

Endemism contd. : the characters of Endemics II

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CHAPTER VI

Endemism contd. The characters of Endemics II

After the evidence that has been produced, here and elsewhere, there can be little doubt that endemics are the descendants of wides of the same place, or usually near by, and were born near the spots where they are found. Apart from genera with endemics only, which we shall presently consider, the commonest type of occurrence is WE, the next WEE, and so on. This does not mean that there are few species at the top, for the genera there may contain many endemics. The curves are too regular to allow of a dividing line being drawn to separate successes and failures or to cut off the relics. The ones and twos especially can only be young beginners. The acceptance of this view changes geographical botany from a confused mass of facts to an arithmetically based subject, and opens up possibilities hitherto unsuspected in economic and in other directions.

Let us now go forward to examine the WEE type of appearance, of which there are 14 examples in CEYLON. The first, *Xylophia* (125, I, p. 28) is there given as three endemics, but *X. parvifolia* has now been found in MADRAS, and may be regarded as the probable parent of the other two. Of these we have put first the endemic with the widest dispersal in CEYLON. Arranging the characters of the three, as given by TRIMEN, with the wide on the left, we get :

Wide	Endemics
a) Flowerbuds narrow acute	E1. <i>Broad, ovoid, obtuse</i> 2. <i>Narrow acute</i>
b) Pedicel straight	E1. <i>Curved</i> 2. <i>Straight</i>

Wide	Endemics
c) Cpls 5, sunk in receptacle	E1. <i>Solitary</i> 2. Five, sunk in receptacle
d) Seeds not enveloped in pulp	E1. <i>Enveloped in pulp</i> 2. Not enveloped
e) Sepals connate halfway up	E1. Connate 2. <i>Slightly connate at base</i>
f) Ovules 4-6	E1. Ovules 4 2. <i>Ovules about 10.</i>

We have already seen in the WE genera how markedly divergent the characters are, and how often the difference can only be due to mutation, and the same thing shows in these WEE genera.

The first character, a, is the one used by TRIMEN in his key as being the most easily noticed; the rest are taken from his descriptions. The keys always divide one from the other two, whether it be W/EE, or WE/E. It will be seen in *Xylophia* that in each of the six characters, *one of the endemics has the parental character, the other a divergent character* (in italics) *which does not show in the parent* (could not, in fact), but is handed on by it. This phenomenon is fairly universal, and examples from all the other CEYLON cases are given in the list that follows: —

*Divergent characters shown in Ceylon groups of WEE endemics
(Dicots). Number of endemic, first or second, in brackets*

	Wide	Endemics
Orophea ¹	Pets. valvate	(1) outer imbricate (2) inner imbricate
	Sta. 6 in two rows	(1) 9 in three (2) 6 in two
	Cpls about 15	(1) 1 or 2 (2) 3
Alsodeia (I. 68)	Anthers distinct	(1) connate (2) distinct
	Disc annular	(1) of 5 scales (2) annular
	Leaves acute	(1) and (2) obtuse
Scolopia (I. 70)	Fruit green when ripe	(1) bright scarlet (2) green
Sophora (II. 94)	Leaflets 15-17	(1) 7-11 (2) 17-23
	Fl. yellow	(1) white (2) violet
Gynura (III. 43)	Leaf with large auricles at base	(1) without (2) with

¹ *Orophea zeylanica* (TRIMEN, I. 35) is the wide; *Bocagea coriacea* and *B. obliqua* (I. 33), now placed in *Orophea*, the two endemics.

	Wide	Endemics
Adenosma (III. 231)	Fl. blueish-purple	(1) yellow (2) purple
	Stem erect cylindrical	(1) bluntly quadrangular (2) quadrang., decumbent
	Leaves whorled	(1) and (2) opposite
Didymocarpus (III. 273)	Rhizome erect, short	(1) erect, short (2) creeping
	Capsule pubescent	(1) pubescent (2) glabrous
	Corolla pubesc. outside	(1) and (2) glabrous
Hemicyclia (IV. 36)	Much branched shrub	(1) small tree (2) moderate sized do.
	Stamens 6-8	(1) about 24 (2) 10-16
Chaetocarpus (IV. 74)	Capsule with rigid prickles	(1) with tubercles (2) with rigid prickles

Some of the important characters of the wide species of each of these WEE genera are shown *in one or in the other* of the two endemics, so that, upon the structural basis which at present rules in taxonomy, they are all closely related. This one would hardly expect unless the endemics were the direct offspring of the wide, and not relics of some more ancient members of the genus. Only very rarely is there anything near by in some other country, that might have been carrying these divergent characters, and might have crossed with, or have itself been, the parent. However divergent one of the characters may be from the other, both must ultimately come from the head of the family, which could not *display* both, but must have been carrying one of them in some kind of recessive manner. Some degree of divergence seems to be shown even in births within the same species, though less perhaps in plants than in animals, where it is specially noticed in one of the earliest families upon record—Cain and Abel were both sons of Adam and Eve, and such differences are by no means infrequent, though not perhaps always solved in the same drastic way, where the solution, be it noted in regard to recent European affairs, was not based upon the real value of the characters in question, and in regard to the actual conditions, but upon other and quite different characters and conditions, which were called in, in the hope that they would be capable of settling the difference in favour of the caller-in. The whole proceeding was illogical and wasteful.

The division of the parental characters between the offspring, especially in plants, is a phenomenon which requires careful genetic investigation, as it seems to suggest some

kind of super-Mendelism. In any case, it still further dissipates the idea that dispersal depends in the long run upon adaptation and selection. No one, presented with a list of the characters of the wide and of the two endemics, would be able to say which was the most likely to be successful or widespread, just as he would be in the same difficulty in placing a plant in the ecological association to which it belonged, save in one of the extremes of water-plants or xerophytes, unless he knew in advance where it was found. It may be worth while to refer to *AA*, ch. XX, especially to the quotation from HOOKER on p. 205.

It is becoming increasingly clear that the great Darwinian theory of evolution¹, probably the most important advance ever made in biology, has a foundation which is not largely chance, as its author supposed, but is based upon a predetermined mathematical formula of some kind, as was indicated in *Evol.*, and as was worked out by YULE in more detail in (158). In (159), YULE and the writer said "Inasmuch as all families, both of plants and animals, show the same type of curve, whether graphic or logarithmic, it would appear that in general the manner in which evolution has unfolded itself has been relatively little affected by the various vital and other factors, these only causing deviations this way and that from the dominant plan". WENT's paper (161) may also be referred to. As we have shown in (146), special creation explained the differences of species as outside the region of man's comprehension, but did not explain the obvious close resemblances, which had always been familiar. DARWIN explained them as due to inheritance, but did not properly explain the divergences, often so great and so complete that as they can only come, as he showed, from common ancestors, there must at times have been in the descent some divergences, to produce them. Such a change

¹I insert the word Darwinian with deliberate intent. Since 1902 my work has been so largely devoted to overthrowing the theory of the natural selection of gradual and adaptational improvement in structure, which has always seemed to me so completely illogical, that many people seem to think that I am simply an anti-Darwinian. In actual fact, I only wish to free the immortal theory of evolution from what are now its great encumbrances of swaddling-clothes, which by reason of their popular appeal became so well established that the name of Darwinism was given to them, rather than to the theory of evolution, where it properly belongs.

might for example be from an introrse to an extrorse anther, or *vice versa*, berry/capsule or *vice versa*, and so on. The theory that we are putting forward, partly derived from de VRIES, partly from GEOFFROY ST HILAIRE, partly original, in a way combines the previous theories, for the new form is supposed to appear, without the aid of selection, by a sudden mutation, so that its production may be described as a creation, though apparently a compulsory one, under the conditions ruling at the spot.

In another set of cases, the character in the wide shows a change in both endemics. In *Scolopia*, for example, the lax racemose panicle becomes a simple lax raceme in one endemic, a dense axillary raceme in the other. In *Sophora* a yellow flower is replaced by a white in E1, a violet in E2, while pubescent leaves are replaced by glabrous in both endemics. The 5-angled stem in the wide *Gynura* disappears in both endemics, and so on. All these are Ceylon cases.

In Monocots the characters are more frequently of a numerical or dimensional kind. As an instance let us take *Coelogyne* (CEYLON, TRIMEN IV, 159) : —

Wide	Endemics
a) Bracts $\frac{1}{2}$ inch to $\frac{2}{3}$ inch	E1 $\frac{2}{3}$ inch to $1\frac{1}{2}$ inches 2 $\frac{1}{4}$ inch
b) Leaves $2\frac{1}{2}$ inch. to 4 inch.	E1 3 to 5 inches 2 4 to 6 inches
c) Pseudobulbs about 1 inch	E1 $1\frac{1}{2}$ to $2\frac{1}{2}$ inches 2 $\frac{1}{2}$ inch
d) Pseudobulbs subglobose	E1 Narrowly ovoid 2 Obpyriform or ovoid
e) Sheaths hyaline	E1 Broad, coriaceous, red-brown 2 Bearded at base with red-brown fibres of old sheaths
f) Racemes 2-4-flowered	E1 4-6-flowered 2 2-flowered
g) Pedicel from base of old pseudobulb	E1 From base of terminal pseudobulb 2 From base of old pseudobulb

The other CEYLON WEE Monocots are

Wide	Endemics
<i>Cleisostoma</i> (TRIMEN IV, 200) Leaf oblong or linear-oblong 1-1 1/2, stem long, scandent	L. lorate, unequally 2-lobed, 6-7", stem long L. lorate, uneq. 2-lobed, 5- 10", stem short and stout
<i>Podochilus</i> (IV, 205) Leaf 1/3 to 1/2" long, petals linear	L. 3/4 to 1" long, pets. orbicul. L. 1/5 to 1/4" long, pets. obo- vate-oblong, obtuse
<i>Curcuma</i> (IV, 240) Spike on long leafless ped., many-flowered	Do., few-flowered Spike terminating leafy stem
<i>Sciaphila</i> (IV, 368) Style much longer than ovary, Stamens 4	Much shorter. Sta. 6. Stigma capitellate Much shorter. Sta. 6. Stigma penicillate

Dimensions seem to come more into the characters of Monocots, though the differences are usually too large to be passed over by selection, which would hardly for example produce one *Cleisostoma* with a leaf of one inch and another with a leaf of 6 inches.

A very important point is the differences that exist between the two endemics themselves, which one may see in looking at any flora that contains them. At the same time, of course, both agree with the parent in characters numerous enough to put them all in the same genus, though it must be pointed out that we have no guarantee that this always happens and it is possible, or probable, that at times sufficient characters, or certain characters, may change in such a way that the result will be a species in a new genus. Or again, it might happen that the offspring took over from its parent a group of characters that placed it in some genus already known. This of course means, that as BOWER suggested with regard to ferns (16), a plant now in a comparatively large genus C may have come, not from a parental C, but from B, while B in turn may even have come from A. But there is little doubt that this is a comparatively rare occurrence, and

that most species in C have probably descended from parents that were already in the genus C.

The whole behaviour of these characters of endemics, in their relation to the "wide" parent, is of considerable interest especially in its resemblance to the phenomena of Mendelian inheritance. It suggests studies in hybridisation between the wide and the endemic in WE combinations, especially where a similar combination, in the same genus, can be found in two or more places; now that the new technique of doubling is coming into use, it might lead to interesting results.

As a confirmation of what we have said, let us look at the flora of the MALAY PENINSULA (107). Taking only the first volume the wide *Tinospora* and one endemic have herbaceous leaves, truncate at base, while the other endemic has sub-coriaceous leaves with round base. The wide *Zanthoxylum* is a shrub with trifoliolate leaves; one endemic is a shrub, but the other is a thorny tree, and both have pinnate leaves. The wide *Strombosia* has pedicelled few-flowered cymes, while the two endemics have sessile many-flowered fascicles. In *Euonymus* the wide has fascicles, the endemics lax cymes. In *Pometia* the wide and one endemic have a pubescent calyx, the other endemic a glabrous one. In *Paranephelium* the fruit of the wide has long stiff acuminate spines, while one endemic has short thick spines, the other a scurfy fruit.

In the WE genera we have seen that the marks of separation are most often of a kind allowing of no transition stages between them; in fact they are frequently subgeneric. And the WEE genera again show much the same kind of thing. If the distinction between one species and the next were in one character only, the task of selection, to say nothing of classification, would be much more simple. Unless so correlated, as in climbing plants, that a change in one character must be accompanied by change in another, it must be more difficult to change two than one, and the difficulty grows with further increase, and if one plant-form were selected in preference to another, it would often be at the expense of one of the characters (p. 115). This is clearly evident if we suppose the evolution to be gradual; and if we substitute small mutations, as is so often done, what is to ensure, as they convey no advantage, that they shall run in the right direction (and *cf.* Testcase X in *Evol.*, p. 114)? In fact the only process that can easily

change two or more apparently unconnected characters at once, and do it perfectly and completely, is a sudden mutation, where the surprise would rather be to see the change incomplete or imperfect.

The connections between characters that occur in any taxonomic difference do not allow of having been produced by selection once for all, for every kind of combination may be seen, and any one character may appear in almost any connection, so that if it were due to selection, it would have to be selected over and over again (*cf. Evol. Testcases X*, p. 114, and *XXIV*, p. 138, where I have shown how in three different, but allied families, the change from mono- to dithecous anthers, or *vice versa*, has occurred independently in each, though of no conceivable value). It was occurrences like this, which are very common, that among many other things led the writer to the conception of kaleidoscopic evolution (155), at which he has now worked for about 35 years.

For taxonomic purposes, a character is mainly valued upon how frequently it occurs among plants which seem to be closely related by having other characters in common. One cotyledon is characteristic of a very large group of plants which also *usually* show 3-merous flowers, parallel-veined leaves, or a peculiar anatomy. There are many more characters found in fewer Monocots, though one can give no reason for their presence or absence (when there is usually something divergent present). Some occur in groups of families, like perisperm in the *Marantaceae* group, or fleshy or oily endosperm in the *Liliaceae* group. Others are confined to one family in any connection, or even to one genus, and as one thus descends the scale, one finds exceptions to the appearance of any one character becoming more frequent, so that in giving the characters of a genus or family one constantly has to use the expressions "usually", "often", "rarely", &c.

But all this is so familiar that only a reminder is needed. The essential point is that some characters go very far back in time, in their existing line of heredity, without, apparently, having undergone any serious change or difference since they first appeared. Others may appear again and again in different places, sometimes remaining unchanged long enough to mark a whole family, a part of a family, a genus, or

only a part of a genus, or even showing change from one species to the next, or upon the same plant, like the alternate and opposite leaves frequently found upon one plant in *Compositae*. As a character may thus appear under any of these descriptions, it becomes impossible sharply to distinguish between family and generic characters, for example, though most characters appear most often in one or the other capacity. But one cannot say of any character what its value will be in any family, until one has examined the family in detail, and only then can one make a proper classification.

This complication of behaviour, hitherto looked upon as "pretty Fanny's way", with no explanation, falls properly into place under mutation such as that for which the writer is contending, where it does not depend for its appearance upon selection. If at one place a character is very old, and also very constant in inheritance, it will be, *there*, of great value, while in another place it may be young, or inconstant, or both, and be of little value. And we must never forget that descent from two or more independent ancestors is always possible, even though not very probable, once we realise that any of the characters of a family or genus seem possible of production in it at any moment. In fact, the formation of new species and genera has a close analogy, which may be more, with human birth and evolution.

The close similarity of species in a large genus is most often, apparently, due, as in *Hieracium* or *Rubus*, to the further breaking up of its larger species into smaller or into varieties, but it must not be forgotten that mere increase in number, especially if combined with a decrease in "size" of the mutations, may have a considerable influence upon the overlapping of species.

The contrasting and incompatibly divergent characters that we have seen in the endemics, appear also, as we shall presently see, in almost all of the small genera. The number of these small genera is very great. We have seen (figures of 1922, in *AA*, p. 185) that out of a grand total of 12,571 genera of flowering plants, there are 4853 ones, 1632 twos, and 921 threes, these alone making up 58.9% of all the genera. If we go back to the now untenable theory that all these little genera are relics, there seems to be no reason whatever why they should all show marked divergences of character

when they have more than one species. Yet this is just what occurs, with a very few exceptions, and the only reasonable explanation seems to the writer to lie in the general tendency to mark the evolution of new species or new genera by divergence of some kind, generally well marked, a fact which fits very well with Dr. BALFOUR STEWART'S suggestion (*Evol.*, pp. 47, 182) of an electrical force controlling sexual cell division.

We have seen that endemism, though easily described, is very difficult to define, as to the area occupied. In actual fact, if we look at the genera of not more than three species, we shall find that a very large proportion are distributed over an area so small that the title of endemic can hardly be refused, even though it be not given to larger ones. Let us begin with a small family, whose monograph happens to be lying upon the table, the *Styracaceae*, in which BENTHAM and HOOKER, with their greater caution, included the *Symplocaceae*. As now made up the family has six genera, five of them not exceeding three species :

Pamphilia (confined to province Minas in Brazil)

Inflorescence spicate, fls. sessile
or sub-sessile

Petiole 1 to 1.5 cm.

1. *styracifolia*

Petiole 0.5 cm.

2. *aurea*

Inflorescence racemose, fls. pedicellate

3. *pedicellata*

Bruinsmea (Java, Celebes)

Filament of sta. glabrous; anther 1 mm. long

1. *styracoides* Java

Filament of sta. stellate-pubescent, 2.5 mm.

2. *celebica* Celebes.

Alniphyllum (S. China, Formosa)

Leaves broadly ovate, ovate, or obovate

1. *Fortunei* S. China

Leaves oblong-lanceolate

L. papery, densely stellate-puberulate on both sides

2. *pterospermum* Formosa.

L. membranous, glabrous above, thinly stellate-hairy below

3. *Faurei* Form.

Halesia (SE. U. S. A.)

Fruit 4-winged. Corolla lobed,
1-2cm. long. Filaments connate
at base only 1. carolina

Fruit 2-winged. C divided al-
most to base, lobes 2-3 cm.
Style tomentose. Fil. connate
to middle or higher 2. diptera

Fruit 2-winged. C lobed, 8-12
mm. long 3. parviflora

Pterostyrax (Japan, China)

Fruit 5-winged, thinly tomentose 1. corymbosus Japan

Fruit cylindrical, densely hispid
Leaves densely hairy below 2. hispidus Jap., Chi.

L. thinly pilose on veins below 3. psilophyllus Chi.

This is so hopelessly incongruous an assortment of genera from the geographical point of view that without real and valid individual evidence that they are relics, we must look upon them as perhaps all descended directly from some overriding genus (151). The sixth genus is *Styrax* itself, which covers all the necessary regions, but a still better one is probably *Symplocos*, which is a very widespread and common genus, but was ejected from *Styracaceae*, in which it was placed by BENTHAM and HOOKER, on account of its inferior ovary, completely divided into loculi, and its round, not narrow, anthers—both obvious mutation characters, which are continually shown in mutations that are really the probable result of some strain placed on the nucleus by some change of conditions. Their appearance thus became inevitable, but adaptation has nothing to do with it, for they have no adaptational significance. Their appearance was not a cause of evolution, but a by-product of it.

But these divergent characters of endemics that are thus shown are in no way characteristic of endemics as such. They occur in all small genera with a very few exceptions, such as those genera whose generic rank is still uncertain. Suppose that we now look at a number of the small genera found upon continental areas, which are not generally, though for no good reason, considered endemic, unless found in a part that is comparatively isolated, like SOUTH AFRICA

OF WEST AUSTRALIA. I have worked out, under various headings, the characters shown by these genera in over a thousand cases. Under the theories which we are here bringing forward, they are just as much beginners as are any genera that are admitted by everyone as endemic. We shall take a few examples from "Leaf— different forms and insertions": —

Genus	Fam.	No and dispersal	Contrasting characters found
Helietta	Rut.	4 trop. Am.	L. opp. or alt.
Fresenia	Comp.	3 S. Afr.	L. opp. glabrous, or alt. villous
Stilpnophytum	Comp.	2 Karroo	L. alt. or opp.
Codonobea	Gesn.	3 Malay Pen.	L. opp. in two, alt. in one
Epipetrum	Diosc.	3 Chile	L. alt. or fascicled
Acidoton	Euph.	3 W. I.	L. large, distichous, or small, spiral
Bosistoa	Rut.	2 E. Austr.	L. pinnate or ternate
Koelreuteria	Sap.	3 China	L. pinnate or bi-pinnate
Eremia	Eric.	4 S. Afr.	L. 3-nate or 4-nate
Touroulia	Quiin.	3 Gui., Braz.	L. simple or pinnate
Thraulococcus	Sap.	2 India	L. simple or pinnate
Bernardinia	Connar.	4 S. Am.	L. trifoliolate (Peru), bijugate (Costarica), 5-jugate (Braz.), imparipinnate (S. Braz)

It may be noted that these are just a dozen examples under one character, but that in practically all of the 1047 genera examined, contrasts were to be found. Divergence in mutation is the outstanding feature of all young genera, and were it necessary, it would be quite simple to make subgenera in them. But for purposes of identification, for which classification is mainly designed, this is simply a waste of time. The important point is that the characters that would be used to mark these subgenera are essentially the same characters as are so much used in the large genera. For example, taking the first book that comes to hand, the first genus shown with subgenera is *Rumex* (fls. ♂ or ♀) a distinction which happens to be matched by the first genus in that heading in my list of small genera— *Galopina* (*Rubia-*

ceae) with two species in SOUTH AFRICA, one with ♂ flowers, one with ♀. Practically any characters of the subgenera of larger genera can be matched among the specific characters of smaller ones, as has long been vaguely known. In both cases *they are divergent characters that appeared early in the life of the genus.*

It is thus fairly evident that at least a great part, if not all, of the characters of a family, may appear anywhere in it, so that the probability is that any member of the family carries with it, dominant or recessive, all the characters of the family. And probably more, for it is a familiar experience that characters may appear in more than one family, like inferior ovary, or porous opening of pollen sacs. In fact, as we have already pointed out, any character may appear in one place in quite a minor role, in a genus or two, in another in the whole of a subtribe, a tribe, or a family; it simply depends upon the age of the character in that place.

We have now seen a good many cases where the characters of plants show such a behaviour that it is best explained by the conception that they were drawn from a kind of Pandora's box which each genus and species carries, and in which are contained all the possible characters (including their own various divergences, like leaf simple or compound, palmate or pinnate, hairy or not in various ways, and so on). If an individual draws from its immediate ancestor the same characters as are shown by that, it will remain specifically unchanged, and up to a certain point it may (and apparently often does) even substitute some new and slightly different characters for some of its own, like a leaf pubescent below for a leaf glabrous on both sides. But if it take more, or more seriously different, characters, it will be regarded as a new species, and will begin as one or a few individuals. And so on, through the stage of a doubtfully new genus to the stage of one universally admitted as new, or even up to the stage of a new family.

It is of course improbable that the characters are carried as such; more likely it is an assortment of genes which when put together in a certain way result in the production of a certain character, and in some other way yet produce a new and divergent form of that character, like a pinnate leaf in place of a simple one; or in a third way alter more than one

character, and so on. It is also so frequent a phenomenon that a character may appear though not usually seen in the family, even if frequent enough elsewhere, that it is not improbable that the Pandora's box may contain the possibilities of any character. But it seems probable that in any single case the characters shown by the actual parent will be those that are much the most likely to occur, though two or three may be changed. There is fairly evidently some super-Mendelian law at work, perhaps or probably complicated, some clue to which might possibly be provided by a counting-up of all the characters shown by the five thousand genera of one species, and careful comparison with those shown by the twos and threes, &c.

If the provision of characters goes on in this way, it is evident that there is nothing surprising in the fact that a character that we are apt to regard as specially marking some genus or small group may appear in some other genus or even small group, whether nearby or at a considerable distance away. Let us take an instance from the first book that comes to hand, the monograph of *Phytolaccaceae* (*P.R.*).

Cpls 2, ovary 2-loc. in <i>Barbeuia</i> (<i>Phytolaccaceae</i> , subtribe <i>Barbeuinae</i> , made largely on account of this character, and with no other genus, all the others of the tribe having 3-∞ cpls.)	1 Madag.
2 in <i>Didymotheca</i> (<i>Gyrostemoneae</i>)	5 Austr.
Cpls. 2, ovary 1-loc. in <i>Microtea</i> (gen. anom., Chenopod. affin.)	9 Am. trop.
<i>Achatocarpus</i> (gen. anom., Chenopod. affin.)	12 Am. trop.
<i>Phaulothamnus</i> (gen. anom., Chenopod. affin.)	1 N. Mex.

It is clear that these genera did not derive their two carpels from immediate ancestors, but by super-Mendelian inheritance from something further back.

Unisexual flowers appear, again, in *Monococcus* (1 Austr.) in tribe 3 *Rivineae*, in the whole of tribe 2, *Gyrostemoneae* (5, 5, 3 and 2, Austr.), and in the anomalous genus *Achatocarpus* (12 C. and S. trop. Am.) and *Phaulothamnus* (1 N. Mexico). All the Australian, though in two subgroups,

might have acquired them from one source, but not the American also, unless that source were *far back* in the family ancestry.

This apparently casual appearance of single characters which are frequent in some other part of a family is a common occurrence. For example in *Annonaceae* (*Gen. Pl.*) while *Uvarieae* have all, or the interior petals imbricate, so also does *Bocageae* in *Miliuseae*. Stamens are 2-5 times the petals in a few *Sageraeas* (*Uvarieae*) and *Popowia*, and in *Orophea* (*Miliuseae*) all Asiatic species, the African *Clathrospermums* (*Uvarieae*) and the American *Bocageas* (*Miliuseae*). In their descriptions, BENTHAM and HOOKER say that for example *Alphonsea* (*Unoneae*), *Clathrospermum* (*Uvarieae*) have the stamens of *Miliuseae*, and make this kind of statement very frequently, or such a one as that genera 34, 35 (of *Gen. Plant.*) have the petals of *Phaeantheae*, 36 of *Mitrephoreae*, 37, 38 of *Unoneae*, 39 of *Uvarieae*; and so on.

The next family at which the *Gen. Pl.* opens is the *Tiliaceae*, where we find opposite leaves in *Plagiopteron*, and a few species of *Sloanieae*. Petals are absent in *Grewieae*, *Triumfetteae*, a few species of *Prockia* (trop. Am.), and nearly all of *Sloanea* (trop.), and they are united in *Antholoma* (N. G., New Cal.), while endosperm is absent in *Brownlowia*.

In *Burseraceae*, leaves are opposite and alternate in *Amyris*; petals are absent in *Ganophyllum* (cf. *Antholoma* above); stamens are opposite the calyx-lobes in *Crepidospermum*, *Filicium*, *Nothoprotium*, alternate with them in *Ganophyllum*; the ovule is solitary in the loculus in *Filicium* and *Hemprichia*.

In *Leguminosae-Papilionatae* the calyx is entire, variously divided at anthesis in *Fissicalyx* (§ 9), *Baphia* (§ 10), *Leucomphalos* (do), these two trop. Afr., while *Bowringia*, also § 10, occurs in Hongkong. It also occurs in I 11, *Swartzieae*, in some *Zollernias* (Brazil), *Exostyles* (do), *Aldina* (do., Guiana), *Cordyla* (trop. Afr.) and in *Swartzia* itself (65 trop. Am., Afr.) from which all the others might easily be derivatives, none having more than a few species.

In *Liliaceae*, one finds three stamens in *Heterosmilax*, *Ruscus*, *Anemarrhena*, *Hodgsoniola*, *Leucocoryne*, *Stawellia*, *Sowerbaea*, *Johnsonia*, *Hewardia*, and species of other genera; more than six stamens in *Pleea* and rarely in *Smilax*; and so on.

It is thus becoming fairly evident that all, or almost all, of the characters of a family may appear anywhere in it, and therefore that the probability is that any member of the family carries with it, dominant or recessive, all the characters of the family, or rather the potentialities of producing them, and probably also, as we have seen, characters that are more frequent in other families, perhaps even far distant in the matter of relationship. The study of characters, and of the factors to which their formation is due, as well as the study of how external conditions affect those factors, may perhaps become one of considerable importance, and we have seen above how in the light that geographical distribution is beginning to throw upon this part of the subject, a number of facts, hitherto without explanation, seem to be falling into place in the general plan of evolution.