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Taxonomy and applied botany

By

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Abstract

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[Plant] taxonomy and [plant] taxonomists are described under a variety of angles, including the general biologists's and the layman's point of view. Taxonomy is shown to have developed concomitantly with the western civilization and to share its present decline. The paper is a strong plea against splitting tendencies at the specific level and for clearcut, broadly defined species easily recognized by their morphology. This lies also in the interest of applied botany, provided that suitable infraspecific taxa can be defined — as may now adequately be done by means of biosystematic investigations.

[Editors' abstract]

What is taxonomy? Apart from theoretical or philosophical aspects, the question seems superfluous to almost every taxonomist. A taxonomist usually assumes, right or wrong, that he knows what he is doing. But he discovers, time and again, often with some surprise, that other biologists do not understand what holds his interest and commands his efforts. They see him as a kind of stamp collector; the difference being that the stamp collector hunts and accumulates stamps and the botanist hunts and accumulates plant specimens. The stamp collector attaches his catchings to sheets of paper, arranging in orderly rows stamps of the same breed. The taxonomist does the same, only he arranges his related specimens not in orderly rows but in orderly piles.

Those biologists who are not inclined to admit taxonomy as a discipline of scientific merit and on equal footing with their own field of interest, nevertheless tolerate it because it cannot be discarded. Taxonomy provides plant names and so is indispensable if one investigates anatomically, karyologically, ecologically, phytochemically, and the like.

Some uneasiness, now and again, makes itself felt among our brethren: will this taxonomical job never be finished? Is so much time needed to provide all plant species, all plant specimens, with this unavoidable scientific name? Do herbarium collections never stop growing? I was asked, some years ago, if, when one specimen of every existing species had been acquired, the University Herbarium would then be complete, and no further expansion or expense be needed? A question of that nature, coming from the quarter where personnel and funds are allotted, may raise a laugh and cause a tear.

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Outside the field of professional biology, the best a taxonomist may hope for, is, that he be seen as a gardener of academic standing. Therefore, he ought to be able to name every plant, when asked, both the scientific name (to please the sophisticated), and the vernacular or common name (to please progressive minds). In addition, he is expected, as circumstances go, to inform the owner how to grow his plants and how to cure them if ill or suffering. If his answers express doubt or otherwise fall short of expectations, he is judged to be not much as a taxonomist, or that taxonomy is not much use anyway.

All this, and more, indicates that taxonomy needs a definition, a fitting circumscription making its contents, its activities and its purposes understood. I have, however, no formula for taxonomy, nor have I ever met a definition of taxonomy that satisfied my requirements. Let us try to approach taxonomy in some different ways to discover some of its characteristics.

Everybody agreeing that taxonomy is part of biology, it becomes easy to assign it, as it shows itself, to a place in the galaxy of sciences that constitute biology. Evidently, its basic subject is the pattern of diversity that nature composed. Diversity as shown among the individual organisms, not the diversified relations living organisms appear to maintain among each other and with their environment. Nevertheless, these latter relations are of importance to the taxonomist and he will never omit to consider and use them. They supplement his morphological observations.

We also find that the taxonomist and the molecular biologist are the extremists in biology. The molecular biologist studies the components of protoplasm, the taxonomist the components of the vegetable and animal kingdoms. In other words, the molecular biologist studies what seems to be the substrate, the matrix of life, the taxonomist what life brought about by means of protoplasm: the organisms.

The taxonomist demands that nature may proceed undisturbed by human interference. What nature produced as "plant specimens" is studied by the taxonomic botanist. Clearly, taxonomy is now well demarcated from the large majority of biological sciences, which adopted the experiment as their means of research, that is, interrupting or deviating the ways of nature.

Taxonomy is one of the non-experimental fields of biology. In other words: Nature puts living organisms to the test and the taxonomist studies the outcome.

What this implies in our present world, where experimenting in life-sciences has received the status of a religion and even God is subject to experimenting, I will not analyse here though the consequences materially and spiritually are far-reaching.

How did and does taxonomy behave? And how the taxonomist?

Taxonomy, as we understand it, began some 6 centuries B.C., when European philosophy and biology came to life, joined from the first. It began

round the eastern Mediterranean. Matter appeared to be dead or alive, though both conditions were considered to be intricately related. The taxa first recognized were: living and dead things.

Slowly biology moved westward, to Alexandria, the Greek islands and Athens, taxonomy being the heart of biology. From there it progressed further westward, round the beginning of the Christian era, and was transplanted into Roman soil, where it never thrived. The first centuries A.D. were the era when taxonomy became part of theology. The early Middle Ages witnessed some ephemeral taxonomic revival and development. Taxonomy continued westward: Spain, Sicily, then turned to the North: Salerno, northern Italy, Montpellier, arriving during the latter part of the Middle Ages in central Europe. In the 16th century taxonomy flourished in Germany, then in the course of the 17th in England, France, Holland, and Switzerland, in the 18th century taxonomy reaches its northern limit. Sweden becomes now the temple of taxonomy and Russia cooperates with Europe. At the onset of the 19th century one may say, taxonomy was recognized as one of the foremost sciences in all biological endeavour; North America joins forces, rapidly and brilliantly. During the 20th century taxonomy lost its leading position in the Western world.

It is worthwhile to consider the course of general history in relation to taxonomy. Western civilization was, in its beginning centuries, in its stagnant mediaeval period, and in its enormous post-mediaeval development, closely and harmoniously reflected by developments in taxonomy. At present, in the second half of the 20th century, now the decline of our civilization is becoming more and more manifest, taxonomy also withers.

Our brief survey has now revealed the following characters of taxonomy: it is a biological science, intent on assembling and conserving facts and objects produced by living matter under natural conditions. Analysis and synthesis are applied to create order. Words and word-signals are used to direct and to standardize. Taxonomy accepts diversity as an essential of living matter: diversification shapes the course of life. It welcomes the results of experiments as contributions to taxonomic conclusions. Taxonomy always was a characteristic of European scientific endeavour and European civilization. It is the oldest of biological sciences and disposed over many centuries of observation, research, discovery, and philosophical evaluation before the large majority of present-day life-sciences originated.

Let us now consider those who make taxonomy a reality: the taxonomists. Perhaps one of the best definitions of taxonomy might be: taxonomy is the science that inspires taxonomists. So, let us observe their behaviour. This again might bring us closer to a portrait of taxonomy recognizable to and recognized by many, biologists or not.

I cannot resist quoting from the prologue to Gargantua, RABELAIS' classic of 1532: "Did you ever see a dog with a marrow-bone in his mouth, — the beast of all others, says Plato, the most philosophical? If you have seen him, you might have remarked with what devotion and circumspectness he wards and watcheth it: with what care he keeps it: how fervently he holds it: how prudently he gobbets it: with what affection he breaks it: and with what diligence he sucks it. To what end all this? What moveth him to take all these pains? What are the hopes of his labour? What does he expect to reap thereby? Nothing but a little marrow."

No doubt you have realized, insofar as taxonomy holds you, that this pictures to perfection the taxonomist in the field. This is how he meets with his coveted specimen, how he looks at it, how carefully and pleased he guards it and brings it in safety and, most of all, this pictures his intent to suck its marrow, to appreciate and uncover its message.

While the dog is — because of this behaviour — judged to be the wisest of animals, should we judge the taxonomist to be the wisest of biologists? This depends on our interpretation of the word "wisest". Actually, many non-taxonomists will think him rather unwise. Can you imagine a physiologist, a phytochemist, an embryologist, a morphologist, an anatomist, a karyologist, and what have we in biology, *e.g.* climbing a mountain for three days, living under unpleasant circumstances, just to find out what plants may grow, or not grow, there, on that almost inaccessible, high ridge? Would any of those scientists I just mentioned, give the same reply, that ADANSON gave, on leaving for West Africa, when asked why he chose to go collecting in a country rightly called "the white man's grave?" ADANSON declared that this was exactly why he went, because so much more and new information was to be expected about the plants occurring there, so somebody had to fetch them and, with some luck, bring them home. This unwise ADANSON wrote, as you know, the book that initiated numerical taxonomy, one of the recent developments in taxonomy.

No other biologists, except those studying ecology, that natural daughter of taxonomy, are willing to undergo without hesitation discomforts and dangers as a normal part of their life, in order to see, to collect, to secure the things they want to study.

Apparently, the taxonomist is devoted to his science. This judgement is supported by three characteristics. One is that he is always and everywhere talking shop. No sooner two taxonomists meet, the topic is to be found, somehow or somewhere, in taxonomy. If more than two meet, it is likely that more than one taxonomical topic attracts an interested taxonomist. The second is that a taxonomist is never tired. Whenever you meet him, he is ready and very much willing to discuss or to verify, or to reconsider, taxonomical questions. The third is that a taxonomist can only be persuaded by wife and

children to take a holiday if he is certain that the resort is at walking distance from some site of botanical, that is, taxonomical interest.

It appears that the taxonomist behaves towards his science and his scientific work very much like a father to his child. A taxonomist considers the taxa he is particularly interested in, his own. Frequently he dislikes, no, abhors the arrival of another taxonomist in his domain, although there are happy exceptions. There is a very real, if difficult to explain, emotional relation between the taxonomist and his subjects under study.

Which tools are employed by the taxonomist to do his research? A pair of dissecting needles, a water bottle, a small container to boil plant fragments in, a pen and paper. Then 5 senses: his eyesight, assisted by a magnifying lens, then: touch, smell, taste, and hearing. This latter, fifth sense is used only occasionally, *e.g.* to hear the seeds rattling in a pod of *Crotalaria* when shaking it, or to recognize an *Adenia* by the passiflorean crackling of the stem when it is twisted. Another sense, a sixth sense, at the taxonomist's disposal, is common sense. Does he use that also? We will find an answer to that question in a few minutes.

By means of this equipment the plant taxonomist performed remarkably well. His results needed, to be listed and become available, the largest work of reference any biological discipline has: Index Kewensis, an unequalled treasury of accurate information.

Among the staple products of a taxonomist are portraits of species. Words which delimit and describe "species", these word-portraits often being illustrated by drawings or otherwise. These portraits are the summarized observations, obtained from plant-specimens judged to belong to one single species. And species serve as the basic units by means of which a hierarchical vegetable system is constructed.

However, there is no workable or theoretically acceptable definition of a "species", no measure for it, no test to locate and trace natural specific boundaries. Playful definitions like "a phase in evolution", or which suppose a high degree of, if not perfect, sexual incompatibility towards other "species", and the like, are almost useless to a taxonomist who studies species. To him, morphology, characters visible on the outside of the plant, sets the bounds. This is an unescapable necessity, the only feasible method, and this will remain so. It is, in addition, implied by the type method and the connected Code of Nomenclature. Now, what happened in the course of time and what may happen, ought to happen, in the future?

The taxonomist, when beginning to study a group of related taxa, is faced with an existing fund of specific names earlier proposed for all or for some of them. The Code of Nomenclature obliges him to interprete these names in the prescribed correct way.

Towards the end of the 19th century, it was decided that every plant specimen belongs to a "species", and this implies that every plant in nature bears one correct scientific name, often accompanied by a number of incorrect ones. It became part of the task and duty of taxonomy to enable biologists to identify species, that is, to furnish all professional botanists with information they can handle, to name their plants. If you now consider the situation in phanerogamic taxonomy as it developed during the last century, when plant specimens to be classified and named multiplied by perhaps more than one hundred times confronted the taxonomists, you may perhaps be willing to agree to the following summary.

A taxonomist looks at his species like a father at his children. So he is most anxious not to overlook or neglect anyone. He has no objective standard to evaluate, no absolute measure or check, and what previously had seemed to be gaps between the morphological patterns of species, appeared to be disjunctions of quite a different size and nature, demonstrated by those numerous new acquisitions. A gap very often turned out to be composed of many gaplets, if you allow me this word. And there is more. Distinguishing among one's children, no parent finds difficult; a mother knows one-egg twins unfailingly apart. The taxonomist's eye noted many characters among his species and specimens no other biologist would observe or consider without a previous training in the detailed or overall features of that group. What happened?

Close and emotional observations, together with obedience to the Code, enticed the creative taxonomist to overrate minor morphological differences among specimens. He sometimes was led to neglect the inexorable demands of practice, of most other biological sciences, to taxonomy: that his conclusions be usable, beyond reasonable doubt, to biologists needing or wanting them. Botanical keys and descriptions must lead to the correct specific name, not only if used by experienced taxonomists but also if handled by anybody who got a modest schooling in terminology and examining plants.

The splitting, however understandable, of certain taxa into numerous "species" which only the fathering taxonomist may recognize, dealt a serious blow to taxonomy, and this not only from a practical point of view. Phanerogamic genera which contain too many "species", sometimes very much too many, are *e.g. Hieracium, Digitaria, Rubus, Rosa,* many Orchid genera, *Oenothera, Taraxacum, Ixora, Pavetta, Ficus, Euphrasia, Eucalyptus, Carex,* just to mention some obvious examples. In those and in similar cases taxonomists did not take full advantage of their sixth sense: common sense.

In the course of the 19th century it became increasingly evident that "species" are a conglomeration of closely related infraspecific taxa which, as such, maintain a measure of constancy. The birth and development of genetics, cytology, phytochemistry, phytogeography, phenology and other disciplines

demonstrated and stressed this natural condition. New developments in taxonomy in the 20th century elaborated and further stressed this. Among the most important are palynology, micromorphology, and breeding trials. These, correlated with still other lines of research in carefully planned research programs, are together called "biosystematics".

Biosystematists apply in their taxonomic studies traditional and partly renewed methods, made possible by modern technical refinements. This most desirable branch of taxonomy was already conceived by LINNAEUS but, of course, the technical means of conducting this kind of research were not yet invented in his days. Transplanting and comparing groups of specimens was feasible (and sometimes, unmethodically, done) but the cytological, palynological and micromorphological controls over large areas of distribution only became possible in the 20th century.

It is evident that detailed and correlated research will lead to a deeper insight and a wider understanding of the ways species behaved in nature or came into being. This, however, is not promoted by narrow species-limits. Biosystematists do not hesitate to cross species-borders, if this seems desirable, but a wide field for activities comprised by evident natural borders, *e.g.* obvious specific limits, certainly is beneficial to biosystematical research, also from a theoretical point of view.

It is to be noted that biosystematics not only supplements taxonomic research with weighty factual information but also that biosystematics involve some experimenting, which means a renewal and extension of taxonomy. Transplantations, comparative trial plantings, belong in the modern concept of "experimenting".

And here a possible task for botanical gardens is conceivable. The aims of a botanical garden — which differ from those of an experimental garden — may in the case of biosystematical trials well be found to allow room and to grant support to experimental plantings as part of a biosystematical research program in addition to providing observations and materials from living specimens.

I have pointed out that both wide and clear specific limits, which means as a rule heterogeneous, variable species, are desirable and preferable for both practical and purely scientific reasons, irrespective whether biological disciplines of long standing or the present-day developments are concerned. And there is, I am convinced, no theoretical argument, supported by scientific proof, opposing this approach and this method when delimiting plant species.

I know that my views are not welcomed by everybody. Yet, I stand not quite alone. One finds signs in support of the views and practice I advocated, *e.g.* in some of AUGUSTIN-PYRAMUS DE CANDOLLE's work; FOURNIER's immensely useful "Quatre flores de la France" is another step in the right direction, and there are many more. To mention a recent publication, in which

the new approach was cautiously tried, I point to the study of African *Allium*, by Dr. DE WILDE-DUYFJES, a step forward in the sense I have outlined above.

All this points in one direction: species ought to be commonly recognizable, and as a rule will be variable and comprise numerous infra-specific taxa. I wish that in a near future daring young men and women, while progressing circumspectly and well-considered, will be bent to reduce drastically the number of species in many genera, widening and clarifying species-limits, in order to arrive at taxonomical results that supply to practice what it has a right to expect.

I will not now discuss the theoretical and philosophical aspects of taxonomy, although it is tempting to review the fascinating ways in which analysis and synthesis, deduction and induction, are interlocked in taxonomy, because we find ourselves now facing applied botany.

Applied botany is not an autonomous science: it is a method. There are in applied botany scientific methods — following the prescripts of occidental biology — and non-scientific methods; only the former will be briefly considered here in their relation to taxonomy.

Applied botany tries to draw profit, to promote human prosperity or well-being by finding serviceable plants, or plant taxa, and make these being used. Applied botany is, therefore, generally not only much more appreciated than taxonomy but also very much better understood.

My plea for variable, spacious species may, at first sight, seem both advantageous and disadvantageous to applied botany. Advantageous because interesting plants can be named (and the name be helpful in the search for information through literature). Disadvantageous because the renewed, "large" species may "hide" closely related taxa, which previously had drawn attention by means of their earlier current binomium.

Very frequently applied botany investigates within one or a few species to uncover characteristics of certain taxa particularly eligible for a desired purpose. And it appears that here biosystematics are a link between taxonomy and applied botany.

Infraspecific taxa, discovered and delimited both by taxonomical and biosystematical research, are exactly what the applied botanist is looking for.

The total of morphological and biosystematical information forms part of the facts and potentialities to be considered during lines of research in applied botany. Of course, the intent and purpose of the applied botanist are of an entirely different nature from those of the biosystematist. But the behaviour, the potentialities, the possible origin, the reactions to environmental conditions, the relationships, the morphological characteristics and other properties of taxa, scrutinized and tested by biosystematic research, is exactly the kind of information that numerous applied botanists may use to approach their aims.

And so one supposed disadvantage of large species to applied botany turns out to be just the contrary, to be of direct advantage, provided of course that biosystematists have shown ways and means concerning the applied botanist's field of activity in the taxa that hold his interest.

I have pointed out that taxonomy closely followed in its development the course of European civilization. Is it just a coincidence that now the popular demand for material profit from scientific research, directly and without delay, is heard more loudly than ever, taxonomy is enriched with biosystematics, and so lends a helping hand to applied botany? Let us leave this question unanswered. After all, hall-mark of all biological science are unanswered questions and these are the most interesting of all.

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