exactly identical with *S. africanus*, is so closely allied to it as to be strictly representative. The genus thus consolidated comprises one tropical African and nine American species, chiefly from the Mexican region, but extending also into tropical South America. A similar structure is observable in the American genus *Montanoa*, of about fourteen species, ranging from Columbia to the Mexican region.

Melanthera is a small natural group of about eight species, distinct in the form of its achenes as well as in habit and minor characters, and common to tropical America and Africa. It has been divided into four purely artificial genera:—*Melanthera* proper, four American species without any female florets; *Lipotriche*, one African species with fertile ray-florets; *Echinocephalum*, one American, and *Wurmschnittia*, one Abyssinian species with neutral ray-florets.

Spilanthus is another natural genus, readily distinguished from its nearest allies by the truncate style-branches and other characters, and widely distributed over the tropical world. It is difficult without a detailed study to fix either the number of species, ranging between twenty and forty, or rightly to appreciate the geographical distribution of some of them. The greater number appear to be American; and one or two of these, as in *Elephantopus*, range over the Old World; but a few also appear to be really of Old-World origin, especially two extending from the Indian archipelago into Australia.

Coreopsis, in the extended sense in which we have taken it, neglecting, as in *Melanthera*, the differences between the neutral and the fertile ray-florets, contains nearly sixty species, and, although chiefly American, has established distinct forms in tropical Africa and in the Sandwich Islands. In America the range of the genus is wide, but chiefly northern, western, or Andine, and consequently not quite of so tropical a character as that of most American genera represented in tropical Africa. Several local American species or groups of species have been separated at various times as distinct genera characterized by the fertility or by the reduction of the pappus of the ray-florets, or by slight modifications in the margins of the achenes, &c. The African species were by some singular misconception of characters referred originally to *Verbesina*; they have since been established by Schultz Bipontinus as a distinct genus under the name of *Prestinaria*; but they correspond too closely to the Peruvian (shrubby) or Californian (herbaceous) *Agaristæ* to be generically separated from them. The Sandwich-Island *Campylotheceæ*, united by A. Gray with *Coreopsis* and by Schultz Bipontinus with *Bidens*, must be regarded as an insular group almost as near to the one as to the other, although technically referable to *Coreopsis*. The species are so varied, however, in habit and in some minor points of structure, that they could scarcely be kept together had not their geogra-

phical isolation indicated a relationship which would not otherwise have been so clear.

Bidens, a genus of about fifty species (nearly doubled by some botanists), although technically distinguished from *Coreopsis* by a somewhat trivial character, the asperities of the awns of the achenes directed downwards instead of upwards, is nevertheless a natural genus; and although geographically it may have as wide a range as *Coreopsis*, its distribution has a different character. The genus has two natural sections; one (*Platycarpæa*) is so generally diffused over the temperate regions of the northern hemisphere that it would be difficult to determine whether its origin is American or Europæo-Asiatic; and the representative species in the two regions differ but little from each other. There are, however, two or three American species unrepresented in the Old World; and Cassini's St.-Domingo genus *Narvalina* (a single species) may be considered as a divergence only from the *Platycarpæa*, thus confirming some other evidences of the American ancestry of the group. One of our common species, *B. tripartita*, Linn., represented in America by *B. frondosa*, Linn., and *B. connata*, Muehl., reappears in the southern mountain-ranges of Australia. The other section, *Psilocarpæa*, is more tropical and essentially American. Two species are indeed amongst the commonest weeds all over the warmer regions of the Old World; but that is a case similar to that of the *Elephantopus*, if, indeed, the presence of these species in some districts be not due to modern importations, wonderfully facilitated by the prehensile nature of the awns of the achenes.

A Sandwich-Island *Bidens*, in its reduced pappus, shows an anomalous insular form, and may possibly be derived rather from the *Coreopsides* (*Campylothecas*) of the same islands. At any rate, this group shows the connexion of *Coreopsis* with *Bidens*, and is an example of divergence, with different combinations of characters in the isolated islands, from those which have become established in the general continental area of the genera.

Various groups, further diverging from *Coreopsis* and *Bidens*, have arisen in various portions of the extended area of the genera:— in west tropical America, extending more or less from Bolivia to the Mexican region, *Dahlia* with four or five species and *Cosmos* with ten; in east tropical America *Isostigma*, five species; in subtropical America, north and south (Mexican and Bonarian regions), *Thelesperma*, four or five species; and in east tropical Asia and Australia, *Glossogyne*, five species.

Amongst the epappose Verbesineæ there are two small and very distinct genera which have a very wide tropical distribution. *Enhydra*, with about a dozen species, is well represented in tropical Asia, Africa, and America, and has no near connexions in either country to indicate its origin, unless perhaps the Andine genus *Aphanactis*, two species, prove to be really allied to it. The most distinct species of *Enhydra* are also American; those of the Old World may be varieties of a single one. The other genus, *Eclipta* (three or four species), has likewise one cosmopolitan tropical species, to which the nearest allied local one is Australian; but beyond that there are no further connexions in the Old World. The remaining one or two species, forming a slightly distinct section, are in extratropical South America, where also is to be found the next nearest monotypic genus, *Leptocarpha*.

Chrysanthellum is a small annual weed dispersed, under various names, over tropical Asia, Africa, and America, without affording any clue as to its original country, except the faint one supplied by a second species which has established itself in the Galapagos, tending to indicate an American origin. Affinities with other genera give no further assistance; for the nearest to it (though quite distinct from it) appear to be *Heterospermum* and *Glossocardia*, both monotypic, the one tropical-American, the other East-Indian. *Synedrella*, which is a nearer approach to the true Verbesineæ, has two American species, of which one, like *Elephantopus*, is dispersed over tropical Africa and Asia.

With regard to the Verbesineæ strictly limited to America, the North-American genera take a great part, although not displaying any proportionate diversity of form except in the Mexican region. *Rudbeckia*, which, taken as a whole, is a natural and distinct genus of twenty-five species, is limited to North America and almost to the United-States region; so also are *Balsamorhiza* (ten species), *Wyethia* (four species), *Helianthella* (six species), all more or less diverging from *Helianthus*, but geographically rather more western. *Tetragonotheca* (three species) is likewise strictly North-American, but more distinct. *Helianthus* itself is by far the largest North-American Helianthoid genus; for about forty out of its fifty-two species are spread over that continent without having any special western character. It is, however, represented in Central and Southern America not only by a few species, which cannot well be generically distinguished from it, descending along

the Andes of Peru as far as Chili, but far more numerous by the Central-American genus *Tithonia*, three or four species, and the general tropical-American *Viguiera*, of about sixty species, both of which are, on the one hand, somewhat artificially distinguished from *Helianthus*, and, on the other hand, pass almost into the already-mentioned tropical *Wedelia* group, or into a few of the smaller Mexican or tropical genera which I shall presently refer to.

Confined to the Mexican region we have nine or ten genera of one or two species each:—*Rumfordia*, *Selloa*, *Axiniphyllum* (*Abasaloa*?), *Varilla*, *Chromolepis*, *Mirasolia*, *Iostephane*, *Otopappus*, and *Podachænum*, to which we may add the Coreopsideous genus *Coreocarpus*, also of two species only. Small as they are, I do not think that any of these genera are sufficiently connected with any of their large cotribuals to be incorporated with them, unless these again be much more consolidated; nor do they form of themselves a separate group in the subtribe. Like so many others of the same region, they may be considered as the scattered remnants of various ancient races. The distinct genus *Encelia*, which, taken in its natural extended limits, comprises twenty-two species, is also Mexican, but extends southwards and northwards from Chili to California.

In the insular genus *Scalesia*, eighteen or ten Galapagian species, may be traced a connexion with the above mentioned *Mirasolia*, which belongs to the southern or Central-American portion of the Mexican region.

In the South-American Andes we have again four genera of one or two species each:—*Monactis*, *Stemmatella*, *Aphanactis*, and *Garcilassa*, as much if not more isolated than those of the Mexican region, none of them having any nearer connexions than the general affinity to the whole subtribe. *Pascalìa*, a monotypic genus of the same region but more southern, and quite or nearly extratropical, is generally allied to the *Wedelia* group.

Among tropical-American Verbesineæ, besides those already mentioned as connected with the North, the most important is *Verbesina* itself, with about fifty species, dispersed over the whole region, and represented by several species in North America, and one or two extending beyond the tropics to the south. One species, distinguished by most authors on very trifling characters under the name of *Ximenesia*, is met with in tropical Africa and some other warm countries, but evidently introduced from America,

where alone true *Verbesinæ* and their immediate connexions are indigenous. The nearest slightly diverging genera are *Actinomeris*, nine species, ranging from the Mexican region eastward in N. America, only distinguished from *Verbesina* by the sterility of the ray-florets, and *Salmea*, twelve W.-Indian and Mexican species. The Brazilian monotypic *Salmiopsis* appears to be a connecting link between *Salmea* and some Brazilian *Viguieræ*; and the above-mentioned Mexican *Otopappus* may also be considered as a divergent form of *Salmea*.

The tropical *Wullfia*, eight species, and the tropical and Mexican *Perymenium*, ten species, have their nearest connexions probably with *Wedelia* and with *Melanthera*.

Gymnolomia, eighteen species, *Zaluzania*, seven species, and *Sabazia*, eight species, might perhaps be considered as a single genus ranging over the Mexican region, Central America, the W. Indies, and Columbia, but not, as far as I am aware, extending into E. tropical S. America. The above-mentioned Mexican *Varilla* might perhaps be included with them. *Jægeria*, six tropical-American species, ranging from Bonaria to Mexico, in some respects approaches the same group, being evidently very near *Sabazia*, but really perhaps more nearly connected with *Stemmatella* and *Siegesbeckia*, the chief geographical centre of all three being apparently the Andine region.

The West-Indian *Borrichia*, three species, and *Chænocephalus*, one species, and the tropical-American *Trichospira*, also monotypic, stand each of them isolated as it were in the great subtribe of *Verbesinæ*.

There are two genera of the subtribe *Coreopsidæ*, bordering upon *Verbesinæ*, that are limited to tropical Africa (and, indeed, both of them have been hitherto observed as indigenous in Abyssinia only)—*Guizotia*, with three species (one of them spread by cultivation over East India), and *Microlecane*, one species. The nearest connexion of both may be with some of the African forms of *Coreopsis*; but it is not very close.

Two Mascarene genera, *Micractis*, one species, and *Epallage*, two species, evidently belong to *Verbesinæ*; but I am unable at present to trace out the genera they are most nearly connected with.

The foregoing genera belong to the subtribes *Verbesinæ* and *Coreopsidæ*; the third subtribe *Galinsogææ*, which I have grouped with them, is entirely American. The genera of which it is com-

posed have been usually classed under Helenioideæ, on account of their scaly pappus; but their affinity appears to me to be much greater with Verbesineæ, of which they have the habit, the paleaceous receptacle, &c., so much so that some species of *Calea* where the pappus is occasionally or constantly deficient, are difficult to distinguish from *Sabazia* and its allied Verbesineous genera. Of the seven genera composing the subtribe, all well defined, if taken in their extended sense, three (*Balduina*, two species, *Marshallia*, three species, and the monotypic *Blepharispermum*) are exclusively N. American, three (*Galinsoga*, three species, *Calea*, about sixty species, and *Tridax*, six species) are widely dispersed over the tropical and even subtropical regions of America, one species of *Galinsoga* and one of *Tridax* having become extensively spread as introduced weeds, the former in the temperate and tropical regions of the Old World, the latter within the tropics only. The seventh genus, *Dubautia*, four species, is insular, limited to the Sandwich Islands.

10. The subtribe MADIÆ forms a very natural group, connected, it is true, with the Helenioideæ as well as with the Helianthoideæ, but most nearly so with the latter, and with a very limited geographical range. Five genera (*Madia* eight species, *Hemizonia* about twenty-five, *Lagophylla* three, *Layia* about twelve, and *Achyrachæna* one species) belong to western N. America from Mexico to British Columbia, one of the species re-appearing in Chili. These might all be easily regarded as a single genus. The two other genera of the subtribe, differing more perhaps in habit and the large size of the capitula than in any important structural characters (*Wilkesia*, one species, and *Argyroxiphium*, two species), are insular, limited to the Sandwich Islands.

6. *Helenioideæ*.

The essentially American Helenioideæ connect the American Helianthoideæ with the Old-World Anthemideæ on the one hand, and with the cosmopolitan Senecionideæ on the other. The tribe is generally considered as forming three subtribes, or divisions of Senecionideæ or Helianthoideæ; but it appears to me that the circumscription of these large groups is more natural if they are kept distinct. The Helenioideæ are not numerous in species, but varied in form; the species (not quite half as many as those of Anthemideæ, under one third of those of Helianthoideæ) average

five to a genus, whilst in Helianthoideæ the average is about eight, in Anthemideæ above sixteen. It differs from Helianthoideæ in the absence of any paleæ to the receptacle, and most frequently in the involucre approaching more to that of Senecionideæ or of Anthemideæ, in the pappus either of distinct equal scales or reduced as in Anthemideæ, or passing almost into the setæ of Senecionideæ, in the shape of the achenes and in the greater fertility of the florets. Sterile disk-florets with undivided styles, characteristic of three considerable subtribes of Helianthoideæ, are only known in the somewhat anomalous genus *Blennosperma* among Helenioideæ; and sterile ray-florets, not unfrequent in the former, have only been observed in *Gaillardia* among the latter. The geographical distribution is nearly that of Helianthoideæ, but more strictly American, and chiefly western or extratropical; only three species out of near 300 are known in the Old World, of which two are S.-African, and one, identical with a S.-American one, is Australian.

The tribe consists of four very natural subtribes, *Bærieæ*, *Flaverieæ*, *Tagetineæ*, and *Euhelenieæ*, besides four more distinct genera technically united as a fifth subtribe under the name of *Jaumieæ*.

The subtribe *Bærieæ*, about 110 species in 30 genera, is the most characteristic of the tribe (although for the latter the name of Helenioideæ has been adopted as having the right of priority) in structure as well as in geographical range. The *Bærieæ* are indeed throughout so eminently W.-American, that very little special mention need here be made of separate genera: 26 out of the 29 are found in the Mexican region (if we include California); three of these (*Chænactis*, *Hymenopappus*, and *Palafoxia*) extend rather more eastward in N. America; one only (*Schkuhria*) extends into E. tropical S. America; four (*Lasthenia*, *Bahia*, *Villanova*, and *Blennosperma*) are represented in Chili by identical or nearly allied species. Of the three genera not yet observed in the Mexican region, one (*Thymopsis*) is not far removed from it, being an insular form limited to Cuba, the two others (*Closia* and *Amblyopappus*) are Chilian, and may yet appear in the northern hemisphere.

The genus *Flaveria*, seven species, with the closely allied monotypic *Sartwellia*, belongs to the same W.-American region as the *Bærieæ*, extending from Chili to Mexico and Florida; one species, either identical with or closely representative of the commonest

of the American ones, is also found in Australia. If only a colonist there, it must be so ancient a one as to have undergone some slight modifications in form. As a subtribe these Flaveriæ are rather further removed from Helianthoideæ, and approach the Tagetineæ; their involucre is the most prevalent one in Senecionideæ, the style that of Anthemideæ and the larger portion of Senecionideæ, the achenes such as are prevalent in Bæriæ and Tagetineæ.

The S.-African monotypic genus *Cadiscus* is anomalous, but appears to me to be much more nearly connected with the Helenioid Flaveriæ than with any S.-African type.

The *Tagetineæ*, 13 or 14 genera and above 100 species, form as a whole a very natural group, which will, moreover, very naturally divide into three, *Porophyllum*, *Tagetes*, and *Pectis*, taken each in the most extended sense. All three have their principal seat in the Mexican region, but extend in a few species all over the warmer parts of South America; very few species reach California, none extend far eastward in N. America. A monotypic form diverging from *Porophyllum* (*Lescaillea*) is insular, limited to Cuba; another monotypic, *Schizotrichia*, is Peruvian. None are known from the Old-World except as introduced weeds, one or two species of *Tagetes* itself, long cultivated for ornament, having almost naturalized themselves in some parts of tropical Asia and Africa.

As a whole the subtribe connects Helianthoideæ with Senecionideæ, *Porophyllum* and some species of *Pectis* having almost the pappus of the latter tribe. The whole, or nearly the whole, are remarkable for the large oily receptacles or glands scattered on their foliage and involucre. *Pectis* (40 species) has the style-branches much shorter than in any other genus of Helenioideæ, or of any of the nearly connected tribes, and is, moreover, marked by the rigid cilia at the base of the leaves or petioles. *Syncephalanthus*, a monotypic form included among those which diverge from *Tagetes*, has a very curious inflorescence; the capitula are collected in clusters which assume precisely the aspect of the single radiate capitula of *Bæbera*, the central capitulum of the cluster having no ray, and the ray-florets of the surrounding ones being only on the outer side, so as to form one continuous ray for the whole cluster. This peculiarity occurs also in the S.-African genus *Edera*, and appears to have no special significance, systematical or geographical. The genus *Clappia*, two species, so

closely connects Tagetineæ with Senecionideæ, that it is difficult to determine to which it should be referred. The aspect and most of the characters, as well as geographical considerations, tend towards Tagetineæ; but there appear to be no oleaginous glands. Both the species require further investigation from more perfect specimens.

Euheleniæ, seven genera and about forty-five species, all American, are chiefly extratropical; they form in some instances a near approach to Anthemideæ, and may be generally considered as the American representatives of that Old-World tribe, although in a very few species they also show an approach to Senecionideæ. Structurally they differ from the preceding subtribes, chiefly by their shorter silky-villous achenes, and by their broader, more open, and sometimes Anthemoid involucre. The principal genera are not in N. America so specially Mexican as most Helenioideæ, but spread more equally to the eastward. They generally, if taken with their most natural limits, include in one genus species with fertile or sterile ray-florets, or without any at all. Under this view *Helenium*, with about sixteen N.-American species, may be said to be represented in extratropical S. America by *Cephalophora*, four or five species; *Gaillardia*, with five N.-American species, has a sixth extratropical southern one (*Güntheria*). *Actinella* with ten species is confined to N. America; but *Hymenoxys*, four species, which is nearly related to it, but with a more Anthemoid aspect, is both in extratropical S. America and in the Mexican region.

Psathyrotes, a Mexican genus of three species, has much of the involucre and pappus of a Senecionidea; but the achenes and some other characters are those of the Euheleniæ, and the closely allied monotypic *Trichoptilium*, from California, connects it with the latter in the pappus also.

There remain four genera, which, on account of their involucral bracts, imbricate in several rows, increasing from the outer to the inner, are anomalous in Helenioideæ, and are artificially placed in a separate subtribe, Jaumiæ. Two of them, *Cacosmia* four or five species, and *Geissopappus* two species, are from tropical America, and correspond in many respects to the Helianthoid genera *Calea* and *Galinsoga* from the same region, but have the naked receptaculum and the achenes of Helenioideæ. *Jaumea* is a small genus which appears to me as distinct in habit and character as it is remarkable for its scattered geographical distri-

bution. Its five species have been published as so many separate genera, but never appear to have been compared with each other. The original typical species is a creeping maritime plant from Buenos Ayres with rayless capitula; *Coinogyne*, a maritime Californian plant, is scarcely to be distinguished from it except by its radiate capitula; *Espejoa* is a Mexican species, with an erect branching stem and radiate capitula; *Chæthymenia* is another erect branching Mexican species with radiate capitula, but with much less obtuse involucre bracts. *Hypericophyllum*, from S. tropical Africa, closely resembles *Chæthymenia*; but the capitula are rayless as in the typical *Jaumea*, and the leaves, though entire glabrous and rather thick as in the other four, are broader. If all these had been found in the same district, no one would have doubted their being congeners; and had any of them, in its own special locality, diverged into allied forms different from those of the distant species, we might have admitted them, as distinct genera upon very slight characters; but as none have any near connexions in their own district, we must conclude that they are all really congeners with the scattered distribution, hitherto unaccounted for, of *Melasma*, *Alectra*, and others.

Venegazia, a monotypic Californian genus thus associated with *Jaumieæ*, appears in some respects to approach *Anthemideæ* in structure; but the involucre, the achenes, and the pappus, as well as the geographical position, are those of *Helenioideæ*. *Olivæa* is another monotypic genus of the Mexican region, but rather more nearly connected with normal *Helenioideæ*.

7. *Anthemideæ*.

Anthemideæ, with very few exceptions, are essentially of the Old World, chiefly extratropical, and far less varied than the two preceding tribes. About 650 species are contained in forty genera; and several of these seem to pass into each other. It is not easy, either, to group them into well-marked subtribes; and, as in the case of *Asteroideæ*, it will be necessary to consider a few of the principal genera as centres of groups round which others are more or less divergent. As a whole, *Anthemideæ* are remarkably constant in their tailless anthers and truncate style-branches; and their pappus, either very shortly paleaceous or coroniform or entirely wanting, has but very few exceptions. Their habit and involucre often connect them with *Asteroideæ* on the one hand and *Arctotideæ* on the other; but their style readily distinguishes

them from both. Between Anthemideæ and Helenioideæ (Eubelenieæ) there is, perhaps, no very definite boundary; but generally the habit, involucre, or geographical distribution, accompanied by various minor indications, do not leave much doubt as to the position of a genus.

In the 'Genera Plantarum' we have, for convenience' sake, classed the genera somewhat artificially. In considering their geographical distribution we must adopt a different sequence, taking:—first the great northern genera *Anthemis* and its allies, *Chrysanthemum*, *Tanacetum*, and *Artemisia*, some of which extend a few species into North America; then the South-African *Athanasia*, *Hippia*, and their allies, all restricted to that region; thirdly, the Cotuleæ, which are more cosmopolitan, belonging in a great measure to the southern hemisphere; and, lastly, a few isolated local genera.

Anthemis, above eighty species, *Anacyclus*, about ten species, *Achillea*, near 100 species, *Santolina*, about eight species, and the monotypic *Cladanthus*, *Diotis*, and, perhaps, *Lonas* and *Mecomiscus*, separated from each other by characters of no great importance, besides habit, are distinguished from *Chrysanthemum* by their paleaceous receptacle. The two larger genera, *Anthemis* and *Achillea*, range over Europe, North Africa, and extratropical Asia, their chief centre being the Mediterranean region and the Levant. One species, the common *Achillea millefolium*, appears to be spread over the whole of Europe, northern and central Asia, and a great part of North America, where are also mountain species of the same genus. But no *Anthemis* is to be met with in America or in the southern hemisphere except as weeds of cultivation. *Santolina* and *Anacyclus* are limited to the Mediterranean region taken in a rather wide sense. *Cladanthus* is a West-Mediterranean plant; *Diotis* a maritime species extending along the greater part of the European and African coasts, around the Mediterranean, and along the Ocean from the Cape to the British Islands. *Mecomiscus* is an Algerian plant, exceptional in the tribe on account of its leaves opposite and entire as in the southern *Eumorphia* and *Ædera*.

Chrysanthemum, taken in the extended sense we have given it in the 'Genera Plantarum,' includes above eighty good species, and has nearly the same range as the *Anthemis* group. It has, however, fewer mountain species than *Achillea*, and extends only into the extreme north of America; southward it reaches much further than

Anthemis or *Achillea*. Several species, usually of a somewhat shrubby growth, are natives of the Canary Islands, and two or three, also shrubby and somewhat anomalous, are South-African. But the circumscription of the genus is somewhat uncertain: some botanists divide it into about twenty genera, which may readily be distributed into five series; others, again, remove the greater part of the perennial species into *Tanacetum*. This, however, does not much affect the group geographically considered. Excepting the Canary-Island *Argyranthema*, the two or three larger series into which the genus might be divided have nearly the same range as the whole genus; and the numerous monotypic genera proposed belong chiefly to its great centre, the Mediterranean region. *Richteria* alone belongs to the mountain-region of Central Asia, where are also found two small genera, *Allardia*, four or five species, and the monotypic *Cancrinia*, which might almost have been included in *Chrysanthemum*, but for their pappus, which in both is exceptional in the tribe, showing an approach in the one case to that of Senecionideæ, in the other to Helenioideæ. One of the few South-African *Chrysanthema* is, perhaps, a still further deviation from the ordinary type than the Canary-Island *Argyranthema*; but it has not been generically distinguished by the botanists who have worked out the Cape flora, and is not, perhaps, sufficiently known properly to appreciate its affinities.

Matricaria, with about twenty species, has the wide range of *Chrysanthemum*, with, however, a southern preponderance—the perennial species with restricted areas belonging chiefly to South Africa, the northern species, chiefly annuals, having a very general distribution (partly as weeds of cultivation), two of them occurring in North, especially North-west America; two or three only of the more restricted species belong to the Mediterranean region. The twenty species have long been in a very unsettled state as to their systematic arrangement. Distributed into half a dozen small genera, or united in two only, severally associated some with *Chrysanthemum*, others with *Tanacetum* or *Cotula*, they are now generally recognized as forming one generic group, connecting, as it were, *Chrysanthemum* with the Cotuleæ, differing from the former chiefly in the ribs of the achenes not equidistant round the achene, but more or less approximate towards the inner face, leaving a broader dorsal interval, and generally by their conical or elongated receptacle and the involucre approaching that of the Cotuleæ. In one species there is also a tendency to

the reduction of the female corollas. This approach to *Cotuleæ* is thus traceable both in geographical distribution and in structure.

Tanacetum, about thirty species as we now propose to limit it, belongs exclusively to the northern hemisphere; for the South-African species retained by Harvey in the genus appear to be much better placed in *Schistostephium*. It has been found difficult to draw up definite structural characters constantly to distinguish *Tanacetum* from *Chrysanthemum*; for the most important difference, the female florets, short and tubular or filiform in *Tanacetum*, ligulate in *Chrysanthemum*, is unavailable in the few species or varieties where the female florets are deficient; and therefore Schultz Bipontinus and some others have brought a large number of the common *Chrysanthema* into *Tanacetum*. But this appears to me to be a very unnatural combination; and in the few cases which might otherwise have been doubtful, habit comes in aid of the distinction. *Tanacetum* also, on the other hand, runs as much into *Artemisia*; and in order to maintain some order in the tribe we must here, as in *Asteroideæ*, admit as genera large and prominent groups, although they may be confluent on their borders.

Tanacetum has a more Eastern range than *Chrysanthemum*; there are but few in Europe or in the West-Mediterranean region, more numerous in the Levant and Central Asia; some species extend into the far north, and thence into North America, where, in the mountains of the western regions, are two endemic species with some slight structural peculiarities which induced Nuttall to propose them as a distinct genus, *Sphæromeria*.

Artemisia, to which some botanists ascribe near 200 species, with the same general centre as *Tanacetum*, Asiatic rather more than European, has a wider range. Abundant in the temperate regions of the northern hemisphere throughout the Old World, it has also many Alpine and Arctic species, and spreads not only over the greater part of North America, but also down the western ranges of mountains to extratropical South America. Geographically *Artemisia* thus meets there with the genus *Ambrosia*, possessing a somewhat similar foliage, nodding capitula, a style in some respects similar, and, according to Delpino, a similar anemophilous fertilization, to which characters I have already alluded under *Ambrosiæ*; but here the affinity ceases. There is nothing in *Artemisia* of that perfect separation of the sexes, of that freedom or very slight connexion of the anthers, of their peculiar

inflected appendages, of the enclosure of the achenes in their subtending bracts, or of the many other features characteristic of the Ambrosiæ; and in the style it is only in a very few species of *Artemisia* that there is any approach to the consolidation of its branches in the sterile flowers, which is constant in Ambrosiæ, and which, moreover, is of common occurrence in the sterile flowers of many other Compositæ belonging to very different groups: geographically, also, it is only as the outskirts of the wide range of some generally diffused species that the Mexican region, the great centre of preservation of the Ambrosiæ, possesses one or two *Artemisiæ*; this genus has not there produced a single endemic form. *Artemisia* is, on the other hand, very closely connected with *Tanacetum*, and has intermediates in the true fatherland of the two genera: *Artemisia fasciculata*, Bieb., for instance, has the habit and inflorescence of *Tanacetum*, with the characters of *Artemisia*; and the monotypic genus *Cronostephium* has the habit and inflorescence of *Artemisia*, with the characters of *Tanacetum*. There are other Asiatic species also which have given no small trouble to determine to which of the two genera they should be referred.

The majority of the South-African genera (excluding Cotuleæ) require but little comment, although distributed with the northern genera into different series of the tribe according as their receptacle is with or without paleæ, or their female florets ligulate, tubular, or deficient. A family likeness may be traced between *Athanasia*, forty species, and some fifty species distributed amongst ten or eleven small genera; but no common character can be assigned them. *Gonospermum*, three or four species, from the Canary Islands, forms the nearest approach to *Athanasia* in the northern hemisphere; and *Schistostephium* and *Pentzia* may be compared with *Tanacetum*. *Hippia*, four species, is in some respects an approach to Cotuleæ. But upon the whole these South-African Anthemideæ show a much more remote affinity to the northern ones than would have been supposed, from the genera being not only intermixed in our artificial classifications, but species of the two areas united by some in the same genera. South-Africa has also some small genera quite isolated, although technically, as to structure as well as geographically, included in Anthemideæ, such as:—*Ædera*, four species, with small opposite leaves and a peculiar inflorescence already alluded to; *Eumorphia*, one species, with small opposite decussate leaves, but with a

normal inflorescence; *Eriocephalus*, seventeen species, with some of the characters of the distant American subtribes Melampodineæ and Ambrosiæ; and *Lasiospermum*, four species, with the densely woolly achenes of some Arctotideæ.

The *Cotuleæ* form a rather more distinct group of Anthemideæ; and, geographically, they have been so long and so widely dispersed as to have established local genera or subgenera in very distant regions. Generally they belong to the southern hemisphere, and are mostly extratropical; but a few range over the temperate regions of the northern hemisphere of the Old World, or are within the tropics of both the Old and the New. They are generally small annuals or dwarf prostrate perennials with small capitula, the involucral bracts nearly equal in about two rows, the female florets usually numerous, with short, regular or irregular corollas, not strictly ligulate, and sometimes very much reduced or entirely wanting. *Cotula* itself, with about forty species, has the wide range of the whole group; it has been variously subdivided into sections or distinct genera, without any of them (except when monotypical) having any distinct geographical area. *Nanthea*, the only allied genus exclusively northern, consists of a single species from the mountains of Corsica, showing some approach to the *Chrysanthema* and other Anthemideæ of the same Mediterranean region. The slightly diverging genus *Cenia*, eight species, and *Otochlamys*, a single species, are limited to South Africa. *Centipeda*, three species, is more tropical in the Old World, although in America it is only in the southern extratropical regions. *Plagiocheilus*, six species, is limited to extratropical or Andine South America; so would also be *Soliva* (four species?) but for one of them which has established itself in Australia, and another in Portugal and South Carolina, perhaps as ancient, possibly as more modern colonists. *Abrotanella* is yet more southern, ranging from Antarctic America to New Zealand and the southern mountains of Australia. The three remaining monotypic genera, *Ceratogyne*, *Elachanthus*, and *Isoetopsis*, all from extratropical Australia, are somewhat anomalous in their styles and some other structural characters, but can scarcely be so well placed in any other tribe, and certainly with none having similar geographical connexions.

8. *Senecionideæ*.

The tribe of Senecionideæ, next to Asteroideæ the most numerous

in species, has, owing to the overgrown proportions of one vast genus, by far the greatest average number of species to a genus: nearly 1400 species are comprised in about 40 genera; but of these species, two thirds belong to *Senecio* itself, reducing the average of the remainder to more ordinary proportions. The tribe is divisible, according to structure, into four somewhat artificial subtribes, which, although generally confirmed by geographical distribution, yet in this respect show some embarrassing exceptions. The principle subtribe, Eusenecioneæ, is truly cosmopolitan; Liabeæ are American, with one tropical-African exception; Tussilagineæ belong to the temperate northern regions, with one South-African exception; Othonneæ to South Africa, with the exception of one widely spread high mountain genus. As a whole, the tribe is distinguished, amongst those which have tailless anthers and a setose pappus, from Vernoniaceæ and Eupatoriaceæ by their yellow disk-florets and frequently heterogamous capitula, and from Asteroideæ by their involucre, habit, and generally, though not always, by their styles.

Senecio itself is not only the largest genus among Compositæ, but one of the largest, if not the largest, among Phænogamous plants, and certainly the most widely spread; truly cosmopolitan and ubiquitous, abounding in local species in almost every region of the globe, in the Old and the New World, from the equator to the arctic regions and the extreme south, on Alpine summits, in stony wastes or sandy deserts, in swamps, on sea-coasts, on the borders of streams, everywhere are *Senecios* to be met with; and yet individually the species have not wide areas. No species is common to the New and the Old World, except in the far north; no one has, I believe its range interrupted by any considerable interval; and notwithstanding the facilities for transport afforded by the proportions of the pappus and the achenes, few have a very wide area, or, as weeds of cultivation, establish themselves in a new country with that readiness so marked in the Conyzoid *Erigerons*, for instance. It is, moreover, not easy to give any definite centre for the genus. It is less abundant, however, in the tropics, and most varied in temperate and cool or mountain-regions; so that some centre may be vaguely traced in the mountain regions and high latitudes of the northern hemisphere down the Andes from California to Chile, in Antarctic America, Southern Australia, and especially in South Africa. It is not easy, either, to divide it into sections or series by any combi-

nation of structural characters and geographical distribution. Although more than forty genera have been proposed for species which we now include in *Senecio*, I have failed in all my endeavours to fix upon even a single group which I could definitely mark out. Besides the vegetative organs, there are differences, it is true, in the achenes, anthers, and styles; but these have been as yet observed in too small a proportion of the known species, or have been found too little in accordance with each other or with habit or geographical relation, to be made available for sectional distinctions. I had observed, for instance, that a number of East-Indian species, erect herbs with entire leaves and numerous few-flowered paniculate capitula, had the auricles of the anthers acute or subcaudate (Pl. IX. fig. 4, 6, or 7), whilst in the majority of species they are truncate, obtuse, or somewhat acute, and then free and approximate to their own filament (figs. 2, 3, and 5); and I thought I had established a good section, to which I gave the name of *Synotios*. I found again the same foliage, and the anthers still more decidedly subcaudate, in some rather tall climbers of the same country, one of which had been generically distinguished by Miquel under the name of *Cissampelopsis*, and I added these to my section, although they differed in the larger many-flowered capitula. In *S. buimala*, Ham., however, another climbing species from the same country with still larger capitula, the character of the anthers failed. In the Canary-Island *S. palmensis*, DC. (the genus *Bethencourtia*, Chois.), the anthers, and in a great measure the habit, were found to be again those of my proposed section *Synotios*, which still might have been kept up; but when I came to the American species, I found the same anthers with pointed connate auricles exemplified here and there in West-Indian or Andine species, which had in other respects no connexion whatever with the above-mentioned East-Indian ones. Again, some North-American species have been retained under the old name of *Cacalia*, characterized mainly by their white-flowered homogamous capitula, with the style-branches produced into short cones and a somewhat distinct habit. The same flowers and styles occur in the South-African *Kleinias* with a totally different habit; and these, again, agree in habit with the Kleiniod *Senecios* of the same country, although the style passes into the common *Senecio* form with truncate tips. The short appendages to the style are more or less distinctly observable in various species, which have on that account been placed in the genera *Cacalia*, *Ligularia*,

Gynoxys, or retained by all botanists in *Senecio* itself. These appendages, however, are very short and often obscure, and scarcely more than rounded instead of truncate tips, or, as observed by Weddell, deceptions caused by the inequalities in the length of the hairs which form the terminal tuft. I had also long retained the North-Asiatic genus *Ligularia*, in which the collecting-hairs or papillæ descend more or less down the back of the style-branches, accompanied by a peculiar habit, with large subracemose radiating capitula. But here, again, I had ultimately to abandon the separation; sometimes the characters, sometimes the habit and geographical relations were at fault; and at present we are obliged to follow De Candolle in making our primary divisions of the genus purely geographical, and in each country subdivide them according to characters which have locally acquired relative importance. I think, however, that if any experienced monograpist were carefully to study the 900 odd species of *Senecio*, and especially to compare the various forms the ripe achenes assume, with the characters derivable from the styles, the anthers, the vegetative organs, and the apparent geographical origins, he might succeed in bringing out sectional combinations which have escaped me, and might even reestablish as independent genera some of those Cacalioid or Ligularioid groups which in the present state of our knowledge I have felt compelled to unite with *Senecio*.

A number of small genera, more or less divergent from *Senecio*, have a much more local character. One only, *Erechthites*, a genus of about a dozen species in a great measure tropical, distinguished chiefly by the filiform female florets, has a wide range. Its great centre is South America; but it is found northwards as far as Carolina; and in Australia and New Zealand it has established several endemic species. In tropical Asia the single species observed is probably a recent introduction from America. In Africa it is, I believe, unknown; the Eusenecioneæ which there assume the above-mentioned main character of *Erechthites* are connected with *Senecio* through different channels.

The other American genera closely connected with *Senecio* are *Culcitium*, about 14 species, and *Gynoxys* (from which, following Weddell, we exclude the alternate-leaved scandent species), about 12 species, both genera Andine. *Culcitium* is very near *Senecio*, differing from some of the genuine species of that genus from the same country only in the involucre; and even in that respect there are intermediate species which have been alternately referred

to the one or the other. *Gynoxys*, with more prominent appendages to the style-branches than in the aberrant *Senecios* above alluded to, is also definitely distinguished by the uniformly opposite leaves, which bring it near to some *Liabeæ* of the same region.

In the tropical regions of the Old World, *Gynura*, about 20 species, including one from Australia, has diverged considerably in the style, which is an approach to that of the *Liabeæ*; but in all other respects the genus is close to *Senecio*: although enjoying a wide range, its chief centre is Eastern Asia. One African species, the genus *Cremonocephalus* of Cassini, has a tendency to exhibit the deviation observed in *Erechthites*, the reduction of the female florets to the slender tubular form; but this character does not here appear to be sufficiently marked or constant to justify the retaining it as a monotypic genus. In the Mascarene Islands there are two genera (*Faujasia*, three species, and *Eriothrix*, one species), a third (*Stilpnogyne*) in South Africa and a fourth (*Melalema*) in Antarctic America, both monotypic, all differing from *Senecio* in the same character, the female filiform florets, but diverging from such very different points of that great genus, that they cannot well be united on this ground, and *Eriothrix* and *Melalema* especially have each a very peculiar habit. In Africa also *Cineraria*, as now reduced to twenty-five species, chiefly southern, with, however, three Abyssinian ones, differs from *Senecio* in the flattened achenes, to which there is no tendency in *Senecio* or its allies in any other country. The New-Zealand monotypic *Brachyglottis* and the Australian *Bedfordia*, two species, are both so near *Senecio* that they have been sometimes merged in it; but they appear at least as distinct as several of the other divergent groups; and *Bedfordia* especially is exceptional in the tribe, and approaches the Australian *Asteroideæ* (*Oleariæ*) in habit and stellate indumentum.

The genera next in order of divergence from *Senecio* are all extratropical; four are N.W.-American (Mexican or Californian)—*Tetradymia* with three or four species, *Raillardella*, *Crocidium*, *Bartlettia*, and *Haploesthes*, all monotypic, these last three showing perhaps some approach towards *Asteroideæ*, but on the whole much nearer to *Senecionideæ*. *Arnica*, about ten species, a mountain genus, extends generally over the central and northern regions of Europe, Asia, and North America; and is distinct, especially in its opposite leaves and its involucre. *Doronicum* (as now modified so as to include *Aronicum* and exclude *Pericallis*)

has ten or twelve species, and approaches *Arnica* in involucre and other characters, but with alternate leaves. Its geographical range in Europe and Asia is nearly the same, but less mountainous or northern, and it does not reach North America. *Lopholæna*, a single South-African species with its singular involucre bracts and long style-appendages, is somewhat isolated in its relationships.

There are three insular genera. 1st. *Raillardia* has nine Sandwich-Island species with an insular shrubby habit; A. Gray unites with it as a section the above-mentioned Californian monotypic *Raillardella*, for both have long narrow style-appendages and a plumose pappus; but their habit is so widely different as to suggest their connexion with the Eusenecioneæ having been quite separate; and I have availed myself of some differences in the achenes and pappus to maintain the two as distinct genera. 2nd. *Robinsonia*, four species, and, 3rd, *Balbisia*, one species, are from the isle of Juan Fernandez, where they form small trees of a very peculiar habit. Although their connexion with Eusenecioneæ seems greater than with any other subtribe or tribe, yet in their dioecious capitula, in the presence of small free anthers without pollen in the female florets, and some other points they approach the subtribe Petrobieæ of Helianthoideæ. Their convolute cotyledons have been pointed out as distinguishing them from all other Compositæ; but, as already observed, that character is not constant in *Robinsonia*. In *R. Gayana* the embryo is usually, if not always, precisely that of the great mass of Compositæ.

There remain two genera which show the great difficulty of giving technical characters to what appear to be natural groups, *Werneria* and *Othonnopsis*, the former with the characters of Othonneæ, but evidently more naturally connected with *Senecio*, and *Othonnopsis* as evidently connected with *Othonna*, but with the characters of Eusenecioneæ. *Werneria* is a high mountain genus of about seventeen species, differing from *Senecio* in the involucre scales strictly uniseriate, united to near the middle or higher up in a regular smooth ribless lobed cup, and with a peculiar habit rare in *Senecio*. Its great centre is in the Andes of South America; but one species, unknown to me, has been described from Mexico; and I am unable to separate from *Werneria* generically, either in habit or in character, *Senecio nanus*, Sch. Bip., from the mountains of Abyssinia, nor the *Ligularia nana*, Dcne., from the Himalayas. *Othonnopsis* is an Old-World genus of eight species, chiefly South-African, but with one North-African, one

Arabian, and one Persian species, all nearly allied to the South-African *Othonna* (from which they were first separated by Spach), but with the styles and involucre of Eusenecioneæ.

Othonneæ, excluding the two last-named genera, form a small subtribe of about 130 species in 5 genera, entirely S.-African, with the exception of *Euryops*, which has established one species in Abyssinia and another in Arabia. The three principal genera, *Euryops*, 27 species, *Gamolepis*, 12 species, and *Othonna* (including *Doria*), about 80 species, appear to me to have a very close natural connexion, although usually placed in three widely distinct tribes. *Euryops* is generally acknowledged as a Senecionidea; *Gamolepis*, only differing from it in the want of any pappus, has on that account been referred to Anthemideæ, where it is evidently a perfect stranger; and an occasional absence of pappus in groups usually provided with it has now been observed in too many parts of the system to retain its formerly supposed importance. The third genus, *Othonna*, has been referred to Cynaroideæ, through a false appreciation of the style, which has neither the termination nor the external ring of hairs or so-called articulation of that tribe, but is a genuine Senecionid style with a truncate penicillate tip; only, as the disk-florets are sterile, it remains undivided as in most other tribes under similar circumstances.

Liabeæ is a small subtribe characterized by its imbricate involucre and Vernonioid style. The principal genus, *Liabum*, of about 40 species, is S.-American, chiefly Andine, but extending in a few species into the W. Indies and northward to Mexico. It has been almost universally classed under Vernoniaceæ on account of its style; but the yellow heterogamous usually radiate capitula, as well as the habit, are very foreign to that tribe, whilst there is much that connects it with Senecionideæ. The opposite leaves, though not common in the latter tribe, are to be met with in *Arnica*, *Haploesthes*, and *Gynoxys*; and the style is scarcely so far removed from that of *Gynura* as the latter from the ordinary truncate style of *Senecio*. The W.-Indian and Columbian genus *Neurolæna*, two species, admitted on all sides to be a Senecionid, is very nearly allied to *Liabum*, and, indeed, closely connected with it through *Schistocarpha*, a Mexican and Peruvian genus of four species, with the opposite leaves of *Liabum* and the paleaceous receptacle of *Neurolæna*. The small genera we have included in *Liabum*, differing from each other more in habit than in

character, have no separate geographical areas; they are all Andine.

There is, however, a tropical-African monotypic genus which technically would belong to Liabeæ rather than to any other subtribe, but appears to be almost as much isolated in its natural affinities as in its geographical position. This is *Gongrothamnus* from E. tropical Africa, enumerated by De Candolle as a species of *Vernonia*, but differing from the whole of that tribe in its yellow flowers and triplinerved leaves, besides that the style-branches, being minutely papillose and not hairy, are not strictly those of Vernoniaceæ. Its nearest affinities remain yet to be traced out.

The subtribe Tussilagineæ, which, as well as the Liabeæ, we consider as more closely connected with Senecionideæ than with any other tribe, belongs in its normal genera to the mountain or temperate regions of the northern hemisphere. These genera are usually placed amongst Eupatoriaceæ on account of a slight resemblance in the style-branches; but their heterogamous capitula, frequently yellow, remove them as far from Eupatoriaceæ as Liabeæ are from Vernoniaceæ; and here we have, moreover, the prevalence of a truly Senecionid involucre. The subtribe comprises four genera of undoubted affinity—*Tussilago* a single species, *Petasites* about twelve, *Homogyne* three, and *Cremanthodium* four or five species; the first three, constituting the old genus *Tussilago*, are all European, and *Homogyne* exclusively so; the other two extend over Asia and N. America. *Cremanthodium* is Himalayan; only one of its species has as yet been published, and has been referred to *Ligularia*, of which, however, it has neither the habit nor the style; and its affinity to *Tussilago* is confirmed by other species.

Here, again, we have three isolated genera, which we can only class artificially as connected with Tussilagineæ. One is *Luina*, a single N.W.-American species, with something of the habit of an *Inula*, and, indeed, some approach to that genus in the almost setose points to the auricles of the anthers; but these points or setæ are exceedingly short, and scarcely more than observable in some *Senecios*. The involucre is that of *Senecio*, the style-branches between those of *Inula* and *Tussilago*, the geographical position very far removed from that of *Inula*, but quite within the range of Tussilagineæ. *Peucephyllum*, another monotypic N.W.-American genus, referred by A. Gray with doubt to Eupatoriaceæ,

appears to me, on account of its yellow flowers and other characters to be referable rather to the present group, although it has even there no near connexions.

The other extraneous genus is the S.-African *Alciope*, with two species, placed by De Candolle amongst Asteroideæ, with which it seems to have much less connexion than with Senecionideæ. Its style is that of *Cremanthodium*; the habit resembles that of *Arnica*, to which Thunberg referred it. It is not nearly allied to any genus of its own country. The anthers are those of the Senecionideæ generally, and remarkable in that those of one species have the contiguous auricles of adjoining anthers connate, in the other the auricles are quite free and closed upon their own filaments.

9. *Calendulaceæ*.

Calendulaceæ constitute the smallest and most compact of the tribes we have adopted, and might almost have been enumerated amongst the subtribes of Senecionideæ (with which it has much more affinity than with Cynaroideæ, under which it is usually classed), but that there is a tendency to produce appendages or tails to the anther-auricles, and there is never any pappus. The sterility of the inner disk-florets, sometimes accompanied by a similar sterility in the ray, and the large size acquired by some or all the perfect achenes are also peculiarities, which justify the maintenance of the group as a distinct tribe. It is almost entirely African. Of the three largest genera, two (*Dimorphotheca*, twenty species, and *Osteospermum*, thirty-eight species) are exclusively S.-African; *Tripteris*, twenty-eight species, is also S.-African, but has likewise a North-African subtropical or tropical species. *Oligocarpus* has three S.-African species and one in the island of St. Helena, whether aboriginal there or whether an introduction from S. Africa, and being yet to be discovered there, remains doubtful. *Calendula*, with scarcely ten species, although double that number have been described, belongs to the Mediterranean region, extending from the Canary Islands to Persia. *Dipterocome* is a curious anomalous monotypic Persian genus, evidently allied to *Oligocarpus*, but thus placed on the limits of the tribe both structurally and geographically. *Eriachænium* is another monotypic genus, which Schultz has correctly referred to this African tribe, although it comes from a distant land, Antarctic America. It is anomalous in habit, but nearer to *Oligocarpus* than to any other genus.

Ruckeria, two species, is a true S.-African, and appears closely to connect Calendulaceæ with Senecionideæ (Othonneæ); but the specimens preserved are as yet insufficient to make us fully acquainted with its characters and affinities.

10. *Arctotideæ*.

The Arctotideæ, although twice as numerous, both in genera and species, as the Calendulaceæ, form still a small Old-World tribe, with their chief area in S. Africa, where, however, they have no immediate connexions. They pass on the one hand rather gradually into Cynaroideæ, an Old-World tribe it is true, but almost exclusively of the northern hemisphere; and at the other end they seem in some measure connected with some of the Anthemideous genera of the Northern, not of the South-African type. On the whole they may perhaps be considered the southern representatives of the Cynaroideæ, with which Lessing and De Candolle associated them, but from which they differ essentially in their usually radiate heterogamous capitula, to a considerable degree in their styles, in the constant deficiency of tails to the anthers, and, as above, in their geographical distribution. They consist of three or, perhaps, rather four subtribes, which must be reviewed separately.

1. The genus *Ursinia* (including *Sphenogyne*) forms a distinct group of about 54 species, all S.-African, although one of them reappears in (or extends into) Abyssinia, differing from Arctotideæ generally in their truncate style-branches, their paleaceous receptacle, and glabrous foliage. It appears to me, however, to be more nearly connected with Euarctoteæ than with any other tribe or subtribe. De Candolle placed it among Heleniæ, where it has certainly no connexions, structural or geographical. The peculiar paleæ of the pappus, distinctly convolute-contorted in their arrangement, are much more those of *Arctotis* itself than of any Helenioidæ. The habit and involucre connect them with some Anthemideæ of the northern type, as well as with several of the true S.-African Euarctoteæ.

2. The *Euarctoteæ* comprise seven genera and about fifty species, with the broad involucre of which the inner bracts are scarious at the end of some of the northern genera of Anthemideæ. They approach that tribe also in their pappus reduced to scales or entirely wanting, but differ in the styles approaching those of

Cynaroideæ, in their achenes usually larger and thicker, and in other points. Their main area is S. Africa. *Arctotis* itself, out of thirty species, has one in Abyssinia; *Landtia*, four species, has two S.-African and two Abyssinian; *Haplocarpha*, four species, *Arctotheca*, one species, and *Venidium*, eighteen species, are exclusively S.-African, although one species of the first extends rather within the tropical limits. *Cryptostemma* has three species, of which one has become perfectly naturalized in Portugal; and *Cymbonotus*, one species (the only one known of the tribe which is not African), has hitherto been only gathered in Australia, where the earliest explorers found it fully established and apparently indigenous. It is totally disconnected from any Australian genus, and it diverges much less from the S.-African genera of Euarctoteæ than the Magellanic *Eriachænium* above mentioned does from the Calendulaceæ; the origin of both is as yet inexplicable.

3. The *Gorterieæ*, with the chief characters of Euarctoteæ, differ from them in the involucre and some other points, which bring them nearer to Cynaroideæ, of which they may be considered the S.-African representatives, differing in their radiate capitula, and more or less in their styles and other points. We have here, therefore, among these Old-World tribes, the Anthemideæ of the *Anthemis* and *Chrysanthemum* type, all belonging to the northern hemisphere, connected with the Cynaroideæ, also all northern, not by any northern groups, but through the almost exclusively southern Arctotideæ; whilst the intermediates between the southern Anthemideæ of the *Athanasia* group and the southern Arctotideæ are to be sought for exclusively among the northern Anthemideæ.

The Gorterieæ comprise about 120 species in seven genera, which do not appear to require any separate mention here; for they have all the same S.-African range, with here and there a species extending to within the tropics, but none, I believe, passing the equator. None have established themselves, even as introduced weeds, into distant lands.

4. *Gundelia*, a single Persian species, and *Platycarpha*, two S.-African species, are two very distinct anomalous forms, which, from some mistaken observation of their styles, had hitherto been placed amongst Vernoniaceæ, next to *Elephantopus*. The only connexion with the latter genus appears to be that of numerous few-flowered capitula being collected in a close general cluster or compound head. But that character exists in Asteroideæ, in

Inuloideæ, in Helianthoideæ, and in Cynaroideæ; and our two genera are in other respects totally at variance with Vernoniaceæ. They appear to me to have the style and several other characters of Arctotideæ, and really almost to close up the gap between the S.-African Arctotideæ (Gorterieæ) and the northern Cynaroideæ (Echinopsideæ); and one genus has the geographical position of the former, the other of the latter, both included in the general range of the two tribes.

11. *Cynaroideæ.*

The Cynaroideæ form the largest tribe in the northern hemisphere of the Old World, where they do not, with the exception of one very widely spread eastern species, cross the tropics southward, their only extension, and that a sparing one, being into N. America and thence down the western ranges of mountains to Chili, with one Australian species. They comprise near 900 species in about 36 genera; the subtribes into which they are divided are not well marked out, or, in some respects, perhaps too artificial, although there are some very distinct genera. As a whole, taking geographical distribution into account as a check upon structural characters, the tribe is definite in its limits; their habit, involucre, receptacle, corolla, anthers, and styles are all characteristic, and though each one may show exceptions, these exceptions never occur in all the organs at once. Their nearest connexions are with the Mutisiaceæ on the one hand, and the Arctotideæ (Gorterieæ) on the other; but the nearest connecting genera belong to these tribes respectively, and not to Cynaroideæ. Not following precisely the subtribes of the 'Genera Plantarum,' we will consider successively six prominent genera—*Centaurea*, *Saussurea*, *Cnicus*, *Carlina*, *Xeranthemum*, and *Echinops*, taking under each the smaller genera more or less diverging from them—the first three of which are the only ones of the tribe which extend into America. The great centre of the whole tribe is the Mediterranean region, taking it in its extended area so as to include Persia; and many genera are limited to its eastern portion.

Centaurea, as most generally understood, is a genus of about 320 species, having the geographical range of the tribe, most abundant in the Mediterranean region and the Levant, but extending in America and Africa to the utmost limits of the general area of Cynaroideæ. Although very fairly defined as a whole, it presents such infinite variety in the tips or appendages of its involucre

scales and in the pappus, that it has been split up by Cassini and others into above fifty genera. Cassini's, founded chiefly on the involucreal scales, are, perhaps, the most natural; those of De Candolle, Spach, and Boissier, derived mainly from the pappus, may be rather more definite, but are very artificial, often widely separating species otherwise closely allied; and very few of the groups formed on either grounds have any local character. The very few American species (North-western or Chilean) are connected with each other by their large capitula with broad fringed or torn scarious appendages to their involucreal bracts; but the nearest approach to these are from the diametrically opposite limits of the general range—two Abyssinian species, which Boissier has even proposed to add to the genus *Plectocephalus*, founded on the American ones. The Abyssinian ones, however, are really, notwithstanding their pappus, more nearly connected with some of the European or Asiatic species of the *Lopholoma* group. A species still more remarkable for its distant outlying station is the Australian *Leuzea australis*, Gaudich., which we now find it necessary to associate with the section *Rhaponticum* of *Centaurea*. It is in some measure allied to the Abyssinian and West-American large-headed species above-mentioned; but its closest affinity is with a Spanish species, the *Leuzea rhaponticoides* of Graells.

A considerable number of the species have a rather wide range within the general area; and some appear to hybridize readily. *C. nigra*, belonging chiefly to temperate regions, extends over the greater part of Europe and extratropical Asia; and two species, *C. calcitrapa* and *C. melitensis*, are frequently carried out in ballast or as weeds of cultivation to distant lands. A large number, however, of the species are restricted to small areas.

The small genera *Crupina*, two (or, according to some, five) species, *Volutarella*, four or five species, *Zoegea*, two species, and *Leuzea*, one species, all slightly diverging from *Centaurea*, belong to the same Mediterranean region taken in an extended sense E. and W., but do not spread northwards.

Carbenia, one species, *Carthamus*, about twenty, and *Carduncellus*, about fourteen species, belong still to the *Centaurea* group and Mediterranean region, more abundant in the west than in the east, the chief character connecting all the above genera consisting in the very oblique or lateral scar at the point of attachment of the achenes.

The same character of the achenes, though perhaps usually no

so much pronounced, prevails in the allied genera *Serratula*, about thirty species, and *Tricholepis*, seven species; but a very perceptible difference in the involucreal scales gives them a different habit, and their geographical range is not quite the same; they are more northern and eastern, and not quite so Mediterranean. *Serratula* itself is, moreover, somewhat exceptional in the tribe by the great reduction or almost total suppression of the tails or appendages to the anther-auricles. This genus extends over the whole of Europe and temperate Asia, but is not in America. *Tricholepis* is exclusively Asiatic.

Myopordon is a monotypic Persian genus of which the affinities are as yet very uncertain. It is evidently near the *Centaureæ* with spinous involucre; but the areola at the point of attachment of the achene seems to be quite basal; the specimens, however, are imperfect.

The *Saussurea* group of genera have the basal scar to the achenes of the *Onicus* series; but their filaments are always glabrous and free, and their involucreal bracts, having neither the prickles of the majority of the *Onicus* series nor the scarious appendages so frequent in *Centaurea*, give to the plants a very different facies. *Saussurea* itself, about sixty species, is also distinguished by the pappus, either with a single row of setæ or the external setæ comparatively few, fine, and short. Geographically it is of a much more mountainous character, with some species consequently of a much wider range than most Cynaroideæ. It has several high-Alpine or Arctic species, and extends over Europe, extratropical Asia, and rather high northern America: two or three species descend in Asia to within the tropics; and one of these Asiatic species has extended itself into eastern Australia to the utmost limits of, and even beyond the tropical region.

Stæhelina, six species (including possibly the monotypic *Kœchlea*), is, as it were, the Mediterranean representative of *Saussurea*, and has also a single-rowed pappus, but of a somewhat different texture, and the setæ mostly united in pairs or in bundles. It is limited to the Mediterranean region.

Jurinea, about forty species, has much of the aspect of *Saussurea*, and is divisible, chiefly according to inflorescence, into sections corresponding to those of *Saussurea*, some of them, perhaps, rather more distinct; and one, *Ægopordon* of Boissier, with the setæ of the receptacle almost as much reduced as in *Onopordon* and *Berardia*, might, perhaps, be retained as a monotypic genus. As a

whole, *Jurinea* differs from *Saussurea* chiefly in the multiseriate pappus. It is less mountainous than that genus, and more Mediterranean in its character; it does not extend to the Arctic regions or to America, although abundant in Asia. The monotypic *Goniocaulon*, from East India, and *Berardia*, also monotypic, from the western extremity of the Alps, though distant from each other, are very near to different sections of *Jurinea*. *Warionia*, from the Sahara of Africa, and therefore from the extreme limits of the Cynaroid-area, is a very distinct form, although still referable to the *Jurinea* group.

Of the Carduinæ proper, or true Thistles, with the leaves and involucre usually prickly, the filaments hairy or monadelphous, the areola or scar of the achenes basal, and the pappus-setæ in several rows, *Cnicus*, above 150 species, is the largest as well as the widest-spread genus. Like *Centaurea* it is diffused over the whole of the Mediterranean region, Europe, and extratropical Asia, from the Canary Islands to Japan, and extends also into North America and down the western mountain-range to the tropics, but scarcely beyond; and two or three species are readily carried with cultivation into the tropics and beyond them. Like other large Cynaroid genera it has been divided; but none of the genera proposed to be dismembered from it among the great mass of Old-World species have any natural structural character or special geographical range. In America, however, it appears to have been very early established in the Mexican region, and there to have diverged more or less into a special group with large heads and peculiar, often highly coloured, involucre, culminating in the *Erythrolæna* of Don, which, however, is too closely connected through a long series of intermediates with some of the Old-World forms to be maintained as a genus. The whole genus *Cnicus* is often merged in *Carduus*, the two differing only in the pappus, plumose in the one, simply setose in the other, and naturally forming but one group. The geographical range would not be materially affected by the union, except that *Carduus* in the limited sense, with between thirty and forty species, has a much more restricted area than that of *Cnicus*, being unknown in America.

Onopordon, twelve species, *Cynara*, six, *Silybum*, one, *Galactites*, two, and *Tyrinnus*, one species, are all forms very slightly diverging from *Carduus* and *Cnicus*; and all belong to the Mediterranean region taken in a wide sense, *Cynara* extending to the Canary

Islands; and one species carried out with man to extratropical S. America, has there found circumstances so congenial to its constitution that, as a successful colonist, it has overpowered the native vegetation over vast tracts of country. None are truly American or high-northern.

Cousinia is another genus of true Thistles, differing from *Carduus* and *Cnicus* in the slender, fragile, usually small and exceedingly caducous setæ of the pappus, and remarkable for the large number of species confined to a small area. Above 100 well-marked species have been described; and many more exist in our herbaria, although the whole genus is limited to Western and Central Asia, the chief centre of its range being in Persia; and at its western extremity it barely reaches the Mediterranean.

Arctium is a small European and temperate Asiatic genus, of which the number of species, whether two or seven or eight, is a matter of contention, and which, though not prickly, is but a slight divergence from *Carduus*, with a pappus nearly that of *Cousinia*.

The *Carlina* group includes three closely allied genera which might be treated as one—*Carlina* itself, fourteen species, *Atractylis*, about the same number, and *Thevenotia*, two species. They connect the *Carduus* and *Cnicus* group with the *Xeranthema*. With the prickly thistle-like aspect of the former, they have the densely villous achenes and simple series of more or less paleaceous pappi of the latter. Geographically they are widely spread, although they do not reach America. Their chief seat is the Mediterranean region; and one or two species extend over the greater portion of Europe and extratropical Asia. They have also, always within their general Old-World range, established some local forms distinct enough to have been often considered genera. These are *Carlowitzia* (belonging to *Carlina*), two species in the Canary Islands, *Thevenotia*, two species in Persia, and *Atractylodes* (now reduced to *Atractylis*), two species in Japan and China. *Atractylis Preauxii* is another Canary-Island form, which might almost be regarded as *sui generis*. The corollas of the sterile florets at the circumference of the capitula in *Atractylis* assume the palmate or 5-merous ligulate form which, as in *Stokesia*, indicates an approach to the Cichoraceous corollas, not to those of the rays of ordinary radiate capitula.

Xeranthemum, four or five species, and the closely allied monotypic *Chardinia* and *Siebera* form a small very distinct group of Cynaroideæ, limited to their great centre the Mediterranean

region and Levant. In habit, achenes, and pappus they show some approach to *Catananche* in Cichoriaceæ; in involucre a distant resemblance, but no affinity, to Helichryseæ; their external female or neutral florets tend towards the bilabiate form of Mutisiaceæ; but their main characters are so essentially those of Cynaroideæ, that they cannot be really considered much in the light of connecting links with either of the above outlying tribes.

Amphoricarpus is a monotypic Dalmatian genus, with which I am not sufficiently acquainted to form any opinion on its supposed relationship to *Xeranthemum*.

Echinops, including the small almost monotypic genus or section *Acantholepis*, forms an exceedingly distinct group of nearly seventy species, ranging over the Mediterranean region, the Levant, and Central Asia, which, in the numerous uniflorous capitula collected in dense globular clusters or compound heads, have the same relation to the true Cynaroideæ that the Gundeliæ have to the Arctotideæ. To a certain degree also there is here some approach of the two tribes to each other; but the gap is still wide. On the other hand, *Cardopatum*, of two species (one from Algeria, the other from the Levant, and therefore from the same region), may be said to form a connecting link between *Echinops* and *Carlina*.

12. Mutisiaceæ.

The Mutisiaceæ are varied in form and widely scattered in geographical position. About 450 species are contained in 50 genera, the chief centre of which is far distant from that of the tribes they are most nearly connected with, although there is some overlapping of their respective areas. They are most nearly allied in structure, though most opposed geographically, to Cynaroideæ; some genera (Gochnatiæ) have almost the characters of that tribe; and there is scarcely a very definite line between the same Gochnatiæ and Inuloideæ (Euinuleæ), whilst there are some genera also which (with *Stokesia* in Vernoniaceæ) exhibit the nearest approach in the order, though still but a distant one, to Cichoriaceæ. The chief centre of Mutisiaceæ may be said to be Western, and especially South-western, America, where Cynaroideæ are not represented by any endemic genus and are very slightly so by a few outlying species of large European genera, where Euinuleæ are unknown and Cichoriaceæ few; whilst the Mediterranean region, the great centre of Cynaroideæ

and Inuloideæ, and in a considerable degree that of Cichoriaceæ, is entirely deprived of Mutisiaceæ, or at most has a single species on its extreme southern limits. The five subtribes into which the tribe is divided on structural grounds are not very strictly geographical: Barnadesiæ are South-American; Onoserideæ also South-American, with the exception of two or three tropical-African forms; Gochnatieæ and Gerbereæ have several representatives in Asia and Africa; Nassauviæ are exclusively American and chiefly, but not entirely, western and extratropical. It is better, however, here to consider the genera of the first four subtribes rather more in the order of their geographical areas.

Barnadesia, ten species, *Mutisia*, thirty-six species, *Onoseris*, about twelve species, *Chuquiragua*, above thirty species, all very distinct and well-defined genera, are all South-American and Andine, but each one extending eastward in one or more Brazilian species (in *Chuquiragua* nearly half the species often separated under the name of *Flotovia*) without any connexion with the Old World. Round the above may be grouped three small Andine genera, *Plagia*, three species, and *Aphylocladon* and *Chionopappus*, both monotypic, as well as three very distinct small genera from east tropical America (Brazil or Guiana), *Schlechtendahlia* and *Wunderlichia*, both monotypic, and *Stiffia*, four species, which might almost be considered as two or three distinct genera. Three tropical-African forms also (*Pleiotaxis*, one species, *Erythrocephalum*, two or three species, and *Phyllactinia*, one species) appear to be more nearly connected with the American *Onoseris* group than with any genera of their own country.

Gochnatia, ten South-American tropical or extratropical species, *Moquinia*, twelve species, all Brazilian except one from Mexico, together with *Seris*, two Brazilian species, and *Hyalis* and *Cyclolepis*, both monotypic and extratropical South-American, all closely allied to each other, form a rather natural group approaching in many respects some Cynaroideæ (of the *Saussurea* group), and more remotely connected with some Euinuleæ. This group is represented in Cuba by the genus *Anastraphia*, four species; in southern and in a less degree in tropical Africa by *Dicoma*, thirteen species, and *Hochstetteria*, one species; and still more closely in the Himalaya by the monotypic *Leucomeris*, scarcely distinguishable from *Gochnatia* itself, except by the corymbose inflorescence.

The African genus *Dicoma* above mentioned, of which one of

the tropical species extends into East India, includes various forms with great diversity in habit, involucre, and pappus, but so connected with each other as to render it difficult to distribute them even into well-marked sections; the most marked form, some species of the section *Pterocoma*, DC., offer the only instance of some approach in outward aspect to the above-mentioned Brazilian *Schlechtendahlia*.

Trichocline, about twenty South-American extratropical, subtropical, or Andine, with one Australian species, *Chaptalia*, eighteen South-American tropical or extratropical species, represented also in Mexico and the southern United States of America, and *Gerbera*, twenty species, chiefly South-African, but with a few tropical or mountain species dispersed over tropical Africa, East India, and Eastern Asia as far Japan, form one natural group, divided by some into about sixteen genera, but fairly separable into the three above mentioned; for I think there are structural characters fully sufficient to separate the American *Chaptalias* from the Old-World *Gerberas*, with which Schultz Bipontinus unites them. All three genera have a uniform habit, the leaves all radical, usually white underneath, and monocephalous scapes. The single Australian species, which I had once described as a genus under the name of *Amblyspermum*, I now find to be inseparable from the South-American *Trichoclinae*.

Lycoseris, ten species, all South-American and chiefly Andine, extending from Bolivia to Central America, *Chætantha*, twenty-six species, and the monotypic *Brachyclados* and *Iobaphes*, all extratropical or high Andine, belong to the same *Gerbera* subtribe, but are very distinct from the three last-mentioned genera, and are unrepresented in the Old World.

Four small genera with a considerable family likeness, although each with well-marked structural characters, *Ainsliæa*, ten species, and the monotypic *Macroclinidium*, *Pertya*, and *Myripnois*, are Asiatic and Eastern Asiatic, and mostly extratropical or Chino-Japanese. The last-named three genera have much of the character of some of the *Gochnatia* group, especially of the Cuban *Anastraphia*, but also show an approach to some Cynaroideæ, as, for instance, to the (similarly Japanese) section *Atractylodes* of *Atractylis*. *Ainsliæa*, on the other hand, which descends sparingly to within the tropics, has somewhat of the habit, though not much of the characters, of some Cichoriaceæ; and one species was originally described as a *Hieracium* (*H. silhetense*, DC.). A very

curious monotypic genus, however, from the Siwalik hills of East India, *Catamixis* of Thomson, has really the pentamerous regularly 5-toothed corollas of Cichoriaceæ, but with the anthers, styles, achenes, and involucre of Mutisiaceæ, thus forming a real point of connexion between the two tribes. The habit is an uncommon one in either tribe, being rather that of a *Baccharis* or a *Pluchea*.

There are two very exceptional South-African genera which can only be referred to Mutisiaceæ, but for which I can suggest no near connexions:—*Anisochæta*, a single species, which, probably from some vague resemblance to *Mikania* in its climbing habit, paniculate inflorescence, and few-flowered capitula, had been placed by De Candolle in Eupatoriaceæ, of which it has neither the anthers nor the style, nor the corolla, nor the opposite leaves. Though far distant, yet it appears to me to be better placed near the *Gochnatia* group than in any other position I can assign to it. The other is *Oldenburgia*, three species, perhaps not strictly congeners, with all the essential characters of the *Gerbera* group, but in their singular habit coming nearer to the Brazilian *Wunderlichia*, belonging to the *Gochnatia* group. The only American plant of the *Gerbera* group approaching it in habit is perhaps the Chilean monotypic *Pachylæna*.

Hesperomannia is an insular (Sandwich-Island) monotypic genus of the *Gochnatia* group, of arborescent habit, with the large capitula, achenes, and pappus of the Brazilian typical *Stiffia*, from which it differs in the involucre and style.

The fifth subtribe, Nassauviæ, with the corollas more constantly and distinctly bilabiate than several of the preceding subtribes, has also rather different connexions, having generally the styles and occasionally the involucre of Senecionideæ. It is exclusively American, chiefly southern and western, extending into North America only along the Mexican region to California. The genera, as consolidated by the most recent synantherologists (without going quite so far as Schultz Bipontinus), are natural and well defined, some of them quite isolated except as to the general tribal characters. *Perezia*, forty, and *Trixis*, thirty species, extend from the Argentine States and Chili to Mexico, with one or two more eastern tropical species in Brazil or the West Indies. *Proustia*, six or seven species, very nearly allied to *Perezia*, with the habit of some *Gochnatia*, is generally South-Andine, but is also represented in Mexico. *Jungia*, with twelve species, very near *Trixis*, does

not reach further north than Columbia. *Leucæria*, twenty-five species, *Polyachyrus*, seven, *Nassauvia*, twenty-five, *Triptilion*, six, *Pamphalea*, four or five species, and the monotypic genera *Oryphyllum* and *Moscharia* are limited to extratropical South America, chiefly Chili, or they advance very little northward along the Andes. *Macrachænum* is a single Magellanic species with the habit of a *Chaptalia*, and the characters nearer those of *Trixis*; and *Cephalopappus* is a single and rare Brazilian species, with the characters nearly of the Chilian *Pamphalea*, but a totally different habit.

13. *Cichoriaceæ*.

The tribe of *Cichoriaceæ* is an extensive one, and, as already observed, is the most definitely marked out in the whole order. It has also a wide geographical range. Its chief seat is in the northern hemisphere and more especially the Old World, where most of the larger genera have the great majority of their species. Most of the genera of limited areas belong to the Mediterranean region; yet several are also located and have been apparently developed in Western America, especially in the Mexican region. The number of species known is above 700, distributed into nearly 60 genera, not always very clearly defined, yet we believe rather better marked out than the very numerous smaller ones into which they have sometimes been divided. It is very difficult to arrange these genera into subtribes; and those we have adopted are in a great degree artificial, and have little or no connexion with geographical distribution; we must therefore now consider the principal genera separately.

Crepis (including *Barkhausia* and *Youngia*), about 130 species, to which might be added about a dozen more contained in the small slightly divergent genera *Pterotheca*, *Phæcasium*, *Phalacroderis*, and *Rodigia*, is essentially of the Old World. The few N.-American species, although proposed by Nuttall as two distinct genera, *Psilachenia* and *Crepidium*, belong to the typical group of *Eucrepis*. The genus is divisible into twelve to fourteen sections, not all very distinct, but each marked by some peculiarities. Most of them, as well as the four small divergent genera above mentioned, belong to the Mediterranean region; two, *Eucrepis* and *Barkhausia*, range over Europe, N. Africa, and extratropical Asia; and the former, *Eucrepis*, extends also into N. America; the sections *Soyeria* and *Intybellia* belong to the

mountain-regions of Central Europe and Asia, and are replaced in the Mediterranean region by numerous species of the section *Omalocline*, some of which are also Alpine, but only in the southern ranges of mountains. *Youngia* is more Asiatic and especially eastern; one species is tropical and extends to the northern districts of Australia. The *Anisoramphus* proposed by De Candolle as a genus, but which we have with some hesitation reduced to a section, is a single tropical-African mountain species.

Hieracium, about 150 species, increased by some botanists to between 200 and 300 or even more, has a geographical range unusual in Compositæ, upon which climatological influences may have had some effect. It belongs chiefly to mountainous or temperate regions; and in the Old World it is essentially western, from Scandinavia to the Spanish Peninsula and the Western Alps; in Eastern Europe the species are more rare, and in Asia very few. In America they reappear in the extratropical regions N. and S., and down the range of the Andes; and two species are in the southern hemisphere in the Old World, one in S. Africa, the other in Madagascar; none are known in Australia. The genus is divided by Fries into three principal and natural sections—*Pilosella*, *Archieracium*, and *Stenotheca*. The first two comprise nearly the whole of the Old-World species of the northern hemisphere. *Stenotheca* is represented in the Old World by one or two species of the Western Alps, and by the two southern species above mentioned, all evidently nearly allied. The American species, of which Fries enumerates forty-five, but which are probably reducible to little more than half that number, have been, with the exception of two or three high northern *Archieracia*, referred by that writer to *Stenotheca*, to which they appear certainly for the most part nearer than to *Pilosella*, to which Schultz Bipontinus refers them; they have, however, to a certain degree a facies of their own, passing, perhaps, from the one to the other, but not representing the *Archieracia* excepting as congeners. The small genus *Andryala*, variously estimated at from half a dozen to above a dozen species, is a slight divergence from the European *Hieracia*, with the same western character but more southern, from the Mediterranean region to the Canary Islands.

Picris, about twenty-four species, has its chief seat in the Mediterranean region, especially its western portion, extending also down to the Azores: two species are generally spread over Europe and Western Asia; and one is to be found in most parts of

the world, especially the extratropical world north and south, and has received a separate name in almost every country, although the distinctive characters given might be generally found in European specimens. It is so readily carried, however, with cultivation, that it is difficult to say how far it is a denizen or a colonist only in the distant regions where it is found.

Sonchus, with about the same number of species (twenty-four) as *Picris*, is similarly circumstanced as to geographical distribution, the chief seat being the Mediterranean region and the Canary Islands, with one or two species everywhere accompanying cultivation and possibly true denizens in more than one distant extratropical region; but neither the one nor the other has established any endemic groups or distinct species beyond the main area of the genus.

Lactuca, sixty species, nearly allied to *Sonchus*, has a much wider range, and is generally more eastern. It is, however, divisible into five or six sections, somewhat different in their geographical distribution. *Brachyrhamphus* and *Phoenixopus* belong specially to the Mediterranean region. *Scariola*, containing the typical Lettuces of many botanists, is more generally spread over Europe and a great part of Asia; *Cicerbita* and *Mulgedium*, especially the numerous and showy blue-flowered species, are frequent in mountain-districts, and extend over Europe, central and temperate Asia, and N. America, with endemic species in each country. *Ixeris*, again, is yet more eastern Asiatic, with one European species, and bears much the same relation to *Lactuca* generally which *Youngia* does to *Crepis*. *Chorisma*, allied to *Ixeris*, consists of a few species scattered over various parts of Asia, from Asia Minor to Japan.

Prenanthes, sixteen species, nearly related to the section *Cicerbita* or *Mulgedium* of *Lactuca*, has the same range, chiefly mountainous, over Central Europe, the mountains of Asia and N. America. The other genera diverging from *Lactuca* and *Sonchus* are limited to the northern hemisphere of the Old World. *Chondrilla*, fifteen species, extends over the Mediterranean region and a great part of temperate Asia. *Picridium*, variously estimated at from five to ten species, and *Microrhynchus*, about twenty species, belong to the Mediterranean region, the latter extending into north tropical Africa and the Canary Islands. *Heterachæna*, one species, is Abyssinian and Arabian; and the monotypic *Dianthoseris*, allied to *Lactuca*, but with the habit of a *Werneria*, is limited to the mountains of Abyssinia. Five small rather more distinct genera,

comprising amongst them only eleven species, connected in some measure both with *Crepis* and *Lactuca* (viz. *Zacintha*, *Acanthocephalus*, *Heteracia*, *Rhagadiolus*, and *Kælpinia*), are also limited to the Mediterranean region.

Leontodon, about forty species, is another of the Mediterranean genera which has a few species widely spread over Europe and extratropical Asia, and two or three are now to be met with in various distant regions, but probably as colonists only, except in North America, where Torrey and Gray's monotypic genus *Aparigidium* may be considered as an endemic species of *Leontodon*, nearly related to one of the European mountain species. The genus has been broken up into ten or twelve sections or genera; but they are either monotypic or have no special area, and all belong to the same general Mediterranean region.

Taraxacum, nearly allied to *Leontodon*, and variously estimated at from four or five to above forty species, has a very wide distribution, accommodating itself to every variety of station (thus accounting for the intricate variability of its forms) and readily colonizing. The extratropical regions of the northern hemisphere comprise its chief centre; and it may be more universal in the Old World than in North America; but it appears to be also a true denizen of the far south, both in America and Australia, and is to be met with even in warmer regions.

The genera *Troximon*, sixteen species, *Pyrrhopappus*, three or four species, *Calycoseris*, two species, and the monotypic *Glyptopleura* are all American and almost exclusively north-western, with their chief centre in the Mexican region (including California). *Troximon* reappears in one or two species in extratropical South America, and *Pyrrhopappus* extends somewhat eastward in North America. These genera are quite absent from the Old World; but they may in some measure be considered as West-American representatives of *Leontodon* and *Taraxacum*.

Hypochaeris, about thirty species, allied to *Leontodon* in habit and structure, has a wider general distribution, and a rather more American character. Common to both the New and the Old World, with two species so generally distributed and so readily colonizing as to make it difficult to say where they are most at home, *Hypochaeris* has perhaps most species in the mountain and temperate regions of America, especially South America, but the most diversified forms in the Mediterranean region of the Old World. Minute differences in the pappus have induced its general

division into three or more very artificial genera. Taking more natural, though not always very well-defined, sections, *Achyrophorus* and *Serioloides* are common to the New and the Old World, *Oreophila* is exclusively Andine, *Amblachænium* is a single Siberian species, *Euhypochæris* and *Porcellites* are the two cosmopolitan species, *Seriola*, *Metabasis*, *Robertia*, and *Arachnites* form a small group exclusively Mediterranean.

Malacothrix, about nine species, and the monotypic *Anisocoma* allied to it are Californian genera, in some respects allied to *Hypochæris* and perhaps to *Hieracium*, but forming a very distinct local group.

Tragopogon, about thirty species, and *Scorzonera*, about one hundred, are widely distributed over the temperate and even subtropical regions of the northern hemisphere in the Old World, with their chief seat again in the Mediterranean region, to which belong also a few small local genera slightly diverging from them:—*Urospermum*, two species, of which one reappears in South Africa, but probably as a rather old colonist; *Epilasia*, five species or varieties, from the Persian region; and *Tourneuxia*, one species, from the deserts of South Algeria. None of these genera extends to America; but the group or subtribe may be said to be in some measure represented in North-west America and the Mexican region by *Lygodesmia*, five or six species, *Stephanomeria*, about eight species, *Scorzonella*, two or three species, and the monotypic *Pinaropappus*, and in extratropical South America by the monotypic *Picrosia*.

Tolpis, fifteen to eighteen species, belongs to the Mediterranean region, more especially the western portion, and extends to the Canary and Azores Islands, where it has established endemic species; the monotypic Spanish *Hispidella* is also allied to it; and no nearly related form is known from any distant region.

Hyoseris, four species, is also peculiar to the Mediterranean region and nearly surrounding districts. *Arnoseris*, a single species diverging from *Hyoseris*, is more generally spread over Europe, especially the western districts, and is a ready colonist in Australia and some other countries. These genera may be said to be in some measure represented in America by *Microseris*, twelve species, *Krigia*, four or five species, and the monotypic *Phalacroseris*, all northern and chiefly north-western, except one species of *Microseris*, which, from extratropical South America, extends to Australasia.

Lapsana, belonging to the extratropical regions of the northern hemisphere in the Old World, has one European species very widely spread, and is found as a colonist in North America as well as in other distant parts of the globe. The genus, however, is truly represented in North America by the nearly allied monotypic *Apogon*, a Japanese species of *Lapsana* being almost intermediate between the common one and this *Apogon*.

Cichorium is a very distinct genus, of which one species is widely distributed over the northern hemisphere in the Old World, readily colonizing in many other districts; and a second is limited to the eastern and southern portions of the Mediterranean region. The cultivated Chicory, often given as a third East-Indian species, is probably only a cultivated modification of the common *C. Intybus*. The genus is wholly unrepresented by any endemic American form.

Catananche, five species, and the monotypic *Hymenonema* and *Hænseleria* form a very distinct Mediterranean group unknown elsewhere; *Hænseleria* is western, *Hymenonema* eastern; *Catananche* is both.

Scolymus, three species from the same region, is still more isolated in habit and foliage, which is almost that of a thistle, and in structure, which, except in those invariable characters which place it among Cichoriaceæ, is unlike that of any other known Compositæ.

We have finally two very remarkable arborescent insular genera; *Dendroseris*, seven species, from the island of Juan Fernandez, and *Fitchia*, one species, from the Pacific islands. Both are truly Cichoriaceous in their corollas, anthers, and styles, and *Dendroseris*, at least, in the milky juice of its bark; but their achenes are different from those of Cichoriaceæ generally, as well as their involucre and habit; and *Fitchia*, in its receptacular paleæ, awned achenes, &c., recalls the Helianthoideæ.

Having thus rapidly sketched out the principal facts which have struck me in the investigation of the geographical distribution of the genera of Compositæ, as compared with their structural characters, we may proceed to the inquiry as to how far they can assist us in the solution of the two great problems:—Which, amongst the numerous types or generic forms now exhibited by the order, represent the most ancient races, the nearest to the primitive form of the order? And what are the principal centres where the greater number of the present races appear to have been differentiated, and whence they have spread over the areas

they now occupy, thus establishing more or less distinct regions?—these centres of individual races to be carefully distinguished from the supposed *centres of creation* or *centres of vegetation*, from which whole diversified floras are supposed to have radiated, and to the fallacy of which I specially alluded in my Address of 1869.

B. COMPARATIVE ANTIQUITY OF RACES IN COMPOSITÆ.

If we are justified in observing that races, like individuals, have successive periods of progressive growth, of full vigour, and of gradual decay, we may, in the one case as in the other, conclude generally that those which we find to be in the latter stage are the oldest—a conclusion, however, which, in the one case as in the other, must of course be very much modified by the consideration of the numerous constitutional or external circumstances which bring on premature decay and extinction.

A preliminary inquiry, however, is necessary into what constitutes, what are the evidences of, progress, vigour, or decay in a genus, species, or other race of plants, all of which may be entirely independent of the evident vigour or decrepitude of the individuals the race is composed of.

The result of the best-founded opinions on this subject which to my knowledge have been propounded is that a race of plants, be it tribe or genus or species, in its period of full vigour, is widely dispersed, accommodates itself to a great variety of climatological, physical or other external influences, is numerous and varied in subordinate races as well as individuals, these subordinate races, especially those immediately subordinate, not being separated by wide structural gaps, and not having acquired any very marked local characters, but for the most part passing, as it were, into each other, their respective distinctive characters not having yet acquired any marked degree of correlation. On the other hand, a race in a state of decay is represented by subordinate races very distinct in structural characters, of restricted areas, and requiring for their preservation special climatological or other physical conditions, and consequently comparatively few in individuals. Of the former, *Vernonia*, *Eupatorium*, *Aster*, *Senecio*, &c.; of the latter, the first five or six subtribes of Helianthoidæ appear to be good examples among Compositæ.

Old decaying and apparently expiring races may, however, in some of their branches, owing perhaps to a slight change in

constitution, habit, or external circumstances, start into new life. Young progressive races, which, like the vigorous young individuals which we see rise from the rotten remains of an aged plane, or olive, or fig-tree, may be rising before our eyes from some branch of an old race which has passed its prime, or whose origin may already be so remote as to be concealed from us. These young progressive races will be very prolific, ready colonizers; and their subordinate races will be generally numerous and so blended together as to defy all positive determination of their limits, and be variously estimated as subgenera, sections, species, subspecies, or varieties. Most of the Cichoriaceous genera may perhaps in this respect be considered as less ancient than most other tribes and still in a state of progress. The six Asteroid types above mentioned and the subtribe Gnaphalieæ of Inuloideæ may perhaps be regarded as races still vigorous, but breaking up into subordinate races of a local character, many of which already give indications of future diminution and extinction, but some of which, as yet of a very low grade, exhibit a great susceptibility of extension and progress.

Some confirmation of the hypothesis that some of the oldest of the primary or tribual and subtribual types of Compositæ are to be sought for in Helianthoideæ, and some of the most recent (of those dating from geological periods antecedent to the present one) among Cichoriaceæ, may perhaps be derived from their structure. The great consolidation and uniform structure of the essential organs of fructification of Compositæ has, as already mentioned, been adduced as evidence of their comparatively recent origin; and this consolidation and uniformity is least marked in Helianthoideæ, most so in Cichoriaceæ. In many Helianthoideæ we find, for instance, the outer bracts of the involucre more foliaceous, the bracts subtending the flowers (or receptacular paleæ) more normally developed and more firmly attached, the calyx-limb (or pappus) less transformed, consisting frequently of persistent teeth or aristæ directly continuous with the ribs of the ovary, and thus showing their really calycine nature, the anthers in some genera less firmly united and perhaps sometimes quite free; and in the female flowers of the Petrobieæ we have an ordinary campanulate regular corolla with the anthers (although small and sterile) well formed on short filaments alternating with the corolla-lobes and far from each other. In Cichoriaceæ the uniformity of the organs of fructification is more absolute than in

any other tribe, neither the pistil nor the andrœcium, nor even the corolla affording the slightest structural or sexual distinctive character throughout the eight hundred odd species; the pappus, though more variable, is always amongst those which show the least resemblance to a calyx-limb; and the receptacular paleæ, in the few cases where present, are the least like ordinary bracts.

We may thus, perhaps, be led to conjecture that the primitive form of Compositæ had regular gamopetalous flowers with an inferior ovary, the calyx, corolla, and uniseriate stamens isomerous and probably 5-merous, and the pistil 2-carpellary as in several Rubiaceæ and allied orders, but the ovary internally already reduced to a single cell with a single erect ovule, and the seed exalbuminous, enclosed in an indehiscent pericarp, and containing a straight embryo with an inferior radicle—and that it is in the gradual course of subsequent consolidations that the bracts have crowded round the condensed flowers and usurped the functions of the calyx-limb, which has become obliterated or transformed so as to be better adapted to its new duties; the corollas have become contracted, or the outer ones variously developed in forms and colours adapted to assist in the process of cross fertilization (*vexillary functions* of Delpino); the anthers, brought into close contact by the compression of the flowers, have become united and their styles gradually modified so as to assist them in discharging their pollen; and the conversion from hermaphroditism to unisexuality may in various races have variously preceded or followed some or all of these changes, and produced those numerous variations observed in the order.

We might further be led to imagine that several of these changes had taken place at a very early period, previously to the disruption or stoppage of communication between what are now the tropical regions of the globe, that, besides the parent form above supposed, Compositæ existed showing several important modifications, such as, 1st, the regular and uniform tubular development of the corolla, accompanied by more or less of suppression of the inner bracts and of the normal calyx-limb and substitution of a pappus; 2nd, the reduction of the corolla-limb, attended frequently by a sexual dimorphism, and occasional oblique development of the outer female corollas; and, 3rd, perhaps at a later period, the uniform unilateral development of the whole of the corollas, accompanied usually by a suppression of the inner bracts and conversion of the calyx-limb into the pappus. From the first of these modifica-

tions would have sprung the Eupatoriaceæ in America, the Vernoniaceæ in the New and the Old World, the Cynaroideæ in the northern and the Mutisiaceæ in the southern hemisphere. From the second modification would have arisen, first, the more slightly altered Helianthoideæ in both the New and the Old World, but chiefly in the former; 2nd, the Helenioideæ in America, and Anthemideæ in the Old World, with the thinly paleaceous modification or total suppression of the inner bracts and calyx-limb; and, 3rd, the cosmopolitan Asteroideæ, Senecioideæ, and the majority of the Inuloideæ, with an almost universal suppression of the inner bracts and conversion of the calyx-limb into a setose pappus. The third general modification, with a very few slight exceptions, has settled down into those Cichoriaceæ whose absolute uniformity has already been observed upon.

Some further remarks bearing upon the above points may be elicited in the investigation of the principle present centres or regions of Compositæ to which I shall now proceed.

C. PRESENT REGIONS OR CHIEF CENTRES OR AREAS OF THE PRINCIPAL RACES OF COMPOSITÆ.

The position of the great centres of the order is evidently in some measure influenced by its prevalent constitution and the consequent effects of climatological and other physical causes upon the gradual migrations of its species. Rarely arborescent and gregarious, still more rarely aquatic, Compositæ are in a great measure excluded from the vast forest-clad lowlands of the Amazon region of America or of east tropical Asia. In the swampy bogs of the northern hemisphere they may not be so rare, but the species are few. Their favourite haunts are treeless or thinly clad mountain-regions, and especially the lower but broken grounds, rocky ridges, or open campos of warm extratropical or subtropical districts. They may be met with, indeed, at the highest altitudes or latitudes which will bear phænogamic vegetation, as well as in the warmest tropical deserts, and a few species as ready colonists are perfectly ubiquitous in the traces of man; but there are tracts of country, such as the Mediterranean region, South Africa, extratropical America, both Mexican and South-Andine, especially abounding in highly differentiated races of very limited areas, others, again, such as the more temperate or mountain districts of the northern hemisphere, where Composite genera and species are as numerous and ill-defined in their sub-

ordinate races as wide and vague in their geographical range. These severally constitute the centres of differentiation or areas of preservation, which I shall endeavour to define as Regions of *Compositæ*. Besides, however, the difficulty of assigning limits to adjoining regions, owing to the mutual interchange of races across their frontiers, even the most distant regions are sometimes connected by races which, owing sometimes to ready colonization, sometimes, perhaps, to antiquity of origin, are now found to occupy very wide or broken and interrupted areas; and a few races may be said to be truly cosmopolitan, affecting no one region more than another. I propose, therefore, to follow up the distinction of regions by a sketch of their connexions and of such evidences as we may trace of the supposed origin of the connecting races. Conjectures, however, as to the original centres or birth-places of all these widely dispersed and interrupted races must, of course, be very hazardous; for if we still hold to the axiom that affinity means consanguinity, we must suppose some preexisting physical conditions and configurations of the globe very different from the present ones, upon the precise nature of which those geologists who admit them at all, seem to be by no means agreed. Into these supposed conditions there would be no advantage in entering now; I only advert to them for the purpose of explaining that, when I speak of ancient connexions between regions now separated by impassable barriers, such as tropical America and Africa, Mexico and the Argentine States, South Africa and Australia, &c., I by no means take it as decided whether that connexion was by contemporaneous continuity of land-elevation or climate now broken off, or by successive connexions with some common land now destroyed, or by means of transport now no longer existing, or by any other facilities afforded by ancient conditions of the globe as yet unknown to us.

In sketching the principal regions of the globe as marked out more or less distinctly by the different races of *Compositæ* which inhabit them, I shall commence with the primary division into the New and the Old World, and then detail the principal regions in each of these great divisions. I should observe, however, that in using the terms New and Old World rather than those of Western and Eastern continents adopted by Grisebach, it is merely because the former appear to me to be more familiar and more readily understood. Neither term is strictly correct; for it is not intended by the words New and Old to indicate any

comparative antiquity of existence (a geological question, upon which I have no right to form any opinion), nor yet the novelty or antiquity of our knowledge of them; for Australia, the most recent of our important discoveries, must in phytogeography be included in the Old World; and the terms Western and Eastern Continents, as applied by inhabitants of Western Europe or Eastern America, must be reversed by the inhabitants of Eastern Asia or Western America. I must observe also that in the Tables given in the following pages the numbers of genera and especially of species must never be taken as absolute; they are at best approximative only, and in some instances may be purely conjectural: they are, however, the best I have been able to arrive at without a careful working-out of the whole of the species known, which would be too many years' labour for me to undertake. Further discoveries would likewise require considerable modifications*; and to those who do not agree with me as to the circumscription of genera and species, the absolute numbers might be very different. I have endeavoured, however, to keep as much as possible to a uniform standard in this respect; and if the same course be adopted by those who multiply or reduce distinctions, the comparative results will probably remain nearly the same.

1. *General Repartition of Compositæ between the New and the Old World.*

In these Tables are included, in the American or New-World division, the West-Indian Islands, and in the Old-World division the Eastern Archipelago and Australia. The Sandwich and South-Sea Islands, the Galapagos, Juan Fernandez, St. Helena, the Atlantic Islands, the Mascarene group, and New Zealand, notwithstanding the American character of the Compositæ of the first groups, and the Old-World connexions of those of the last three, are here omitted; for their endemic races affect very little the general repartition between the two great divisions of the globe, and their geographical peculiarities appear to require consideration under distinct heads. The numbers given, both of genera and species, are intended to apply to natives only, or races which may have been anciently established without the intervention of man, to the exclusion of modern colonists.

* Two or three new genera and a few new species received since this paper was placed in the printers' hands, would already require some slight changes in a few of the figures of some of the following Tables.

Table 1. *Repartition of Genera in the New and Old Worlds.*

Tribes.	America.		Old World.		Com- mon to the two.	Total.	Add Insular.	Grand Total.
	Ende- mic.	Total.	Ende- mic.	Total.				
Vernoniaceæ.....	25	29	10	14	4	39	1	40
Eupatoriaceæ ...	30	35	...	5	5 ^a	35	...	35
Asteroideæ	39	49	34	44	10 ^b	83	8	91
Inuloideæ	16	27	107	118	11 ^c	134	8	142
Helianthoideæ ...	107	125	4	22	18 ^d	129	9	138
Helenioideæ	57	59	1	3	2 ^e	60	...	60
Anthemideæ	3	12	32	41	9 ^f	44	1	45
Senecionideæ ...	14	19	19	24	5	38	6	44
Calendulaceæ ...	1	1	7	7	...	8	...	8
Arctotideæ .....	...	...	17	17	...	17	...	17
Cynaroideæ .....	...	3	34	37	3	37	...	37
Mutisiaceæ	37	38	14	15	1 ^g	52	1	53
Cichoriaceæ	14	24	30	40	10 ^h	54	2	56
Total.....	343	421	309	387	78	730	36	766

- a* 4 almost entirely American.
- b* 1 almost entirely American, and 1 chiefly Old-World.
- c* Nearly all chiefly Old-World.
- d* Most of them chiefly American.
- e* All almost entirely American.
- f* 1 chiefly American, 7 chiefly Old-World.
- g* All chiefly American.
- h* 1 chiefly American, 7 chiefly Old-World.

Table 2. *Repartition of Species in the New and Old Worlds.*

The numbers in the following Table, especially as to the larger genera, are often but roughly estimated, and may on a close scrutiny require in some instances considerable modification. The common species do not include the weeds of cultivation introduced in modern times from one division to the other.

Tribes.	America.		Old World.		Com- mon to the two.	Total.	Add Insular.	Grand Total.
	Ende- mic.	Total.	Ende- mic.	Total.				
Vernoniaceæ.....	372	376	152	156	4	528	12	540
Eupatoriaceæ ...	740	743	13	16	3	756	1	757
Asteroideæ	822	830	434	442	8	1264	94	1358
Inuloideæ	146	157	939	950	11	1096	93	1189
Helianthoideæ ...	953	963	67	77	10	1030	47	1077
Helenioideæ	304	304	3	3	...	307	1	308
Anthemideæ	48	63	593	608	15	656	28	684
Senecionideæ ...	497	502	682	687	6	1184	50	1234
Calendulaceæ ...	1	1	102	102	...	103	3	106
Arctotideæ .....	...	...	237	237	...	237	...	237
Cynaroideæ	41	42	971	972	1	1013	13	1026
Mutisiaceæ	383	383	60	60	...	443	1	444
Cichoriaceæ	156	161	605	610	5	766	48	809
Total.....	4463	4525	4858	4920	63	9383	386	9769

Upon the whole it would appear from the above Tables that Compositæ are not unfairly distributed between the New and the Old World as well as to numbers as to variety of forms, although with a balance in both respects rather in favour of America, the numbers being 4525 species in 421 genera in the New World, against 4920 species in 387 genera in the Old. Further discoveries may also, probably, increase this disparity; for there are many tracts in the great mountain-chain extending from California to Chili, so rich in Compositæ over the whole of its vast extent, which are as yet but little known or wholly unexplored, whilst in the two richest Composite regions in the Old World, the Mediterranean and South-African, the Composite forms as yet unknown must be comparatively few. From tropical Africa we may expect rather more, especially as to generic forms; but these may be compensated by fresh discoveries from the interior of Brazil and La Plata. Were the insular floras included in the enumeration, the disparity would again be slightly diminished; for the imperfectly known Mascarene and the well-explored Atlantic Islands would add 18 genera and species to the Old World, whilst the Sandwich and Galapago Islands, now pretty fairly investigated, only add 8 genera and 70 species to the New. St. Helena, New Zealand, and the South-Sea Islands are wholly excluded from these calculations, as not being specially referable to either of the two great divisions.

With regard to the comparative diversity and distinctness of forms in the two divisions, it may be observed that the number of species to a genus is about 10·7 in America, and 12·7 in the Old World, showing in the former more numerous remnants of old types, in the latter a greater luxuriance of flourishing and increasing genera. It will be seen, however, that in each division there are regions remarkably characterized in both respects.

When we come to consider the tribes into which Compositæ have been divided, we at once see a great disparity in their repartition between the two great divisions. Two tribes are almost entirely American, the Eupatoriaceæ and Helenioideæ. In the former 30 genera, including above 200 species, are exclusively American, 3 genera, containing together above 80 species, have each one of their species extending into the Old World. *Eupatorium* itself, of above 400 American species, is represented in the Old World by about 10 species; and the small genus *Adenostyles* alone has an Old-World preponderance, having 2 European and 1 Californian

species. Helenioideæ have 57 genera, containing nearly 300 species, exclusively American; one genus, *Flaveria*, of 7 American species, has one of them extending into Australia, another, of four American species, is represented by 1 in South Africa, and a third, *Cadiscus*, is a monotypic South-African plant. Three more tribes have a strong American preponderance, both in their entirety and in their subtribes: Vernoniaceæ have $\frac{29}{39}$ genera and $\frac{376}{528}$ species American, against $\frac{14}{39}$ genera and $\frac{156}{528}$ species in the Old World; Helianthoideæ $\frac{125}{129}$ American genera and $\frac{963}{1030}$ species, against $\frac{22}{129}$ Old-World genera and $\frac{77}{1030}$ species; and Mutisiaceæ $\frac{38}{52}$ American genera and $\frac{383}{443}$ species, against $\frac{15}{52}$ Old-World genera and $\frac{60}{443}$ species. Three more large tribes are more equally distributed: Asteroideæ have $\frac{49}{83}$ New-World genera and $\frac{830}{1264}$ species, against $\frac{44}{83}$ genera and $\frac{442}{1264}$ species in the Old World, showing still an American preponderance, which is slightly reversed in Senecionideæ with $\frac{19}{38}$ genera and $\frac{502}{1184}$ species, against $\frac{24}{38}$ genera and $\frac{687}{1184}$ species in the Old World, and still more so in Cichoriaceæ, with $\frac{24}{54}$ American genera and $\frac{161}{766}$ species, against $\frac{40}{54}$ genera and $\frac{610}{766}$ species in the Old World. The remaining tribes are much more decidedly characteristic of the Old World. Of Inuloideæ the largest, the nine subtribes are all of the Old World, three only of them being represented in America in comparatively few numbers; and the genera are $\frac{118}{134}$ and the species $\frac{950}{1096}$ in the Old World, to $\frac{27}{134}$ and $\frac{157}{1096}$ in the New. Anthemideæ have $\frac{41}{44}$ genera and $\frac{608}{665}$ species in the Old World, to $\frac{12}{44}$ genera and $\frac{62}{656}$ species in the New. Cynaroideæ, with all the 37 genera and $\frac{972}{1013}$ species in the Old World, are represented in America by only $\frac{42}{1013}$ species, belonging to 3 of those genera. Calendulaceæ with 7 of its 8 genera, including 102 species, in the Old World, has a single monotypic American genus; and the 17 genera and 237 species of Arctotideæ are exclusively of the Old World. To sum up in a few words, Compositæ as a whole are not very unequally distributed between the two divisions of the globe; and of the 13 tribes, 12 are common to the two, and only one restricted to one of them. But out of 730 genera 78 only are common to the two, showing already a far greater difference

in the character of the Compositæ of the two divisions than can be attributed to any climatological or other physical causes; and the difference is still more striking in the species, of which only 63 out of a total number of nearly 9400 are common to the New and the Old World; and these common ones are chiefly either Alpine or high northern, where the general flora is more continuous, or ready colonizers, although their presence in the two divisions cannot be attributed to recent colonization.

These genera and species common to the two divisions require separate consideration, according as they are tropical, northern, or southern.

Table 3. *Tropical connexion between America and the Old World as indicated by identical or closely allied Genera and Sections without identical Species.*

Genera.	Tropical-American representatives.	Tropical Old-World representatives.
CENTRATHERUM	2 widely spread species, extending southward of the tropics, and one of them reappearing in Australia.	4 Asiatic species, differing perhaps sectionally from the American ones.
Connexions	<i>Oiospermum</i> , a closely allied monotype, otherwise those of <i>Vernonia</i> .	None nearer than <i>Vernonia</i> .
VERNONIA.		
Representative sections.	<i>Hololepis</i> 2 species. <i>Lepidaploa</i> about 200 species, a few of which extend beyond the tropics both north and south. <i>Critoniopsis</i> 6 species.	<i>V. calycina</i> , Wall., in Asia, and <i>V. purpurea</i> , Sch. Bip., in Africa. <i>Gymnanthemum</i> about 20 species, Asiatic and African, and perhaps a few Asiatic true <i>Lepidaploa</i> . <i>Strobocalyx</i> about 20 species, Asiatic and African.
Diverging sections	<i>Leiboldia</i> , <i>Stenocephalus</i> , <i>Trianthæa</i> , and <i>Eremosis</i> , all small Columbian or Mexican sections.	<i>Xipholepis</i> about 12 species, <i>Cyanopsis</i> about 20 species, <i>Tephrodes</i> about 20 species, all with the majority Asiatic, but also several African species. <i>Lepidella</i> 15 species and <i>Stengelia</i> 14 species, exclusively African, or nearly so.
Connexions	<i>Piptocarpha</i> 24 species, <i>Piptolepis</i> 8 sp., and <i>Albertinia</i> , <i>Vanillosmopsis</i> , <i>Blanchetia</i> , <i>Lachnorhiza</i> , and <i>Bolanosa</i> , all monotypic, immediately connected with <i>Vernonia</i> ; and 17 genera with above 80 species rather more remote.	<i>Bothriocline</i> in Africa, <i>Adenoon</i> and <i>Lamprospermum</i> in Asia, <i>Pleurocarpæa</i> in Australia, and <i>Centauroopsis</i> in Madagascar, all monotypic and immediately connected, and 4 genera with about 9 species rather more remote.
ERIGERON	See northern connexions, Table 5.	
CONYZA.		
Identical groups	<i>Dimorphantes</i> , Cass., or genuine <i>Conyzæ</i> , represented by <i>C. chilensis</i> and allies.	<i>Dimorphantes</i> , represented by <i>C. ægyptiaca</i> and allies.
Diverging groups	<i>Lennecia</i> (<i>C. gnaphalioides</i> and allies), <i>C. triplinervia</i> and allies.	<i>Marginatæ</i> (<i>C. Gouani</i> and allies), <i>Fimbrillaria</i> (<i>C. ivafolia</i> and allies).
Connexions	<i>Erigeron</i> (<i>Cænotus</i>) more northern, and in the tropics <i>Nidorella</i> and <i>Psadia</i> , on the one hand, <i>Laggera</i> , <i>Blumea</i> , <i>Pluchea</i> , and smaller ones on the other.	<i>Erigeron</i> (<i>Cænotus</i>), more northern; and in the tropics <i>Baccharis</i> on the one hand, and <i>Pluchea</i> and allies on the other.
PLUCHEA.		
Representative species	<i>P. purpurascens</i> and allies.	<i>P. tomentosa</i> and allies.

Genera.	Tropical-American representatives.	Tropical Old-World representatives.
<p>PLUCHEA. Diverging groups</p>	<p><i>P. Quitoc</i> and allies, several of them extratropical.</p>	<p><i>P. indica</i>, <i>Berthelotia</i>, DC., <i>P. pinnatifida</i>, Hook. f., and allies; the species more Asiatic than African, and a few more divergent extratropical Asiatic or Australian species.</p>
<p>Connexions</p>	<p><i>Stenachanium</i> 3 species (Brazil), <i>Sachsia</i> 3 species, and <i>Rhodogeron</i> 1 species (Cuba), <i>Tessaria</i>, 5 species (Western).</p>	<p><i>Laggera</i> 10 species, <i>Blumea</i> 55 species, and, in another direction, <i>Conyza</i>.</p>
<p>ACHYROCLINE ...</p>	<p>10 species, Brazilian and Western.</p>	<p>6 species, all African.</p>
<p>Connexions</p>	<p><i>Gnaphalium</i> and <i>Stenocline</i>.</p>	<p><i>Gnaphalium</i>, <i>Stenocline</i>, and others.</p>
<p>GNAPHALIUM ...</p>	<p>See cosmopolitan genera, Table 8.</p>	<p>6 species, Mascarene.</p>
<p>STENOCLINE</p>	<p>2 species, Brazilian.</p>	<p><i>Helichrysum</i>, <i>Gnaphalium</i>, <i>Achyrocline</i>, and others.</p>
<p>Connexions</p>	<p><i>Gnaphalium</i> and <i>Achyrocline</i>.</p>	<p><i>Grangea</i> 2 species.</p>
<p>GRANGEINÆ. Representative genera</p>	<p><i>Egletes</i> 6 species.</p>	<p><i>Ceruana</i> 1 species and several small tropical genera and, more distant, several north-eastern Asteroideæ, and, in another direction, <i>Cotuleæ</i>.</p>
<p>Connexions</p>	<p><i>Aphanostephus</i> 3 species, and, more distant, several north-western Asteroideæ.</p>	<p>1 species (Philippines) and a colonist from America.</p>
<p>MELAMPODIUM...</p>	<p>17 species (tropical or north subtropical).</p>	<p>None near.</p>
<p>Connexions</p>	<p><i>Acanthospermum</i> 2 species (tropical), <i>Lecocarpus</i> 1 species (Galapagos).</p>	<p>1 species, tropical Australian, closely representing the North-American one; 2 species Australian and 3 species Asiatic, all tropical and somewhat divergent.</p>
<p>CHRYSOGONUM ...</p>	<p>1 species, North-American, subtropical.</p>	<p>None near.</p>
<p>Connexions</p>	<p><i>Silphium</i> 11 species (North-American), <i>Berlandiera</i>, <i>Lindheimera</i>, and <i>Engelmannia</i> 7 species (Mexico and Texas), and <i>Schizoptera</i> 1 species (Andine).</p>	<p>1 species, African and Asiatic.</p>
<p>ENHYDRA</p>	<p>3 or 4 species, aquatic and tropical.</p>	<p>None near.</p>
<p>Connexions</p>	<p><i>Aphanactis</i> 2 species, Andine.</p>	<p>1 species, African, closely representative of one of the American.</p>
<p>SCLEROCARPUS ...</p>	<p>9 species, tropical or north subtropical.</p>	<p>None near.</p>
<p>Connexions</p>	<p><i>Montanoa</i> 14 species, Mexican and Andine.</p>	<p>3 or 4 species African, 1 also Asiatic, all cosectional with 1 American.</p>
<p>BLAINVILLEA.....</p>	<p>1 species cosectional with the African, and 2 or 3 species sectionally different.</p>	<p><i>Wedelia</i> and <i>Aspilia</i>.</p>
<p>Connexions</p>	<p><i>Wedelia</i>, <i>Aspilia</i>, &c.</p>	<p>1 species, East-Asiatic.</p>
<p>WEDELIA. Sect. <i>Stemmodon</i></p>	<p>4 species, mostly maritime.</p>	<p>1 species African, 1 species Asiatic.</p>
<p>Sect. <i>Cyathophora</i></p>	<p>About 25 species, Brazilian, Andine, &c.</p>	<p>About 10 species, Asiatic and Australian.</p>
<p>Sect. <i>Wollastonia</i></p>	<p>None.</p>	<p>None but <i>Blainvillea</i> and <i>Aspilia</i>.</p>
<p>Connexions</p>	<p>Besides <i>Blainvillea</i> and <i>Aspilia</i>, <i>Zexmenia</i> 20 species, <i>Oyedæa</i> 22 species, &c.</p>	<p>8 species, of which 5 African cosectional with 2 or 3 American, 2 African and 1 Mascarene divergent.</p>
<p>ASPILIA</p>	<p>About 30 species, 2 or 3 cosectional with 5 African; the others divergent.</p>	<p>None but <i>Wedelia</i> and <i>Blainvillea</i>.</p>
<p>Connexions</p>	<p>Besides <i>Wedelia</i> and <i>Blainvillea</i>, <i>Zexmenia</i>, <i>Oyedæa</i>, &c., as above.</p>	<p>1 species, African.</p>
<p>MELANTHERA. Sect. <i>Wurm-schmidtia</i> or <i>Echinocephalum</i>.</p>	<p>1 species, Brazil.</p>	<p>None.</p>
<p>Sect. <i>Eumelanthera</i>.</p>	<p>4 species, Brazil, Indian Ocean, &c.</p>	<p>1 species, African.</p>
<p>Sect. <i>Lipotriche</i></p>	<p>None.</p>	<p>None near.</p>
<p>Connexions ...</p>	<p>None very near, but less distant than in Old World.</p>	<p>2 or 3 species, Asiatic, Australian, and chiefly East-African; all tropical.</p>
<p>SPILANTHES</p>	<p>About 20 species, tropical.</p>	<p>None.</p>
<p>Connexions</p>	<p>None very near, but <i>Sabazia</i> nearer than any Old-World.</p>	<p>None.</p>

Genera.	Tropical-American representatives.	Tropical Old-World representatives.
COREOPSIS	3 or 4 Peruvian species near the African, and nearly 40 diverging, chiefly North-American and Mexican.	About 8 species, East-African (<i>Prestinaria</i>), near the Peruvian.
Connexions	<i>Bidens</i> (<i>Psilocarpæa</i>) nearly 40 species, <i>Cosmos</i> 10 species, <i>Dahlia</i> 4, <i>Hidalgoa</i> 2, <i>Isostigma</i> 5, <i>Thelesperma</i> 4 or 5 species, all tropical or subtropical.	<i>Bidens</i> (<i>Psilocarpæa</i>) 2 species (colonists?), <i>Glossogyne</i> 5 species (East-Asiatic and Australian), <i>Guizotia</i> 3, and <i>Microlecania</i> 1 (African).
CHRYSANTHELLUM.	1 species tropical-American, 1 Galapagos.	1 species, African and Asiatic, probably the same as the American.
Connexions	<i>Heterospermum</i> 1 species.	<i>Glossocardia</i> 1 species, Asiatic.

A first rapid glance over the above Table shows the general American character of the whole. For the most part the African and Asiatic species sections or genera are few and disconnected, the corresponding American ones numerous and closely connected on all sides with American allies. And yet the endemic Old-World races from species to genera are too numerous and varied to admit of the supposition that they can ever have migrated from America and become extinct in their birth-place. It would seem rather that whatever may have been the cause of the parent *Wedeliæ*, *Sclerocarpi*, *Melantheræ*, &c. having once been established both in Africa and in America, or in some land at one or different times in connexion with the two continents, they had by long isolation become more and more differentiated in the two—that in America they have as races prospered and multiplied in every direction and possibly retained many of their very early forms; whilst in the Old World they have found less genial circumstances, they have for the most part dwindled away, a far greater proportion than in America have become extinct, and the few local representatives we now see are probably in the course of extinction. And this will, I believe, be found to be more particularly the case with the African races. Here, more perhaps than in any other part of the globe, in Compositæ as in so many other orders, we may fancy we see the scattered remains of ancient races dwindling down to their last representatives.

It is not so, however, with a few of the races included in the above Table, especially some of those which have rather more of an Asiatic than an African character. The sections *Tephrodes*, *Cyanopis*, and *Gymnanthemum* of *Vernonia*, the section *Wollastonia* of *Wedelia*, the genera *Ethulia* and *Chrysanthellum* may be flourishing and increasing races, which have already been much differentiated in the Old World and are likely to become more so; the two last-named, as well as *Vernonia* (*Tephrodes*) *conyzoides*, are

ready colonizers, although neither the *Ethulia* nor the *V. conyzoides* has as yet appeared in America. The African *Vernoniæ* (section *Stengelia*) and *Coreopsides* (section *Prestinaria*) and the eastern *Chrysogona* and *Glossogynes*, although showing each several species, have probably already seen their best days.

Table 4. *Tropical connexion between the New and the Old World as indicated by identical Species.*

This Table includes the species of those genera only which have an essentially tropical character, although some may, perhaps, extend northwards or southwards beyond the tropics, excluding the common species as well of the cosmopolitan genera enumerated in Table 8 as of the northern or southern connecting genera contained in Tables 5, 6, and 7, which may also be found within the tropics, as in both cases the original connexion or communication was probably extratropical.

Species.	Area.	Congeners.	Connexions.
<i>Sparganophorus Vaillantii</i>	East tropical America, West tropical Africa, (semiaquatic).	None.	(<i>Pacourina</i>) American.
<i>Elephantopus scaber</i>	America, Asia, and Africa, tropical and subtropical.	8 American and 1 African species.	None immediate, but the nearest American.
<i>Adenostemma viscosum</i> ...	Cosmopolitan, tropical and subtropical (ready colonist).	4 American species.	All American.
<i>Ageratum conyzoides</i>	Cosmopolitan, tropical and subtropical (ready colonist).	15 American species.	All American.
<i>Mikania scandens</i>	America, Asia, and Africa, tropical and subtropical.	60 American species.	All American.
<i>Epaltes brasiliensis</i>	East tropical America, West tropical Africa (semiaquatic?).	1 American cosectional species, 6 African, Asiatic, or Australian, tropical or subtropical, forming separate sections.	Chiefly African.
<i>Ambrosia maritima</i>	America, Asia, Africa, and South Europe, tropical and subtropical (maritime).	11 American species.	All American.
<i>Xanthium strumarium</i> ...	America, Asia, Africa, and South Europe, tropical and subtropical (ready colonist).	2 or 3 American species (all ready colonists).	All American.
<i>Siegesbeckia orientalis</i>	America, Asia, and Africa, tropical and subtropical (ready colonist).	1 American species.	All American.
<i>Eclipta alba</i> , Hassk. (<i>E. erecta</i> , <i>E. prostrata</i> , &c.).	America, Asia, Africa, and Australia, tropical and subtropical (ready colonist).	1 cosectional species, East-Asiatic and Australian, 1 or 2 American, forming a separate section.	All American.

Species.	Area.	Congeners.	Connexions.
<i>Bidens pilosa</i> and <i>B. bipinnata</i> .	Cosmopolitan, tropical and subtropical (ready colonists).	About 40 cosectional species, all tropical American; a distinct section, amphigeous and extratropical.	Chiefly American, with a few African.
<i>Synedrella nodiflora</i>	America, Asia, and Africa, tropical (ready colonist).	1 tropical-American species.	Chiefly American, with a few African, besides the following.
<i>Chrysanthellum</i>	America, Asia, and Africa, tropical.	1 tropical-American (Galapagian).	1 tropical-Asiatic monotype (<i>Glossocardia</i>) and 1 tropical - American (<i>Heterospermum</i>), the further ones chiefly American.
<i>Enhydra</i> (several names, probably one species).	America, Asia, Africa, and Australia, tropical (semiaquatic).	2 or 3 tropical-American species.	None immediate; the nearest American.
<i>Cotula coronopifolia</i>	Europe, South Africa, Australia, extratropical South America.	About 35 Old-World species, chiefly South - African, 2 South-American.	A few small allied genera chiefly South-African, Australian, New Zealand, and extratropical or Andine, 1 American.
<i>Centipeda orbicularis</i> (<i>Myriogyne minuta</i> and <i>M. elatinoides</i>).	South Africa, Australia, New Zealand, extratropical South America.	1 Australian (and 1 African?) species.	Same as <i>Cotula</i> .

We have here, as in the first list, a marked American preponderance; for, with the exception of *Chrysanthellum*, *Cotula*, and *Centipeda*, the connexions are exclusively, or almost exclusively, American. It is possible, indeed, that the *Ageratum*, the *Siegesbeckia*, the two *Bidens*, and even the *Synedrella* may be of comparatively modern introduction, and may belong therefore rather to the class of species of which the interchange between various regions is now going on. The *Ambrosia* also as a maritime plant may have been brought over at any time. The *Sparganophorus*, the *Enhydra*, and perhaps the *Epaltes* belong to the class of semiaquatic plants whose wide diffusion and ready dispersion to great distances have been frequently observed, although, perhaps, not yet satisfactorily accounted for. *Xanthium spinosum*, long known in the Old World, but which has only very recently taken possession of Australia, is here omitted, as being believed by many to be only a modern colonist in the Old World. But the *Elephantopus*, *Adenostemma*, *Mikania*, *Eclipta*, *Xanthium strumarium*, and *Chrysanthellum*, besides the above-mentioned *Enhydra* and *Epaltes*, give strong presumptive evidence of a prehistoric establishment in the Old World, not, perhaps, ancient enough to have settled down into distinct species, but having most of them already produced more or less marked varieties, which may be considered as incipient species, to be further

differentiated should any change in physical conditions tend to isolate them. It will be observed that these American species supposed to be prehistorically established in the Old World are in their present distribution mostly rather of an Asiatic and chiefly Eastern than of an African character; and this, taken in conjunction with the *Wedelia* (*Stemmodon*), *Melampodium*, and some other E.-Asiatic types of the first list, and with many instances that might be taken from other orders, might induce a belief that, as far as plants are concerned, the connexion or communication (whatever may have been its nature) between America and east tropical Asia was of an antiquity less remote than that between tropical America and Africa.

Table 5. *Extratropical Northern connexion between America and the Old World as indicated by identical or nearly allied Species, Sections, or Genera.*

This Table includes all the genera whose connecting sections or species are northern and extratropical, although some of them may extend into the tropics in one or both divisions of the globe, but generally with a greater divergence in character as well as in geographical position than in the north. Some may reappear in the south, and even may there cross again from the New to the Old World (e. g. *Centaurea*), and may therefore be repeated in Table 7, although the primary connexion was probably northern.

Genera.	American races.	Common races.	Old-World races.
EUPATORIUM...	About 24 North-American species, but about 400 more dispersed over Central and South America.	None; but some of the North-American ones nearer to the Old-World forms than to the mass of American ones.	7 or 8 Asiatic species, 2 or 3 extending westward to the Mediterranean region and Europe generally, and 1 in east tropical Africa; all closely allied to each other and to some North-American forms.
Connexions ...	Several American genera	.....	None very near.
ADENOSTYLES	1 Californian species.	None; but the American species nearer to one of the European than they are to each other.	2 European species.
Connexions ...	None very near; but <i>Brickellia</i> perhaps nearer than <i>Eupatorium</i>.	.....	None nearer than <i>Eupatorium</i> , a more remote one with some <i>Senecionideæ</i> .
SOLIDAGO	Nearly 80 species, chiefly North-American; a few West-American or southern extratropical.	<i>S. virga-aurea</i> , L.	None besides the common one and a few colonists.
Connexions ...	Several North or West American or south extratropical genera.	.....	None in the north; a few extratropical South-African genera.

Genera.	American races.	Common races.	Old-World races.
BELLIS.....	2 North-American (Southern States) species.	No common species.	6 Mediterranean-region species.
Connexions ..	None very near.	.....	<i>Bellium</i> in the Mediterranean region, <i>Brachycome</i> and <i>Steirodiscus</i> in Australia and South Africa.
BOLTONIA	7 North-American or Mexican species.	No common species.	5 East-Asiatic species, not strictly cosectional with the American.
Connexions ...	<i>Townsendia</i> and others, connecting with <i>Aster</i>.	.....	<i>Heteropappus</i> and others, connecting with <i>Aster</i> .
ASTER	Nearly 100 species, belonging to the common sections in North America and the Mexican region. Several southern species of divergent sections.	4 common sections— <i>Alpigenia</i> , <i>Euaster</i> , <i>Orthomeris</i> , and <i>Galatella</i> ; 1 species, <i>A. (Alpigenia) alpinus</i> .	About 40 species, belonging to the common sections; all extratropical, chiefly Asiatic, few European, and 1 South-east African.
Connexions ...	Numerous extratropical or Alpine, both north and south.	.....	Few north, but numerous south; all extratropical.
ERIGERON	Nearly 40 species, belonging to the common section in North or West America. Several diverging sections in North and South America.	<i>E. alpinus</i> , L.; <i>E. uniflorus</i> , L.; <i>E. glabratus</i> , Hoppe (<i>E. acris</i> , L. ?); all in section <i>Trimorphæa</i> , besides colonists in other sections.	About 8 or 9 species, belonging to the common section, chiefly northern. Several diverging sections, northern, tropical, or southern.
Connexions ...	Extratropical; <i>Aster</i> and allies tropical. See <i>Conyza</i> , Table 3.	.....	Extratropical; <i>Aster</i> and allies tropical. See <i>Conyza</i> , Table 3.
BRACHYACTIS.	None besides the common species.	<i>B. ciliata</i> , Ledeb.	6 Asiatic species.
Connexions ...	<i>Erigeron</i> and <i>Conyza</i> , both very close.	.....	<i>Erigeron</i> and <i>Conyza</i> , both very close.
FILAGO group.	<i>Filago</i> 1 Californian species cosectional with the Old-World species, the common species in Chili; <i>Evax</i> 1 species, <i>Micropus</i> 4 species, of divergent sections.	<i>Filago gallica</i> , L. (colonist?); the Californian <i>Filago</i> closely representative.	<i>Filago</i> 7 species, <i>Evax</i> 9, and <i>Micropus</i> 3 species, all Mediterranean or Europæo-Asiatic.
Connexions ...	<i>Psilocarpus</i> , <i>Diaperia</i> , and <i>Micropsis</i> (12 species), all very close and North-American, chiefly western. <i>Gnaphalium</i> more remote.	.....	<i>Ifloga</i> 8 species, Mediterranean and South-African, nearly connected. <i>Gnaphalium</i> more remote.
GNAPHALIUM.	Numerous species, northern and southern, chiefly extratropical or mountain, but also tropical.	<i>G. luteo-album</i> , L.; <i>G. purpureum</i> , L.; <i>G. uliginosum</i> , L.; <i>G. sylvaticum</i> , L.; <i>G. supinum</i> , Vill.	Numerous species, north and south, chiefly extratropical or mountain, but also tropical.
Connexions ...	The following three genera and a few others, chiefly South-American, and not numerous in species.	.....	<i>Helichrysum</i> , with several northern and very numerous southern species, and several other southern genera, with numerous species, very close. The following three northern genera and several others, chiefly southern, rather more distant.
ANTENNARIA ...	8 North-American species, including the 3 common species and 1 southern extratropical.	<i>A. dioica</i> , Gært. n.; <i>A. alpina</i> , Gært. n.; <i>A. carpathica</i> , Br.	5 species, Europæo-Asiatic, including the 3 common species.
Connexions ...	The two following genera and, through them, <i>Gnaphalium</i>.	.....	The two following genera and, through them, <i>Gnaphalium</i> .

Genera.	American races.	Common races.	Old-World races.
LEONTOPODIUM	2 Andine species.	No common species.	3 species, Europæo-Asiatic.
Connexions ...	<i>Antennaria</i> and <i>Gnaphalium</i>.	.....	<i>Antennaria</i> and <i>Gnaphalium</i> .
ANAPHALIS.....	None besides the common species.	<i>A. margaritacea</i> (<i>Gnaphalium</i> , Linn.).	About 24 species, all Asiatic, northern or tropical, chiefly mountainous, besides the common species, which is North-east Asiatic and perhaps European.
Connexions ...	<i>Gnaphalium</i>.	.....	<i>Gnaphalium</i> .
ADENOCAULON.	1 North-west American, 2 Chilian species.	No common species; but the North-west American and the Asiatic species closely representative.	1 or 2 species, Japan and Himalaya.
Connexions ...	Milleriæ generally, but none very close.	.....	None.
ACHILLEA.....	3 North-American species, including the common species.	<i>A. millefolium</i> , Linn.	About 80 Europæo-Asiatic and Mediterranean species.
Connexions ...	None.	.....	<i>Santolina</i> , <i>Anthemis</i> , &c., numerous species.
CHRYSANTHEMUM.	None besides the common species.	<i>C. leucanthemum</i> , L. (2 or 3 varieties or species).	About 100 species, Europæo-Asiatic and a few South-African; several cosectional, the others divergent.
Connexions ...	None besides <i>Matricaria</i>.	.....	<i>Matricaria</i> and several other Anthemideæ.
MATRICARIA ...	None besides the common species.	<i>M. inodora</i> , L., and <i>M. discoidea</i> , DC.	About 20 species, above half Mediterranean and Europæo-Asiatic, the remainder South-African.
Connexions ...	None besides <i>Chrysanthemum</i>.	.....	<i>Chrysanthemum</i> , on the one hand, and, through <i>Nananthea</i> , <i>Cotula</i> on the other, numerous species.
TANACETUM ...	5 North-American species.	No common species.	About 30 species, Mediterranean and Europæo-Asiatic, but chiefly Asiatic.
Connexions ...	<i>Artemisia</i> only.	.....	On the one hand <i>Artemisia</i> , through <i>Crossostephium</i> , on the other several South-African genera.
ARTEMISIA.....	About 30 N.-American species, including the 9 common species, and 2 or 3 south extratropical or Andine species.	<i>A. borealis</i> , Pall.; <i>A. dracunculoides</i> , Pursh? (= <i>A. dracunculus</i> ?); <i>A. vulgaris</i> , L.; <i>A. glomerata</i> , Ledeb.; <i>A. globularia</i> , Cham.; <i>A. arctica</i> , Less.; <i>A. frigida</i> , Willd.; <i>A. absinthium</i> ?, L.	About 120 species, chiefly Europæo-Asiatic and Mediterranean, and most abundant in Asia. A few South-African or tropical species.
Connexions ...	<i>Tanacetum</i> and a distant one with Ambrosiæ.	.....	<i>Tanacetum</i> , through <i>Crossostephium</i> .
PETASITES.....	4 North-American species.	No common species.	8 Europæo-Asiatic species.
Connexions ...	None very near; <i>Luina</i> 1 species, and <i>Peucephyllum</i> 1 species, both North-west American, and rather distant.	.....	<i>Tussilago</i> , <i>Homogyne</i> , and <i>Cremanthodium</i> , together 9 species, all very near and Europæo-Asiatic.
ARNICA.....	9 North-American species, including the common species.	<i>A. angustifolia</i> , Vahl? (<i>A. montana</i> , var.?).	The common species in North Asia, and the typical <i>A. montana</i> , Europe and Asia.

Genera.	American races.	Common races.	Old-World races.
ARNICA.			
Connexions ...	None close; <i>Crocidium</i> , 1 species, rather distant.	.....	<i>Doronicum</i> , 10 species, Mediterranean and Europæo-Asiatic.
SENECIO	Very numerous species, north and south.	<i>S. palustris</i> , Hook.; <i>S. frigidus</i> , Less.; <i>S. resedifolius</i> , L.; <i>S. pseudoarnica</i> , Less.	Very numerous species, north and south.
Connexions ...	<i>Culcitium</i> , <i>Gynoxys</i> , and other divergent genera.	.....	<i>Notonia</i> , <i>Emilia</i> , <i>Gynura</i> , <i>Cineraria</i> , and other divergent genera.
WERNERIA	16 Andine species.	No common species.	1 Himalayan, 1 Abyssinian species.
Connexions ...	<i>Senecio</i> , very near.	.....	<i>Senecio</i> , very near.
CNICUS	35 North-American and Mexican species.	No common species besides colonists.	About 130 species, Europæo-Asiatic, Mediterranean, with a few tropical species.
Connexions ...	None very near; the two following genera the only cotribuals.	.....	<i>Carduus</i> , 60 species, very close, and many others slightly divergent.
SAUSSUREA	None besides the common species.	<i>S. alpina</i> , DC.	About 60 species, chiefly Asiatic, a few European.
Connexions ...	None near.	.....	<i>Serratula</i> , <i>Jurinea</i> , and several others, numerous in species.
CENTAUREA ...	1 North - American, 5 Chilian species.	No common species, but the American almost cosectional with a few Mediterranean, tropical African, and the Australian species.	Above 300 species, Europæo-Asiatic and Mediterranean, 6 tropical and 1 Australian species.
HYOSERIS group	<i>Microseris</i> , <i>Krigia</i> , and <i>Phalacroseris</i> , 16 species, chiefly North-west American.	No common genera.	<i>Hyoseris</i> and <i>Arnosaris</i> , 5 Mediterranean and Europæo-Asiatic species.
Connexions ...	Cichoriaceæ generally.	.....	Cichoriaceæ generally.
LAPSANA group.	<i>Apogon</i> 1 North-American species.	No common genera.	<i>Lapsana</i> , 4 species, 1 North-east Asiatic (the nearest to <i>Apogon</i>), the others Europæo-Asiatic and Mediterranean.
Connexions ...	Cichoriaceæ generally.	.....	Cichoriaceæ generally.
CREPIS	6 species, North-American; all <i>Eucrepis</i> , including the 2 common species.	<i>C. nana</i> , Richards.; <i>C. biennis</i> , Linn.	About 90 species, Europæo-Asiatic and Mediterranean, 1 South-African, and 1 Australian. <i>Eucrepis</i> and several diverging sections.
Connexions ...	None nearer than <i>Hieracium</i>.	.....	<i>Phacelium</i> and a few other small nearly allied genera. <i>Hieracium</i> rather more distant.
PICRIS	None besides the common species.	<i>P. hieracioides</i> , Linn.	About 28 species, Europæo-Asiatic and Mediterranean, including the common species, which is almost cosmopolitan.
Connexions ...	None nearer than <i>Crepis</i>.	.....	None nearer than <i>Crepis</i> .
HIERACIUM	About 25 northern and 15 southern species, belonging to the common sections; mostly extratropical or mountain, and chiefly <i>Stenotheca</i> .	Sections <i>Archhieracium</i> and <i>Stenotheca</i> . <i>H. murorum</i> , Linn.?	Above 100 species, many <i>Archhieracium</i> , few <i>Stenotheca</i> besides <i>Pilosella</i> , which is not American.
Connexions ...	<i>Malacothrix</i> , 9 species, <i>Anisocoma</i> , 1 species; neither very close.	.....	<i>Andryala</i> , 6 Mediterranean species, very close.

Genera.	American races.	Common races.	Old-World races.
HYPOCHÆRIS...	About 25 species, South American, chiefly Andine or extratropical.	Sections <i>Achyrophorus</i> and <i>Serioloides</i> , but no common species except <i>H. glabra</i> , L., and <i>H. radicata</i> , L., probably colonists in most stations.	About 10 species, Mediterranean and Europæo-Asiatic, including the common sections and small endemic sections.
Connexions ...	<i>Leontodon</i> the nearest.	.....	<i>Leontodon</i> the nearest.
LEONTODON ...	Section <i>Apargidium</i> , 1 species.	No common section or species.	Near 40 species of sections distinct from the American.
Connexions ...	<i>Troximon</i> , 16 species North-American, with 1 South-American species, besides <i>Hypochæris</i> and <i>Taraxacum</i>.	.....	None nearer than <i>Hypochæris</i> and <i>Taraxacum</i> .
TARAXACUM ...	None besides the common species.	<i>T. officinale</i> (often colonist?).	About 5 species besides the common one, Europæo-Asiatic and Mediterranean, the common one cosmopolitan.
Connexions ...	<i>Leontodon</i>.	.....	<i>Leontodon</i> and <i>Chondrilla</i> .
LACTUCA.....	8 species North-American, of the two common sections, and 1 or 2 tropical-American.	Sections <i>Cicerbita</i> and <i>Mulgedium</i> , no common species.	About 60 species, chiefly Europæo-Asiatic and Mediterranean; the common sections chiefly Europæo-Asiatic, the Mediterranean often divergent, and a few tropical species.
Connexions ...	None nearer than <i>Prenanthes</i>.	.....	<i>Chondrilla</i> and some small genera, Europæo-Asiatic and Mediterranean. <i>Prenanthes</i> rather further.
PRENANTHES ...	10 North-American species of a distinct (?) section.	No common section or species.	About 6 Europæo-Asiatic and Mediterranean species, near to but distinct from the American section.
Connexions ...	<i>Lactuca</i> and <i>Sonchus</i> , not very near.	.....	<i>Lactuca</i> and <i>Sonchus</i> , not very near.
SONCHUS.....	None besides the common species.	<i>S. oleraceus</i> , L. (incl. <i>S. asper</i> , Hoffm.), frequent colonist.	About 24 species, Europæo-Asiatic and Mediterranean, including the common (cosmopolitan) species.
Connexions ...	None nearer than <i>Prenanthes</i>.	.....	<i>Microhynchus</i> , <i>Heterachena</i> , and <i>Picridium</i> about 27 species, chiefly Mediterranean. <i>Prenanthes</i> more distant.
SCORZONERA group.	<i>Pinaropappus</i> , <i>Lygodesmia</i> , <i>Scorzonella</i> , and <i>Stephanomeria</i> , about 20 North-west American, and <i>Picrosia</i> 1 South-American species.	No common genera.	<i>Tragopogon</i> , <i>Urospermum</i> , <i>Scorzonera</i> , <i>Epilasia</i> , and <i>Tourneuxia</i> , nearly 140 species, Europæo-Asiatic and Mediterranean.
Connexions ...	Cichoriaceæ generally.	.....	Cichoriaceæ generally.

The above Table would appear to give ample evidence of a (geologically) modern interchange of Composite vegetation. Thirty of the thirty-eight generic groups have a general range over North-eastern Asia and Northern America, and may therefore be considered as comparatively continuous. They include about four-and-twenty species absolutely identical in the two divisions;

and many others are closely represented in both, indicating a common origin in one of the two; but whether the flora, or, indeed, any individual race, has travelled eastward or westward it would be difficult to decide; the evidence is different as to different genera, and in almost any case may be explained both ways. *Eupatorium*, *Solidago*, and *Aster* (*Euaster*) are very large American genera, numerous in species throughout North America, diminishing, however, in numbers in the north-west, reduced to very few in East Asia, and dwindling down to a single one or two in West Europe. Most of the Anthemideæ and Cichoriaceæ, numerous in the Mediterranean region and West Asia, as well as *Tanacetum* and *Artemisia*, whose chief seat is, perhaps, Central Asia, all diminish eastwards, and are reduced to very few in North America, chiefly at high latitudes or along mountain-ranges. The *primâ facie* conclusion would be that the former, of American origin, had struggled to extend themselves westward with less and less of success as the distance from home increased, and the latter, of Old-World origin, had met with a similar fate in their progress eastwards. But, on the other hand, it might also be argued (perhaps, however, with less plausibility) that both had once ranged over the whole region in a small number of specific races, but that, the one set finding the west and the other the east more congenial, the circumstances more favourable to their preservation and development, they had in course of time multiplied in the one division not only in individuals but in differentiated races, whilst in the other they had more or less succumbed to adverse influences and gradually become extinct, barring the few representatives still capable of accommodating themselves to the circumstances among which they are placed. Eight or ten, however, of the generic groups enumerated have no such apparent continuity; their widely disconnected areas seem to imply an ancient very wide range, early broken up through the greater part of its extent, leaving here and there a few isolated remnants which have lasted long enough to produce endemic races at the opposite extremes, the common parent races having become extinct in their typical forms. *Adenostyles*, with one species in California and two in Central Europe, Filagineæ (*Evax*, *Filago*, and *Micropus*), with seven North-west-American and nineteen Mediterranean species, *Bellis*, with two in the southern states of North America, six in the Mediterranean region, *Werneria*, with one Abyssinian, one Himalayan, and about sixteen Andine species, *Oentaurea*, of a type unknown in Central

or Northern Asia, with one species in the United States, four or five in Chili, one in the mountains of South-east Australia, three or four in the Mediterranean region, and two in Abyssinia, would, under the theory that affinity indicates consanguinity, imply an immense and luxuriant dispersion in early times, such as we now see in *Sonchus*, *Picris*, or *Hypochaeris*, followed by an almost equally general destruction from causes as to which it seems at present vain to offer any conjecture. *Adenocaulon*, *Leontopodium*, *Cnicus*, and some sections of *Aster*, *Hyoseris*, &c. show a dispersion somewhat intermediate in character, less disjointed than the second series of genera, but of an area more broken than the first series.

Extratropical southern connexion between America and the Old World, as indicated by identical or nearly representative Species, Sections, Genera, or marked groups of Genera.

These connexions are twofold—first, between South America and South Africa, and, secondly, between South America and Australia. The two are quite distinct from each other, the former very few and remote, the latter rather marked, and all quite independent of the connexions between South Africa and Australia enumerated below at the end of the notes on Old-World distribution. Taking, first, the South-African races, we have

Table 6. *Connexions between South America and South Africa.*
(There are no species common to the two.)

Genera.	Exoptical South-American representatives.	South-African representatives.
ASTER type.....	<i>Sommerfeldtia</i> , 1 species (South-east America).	<i>Felicia</i> , 45 species:
Connexions	<i>Aster</i> (North and West America), nearer than <i>Diplostegium</i> (Andes), or <i>Chilotrachium</i> (extratropical South America).	<i>Aster</i> (Europe, North Asia, and 1 South-east African species), nearer than <i>Olearia</i> (Australia).
HOMOCHROMOUS ASTEROIDEÆ ...	<i>Hysterionica</i> , <i>Nardophyllum</i> , and <i>Lepidophyllum</i> , about 20 species.	<i>Pteronia</i> , <i>Fresenia</i> , and <i>Homochroma</i> , about 55 species.
Connexions	<i>Solidago</i> , <i>Haplopappus</i> , &c., above 150 North- and West-American species.	None except the Mascarene <i>Rochonia</i> and <i>Glycideras</i> , 3 or 4 species.
JAUMEA	2 South-American species, 1 Mexican and 1 Californian species.	1 south-east tropical species (<i>Hypericophyllum</i>), nearer to the Mexican (<i>Espejoa</i>) than to the South-east American (<i>Jaumea</i>) and North-west American species (<i>Coinogyne</i>).
Connexions	<i>Venegasia</i> and <i>Olivæa</i> , Mexican monotypes, and, through them, the whole tribe of Helenioideæ.	None except the remote one with the monotypic <i>Cadiscus</i> .
FLAVERIÆ.....	<i>Flaveria</i> , 8 species, South and West America; the nearest genus to <i>Cadiscus</i> , but not closely representative.	<i>Cadiscus</i> , 1 species.

Genera.	Extratropical South-American representatives.	South-African representatives.
FLAVERIÆ. Connexions	<i>Tagetinea</i> , near 100 species, not very closely allied.	None.
COTULÆ.....	<i>Plagiocheilus</i> , 6 species, chiefly south-western.	<i>Cotula</i> and <i>Cenia</i> , about 30 species.
Connexions	<i>Soliva</i> and <i>Abrotanella</i> , about 5 species, further ones very remote.	Gradual with the whole tribe of Anthemidæ.
CALENDULACÆ	<i>Eriachænium</i> , 1 species, Antarctic America.	<i>Oligocarpus</i> ?, 3 species.
Connexions	None.	7 genera of Calendulacæ, including 112 species, and, through them, South-African Senecionidæ on the one hand, and Arctotidæ on the other.
GERBERA type ...	<i>Chaptalia</i> , 18 species, southern and tropical.	<i>Gerbera</i> , 20 species, South- and West-African, with a few Asiatic.
Connexions	<i>Trichocline</i> , 20 species, southern and tropical, and, through them, with several other Mutisiacæ.	None very near; a marked gap between <i>Gerbera</i> and the other African and Asiatic Mutisiacæ.

Out of the above list *Felicia* and *Sommerfeldtia*, *Pteronia* and allies with *Hysterionica* and allies, *Plagiocheilus* and *Cotula*, *Chaptalia* and *Gerbera*, may be regarded as the results of the partial break-up of four great cosmopolitan or very widely spread southern or extratropical races—the *Aster* type, the *Solidago* type, the *Cotula* type, and the *Gerbera* type. But *Jaumea*, section *Hypericophyllum*, and *Cadiscus* are very singular in their geographical position. Both monotypic, they are the unique representatives in the Old World of the great American tribe of Helenioidæ. One of them, *Hypericophyllum*, is so near in structure to the South-American *Jaumea*, to the Californian *Coinogyne*, and especially to the Mexican *Espejoa*, that I have ventured to unite them generically—to which course I fear I may meet with many objectors, chiefly on account of the very great geographical discrepancy. But I may observe that a similar distribution, although rare, has been noted in other parts of the vegetable kingdom, as, for instance, in the two Scrophularineous genera *Melasma* and *Alectra*, which have each a South-African, a South-American, and a Mexican species. *Cadiscus* is less closely allied to *Flaveria* and *Porophyllum*, but is much nearer to them than to any Old-World forms. As a pendant to these two cases we have the monotypic *Eriachænium*, from the southern extremity of South America, the sole American representative of the eminently African tribe of Calendulacæ, whose connexions with other tribes are also exclusively of the Old World.

Table 7. *Connexions between South America and Australia.*

Genera.	Extratropical South-American representatives.	Australian representatives.
CENTRATHERUM	2 South-American species.	1 species identical with one of the American ones.
Connexions	<i>Oiospermum</i> , 1 species, and very numerous Vernoniaceæ.	<i>Pleurocarpæa</i> , 1 species, not very near, and no other Vernoniaceæ.
ASTER type	<i>Chiliotrichium</i> , 3 species, quite southern.	<i>Olearia</i> about 80 species, Australia and New Zealand.
Connexions	<i>Diplostephium</i> 18 Andine species, and, through them, the northern and western <i>Asters</i> .	None nearer than <i>Erigeron</i> .
ERIGERON type (for <i>Erigeron</i> itself see Table 8)	<i>Vittadinia</i> , 1 species, <i>Podocoma</i> , 5 species.	<i>Vittadinia</i> , 4 species, <i>Podocoma</i> , 1 species (none identical).
Connexions	<i>Erigeron</i> about 14 species, and, through them, with <i>Sommerfeldtia</i> and the northern and western <i>Asters</i> .	<i>Erigeron</i> , 4 species, but no other nearer than <i>Olearia</i> .
PTEROCAULON ...	6 species, mostly tropical or even northern.	7 species, only 2 Australian, the others North-Caledonian, and 1 South-Asiatic.
Connexions	Tropical, with <i>Epaltes</i> , <i>Pluchea</i> , and allies.	<i>Epaltes</i> , 2 species, but no others near.
ECLIPTA (see also Table 4).....	2 Chilean species (besides the cosmopolitan one).	1 Australian and South-east Asiatic species (besides the cosmopolitan one).
Connexions	<i>Leptocarpus</i> , 1 Chilean species, and epappose Verbesineæ generally.	None near, and very few more distant Verbesineæ.
FLAVERIA	7 American species, chiefly southern and western.	1 species closely representative of the commonest American one.
Connexions	<i>Sartwellia</i> , 1 North-west American species, and more distant with the Tagetineæ, all American.	None.
COTULÆ	<i>Plagiocheilus</i> , 6 South-American species.	<i>Cotula</i> , section <i>Leptinella</i> , 3 Australian species and of various sections, 11 New-Zealand and Australian species.
Connexions	<i>Soliva</i> , 4 South-American extratropical and tropical species.	<i>Soliva</i> , 1 species, identical with one of the South-American.
ERECHTHITES ...	<i>Abrotanella</i> , 1 Antarctic American species.	<i>Abrotanella</i> , 3 Australian and 4 New-Zealand species.
Connexions	None nearer than <i>Artemisia</i> .	None.
CENTAUREA	7 tropical or western species, 1 extending to North America.	6 Australian and New-Zealand species, 1 (colonist?) in South Asia.
Connexions	The cosmopolitan <i>Senecio</i> .	The cosmopolitan <i>Senecio</i> .
TRICHOCLINE	5 Chilean species.	1 Australian species.
Connexions	None except 1 North-American species; the numerous other species and allied genera all northern Old World.	None.
MICROSERIS	About 20 American, chiefly southern, species.	1 Australian species.
Connexions	<i>Chaptalia</i> , 18 American species, and, through them, many American Mutisiaceæ.	None.
MICROSERIS	1 American extratropical and several North-west American species.	1 Australian and New-Zealand species.
Connexions	None southern nearer than <i>Hypochaeris</i> ; in the north <i>Krigia</i> , and, through it, other Cichoriaceæ.	None except colonists.

The amphigeous races enumerated in the above Table are of a very mixed geographical character. The *Vittadinia*, *Podocoma*, *Pterocaulon*, *Eclipta*, and *Erechthites* are subtropical; and although they have no representative, except presumed colonists, in tropical Africa and Asia, and therefore did not find a place in Table 3,

yet their geographical connexions and presumable origin may be assimilated to the few genera of that Table whose Asiatic character approaches or even exceeds the American. The single species of *Centratherum*, *Flaveria*, *Soliva*, and *Trichocline*, identical with, or closely representative of, corresponding American species of essentially American genera, suggest doubts whether they are ancient (or even modern?) colonists from America or really remains of an ancient common flora. The *Chiliotrichium* and *Olearia*, the *Plagiocheilus* and *Leptinella*, the *Abrotanella* and the *Microseris*, and even the *Centaurea* form part of that general Antarctic flora which in so many orders shows a striking connexion between Australia (especially South-east Australia and Tasmania), New Zealand, and the southern extremity of South America, the *Microseris* and *Centaurea* showing in Australia the extreme end of an area extending from the northern extratropical Old World over North America down the western backbone of the New World to the extreme south, and thence to Australasia. Australia, therefore, in regard to America, would appear once to have had in the south an antarctic or mountain connexion or communication sufficient for the interchange of races, to have received in the north in ancient times, as part of the Indo-Australian region, a few tropical or subtropical American races, and in ancient, as in recent, times to have readily admitted and favoured the spread of colonists from America as well as from South Africa, and more recently from Europe.

Table 8. *Endemic Species of cosmopolitan or very widely spread Genera.*

I include under this head those genera or groups of genera which have endemic representatives both in the New and the Old World, and both in the northern and in the southern hemisphere. The numbers given are necessarily very vaguely estimated for the northern and tropical regions, and must be taken rather as relative than as absolute; those for South Africa and Australia, founded on already worked-up floras, will be found more accurate. Such cosmopolitan or widely spread species as *Gnaphalium luteoalbum*, *Erigeron linifolium*, *Pluchea indica*, *Cotula coronopifolia*, &c. are omitted, as having nearly the area of the genus, at least in their own primary division of the globe. *Senecio* has no such cosmopolitan species.

Genera and groups of genera.	Endemic Species in						
	North America, including Mexico.	Tropical South America.	Extratropical South America.	Europe and extratropical Asia.	Tropical Asia and Africa.	South Africa.	Australia.
Aster type	120	28	11	50	2	53	63
Erigeron	45	35	18	8	1	1	3
Conyza	3	4	3	2	20	8	2
Pluchea	7	5	...	1	10	...	4
Gnaphalium	18	20	18	10	12	8	6
Cotula	1	...	...	6	1	20	8
Senecio	105	265	100	160	80	190	28
Gerbera type	1	26	11	1	4	15	1
Hieracium	26	10	4	110	...	2	...

Of the above genera, *Conyza*, *Pluchea*, and, in a less degree, *Gerbera* have a rather tropical character; the others are more prevalent in temperate or mountain-regions. All, except *Cotula*, are endowed with means of dispersion which we should, *primâ facie*, qualify as ready, the pappus spreading and light in proportion to the achene; but the ready colonizers (one, two, or three to a genus) belong to three or four only (*Erigeron*, *Conyza*, *Gnaphalium*, and perhaps *Pluchea*) of the eight pappose genera, or to *Cotula*, which has no pappus. *Senecio* is remarkable for the enormous number of locally restricted species, no one of them common to any two of the above regions, and not yet satisfactorily distributed into sections at once geographical and structural. Its only colonizer, *S. vulgaris*, is not classed here amongst the ready colonists; for, as far as I can learn, although carried out into some distant lands with cultivation, it does not, like *Erigeron canadense* and others, establish itself over the country in waste and uncultivated localities. The sections or divisions of *Gnaphalium*, *Erigeron*, and *Conyza* are more marked than those of *Senecio*; but the principal ones are not geographical. *Aster*, *Cotula*, and *Gerbera* have established subordinate races, geographical as well as structural, sufficiently distinct for us to have adopted them as genera.

To the above genera might be added a few of very wide distribution, which, from Europe and northern Asia, spread round by North America and the Andes down to extratropical South America and even to Australia, such as *Centaurea*, *Hypochoeris*, *Cnicus*, &c.; but they appear to be better placed, as instances of extratropical northern connexions, in Table 5. To the same Table belongs also *Hieracium*, which I have added also to the present one on

account of the two South-African species belonging to a section more abundant in America than in the Old World, and indicating perhaps an ancient area much more extended than the present one.

2. *Separate distribution of Compositæ into Regions.*

Coming now to the consideration of the separate distribution of Compositæ in America and in the Old World, we may observe one striking difference in this respect in the two divisions of the globe with regard to the extratropical or subtropical races which form the great bulk of the order. In America the northern and southern tribes are the same, although in different proportions; and there are a considerable number of identical genera and even species in the north and in the south. In the Old World, on the contrary, two large northern tribes (Cynaroideæ and Cichoriaceæ) are absent, or very sparingly represented, in the south; whilst the southern Arctotideæ, as well as several subtribes of other tribes, are wanting in the north; and the genera common to the Mediterranean and S.-African regions (excepting cosmopolitan genera) are very few. This great difference in the two divisions of the globe may be due in a great measure to the direction of the great chain of mountains which in America, running north and south, facilitates, or has facilitated, means of intercommunication to races of the constitution of Compositæ, to which the east and west mountain-ranges, plains, and deserts of the Old World only oppose obstacles. In both divisions, omitting the comparatively few Alpine and cosmopolitan races, we have three great specially composite regions which may be at once centres of differentiation of races and areas of preservation of mixed floras, having more of the former character in the Old World and of the latter in America. The Mediterranean, the South-African, and the Australian Compositæ are respectively far more distinct than the Mexican, the Chilian, and the Brazilian, which are, moreover, further connected by what may be termed a fourth intervening region, the Andine; whilst in the Old World the only intermediate connecting-region between the north and south is a very partial one in eastern Africa. I shall now, however, enter into some further details as to each of these regions, as well as in regard to a few others less defined—that is to say, the United-States region in America, and, in the Old World, the western, or African, and eastern, or Asiatic, tropical regions. I add also to the American regions the West-Indian insular group, as being enclosed, as it were, between

North and South America, and closely connected botanically with the united continents, giving altogether six American and six Old-World regions. It must, however, be remembered that these regions have reference to Compositæ alone, and would require great modifications for orders rich in forest-trees, or in paludose or aquatic races, &c., which are, as already observed, so very rare in Compositæ. It must also be borne in mind, in making use of the two following Tables of the distribution of Compositæ in America and in the Old World respectively, that the limits of the regions are in some instances as vague as the absolute numbers of species are uncertain, owing to our insufficient acquaintance with the data on which they should be founded. Such limits as are here had in view will be specially explained in the notes which follow each of the Tables. The insular regions severally connected with the two divisions will be separately considered, and are not included in the totals given in the following Tables 9 to 12.

Table 9. *Number of Species of Compositæ in each of the American Regions.*

Genera.	Number of Species.							Genera in Old World.
	Mexican region.	United States reg.	West Indies.	Andine region.	Brazilian region.	Chilian region.	Total in America.	
VERNONIACEÆ.								
Sparganophorus	1	...	1	...	1	o. w.
Pacourina	2	1	...	2	
Heterocoma	1	...	1	
Oiospermum.....	1	...	1	
Centratherum	1	2	2	...	2	o. w.
Blanchetia.....	1	...	1	
Vanillosmopsis	7	...	7	
Albertinia	1	...	1	
Vernonia	20	8	24	32	180	12	250	o. w.
Lachnorhiza	1	...	...	...	1	
Piptocarpha	1	4	20	...	24	
Bolanosa	1	...	...	...	...	...	1	
Stilpnopappus	14	...	14	
Piptolepis	8	...	8	
Oliganthes	2	...	1	4	1	...	8	
Piptocoma	1	...	...	...	1	
Proteopsis	1	...	1	
Stokesia.....	...	1	...	...	...	...	1	
Haplostephium	2	...	2	
Lychnophora	17	...	17	
Carried forward	23	9	30	44	258	12	344	

Genera.	Number of Species.							Genera in Old World.
	Mexican region.	United States reg.	West Indies.	Andine region.	Brazilian region.	Chilian region.	Total in America.	
VERNONIACEÆ.								
Brought forward	23	9	30	44	258	12	344	
Lychnophoriopsis.....	...	...	...	...	1	...	1	
Eremanthus .....	...	...	...	...	16	...	16	
Pithecoseris .....	...	...	...	...	1	...	1	
Soaresia.....	...	...	...	...	1	...	1	
Chronopappus .....	...	...	...	...	1	...	1	
Telmatophile .....	...	...	...	...	1	...	1	
Elephantopus	2	1	3	2	9	...	9	o. w.
Rolandra .....	...	...	1	1	1	...	1	
Spiracantha .....	...	...	...	1	...	...	1	
Total Vernoniaceæ.....	25	10	34	48	289	12	376	
EUPATORIACEÆ.								
Piqueria	2	...	...	8	...	...	10	
Phania .....	...	...	3	...	...	...	3	
Decachæta	2	...	...	...	...	...	2	
Ophryosporus	1	...	...	2	2	2	7	
Helogyne .....	...	...	...	1	...	...	1	
Gymnocoronis	1	...	...	...	...	1	2	
Adenostemma	1	...	2	1	4	...	5	o. w.
Sclerolepis.....	...	1	...	...	...	...	1	
Alomia	1	...	...	...	8	...	9	
Trichocoronis	2	...	...	...	...	...	2	
Tuberostylis .....	...	...	...	1	...	...	1	
Carelia .....	...	...	...	...	1	...	1	
Aschenbornia	1	...	...	...	...	...	1	
Ageratum	9	1	2	1	6	1	16	o. w.
Schætzelia.....	1	...	...	...	...	...	1	
Stevia.....	60	...	...	20	15	5	100	
Dissothrix .....	...	...	...	...	1	...	1	
Fleischmannia	2	...	...	...	...	...	2	
Hofmeisteria	2	...	...	...	...	...	2	
Carminatia	1	...	...	...	...	...	1	
Trichogonia .....	...	...	...	1	7	...	8	
Brachyandra.....	...	...	...	...	...	1	1	
Leptoclinium .....	...	...	...	...	1	...	1	
Agrianthus .....	...	...	...	...	2	...	2	
Symphiopappus .....	...	...	...	...	6	...	6	
Eupatorium	100	24	80	100	100	30	420	o. w.
Mikania.....	15	1	6	20	30	1	60	o. w.
Kanimia .....	...	...	...	1	5	...	6	
Adenostyles	1	...	...	...	...	...	1	o. w.
Brickellia	38	1	1	...	1	...	40	
Carpochæte	3	...	...	...	...	...	3	
Kuhnia .....	...	1	...	...	...	...	1	
Liatris	1	18	...	...	...	...	18	
Trilisa .....	...	2	...	...	...	...	2	
Carphephorus	2	4	...	...	...	...	6	
Total Eupatoriaceæ	246	53	94	156	189	41	743	

Genera.	Number of Species.							Genera in Old World.
	Mexican region.	United States reg.	West Indies.	Andine region.	Brazilian region.	Chilian region.	Total in America.	
ASTEROIDEÆ.								
Gymnosperma	5	...	...	...	...	...	5	
Xanthocephalum	7	...	...	1	...	...	8	
Gutierrezia	14	1	...	...	...	6	20	
Grindelia	8	6	...	1	...	8	20	
Pentachæta	2	...	...	...	...	...	2	
Aphantochæta	1	...	...	...	...	...	1	
Steriphe .....	...	...	...	...	...	1	1	
Bradburia .....	...	1	..	...	...	...	1	
Heterotheca	5	1	...	...	...	...	5	
Chrysopsis	17	6	...	...	...	...	18	
Hysterionica.....	...	...	...	...	2	4	5	
Xanthisma	1	...	...	...	...	...	1	
Haplopappus	16	25	1	...	...	24	62	
Chrysothamnus	10	9	...	4	...	...	20	
Ericameria	4	1	...	...	...	...	4	
Solidago	7	72	3	...	1	2	80	o. w.
Brachychæta.....	...	1	...	...	...	...	1	
Lessingia	4	...	...	...	...	...	4	
Nardophyllum .....	...	...	...	1	...	5	6	
Lepidophyllum .....	...	...	...	2	...	3	5	
Chiliophyllum .....	...	...	...	...	...	1	1	
Læstadia .....	...	...	...	4	...	...	4	
Egletes	2	1	3	2	1	...	6	
Aphanostephus.....	3	...	...	...	...	...	3	
Keerlia	2	...	...	...	...	...	2	
Lagenophora .....	...	...	...	...	...	2	2	o. w.
Bellis.....	1	1	...	...	...	...	2	o. w.
Monoptilon	1	...	...	...	...	...	1	
Townsendia	3	7	...	...	...	...	8	
Distasis	2	...	...	...	...	...	2	
Chætopappa .....	...	1	...	...	...	...	1	
Psilactis	3	...	...	...	...	...	3	
Boltonia	3	4	...	...	...	...	7	o. w.
Corethrogyne	6	...	...	...	...	...	6	
Eremiastrum	1	...	...	...	...	...	1	
Sericocarpus.....	...	5	...	...	...	...	5	
Aster.....	24	88	...	6	4	7	124	o. w.
Sommerfeldtia .....	...	...	...	...	...	1	1	
Hinterhubera .....	...	...	...	3	...	...	3	
Diplostephium .....	...	...	...	18	...	...	18	
Chiliotrichium .....	...	...	...	...	...	3	3	
Podocoma.....	...	...	...	1	3	2	5	o. w.
Brachyactis .....	...	1	...	...	...	...	1	o. w.
Erigeron	15	33	11	16	5	14	84	o. w.
Vittadinia .....	...	...	...	...	...	1	1	o. w.
Conyza	6	...	2	5	3	4	11	o. w.
Parastrephia.....	...	...	...	1	...	...	1	
Baccharis	30	5	7	70	100	40	250	
Heterothalamus .....	...	...	...	2	...	3	5	
Total Asteroideæ	203	269	27	137	119	131	830	

Genera.	Number of Species.						Total in America.	Genera in Old World.
	Mexican region.	United States reg.	West Indies.	Andine region.	Brazilian region.	Chilian region.		
INULOIDEÆ.								
Stenachænium .....	...	...	...	...	3	...	3	
Pluchea.....	6	4	3	3	3	...	12	O. W.
Sachsia .....	...	...	3	...	...	...	3	
Rhodogeron .....	...	...	1	...	...	...	1	
Tessaria.....	1	...	...	4	1	1	5	
Epaltes	1	...	...	...	1	...	2	O. W.
Pterocaulon .....	...	2	2	1	4	...	6	O. W.
Evax	1	...	...	...	...	...	1	O. W.
Psilocarphus	1	1	...	...	...	1	3	
Micropus	4	...	...	...	...	...	4	O. W.
Diaperia	2	4	...	...	...	...	4	
Micropsis .....	...	...	...	...	...	1	1	
Filago	1	...	...	...	...	1	2	O. W.
Tafalla .....	...	...	...	4	...	...	4	
Mniodes .....	...	...	...	2	...	...	2	
Antennaria	2	7	...	...	...	1	9	O. W.
Luciliopsis .....	...	...	...	2	...	...	2	
Oligandra .....	...	...	...	1	1	...	2	
Chionolæna .....	...	...	...	2	2	...	4	
Leontopodium .....	...	...	...	2	...	...	2	O. W.
Anaphalis .....	...	1	...	...	...	...	1	O. W.
Chevreulia .....	...	...	...	2	2	4	7	
Facelis .....	...	...	...	1	...	2	3	
Achyrocline	1	...	...	7	4	...	10	O. W.
Gnaphalium	10	11	3	20	3	20	60	O. W.
Stenocline .....	...	...	...	...	2	...	2	Masc.
Leucopholis .....	...	...	...	...	2	...	2	
Total Inuloideæ	30	30	12	51	28	31	157	
HELIANTHOIDEÆ.								
Lagascea	7	...	1	1	1	...	7	
Heptanthus .....	...	...	2	...	...	...	2	
Pinillosia .....	...	...	3	...	...	...	3	
Tetranthus .....	...	...	2	...	...	...	2	
Elvira	1	...	1	1	1	...	1	
Lantanopsis .....	...	...	1	...	...	...	1	
Stachycephalum	1	...	...	...	...	...	1	
Milleria.....	1	...	...	1	...	...	1	
Adenocaulon.....	...	1	...	...	...	2	3	O. W.
Riencourtia .....	...	...	...	...	5	...	5	
Desmanthodium	2	...	...	...	...	...	2	
Clibadium.....	3	...	6	6	4	...	14	
Ichthyothere.....	...	...	...	3	6	...	8	
Trigonospermum	2	...	...	...	...	...	2	
Polymnia	4	2	...	6	1	...	12	
Espeletia .....	...	...	...	11	...	...	11	
Philoglossa .....	...	...	...	2	...	...	2	
Dicranocarpus	1	...	...	...	...	...	1	
Carried forward.....	22	3	16	31	18	2	78	

Genera.	Number of Species.							Genera in Old World.
	Mexican region.	United States reg.	West Indies.	Andine region.	Brazilian region.	Chilian, region.	Total in America.	
HELIANTHOIDEÆ.								
Brought forward	22	3	16	31	18	2	78	
Guardiola	4	...	...	...	...	...	4	
Baltimora	1	...	...	1	1	...	1	
Melampodium	15	...	...	4	4	...	18	O. W.
Acanthospermum.....	...	...	2	...	2	...	2	
Schizoptera .....	...	...	...	1	...	...	1	
Silphium .....	...	11	...	...	...	...	11	
Chrysogonum .....	...	1	...	...	...	...	1	O. W.
Berlandiera	5	...	...	...	...	...	5	
Lindheimera.....	1	...	...	...	...	...	1	
Engelmannia	1	...	...	...	...	...	1	
Parthenium	4	3	1	1	1	1	6	
Aiolothea.....	1	...	...	...	...	...	1	
Parthenice	1	...	...	...	...	...	1	
Iva.....	1	6	1	...	...	...	7	
Oxytænia	1	...	...	...	...	...	1	
Dicoria	1	...	...	...	...	...	1	
Cyclachæna	1	1	...	...	...	...	2	
Euphrosyne	1	...	...	...	...	...	1	
Hymenoclea	2	...	...	...	...	...	2	
Ambrosia	4	6	3	2	4	2	12	O. W.
Franseria	6	2	...	2	...	3	10	
Xanthium	1	2	1	1	1	2	4	O. W.
Podanthus .....	...	...	...	...	...	2	2	
Astemma .....	...	...	...	1	...	...	1	
Tragoceros	4	...	...	...	...	...	4	
Philactis	1	...	...	...	...	...	1	
Zinnia	12	...	...	...	...	...	12	
Sanvitalia	4	...	...	...	...	...	4	
Heliopsis	2	1	...	1	...	...	3	
Aganippea.....	2	...	...	...	...	...	2	
Monactis .....	...	...	...	2	...	...	2	
Rumfordia	1	...	...	...	...	...	1	
Siegesbeckia	1	...	...	2	...	2	2	O. W.
Stemmatella .....	...	...	...	1	...	...	1	
Jægeria	4	...	...	1	1	1	4	
Enhydra	1	...	1	1	4	...	4	O. W.
Aphanactis .....	...	...	...	2	...	...	2	
Eclipta	1	1	1	1	1	2	2	O. W.
Leptocarpha .....	...	...	...	...	...	1	1	
Selloa	1	...	...	...	...	...	1	
Axiniphyllum	2	...	...	...	...	...	2	
Abasaloa	1	...	...	...	...	...	1	
Zaluzania	7	...	...	...	...	...	7	
Sabazia	4	...	...	4	...	...	8	
Varilla	2	...	...	...	...	...	2	
Gymnoloma	12	1	...	2	2	...	16	
Sclerocarpus.....	6	1	...	4	1	...	10	O. W.
Montanoa	11	...	...	3	...	...	14	
Carried forward.....	152	39	26	68	40	18	280	

Genera.	Number of Species.							Genera in Old World.
	Mexican region.	United States reg.	West Indies.	Andine region.	Brazilian region.	Chilian region.	Total in America.	
HELIANTHOIDEÆ.								
Brought forward	152	39	26	68	40	18	280	
Isocarpa	1	...	2	3	...	...	5	
Rudbeckia.....	2	23	...	...	...	...	25	
Chromolepis.....	1	...	...	...	...	...	1	
Balsamorhiza	3	9	...	...	...	...	10	
Tetragonotheca.....	...	3	...	...	...	...	3	
Wulffia .....	...	...	2	2	6	...	8	
Mirasolia	2	...	...	...	...	...	2	
Iostephane	2	...	...	...	...	...	2	
Borrichia	1	1	1	1	...	...	2	
Pascalía.....	...	...	...	...	...	1	1	
Blainvillea	1	...	...	1	3	...	4	o. w.
Wedelia.....	1	...	8	10	17	...	30	o. w.
Eleutheranthera .....	...	...	1	1	1	...	1	
Aspilia	2	...	...	2	26	1	28	o. w.
Zexmenia	16	1	2	4	3	1	25	
Oyedaca.....	2	...	...	9	11	...	22	
Wyethia	2	2	...	...	...	...	4	
Tithonia	5	...	1	...	...	...	5	
Viguiera	18	1	1	16	24	1	60	
Helianthus	10	32	...	10	...	2	52	
Dimerostemma.....	...	...	...	...	1	...	1	
Perymenium.....	8	...	...	2	...	...	10	
Melanthera	3	1	3	2	2	...	6	o. w.
Encelia	15	1	...	2	...	3	20	
Helianthella.....	2	4	...	...	...	...	6	
Actinomeris	3	6	...	...	...	...	9	
Verbesina	27	3	5	18	9	2	50	
Otopappus .....	...	...	...	1	...	...	1	
Podachænum	1	...	...	...	...	...	1	
Spilanthes.....	5	2	4	5	7	4	20	o. w.
Salmea	5	...	8	1	...	...	12	
Salmeopsis .....	...	...	...	...	1	...	1	
Hymenostephium	1	...	...	1	...	...	2	
Chænocephalus .....	...	...	1	...	...	...	1	
Garcilassa .....	...	...	...	1	...	...	1	
Synedrella.....	...	...	1	2	1	...	2	o. w.
Trichospira .....	...	...	1	...	1	...	1	
Heterospermum	2	...	...	...	3	...	5	
Coreocarpus	2	...	...	...	...	...	2	
Coreopsis	10	27	...	6	...	...	40	o. w.
Dahlia	5	...	...	...	...	...	5	
Hidalgoa	2	...	...	1	...	...	2	
Thelesperma	3	2	...	...	...	1	5	
Cosmos	9	1	2	2	1	...	10	
Bidens	16	7	5	20	12	3	45	o. w.
Narvalina .....	...	...	1	...	...	...	1	
Isostigma .....	...	...	...	...	5	...	5	
Chrysanthellum	1	1	1	1	1	2	2	o. w.
Carried forward.....	341	166	76	192	175	39	836	

Genera.	Number of Species.							Genera in Old World.
	Mexican region.	United States reg.	West Indies.	Andine region.	Brazilian region.	Chilian region.	Total in America.	
HELIANTHOIDEÆ.								
Brought forward	341	166	76	192	175	39	836	
Galinsoga	2	...	1	4	1	1	5	
Calea	14	...	1	18	30	...	60	
Balduina .....	...	2	...	...	...	...	2	
Marshallia .....	...	3	...	...	...	...	3	
Blepharipappus .....	...	1	...	...	...	...	1	
Tridax	5	...	1	3	...	...	7	
Madia	8	2	...	...	...	1	8	
Hemizonia	25	...	...	...	...	...	25	
Lagophylla	3	...	...	...	...	...	3	
Layia	12	1	...	...	...	...	12	
Achyraena	1	...	...	...	...	...	1	
Total Helianthoideæ.....	411	175	79	217	206	41	963	
HELENIOIDEÆ.								
Cacosmia .....	...	...	...	3	...	...	3	
Geissopappus .....	...	...	...	...	2	...	2	
Jaumea	3	...	...	...	...	1	4	O. W.
Venegasia	1	...	...	...	...	...	1	
Olivæa	1	...	...	...	...	...	1	
Rosilla	1	...	...	...	...	...	1	
Laphamia	12	...	...	...	...	...	12	
Perityle	2	...	...	...	...	...	2	
Oxypappus	1	...	...	...	...	...	1	
Burrielia	2	...	...	...	...	...	2	
Bæria	5	...	...	...	...	...	5	
Actinolepis	6	...	...	...	...	...	6	
Whitneya	2	...	...	...	...	...	2	
Lasthenia	2	...	...	...	...	1	3	
Monolopia	2	...	...	...	...	...	2	
Hecubæa	1	...	...	...	...	...	1	
Riddellia	3	1	...	...	...	...	3	
Hulsea	6	...	...	...	...	...	6	
Chænactis	11	3	...	...	...	...	12	
Hymenopappus	1	6	...	...	...	...	7	
Syntrichopappus	1	...	...	...	...	...	1	
Bahia	16	4	...	...	...	1	20	
Schkuhria	6	...	...	3	...	2	8	
Hymenothrix	2	...	...	...	...	...	2	
Amauria	1	...	...	...	...	...	1	
Closia .....	...	...	...	...	...	5	5	
Blennosperma	1	...	...	...	...	1	2	
Villanova	2	2	...	...	...	...	4	
Florestina	2	...	...	...	...	...	2	
Palafoxia	2	4	...	...	...	...	6	
Rigiopappus	1	1	...	...	...	...	1	
Pericome	2	...	...	...	...	...	2	
Galeana	1	...	...	...	...	...	1	
Carried forward	99	21	...	6	2	11	131	

Genera.	Number of Species.							Genera in Old World.
	Mexican region.	United States reg.	West Indies.	Andine region.	Brazilian region.	Chilian region.	Total in America.	
HELENIOIDEÆ.								
Brought forward	99	21	...	6	2	11	131	
Amblyopappus .....	...	...	...	...	...	1	1	
Thymopsis .....	...	...	1	...	...	...	1	
Microspermum	1	...	...	...	...	...	1	
Sartwellia	1	...	...	...	...	...	1	
Flaveria	4	1	3	1	1	1	6	o. w.
Porophyllum	10	...	1	3	6	1	15	
Lescaillea .....	...	...	1	...	...	...	1	
Adenophyllum	3	...	...	...	...	...	3	
Nicolettia	2	...	...	...	...	...	2	
Dysodia	10	2	1	...	...	...	10	
Syncephalanthus	1	...	...	...	...	...	1	
Schizotrichia .....	...	...	...	1	...	...	1	
Hymenatherum	14	...	...	...	...	1	14	
Thymophylla	3	...	...	...	...	...	3	
Adenopappus	1	...	...	...	...	...	1	
Tagetes	14	...	...	10	4	...	20	
Chrysactinia	1	...	...	...	...	...	1	
Pectis	16	...	8	10	10	...	40	
Clappia	2	...	...	...	...	...	2	
Cephalophora .....	...	...	...	1	...	4	5	
Helenium	9	12	...	...	...	...	18	
Gaillardia	2	6	...	...	...	2	8	
Actinella	2	9	...	...	...	...	10	
Hymenoxys	2	...	...	...	...	2	4	
Trichoptilium	3	...	...	...	...	...	3	
Psathyrotes	1	...	...	...	...	...	1	
Total Helenioideæ.....	201	51	15	32	23	23	304	
ANTHEMIDEÆ.								
Achillea	1	3	...	...	...	...	3	o. w.
Leucampyx	1	...	...	...	...	...	1	
Baileya	3	...	...	...	...	...	3	
Chrysanthemum .....	...	2	...	...	...	...	2	o. w.
Matricaria .....	...	2	...	...	...	...	2	o. w.
Cotula	2	...	...	1	...	...	3	o. w.
Centipeda .....	...	...	...	...	...	1	1	o. w.
Plagiocheilus .....	...	...	...	5	...	1	6	
Soliva	1	...	...	2	2	3	4	o. w.
Abrotanella .....	...	...	...	...	...	1	1	o. w.
Tanacetum	1	5	...	...	...	...	5	o. w.
Artemisia	3	30	...	...	...	3	32	o. w.
Total Anthemideæ.....	12	42	...	8	2	9	63	
SENECIONIDEÆ.								
Liabum	6	...	3	32	...	1	40	
Allendea	1	...	...	...	...	...	1	
Carried forward.....	7	...	3	32	...	1	41	

Genera.	Number of Species.							Genera in Old World.
	Mexican region.	United States reg.	West Indies.	Andine region.	Brazilian region.	Chilian region.	Total in America.	
SENECIONIDÆ.								
Brought forward	7	...	3	32	...	1	41	
Schistocarpha	3	...	...	2	...	...	5	
Neurolæna .....	...	...	1	1	...	...	2	
Peucephalum	1	...	...	...	...	...	1	
Luina.....	...	1	...	...	...	...	1	
Petasites .....	...	4	...	...	...	...	4	O. W.
Arnica .....	...	7	...	...	...	...	7	O. W.
Crocidium.....	...	1	...	...	...	...	1	
Bartlettia	1	...	...	...	...	...	1	
Haploesthes	1	...	...	...	...	...	1	
Raillardella	2	...	...	...	...	...	2	
Melalema .....	...	...	...	...	...	1	1	
Erechthites	3	1	1	4	4	...	7	O. W.
Culcitium .....	...	...	...	13	...	1	14	
Senecio	80	38	10	130	25	100	380	O. W.
Gynoxys.....	...	...	...	12	...	...	12	
Tetradymia	3	2	...	...	...	...	4	
Werneria	1	...	...	17	...	...	18	O. W.
Total Senecionideæ.....	102	54	15	211	29	103	502	
CALENDULACEÆ.								
Eriachænium .....	...	...	...	...	...	1	1	
CYNAROIDEÆ.								
Cnicus	20	15	...	...	...	...	35	O. W.
Saussurea .....	...	1	...	...	...	...	1	O. W.
Centaurea .....	...	1	...	...	...	5	6	O. W.
Total Cynaroideæ	20	17	...	...	...	5	42	
MUTISIACEÆ.								
Schlechtendahlia .....	...	...	...	...	1	...	1	
Barnadesia .....	...	...	...	9	1	...	10	
Chionopappus .....	...	...	...	1	...	...	1	
Mutisia .....	...	...	...	18	3	15	36	
Hyalis .....	...	...	...	1	...	4	4	
Plazia.....	...	...	...	3	...	...	3	
Gypothamnium .....	...	...	...	...	...	1	1	
Onoseris .....	...	...	...	10	1	1	12	
Urmenetea .....	...	...	...	...	...	1	1	
Chuquiragua .....	...	...	...	6	15	12	33	
Doniophyton.....	...	...	...	...	...	1	1	
Wunderlichia .....	...	...	...	...	1	...	1	
Gochnatia .....	...	...	1	1	3	3	11	
Moquinia	1	...	...	...	11	...	12	
Cyclolepis .....	...	...	...	...	...	1	1	
Seris .....	...	...	...	...	2	...	2	
Stiffia .....	...	...	...	...	5	...	5	
Carried forward	1	...	1	49	43	39	135	

Genera.	Number of Species.							Genera in Old World.
	Mexican region.	United States reg.	West Indies.	Andine region.	Brazilian region.	Chilian region.	Total in America.	
MUTISIACEÆ.								
Brought forward	1	...	1	49	43	39	135	
Anastraphia .....	...	...	4	...	...	...	4	
Pachylæna .....	...	...	...	...	...	1	1	
Lycoseris .....	...	...	...	10	...	...	10	
Brachyclados .....	...	...	...	...	...	1	1	
Chætanthera .....	...	...	...	1	...	25	26	
Trichocline .....	...	...	...	2	12	8	20	o. w.
Chaptalia	2	1	6	10	3	2	18	
Macrachænum .....	...	...	...	...	...	1	1	
Leucæria .....	...	...	...	2	...	23	25	
Oxyphyllum .....	...	...	...	...	...	1	1	
Polyachyrus .....	...	...	...	1	...	6	7	
Proustia	1	...	...	2	...	5	7	
Perezia	12	...	...	10	2	22	46	
Leunisia .....	...	...	...	...	...	1	1	
Trixis	6	...	1	6	18	3	30	
Jungia .....	...	...	...	9	2	1	12	
Nassauvia .....	...	...	...	...	...	25	25	
Triptilion .....	...	...	...	...	...	6	6	
Moscharia .....	...	...	...	...	...	1	1	
Pamphalea .....	...	...	...	...	...	5	5	
Cephalopappus .....	...	...	...	...	1	...	1	
Total Mutisiacæ	22	1	12	102	81	176	383	
CICHORIACEÆ.								
Microseris	9	2	...	...	...	1	11	o. w.
Krigia .....	...	4	...	...	...	...	4	
Phalacroseris	1	...	...	...	...	...	1	
Apogon .....	...	1	...	...	...	...	1	
Picris	1	1	...	...	...	...	1	o. w.
Crepis	1	6	...	...	...	...	6	o. w.
Hieracium	16	12	...	10	2	4	40	o. w.
Malacothrix	9	1	...	...	...	...	9	
Anisocoma	1	...	...	...	...	...	1	
Hypochoeris .....	...	...	...	9	3	15	25	o. w.
Leontodon .....	...	1	...	...	...	...	1	o. w.
Troximon	2	10	...	...	...	6	16	
Taraxacum .....	...	1	...	...	...	1	1	o. w.
Pyrrhopappus	1	2	...	...	...	...	2	
Calycoseris	2	...	...	...	...	...	2	
Glyptopleurum	1	...	...	...	...	...	1	
Lactuca	1	8	2	1	...	...	10	o. w.
Prenanthes .....	...	10	...	...	...	...	10	o. w.
Sonchus	1	1	1	...	...	1	1	o. w.
Pinaropappus	1	...	...	...	...	...	1	
Lygodesmia .....	...	5	...	...	...	...	5	
Picrosia .....	...	...	...	...	...	1	1	
Scorzonella	3	2	...	...	...	...	3	
Stephanomeria	6	4	...	...	...	...	8	
Total Cichoriacæ	56	71	3	20	5	29	161	

Table 10. Summary of American distribution as compared with the Old World.

Tribes.	Regions.												Total in America.	Total in Old World.		Common to the two divisions.		
	Mexican.		United States.		West Indies.		Andine.		Brazilian.		Chilian.			G.	Sp.	G.	Sp.	
G.	Sp.	G.	Sp.	G.	Sp.	G.	Sp.	G.	Sp.	G.	Sp.	G.	Sp.					G.	Sp.	G.	Sp.
Vernoniaceæ ...	4	25	3	10	9	34	8	47	24	290	1	12	29	376	14	156	4	3
Eupatoriaceæ ...	21	246	9	53	6	94	11	156	15	189	7	41	35	743	5	16	5	3
Asteroideæ	29	203	20	269	6	27	16	137	8	119	19	131	49	830	44	444	10	8
Inuloideæ.....	11	32	7	31	5	12	13	51	12	28	8	31	27	157	118	950	11	11
Helianthoidæ	90	411	38	175	36	79	57	217	39	206	23	41	125	963	22	77	18	10
Helenioidæ ...	51	201	12	51	6	15	8	32	5	23	13	23	59	304	3	3	2	...
Anthemideæ ...	7	12	5	42	...	...	3	8	1	2	5	9	11	63	41	608	9	15
Senecionideæ ...	11	102	7	54	4	15	8	211	2	29	4	103	19	502	24	687	5	6
Calendulaceæ ...	...	.....	...	....	...	...	...	....	...	....	1	1	1	1	7	102	...	...
Arctotideæ .....	...	.....	...	....	...	...	...	....	...	....	...	....	...	....	17	237	...	...
Cynaroidæ.....	1	20	3	17	...	...	...	....	...	....	1	5	3	42	37	972	3	1
Mutisiaceæ	5	22	1	1	4	12	18	81	16	101	27	176	38	383	15	60	1	...
Cichoriaceæ ...	16	56	17	71	2	3	3	20	2	5	7	29	24	161	40	610	10	5
Total	246	1330	122	774	78	291	145	980	124	972	116	602	420	4525	387	4922	78	62

NOTES.

1. Mexican Region.

I propose the name of Mexican region for a tract of country with a very remarkable Composite character, extending along the great north and south chains of American mountains, and chiefly on its western declivities, from California to Central America, including the greater portion of both. I am unable at present to give it any more definite limits. I have no doubt that materials from which a general line could be drawn might be extracted from the numerous Boundary Surveys of the United-States Expeditions; but that would be a labour which we could only hope to see achieved within a reasonable time by Americans themselves. It is chiefly from a general estimate of the recorded areas of the species we possess, that I would exclude to the north the Oregon territory and northern Rocky Mountains, as characterized by the Asteroid Gnaphaloid Artemisioid and other mountain-races connecting North-American with Asiatic Composites; and to the west the greater part of Texas, as showing, in their Rudbeckioid Helianthoid and other races the characters of the United States rather than of the Mexican region. In the intermediate Salt-Lake region, the limits between the western and eastern Composite floras would seem, by Mr. Serene Watson's 'Introduction to the Nevada and Utah Flora,' to lie in the Washoe Mountains of Western Nevada. To the south, the Compositæ of the *tierra fria*

and *tierra templada*, at least of Central America, are decidedly Mexican in character; whilst the hot moist southern provinces show a much greater proportion of Columbian races and would therefore fall into the Andine region; the transition, however, from the one to the other is here evidently gradual and complicated.

It is possible, when better known, that this region may be subdivided into two or more, for there are many genera peculiar either to the northern or to the southern districts; but at present the whole appear to maintain the same general character. The more distinct of the monotypic genera are often confined to limited areas as well in the north as in the south, and those which contain several species either range over the whole area, or the northern and southern species blend very much together; and in the superficial sketch which alone I am able now to give I feel compelled to regard the whole as a single region.

The first peculiarity that strikes one in glancing down the Mexican columns of the above lists is the great diversity of forms shown by the large number of genera, both absolute and in proportion to the species, as compared with most other regions. Those of the Mexican region are about 100 more than in either of the other three most varied regions (246 against 143 in the Andine, 145 in the Mediterranean, and 149 in the South-African regions). Nearly half of these Mexican genera are endemic, with an average of about three species to a genus, and one half of these are quite monotypic—several of them with but few connexions, although not so many perhaps absolutely isolated as in some of the Old-World or insular regions. If we deduct the larger genera which have their chief seat without the region, *Vernonia*, *Eupatorium*, *Aster*, *Senecio*, and *Cnicus*, the average number of species in the whole region is about four to the genus, and even with the addition of the above five it is not much above five to the genus; whilst in the adjoining United-States and Andine regions it is above six, and in the Old World, in the corresponding Mediterranean region, the average is more than thirteen species to a genus. The larger genera of a specially Mexican type which have flourished and established a large number of species and varieties are *Stevia*, also abundant in the Andes, *Brickellia*, scarcely extending beyond the region except in a single tropical species, the homochromous Asteroideæ, some of them repeated in the south, and the *Madiæ* and *Tagetineæ*, almost endemic.

The characteristic tribes of the Mexican region are, in the first place, the Helianthoideæ, Helenioideæ, and homochromous Asteroideæ; and, secondly, the Eupatoriaceæ, the former including most of the small endemic genera which mark the region as a great centre of preservation of ancient forms, the latter exhibiting the genera which appear to be now in the greatest degree of prosperity. In the remaining Asteroideæ, Vernoniaceæ, Gnaphalioid Inuloideæ, and even Senecionideæ the endemic genera are few, and those which have numerous endemic species are still richer in the more southern Andine region; the Cichoriaceæ are below those of the adjoining United-States region, although considerably more numerous than those of the adjoining Andine, and even of the more congenial, though distant, Chilean region; the few Mutisiaceæ are the outlying representatives of a South-American and eminently Chilean tribe. A few Old-World, and especially European and Mediterranean, races are here represented more strongly than in the intermediate United States, or in some cases to their exclusion. *Adenostyles californica* is intermediate, as it were, between the two European species. *Leucampyx* is a close representative of the European *Anthemis*; *Baileya* is also nearer to some Old-World *Chrysanthema* than to any American genus; and the Old-World *Cnicus* has more numerous and much more marked Mexican than United-States species.

It is probable that many additions will be made to the Composite flora of the Mexican region by future explorations, and more especially in well-marked endemic monotypes, which, from the severe struggle they have sustained, are generally confined in small numbers to limited localities. The above-mentioned *Leucampyx*, so remarkable in its European connexions, is one of the most recent discoveries, and only reached me, in fact, at the moment when these notes are undergoing the last revision for press.

2. United-States Region.

Under this name I would, so far as Compositæ are concerned, include the whole of North America east and north of the Mexican region. It is true that this may be a combination of two floras of separate origin which may appear at first to be very distinct, the Rocky-Mountain British-Columbian and Canadian flora connected with the Asiatic, and the more strictly American flora characterized in Compositæ by such genera as *Helianthus*, *Coreopsis*, *Rudbeckia*, *Solidago*, *Liatris*, &c.; but the two are so

blended together that, with the data now at my command, I have been unable to separate them; and both present some general features which may justify the considering the two regions, for the present purpose, as one.

The United-States region presents in its endemic, or almost endemic, genera a great contrast to the Mexican; the strictly endemic genera, indeed, which do not cross into Mexico or California are but very few; but above thirty are almost confined to the region; and if we include in them the *Euaster* section of *Aster*, *Solidago*, and *Helianthus*, which, with *Rudbeckia*, *Liatris*, *Silphium*, *Helenium*, &c., are so characteristic of the region, we have an average of twelve or thirteen species, instead of about four, to a genus. The averages are brought much nearer together if we take into account the representatives of the genera belonging chiefly to other regions; for whilst the Mexican region has a very large number of the southern genera *Vernonia*, *Eupatorium*, &c., the United States have but few species either of specially Mexican or southern genera or of those which belong to the northern regions of the Old World. The general average of species to a genus is thus brought to a little above six (774 species in 122 genera) in the United-States region, against a little over five (1330 species in 246 genera) in the Mexican. This remarkable development of the endemic genera in the United States, compared with the paucity of their species in the Mexican region, may be taken as evidence of the prosperity of progressive races in the former, whilst the Mexican region affords greater protection for the preservation of expiring races.

There are, however, two or three of the United-States monotypes as remarkable in their isolation or distant connexions as any of the Mexican genera. *Stokesia* and *Sclerolepis* have no immediate affinities, the former being intermediate, as it were, between the otherwise distant tribes of Vernoniaceæ and Cichoriaceæ; and *Sclerolepis*, although technically placed among Eupatoriaceæ, differs in habit and foliage from all other Compositæ. *Chryso-gonum* is also remarkable from its connexion with the tropical-Asiatic *Moonia*, so close as to force us to unite them in one genus. The other endemic or prevailing genera belong to American tribes subtribes or genera, but with a greater proportion than in any other American region of the Old-World Anthemideæ Cynaroideæ and Cichoriaceæ; whilst the South-American Mutisiaceæ are only represented by a single widely spread species, and the Old-

World southern Cotuleæ Calendulaceæ and Arctotideæ are wholly absent.

It is probable that some modifications in the above relative numbers may ensue from a rectification of the limits now so vaguely assigned to the Mexican and United-States Composite regions; but the flora of the latter has now been so generally investigated that the future discoveries of endemic monotypes are likely to be but very few in proportion to those we may expect from Mexico and California.

3. *West-Indian Region.*

Although the West Indies in their Compositæ show a generally close connexion with the continent of Central and Southern America, yet they are sufficiently separated to exhibit many of the characteristics of insular floras, and to require treating as a separate region. Among the larger islands, Cuba shows more of the character of the Mexican, Jamaica of the Andine, Trinidad of the North-east Brazilian or Guiana region, Porto Rico and San Domingo, which, as far as known, may be considered an extension of the Cuban chain, have as yet been but very imperfectly explored. The connexion of any of the islands with the opposite coast of North America appears in Compositæ to be confined to a few maritime species or to such as have a very wide American range.

Among the characteristic genera of the West Indies may be reckoned *Salmea*, which out of twelve species has eight West-Indian and four Columbian or Mexican, *Neurolæna*, with one West-Indian and one Columbian species, and *Borrichia*, which from the islands extends round the coasts north, south, and west. Each of the larger islands has also its monotypic or small endemic genera, ten in Cuba, *Lachnorhiza*, *Phania*, *Sachsia*, *Rhodogeron*, *Heptanthus*, *Pinillosia*, *Lantanopsis*, *Thymopsis*, *Lescaillea*, and *Anastraphia*, averaging two species each, one in Jamaica, the monotype *Chænocephalus*, and three in San Domingo, *Piptocoma*, *Narvalina*, and *Tetranthus*, the former two monotypic, the latter of two species. These islands partake also of some of the generally dispersed large South- and Central-American genera. Cuba, for instance, has twelve species of *Vernonia*, twenty-four of *Eupatorium*, twelve of *Mikania*, and five or six each of a few others; and in Grisebach's Flora of the British West Indies (slightly modified to reduce the genera to the standard we have adopted) are included twelve species of

Vernonia, thirty-one of *Eupatorium*, ten of *Mikania*, and six or seven each of a few others ; but the number of Mexican or South-American genera represented in the islands by single or only by two or three species is sufficient to give, as a general average, not quite three to a genus in Cuba, and rather more than three in the British Islands ; or if the whole of the islands, as far as known, are taken into account, the average is brought up nearly to four species to a genus.

The endemic genera of the islands consist generally of herbaceous and often small species ; where shrubby they belong to groups which are elsewhere shrubby, and the species of genera common to other countries are not more shrubby than their continental congeners. *Narvalina*, however, may be exceptionally regarded as a shrubby representative of the herbaceous genus *Bidens*. There is no tendency to the arborescent forms of the more isolated islands of the Pacific and Atlantic Oceans. The mountainous islands of Cuba and San Domingo have more the character of detached fragments of a continental mountain-chain which have preserved the remains of a very varied flora, than of really isolated islands that have through a long course of ages modified such races as may have been casually brought to them under former physical conditions.

4. *Andine Region.*

The Andine or west tropical region of South America is but vaguely defined for our present purpose. It is a mountain-tract, connected in the north with the Mexican, to the east with the Brazilian, and to the south with the Chilian region, including generally the Columbian, Ecuadorian, Peruvian, and Bolivian States ; but the bordering districts on each frontier are among those of which the vegetation is, perhaps, the least known to us, thus depriving us of the data necessary for determining not only what are the precise limits of the region, but even whether any such can be assigned. The statistics of its Compositæ are thus, as yet, very uncertain. With a marked general character, it contains also numerous species of the great and widely diffused American genera *Vernonia*, *Eupatorium*, *Stevia*, *Mikania*, and *Baccharis*, as well as of the cosmopolitan *Senecio*. Its own genera are connected sometimes with the Mexican ones to the north, sometimes with the Chilian ones to the south, or with the Brazilian to the east ; and some of those common to Mexico and

Chili run also along the western declivity of these intermediate Andes. All numbers given in the preceding Tables are in this case, therefore, particularly uncertain, notwithstanding the valuable data supplied by Weddell's 'Chloris Andina.' Accurate as his details are, he followed for the limits of his region chiefly altitude, which affects what Grisebach terms plant-forms and species, rather than genera or other races more indicative of origin, which are mostly very different in the Chilian and Columbian Andes.

In comparing the Compositæ of this region with those of the adjoining Chilian, Brazilian, and especially the Mexican region, a striking peculiarity is the small number of endemic monotypes. They do not exceed ten; and not more than half a dozen endemic genera of two or three species could be added. The physical conditions are not adapted for the preservation of isolated races of varied idiosyncracies; they are too generally uniform to afford the necessary protection against luxuriant races which can freely range over large districts. As in the temperate and mountain regions of the north, this comparative uniformity of physical conditions has given at once a wide range to species and a large average of species to the characteristic genera. These comparatively uniform conditions are also evidently such as to favour the development of Compositæ; and, moreover, the region itself is probably one which was very early inhabited by the order. The total number now known, very nearly the same as that of the Brazilian region, far exceeds that of any other American one except the Mexican. A few of the endemic or nearly endemic genera (such as *Astemma*, some of the Mutisiaceæ, &c.) may be supposed to bear evidences of great antiquity; others appear to be in the height of prosperity and luxuriance; and the region exhibits more arborescent Compositæ than any other, except insular ones.

Among the characteristic tribes of the Andine region the heterochromous Asteroideæ, the Senecionideæ, and Eupatoriaceæ, which take a second place in the Mexican region, may be here placed in the first rank on a par with the Helianthoideæ; the Mexican Helenioideæ and homochromous Asteroideæ are reduced to very few species; and the only endemic races of any higher value are a small Andine section of *Chrysothamnus** (four species), *Cacosmia* (three species), which is almost as near to *Calea* as to its technical cotribuals, and *Schizotrichia*, a single species as yet, perhaps, imperfectly known. Vernoniaceæ, rather more numerous than in

* Since this paper has been in the printer's hands it has been pointed out to me by Asa Gray that De Candolle's name *Bigelovia* has the right of priority for this genus.

the Mexican, are still far below those of the Brazilian region; the Gnaphalioid Inuloideæ, generally mountain plants, are rather more at home than in either. Mutisiaceæ, characteristic of the Chilian region and very rare in the Mexican, have several large and flourishing genera endemic, or, at any rate, with their chief seat, in the Andine region. The Old-World orders partially represented both in the north and south are reduced in the intermediate Andes to fewer numbers than in any American region except the Brazilian: such as are to be met with (*Cotuleæ*, *Hieracium*, *Hypochaeris*) may be regarded as remnants of those ancient migrations from north to south or from south to north to which I shall allude under Table 10, these remnants having alone survived the altered physical conditions so as to establish a few subordinate endemic races.

Future discoveries may probably add much to the Compositæ of the Andine region, the eastern valleys of the great mountain-range being, as yet, but little explored; but these additions we must expect rather to consist of new species to the prevailing genera, than of such new forms, especially monotypes, as the three adjoining regions may be more likely to supply.

5. *Brazilian Region.*

The Brazilian or east tropical region of South-American Compositæ is that vast tract of country extending from the eastern declivity of the Andes to the Atlantic, southward to the Rio Grande do Sul, and northward to the valley of the Orenoco. It might be supposed to be naturally divided into two, the northern or Guiana and the southern or true Brazilian region, separated by the broad forest-valley or plain of the Amazon, so poor in Compositæ; but, as far as known, the Compositæ peculiar to the mountains east of the Orenoco are generally of a Brazilian type, or, at least, rather Brazilian than Andine; and the few that are characteristic of the low moist valleys of the great rivers spread over too wide an area and are too much interwoven with the others to be made use of for the distinction of separate districts. The statistics of the order in the whole region, however, are as yet more unsettled even than those of the Andine region. This portion of the Brazilian flora is now being worked up, and, when completed, will no doubt give many corrections to the numbers given in the above Table, which are necessarily often little more than conjectural, founded on a hasty turning over of specimens and reference to publications.

We have here, again, as in the Mexican region, a large proportion of endemic monotypes or small genera; but the larger wide-spread American genera, especially *Vernonia*, *Eupatorium*, *Mikania*, and *Baccharis*, are so copiously represented, and some of the characteristic ones so rich in species, that the total average of the region is above seven to the genus, at least one more than in the Andine and two more than in the Mexican. Notwithstanding the large extent of the forest-plains above mentioned, almost as unfavourable for the development and preservation of Composite races as those of east tropical Asia, the physical conditions of the hilly districts appear to be suited both for the preservation of expiring types in limited stations and for the luxurious development of others in the prime of life.

The greater number of the monotypic or small endemic genera of the region belong to the southern portion, the campos and sierras of the Upper Rio San Francisco, and thence to Mattogrosso and Chiquitos, separating the great valleys or plains of the Amazon and the Parana. It is there also that are to be found the most remarkable forms, unrepresented in any other part of America, the *Lychnophoræ*, *Schlechtendahlia*, *Wunderlichia*, &c., the two latter having no very near connexions anywhere. A few, such as *Pacourina*, *Sparganophorus*, *Riencourtia*, *Trichospira*, &c., belong more specially to the northern or intermediate portion, but extend more or less into Brazil proper, and some of them have crossed over into tropical Africa; others, again, like *Stiffia*, belong to both north and south divisions, with endemic species of limited areas in each.

As characteristic tribes of the region, Vernoniaceæ undoubtedly take the first rank in the number of species, both in relation to the total Compositæ of the region (nearly one third) and in relation to the total number of the tribe in America (more than three fourths, including eighteen endemic genera). Helianthoideæ, mostly of the subtribe Verbesineæ, are also dominant, Eupatoriaceæ rather more numerous than in the Andine region, and Mutisiaceæ about the same, several of the latter having their chief seat or being quite endemic in Brazil. Senecionideæ, especially the genus *Senecio*, and Helenioideæ are fewer than in any other American continental region; so also Asteroideæ, with the exception of *Baccharis* and the Gnaphalioid Inuloideæ. The Old-World orders have but very few species or are quite unrepresented.

Additions to the Composite flora of the region are chiefly to be expected from Mattogrosso and other western districts, and per-

haps from the Upper Rio San Francisco, and possibly a few from the unexplored regions of Guiana bordering on Venezuela; but the collections of Schomburgk, Spruce, and others from Guiana and North Brazil have hitherto shown fewer remarkable Compositæ than of several other orders.

6. *Chilian Region.*

The Chilian or extratropical South-American region of Compositæ comprises the whole of that continent south of the Andine and Brazilian ones. It is in some degree a mixed region: the elevated ridge partakes of the general Andine character as to its Compositæ; the extreme south might perhaps be separated as a portion of a general Antarctic region; and many of the strictly Chilian genera, confined to the Cordilleras, do not reach the plains of Buenos Ayres to the east. Yet, on the whole, it is a general area of preservation of Composite races sufficiently distinct from the Andine and Brazilian, which immediately border it on the north, to be regarded as one general region—the more so, as in its repetitions or representations of distant northern races the eastern districts take their proportionate share with the western ones. The flora of Chili proper is perhaps better known than that of Brazil or the Andes; but still there is a large tract of country in the interior, especially where it borders on Bolivia, as well as the provinces of Tucuman and others of La Plata, in regard to which the data are too scattered to enable us to judge readily to which region they should be referred. The Atacama plants described by Philippi evidently belong to the Chilian, and are included under that head in the preceding Table.

The small or monotypic endemic genera, about as numerous as the Brazilian ones, bear a much greater proportion to the total number of Compositæ in the region, although they are still considerably fewer than in the Mexican region. The large American genera *Vernonia*, *Eupatorium*, and *Baccharis* have much fewer representatives than within the tropics, and *Mikania* has but a single species, a deficiency partly compensated by a greater specific luxuriance in *Senecio* and some specially Chilian genera; and the average of species to a genus is brought to a little above five, the same as in the Mexican region. Extratropical South America appears to have afforded physical conditions favourable at once for the preservation of locally limited types, either the remnants of very ancient introductions or differentiated in the region itself,

and for the development and differentiation of numerous species in a considerable number of genera.

Among the characteristic tribes Mutisiaceæ evidently come first. This is the sole region in which they are dominant, and so much so as to form nearly one third of the total number of its Compositæ, and to include nearly one half of the whole number of American species of the tribe, fifteen of the twenty-seven genera of the region being almost or quite absolutely endemic. Asteroideæ, especially the homochromous genera corresponding to the Mexican ones, besides *Baccharis* and *Erigeron*, the Gnaphalioid Inuloideæ and Eupatoriaceæ are fairly represented; the more tropical or northern Helianthoideæ and Vernoniaceæ are but very few; Helenioideæ are also few, but more in proportion than in the tropical regions. The European Cichoriaceæ and Anthemideæ also reappear; and even Cynaroideæ and Calendulaceæ are amongst the evidently ancient inhabitants, the former represented by five endemic species of the specially Mediterranean genus *Centaurea*, the latter by an endemic monotype of an otherwise African and Mediterranean tribe.

7. *Connexions between distant American Regions.*

Under this head we can only refer to north and south; for although there is a great difference between the Compositæ of the east and west coasts, both in North and in South America, the regions are continuous; there is no special eastern centre or area of preservation separated by a broad interval from the great western ridge, which might render the appearance of the same genera in both a noteworthy circumstance. The eastern genera, except a few local and monotypic, either extend to the western limits of the region or penetrate continuously into the western region; some of the western genera send a few species into or all over the eastern region, but do not reappear abruptly after a broad interval. But the case is very different with respect to north and south. A considerable number of genera and even some species are established in extratropical North and South America, completely separated by a long tropical interval. The physical or other conditions which have in ancient or modern times admitted of the gradual extension of certain Composite races from east to west or from west to east have not been interrupted by the interposition of impassable barriers; whilst any such continuity between north and south is in the present geological period absolutely broken by

the intervention of tropical ungenial regions, far too wide to be crossed by the ordinary gradual progress of plant-races. The reappearance of identical races, generic or specific, in the north and south can therefore only be attributed either to a preexistence of different physical or other extraneous conditions allowing of gradual migrations, or to ancient colonizations through channels which now appear no longer to exist.

These remarks may be illustrated by the following list of genera, identical or representative, in extratropical North and South America, without any, or rarely with only a single, species in the intermediate tropical regions:—

Genera.	Species in extratropical		Genera.	Species in extratropical	
	North Amer.	South Amer.		North Amer.	South Amer.
Gymnocoronis	1	1	Madia	8	1
Gutierrezia	14	6	Jaumea	3	1
Grindelia	8	8	Lasthenia	2	1
{ Chrysopsis	17		Bahia	19	1
{ Hysterionica .....	...	5	Blennosperma.....	1	1
Haplopappus	38	26	{ Villanova.....	4	
Solidago	80	2	{ Closia .....	...	5
{ Ericameria	4		Hymenatherum	14	1
{ Nardophyllum }		8	Gaillardia	6	2
{ Lepidophyllum }	...		Hymenoxys.....	2	2
Filagineæ	9	3	Artemisia	30	3
Antennaria	8	1	Centaurea	1	5
Adenocaulon	1	2	Microseris	10	1
Franseria.....	6	3	Troximon	10	6
Encelia	15	3	{ Scorzonella	3	
Thelesperma	4	1	{ Picrosia .....	...	1

Table 11. *Number of Species of Compositæ in each of the Old-World Regions.*

Genera.	Number of Species.						Genera in America.	
	Mediterranean region.	Europæo-Asiatic region.	Tropical-African region.	Tropical-Asiatic region.	South-African region.	Australian region.		Total in Old World.
VERNONIACEÆ.								
Sparganophorus .....	...	...	1	...	...	...	1	Amer.
Ethulia .....	...	...	1	2	...	...	2	
Erlangea .....	...	...	1	...	...	...	1	Amer.
Gutenbergia .....	...	...	5	...	...	...	5	
Centratherum .....	...	...	1	4	...	1	5	Amer.
Lamprachænium .....	...	...	...	1	...	...	1	
Bothriocline .....	...	...	1	...	...	...	1	Amer.
Adenoon .....	...	...	...	1	...	...	1	
Pleurocarpæa .....	...	...	...	...	...	1	1	Amer.
Vernonia .....	...	...	70	46	15	1	125	
Hoplophyllum .....	...	...	...	...	2	...	2	Amer.
Herderia .....	...	...	2	...	...	...	2	
Corymbium .....	...	...	...	...	7	...	7	Amer.
Elephantopus .....	...	...	2	1	...	1	2	
Total Vernoniaceæ.....	...	...	84	55	24	4	156	
EUPATORIACEÆ.								
Adenostemma .....	...	...	1	1	1	1	1	Amer.
Ageratum .....	...	...	1	1	1	1	1	Amer.
Eupatorium	2	5	1	5	...	...	10	Amer.
Mikania .....	...	...	1	1	1	...	1	Amer.
Adenostyles	2	3	...	...	...	...	3	Amer.
Total Eupatoriaceæ.....	4	8	4	8	3	2	16	
ASTEROIDEÆ.								
Solidago.....	1	1	...	...	...	...	1	Amer.
Homochroma .....	...	...	...	...	1	...	1	
Fresenia.....	...	...	...	...	3	...	3	Amer.
Pteronia.....	...	...	...	...	51	...	51	
Microtrichia .....	...	...	1	...	...	...	1	Amer.
Dicrocephala.....	1	...	3	4	...	...	5	
Cyathocline .....	...	...	1	2	...	...	2	Amer.
Grangea.....	...	...	2	1	...	...	2	
Ceruana	1	...	1	...	...	...	1	Amer.
Myriactis	1	...	1	5	...	...	5	
Rhynchospermum .....	...	...	...	1	...	...	1	Amer.
Lagenophora .....	...	...	...	2	...	4	5	
Garuleum .....	...	...	...	...	3	...	3	Amer.
Steirodiscus .....	...	...	...	...	2	...	2	
Brachycome .....	...	...	...	...	1	36	37	
Carried forward.....	4	1	9	15	61	40	120	

Genera.	Number of Species.							Genera in America.
	Mediterranean region.	Europæo-Asiatic region.	Tropical-African region.	Tropical-Asiatic region.	South-African region.	Australian region.	Total in Old World.	
ASTEROIDEÆ.								
Brought forward	4	1	9	15	61	40	120	
Bellis	6	1	...	...	...	...	6	Amer.
Bellium	3	...	...	...	...	...	3	
Amellus .....	...	...	...	...	8	...	8	
Gymnostephus .....	...	...	...	...	6	...	6	
Charieis .....	...	...	...	...	1	...	1	
Mairia .....	...	...	...	...	10	...	10	
Minuria .....	...	...	...	...	...	5	5	
Calotis .....	...	...	...	...	...	15	15	
Heteropappus .....	...	5	...	...	...	...	5	
Boltonia.....	...	5	...	1	...	...	5	Amer.
Callistephus .....	...	1	...	...	...	...	1	
Aster	8	48	...	...	1	...	50	Amer.
Felicia .....	...	...	2	...	43	...	45	
Olearia .....	...	...	...	...	...	63	63	
Celmisia.....	...	...	...	...	...	1	1	
Podocoma .....	...	...	...	...	...	1	1	Amer.
Lachnophyllum.....	1	1	...	...	...	...	2	
Brachyactis	2	4	...	...	...	...	6	Amer.
Erigeron	5	9	2	3	1	4	15	Amer.
Vittadinia .....	...	...	...	...	...	4	4	Amer.
Microglossa .....	...	...	3	4	...	...	6	
Nidorella .....	...	...	2	...	14	...	15	
Conyza	4	...	14	7	9	2	32	Amer.
Psiadia .....	...	...	2	...	1	...	3	
Adelostigma .....	...	...	2	...	...	...	2	
Thespis .....	...	...	...	1	...	...	1	
Heteromma .....	...	...	...	...	1	...	1	
Chrysocoma .....	...	...	...	...	8	...	8	
Nolletia	1	...	...	...	3	...	4	
Total Asteroideæ	34	75	36	31	167	135	444	
INULOIDEÆ.								
Brachylæna .....	...	...	...	...	6	...	6	
Tarchonanthus .....	...	...	...	...	3	...	3	
Blumea	1	...	3	48	4	7	55	
Laggera .....	...	...	9	3	...	...	10	
Pluchea .....	...	1	4	6	...	6	16	Amer.
Pterigeron .....	...	...	...	...	...	7	7	
Thespidium .....	...	...	...	...	...	1	1	
Coleocoma .....	...	...	...	...	...	1	1	
Nanothamnus .....	...	...	...	1	...	...	1	
Denekia .....	...	...	1	...	2	...	2	
Epaltes .....	...	1	3	1	2	2	8	Amer.
Sphæranthus	1	...	4	3	...	2	8	
Carried forward.....	2	2	24	62	17	26	118	

Genera.	Number of Species.							Genera in America.
	Mediterranean region.	Europæo-Asiatic region.	Tropical-African region.	Tropical-Asiatic region.	South-African region.	Australian region.	Total in Old World.	
INULOIDEÆ.								
Brought forward	2	2	24	62	17	26	118	
Pterocaulon .....	...	...	...	2	...	5	5	Amer.
Blepharispermum .....	...	...	1	2	...	...	3	
Athroisma .....	...	...	...	1	...	...	1	
Symphyllocarpus .....	...	1	...	...	...	...	1	
Evax	9	...	...	...	...	...	9	Amer.
Micropus	3	1	...	...	...	...	3	Amer.
Filago	7	7	...	...	...	...	7	Amer.
Ifloga	1	...	...	1	7	...	8	
Stuartina .....	...	...	...	...	...	1	1	
Amphidoxa .....	...	...	...	...	1	...	1	
Chiliocephalum.....	...	...	1	...	...	...	1	
Antennaria.....	1	4	...	...	...	1	5	Amer.
Leontopodium .....	...	3	...	...	...	...	3	Amer.
Anaphalis .....	...	13	...	12	...	...	25	Amer.
Pterygopappus .....	...	...	...	...	...	1	1	
Lasiopogon	1	...	...	...	1	...	2	
Phagnalon	9	1	1	...	...	...	9	
Achyrocline .....	...	...	6	...	...	...	6	Amer.
Gnaphalium	8	6	10	6	10	8	30	Amer.
Raoulia .....	...	...	...	...	...	2	2	
Leptorhynchus .....	...	...	...	...	...	8	8	
Waitzia .....	...	...	...	...	...	6	6	
Helipterum .....	...	...	...	...	12	30	42	
Helichrysum	30	3	23	2	137	52	235	
Leontonyx .....	...	...	...	...	5	...	5	
Pachyrhynchus .....	...	...	...	...	1	...	1	
Cassinia .....	...	...	...	...	1	13	14	
Phænocoma .....	...	...	...	...	1	...	1	
Schœnia .....	...	...	...	...	...	1	1	
Anaxeton .....	...	...	...	...	7	...	7	
Petalacte .....	...	...	...	...	1	...	1	
Ixiolæna.....	...	...	...	...	...	5	5	
Podotheca .....	...	...	...	...	...	5	5	
Millotia .....	...	...	...	...	...	2	2	
Quinetia .....	...	...	...	...	...	1	1	
Rutidosis .....	...	...	...	...	...	7	7	
Ammobium .....	...	...	...	...	...	2	2	
Scyphocoronis .....	...	...	...	...	...	1	1	
Toxanthus .....	...	...	...	...	...	2	2	
Eriochlamys .....	...	...	...	...	...	1	1	
Humea .....	...	...	...	...	...	4	4	
Acomis .....	...	...	...	...	...	2	2	
Pithocarpa.....	...	...	...	...	...	1	1	
Ixodia.....	...	...	...	...	...	1	1	
Cæsulia .....	...	...	...	1	...	...	1	
Carried forward.....	71	41	66	89	201	188	597	

Genera.	Number of Species.							Genera in America.
	Mediterranean region.	Europæo-Asiatic region.	Tropical-African region.	Tropical-Asiatic region.	South-African region.	Australian region.	Total in Old World.	
INULOIDEÆ.								
Brought forward	71	41	66	89	201	188	597	
Myriocephalus .....	...	...	...	...	...	8	8	
Angianthus .....	...	...	...	...	...	22	22	
Gnephosis .....	...	...	...	...	...	12	12	
Calocephalus .....	...	...	...	...	...	10	10	
Cephalipterum .....	...	...	...	...	...	1	1	
Gnaphalodes .....	...	...	...	...	...	3	3	
Eriosphæra .....	...	...	...	...	1	...	1	
Craspedia .....	...	...	...	...	...	4	4	
Chthonocephalus .....	...	...	...	...	...	3	3	
Perotriche .....	...	...	...	...	1	...	1	
Stœbe .....	...	...	...	...	19	...	19	
Disparago .....	...	...	...	...	5	...	5	
Elytropappus .....	...	...	...	...	6	...	6	
Pterothrix .....	...	...	...	...	3	...	3	
Amphiglossa .....	...	...	...	...	3	...	3	
Bryomorphe .....	...	...	...	...	1	...	1	
Metalasia .....	...	...	...	...	20	...	20	
Lachnospermum .....	...	...	...	...	1	...	1	
Nestlera .....	...	...	...	...	10	...	10	
Anaglypha .....	...	...	...	...	2	...	2	
Relhania .....	...	...	...	...	18	...	18	
Rosenia .....	...	...	...	...	1	...	1	
Leyssera	1	...	...	...	3	...	4	
Macowania .....	...	...	...	...	1	...	1	
Podolepis .....	...	...	...	...	...	12	12	
Heterolepis .....	...	...	...	...	3	...	3	
Athrixia .....	...	...	2	...	6	5	13	
Antithrixia .....	...	...	2	...	1	...	3	
Arrowsmithia .....	...	...	...	...	1	...	1	
Codonocephalum	1	...	...	...	...	...	1	
Inula	24	28	6	5	...	...	52	
Homochæta .....	...	...	...	...	1	...	1	
Bojeria .....	...	...	...	...	1	...	1	
Minurothamnus .....	...	...	...	...	1	...	1	
Cypselodontia .....	...	...	...	...	1	...	1	
Grantia	4	...	...	...	...	...	4	
Jasonia	2	...	...	...	...	...	2	
Printzia .....	...	...	...	...	5	...	5	
Iphiona	8	1	1	...	3	...	13	
Pegolettia .....	...	...	1	...	2	...	3	
Vicoa	4	...	1	1	...	...	6	
Calostephane .....	...	...	1	...	...	...	1	
Pulicaria	16	2	4	4	1	...	22	
Porphyrostemma .....	...	...	1	...	...	...	1	
Amblyocarpum	1	...	...	...	...	...	1	
Carried forward	132	72	85	99	322	268	903	

Genera.	Number of Species.							Genera in America.
	Mediterranean region.	Europæo-Asiatic region.	Tropical-African region.	Tropical-Asiatic region.	South-African region.	Australian region.	Total in Old World.	
INULOIDEÆ.								
Brought forward	132	72	85	99	322	268	903	
Carpesium	1	5	...	1	...	...	5	
Geigeria.....	2	...	...	...	8	...	10	
Gymnarrhena	1	...	...	...	...	...	1	
Rhanterium	2	...	...	...	...	...	2	
Anvillea	2	...	...	...	...	...	2	
Ondetia .....	...	...	...	...	1	...	1	
Buphthalmum	4	3	...	...	...	...	4	
Callilepis .....	...	...	...	...	2	...	2	
Anisopappus .....	...	...	2	1	...	...	2	
Odontospermum	5	...	...	...	...	...	5	
Pallenis	1	...	...	...	...	...	1	
Chrysophthalmum	3	...	...	...	...	...	3	
Osmites .....	...	...	...	...	6	...	6	
Osmitopsis.. ..	...	...	...	...	1	...	1	
Nablonium.....	...	...	...	...	...	1	1	
Oligodora .....	...	...	...	...	1	...	1	
Total Inuloideæ	153	80	87	101	341	269	950	
HELIANTHOIDEÆ.								
Adenocaulon .....	...	2	...	...	...	...	2	Amer.
Melampodium .....	...	...	...	2	...	...	2	Amer.
Chrysogonum .....	...	...	...	2	...	3	5	Amer.
Ambrosia	2	...	2	1	...	...	2	Amer.
Xanthium	2	...	2	1	...	...	2	Amer.
Siegesbeckia	1	1	1	1	1	1	1	Amer.
Enhydra.....	...	...	1	1	...	...	2	Amer.
Eclipta .....	...	...	1	1	1	2	2	Amer.
Sclerocarpus .....	...	...	1	1	...	...	1	Amer.
Blainvillea.....	...	...	2	1	...	...	2	Amer.
Wedelia .....	...	...	4	6	1	6	14	Amer.
Aspilia .....	...	...	8	...	...	...	8	Amer.
Melanthera .....	...	...	2	...	1	...	2	Amer.
Spilanthes .....	...	...	3	4	1	2	5	Amer.
Guizotia.....	...	...	3	1	...	...	3	
Synedrella .....	...	...	1	1	...	...	1	Amer.
Glossocardia .....	...	...	...	1	...	...	1	
Microlecanne .....	...	...	1	...	...	...	1	
Coreopsis .....	...	...	8	1	...	...	9	Amer.
Bidens	3	2	5	2	1	3	7	Amer.
Glossogyne.....	...	...	...	2	...	3	4	
Chrysanthellum .....	...	...	1	1	...	...	1	Amer.
Total Helianthoideæ	8	5	46	30	6	20	77	

Genera.	Number of Species.						Genera in America.	
	Mediterranean region.	Europæo-Asiatic region.	Tropical-African region.	Tropical-Asiatic region.	South-African region.	Australian region.		Total in Old World.
HELENIOIDÆ.								
Jaumea .....	...	...	1	...	...	...	1	Amer.
Flaveria .....	...	...	...	...	...	1	1	Amer.
Cadiscus.....	...	...	...	...	1	...	1	
Total Helenioideæ .....	...	...	1	...	1	1	3	
ANTHEMIDÆ.								
Eriocephalus .....	...	...	...	...	17	...	17	
Laiospermum .....	...	...	...	...	4	...	4	
Athanasia .....	...	...	...	...	40	...	40	
Lonas	1	...	...	...	...	...	1	
Œdera .....	...	...	...	...	4	...	4	
Eumorphia .....	...	...	...	...	1	...	1	
Mecomiscus	1	...	...	...	...	...	1	
Anacyclus	10	...	...	...	...	...	10	
Achillea	60	25	...	...	...	...	75	Amer.
Santolina	8	...	...	...	...	...	8	
Diotis	1	1	...	...	...	...	1	
Anthemis	75	10	2	...	...	...	80	
Cladanthus	1	...	...	...	...	...	1	
Lepidostephium.....	...	...	...	...	1	...	1	
Phymaspermum .....	...	...	...	...	4	...	4	
Lidbeckia .....	...	...	...	...	2	...	2	
Thamnophyllum .....	...	...	...	...	2	...	2	
Cancerinia .....	...	1	...	...	...	...	1	
Allardia .....	...	5	...	...	...	...	5	
Chrysanthemum	62	30	...	2	4	...	96	Amer.
Matricaria	12	3	...	...	11	...	20	Amer.
Nananthea.....	1	...	...	...	...	...	1	
Otochlamys .....	...	...	...	...	1	...	1	
Cotula	7	1	2	1	22	9	36	Amer.
Cenia .....	...	...	...	...	8	...	8	
Centipeda .....	...	...	...	...	2	2	3	
Soliva .....	...	...	...	...	...	1	1	Amer.
Abrotanella .....	...	...	...	...	...	3	3	Amer.
Ceratogyne.....	...	...	...	...	...	1	1	
Elachanthus .....	...	...	...	...	...	1	1	
Isoetopsis .....	...	...	...	...	...	1	1	
Peyrousea .....	...	...	...	...	1	...	1	
Schistostephium .....	...	...	...	...	6	...	6	
Marasmodes .....	...	...	...	...	3	...	3	
Stilpnophytum .....	...	...	...	...	2	...	2	
Asæmia .....	...	...	...	...	1	...	1	
Pentzia .....	...	...	...	...	10	...	10	
Tanacetum.....	16	15	...	...	...	...	30	Amer.
Hippia .....	...	...	...	...	4	...	4	
Carried forward	255	91	4	3	150	18	487	

Genera.	Number of Species.							Genera in America.
	Mediterranean region.	Europæo-Asiatic region.	Tropical-African region.	Tropical-Asiatic region.	South-African region.	Australian region.	Total in Old World.	
ANTHEMIDEÆ.								
Brought forward	255	91	4	3	150	18	487	Amer.
Crossostephium.....	...	1	...	...	...	...	1
Artemisia	95	30	2	2	1	...	120	
Total Anthemideæ	350	122	6	5	151	18	608	
SENECIONIDEÆ.								
Gongrothamnus	2	2	Amer.
Tussilago	1	1	...	...	...	...	1
Petasites.....	2	7	...	...	...	...	8
Homogyne.....	...	3	3	Amer.
Cremanthodium .....	...	5	...	...	...	...	5
Alciope .....	...	...	...	...	2	...	2
Arnica	1	1	1	Amer.
Doronicum	5	8	10	Amer.
Lopholæna .....	...	...	...	...	2	...	2
Erechthites .....	...	...	...	...	...	6	6
Stilpnogyne	1	...	1	Amer.
Gynura .....	...	4	3	14	...	1	20
Cineraria .....	...	...	3	...	22	...	25
Emilia	1	5	...	1	5	Amer.
Notonia .....	...	...	...	2	...	...	2
Senecio	90	110	40	40	190	28	460	
Bedfordia	2	2	Amer.
Othonnopsis	3	...	...	...	5	...	8
Werneria .....	...	1	1	...	...	...	2
Oligothrrix	1	...	1	Amer.
Echinops .....	...	...	1	...	26	...	27
Gamolepis .....	...	...	...	...	12	...	12
Gymnodiscus.....	2	...	2	Amer.
Othonna.....	...	...	...	...	80	...	80
Total Senecionideæ	102	140	51	61	343	38	687	
CALENDULACEÆ.								
Ruckeria	2	...	2	Amer.
Dimorphotheca .....	...	...	...	...	20	...	20
Calendula	10	1	...	...	...	...	10
Dipterocome	1	1	Amer.
Oligocarpus .....	...	...	...	...	3	...	3
Tripteris .....	...	...	1	...	27	...	28
Osteospermum	38	...	38	Amer.
Total Calendulaceæ	11	1	1	...	90	...	102	

Genera.	Number of Species.						Genera in America.	
	Mediterranean region.	Europæo-Asiatic region.	Tropical-African region.	Tropical-Asiatic region.	South-African region.	Australian region.		Total in Old World.
ARCTOTIDEÆ.								
Ursinia .....	...	...	1	...	54	...	54	
Landtia .....	...	...	2	...	2	...	4	
Haplocarpha .....	...	...	1	...	4	...	4	
Cymbonotus .....	...	...	...	...	...	1	1	
Arctotheca .....	...	...	...	...	1	...	1	
Cryptostemma .....	...	...	...	...	3	...	3	
Arctotis .....	...	...	1	...	30	...	31	
Venidium .....	...	...	...	...	18	...	18	
Gorteria.....	...	...	...	...	4	...	4	
Gazania .....	...	...	...	...	24	...	24	
Hirpicium .....	...	...	...	...	2	...	2	
Cullumia .....	...	...	...	...	14	...	14	
Berkheya .....	...	...	1	...	69	...	70	
Stephanocoma .....	...	...	...	...	1	...	1	
Didelta .....	...	...	...	...	3	...	3	
Gundelia	1	...	...	...	...	...	1	
Platycarpha .....	...	...	...	...	2	...	2	
Total Arctotideæ	1	...	6	...	231	1	237	
CYNAROIDEÆ.								
Echinops	60	12	4	1	...	...	70	
Acantholepis	2	...	...	...	...	...	2	
Cardopatum	2	...	...	...	...	...	2	
Xeranthemum	5	...	...	...	...	...	5	
Chardinia	1	...	...	...	...	...	1	
Siebera	1	...	...	...	...	...	1	
Amphoricarpus.....	1	...	...	...	...	...	1	
Carlina	10	5	...	...	...	...	12	
Atractylis	12	2	...	...	...	...	14	
Thevenotia.....	2	...	...	...	...	...	2	
Arctium.....	2	1	...	...	...	...	2	
Cousinia	128	4?	...	...	...	...	130	
Carduus	46	26	2	...	...	...	60	
Cnicus	100	40	4	2	...	...	130	Amer.
Onopordon	12	1	...	...	...	...	12	
Cynara	6	...	...	...	...	...	6	
Silybum	1	1	...	...	...	...	1	
Galactites	3	...	...	...	...	...	3	
Tyrimnus	1	...	...	...	...	...	1	
Stæhelina	6	...	...	...	...	...	6	
Kœchlia	1	...	...	...	...	...	1	
Saussurea .....	...	75	...	1	...	1	75	Amer.
Goniocaulon .....	...	...	...	1	...	...	1	
Jurinea	31	19	...	...	...	...	40	
Berardia .....	...	1	...	...	...	...	1	
Carried forward	433	187	10	5	...	1	579	

Genera.	Number of Species.							Genera in America:
	Mediterranean region.	Europæo-Asiatic region.	Tropical-African region.	Tropical-Asiatic region.	South-African region.	Australian region.	Total in Old World.	
CYNAROIDEÆ.								
Brought forward	433	187	10	5	...	1	579	Amer.
Warionia	1	...	...	...	...	...	1
Myopordon	1	...	...	...	...	...	1
Serratula	18	15	...	...	...	...	30
Tricholepis	1	2	...	6	...	...	7
Crupina	2	...	...	...	...	...	2
Volutarella	5	...	...	...	...	...	5
Zoegea	2	...	...	...	...	...	2
Leuzea	2	...	...	...	...	...	2
Centaurea	295	34	6	2	...	1	310	
Carbenia	1	...	...	...	...	...	1
Carthamus.....	18	...	...	...	...	...	18
Carduncellus	14	...	...	...	...	...	14
Total Cynaroideæ	793	238	16	13	...	2	972	
MUTISIACEÆ.								
Pleiotaxis	1	1	Amer.
Erythrocephalum.....	...	...	3	...	...	...	3
Phyllactinia .....	...	...	1	...	...	...	1
Leucomeris .....	...	...	...	1	...	...	1
Dicoma .....	...	...	2	1	11	...	13
Hochstetteria.....	1	...	1	...	...	...	1
Anisochaeta .....	...	...	...	...	1	...	1
Ainsliæa.....	...	8	...	3	...	...	10
Pertya .....	...	2	...	...	...	...	2
Macroclinidium .....	...	1	...	...	...	...	1
Myripnois .....	...	1	...	...	...	...	1
Catamixis .....	...	...	...	1	...	...	1
Oldenburgia .....	...	...	...	...	3	...	3
Trichocline .....	...	...	...	...	...	1	1
Gerbera .....	...	1	1	4	15	...	20
Total Mutisiaceæ	1	13	9	10	30	1	60	
CICHORIACEÆ.								
Scolymus	3	3	Amer.
Catananche	5	...	...	...	...	...	5
Hymenonema	1	...	...	...	...	...	1
Hænseleria	1	...	...	...	...	...	1
Cichorium	2	1	...	...	...	...	2
Microseris .....	...	...	...	...	...	1	1
Arnosoris	1	1	...	...	...	...	1
Hyoseris	4	1	...	...	...	...	4
Tolpis	15	...	...	...	...	...	15
Hispidella	1	...	...	...	...	...	1
Lapsana	4	2	...	...	...	...	4
Carried forward	37	5	...	...	...	1	38

Genera.	Number of Species.						Genera in America.	
	Mediterranean region.	Europæo-Asiatic region.	Tropical-African region.	Tropical-Asiatic region.	South-African region.	Australian region.		Total in Old World.
CICHORIACEÆ.								
Brought forward	37	5	...	...	...	1	38	
Kœlpinia	1	...	...	...	...	...	1	
Rhagadiolus	5	1	...	...	...	...	5	
Heteracia	2	...	...	...	...	...	2	
Acanthocephalus	1	1	...	...	...	...	2	
Zacintha	1	...	...	...	...	...	1	
Rodigia	1	...	...	...	...	...	1	
Phalacroderis	1	...	...	...	...	...	1	
Picris.....	22	3	...	...	1	1	22	Amer.
Crepis	60	35	...	...	1	1	90	Amer.
Phæcasium	3	1	...	...	...	...	3	
Pterotheca	5	...	...	...	...	...	5	
Hieracium	60	70	...	...	2	...	110	Amer.
Andryala	6	...	...	...	...	...	6	
Hypochoëris	8	5	...	...	1	1	10	Amer.
Leontodon	35	10	...	...	...	...	40	Amer.
Taraxacum	6	2	...	...	1	1	6	Amer.
Chondrilla	6	10	...	...	...	...	15	
Lactuca	30	30	5	8	2	...	60	Amer.
Heterachæna .....	...	...	1	...	...	...	1	
Prenanthes	2	4	...	...	...	...	6	Amer.
Picridium	6	...	...	...	...	...	6	
Dianthoseris .....	...	...	1	...	...	...	1	
Sonchus	18	4	2	1	4	1	24	Amer.
Microrhynchus	18	...	1	3	1	...	20	
Tragopogon	25	8	...	...	...	...	30	
Urospermum	2	...	...	...	...	...	2	
Scorzonera.....	96	8	...	...	...	...	100	
Epilasia	1	1	...	...	...	...	1	
Tourneuxia	1	...	...	...	...	...	1	
Total Cichoriaceæ.....	459	198	10	12	13	6	610	

Table 12. *Summary of Old-World distribution as compared with American.*

Tribes.	Regions.												Total in Old World.	Total in America.		Common to the two divisions.		
	Mediterranean.		Europæo-Asiatic.		Tropical African.		Tropical Asiatic.		South-African.		Austrian.			G.	Sp.	G.	Sp.	
Vernoniaceæ ...	...	...	...	...	9	84	6	55	3	24	4	4	14	156	29	376	4	3
Eupatoriaceæ ...	2	4	2	8	4	4	4	8	3	3	2	2	5	16	35	743	5	3
Asteroideæ	12	34	9	75	13	36	11	31	19	167	10	135	44	444	49	830	10	8
Inuloideæ	29	155	16	82	22	87	19	101	51	341	43	269	118	950	27	157	11	11
Helianthoideæ..	4	8	3	5	17	46	18	30	6	6	7	20	22	77	125	963	18	10
Helenioideæ ...	...	...	...	...	1	1	...	...	1	1	1	1	3	3	59	304	2	...
Anthemideæ ...	15	350	11	122	3	6	3	5	23	151	7	18	41	608	11	63	9	15
Senecionideæ...	6	102	9	140	7	51	4	61	11	343	5	38	24	687	19	502	5	6
Calendulaceæ...	2	11	1	1	1	1	...	...	5	90	...	...	7	102	1	1	...	...
Arctotideæ	1	1	...	...	5	6	...	...	15	231	1	1	17	237	...	...	...	...
Cynaroideæ.....	34	793	15	238	4	16	6	13	...	...	2	2	37	972	3	42	3	1
Mutisiaceæ	1	1	5	13	6	9	5	10	4	30	1	1	15	60	38	383	1	...
Cichoriaceæ ..	37	459	20	198	5	10	3	12	8	13	6	6	40	610	24	161	10	5
Total	143	1918	91	882	97	357	79	326	149	1400	89	497	387	4922	420	4525	78	62

NOTES.

1. *Mediterranean Region.*

The Mediterranean or, as it might perhaps be more accurately designated, the Mediterraneo-Persian region, must, so far as Compositæ are concerned, be taken in a rather wider sense than that assigned to it by Grisebach; for the whole of Boissier's 'Flora Orientalis' is so strongly impressed with the Mediterranean type as to be inseparable from it in a general view. The region would thus comprise the three great South-European peninsulas up to the southern declivities of the Pyrenees the Cevennes the Alps and the Balkan, Asia Minor and the Levant generally, including Persia and Afghanistan, although with eastern limits at present somewhat vague; whilst the southern boundary would lie along the tropical or subtropical little-known mostly desert lands of Arabia and Africa to the Atlas, extending westward in some respects even to the Canary Islands, although on the present occasion their Compositæ are not included in the preceding Table as requiring separate consideration from their insular character. It might be thought, perhaps, that this vast region ought to have been divided; and there certainly are differences between many of the Composite races of the east and the west. There is, for instance, no *Cousinia* west of Boissier's flora, no *Tolpis* or *Calendula* in Persia; but in general the genera of the two extremities are so blended together, so many of the smaller ones with species of limited areas are

represented both in west Mediterranean Africa and in Persia, there are so many evidences of ancient continuity and interchange of races, that I have been unable to suggest any division useful for our present purpose.

The flora of the greater part of this region has now been very fairly investigated; or, at least, copious materials for working it out have accumulated in our herbaria; but much remains to be done before they can be made properly available for geographical purposes, before any real accuracy can be given to the figures given in the preceding Table. It has often been a matter of great uncertainty to me as to which of the species are so far limited to the southern declivities of the great east-and-west chains of mountains as to belong to the Mediterranean, not to the Euro-pæo-Asiatic, region, or how far a few mountain species which extend into the higher ranges of the three peninsulas should or should not be included in the Mediterranean flora. The stations given in the floras of Spain, Italy, and the Caucasus will require to be much more carefully tabulated than I have had time to do it. Boissier's most valuable Oriental Flora has not yet reached the Compositæ; and even when that is done, there will still remain the Turkish peninsula and a great portion of Mediterranean Africa, of which the Composite statistics are very vague. So local also are many of the most marked species and genera that we may still expect that a considerable number have been overlooked in the southern and eastern districts, though, probably, the additions will not be so large as in the case of the Mexican region.

This Mediterranean region, however, is undoubtedly by far the richest in Compositæ of all those into which I have divided the area of the order. It surpasses the South-African by 500, the Mexican by 600, species, and contains nearly two fifths of the whole number of Old-World Compositæ. It may not be so diversified as either of the two just mentioned; for the genera, about the same in number as the South-African, are not much more than half those of the Mexican region, and more of the thirteen tribes are scarcely or not at all represented; but a large proportion of the genera (about half) are endemic, and about half of these are almost or quite monotypic. On the other hand, so large is the number of species of some endemic or prevailing genera, such as *Cousinia*, *Centaurea*, &c., that the general average is brought up to full fourteen to a genus, or much higher than in any other region.

Although the diversity exhibited, as tested by the number of genera both absolute and proportional, may thus be far below that of the Mexican region, yet the Mediterranean in other respects, owing, probably, to its extraordinarily broken physical conditions, shows quite as much the preservation or development of distinct forms in restricted localities as that or any other of our regions. The above-mentioned genus *Cousinia* is the most remarkable instance in the order of a large number of species confined to a comparatively small area; the whole 130 are limited to the Asiatic portion of the region. This far surpasses any single one of the numerous instances of large Composite genera of very limited areas exhibited by the South-African region. At the same time such monotypes as *Gymnarrhena*, *Rhanterium*, *Dipterocome*, *Gundelia*, *Warionia*, *Hochstetteria*, *Hymenonema*, *Hænseleria*, *Acanthocephalus*, *Tourneuxia*, and a few oligotypes, are almost, if not quite, as widely distinct from their cotribuals as any South-African or Mexican monotypes. The Mediterranean region can thus bring forward evidences at once of the great present luxuriance of its Composite races, as well as of the great antiquity of several of them.

Of the monotypic or other genera of very limited areas, the majority are Oriental, chiefly Persian; but *Hænseleria* and *Hispidella* are Spanish; *Rhanterium*, *Mecomiscus*, *Warionia*, and *Tourneuxia* are Algerine; *Grantia*, *Anvillea*, and *Cardopatum* are represented by Algerine and by Oriental species without occurring in the intermediate districts; *Nananthea* and *Phalacroderis* are insular; none belong exclusively to the Italian or to the Turkish peninsula.

Among the prevailing tribes, the Cynaroideæ, Cichoriaceæ, and Anthemideæ, all specially Old-World tribes, are the most characteristic. The region contains four fifths of the Old-World species of the first, three fourths of the second, and above half of the Anthemideæ. It is also the special seat of three subtribes of the Inuloideæ, the Filagineæ, Euinuleæ, and Bupthalmæ. In Senecionideæ, Asteroideæ, and Calendulaceæ the numbers are far below those of the South-African region; the southern Arctotideæ and Mutisiaceæ have each only a single species encroaching on its frontier; the American Eupatoriaceæ and Helianthoideæ are but very scantily, the Vernoniaceæ and Helenioideæ not at all represented.

2. *Europæo-Asiatic Region.*

Under the name of Europæo-Asiatic or North temperate and Mountain region of the Old World, I would designate that vast area extending from the Atlantic to the North Pacific, which has been so frequently adverted to as presenting a remarkable continuity in the character of its vegetation through its entire length, a character fully maintained in respect of Compositæ. Its limits would at first sight appear to be more readily fixed than those of some other regions, although on investigation numerous difficulties occur. It should include all the mountain-races which inhabit the Pyrenees, the Alps, the Caucasus, and the Himalayas; but along the whole range it is often no easy problem to separate the southern races which have ascended or maintained themselves with or without specific modification in the warmer valleys, or the northern or mountain ones which, carried down to the lower grounds at their southern feet, have there become definitively established. At the eastern extremity, also, that intermixture of northern and southern forms which I have commented upon in recent Anniversary Adresses is exemplified in Compositæ, as in other orders, interfering with any definite line of demarcation.

The region is rich in Compositæ. It has not, it is true, half the numbers of the Mediterranean; but it is richer than the corresponding American (United States) region, although less diversified. With a hundred more species, the genera are fewer by thirty; and the local endemic monotypes can scarcely be computed at more than ten, unless, indeed, we consider as such a few species which have, on slight technical characters, been raised to that grade; and even among those ten none have so marked a character as some of the American ones. If, again, the Europæo-Asiatic species are numerous, averaging nearly ten to a genus, the varieties are still more so, and individual species, as well as the prevailing genera, have very large areas, many of them extending from one end to the other of the region. This prevents the separation of a European from an Asiatic region which the presence of a few endemic genera in each might at first sight have suggested.

Two small genera only are limited to Europe, *Adenostyles* and *Homogyne*; the former, represented by a closely allied species in California, belongs to a tribe (Eupatoriaceæ) which is essentially American, although it be in some respects an outlying member tending towards the *Cacalia* group of the cosmopolitan *Senecio*;

the other genus, *Homogyne*, is one of the *Tussilago* group, chiefly Europæo-Asiatic, but also extending into North America, where, indeed, the section *Nardosmia* of *Petasites* is, perhaps, the nearest connexion of the European *Homogyne*. To these two European genera, not extending into Asia, might perhaps be added *Berardia*; but, although limited to the Alps of Dauphiné, that plant is so essentially Mediterranean in its character that it seems to be more appropriately regarded as an outlying member of the Mediterranean flora.

After deducting a few Mediterranean species which have extended northwards over the temperate portions of our Europæo-Asiatic region, and perhaps a few endemic species which Mediterranean genera have there established, the great majority of the genera are essentially Asiatic—many of them exclusively so, others gradually diminishing in species as they extend westward; and some of them, as shown in Table 5, are also represented by identical species or by congeners in North America. All these, together with the two above-mentioned European genera, must probably have had their origin in the flora which has often been commented on as having once extended over the greater part of the higher northern region of the globe, and of which we have now sometimes detached remnants preserved in limited localities often at great distances from each other, sometimes thriving descendants which have multiplied in species and individuals over a large portion of the area.

To these probably very ancient denizens of the region must be added in its eastern portion a few genera of one or two species each, *Myripnois*, *Pertya*, *Macroclinidium*, which, with the northern species of *Ainsliea* and perhaps *Leucomeris* and *Catamixis*, are the northern representatives of the essentially southern tribe of *Mutisiaceæ*. These, with *Gynura*, *Tricholepis*, and other southern genera of other tribes, are instances of that interchange of northern and southern races in eastern Asia to which I have above alluded, the return being made in the few species of *Eupatorium*, *Boltonia*, *Anaphalis*, *Chrysanthemum*, *Artemisia*, *Saussurea*, &c., which, from the Europæo-Asiatic region, have in its eastern portion protruded southward to within the tropics, one, *Saussurea*, crossing over even into Australia.

I can find no traces in *Compositæ* of that strictly western flora exemplified in *Lobelia*, *Erica*, *Ulex*, and other *Genistææ*, &c.; owing possibly to the supposed less ancient origin of the order.

The chief characteristic tribes of the region are, as in the Mediterranean:—first, the Cynaroideæ; secondly, the Cichoriaceæ; and, thirdly, the Anthemideæ. Beyond that the sequence is different. Senecionideæ, Asteroideæ, and Gnaphalioid Inuloideæ are richer in species, though not in genera, than in the Mediterranean region, owing either to the mountainous character or to the American connexion of their genera; whilst the Mediterranean subtribes of Inuloideæ are much reduced in the Europæo-Asiatic region. The connexion with America gives also a few more species of Eupatoriaceæ; and the above-mentioned Mutisiaceæ are unrepresented in the Mediterranean. The other American or southern tribes are again insignificantly represented in or totally absent from the Europæo-Asiatic region.

Fewer additions may be expected to be made to the Compositæ of this region than to those of perhaps any other, although many corrections will have to be made to the figures of the preceding Table when the rich materials accumulated at Kew shall have been worked up for the Indian flora, and when Maximovicz will have concluded the revision he has so well begun of the principal Composite genera of North-eastern Asia.

3. *Tropical-African Region.*

In respect of geographical distribution tropical Africa is one of the most interesting regions for investigation in its Compositæ as in other orders, though with some differences. It is essentially a connecting region, one which, besides its present adjoining neighbours, gives indications of ancient connexions now so completely broken off by wide impassable intervals as to leave us to very vague guesses only of how such ancient connexions could have been effected. We have examined already into its correspondence with tropical America in Composite genera and representative species, of which examples might be produced from other orders. The occurrence, however, of identical genera and closely representative species in tropical Africa and Australia observed among arborescent Cæsalpineæ, Mimoseæ, Malvaceæ, &c. has not been verified in Compositæ. Whether or not this is any ways the result of the rarity of the arborescent plant-form in Compositæ is a matter of mere conjecture. The more immediate connexions are with the Indian or tropical-Asiatic region to the east, and with the two rich Composite regions, the Mediterranean to north and the South-African to the south. In itself tropical Africa

cannot be said to be rich in Compositæ, especially in species, very much less so than tropical America, but the forms are more varied. All the tribes are represented in it, although the three in which its neighbour the Mediterranean region is so rich (the Cynaroideæ, Cichoriaceæ, and Anthemideæ) have but very few species, and those few chiefly in the Abyssinian mountains, which have some connexion northwards. The southern Mutisiaceæ and Arctotideæ are also as scantily represented; the Calendulaceæ, an African tribe both northern and southern, have, as far as known, only a single species within the tropics. All these, however, are chiefly extratropical tribes. Those which exhibit in tropical Africa the greatest numbers are among those which elsewhere have a more tropical character:—Vernoniaceæ, of which the genus *Vernonia* alone numbers seventy species, including the considerable endemic section *Stengelia*; Inuloideæ, chiefly Plucheineæ and Gnaphalieæ, also, however, with several of the more specially African subtribes Euinuleæ and Bupthalmæ; and Helianthoideæ, chiefly American types. The American Eupatoriaceæ, notwithstanding their semi-tropical character, as well as the Helenioideæ, are represented each only by a single endemic species, and the Eupatoriaceous one is probably a modification of an Asiatic rather than of an American *Eupatorium*; the three other tropical-African Eupatoriaceæ which figure in the preceding Table are amphigeous species enumerated in Table 4, the origin of whose dispersion is uncertain, but which might be supposed to be of ancient introduction from America.

The numbers, however, of all the above tribes are small; the only large genera are *Vernonia* and *Helichrysum*; all the others, except *Gnaphalium* and *Conyza*, have less than ten species; and the general average, including *Vernonia*, is under four to a genus, lower than in any region except limited insular ones. The total number of species is also much smaller than in any except the tropical-Asiatic region; whilst the genera are more numerous and more diversified than in the tropical-Asiatic, the Australian, or the Europæo-Asiatic regions. About twenty of them are endemic: the majority of these, as well as of the endemic species of other genera, appear to be limited to the eastern portion of the region; it is there chiefly that several South-African and American genera are represented by single or very few species, and there also that some of the Mediterranean genera extend a few representatives. East tropical Africa seems, indeed, to be the principal area of preservation of the most ancient tropical flora of the Old World. The

American identical species are more specially in West Africa, accompanying a smaller number of endemic species and genera.

There is, however, much yet to be discovered before the Compositæ of tropical Africa are sufficiently known to establish reliable proportions. Even the materials we have are not fully worked out, this part of Oliver's Flora, although far advanced, not being yet completed; and it is probable that the number of marked endemic forms, often connecting genera or higher races which are elsewhere distinct, will be considerably increased by future explorers. We have, indeed, already indications of two species which may have to be added to the endemic monotypes: one is the *Moquinia Bojeri*, DC., Prod. vii. 23, from Zanzibar, which, with its short corolla-lobes, is certainly out of place amongst Gochnatieæ and may possibly be some Inuloid allied to *Printzia*; the other is a fine plant with *Eryngium*-like prickly-toothed single leaves, and large almost *Stiffia*-like heads, of which we have seen several specimens in Afzelius's herbarium, and one in the Kew herbarium collected by Barter on the Niger; in all these specimens the corolla-limb and upper parts of the anthers and style are eaten off or rotted away, so as to render the fixation of their affinities impossible; but the anther-tails remaining in Barter's specimen seem to indicate a new Mutisiaceous genus allied to *Dicoma*.

4. *Tropical-Asiatic Region.*

This comprises the Indian peninsula, the plains and lower hills of India to the foot of the Himalayas, the island of Ceylon, the Malayan peninsula, and the Indian archipelago. It is at once the poorest in Compositæ and the least diversified of all the continental regions, exemplifying on a large scale the characteristics of the low forest-lands of east tropical South America mentioned under the Brazilian region. It is only the Nilgherry range, bordering the western side of the peninsula, that possesses a few endemic monotypes (*Ade-noon*, *Lamprachænum*, *Nanothamnus*, *Athroisma*) with restricted stations marking the site as a centre of preservation of detached races. The same hills have also endemic species of other genera of the same local character; but neither Ceylon nor any of the islands of the archipelago nor the Malayan peninsula, as far as known, have a single endemic genus of Compositæ, none more than a few species that do not also spread more or less over the Indian continent. A large proportion, indeed, of the true denizens (the Blumeas and allies, the Grangeineæ, most Helianthoideæ,

&c.) are little more than weeds which spring up rapidly in numerous individuals where a forest has been cleared or cultivated ground abandoned; and even these decrease eastward. If the known Compositæ of the Indian archipelago were reduced to our ordinary standard they would not probably extend to above 110 to 120 species. Beccari's collection of 1849 Sarawak plants as received at Kew contained only six Compositæ, including such ubiquitous weeds as *Ageratum*, *Spilanthus*, and *Crepis* (*Youngia*), and a very common *Blumea* and *Vernonia*.

The principal Composite genera or races of a higher grade prevalent in tropical Asia are *Vernonia*, *Blumea* and allies, *Conyza* and allies, Grangeineæ, Gnaphalioid Inuloideæ, and Senecionideæ. No others can count ten species, the most remarkable among them being a few Mutisiaceæ mostly allied to South-African ones, but with some special types, such as *Ainsliæa* and *Tricholepis* (the only genus of Cynaroideæ which is chiefly tropical). Three tribes, the American Helenioideæ and the South-African Calendulaceæ and Arctotideæ, are wholly unrepresented in tropical Asia.

It is not probable that future investigations will add very materially to the Compositæ of the region. Even if the mountains of New Guinea should exhibit any Australian character in their vegetation, it would be more probably exemplified in Proteaceæ, Myrtaceæ, and other woody orders now common to New Caledonia and Australia than in the herbaceous Compositæ.

5. South-African Region.

This may be generally described as extratropical South Africa, although we are not in a position to assign to it any precise limits to the northward. In the west it may be naturally bounded by the dry deserts assigned by Grisebach to the Kalahari region, which appear to be unfavourable to the development or extension of Compositæ. Eastward a few of the southern genera seem to penetrate further north, intermixing with the tropical genera, and represented by some species even in Abyssinia; but these are so few in comparison with their strictly South-African congeners, that the region is better defined, and the Composite statistics, owing to the recent elaboration of the order by Harvey in the 'Flora Capensis,' better established, than in almost any other region.

As the tropical-Asiatic is the poorest, so is the South-African, in proportion to its extent, at once the richest and the most diversified of all our regions, and the genera and species more

universally endemic than in any other except insular ones. Above 100 out of 149 genera (that is, above two thirds) are strictly endemic, or at most have a single species penetrating into tropical Africa; and out of 1400 species, if we deduct a very few, like *Denekia capensis*, which cross the frontier to the north, there are not, as far as I can estimate, above a dozen common to other regions; and these are chiefly widely spread weeds, such as *Bidens leucantha*, *Eclipta alba*, *Siegesbeckia orientalis*, *Sonchus arvensis*, &c. The number of species to a genus is often also very large in endemic genera as well as in others which have a wide range in the Old World. *Pteronia*, *Felicia*, *Athanasia*, *Othonna*, *Ursinia*, *Berkheya* have each from forty to eighty species; many others vary from ten to near forty; *Helichrysum* has 137, and *Senecio* 190; so that, notwithstanding the number of well-marked monotypes or oligotypes, the average of species to a genus is very nearly ten, an average which exceeds that of the well-developed, but comparatively little diversified, Composite flora of the Europæo-Asiatic, and is only surpassed by that of the Mediterranean region.

One of the most striking features in the South-African Compositæ is the perfect isolation of many of the above-mentioned monotypic or small genera. *Corymbicum*, *Brachylæna* cum *Tarchonantho*, *Denekia*, *Ædera*, *Cadiscus*, *Eriocephalus*, *Lasiospermum*, *Eumorphia*, *Alciope*, *Lopholæna*, *Platycarpha*, *Anisochæta*, *Oldenburgia*, &c. have but a distant affinity with their cotribuals, or, rather, as I should say of many of them, with the genera with which they are technically associated. They may all be considered as the expiring remnants of long-lost races; but whether of races which have been differentiated, have grown flourished and gradually been worn out in the region itself, or of races once ranging widely over adjoining regions which have there been generally destroyed by physical or other changes, but have left these few outlying survivors in situations where they have met with protection from such general causes of destruction, is a question for the solution of which we may as yet have no data.

The prevailing tribes are, in the first place, those marked by the two large above-mentioned genera *Senecio* and *Helichrysum*, the Senecionideæ and the Gnaphalioid Inuloideæ; in the next place, the almost endemic Arctotideæ, then the Anthemideæ, Asteroideæ, radiate Inuloideæ, and Calendulaceæ, all the above being either essentially Old-World or cosmopolitan tribes. There are also more Mutisiaceæ, a southern tribe, than in any other Old-World

region, as well as several Vernoniaceæ of an Old-World character or as isolated oligotypes. The Cichoriaceæ in which the Mediterranean region is so rich, are here very scantily represented; and the Cynaroideæ, still more characteristic of that region, are wholly absent. The American Eupatoriaceæ, Helianthoideæ, and Helenioideæ are also represented by very few species only, the Helenioideæ by a single isolated monotype (*Cadiscus*).

There does not appear to be so great a contrast between the eastern and western districts of the region in Compositæ as in Ericaceæ and several other more shrubby orders.

There are probably still many species or even genera to be discovered in the South-African region, although in the least-known parts, those bordering on the northern limits, Compositæ certainly diminish rapidly in numbers in proportion to other plants. The disproportionate numbers of the South-African and tropical-African Compositæ may probably, therefore, be somewhat modified by future researches; but it is expected that their highly diversified character in both regions will only be further confirmed.

6. *Australian Region.*

The insular character of the Australian territory renders it needless to say any thing of the delimitation of the region as to its Compositæ, beyond noting that it should include Tasmania. I do not, however, for the present purpose, extend it to Australasia generally, so as to comprise New Zealand; for the vegetation of that group of islands has in many respects either a peculiar or a more Antarctic character, and will be considered under the head of Insular Regions.

Although the Composite flora of Australia is considerable, with a fair proportion of endemic genera, these are neither so numerous, nor so isolated, nor yet so diversified as those of the much smaller South-African region. The total number of known species (497) is but little more than one third of the South-African, that of the genera altogether (89) rather more than half as many, but of the endemic genera (39) not so much as two fifths as many as those of South Africa; and, notwithstanding the rather high figure at which stand *Helichrysum*, *Olearia*, and a few others, the general average of species is scarcely above five, instead of nearly ten, to a genus. Very few of the endemic genera are really anomalous; most of them are nearly connected with South-African, South-American, or tropical-Asiatic types.

Only one subtribe is nearly endemic, the Angiantheæ belonging to Inuloideæ; it represents, as it were, the Filagineæ of other regions, but in many respects is more nearly connected with the *Helichrysum* group; and even this subtribe has one South-African representative, *Eriosphæra*, whilst the tropical-Asiatic *Cæsulia* and the South-American *Leucopholis* are, or might be, technically added to the Angiantheæ, although perhaps not joined very closely by natural affinity. Among the other endemic genera, the most distinct are perhaps *Thespidium*, *Coleocoma*, *Nablonium*, *Elachanthus*, and *Isoëtopsis*, all monotypes, but none so far removed from all allies as many of the above-enumerated South-African ones. There is, indeed, in the Australian Compositæ but little of that singularity which has been observed in so many other orders of plants as well as in animals. We might perhaps be disposed to attribute this to the supposed less remote antiquity of the order.

The principal characteristic tribes in the region are the Gnaphalioid Inuloideæ, related to *Helichrysum* and partaking more or less of a South-African character, the Asteroideæ, and Cotuloid Anthemideæ, connected sometimes with extratropical South-American or Andine, sometimes with South-African types, and the cosmopolitan Senecionideæ, each of these tribes having established a few Australian endemic genera or sections. Some Helianthoideæ and the very few Vernoniaceæ belong to the tropical-Asiatic connexion. Six tribes (Eupatoriaceæ, Helenioideæ, Arctotideæ, Cynaroideæ, Mutisiaceæ, and Cichoriaceæ) are represented only by single or exceedingly few species, either identical with or closely allied to those of other regions, with the exception perhaps of *Cymbonotus*, the sole representative of the South-African Arctotideæ, and, although closely connected with them, yet sufficiently marked to be generally admitted as an endemic monotype. Calendulaceæ have no such Australian representative, although, as above mentioned, they have one in Antarctic America.

Another great contrast of the Australian (insular) Compositæ as compared with the South-African (continental) ones is derived from the fact that fifty-eight out of nearly five hundred (that is, above one tenth) of the species are common to other countries, instead of scarcely one in a hundred. Of these fifty-eight common species, ten are also in New Zealand, two in South America, twenty-eight in tropical Asia, five in the extratropical northern regions of the Old World, twelve are common tropical weeds, and

only one is South-African, although in modern times several South-African Compositæ have shown a great aptitude to colonize in Australia.

The distribution of Compositæ within the Australian region, the non-identity of eastern and western races, the number, diversity, and distinctness of genera and species in the south-western districts, giving them a marked character as a centre of preservation of ancient races, the variability and confusion of specific forms in the Eastern States almost unexampled, except in New Zealand, showing a high state of specific luxuriance, now perhaps undergoing a process of differentiation, the evidences of an ancient engrafting of Antarctic races in the mountain-regions of Victoria and Tasmania, and of a less remote intrusion continued in recent times of Asiatic races in the northern and especially the north-eastern districts, are all questions of great interest, but requiring too much detail to be entered into on the present occasion. They cannot either be well treated in regard to Compositæ alone without regard to the general vegetation of the region. For the general consideration of this subject we require a complete Flora of Australia drawn up on a uniform standard. Although I am now far advanced in this work, having now completed Dicotyledons, it will yet take me two or three years to reach the end. Should life be so long spared to me, it is to be feared that age would then interfere with my working out satisfactorily the necessary comprehensive considerations, which, indeed, would be much better placed in the hands of those who have acquired a personal knowledge of the country.

7. *Connexions between distant Old-World Regions.*

As in America, these are chiefly between north and south, but with rather more complication. The great Old-World continent, although nearly double the breadth of America, has no more than that continent any two distinct and distant east and west regions or endemic centres of Compositæ; it has not even any north and south chain of mountains to interrupt by a climatological barrier the gradual east and west extension or modification of races. On the other hand, the independent position of Australia establishes a break, unconnected with climate, not observable in America. We have therefore to consider, besides the connexions between the Mediterranean or Europæo-Asiatic regions on the one hand, and the South-African on the other, the separate connexions of Australia with South Africa, with tropical Africa, and with tropical Asia.

1. *Connexion between the Mediterranean and the South-African Regions.*

This is very much less prominent than that between the Mexican and the Chilian regions. Identical species are very few, if any, besides colonists; and if we omit cosmopolitan genera or those generally distributed over the tropical as well as the temperate regions of the Old World, we have only the following nine genera repeated north and south of the intermediate tropical-African region:—

<i>Nolletia</i> ...	3	southern,	1	Algerine species.
<i>Ifloga</i>	7	„	1	East- and West-Mediterranean species.
<i>Lasiopogon</i>	1	„	1	East- Mediterranean species.
<i>Leyssera</i> ...	3	„	1	West-Mediterranean species.
<i>Iphiona</i> ...	3	„	10	Mediterranean and tropical species.
<i>Pegolettia</i> ..	2	„	1	North-African subtropical species.
<i>Geigera</i> ...	8	„	2	„ „ „ „
<i>Matricaria</i>	10	„	12	Mediterranean and Europæo-Asiatic species.
<i>Othonnopsis</i>	5	„	3	North-African and Oriental species.

Compositæ, as already observed, do not appear to have formed part of that curious West-European flora, consisting in a great measure of repetitions or representations of South-African races, as exemplified in *Ericæ*, *Genisteæ*, *Lobelias*, &c. The connexion, such as it is, is rather East-African than Western. Several European Composite weeds have become quite naturalized in South Africa; whilst the South-African ones received in return are but very few, established in very restricted localities.

2. *Australian connexions with the Old World.*

First with South Africa. Besides the cosmopolitan genera *Senecio* and *Gnaphalium* and a few cosmopolitan or subtropical weeds, the following genera are common to the two regions:—

<i>Brachycome</i> ...	36	Australian,	1	South-African species.
<i>Helipterum</i> ...	30	„	12	„ „
<i>Helichrysum</i> .	52	„	137	„ „
<i>Cassinia</i>	13	„	1	„ „
<i>Athrixia</i>	5	„	6	„ „
<i>Cotula</i>	9	„	22	„ „

Although we have here only six characteristic genera common to Australia and South Africa, or seven if we include *Senecio*,

which has 28 Australian and 190 South-African species, yet those seven form a very prominent feature in the Composite flora of both, constituting above a third of the total number of species in Australia and above a fourth in South Africa. There are no species (except such weeds as *Cotula coronopifolia*) identical in the two regions; but one in each of them of *Athrixia* and two or three of *Helipterum* and *Helichrysum* are very closely representative. Of *Cassinia*, the South-African species (*Rhynea*) belongs to a section not met with in Australia, but represented by four species in New Zealand. To these representative plants must be added *Cymbonotus*, an endemic Australian monotype of the very distinct tribe (scarcely more than a Linnean genus) Arctotideæ, which, besides this one species and a very few stragglers into tropical Africa, is exclusively South-African. This approximation of the Compositæ of Australia and South Africa may possibly date from times less ancient than those in which they established a communication between the New and the Old World; and it may even have been less remote than the period in which flourished the common parents of Australian and South-African Proteaceæ and Restiaceæ, or of Australian Epacrideæ and South-African Ericaceæ; for it is exemplified not in tribes only, but also in identical genera and sections. On the other hand, the separation may be supposed to be either more distant in point of time or more complete physiologically than in the case of *Pelargonium*, *Nicotiana*, and others, where the specific divergence of Australian from South-African or South-American races may be said to have only commenced.

The connexion between Australia and tropical Africa exemplified in a few arborescent or large shrubby Cæsalpineæ, Mimoseæ, Malvaceæ, &c. (*Cassia*, *Erythrophlœum*, *Adansonia*, &c.) has no instance, as far as I am aware, in Compositæ, perhaps owing to the absence of arborescent forms. With tropical Asia the northern and north-eastern coasts of Australia are more nearly connected; and in many orders tropical Australia possesses common or endemic genera and species forming part of the general tropical Indo-Australian flora. In Compositæ these Australian representatives of the flora are few, owing to the general poverty of the order in that region. There is in tropical Australia only one endemic genus (*Pleurocarpæa*), which may be said to be the Australian representative of the peninsular Indian *Adenoon*. The two tropical Old-World genera *Epaltes* and *Chrysogonum* (*Moonia*) have, the former two, the latter three, Australian endemic species, without any

common ones. *Blumea* has in Australia three endemic and four common Asiatic species, *Glossogyne* two endemic and one common species, *Centipeda* one endemic and one common species; and the ten Asiatic or general tropical genera, *Saussurea* (a Northern genus extending into tropical Asia), *Vernonia*, *Elephantopus*, *Adenostemma*, *Conyza*, *Sphæranthus*, *Siegesbeckia*, *Spilanthes*, *Enhydra*, and *Gynura*, have each one or two species in Australia identical with wide-spread Asiatic ones, without any endemic congeners. The connexion in these cases is geographically not a very widely dissevered one considering the comparative vicinity of Timor, where outlying representatives of many truly Australian races are to be found.

The singular and hitherto inexplicable connexion between Australia and the Mediterranean region exemplified in *Gypsophila*, *Nitraria*, *Trigonella*, and some other herbaceous genera has no example in Compositæ; for that of the *Leuzea australis*, Gaudich. (which we have now thought it better to transfer to the section *Rhaponticum* of *Centaurea*), may have passed through a different channel. The species nearest approaching to it is a Spanish one; but it is also allied in many respects to a small group of large-headed *Centaureas* represented by two species in Abyssinia, one in North America, and four or five in Chile; and this connexion may therefore be similar to that remote mountain connexion between Victoria and Tasmania, on the one hand, and the high northern regions on the other, observable in *Anemone*, *Arabis*, *Oxalis*, &c., but which is otherwise unknown in Compositæ.

Insular Regions.

The detached islands scattered over the ocean show each one or each group so much of an endemic character in their Compositæ, that they can scarcely in this respect be distributed into regions as Grisebach has attempted in a general way. It appears to me to be more instructive to consider them separately in the following order:—In the Pacific Ocean: 1, the Sandwich Islands; 2, the Galapagos; 3, Juan Fernandez, Masafuera, &c.; 4, the South-Sea Islands. In the Atlantic: 5, the Atlantic group (the Azores, Canaries, and Cape-Verd Islands); 6, St. Helena and Tristan d'Acunha. In the Indo-Australian seas: 7, the Mascarene islands (Madagascar, Mauritius, and Bourbon); 8, New Caledonia; and 9, New Zealand. In all, the general features of insular floras are more or less illustrated also by their Compositæ—viz. a large pro-

portion of endemic genera and species with often a different combination and value of distinctive characters than in their nearest-allied continental races, and (in many of them) a general tendency to an arborescent development.

1. *The Sandwich Islands.*

The flora of these islands is now pretty fairly known and well worked up by Asa Gray, and after him by the late Horace Mann and by W. T. Brigham, from whose enumeration in the *Memoirs of the Boston Society of Natural History*, vol. i. pp. 528 & 535, the following data are taken* :—

Table 13. *Compositæ of the Sandwich Islands.*

Genera.	Species.	Connexions.
<i>Adenostemma</i>	<i>A. viscosum</i> , Forst.	Cosmopolitan (colonist?).
<i>Ageratum</i>	<i>A. mexicanum</i> , Linn.	Cosmopolitan (colonist?).
<i>Lagenophora</i>	1 endemic species.	South extratropical American and Old-World.
<i>Aster</i>	1 endemic species.	
<i>Tetramolopium</i> (endemic).....	6 endemic species.	South extratropical American rather than Old-World.
<i>Vittadinia</i>	1 endemic species.	South extratropical American and Australian.
<i>Gnaphalium</i>	<i>G. luteo-album</i> , Linn.	Cosmopolitan (colonist?).
<i>Coreopsis</i> (<i>Campylotheca</i> , endemic section).	6 endemic species.	<i>Coreopsis</i> and <i>Bidens</i> , chiefly the tropical-American and the very few Old-World species.
<i>Bidens</i>	1 endemic species.	The tropical-American species
<i>Lipochaeta</i> (endemic, except Galapagos).	10 endemic species.	Wedelioid Helianthoidæ, chiefly American.
<i>Argyroxiphium</i> (endemic).....	2 endemic species.	Madiæ of the Mexican region.
<i>Wilkesia</i> (endemic)	1 endemic species.	Madiæ of the Mexican region.
<i>Dubautia</i> (endemic)	3 endemic species.	Madiæ and Galinsogæ of the Mexican region, the nearest but distant.
<i>Raillardia</i> (endemic)	11 endemic species.	<i>Raillardella</i> of the Mexican region.
<i>Hesperomannia</i> (endemic) ...	1 endemic species.	<i>Stiffia</i> and <i>Wunderlichia</i> of the Brazilian region.
<i>Sonchus</i>	<i>S. oleraceus</i> , Linn.	Cosmopolitan (colonist?).
16 genera, of which 12 endemic.	48 species, of which 45 endemic.	Generally American, but also in some measure Old-World, through Australasia.

In considering the above relations we must omit the four cosmopolitan species; for, whether they be really of modern or ancient introduction with or without the intervention of man, their presence may be accounted for by means of dispersion actually in

* Since these Tables have been made out the collections of Hillebrand have added one endemic genus and two or three endemic species to the Sandwich-Island Compositæ.

force. The remaining forty-five species are all strictly endemic, showing that the ancient connexion, of whatever nature it may have been, with America on the one hand or with Australasia on the other, has been so long severed as not to have left a single unmodified common form. The species are all either descendants altered by long isolation or possibly, in some instances, preserved remnants of types long since extinct elsewhere.

2. *Galapagos Islands.*

The flora of these islands is as well known as that of the Sandwich Islands, and has been well illustrated by Hooker and after him by Anderssen. The following data are taken from his "Vegetation of the Galapagos" in the 'Fregatten Eugenie's Resa,' p. 65, with some slight modifications resulting from the researches of A. Gray and Hooker:—

Table 14. *Compositæ of the Galapagos Islands.*

Genera.	Endemic species.	Total.	Connexions.
<i>Ageratum</i> .....	...	2	American, chiefly Mexican.
<i>Haplopappus</i>	1	1	North-American, Mexican, and United States.
<i>Erigeron</i>	2?	2	American, nearest to western types.
<i>Baccharis</i>	1	2	American.
<i>Elvira</i> (endemic section) ...	2	2	American, Mexican, and tropical, chiefly western.
<i>Lecocarpus</i> (endemic)	1	1	<i>Melampodium</i> , American, chiefly Mexican.
<i>Jægeria</i>	2	2	American, chiefly Mexican and Andine.
<i>Scalesia</i> (endemic)	10	10	<i>Mirasolia</i> and other central-American Wedelioid <i>Helianthoideæ</i> .
<i>Blainvillea</i>	1	1	American, Mexican, more Brazilian and Andine.
<i>Wedelia</i>	1	2	American, chiefly Brazilian and Andine.
<i>Lipochaeta</i>	1	1	Sandwich-Island congeners, with American allies.
<i>Encelia</i>	1	1	American, chiefly Mexican.
<i>Spilanthes</i> .....	...	2	Cosmopolitan (tropical and subtropical).
<i>Chrysanthellum</i>	1	1	Cosmopolitan (tropical).
<i>Hemizonia</i>	1	1	American, Mexican.
<i>Flaveria</i> .....	...	1	American, chiefly Mexican.
<i>Porophyllum</i>	1	1	American, tropical and subtropical, chiefly Mexican.
<i>Pectis</i>	1	5	American, Mexican, Andine, and Brazilian.
18 genera.	27	38	

The Galapagos, so much nearer to the American coast than the Sandwich Islands, are also much more decidedly American in the character of their Compositæ, although their affinity seems to be rather with those of Central America than of the more immediately opposite coast of Ecuador. A large proportion of the species are

above shown to be endemic, the eleven common to America being chiefly weeds of cultivation or maritime plants capable of wide dispersion by present means, or species which for other reasons have an extended American area. Among the endemic species the majority are also slight modifications of extreme western or maritime Central-American or Mexican forms; and those which have been proposed (and some of them maintained) as independent endemic genera are not nearly so distinct as such Sandwich-Island ones as *Argyroxiphium*, *Wilkesia*, *Dubautia*, and *Hesperomannia*. *Desmocephalum* and *Microcæcia* are included by us in the Central-American *Elvira*; *Lecocarpus* and *Scalesia* might without difficulty have been referred to *Melampodium* and *Mirasolia* respectively as sections; *Macræa*, reduced by A. Gray to the Sandwich-Island *Lipochæta*, is also very near to the American *Wedeliæ*. None of the Galapagos Compositæ show any tendency to the arborescent forms observable in the more isolated insular groups.

3. *Juan Fernandez, Masafuera, San Ambrosio, and San Felix.*

The flora of these islands, lying some four or five hundred miles off the coast of Chile, has been only incidentally mentioned in treating of the plants of the Chilean region, and I can find no separate enumeration of the plants they contain; but the few Compositæ recorded are strongly characteristic of their long isolation. Juan Fernandez possesses twelve species belonging to the endemic genera *Robinsonia*, *Balbisia*, and *Dendroseris*, all arborescent or shrubby, and an endemic species of *Erigeron* with an exceptionally shrubby habit and some other slight characters which might justify the adoption for it of Colla's genus *Terranea*. The two first-named genera belong to the cosmopolitan tribe Senecionideæ, largely represented in extratropical South America, but with a very remarkable character of which only faint traces are to be met with in a very few other species of the whole order. The cotyledons in most (but not all) of the species are folded longitudinally or undulate. The third genus, *Dendroseris*, is a very exceptional arborescent Cichoriacea allied only to the rare *Fitchia* of the South-Sea Islands. These two genera, technically placed amongst Cichoriaceæ, have so little of the habit and characters of that tribe, except their peculiar corollas, that one cannot but conjecture that their departure from or connexion with the Mutisiaceous type must have been quite independent of that of the Old-World Cichoriaceæ.

Masafuera is known to possess at least one of the Juan-Fernandez *Dendroserides*. San Ambrosio and San Felix were visited in 1869 by Commander Simpson, of the Chilian vessel of war 'Chacabuco,' who brought some specimens of the vegetation in a very bad state to Philippi, who has published them in the 'Botanische Zeitung' for 1870, p. 496. He mentions one Composita, which he proposes as a distinct genus, differing from the South-American *Alomiæ* by having paleæ on the receptacle, a character which can scarcely be admitted as sufficient considering its variability in some nearly allied genera. It is, however, judging from Philippi's description, evidently a distinct endemic species. A plant of which he has seen the foliage only appears to him to be very probably an additional species of the Juan-Fernandez *Dendroseris*.

4. South-Sea Islands.

The islands of the South Pacific, from the Feejees to the Marquesas, have generally, in respect of Compositæ, the same character of extreme poverty observable in South-east Asia and the Archipelago. Scarcely twenty species are enumerated in the few works treating of their flora, the principal ones of which are Endlicher's 'Enumeration,' Guillemin's 'Zephyrtis Taitiensis,' some of Asa Gray's papers on the plants of the American Exploring Expedition, and, still more recently, Seemann's 'Flora Vitiensis.' These twenty species include the weeds to be met with in almost all tropical and subtropical lists—*Adenostemma viscosum*, *Ageratum conyzoides*, *Erigeron linifolium*, *Siegesbeckia orientalis*, *Eclipta alba*, *Bidens pilosa*, *Centipeda orbicularis*, and *Sonchus asper*. There are also a *Vernonia* (*Cyanopsis*), a *Blumea*, a *Wedelia* (*Wollastonia*), and a *Dichrocephala*, belonging to the flora of the Indian archipelago and tropical Asia. Four species are described as endemic in the Fiji or in the Tonga islands—a *Vernonia* (*Strobocalyx*), a *Blumea*, figured by Seemann, both requiring, perhaps, some further comparison with Archipelago species, a *Lagenophora*, and a *Glossogyne*, perhaps both of them also in New Caledonia. There are also two species of *Bidens* described as endemic in the Society Islands, and allied to some of the Sandwich-Island species of *Bidens* or *Coreopsis*. Lastly, there is the very remarkable *Fitchia*, found once only, I believe, in each of two different South-Sea Islands, and systematically connected with none but the Juan-Fernandez *Dendroseris*, mentioned under the last head. Of the

whole nineteen or twenty Compositæ this will probably prove to be the only one presenting a remnant of an ancient flora, the only exception to the more or less adventitious character of the remainder.

5. *Atlantic Islands.*

Under this head are included the Azores, Madeira, the Canary Islands, and the Cape-Verd Islands. Their flora has been well investigated; and there are probably but very few species that have escaped notice, although there is much to be learnt yet as to the limits of variation which the native species have undergone, and different botanists have from the same materials very variously estimated the numbers of the principal genera, such as *Chrysanthemum*, *Senecio*, *Sonchus*, *Tolpis*, &c. The following Tables are deduced from data supplied by Seubert's 'Flora Azorica,' Webb's 'Phytographia Canariensis' worked up as to Compositæ by Schultz Bipontinus, Lowe's 'Flora of Madeira,' and Webb's 'Spicilegia Gorgonea' inserted in Hooker's 'Niger Flora,' with a few modifications, chiefly reductions of species, suggested by the specimens preserved in the Kew herbaria. As a general result, these islands, in respect of Compositæ, may be considered as an outlying district of the rich Mediterranean region, with a very slight tendency in a few Canary forms to a South-African type, without, however, any identical or even representative species, and in the most southern, the Cape-Verd group, an admixture of a few genera or species belonging to the neighbouring tropical African continent. More of the introduced species are here admitted than in the Tables of Continental distribution; for in islands introduced plants sometimes form so essential a part in the vegetation that they are inserted without remark in the local floras, and I have not been always able to distinguish them from more ancient inhabitants. I have, however, omitted such evident escapes from gardens as *Tagetes* and *Zinnia*.

Table 15. *Distribution of Compositæ in the Atlantic Islands.*

Genera.	Species.					Area of genera and observations.
	Azores.	Madeira.	Canary.	Cape-Verd.	Endemic.	
Vernonia .....	...	...	...	1	...	Introduced (American).
Ageratum .....	...	1	...	...	...	Introduced (tropical weed).
Eupatorium .....	...	1	...	...	...	Introduced (American).
Solidago	1	...	...	...	...	Introduced? (American).
Bellis	1	1	1	...	1	Europe, Mediterranean.
Erigeron	1	2	1	1	1	Cosmopolitan.
Conyza .....	...	...	1	1	1	Cosmopolitan (tropical or subtropical).
Laggera? .....	...	...	...	1	1?	African.
Pluchea .....	...	...	...	1	1?	African section.
Evax .....	...	...	1	...	...	Mediterranean.
Filago	2	3	2	...	...	Europæo-Asiatic and Mediterranean.
Ifloga .....	...	...	1	...	...	Mediterranean species, the genus also South-African.
Phagnalon.....	...	3	4	2	5	Mediterranean.
Gnaphalium	2	2	1	2	1	Cosmopolitan.
Helichrysum .....	...	3	2	...	2	Old-World, chiefly South-African.
Inula .....	...	1	2	1	2	Europæo-Asiatic, Mediterranean, African tropical.
Allagopappus .....	...	...	1	...	1	Endemic genus
Vieræa .....	...	...	1	...	1	Endemic genus } <i>Inula</i> connexion.
Pegolettia .....	...	...	...	1	...	Tropical and South-African.
Pulicaria .....	...	...	2	1	...	Mediterranean.
Odontospermum .....	...	1	5	1	3	Mediterranean.
Pallenis .....	...	...	1	...	...	Mediterranean.
Xanthium .....	...	1	1	...	...	Introduced (from Europe?).
Ambrosia .....	...	1	...	...	...	Introduced? (American) (maritime).
Siegesbeckia .....	...	...	1	...	...	Tropical weed.
Eclipta .....	...	1	...	...	...	Tropical weed.
Sclerocarpus .....	...	...	...	1	...	African and American, tropical and subtropical.
Blainvillea.....	...	...	...	1	...	Tropical weed.
Bidens	1	1	1	2	...	Tropical and subtropical weeds.
Gonospermum .....	...	...	4	...	4	Endemic genus; connexion between South Africa and Mediterranean.
Anacyclus .....	...	...	1	...	...	Mediterranean.
Achillea .....	...	2	...	...	...	Europe, Mediterranean.
Santolina	1	...	...	...	...	Mediterranean.
Diotis .....	...	...	1	...	...	Mediterranean, Europe, Africa (maritime).
Anthemis	2	2	2	...	...	Europæo-Asiatic, Mediterranean.
Chrysanthemum .....	...	6	9	4	7	Old-World, chiefly Mediterranean, one section endemic.
Matricaria .....	...	...	1	...	...	Temperate and subtropical weed.
Carried forward ...	11	32	47	21	31	

Genera.	Species.					Area of genera and observations.
	Azores.	Madeira.	Canary.	Cape-Verd.	Endemic.	
Brought forward...	11	32	47	21	31	
Cotula .....	...	1	...	...	...	Introduced? Europe and South Africa.
Soliva.....	...	1	...	...	...	Introduced (American).
Artemisia	1	1	3	...	2	North temperate and subtropical Old-World and America.
Senecio .....	...	5	14	2	14	Cosmopolitan.
Calendula .....	...	2	1	1	1	West-Mediterranean, Africa.
Carlina .....	...	1	2	...	2	Mediterranean (endemic section).
Atractylis .....	...	...	2	...	1	Mediterranean.
Arctium.....	...	1	...	...	...	Introduced? (Europe).
Carduus.....	...	2	3	1	2	Mediterranean, Europæo-Asiatic.
Cnicus .....	...	2	1	1	1	Mediterranean, Europæo-Asiatic.
Cynara .....	...	1	1	...	...	Introduced? (Mediterranean).
Silybum.....	...	1	1	...	...	Mediterranean, Europæo-Asiatic.
Galactites .....	...	1	1	...	...	Mediterranean.
Volutarella .....	...	...	1	...	...	Mediterranean.
Centaurea	1	5	7	1	6	Europæo-Asiatic, Mediterranean, North-African.
Carthamus.....	...	2	2	...	...	Mediterranean.
Carduncellus .....	..	1	1	...	...	Mediterranean.
Scolymus .....	...	1	2	...	...	Mediterranean.
Cichorium .....	...	1	1	1	...	Introduced? (Mediterranean &c.).
Tolpis	2	3	3	2	5	Mediterranean.
Lapsana.....	...	1	1	...	...	Old-World weed.
Rhagadiolus .....	...	1	2	...	...	Mediterranean.
Picris.....	...	1	2	3	2	Mediterranean (one Old-World weed).
Crepis .....	...	4	4	1	4	Europæo-Asiatic, Mediterranean.
Andryala .....	...	2	1	...	1	West-Mediterranean.
Hypochoeris .....	...	2	1	1	...	Old-World weed.
Leontodon.....	...	1	1	1	...	Europæo-Asiatic, Mediterranean.
Taraxacum .....	...	1	1	...	...	Old-World weed.
Lactuca .....	...	1	1	...	...	Europæo-Asiatic, Mediterranean.
Prenanthes .....	...	...	1	...	1	Europæo-Asiatic, Mediterranean.
Picridium .....	...	...	3	...	2	Mediterranean.
Sonchus.....	1	4	13	1	14	Europæo-Asiatic, Mediterranean (one Old-World weed).
Microrhynchus.....	3	...	1	...	2	Mediterranean, African tropical.
Tragopogon .....	...	1	2	...	...	Mediterranean, Europæo-Asiatic.
Urospermum	1	1	1	1	...	Mediterranean.
Scorzonera.....	...	...	1	...	...	Europæo-Asiatic, Mediterranean.
Total	20	84	129	38	91	

From the above list must be deducted five genera, *Vernonia*, *Ageratum*, *Eupatorium*, *Solidago*, and *Soliva*, containing each a single species introduced from America. Five more, *Xanthium*, *Ambrosia*, *Siegesbeckia*, *Eclipta*, and *Bidens*, are widely spread weeds of an

American character, but common also in the Old World. Two also of the three or four species of *Erigeron* and one of the four or five *Helichrysa* are colonists only, the former of American, the latter of South-African origin. There remain sixty-three genera, comprising about 180 species, which may be regarded as indigenous. Amongst these there are three genera (all Canarian), and about ninety species (or half the total number) belonging to thirty genera, apparently endemic, the character of which we will consider under the separate groups of islands. Of the sixty apparently indigenous genera not confined to the Atlantic islands, five (*Laggera*, *Pluchea*, *Pegolettia*, *Sclerocarpus*, and *Blainvillea*, all from the southern Cape-Verd group) are African, but not at all, or scarcely, Mediterranean; the remaining fifty-five are all either essentially of a Mediterranean character, or are widely spread, or even cosmopolitan genera well represented in the Mediterranean region.

The Azores, the most northern of these groups, appear to have only twenty Compositæ, natives or colonists, the natives all Mediterranean species, except five belonging to the genera *Bellis*, *Tolpis*, *Sonchus*, and *Microrhynchus*, all chiefly or exclusively Mediterranean. Seubert enumerates seven endemic Compositæ; but the *Solidago azorica*, Seub., which is said to form so striking a feature on the sea-coast, is evidently the same as *S. mexicana*, Linn., a maritime plant from the southern coasts of North America, which must be regarded as a colonist in the Azores, although we may have no evidence as to the time or mode of its introduction. It is also believed that Seubert's *Tolpis nobilis* is only a luxuriant large-flowered form of *T. macrorhiza*, DC., from Madeira.

The Canary Islands with Madeira exhibit rather more of the insular character. Out of about 150 species of Compositæ, one half are endemic. Only three genera have that character; but to these might be added the endemic sections *Argyranthemum* of *Chrysanthemum*, *Pericallis* and *Bethencourtia* of *Senecio*, *Clavena* of *Carduus*, *Carlowitzia* of *Carlina*, and *Atractylis Preauxii*, which are all endemic groups of higher than specific value. There are tracts of country within the Mediterranean region, perhaps not of much greater extent, where an equal number of endemic races might be found, but never any thing near so large a proportion, the total number of Compositæ being everywhere much greater than those of the Canary Islands.

The above endemic genera are closely connected with, as the endemic sections and species belong to, Mediterranean genera, with a slight tendency to South-African forms in the genus *Gonospermum* and in some of the species of *Helichrysum* and *Chrysanthemum* and perhaps of *Senecio*. The insular tendency to a more shrubby form than their continental congeners or allies is also exhibited in *Allagopappus*, *Vieræa*, *Gonospermum*, *Chrysanthemum*, *Senecio*, and *Sonchus*; but there is nothing of the arborescent or highly differentiated character of the *Petrobium* of St. Helena, of the *Dendroseris* and others of Juan Fernandez, or of the *Fitchia* of the South-Sea Islands. There are none even of the locally restricted genetically isolated monotypes or small races of which we have noticed so many in the Mediterranean and South-African regions.

The Cape-Verd group has still less of the insular feature in its Compositæ; and the order is so little characteristic of its general vegetation, that it would be unfair to deduce from them any general considerations. The total number is only thirty-eight, including several widely spread Mediterranean species which may prove to be modern colonists. There are no endemic genera or sections; and the few apparently endemic species are of an African character, and may yet be found on the opposite continental coast, although the distance be as great as that which separates the Canary Islands from the opposite mainland.

6. *St. Helena and Tristan d'Acunha.*

The expiring flora of the isle of St. Helena is as remarkable in Compositæ, as in other orders, in its distant connexions. Although nearer to Africa than to any other continent, those Composite denizens which bear evidence of the greatest antiquity have their affinities for the most part in South America, whilst the colonists of a more recent character are South-African. Seven endemic species are known—*Commidendron* four species, *Melanodendron*, *Petrobium*, and *Psiadia*, one each. All, except one species of *Commidendron*, have more or less of the insular arborescent character. *Commidendron* and *Melanodendron* are among the woody Asteroid forms exemplified in the Antarctic-American *Chiliotrichium*, in the Andine *Diplostephium*, and in the Australasian *Olearia*. *Petrobium* is one of three genera, remains of a group probably of great antiquity, of which the two others are *Po-*

danthus in Chile and *Astemma* in the Andes. The *Psiadia* is an endemic species of a genus otherwise Mascarene or of eastern Africa, presenting a geographical connexion analogous to that of the St.-Helena *Melhaniæ* of De Candolle with the Mascarene *Trochetia*.

The remaining Compositæ of the island are species belonging to other countries, and especially South-African. How far they have been introduced in modern times through the agency, direct or indirect, of man, or how far they may be ancient colonists brought to the island by currents, birds, or other causes still in operation or whose action may have ceased, it will perhaps not be possible to determine. The following are those which are said to be well established:—*Gnaphalium indicum* and *G. sylvaticum*?, *Cotula coronopifolia* and *C. australis*, *Siegesbeckia orientalis*, *Eclipta alba*, *Senecio vulgaris* and *S. sylvaticus*, *Osteospermum moniliferum*, *Hypochoeris radicata* and *H. glabra*, and *Sonchus oleraceus*, besides an *Oligocarpus*, which I have been unable to match with the known species, but may yet very likely be found in South Africa with its congeners. Several planted trees, also from various countries, thrive so as to appear wild.

Our knowledge of the plants of Tristan d'Acunha is derived from Dupetit Thouars's Flora of the island in his 'Mélanges,' supplemented by Captain Carmichael in the 12th volume of the Linnean Transactions. He enumerates four Compositæ, of which two, *Chevreulia stolonifera* and *Lagenophora Commersonii*, growing sparingly on the most barren exposed rocks, are Antarctic South-American plants; the other two are weeds of the cleared grounds—one the cosmopolitan *Sonchus oleraceus*; the other *Gnaphalium pyramidale*, Thou., is described as endemic, which, however, is not probable. I know not where any specimen may be preserved to determine the point.

7. Mascarene Islands.

The Composite flora of Madagascar, Mauritius, and Bourbon is of high interest in a phytogeographical point of view, from its evident connexion with the most ancient types of the African continent. Unfortunately it is as yet too little known to found upon it any satisfactory conclusions. The following data are gleaned from De Candolle's 'Prodromus,' and from such specimens as are preserved in the Kew herbarium. It is probable

that many additions might be made from a careful scrutiny of the herbarium of the Jardin des Plantes at Paris, and that much remains yet to be discovered in the interior of Madagascar.

Table 16. *Compositæ of the Mascarene Islands.*

Genera.	Endemic species.	Total.	Connexions.
Vernonia.....	6	7	African.
Centauroopsis	2	2	Asiatic <i>Adenoon</i> , Australian <i>Pleurocarpæa</i> .
Adenostemma .....	...	1	Tropical weed.
Ageratum .....	...	1	Tropical weed.
Rochonia.....	2	2	} African and American homochromous Asteroidesæ.
Glycideras	1	1	
Henricia	1	1	South-African <i>Felicia?</i> or Australian <i>Olearia?</i>
Conyza.....	5	5	Tropical regions generally.
Psiadia.....	16	16	Tropical-African.
Synchodendron.....	1	1	South-African.
Blumea	1	2	Tropical Africa and Asia.
Pluchea	1	2	Tropical Africa and Asia.
Sphæranthus	1	1	Tropical Africa and Asia.
Pterocaulon	1	1	South America, Australia, New Caledonia.
Monarrhenes	3	3	} None very near.
Cylindrocline.....	1	1	
Demidium	1	1	Little known.
Gnaphalium	4	5	African.
Helichrysum	22	22	African and Australian.
Stenocline	16	16	South-American and somewhat African.
Syncephalum	1	1	African?
Stœbe	1	1	South-African.
Athrixia	2	2	African and Australian.
Printzia	1	1	African.
Sphacophyllum.....	1	1	African.
Bojeria	1	1	African.
Aspilia.....	2	2	African and South-American.
Epallage	2	2	South-American (and African?).
Micractis	1	1	African and South-American?
Centipeda .....	...	1	Tropical weed.
Eriothrix.....	1	1	None near.
Faujasia	3	3	African <i>Senecios</i> .
Gynura	2	3	African and Asiatic.
Emilia.....	3	4	Asiatic, 1 tropical weed.
Senecio	30	30	Cosmopolitan and somewhat specially African.
Crepis	1 (?)	2	Tropical weed.
Hieracium	1	1	African (1 species), Europæo-Asiatic, American, &c.
Lactuca .....	...	1	Asiatic.
Microrhynchus.....	1	2	Asiatic and African.
39 genera, of which 15 endemic.	139	151	1 African, 2 Asiatic, 3 Australian, 4 South-American.

The twelve species in the above list which are not endemic may all be regarded as common tropical Old-World weeds, with the exception, perhaps, of the *Pluchea* and the *Gynura* (*Cremonocephalus*), which are African. The Composite flora is therefore almost as strictly endemic as that of the Sandwich Islands. It is also much diversified, with evidences of great antiquity. The genera *Synchodendron*, *Monarrhenes* cum *Cylindrocline*, *Syncephalum*, and especially *Eriothrix* are almost as isolated as any South-African

ones. It further shows insular characteristics in another point, the tendency to a tall shrubby or arborescent form of several of the endemic or prevailing genera.

The connexions of the Mascarene endemic Compositæ are eminently with the southern and subtropical African races, especially those of Madagascar itself; the more tropical races, Plucheinæ &c., may be rather more of an Asiatic type. A slight Australian character is shown in *Centauroopsis*, *Henricia*, *Pterocaulon*, *Helichrysum*, and *Athrixia*, the last two, and possibly *Henricia*, belonging to groups common to South Africa and Australia; the other two genera are more tropical; *Pterocaulon* is Australasian and South-American, but not Asiatic. *Centauroopsis*, of two species, is represented only by two monotypes, *Adenoon* in the East-Indian peninsula and *Pleurocarpæa* in tropical Australia.

8. *New Caledonia.*

This island was not included above among those of the South Pacific on account of the rather more Australian character of its Compositæ. Its vegetable statistics, however, are very much in arrear. We have no New-Caledonian Flora; the rich materials accumulated of late years, especially in the Paris herbarium, have only been very partially worked up. Messrs. Brongniart and Gris have published chiefly the most remarkable among the shrubby and arborescent orders and genera, which, as the chief representatives of the ancient indigenous races, have of course the greatest interest in a phytogeographical point of view. The Compositæ have not been touched; and I am not aware that De Candolle's 'Prodromus' contains any more than the three species published by Labillardière in his 'Sertum.' On a hasty glance with Dr. Hooker some years since over the Parisian collection, it appeared to us that there were about thirty species of Compositæ, at least half of them widely spread weeds of the tropical-Asiatic or Indo-Australian region, including *Ageratum*, *Eclipta*, *Siegesbeckia*, *Xanthium*, &c. These were accompanied by a *Vittadinia*, two or three species of *Pterocaulon* (*Monenteles*), two or three of *Helichrysum* (or *Cassinia*?), one or two of *Gnaphalium*, a *Wedelia* (*Wollastonia*), and a *Glossogyne*, of which the three former genera have more of an Australian than an Asiatic character, the three latter belonging to both countries; and several of these species may prove to be endemic; but we saw nothing, nor have I met elsewhere

with any specimen showing any probability of a New-Caledonian endemic genus of Compositæ, nor do I know of any species assuming an arborescent form. The New-Caledonian connexions with distant lands were probably of an earlier date than the general development and dispersion of Compositæ.

9. *New Zealand and neighbouring Antarctic Islands.*

The flora of these islands has been so well and so recently worked up by Hooker, that little need here be said beyond giving the following.

Table 17. *Compositæ of the New-Zealand group.*

Genera.	Endemic species.	Total species.	Connexions.
Lagenophora	3?	4	Indian archipelago, Australia, extratropical South America.
Brachycome	3	3	Australia, more remote South-African and Mediterranean.
Olearia.....	22	22	Australia, and less close <i>Chiliophyllum</i> , Antarctic South America.
Pleurophyllum	2	2	Endemic genus, allied to <i>Celmisia</i> .
Celmisia	24	25	Australia, and, less close, some Andine <i>Eriogonns</i> .
Vittadinia .....	...	1	Australia, South-Pacific islands, and extratropical South America.
Haastia	3	3	Endemic genus, allied to none nearer than some Mascarene <i>Pluchas</i> or <i>Conyzas</i> .
Gnaphalium	5	8	Cosmopolitan, with forms specially Australian or Indian-archipelago.
Raoulia	12	12	Australia, and Australian <i>Gnaphalia</i> and <i>Helichrysa</i> .
Helichrysum	12	12	General Old World, with types, some endemic, some Australian, some northern.
Cassinia	4	4	Nearer to the South-African section <i>Rhynca</i> than to the Australian species.
Craspedia	1	2	Australia.
Bidens.....	...	1	Cosmopolitan weed.
Cotula	11	13	Australia and extratropical South America.
Centipeda .....	...	1	Cosmopolitan, tropical, and south extratropical weed.
Abrotanella	4	4	Australia and extratropical-South-American.
Erechthites.....	1	4	Australia and South-American.
Brachyglottis.....	1	1	Endemic, but allied to the cosmopolitan <i>Senecio</i> .
Senecio	20	21	Cosmopolitan, and no special New-Zealand section, the non-endemic species Australian.
Microseris .....	...	1	Australia and extratropical South and North America.
Pieris .....	...	1	Cosmopolitan (colonist?).
Taraxacum .....	...	1	Cosmopolitan (colonist?).
Sonchus	1	2	One cosmopolitan (colonist?), the other very distinct.
23 genera, of which 3 endemic.	129	148	1 Australia, 2 extratropical-South America, 3 Indian archipelago and South-Pacific isles.

The usual endemic character of insular flora is shown by the

above Table, although not so absolute as in several of the preceding insular groups. Of the fifteen species common to other lands eight (belonging to *Gnaphalium*, *Cotula*, *Bidens*, *Picris*, *Taraxacum*, and *Sonchus*) are widely spread weeds which may have been earlier or later received by means of transmission still in operation; the remaining seven are Australian, some of them extending also northwards to the Indian archipelago. The common genera with endemic species are also mostly Australian; several, however, are also in extratropical or Antarctic South America, the New-Zealand races forming, as it were, a connecting-link between the Australian and the Chilian regions. The three endemic New-Zealand genera are not very highly differentiated. *Brachyglottis* is near some forms of the cosmopolitan *Senecio*: *Pleurophyllum* and *Celmisia* (which last, the largest New-Zealand genus of Compositæ, is almost, but not quite, endemic) are nearly allied to some Andine forms of *Erigeron*. The Gnaphalioid group is the most exceptional in its relations; the endemic genus *Haastia* appears more nearly allied to those Mascarene species of *Psiadia* or *Conyza* upon which Cordemoy has founded his genus *Frappiera*, than to any other New-Zealand genus. The New-Zealand *Cassinia* have the characters of the South-African section *Rhynea*, rather than of the Australian typical *Cassinia*; and some of the *Helichrysum* forms have their nearest counterparts in some mountain-species of the distant Mediterranean region. *Sonchus*, another northern race, has one well-marked species endemic in New Zealand.

Some of the genera present highly developed shrubby species, but none so arborescent as in some of the preceding more perfectly isolated island groups.

D. COLONIZING COMPOSITÆ OR INTRODUCED SPECIES.

In Compositæ, as in other orders, there are a certain number of species which when carried through the agency of man, intentionally or unintentionally, into distant lands become there established, sometimes even to the exclusion of much of the native vegetation. We might, indeed, have expected in an order where there are apparently so many provisions for the dispersion of the seeds, and where we so frequently observe the greatest readiness in germination, that such colonization would be very extended. But when the list has to be made out, it is by no means a long one; such species appear to be fewer in proportion

than in herbaceous Papilionaceæ, Labiateæ, and some other orders not endowed with any specially evident facilities for dispersion.

I cannot reckon above seventy species which have in recent times naturalized themselves in countries distant from their own. I must, however, acknowledge that the following lists may be very imperfect. It would require much more time than I have been able to bestow to glean the necessary data from the multitudinous publications in which they are noted, and still more to form a correct idea of the value of these data. Local botanists, and especially travelling collectors, rarely distinguish between a single apparently wild individual which may have been planted, or may have once or twice sprung up without further propagation and a well-established weed. These lists, however, such as they are, may be sufficient to found some considerations on the specific qualifications best suited for successful colonization, and which may be taken as supplementary to the elaborate treatment of the general subject in the second volume of A. De Candolle's 'Géographie Botanique,' more especially to the head of "Naturalisation à grande distance," p. 709.

We may, in the first place, distinguish escapes from cultivation and weeds of cultivation—the former being plants specially introduced by man for ornament or use, and which have spontaneously spread from the spots where he had planted them; the weeds of cultivation including all those which man had unintentionally transported, either mixed with the cultivated seeds or attached to goods transmitted, or with ballast, or other means connected with transmarine or terrestrial overland traffic.

Table 18. *Composite escapes from Cultivation.*

Species.	Where established.	Qualifications.
<i>a. of American origin.</i>		
<i>Aster salignus</i>	Marshes and wet places in many parts of Europe.	Pappus. Marsh-plant.
<i>Aster Novi Belgii</i> and a few others.	Europe, chiefly Germany, banks of streams.	Pappus; persistent root.
<i>Solidago canadensis</i>	Europe and some other temperate countries.	" "
<i>Zinnia</i> , two or three species or varieties.	Atlantic islands, tropical and subtropical Africa and Asia.	Abundance of seed; ready germination?

Species.	Where established.	Qualifications.
<i>a. of American origin.</i>		
Coreopsis tinctoria	East India.	Abundance of seed ; ready germination ?
Gaillardia, sp.	East India.	
Cosmos sulphureus	East India.	
Tagetes erecta or Tagetes patula.	Atlantic islands, Africa, East India.	
<i>b. of European origin.</i>		
Inula Helenium	North America.	Pappus ; persistent root.
Tanacetum vulgare	North America.	Abundance of seed ; persistent root.
Artemisia Absinthium.....	North America.	Abundance of seed ; persistent root.
Chrysanthemum coronarium and C. carinatum.	East India.	Abundance of seed and ready germination.
Matricaria Parthenium ...	North America.	Abundance of seed ; persistent root.
Calendula officinalis	South Africa.	Ready germination ; adherence.
Carthamus tinctorius	East India.	Vitality of seed ? ready germination ?
Tragopogon porrifolium ...	Australia.	Pappus ; persistent root.

Of the above fourteen species or groups of species four or five only appear to be endowed with any special facilities for being carried beyond the limits of the gardens they had been cultivated in to localities suitable for their preservation. The remainder, apparently limited to the ordinary chances of transport, have either had those chances multiplied by their great fertility, or have been better able to avail themselves of them by some such qualifications as long-preserved vitality, external protection, hardiness or persistence when once established, &c., which may be more conveniently discussed under the following head of weeds of cultivation.

Table 19. *Composite weeds of cultivated and waste places of foreign origin.*

Species.	Where established.	Qualifications.
<i>a. of American origin.</i>		
Solidago mexicana	Atlantic Islands (Azores).	Pappus. Maritime plant.
Aster annuus	South and Central Europe, East India.	Pappus ; abundance of seed.
Erigeron canadense	All temperate and warm countries.	Pappus ; abundance of seed.

Species.	Where established.	Qualifications.
<i>a. of American origin.</i>		
Erigeron bonariense.....	Africa.	Pappus; abundance of seed.
Gnaphalium purpureum...	East India, Australia.	Pappus; abundance of seed; adherence?
Lagascea mollis	Tropical Asia and Africa.	
Xanthium spinosum	Europe, East India, Australia.	Adherence, vitality, and protection of seed.
— macrocarpum and allies.	Europe.	Adherence, vitality, and protection of seed.
Bidens pilosa and Bidens bipinnata.	Most warm countries.	Abundance of seed; adherence.
Synedrella nodiflora	East India.	
Galinsoga parviflora.....	Europe, East India, Australia.	Abundance of seed, ripening with corn.
Tridax procumbens	East India.	
Soliva	Portugal, Australia, Chili.	Adherence. Maritime plant.
<i>b. of European origin.</i>		
Filago germanica.....	North America.	Pappus; abundance of seed; adherence?
Anthemis Cotula	North America, Chili, Australia.	Abundance of seed, ripening with corn?
— arvensis	North America, Chili.	Abundance of seed, ripening with corn?
Achillea ptarnicea	North America.	Persistent root.
— millefolium	North America.	" " "
Matricaria Chamomilla ...	North America.	Abundance of seed, ripening with corn?
Chrysanthemum segetum...	South Africa, Australia.	Abundance of seed, ripening with corn?
— leucanthemum.....	North America, Chili.	Persistent root.
Tussilago Farfara.....	North America.	Pappus; persistent root.
Senecio vulgaris	North America, South Africa, Chili.	Pappus; abundance of seed.
Arctium Lappa.....	North America.	Adherence; vitality of seed.
Carduus marianus	Australia.	Pappus; vitality of seed?
Cnicus lanceolatus	North America, Australia, Chili.	" " "
— arvensis	North America, Chili.	Pappus; vitality of seed; persistent root.
Onopordon acanthium.....	North America, Australia.	Pappus; vitality of seed; persistent root?
Cynara Cardunculus	Extratropical South America, Australia.	Pappus; vitality of seed; persistent root.
Carthamus lanatus	South Africa.	Pappus; vitality of seed.
Centaurea nigra	North America.	Vitality of seed?
— Cyanus.....	North America, South Africa.	Vitality of seed? ripening with corn.
— solstitialis and melitensis.	North America, South Africa, Chili, Australia.	
— Calcitrapa	North America, Australia.	Adherence; vitality of seed? maritime habitat.

Species.	Where established.	Qualifications.
<i>b. of European origin.</i>		
<i>Carbenia benedicta</i>	North America, South Africa, Chili.	Vitality of seed?
<i>Lapsana communis</i>	North America.	Abundance of seed.
<i>Arnoseris pusilla</i>	Tasmania.	” ”
<i>Pieris hieracioides</i>	Most temperate regions.	Pappus.
<i>Leontodon autumnale</i>	North America.	”
— <i>hirtum</i>	Australia.	”
<i>Hypochoeris glabra</i>	Most temperate regions.	”
— <i>radicata</i>	Australia.	”
<i>Taraxacum dens-leonis</i> ...	Most temperate regions.	Pappus; persistent root.
<i>Sonchus oleraceus</i>	Most temperate and sub-tropical regions.	Pappus.
— <i>arvensis</i>	North America.	”
<i>Lactuca saligna</i>	Australia.	”
<i>Urospermum picroides</i> ...	South Africa.	”
<i>c. of South-African origin.</i>		
<i>Helichrysum foetidum</i>	Atlantic Islands, West France.	”
<i>Cotula coronopifolia</i>	Various temperate regions.	Maritime station.
<i>Osteospermum moniliferum</i> .	St. Helena.	Vitality of seed?
<i>Cryptostemma calendulaceum</i> .	Australia (South-west Europe?)	
<i>Tripteris clandestina</i>	Australia.	

To the above list might perhaps be added from the species common to the New and the Old World, Table 4, *Sparganophorus*, *Elephantopus*, *Adenostemma*, *Ageratum*, *Epaltes*, *Ambrosia*, *Siegesbeckia*, *Eclipta*, all probably colonists in the Old World from America, although perhaps previous to and independent of human traffic. We should then have about sixty Composite weeds carried by various causes, including the unintentional agency of man, to distant lands, and there naturalized, about $\frac{2}{3}$ per cent. of the total number of known Compositæ. It would be interesting to ascertain what are the special qualifications and properties which have enabled these few alone to profit by facilities which would seem to have been equally offered to a large proportion of the $99\frac{1}{3}$ per cent. which have remained within their own areas, or have only spread gradually and continuously. These qualifications or properties can, however, in many instances be but conjectural, and require much experimental investigation; and it may, moreover, in each case require a combination of many and varied peculiarities to ensure success.

First, as to means of transport. In the case of Compositæ a

most obvious one to the casual observer is the pappus, enabling the seed* to be carried off by winds. But A. De Candolle, in his above-mentioned 'Géographie Botanique,' had already shown how inefficient this is for transport across seas; and his views have been fully confirmed by the observations of Kerner. The most violent winds will not carry them above two or three miles; the moment the pappus gets into a damper atmosphere it collapses, and when once the seed has fallen to the ground it is very rarely again raised by the wind. The most that the pappus does to assist the species in its migration is to carry the seed to a short distance from its parent and deposit it in running water, on bales of goods, on soil to be taken as ballast, or in other places where it has a chance of being carried further by other means. That the pappus, indeed, is really and solely a provision for the transport of the seed will scarcely be maintained when we consider, first, that in the great majority of more or less unisexual Compositæ the pappus is much more developed on the male or sterile achenes than on the female fertile ones, and that in a large number of Cynaroidæ, and even in many Cichoriaceæ, the pappus separates so readily from the achene that the down we see floating in such quantities over a field of thistles has, for the most part, left the achene enclosing the seed behind. So little, indeed, does the pappus really assist the emigration of species, that we find in the above list of sixty colonists only twenty-two or twenty-three, or but little above one third, possessing an available pappus; whilst in the total number of known Compositæ more than two thirds are so endowed.

Adherence to moving or moved objects by means of hooked points, spines, glutinous exudations, intricate scabrous-fibred wool, &c. is a well-known cause of the transport of Composite fruiting heads, and has so much assisted, for instance, the spread of *Xanthium* and other nuisances; but even that alone is not so frequent as is supposed. Some half a dozen only of the above list have adherent heads, a few more (*Bidens*, *Calendula*, *Adenostemma*) have adherent achenes; and adherence alone is quite insufficient. Many Composite burrs, such as *Acanthospermum*, have but a comparatively limited area. As in Boragineæ, the burr-nutted *Echinosperrmums* are, as a rule, much less generally diffused than the smooth-nutted *Myosotises*; so, in Compositæ, *Arctium lappa* migrates much less than *Cnicus arvensis*; *Calotises* have a more limited area than many *Brachycomes*.

* I use the word "seed" here in the popular sense, which, in Compositæ, is the botanical achene, including the inseparable pericarp.

The ripening the seed at the same time as the corn or other cultivated seed-crop with which the plant has become mixed is a great assistance to the transport of cornfield-weeds, their seed being usually gathered, mixed, and carried with that of the cultivated plant. Cornfield-weeds, however, are not so numerous in Compositæ as in Papilionaceæ, Caryophyllæ, &c.: *Anthemis cotula* and *arvensis*, *Matricaria chamomilla*, *Chrysanthemum segetum*, and *Centaurea cyanus*, amongst the European ones, and the American *Galinsoga* are the principal ones; and perhaps some of the tropical weeds similarly deprived of any serviceable pappus, such as *Eclipta*, may owe their wide dissemination partly to their ripening their seeds with those of the cultivated crops.

The stations affected by certain species may be such as to place them specially within reach of means of transport, as, for instance, maritime plants, which are often carried out across seas to great distances, probably in some measure connected with navigation and commerce. In Compositæ *Solidago mexicana*, *Soliva*, *Cotula coronopifolia*, *Centaurea melitensis* and *calcitrapa* may owe their disjointed areas to this amongst other causes.

Great fertility, the very abundant production of small seeds, is most serviceable in multiplying the chances of some of them being seized upon by extraneous means of transport, as well as in establishing a plant when transported. This may be specially exemplified in the dispersion of annuals to short distances, as in the case of the annuals escaped from cultivation in table 18, and of the rapid establishment of *Ageratum*, *Erigeron canadense*, &c. when carried to great distances, as well as of the sudden appearance from nearer homes of such extraordinary numbers of *Blumeas*, *Conyzas*, *Erigerons*, *Senecios*, &c. in newly cleared ground or drained lakes.

Of the various other means of transport and facilities offered to plants fitted for availing themselves of them, commented upon by Alphonse De Candolle, Darwin, and others, no special instances calling for remark have occurred to me in Compositæ. It is not, however, enough for the seed to be carried to a new spot; when there, the seed and the plant to proceed from it must present qualifications and properties enabling them to germinate, grow, and multiply.

Ready germination is often highly serviceable. Small seeds arriving in great numbers have usually great obstacles to overcome, many enemies to contend with. If the physical and meteorological conditions of the soil they are deposited upon are not favourable

at the time of their arrival, or if their germination is slow when the conditions are such as to produce it, the chances are that the seeds will have died or have been destroyed before they have fixed themselves in the soil. The rapid germination of small seeds is probably an essential condition of the above-mentioned sudden appearance of large numbers of *Blumeas* and others, and enables certain plants, which chance has thus brought, immediately to take almost exclusive possession of cleared grounds, fresh turned-up soil, drained lakes, &c., as in the case of the *Senecio* that covered the bed of the lake of Haarlem the first year after the water was drained off. Marsh and aquatic plants, when of ready germination, enjoy peculiar facilities for establishing themselves; for, as a rule, they find the physical conditions almost at all times and seasons equally favourable for their germination. These plants are rare in Compositæ; and a considerable proportion of those that are known (*Sparganophorus*, *Enhydra*, *Aster acris*, *A. salignus*, &c.) are amongst the widely dispersed or amphigeous plants or distant colonists. Ready germination is probably also an essential element in the spread of annual escapes from cultivation.

Where seeds are few or of slow germination, great vitality and external protection are most useful; and these, more even than the burr-like facilities for transport, have probably effected the noxious multiplication of the *Xanthiums*. Securely encased in a bony envelope, which may defy the efforts of most of its enemies to reach the scanty food within, the seed may await the occurrence of favourable conditions for germination, through successive seasons which would utterly destroy myriads of the smaller unprotected seeds. Similar causes may perhaps similarly facilitate the establishment of some of the *Centaureas*, which have usually but few good achenes enclosed in their hard prickly involucre.

But successful germination, however abundant, is not sufficient to establish a colonist if it has not among its inherent properties those which will enable it to hold its own against the numerous enemies which will attack it, the numerous rivals which will dispute the possession of the soil. Enormous reproduction is insufficient without individual tenacity of life. The *Senecios*, *Blumeas*, *Erigerons*, *Conyzas*, which may cover new ground and produce their seed a thousandfold, ten thousandfold, or more, may succumb in the course of a few years to the individually vigorous denizens that may gain a footing amongst them, in the same manner as we see vigorous foreigners (like *Cryptostemma* in

Australia and *Xanthiums* in South Europe) in certain situations smother out the native vegetation. *Xanthiums*, indeed, amongst annuals, and probably also *Erigeron canadense*, appear to possess this individual vitality to a very great degree. *Xanthium strumarium*, a great nuisance in the southern vineyards, on account of the disagreeable flavour it is supposed to or actually does impart to the wine, however carefully hoed up will, if left on the soil, most readily take root again and grow. But perennials with creeping roots or underground rhizomes capable of sending up shoots from any small portion left in the soil enjoy and avail themselves of this vitality in the highest degree; and this, much more than the supposed efficiency of the pappus, appears to be the great cause of the extension of such plants as *Tussilago farfara*, *Cnicus arvensis*, *Taraxacum dens-leonis*, &c.

The introduction and establishment of colonizing plant-races is now proceeding so rapidly, especially in new countries such as Australia, New Zealand, central and western North America, &c., and the attention of local naturalists is so generally called to it, that we must expect numerous observations in correction of many of the foregoing conjectures, and in elucidation of the theories of the changes which are now taking place, and have from time immemorial taken place, in the vegetation and plant-distribution over the surface of our globe.

CONCLUSION.

If, after summing up the data collected in the foregoing pages, we attempt any general conclusions as to the special fatherland of Compositæ, their original birth-place, the history of their migrations, and their present homes of predilection, all that we can put forward as plausible conjecture is:—that Africa, West America, and possibly Australia possessed the order at the earliest recognizable stage, Africa showing the greatest variety of individual isolated remnants of extinct races, Andine America and some of the scattered islands showing a few of what may be deemed the nearest approach to what we have conjectured to have been the primitive form of the order; that at this early period there must have been some means of reciprocal interchange of races between these regions; that, since the disruption of this intercourse between the two great divisions of the globe, there must have been for a time a certain continuity of Composite races across the tropics from south to north, a continuity which was

probably further prolonged in America than in the Old World; that as *Compositæ* began to disappear from these tropical regions which thenceforth opposed to them impassable barriers, they became rapidly differentiated and multiplied both northward and southward, with greater structural divergences in the Old World than in the New, owing to the isolation being more complete in the former than in the latter; that those forms, those more or less differentiated races which had reached and accommodated themselves to high northern latitudes or mountain altitudes retained some means of communication and interchange between the Old and the New World long after it was broken off in the warmer parts of the globe; and that the homes where *Compositæ* now flourish in the greatest luxuriance of specific variety and individual numbers appear to be, tropical America exclusive of the great alluvial low grounds and forest regions, the United States, South Africa, the Mediterranean region, West Central Asia, and extra-tropical Australia.

The above paper had already been ordered for printing by the Council of the Linnean Society, and the corresponding portion of the 'Genera Plantarum' placed in the printer's hands, when I received from Mr. C. B. Clarke, who has for many years been studying on the spot the flora of Bengal, a detailed enumeration of the *Compositæ* of that province, with many valuable notes on their synonymy and on the circumscription of their genera and species. The views expressed in this paper so far coincided with those I had already entertained in working up the order, that I did not think it worth while to enter into the reexamination which would be necessary for a careful comparison; but as it was only fair to Mr. Clarke that he should have due credit for his investigations, I read his letter at a meeting of the Society, and applied to him for leave to print his observations as an appendix to the present notes. He has, however, observed in reply that his communication was only intended as an aid to me in working out the order, and not sufficiently matured for publication in its present form. Acknowledging, therefore, the full value of these critical notes, I have reserved them for the use of the editors of the new 'Flora Indica,' now, it is hoped, in a state of steady progress.

Note to Mr. CURREY's paper on *Cunninghamia infundibulifera*.

SINCE the above paper was published, it has been suggested to me that the existence of the Coniferous genus *Cunninghamia* will prevent the adoption of that name for the Fungus which I have described, and I propose, therefore, to call the plant *Choanephora Cunninghamiana**.

* From *χοάνη*, a funnel.

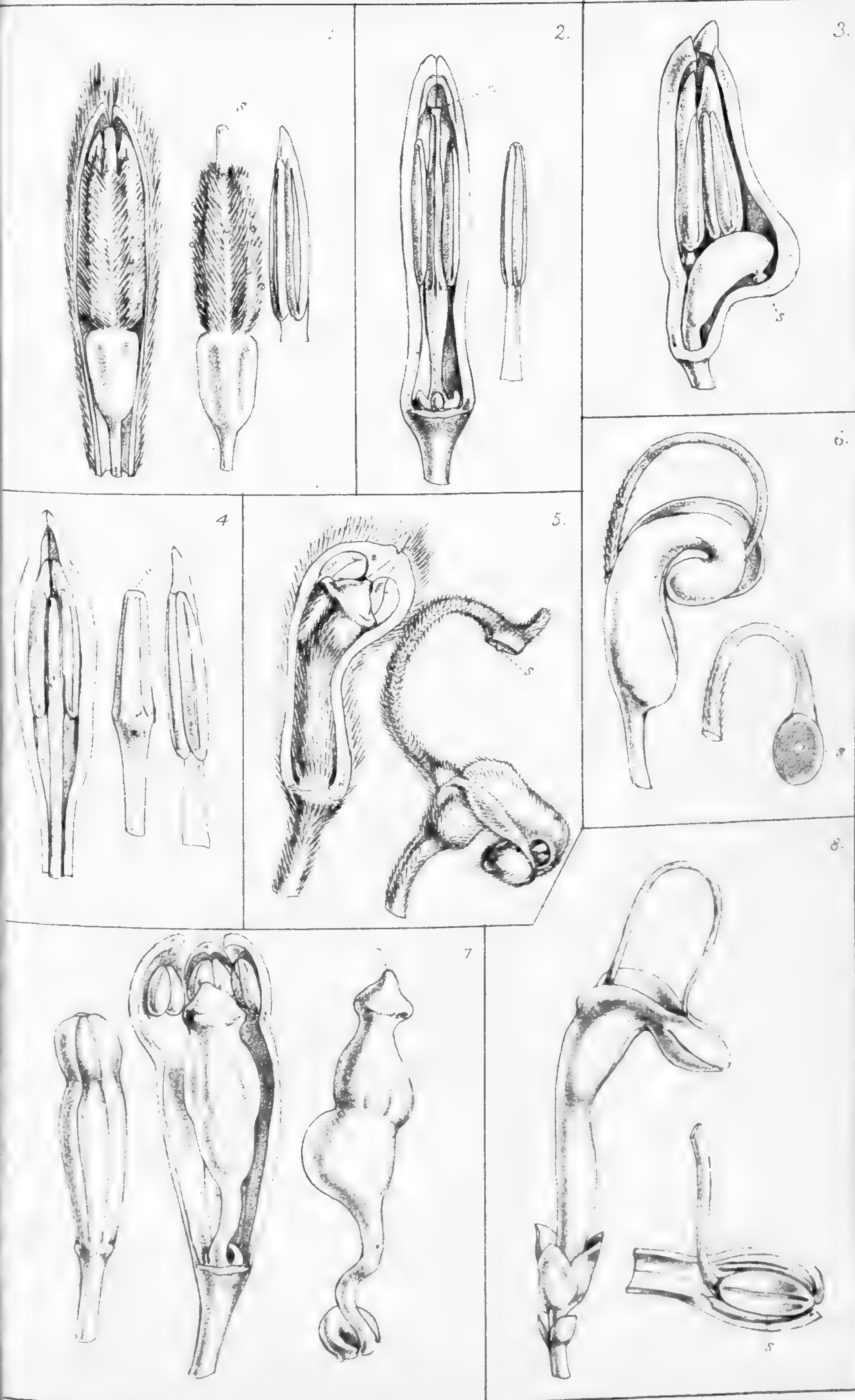
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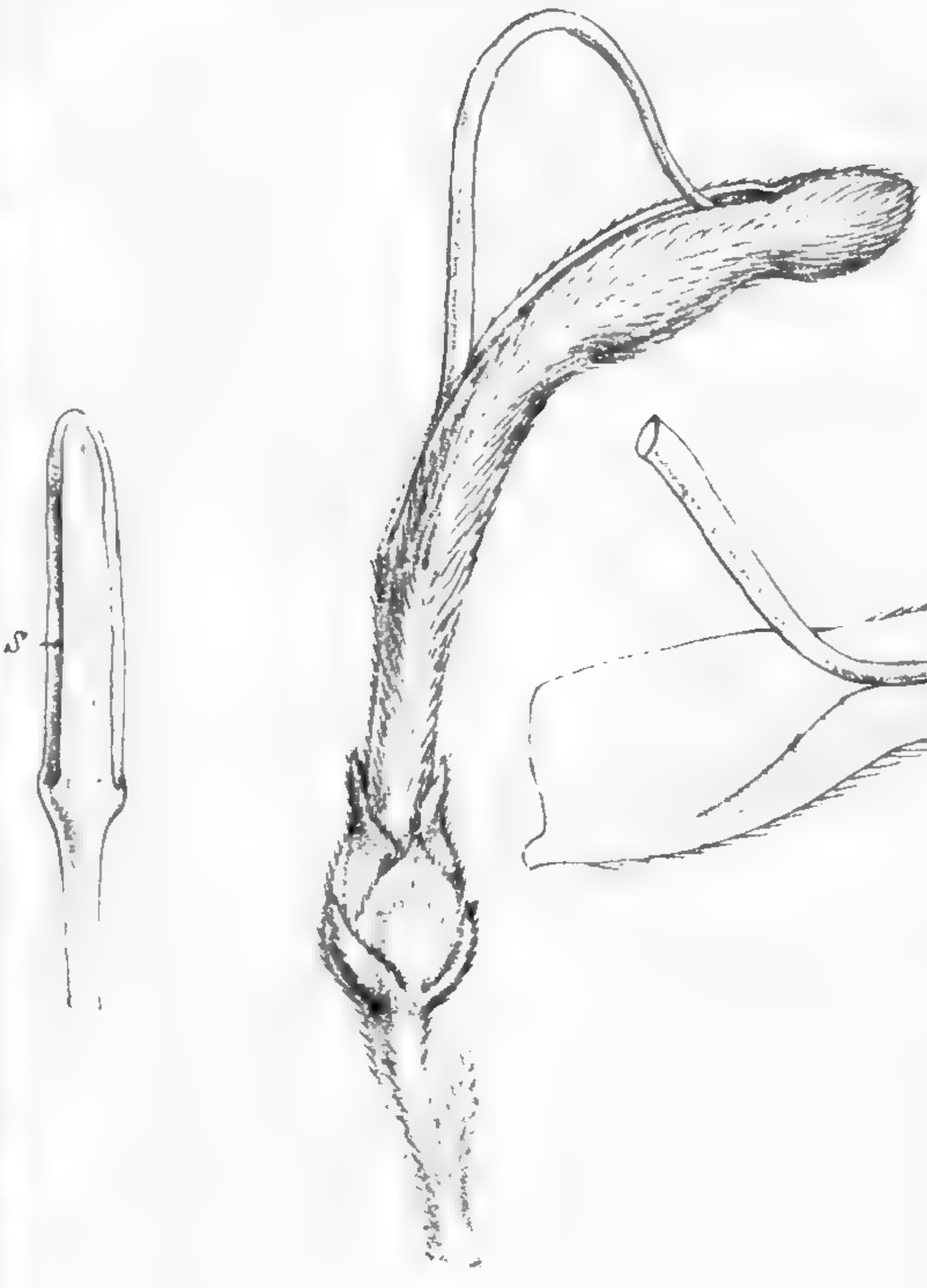
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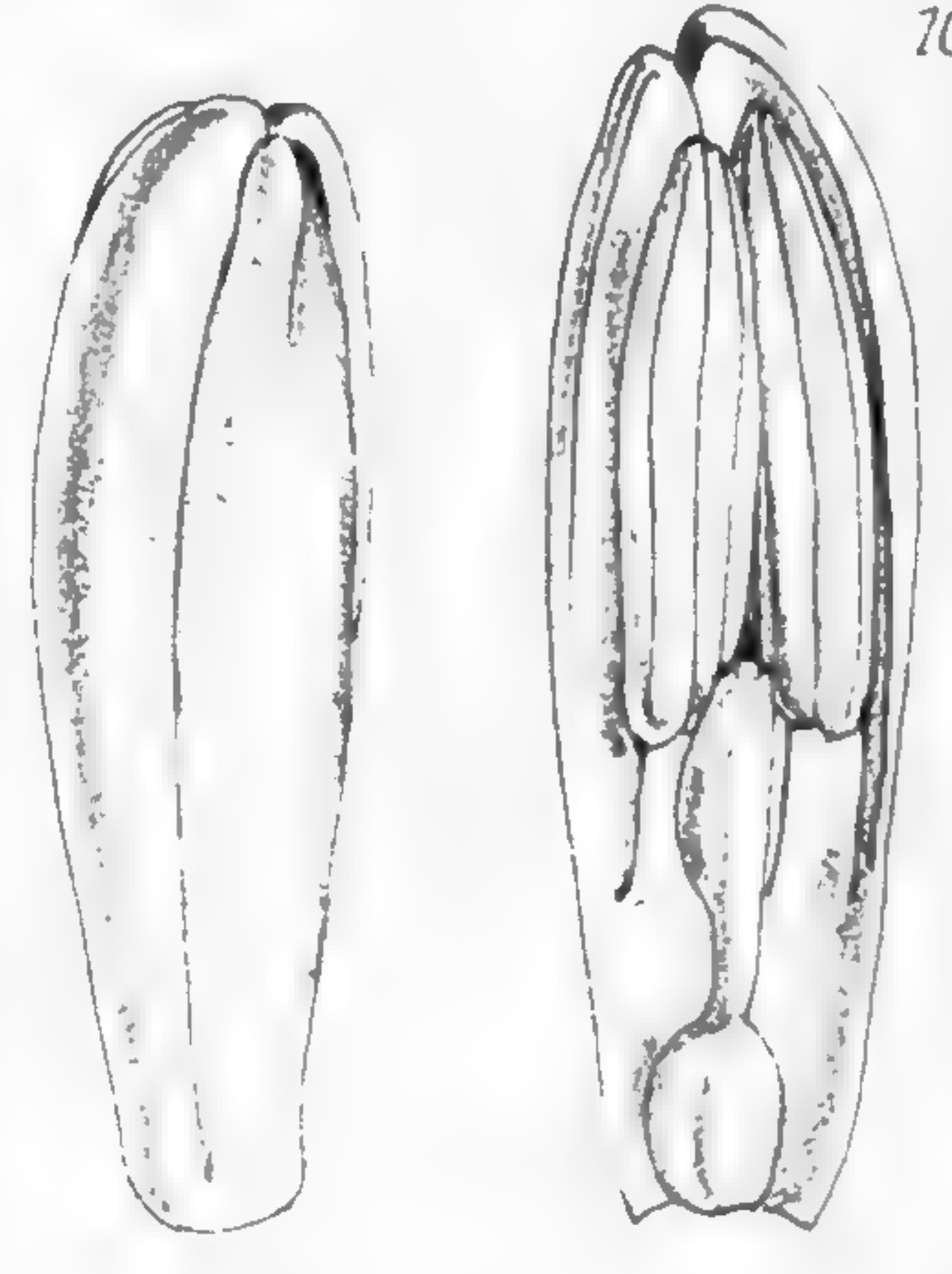
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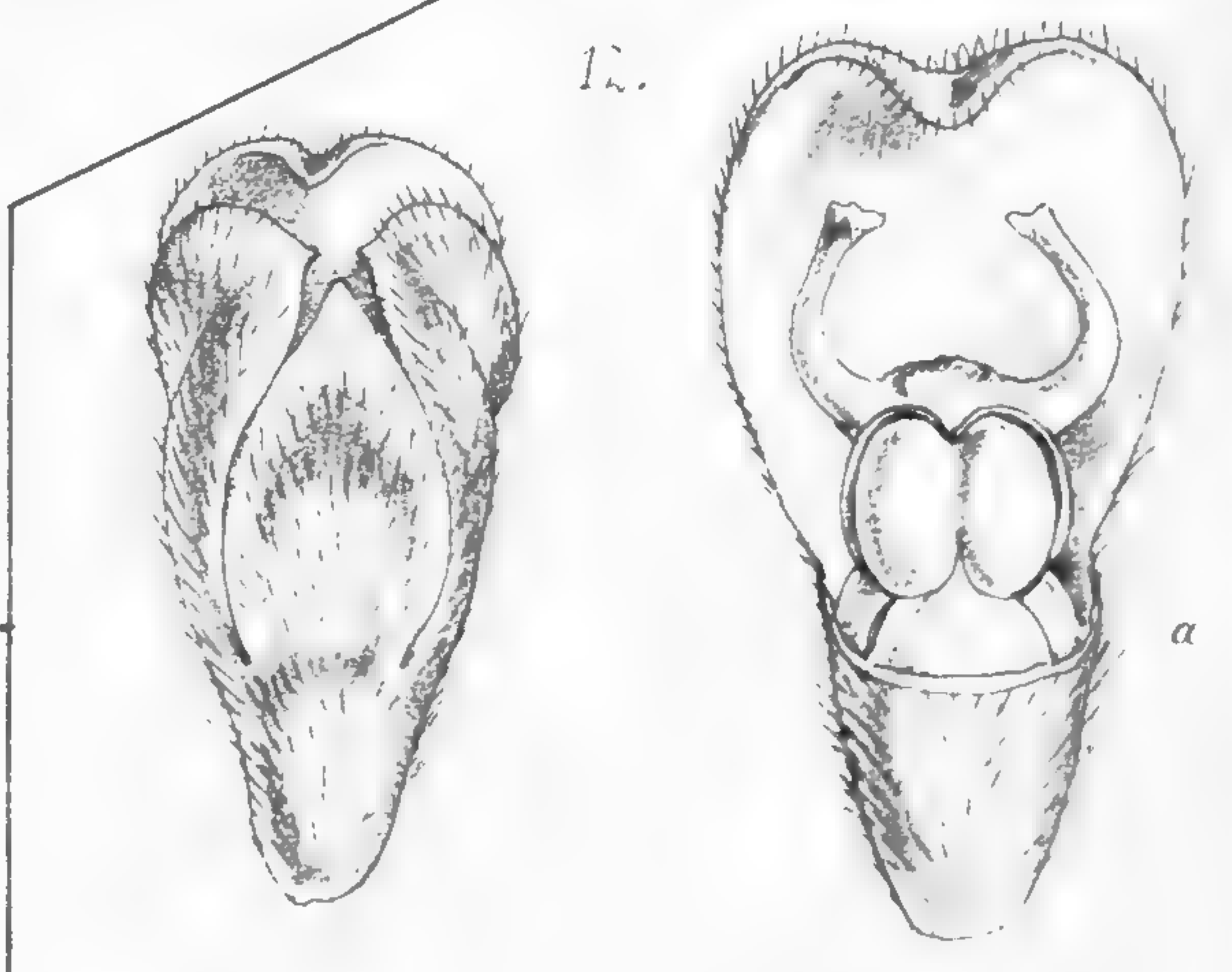




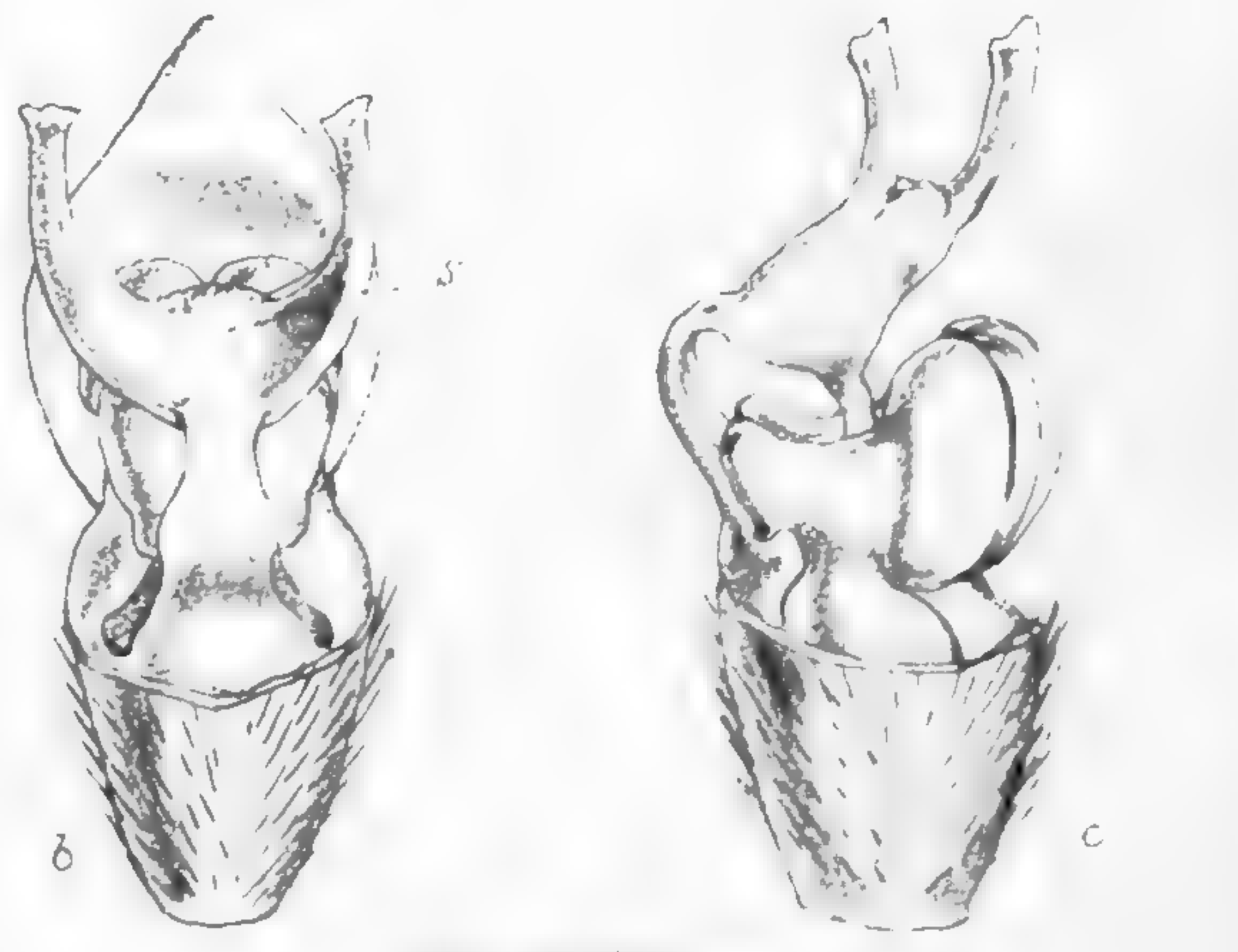
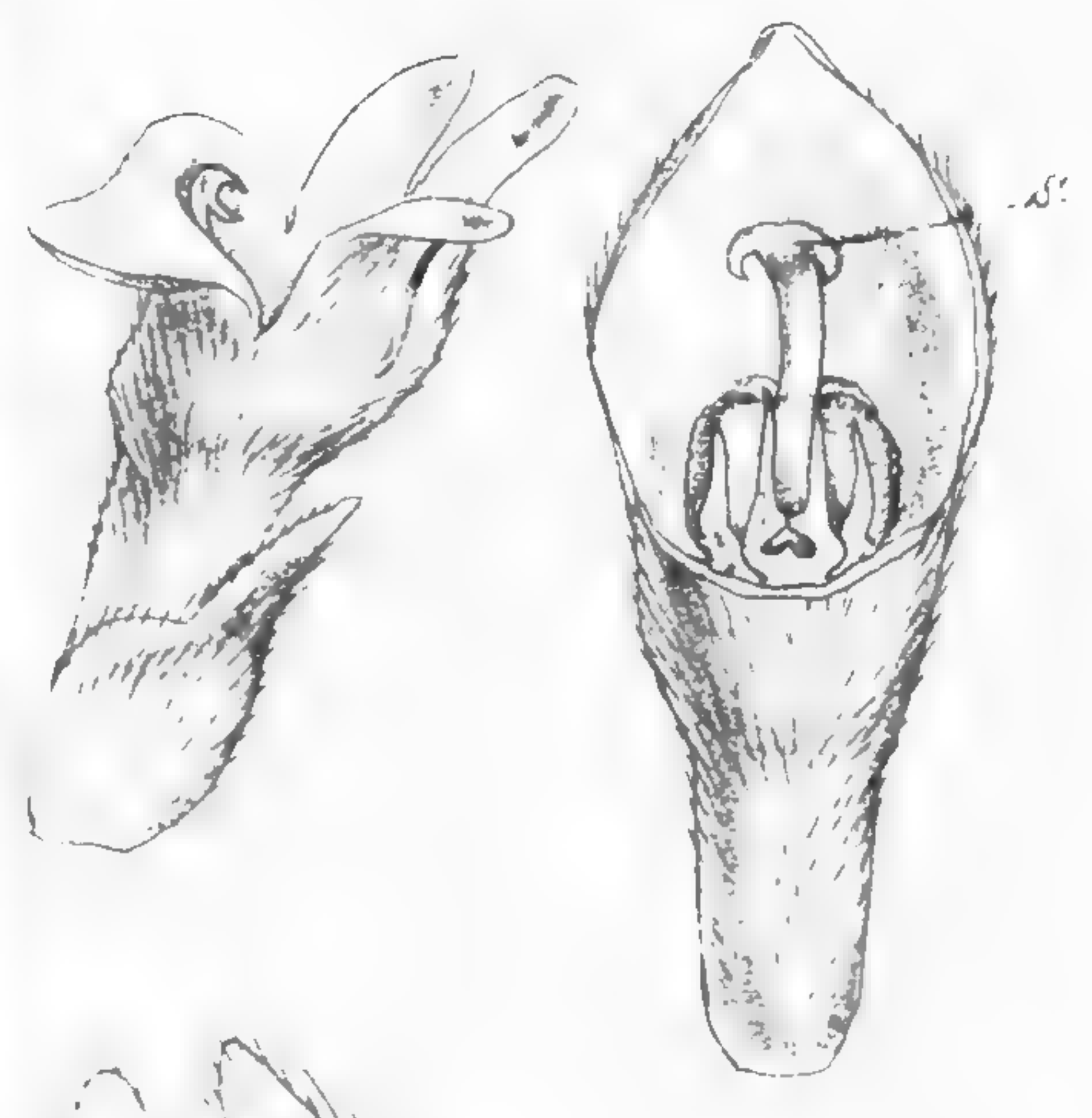
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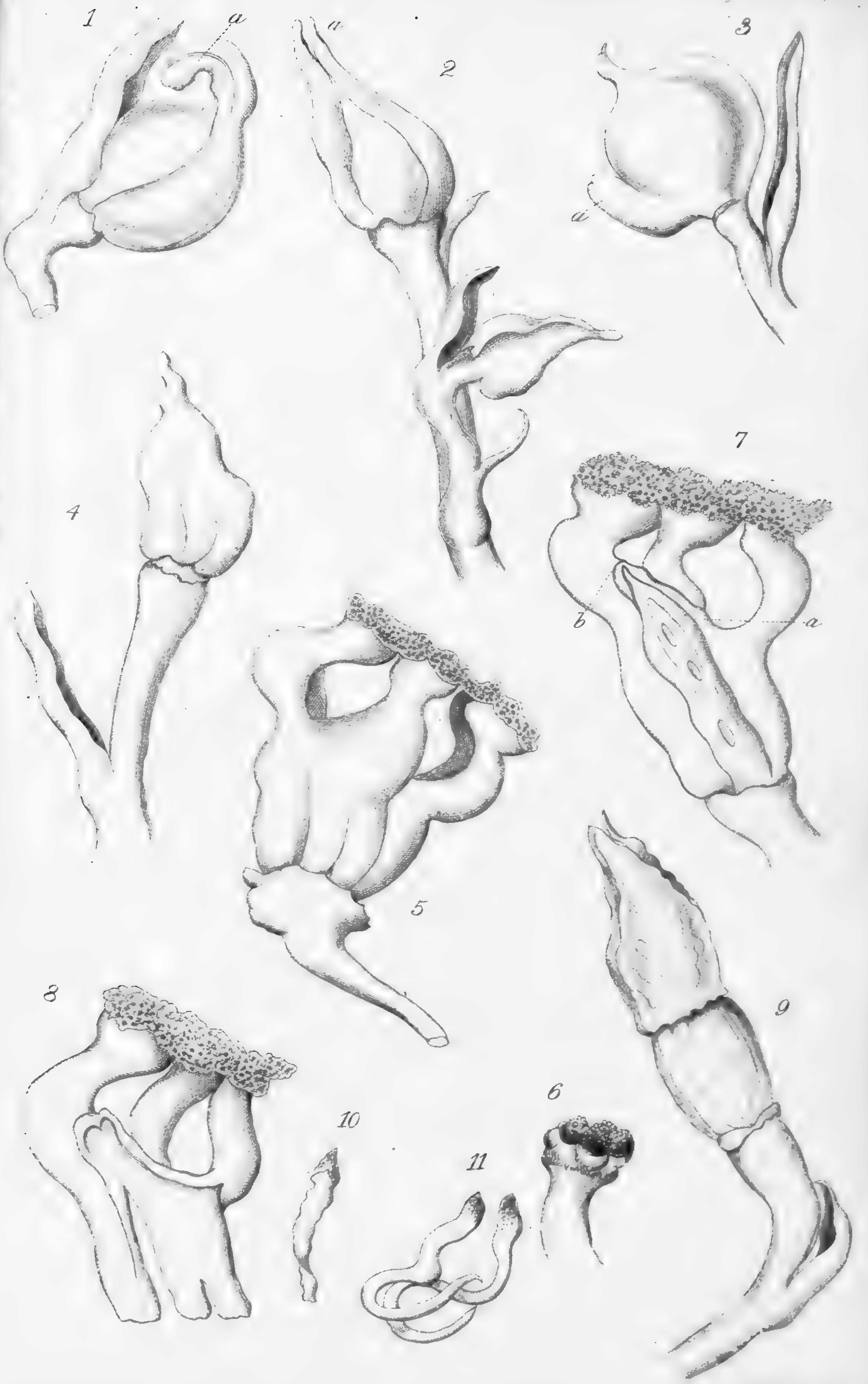


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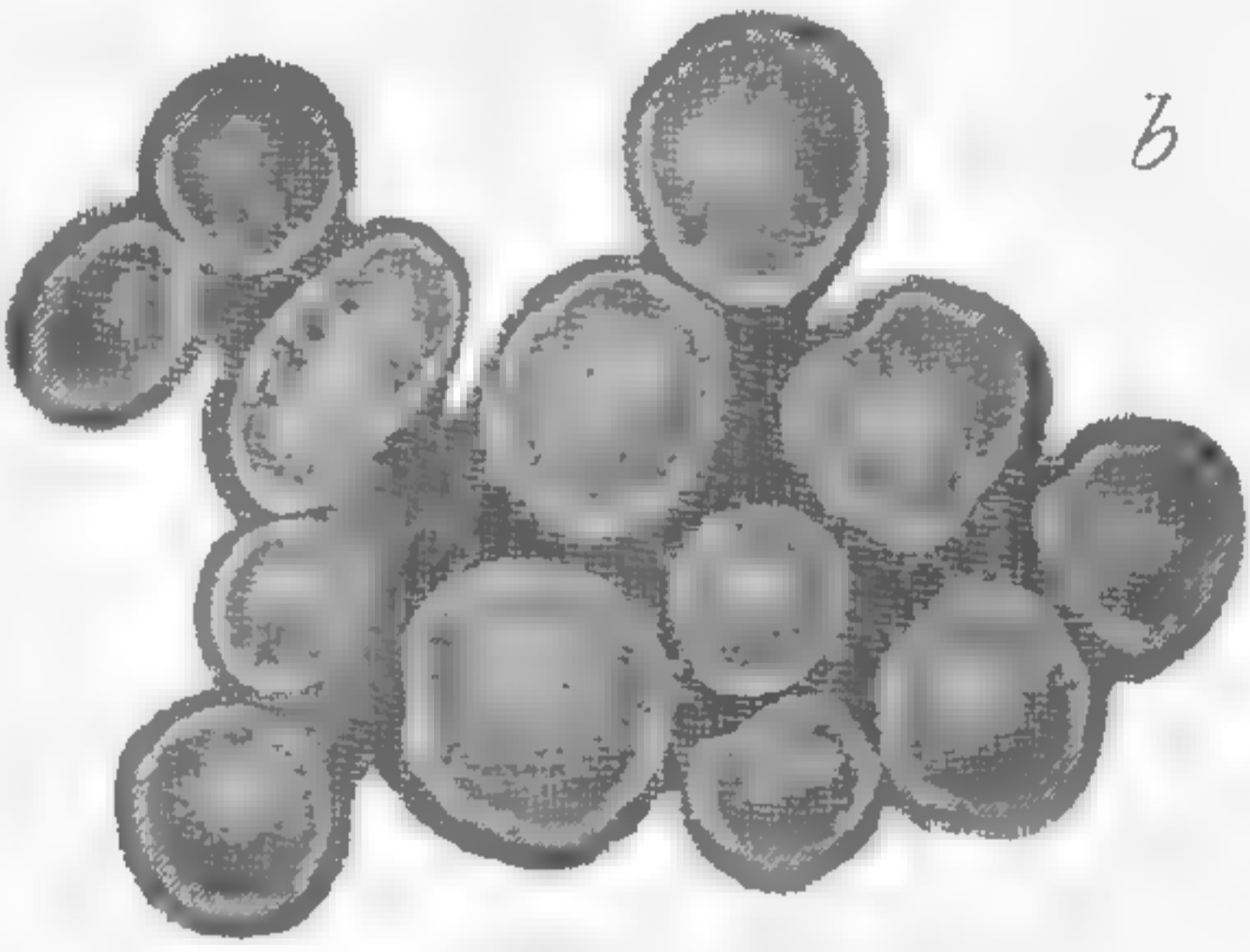
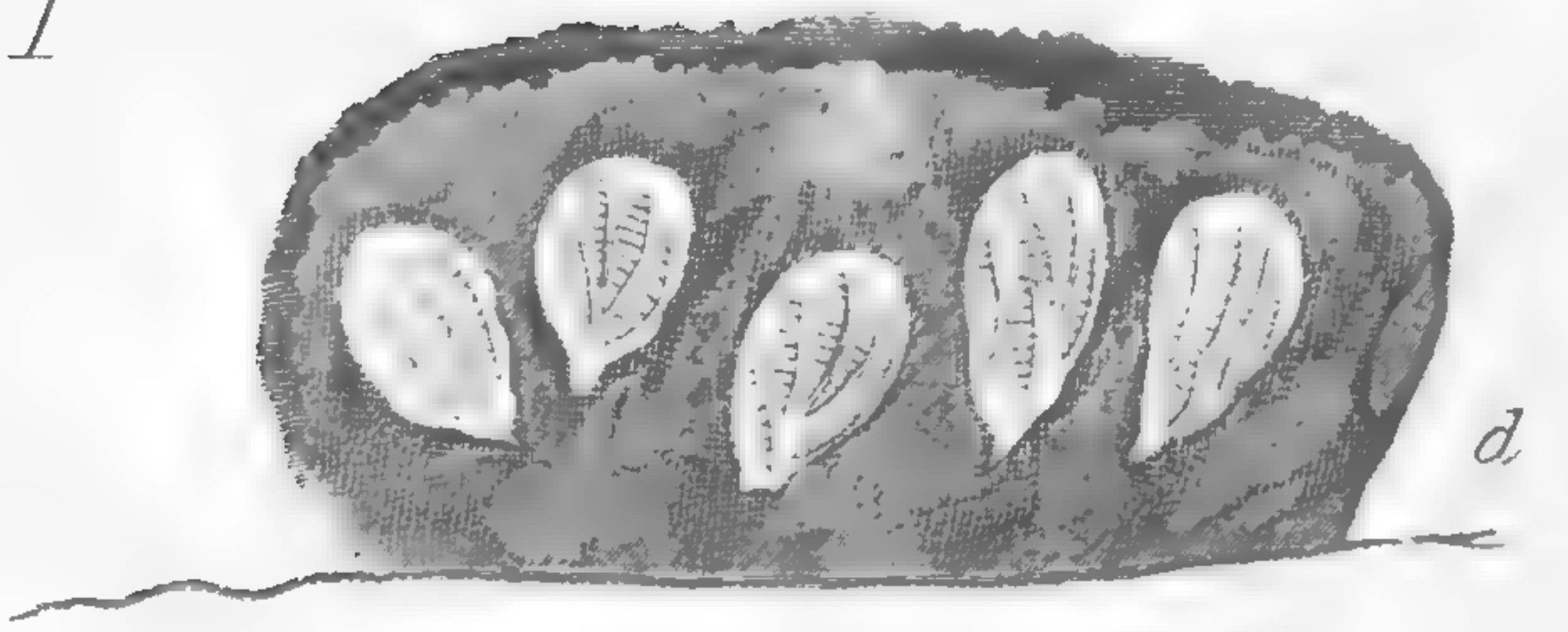
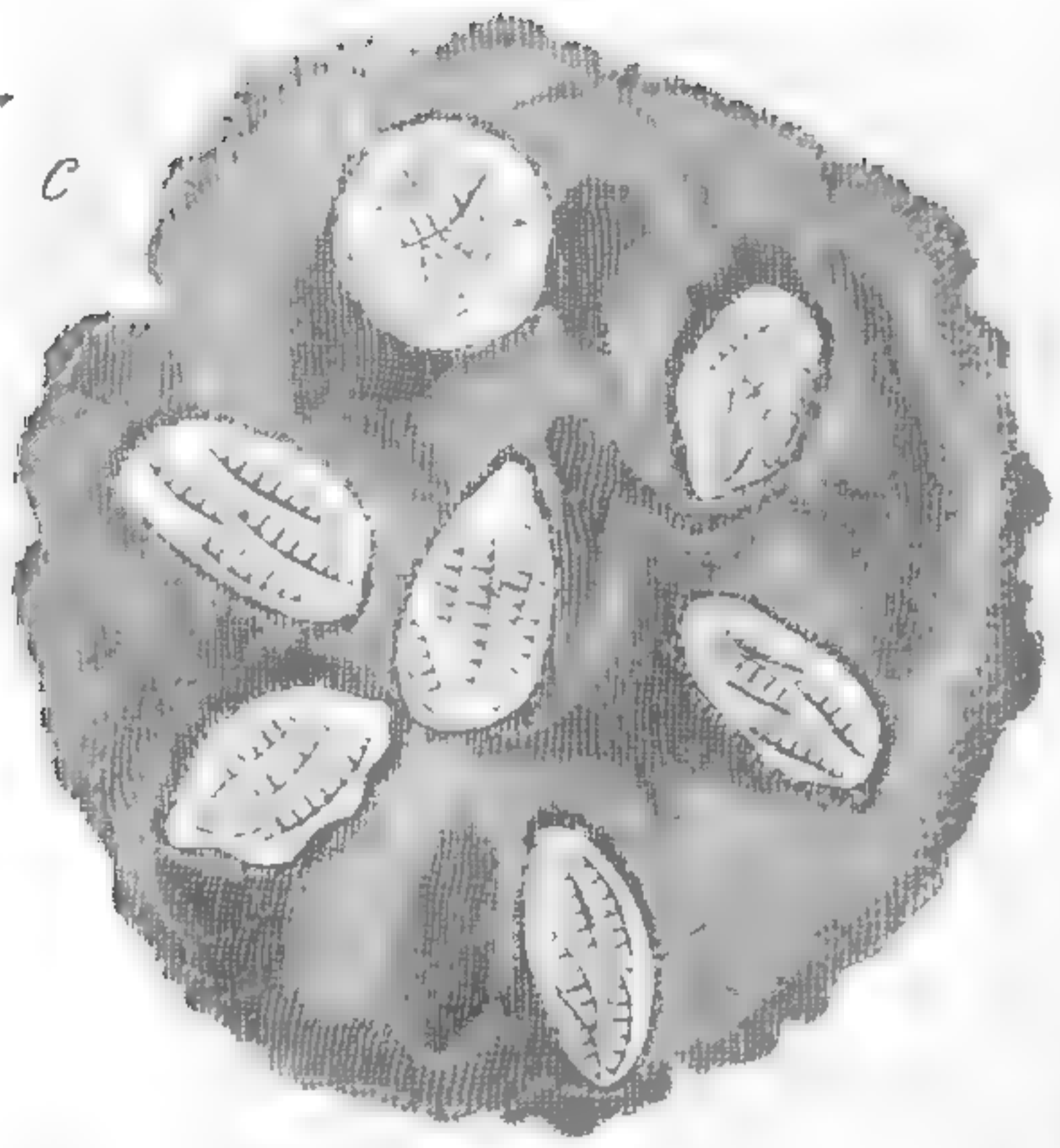


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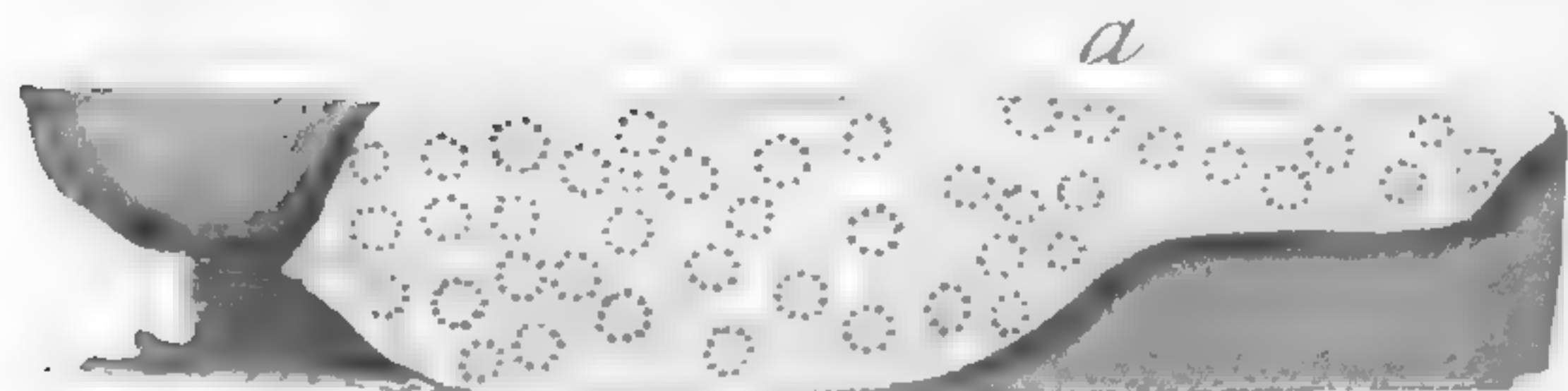
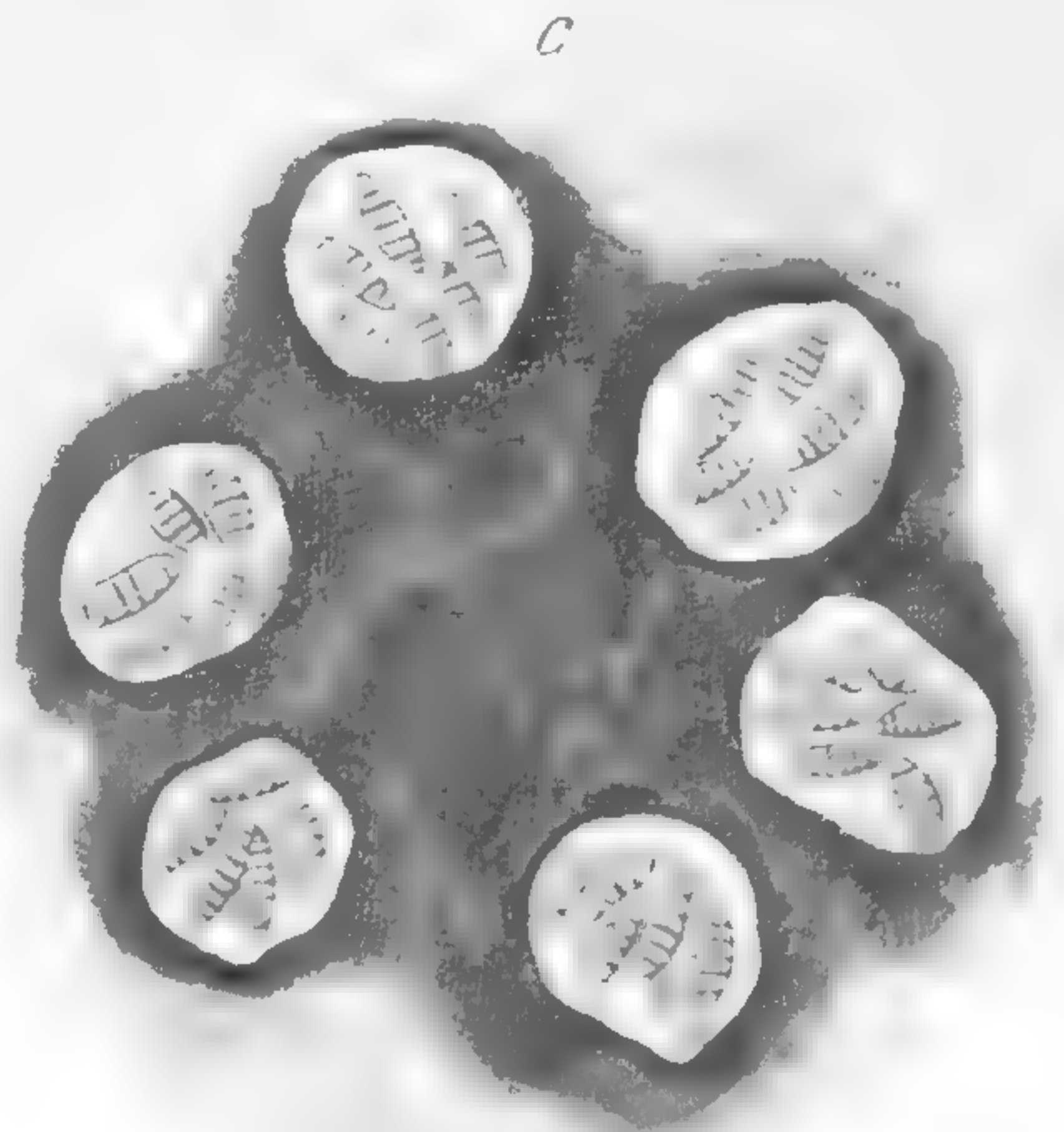
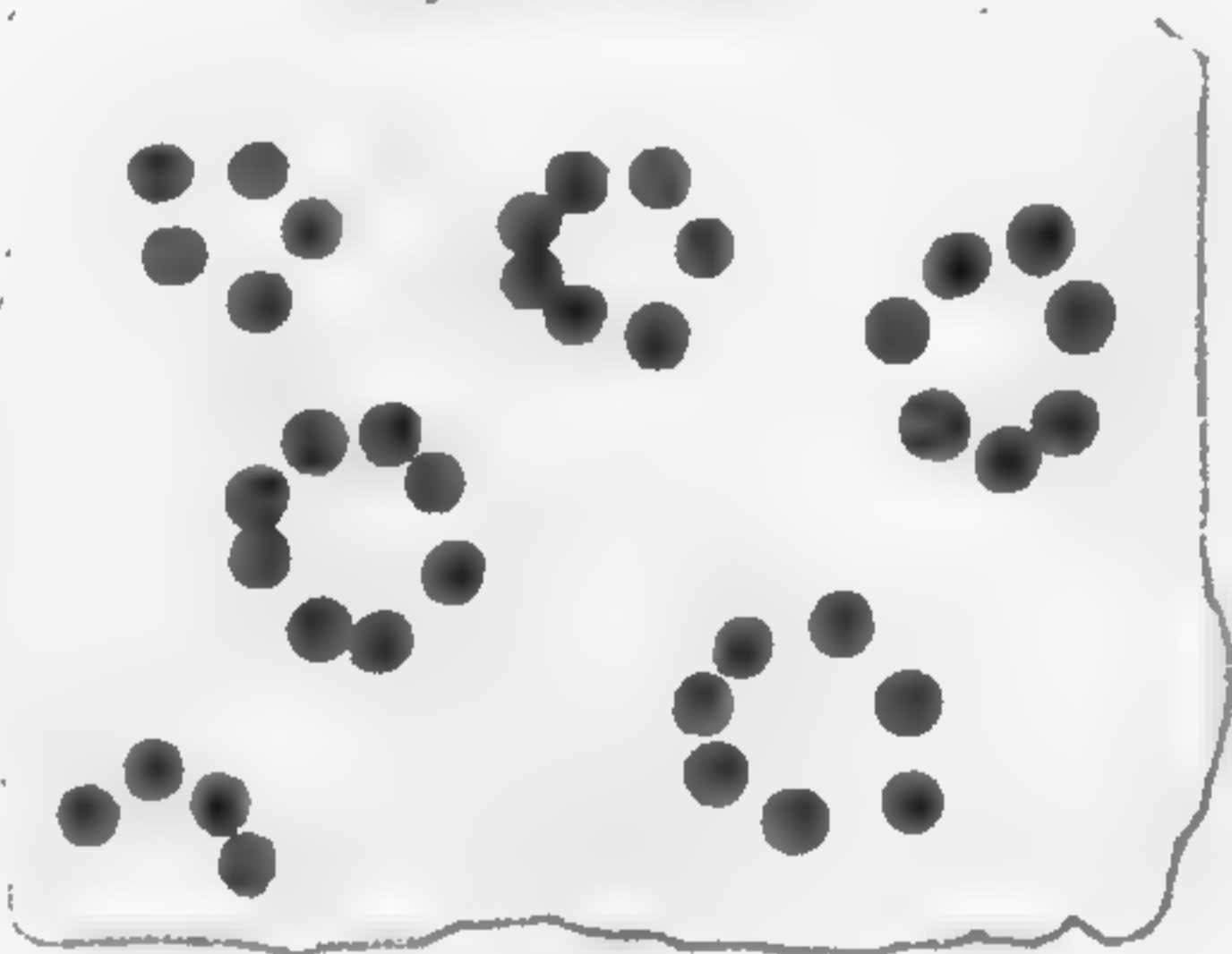
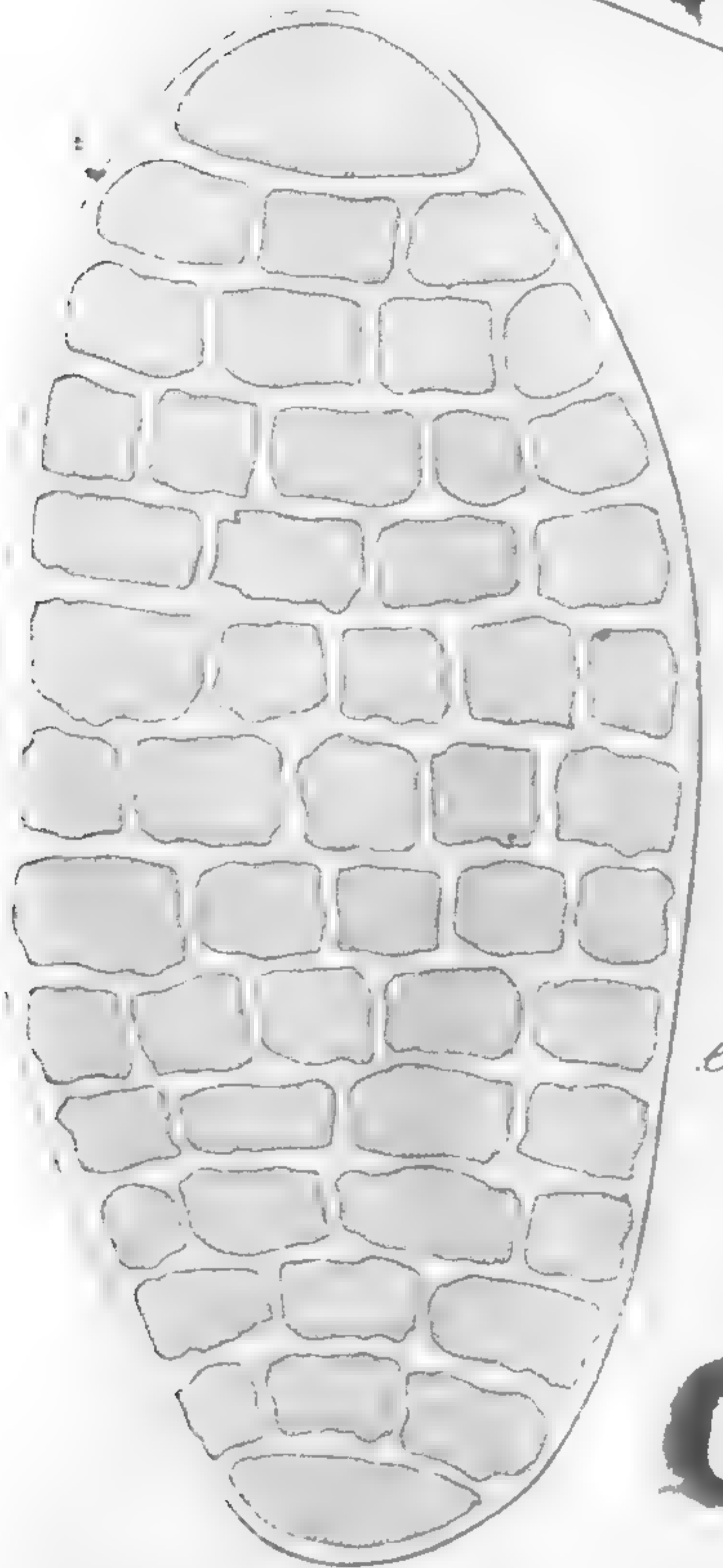
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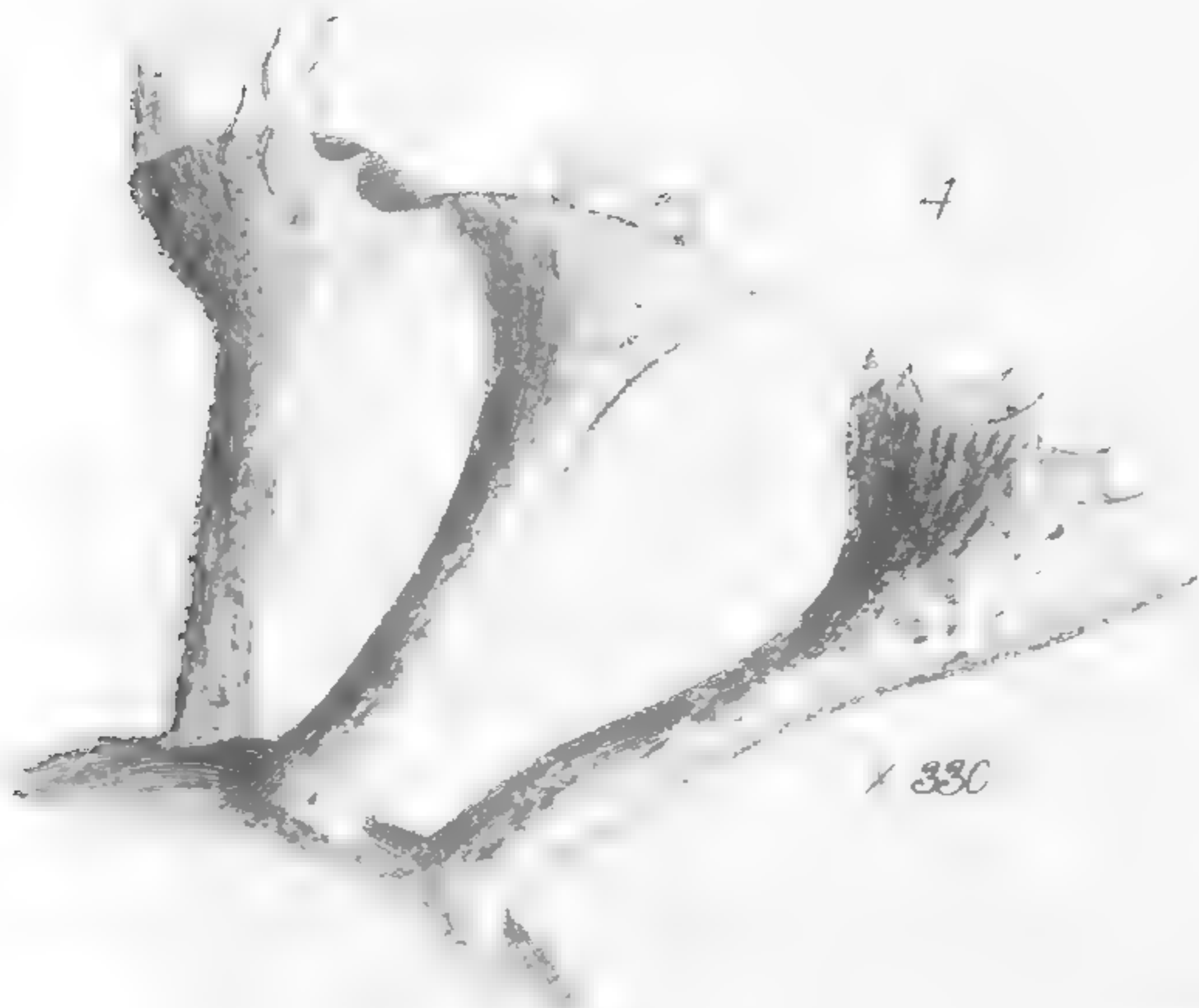
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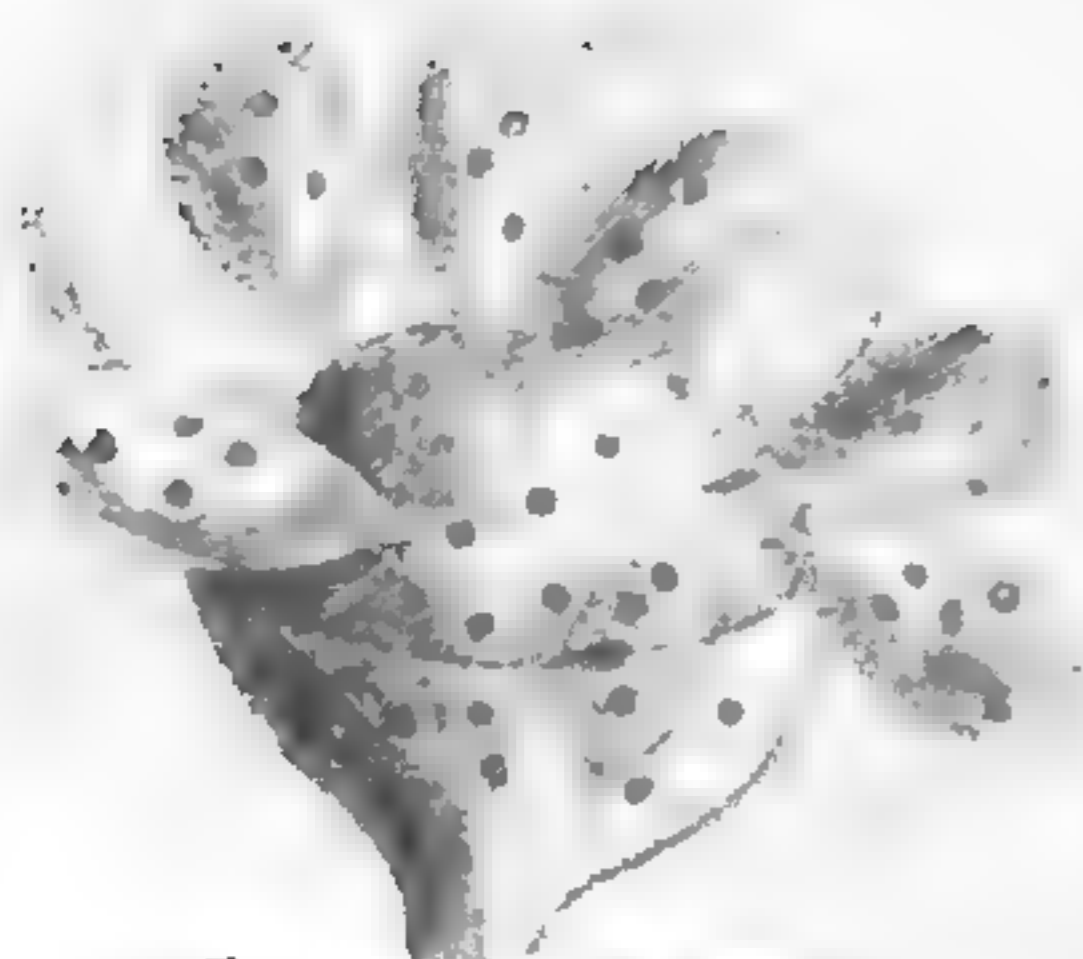
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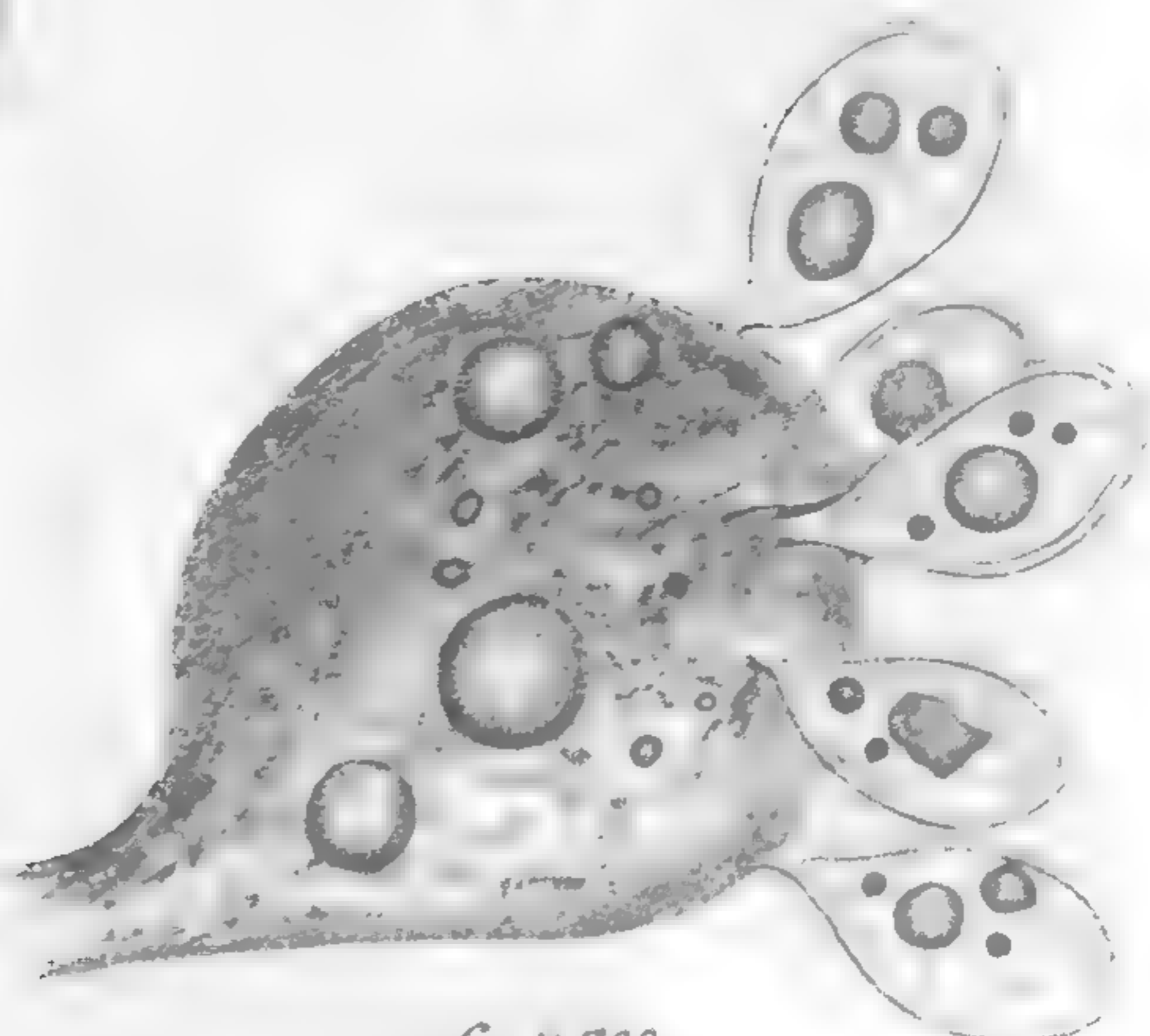
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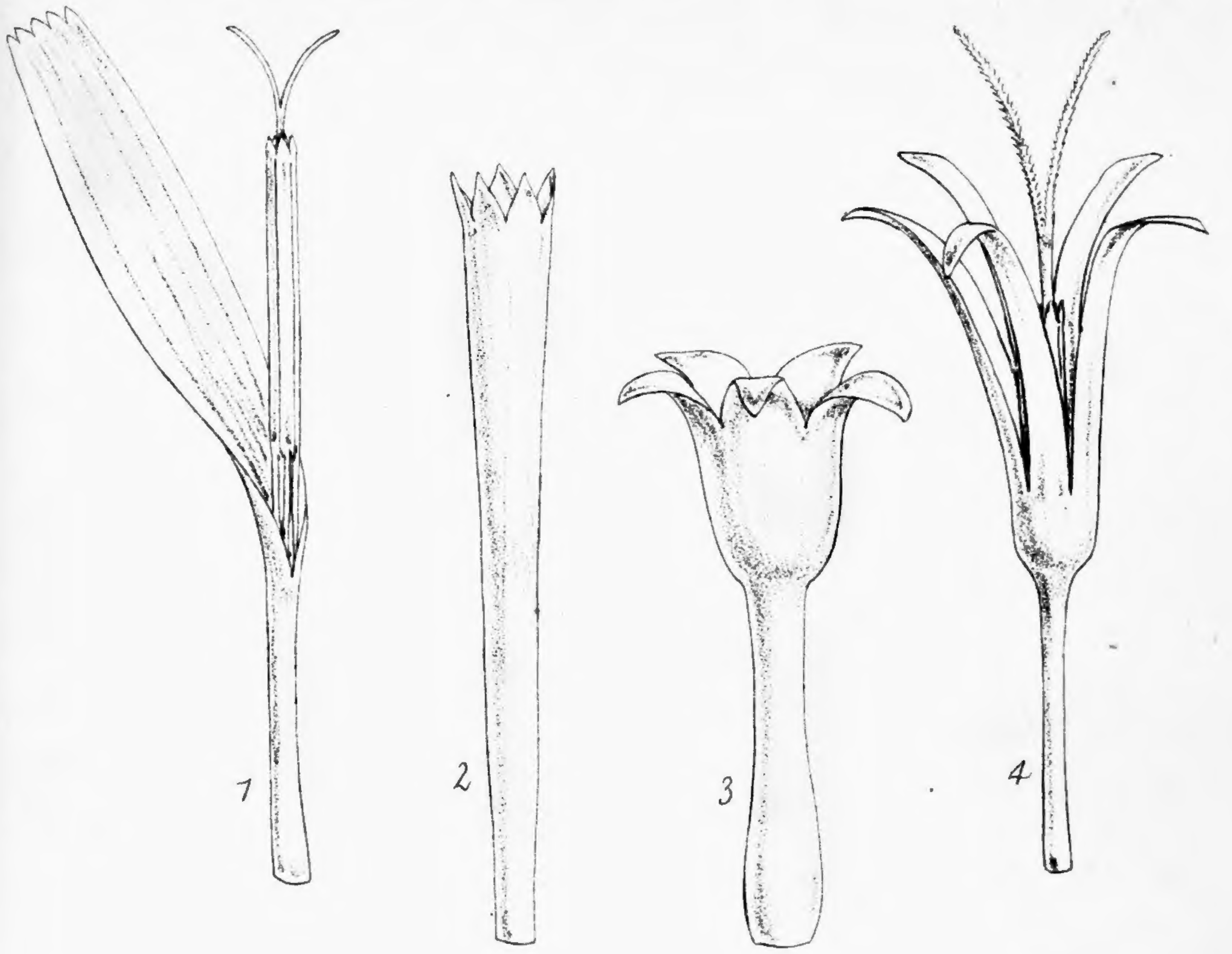


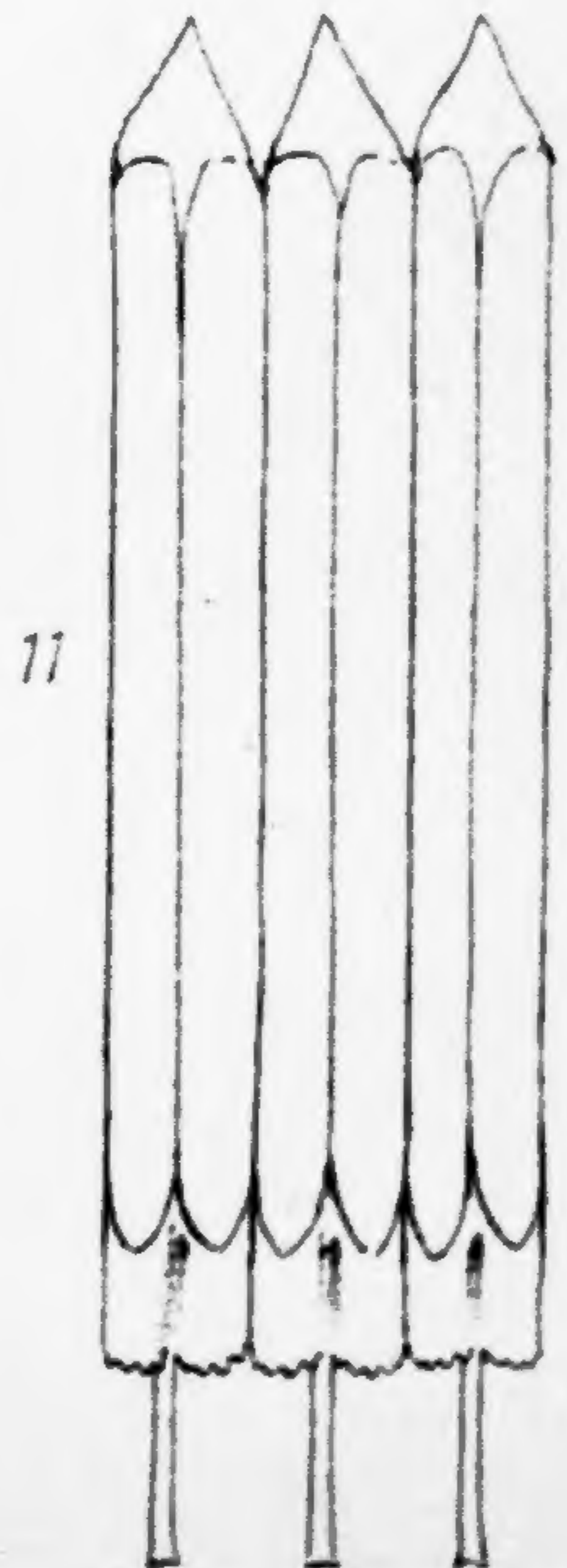
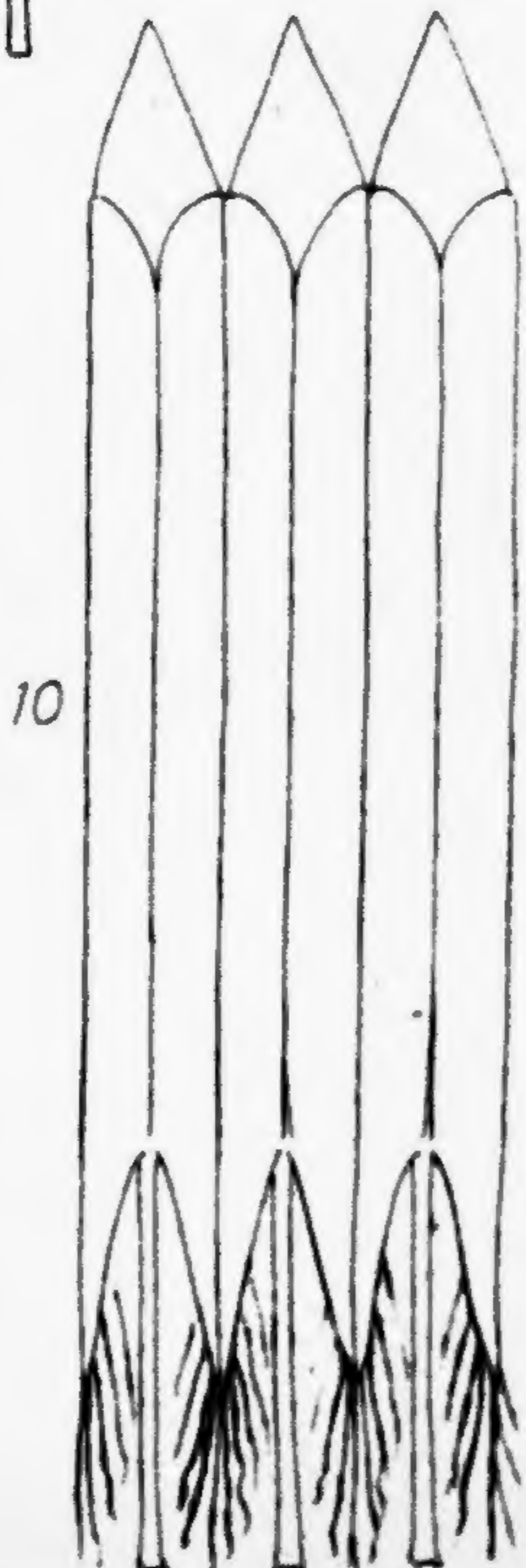
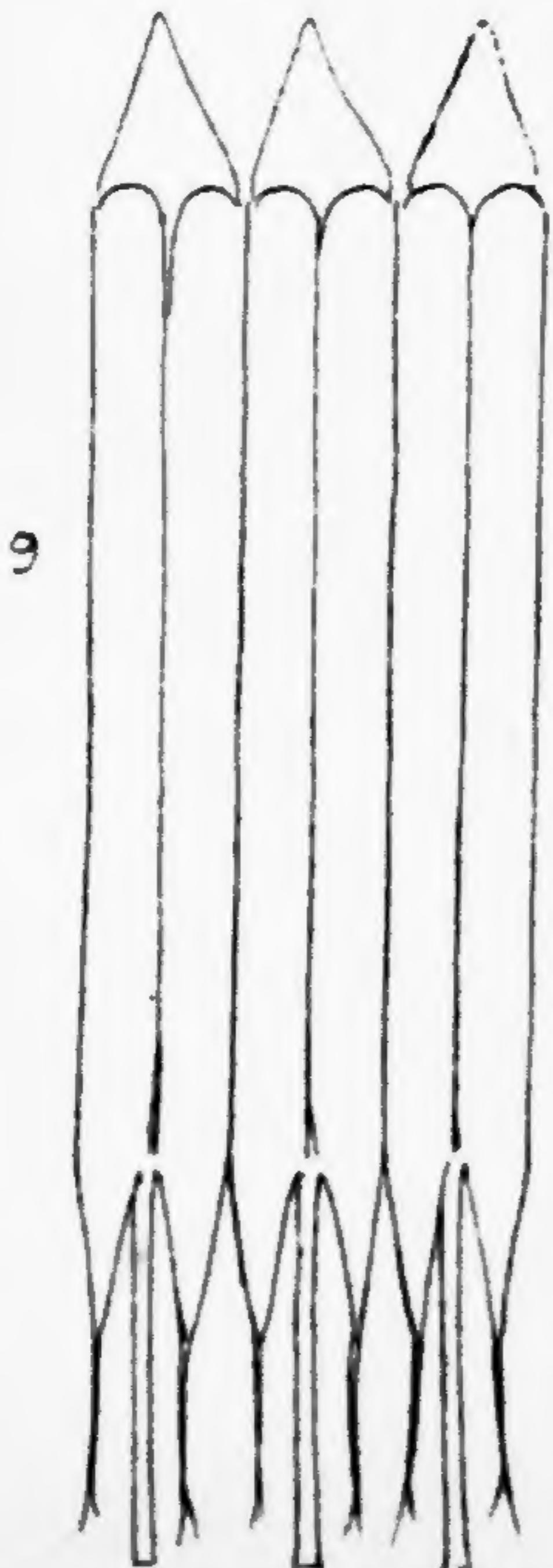
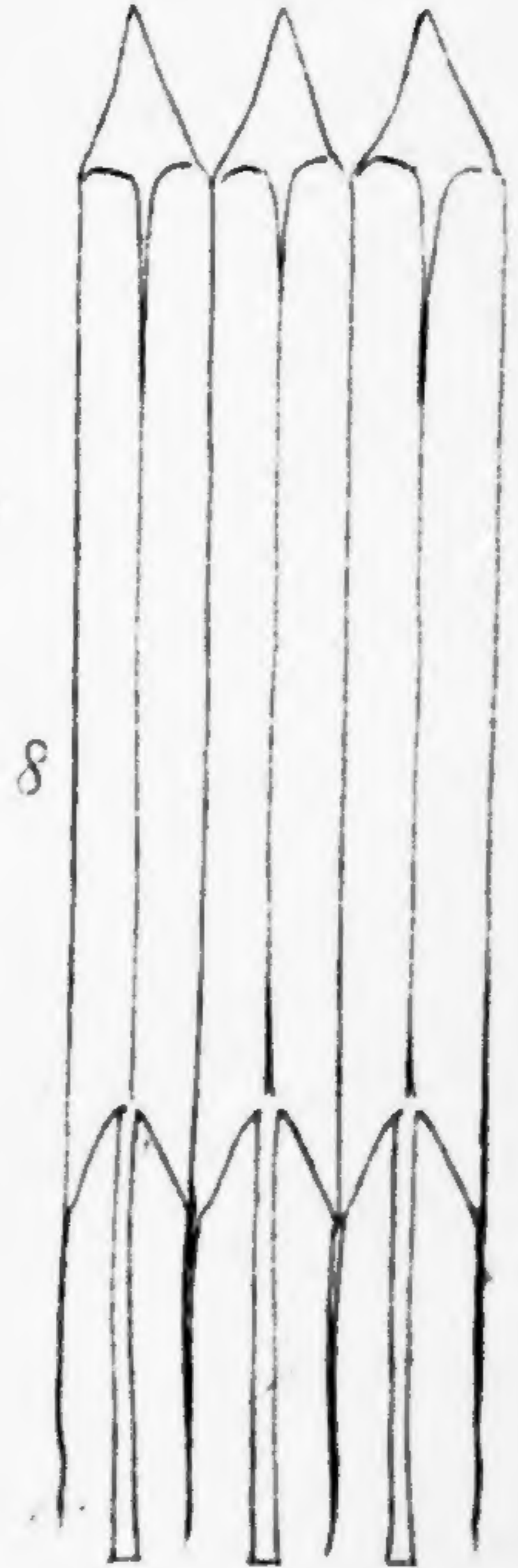
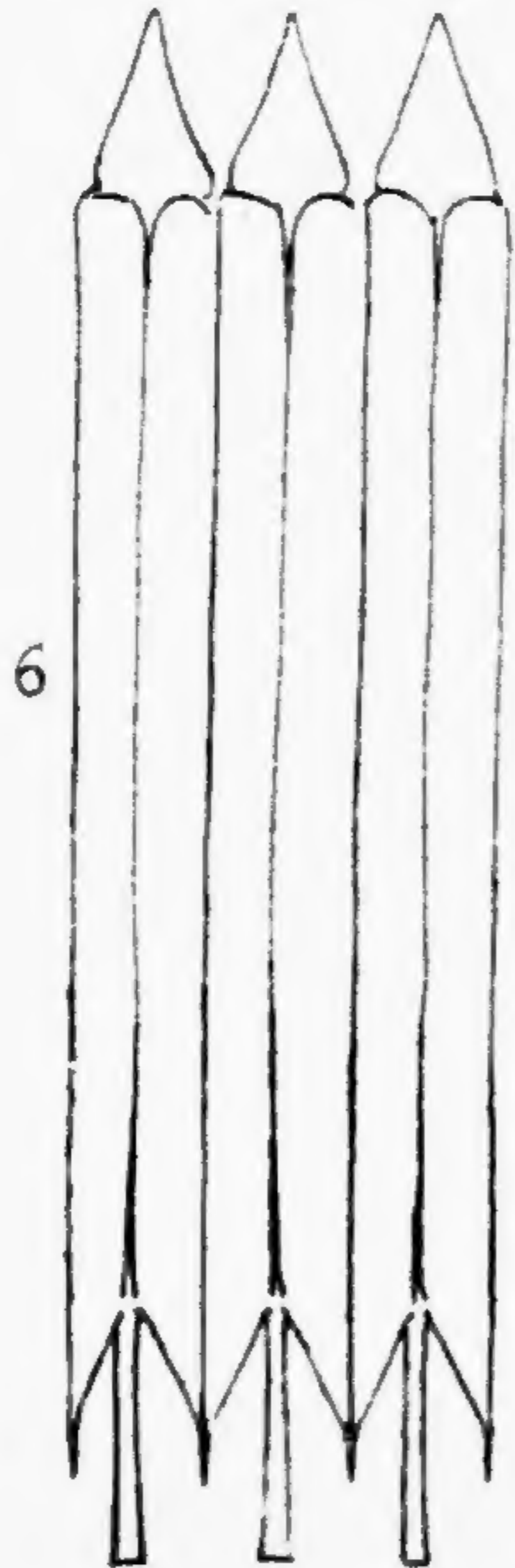
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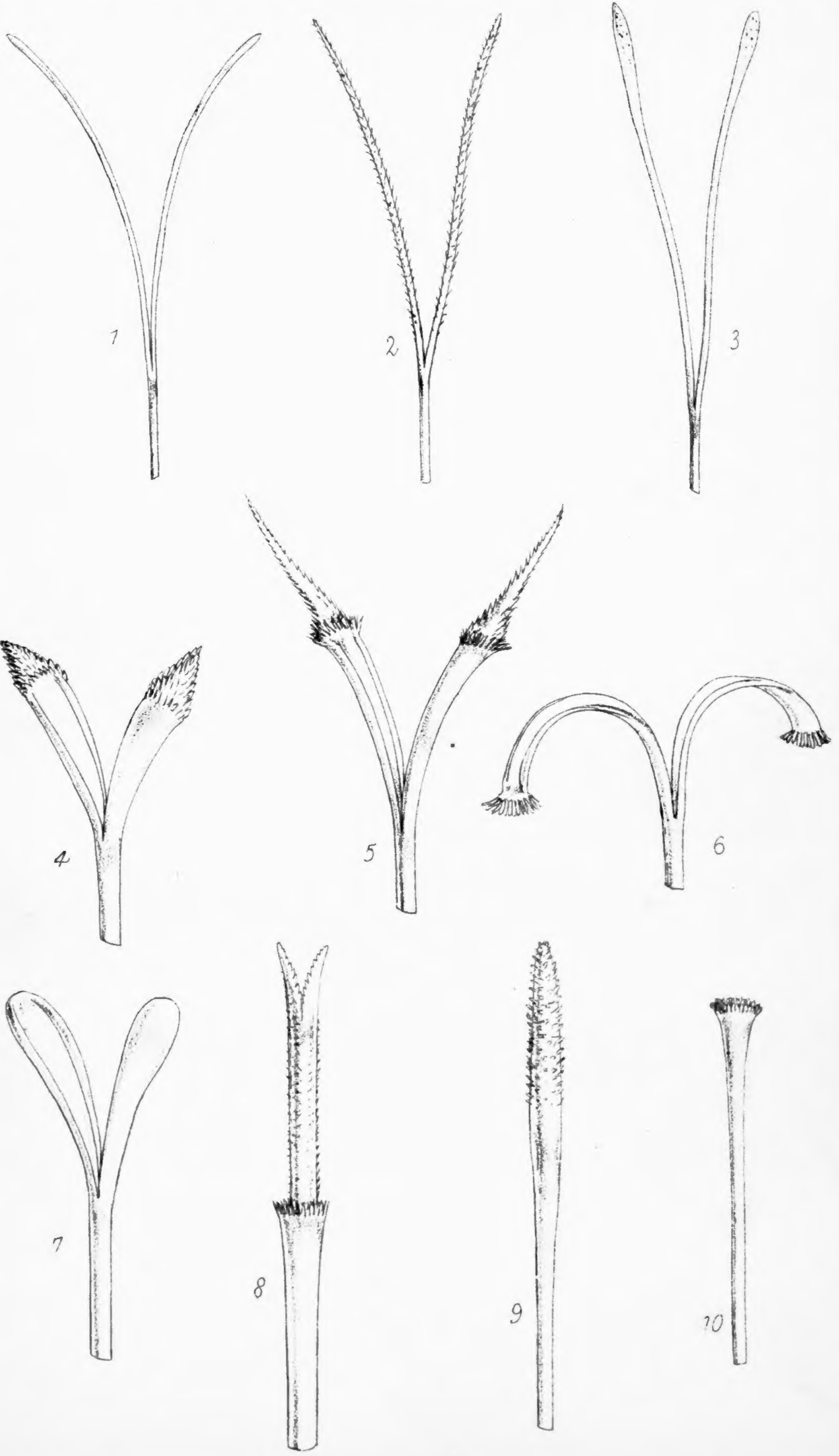
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Calycereae

Lobeliaceae

