GENERAL PRINCIPLES AND RULES IN BIOSYSTEMATICAL PHANEROGAMY

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The slowness of theoretical progress in systematical taxonomy ought to be considered as an outstanding feature of our time's political troubles. On the one hand, pessimistic assumptions derived from Malthus theory admit no other aim to human fate than starvation-to-death resulting from world's overcrowding. On the other hand, for lack of a definition of species, theoretically correct and hitherto uniform, linking morphological variations to ecological conditions, plant's selection remains empirical: deceivingly expensive as its local results cannot be legitimately nor practically extrapolated.

In various branches of natural history, inventories of species, genera, even of tribes, are still very far from being complete. In phanerogamy, however, since the end of XIXth century no new forms have been discovered, sufficiently different from yet known, as to deeply modify the general conspectus achieved. Thus a general synthesis of knowledge in this branch may be considered as possible; whilst it remains impossible in other branches, entomology for instance. Now practically all human alimentation is, directly or through transformation by edible mammals, obtained from phanerogams.

"Botanicorum principes" of the early XIXth century, such as ROBERT BROWN or A.L. DE JUSSIEU, used to work, in herbarium, with dried specimens sent from any part of the world, in heterogenous lots and with no names, except a few local vernacular. They had to put in order these. So they had to look for general resemblances (whilst nowadays herbarium specialists have to care for differences only, in their generally classified collections). And actually they did discover the main lines of delimitation between these higher taxa we now name families. We say their "nose" was responsible for that, which remains wonderfully accurate. It must be borne in mind that such a nosing simply resulted from keen examination of very many very different phanerogams and the more or less conscious synthesis of a hierarchy in their apparent characters.

This hierarchy is actually different in the different families. For instance, number and disposition of stamens are a familial constant character in Oleaceae (2, epipetalous) and Brassicaceae (6, hypoginous); in Mimosaceae number may be indefininite or fixed (8 or 10, twice as many as petals) and filaments free or united, which, in the general scheme I here try to explain, gives to the character tribal rank.

So it may not be obvious that any hierarchy of taxa, natural groups of living beings, actually is a hierarchy of characters, id est of physiological functions plus the morphological charcteristics of the responsible organs. Nevertheless so is it. If not, no correlation at all would exist between ecology and morphology and then all we are honestly certain of, concerning struggle for life or smoother adaptative processes, ought to be considered as mere humbugs.

Now, if a correlation does exist between ecology and morphology, to the different hierarchy of characters, id est the different order of their specification in the evolutive timing of any group constituting a natural evolutive unit, will logically respond differences in the thinning of their diversification.

Let us go slow; in the preceding lines three general assumptions have, more or less plainly, been put out :

A. phanerogamic evolution is originally divided in numerous independant phyla, each family being one;

B. general, physical for instance, laws of evolution are also valid in biology;

c. consequently to A and B, taxinomic hierarchy must be supported by a classification of physio-morphological characters, based on their natural degree of diversification in the phylum concerned.

A. PREFAMILIAL EVOLUTION OF PHANEROGAMS

Most probably life has arisen on Earth under the form of a coloured jelly in the shallow brackish waters of prearchean era. Necessarily these primitive being were autotrophous; specialists suppose the very first ones to have been red-brown, next only did appear the truly chlorophyllous, green; notwithstanding this difference in coloration, we may believe all the primitive jelly to have multiplicate its cells according to moods very similar to those of nowadays Myxomycetes.

Slowly, in the central parts of these amorphous masses must have appeared non-chlorophyllous beings, at first unicellular, necessarily heterotrophous. Thence come all nowadays direct or indirect parasites, from mushroom to man.

Autotrophous beings must have had, for a long time, no struggle-for-life problems: continuously but slowly spreading over Earth's surface, from probably very few and narrowly bounded starting places, if not from only one. In their collectivity were included all the morphological potentialities actualised since, as well as many others of which we remain ignorant through lack of present or fossile representatives.

Vegetative, merely somatic, specialisation of autotrophous may so have reached to a very high degree. Hereditary specialisation, I mean accurate and permanently transmissible adaptation to specialised biotopes, was lastingly useless : as long as Earth's surface remained protected by a thick and dense layer of tepid clouds. Gradually, however, did seasons and climates appear; at least partially as a consequence of this layer's decantation by the respiration and transpiration of more and more numerous and efficiently specialised green plants.

Lack of vegetable fossils forbids us to be affirmative about what may have happened then : at the end of the secondary era. We nevertheless know that the superabundant flora from which coal derives and, later on, which provided the enormous mass of fodder necessary to gigantosaurians, must then have been considerably modified. In the following eras, paleontological information becomes exceedingly scarce, with the exception of peat-bogs' palynological analysis. According to those, all our present phanerogamic families practically do appear at one go : with no track towards any sort of interfamilial linking ancestors. This may be considered as the normal result of a prefamilial, presexual, long-lasting evolution of phanerogams by purely vegetative and haphazard morphological preadaptations.

In these preadaptative and somatic, hence freely variable forms, sexual reproduction, itself as a result of seasons and climates newly appeared, has introduced hereditary adaptative determinisms : each familial ancestor, individual or more probably collective, necessarily becoming then the immediate basis from which intrafamilial evolution has arisen; this being a success or a failure if its prefixed bounds prove or not to agree with those of its geographical expansion.

B. GENERAL LAWS OF EVOLUTION

The tremendous development of modern knowledge about nonliving beings and the forces to which they obey, is entirely supported by two, purely theoretical, principles :

1° in any closed energetic system, no energy can disappear or appear;

2° every such a system irreversibly advances towards its internal statute the most probable, this means inwards equilibrium.

These principles have been discovered by logical examination of how do work steam-engines. Ancient, medieval and even, on to the middle of XIXth century, modern most accurately drilled logicians, although well knowing the prototype of all steam-engines (any boiling-pot with its jolting cap), remained deeply convinced, by the rules of reasoning they stuck to, that no available work had to be hoped from them. We, biologists, must pay utmost attention to this historical fact : so may prove useful to us an attempt towards some new type of logical reasoning, applied to biosystematics, even if its working hypothesis appears definitely condemned by linnean, lamarckian or darwinian dogmatisms.

First of these fundamental principles of physical evolution affirms the quantitative conservation of energy, second the irreversibility of its qualitative degradation, *e.g.*, : from localised and powerful pressure to general and motionless heath. What can they mean if applied to biological evolution, with special reference to the phanerogams ?

Well, first principle simply emphasizes the logical as well as experimental necessity for any reasoning to be restrained within clear-cut boundaries : into what modern physicists name a "closed system." In a preceeding paragraph, I have attempted to demonstrate that, from biological evolution viewpoint, phanerogamic families might each be considered as such a closed system.

Second priciple shows that any energy, initially "potential" (this means possibly dynamic), as soon as bound within a closed system, irreversibly becomes "actual" (this means definitely static, even if it has apparently vanished). Now this irreversibility most evidently agrees with the classical "orthogenesis" of biological evolution theoreticians. As well, this potentiality responds to the remaining adaptability in hereditary impulses of living beings, this actuality to their established characters.

C. INTRAFAMILIAL DIVERSIFICATION OF CHARACTERS AND ITS GENERAL ACCOUNTABILITY IN (PHANEROGAMIC), TAXONOMIC HIERARCHY

Experimental evidence may easily be obtained of the successive deposit from thickest to thinnest elements in all physical evolutions by sedimentation or decanting. Likewise may we admit that, in biological evolutions, first do appear the more general features, later on the more and more particular ones.

So, logically, systematically higher—this meaning evolutionarily earlier—taxinomic characters will morphologically be the less diversified inside any phanerogamic phylum: closed evolutive system, family in the average width of this classical term.

To the androceum example previously given very many may be added. Let us give but one more. In Icacinaceae, flowers can be gamopetalous, dialypetalous or apetalous; this drives us to found on this most evident characteristic of the corolla the highest intrafamilial taxa: subfamilies. But in Convolvulaceae, corolla is always present and gamopetalous and varies in general shape according to relative width of basis, throat and limb, also to relative depth of limb's lobes; here then corolla's characteristics are less widely but more thinly diversified; so will they support a taxinomic character of lower rank: generic in this case, we shall see why later on.

This analysis of natural intraphyletic diversity must be led in agreement with what we know of genetical processes. So is it convenient to assimilate physio-morphological characters to genetical ones, notwithstanding the very wide differences in the scales of observation. Now such an assimilation proves to be practically useless, if not merely senseless, when this difference of scale is not taken in account by some bias or other. Hence does it prove necessary, at first sight, to restrict the meaning of the word "character" in its physio-morphological sense. For instance, general appearance of the corolla will always be a character; but if its complete description, according to intrafamilial diversity, needs more than one morphological term (in gross equivalent to a genetical allelomorph) then each of these will be named a "characteristic." Reciprocally: the number of characteristics involved in a character's systematic description will measure its intrafamilial diversification degree: its taxinomic value and hierarchic rank.

Here appears a trend towards a mathematical scheme, possibly always the same in the whole of phanerogamic families.

After very many attempts, often deceiving, always very tedious, I finally have chosen the simplest of all the mathematical developments available as a valid solution to this formal problem.

This development has the general form : $(a/1 + a/a + 1/a)^n$.

The term a/1 and 1/a respond to the a and A or non-a of geneticians in whose scale of observations, within an extremely thin slice of time, general evolution practically does not exist. In the systematician scale of observation evolution does exist. There, as the word evolution itself shows it, a and non-a appear as segregates from an indifferentiated common ancestor, hereupon symbolized by a/a. Now this symbol, in the beginnings, mathematically responds to the mean value in a continuous variation from a/1 to 1/a; once evolution achieved it will not disappear but mathematically be a median value between the segregated extremes and, so, itself segregated.

It has proved most practical to generally translate : a/1 by *o*, a/a by *1* if a mean and by *I* if a median, 1/a by *2*. The italic printing of these figures accounting for their descriptive value : qualitative and not quantitative.

Now some general link had to be found between all the values qualified by *o*, all those qualified by *2*; the *1* or *I* being, theoretically, equivalent to a zero-adaptation.

The most important adaptative problems, for phanerogams, doubtlessly arise from their individual inability to displace themselves, either for sexual intercourses, or towards a better habitat. Thence, adaptation of flowers to entomogamy or anemogamy, adaptation of seeds to zoochory or anemochory, adaptation of leaves to shade or sun, moisture or drought...a. s. o. will have an utmost adaptative meaning. Now, most generally, animal life is specially intense within shady, humid and tepid biotopes; whilst winds are specially frequent and violent in sunny, dry and open ones. So does appear a possible dichotomy, of course relative to the geographical location of the family accounted for: on the one hand, *o* will stand for zoo-hygro-scia-meso...phily; on the other hand *2* will stand for anemo-xero-helio-tropo...phily. Of course, this general rule has always to be smoothly and thoughtfully, shall I say "nosingly", applied; for instance: awns in spikes or spikelets of grasses generally mean adaptation to zoochory, acting as hooks towards mammal's fleece; nevertheless awns may, in some genera or species, wear a long, dense and plumose covering of hairs, so being adapted to anemochory by this secondary achievement of a zoochorous organ.

This being admitted, systematic description of any species in numerical symbols becomes easy.

Successive values of n will define the hierarchic rank and mathematical development of $(a/1 + a/a + 1/a)^n$ will lead us to the following board:

n	N	C	A
1	1	3	3
2	2	5	9
3	4	9	81
4	8	17	6,561
5	16	33	43,046,721
6	32	65	1,853,020,189,551,241

$N = 2^{n-1}$ is the number of characteristics necessary to qualify the character of rank n.

$C = 2N + 1$ is the number of biogeographic units in rank n; these units being defined by the sum of all *o, 1* and *2* of their symbolic description: *02, 11* and *20* whose such a sum is 2 belong to a same biogeographic unit, although *02* and *20* are most evidently different from a morphological viewpoint.

$A = 3^N$ is the number of morphological units in rank n; such as individual *02, 11* and *20* in the previous example. Tables of these numbers in each of the biogeographical units, from n = 1 to n = 4 have yet been given (G. ROBERTY, Monographie systématique des Andropogonées du globe, Genève et Paris 1960, p. 19). I have also given tables for the ordinal translation, in decimal system, of the descriptive sequencies in *o*, *1* and *2* (l. c. pp. 22 & 26-31).

First rank (n = 1) will be termed subfamilial. Here 3 subfamilies can exist: 1st whose character has its only characteristic = *o*, 2nd with its characteristic = *1* (or *I*), 3rd with its characteristic = *2*.

Second rank (n = 2, C = 5, A = 9) will be termed tribal. Here 5 tribes include 9 subtribes (1 + 2 + 3 + 2 + 1).

Third rank (C = 9, A = 81) will be termed generic. Here 9 cohorts include 81 genera (1 + 4 + 10 + 16 + 19 + 16 + 10 + 4 + 1).

Fourth rank will be termed specific, with (C = 17) 17 sections including (A = 6,561) 6,561 species.

These figures must be considered as maxima. Actually most of families can be divided into 3 subfamilies but divergence of actual from theoretical figures promptly becomes very great. For instance, in Andropogoneae, first tribe (with formula *oo*) hence with but 1 subtribe of Poaceae Panicoideae, we have found but 30 genera instead of the theoretically possible 81. In Convolvulaceae we have found but 62 genera, in Polygonaceae 42, in Achradaceae (Sapotaceae) 26, in Mimosaceae 36; whilst the theoretical maximum for any family amounts to: $3 \times 9 \times 81 = 2{,}187$.

Fifth rank may be termed ecological, with its 33 biogeographical subdivisions and more than 43 millions of possibly different morphological forms.

Sixth rank may be termed genetical. Its nearly 2.10^{15} phenotypes, in each of the millions of forms previously mentioned may actually respond to the possible differentiation of morphological details taken in account by formal genetics. Of course, any attempt to classify such a number of forms at their own level will be vain. On the reverse, if the character and its 32 characteristics have been correctly selected and defined, it may prove easy to localise which combinations or arrangements are physiologically unfit, id est genetically lethal.

I have a clear idea of the criticism to which I do expose myself in this attempt towards a standard mathematical skeleton of systematical analysis in phanerogamic families.

Most will say it too clever to be true.

Some will argue against the too low theoretical numbers for subfamilies and tribes ; others will argue against these same too high numbers for species and their subdivisions.

Many have yet said the whole thing to be artificial, apparently ignoring that systematic and artificial are mere synonyms.

Those who have taken the care to apply themselves the method in their own specialised field of knowledge, generally regret the increasing discontinuity between the numbers of characteristics : 1, 2, 4, 8, 16, 32. They certainly have valuable reasons to do it. Now let us go again to the heart of the subject : which is the medieval structure of biological theories, compared to the modern structure of physical ones. When the first theoreticians of modern chemistry discovered the atomic numbers and said them to be integers, they were wrong ; we do know it now. But if this working hypothesis had not been admitted, for more than half a century, we should have remained unable to go further and, for instance, to discover how and why it had to be corrected.

Einstein used to say : "theory can be tested by experience but no path does exist which leads from experience towards theory." This, too many biologists, principally among those who specialise themselves in the fields of applied systematics, seem to ignore. I shall not deny that Linnaeus' "fixism", Lamarck's "adaptationism" or Darwin's "struggle for life" now do belong to the history of biological research, not to its accurate and available philosophy. Nevertheless, any new philosophy of biological evolution and adaptation must take in account the actual facts on which were these hypothesis [illegible] built. These facts may appear now as innumerable. So must they be classified according to the mathematical, id est logical or, more exactly, stenological, methods especially adapted to the handling of large numbers. This is what I am trying to do : with a very clear feeling of how the attempt is a difficult one and how much any help in the same direction or nearby ones, could be useful !

As a native from western Europe, I have not to be ashamed for the unbalanced distribution of wealth and food on Earth's surface. This is a problem of technics and not of ethics. But I have to be thoroughly conscious of the problem, its seriousness and urgency.

As a systematic botanist, responsible for the theoretical solution of this technical problem, I must—and, *a fortiori*, I may—research any new way towards this solution and for this call to every one's help, especially in countries where underfeeding if not actual starvation does exist. This is why these lines have been written.

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Reprinted from
ADVANCING FRONTIERS OF PLANT SCIENCES, Vol. 1 (1962)
edited by
RAGHU VIRA

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