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The Concept of the Genus¹

I. History of the Generic Concept in Botany²

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The concept of the genus must be as old as folk science itself. Certainly we find a nomenclature for plants and animals that is hardly different from modern scientific nomenclature among many peoples and in many languages.

It would be quite futile to speculate at too great length about how generic grouping had its beginnings, but there are two processes that must have been operative in ancient times just as they are today. (1) With enlarging experience, people make finer distinctions, and need different names for newly distinguished entities which have previously been called by the same original name. The original name becomes generic in its application; variously qualified it provides the basis for specific names. Thus genera are set up by analysis. (2) As language becomes clumsily rich in separate names for closely similar things, there is a tendency toward grouping or classification under the same name on the basis of newly perceived similarities. Thus genera are set up by synthesis. Many kinds of grass are so similar that we can hardly believe that the concept "grass" was not more ancient than the distinction of particular kinds. Here we have a hypothetical instance of the origin of a folk-science genus by analysis. On the contrary, the generic concept "fern" is a technical one, depending upon close observation, so when we find a people of relatively low culture, such as the Batak of Sumatra, defining extremely diverse plants as

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² Papers from the Department of Botany of the University of Michigan, no. 713.

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"fern" pretty much as the modern botanist does, on the basis of a relatively obscure characteristic, namely, the leaf-borne sporangia, we feel sure that a genus has been set up by synthesis of things superficially very unlike.

The grouping of distinguishable but similar kinds into genera seems always to have been a linguistic necessity if there was to be reasonable flexibility and precision in the nomenclature of plants and animals. The flexible and undefined categories genus and species ever sufficed for most purposes of folk science, and so we find by the analysis of common speech that only these two are indicated in the plant nomenclature of most languages.

The scientific concept of the genus is therefore not modern at all. It did not originate with Linnaeus or with his great predecessor, Tournefort. Rather, the nomenclatural reforms of both brought the Latin names of plants back into conformity with the usages of common speech, a conformity which had existed in science at the beginning of the sixteenth century but was gradually lost through the two centuries that intervened between the German Fathers of Botany and the great reformer, Linnaeus.

Complete scientific systematization of plants and animals has brought into recognition higher or more inclusive categories than the genus. Folk science had a vague need for these, and sometimes recognized their existence, as in instances that will later be briefly alluded to. Nevertheless, in speaking of the generic concept in folk botany as needing little change to become essentially the generic concept of modern science, I must of course guard myself by insisting that the inclusiveness or size of genera, now as in the past, is less a matter of science than of linguistic preference and convenience.

Classical botany was folk science. It did not progress far beyond the gathering together of folk beliefs and practical information. Theophrastus dealt almost entirely with cultivated plants, and Dioscorides with medicinal ones, and each systematized the knowledge or belief of his time with regard to the particular plants that interested him. Although they had no Dioscorides to record it, the illiterate barbarians of northern Europe probably had a folk science and terminology nearly as extensive and useful as that of Greece or Italy. Contemporaneously, an equivalent folk science would have been found in Egypt, in Ethiopia, in Palestine, in Persia, in Mesopotamia. There is, as a matter of fact, a modern interpretation of an old Babylonian herbal. China has its ancient knowledge of plants with a surviving literary record in a long series of printed *Pên's'ao* or herbals dating back at least to 1100, and based upon folk science hundreds or thousands of years older. China passed its learning on to Japan, where there was certainly already a native lore which was grafted upon the Chinese. India

early had systems of native medicine and associated plant lore which have come down to the present time partly by way of literature and partly by way of tradition. Anyone who delves into the beliefs of the peoples of the East Indies cannot fail to be impressed by the voluminous lore of plants, comparable in extent and value to that of the classical Greeks or Romans, and maintained by a nomenclature quite as scientific as the best in European botany during the time preceding Linnaeus. The New World had developed its own plant lore, an extensive body indeed in ancient Mexico, with its associated system of plant names and plant classification. Wherever we look into the matter, whatever the people or the language, we find naming and classification of plants, and almost invariably a more or less well-defined idea of the genus, as the smallest group that almost everyone might be expected to have the name for in his vocabulary. It might or might not be subdivided into species.

The idea that the generic concept is a characteristic of folk science will be found carefully developed in E. L. Greene's *Landmarks of Botanical History*. I have carried the development somewhat farther, anxious to show that the generic idea is concerned in its beginnings with the psychology of language, that those beginnings are lost in pre-history, and that we can only recover some conception of them by the consideration and comparative study of the plant names of people everywhere.

The tendency to group plants into named genera, so generally characteristic of human thought and language, reflects the fact that there are not enough different words in the living, current vocabulary of any language to supply each closely similar plant with a basically distinctive name. We, for example, apply the name oak to many different trees, but so long as we stay in our own proper north-temperate habitat, our generic feeling for the oaks is true and consistent. As a matter of fact, Greene has shown that the generic idea "oak," as held today, was really borrowed by scientific systematic botany from the folk science of the English pioneer settlers in temperate America, who extended the English folk concept of "oak" to cover the various widely different American oaks. In the eastern United States we distinguish white oak, burr oak, chestnut oak, live oak, scarlet oak, black oak, shingle oak and others, having a perfect binomial nomenclature for them in English, and, from the literary record, we may be sure that these designations owe nothing to scientific botany. They were in use in folk science before the botanists with their imperfect materials had anywhere nearly as good an idea of the oak species as the English colonists in the American woods.

In this instance the generic concept came from England, where there were only a couple of closely allied oaks, and was successfully applied to a multitude of popularly distinguished species. The botanists had long

labored under the difficulty of trying to recognize as many genera as there were Latin words for the few but exceedingly distinct oaks of Europe, namely, *suber*, *ilex*, *cerris*, *robur*, and *quercus*. We have here one example from folk science of the linguistic advantage of a large genus over several small genera. The generic concept is a variable thing in popular consciousness, as in science, but probably more uniformly and consistently applied in the folk science of most countries than in the systematic botany of the sixteenth and seventeenth centuries. We need have no doubt that ancient Latin and Greek folk botany, only imperfectly preserved in the literary record, were much more complete and perfect than the medieval "scientific" botany which in countries remote from the Mediterranean basin forced vaguely understood Greek and Latin nomenclature upon the plants of Germany and other parts of northern Europe. Likewise we may be sure that the folk science of unsophisticated peasants in almost any place in Europe, in any period of the Middle Ages, if it had ever been painstakingly and completely recorded, would have been better, from the standpoint of system, recognition of natural genera, and nomenclature, than the degenerated classical botany of the sophisticated at the same time.

Beginning with the great German botanists of the sixteenth century, the more the botanists broke away from the shackles of the completely decadent literary tradition, the more ready they were to make a beginning in good systematic botany by translating into Latin the names of plants that the common man knew, and knew not merely as species but also in groups, for which there were vernacular generic names. Reverting to the example drawn from our oaks, the folk botany of the American pioneer gave botany eventually not only such species concepts as those of *Quercus coccinea*, scarlet oak, *Quercus imbricaria*, shingle oak, and *Quercus tinctoria*, dyer's oak, but the generic concept implied by the adoption of these translated names. Many unnatural concepts of the late medieval botanists in time came to be corrected by adoption of popular concepts that were better than the quasi-scientific. To jump over several centuries in our argument, for the sake of driving the point home, it may be pointed out that Linnaeus, who followed folk botany in the matter of the oaks, followed pseudo-classical medieval tradition in disregarding it when he made the classical name *Juglans* do service for both the walnuts and the newly discovered hickories of the New World. It was not long after the time of Linnaeus that the popular generic conceptions of "hickory" and "walnut" superseded his earlier and unnatural forcing of the hickories into *Juglans*. The popular generic concepts of "sumac" and "poison-ivy" are now by way of prevailing over the impossibly inclusive *Rhus* that many scientists have held even down to the present. Although it would be absurd to force

the idea too far, it is clear that folk nomenclature may provide good indications not only for practical but for scientific generic grouping.

In whatever race or country we look for it, we find the classificatory instinct more or less strongly developed, and finding expression in the grouping of species into genera. There is everywhere a tendency to group similar species under generic names, and to name the species by using some linguistic device not unlike the binomial nomenclature of Linnaeus. There would seem to be a good psychological basis for binomial nomenclature. As many basically distinct words will be current in each vernacular as an intelligent speaker (or better, perhaps, the total of those persons of diversified experience and occupation who speak a vernacular) can attach ideas to. These basic plant names are not enough to go around. Therefore grouping into genera is linguistically and psychologically inevitable, whether the grouping results from failure to see differences or from especially keen apprehension of similarities.

Recently I have been giving much attention to the climbing palms of the Malayan region. Since these plants are very different from each other in their utilities, it is natural that they should be critically systematized by the native peoples who live where they grow. Ordinarily they form, popularly, only a single genus, which may be called *rotang* (we get our English word "rattan" from this), or *hotang*, or *uwai*. Under the genus are arrayed the species, *hotang sogá*, *hotang djorlang*, *hotang sumambu*, *hotang ahonir*, *hotang taritting*, *hotang pahoe* and many others, to cite only part of the names from a single place and dialect.¹ The distinctions are known to most of the people of the forest, and are based upon many of the same morphological features that would be utilized in classification by a trained botanist. Of all the plants called *hotang* (in the district of the east coast of Sumatra where I am best acquainted with people and flora) only one, *hotang da ursa*, is not a climbing palm, but it is *Flagellaria*, a climbing, monocotyledonous plant recognized by the natives as so different that *hotang da ursa* is itself treated as a genus. Whereas any of the climbing palms may be called simply *hotang*, the *Flagellaria* may not be. It must be called by its full name, *hotang da ursa*. Here we get an inkling of how generic designations of more than one word arose in other languages.

In these names of the climbing palms we have a paradigm to illustrate the working of the human mind in arriving at a classification and nomenclature of plants. We see the interplay and balance between the limitations of vocabulary, on the one hand, and comprehension of differences among a multiplicity of interesting and useful natural objects, on the other. The number of basically independent words that can be sufficiently utilized to

¹ Pardembanan dialect (a sub-Toba dialect) of Asahan, Sumatra.

be retained in the vocabulary is so much more limited than the objects for which names are needed that a binomial system develops as a matter of course. Among the Batak the grouping of inconsequential things is very inclusive. For instance, "*duhut*" will do for a wide range of weeds or herbaceous plants, but scores or hundreds of kinds of *duhut* that are important enough so that they must be talked about have generic and specific names. *Pahu* will do as the generic name for almost any fern, but a great many species and a few restricted genera are recognized. Even such an aberrant thing as *Ceratopteris* is recognized as a fern. *Saio* is *Selaginella*. It is recognized that there are several closely similar kinds, but nobody bothers to give them names. (Until recently the botanists did not, either!) An inclusive generic name for almost all moss-like plants is *lumut*. Classification of *lumut* is hardly attempted, but the conspicuous *Leucobryum* has a generic name. The condition of moss nomenclature is after all not so very different from that in scientific systematic botany before Dillenius. As to plants in general, there is a partial classification, going to genera or species in hundreds of instances, but leaving many plants unclassified, regarding which all that the native botanist will say is that they are trees, herbs, vines, ferns, or mosses. Any very slender sedge is *si martihe-tihe*, "the one who passes for *tihe*" or "the *tihe*-like one" (*tihe* being a particular kind of sedge) and many other designations of this sort are very broadly but discriminatively classificatory. Here we have an inkling of the family concept and a name which is linguistically a reflection of the same kind of thinking that gave us the botanical family names in current scientific use. But we are concerned with genera, and must not digress too far.

To repeat, the generic concept is so useful in classifying knowledge and has been so logically and extensively applied in various parts of the world, that to trace its history would be to trace the history of language and thought itself. All that we can profitably do by way of tracing the concept as it is reflected in scientific botanical nomenclature is to review the status of genera in works of some of the great botanists who preceded Linnaeus, to show that Linnaeus based his clear concepts of genera largely upon Tournefort and Plumier, and that his reform in nomenclature was a reversion to ancient simplicity of speech, and to point out that in the main the changes that have come about since Linnaeus have been to define genera as groups of species that do not seem to violate the conceptions of natural affinity by descent that were developed by Darwin.

Let us begin with the work of the first of the German Fathers, Brunfels, whose great herbal was first published in 1532. In discussing his work, I wish to make an important point clear at the outset, namely, that his generic names were generally but not always single words. During the

middle ages the language in common use for learned books was Latin. Latin has only a small store of original plant names and does not readily lend itself to the formation of new ones, as Greek does. In Latin, therefore, many genera had two-word names, and to name a species, by adding a qualifying term to the generic name, required the use of at least three words. Brunfels replaced some, but not all, of the confusing two-word Latin generic names by single words. He left, for instance, the two-word generic names *Sigillum Salomonis*, "Solomon's seal," and *Bursa Pastoris*, "shepherd's purse."

Even if Brunfels' genera are not always such, according to our modern evolutionary ideas of plant affinities, they often conform exactly to modern genera, or at least their species belong to the same family. Thus he had a mallow, which, being in his opinion the true *Malva* of the ancients, he called simply *Malva*, with no qualifying designation, whereas a second species he called *Malva equina*, "horse mallow." In the Latin edition of his herbal he gives a German nomenclature that corresponds exactly to the Latin names, namely, *Bappelen* and *Rossbappelen*. If, however, we turn to the German edition, the nomenclature is more in accord with Linnaean and modern usage. The true *Malva* is *Gaenssbappelen*, "goose-mallow," and the other is *Rossbappelen*, "horse-mallow." We have specific names made in a Teutonic way by compounding an adjective modifier with the generic name rather than in the Latin manner, which keeps the words separate, but the basic idea of qualifying a generic name to make a specific one is there. Brunfels has examples of both ways, in his German edition. We do not find complete consistency in Brunfels' work, but enough to show that he had the modern idea of the genus, as a group with morphological similarities, within which the species were grouped. Furthermore, he arrived at the more modern features of his work by turning German common names, of the sort just cited, into Latin. The result of necessity resembled the Linnaean binomial system if the generic name was only a single word, for then the addition of one qualifying term made a binomial specific name of quite modern aspect.

We find *Helleborus niger*, for example, and *Plantago major*, names which meant to Brunfels in the year 1532 just what they mean to us now. One of the most interesting points in connection with Brunfels' nomenclature is that it displays the generic concept quite as definitely in German as in Latin. A glance through the German edition brings to light such genera as *Seebäum* for the water lilies, the species being two, the white and the yellow. They are separate genera in the eyes of modern botanists, but in German folk botany, as reflected by common names, they constituted a genus of two species. We find two primroses, *Geel Hymmschlüssel* and *Weiss Hymmschlüssel*, a perfectly good example of the generic concept

as well as of binomial nomenclature, and, a few pages farther on, *Edler Augentrost* and *Weisszer Augentrost*. Here, according to modern ideas, the genera are different but the family is the same. The important point is that it is quite as characteristic of folk botany as of modern systematic science to classify to the genus, which is more or less consciously thought of as the smallest grouping requiring a distinctive name. Within the genus, if the distinction of several kinds is necessary, a qualifying designation is used and the whole name becomes a binomial. If there is but one sort within a genus, no qualifying word is necessary, for the generic name is sufficient. Brunfels did not try to invent Latin names for plant genera that perhaps the ancients did not know. He was satisfied to call the little *Draba verna* of later botanists merely *Gaenssblum*, and Adanson, the radical in botanical nomenclature, who did not care whether nomenclature was Latin or not, took this German name as the valid scientific one for the genus, attributing it to Brunfels. For another plant that Brunfels found no name for, not even in German, he was content to say that the name was unknown. That was equivalent to recognizing its generic distinctness from the other plants in his herbal, even though he does not go to the length of naming it. It was the first published record of *Anemone nemorosa*. There is little evidence that Brunfels' botanical knowledge, aside from his efforts to identify most of his plants with those known to classical writers, was other than a very intelligent sifting of current folk botany. His definite attempts at classifying similar plants into genera we may think of as expressing the natural tendency of Germanic thought and language. His recording of what appears to be genuine folk science represented an immense improvement over the debased travesty of classical botany which, constantly vitiated by gross error, superstition and fraud, had reached an unbelievably low level in some of the works of the type of the *Hortus Sanitatis*.

This glimpse at Brunfels' simple and practical generic ideas and terminology must suffice for his century. Unfortunately many of his successors continued in vain the process of trying to squeeze plants totally unknown into old genera, with the result that the simplicity and clarity of Brunfels' work soon disappeared. Scientific botany became more and more involved. The generic idea, so clear in most folk botany, became less so, and specific names, long and rambling ones, did not necessarily incorporate the generic name at all.

In 1623 the learned Caspar Bauhin published his *Pinax Theatri Botanici*, a work on which he spent forty laborious years. It was an index to all plants known up to his time, listing all the supposed synonymy. As the title indicates, it was but a prepublication of the index to a most ambitious work, the *Theatrum Botanicum*, of which Book I, treating

"grasses," was the only part that was complete at the time of his death, and which was actually published in 1658 by his son. There is also a *Prodromus Theatri Botanici*, published in 1620, including only preliminary descriptions of the undescribed species detected by Bauhin during his long botanical career. The three works together are an excellent source of information on the status of the generic concept at the beginning of the seventeenth century.

Bauhin's *Pinax* says that Dioscorides and Pliny made four genera of grasses, whereas later botanists made many. These later "genera," to take a couple at random, are such as the following: *Gramen caninum* (comprehending species that Linnaeus later put into *Triticum*, *Poa*, *Agrostis*, *Aira*, and *Cenchrus*) and *Gramen junceum et spicatum* (including Linnaean species of *Festuca*, *Aira*, *Juncus*, *Scirpus*, *Carex*, and *Triglochin*). Such genera are not so good, on the whole, as some of Bauhin's predecessors nearly a hundred years before would have made, and the generic concepts and nomenclature have become vastly complicated, but we must bear in mind that Bauhin was primarily indexing rather than reforming. Taking a typical case, that of *Cyperus*, he says that the species may be bitter, or they may be sweet (and edible). A bitter *Cyperus* may be either odorous or inodorous, and some part of it may be either round or long. So he divides *Cyperus* into five genera, with the polynomials *Cyperus rotundus odoratus*, *Cyperus rotundus inodorus*, *Cyperus longus inodorus*, and *Cyperus esculentus*. The assemblage as a whole includes a medley of types, Linnaean species of *Cyperus*, *Carex*, *Schoenus*, *Scirpus*, these all *Cyperaceae*, but with them also *Dorstenia* in the *Moraceae*. Obviously there was only a vague idea of any morphological criterion of a genus in Bauhin's mind. As to his nomenclature, there are many instances, perhaps a majority, in which the generic name is incorporated at the beginning into the name of the species, as for instance, most of the species of the genus *Gramen caninum*, two of which are *Gramen caninum*, *supinum minus*, and *Gramen caninum maritimum spicatum*. Another species of the same Bauhinian genus, however, is *Gramen murorum radice repente*. Here there is nothing in the name to indicate that the plant belongs to the genus *Gramen caninum*. Then there are many instances in which the name for a segregated genus is a condensation of the polynomial name of a species. Thus the two species of the genus *Cyperus esculentus* are *Cyperus rotundus esculentus angustifolius* and *Cyperus rotundus esculentus latifolius*.

The casual reader of Bauhin might too hastily conclude from the chapter headings that his real genera were not the groups, often with binomial and trinomial designations, which are divided into numbered species, but rather the larger categories with monomial designation that head the chapters. It is quite true that some of the genera do indeed have one-word

names, which are used also as chapter headings, but more often this is not so. For instance, Bauhin says that it is possible to reduce the orchids to the five genera which he calls (1) *Cynorchis*, including a subgenus (although he nowhere uses this term) *Cynorchis militaris*, (2) *Testiculus morionis*, which he immediately changes to *Orchis Morio*, (3) *Orchis foetida*, (4) *Orchis Serapias*, and (5) *Testiculus odoratus*. By the time he gets to the actual treatment of the fifth it appears as *Monorchis et Triorchis*. Aside from a few specific names that begin as we would expect with the generic name, we find some species under each whose long names give no clue to the genus under which they are placed. Thus under *Cynorchis* we find names beginning with *Orchis* and *Chamaeorchis*; under *Orchis Morio* are *Orchis flore nudi hominis effigiem repraesentans, mas [et foemina]* and *Orchis flore simiam referens*; under the genus *Orchis foetida* are species with names such as *Orchis odore hirci minor*; under *Orchis Serapias* no names begin thus; under *Monorchis et Triorchis* (treated, if we may judge by the numbering of the species, as a single genus) the specific names begin with *Orchis*, *Triorchis*, and *Chamaeorchis*.

In the work of Caspar Bauhin, therefore, the generic concept in botanical classification has become almost wholly divorced from language. The names of species need have nothing whatever to do with the genera to which the species belong. Not one of the phrase names which he retains or proposes for the species of *Curcuma* refers to the genus, and such as *Cyperus genus ex India* and *Crocum indicum proposuit Garcias, foliis milii majoribus: et Acosta, foliis Orchidis Serapiae dictae majoribus latioribusque*, give an altogether wrong indication of relationship, for a *Curcuma* can neither be a *Cyperus* nor a *Crocus* according to Bauhin's own classification. The name of a species by Bauhin's time has become something that need not indicate any genus and may even indicate a genus from which the species is excluded. A name is merely a name, not necessarily indicating generic affinity at all, and knowing where species belong has become merely a feat of memory. Truly simple generic grouping, as found in folk botany and reflected in language, had been lost, by the time of Bauhin's *Pinax*, in a maze of complexity and obscurity.

Matters did not greatly improve until drastic reforms were instituted by Tournefort about 1700. He restored the generic concept to simplicity and utility, and in conventional botanical history is the originator of genera. Of course he was not, but he certainly wrought a revolution in the jumbled botany that he found, turning chaos into order.

From the fact that Tournefort referred all the plants he knew to definite genera, it might be assumed that he had a well-defined underlying philosophy which enabled him to judge of what constituted a genus. He did have, and it is worth while to look into it, as he expounded it in the

famous *Isagoge in Rem Herbariam* which forms the introduction to his *Institutiones Rei Herbariae*.

In the first place he shows that plants generally have roots, stems, leaves, flowers, fruits, and seeds. There may be other parts, and at least five may generally be considered in establishing a genus, for most plants have that many, although some lack stems, some lack leaves, and some lack flowers.

It is of no use, he says, to require close correspondence in as many as five parts, in the species of a genus. There are not many genera with species closely similar in roots, leaves, stems, flowers, and seeds. For instance there are species of *Ranunculus* with tuberous roots, others with fibrous, still others with grumose. The leaves of species in this same genus resemble those of *Aconitum*, of grass, of rue, or of other plants, so one cannot even demand correspondence in four parts.

Suppose correspondence in only one part is required. Then, he says, we can't often arrive at good genera. The leaves alone would not do as a criterion, for then to *Plantago* would have to be added all the plants with leaves like those of plantain, such as the genus *Plantago aquatica*, and the species *Ranunculus Plantaginis folio*. (Note that Tournefort keeps binomial generic names, such as *Plantago aquatica* (now *Alisma*), *Lilium Convallium* (now *Convallaria*), *Primula veris*, *Ruta muraria*, and a few others.) Such a genus as *Plantago*, defined by leaves alone, would make botanists laugh, Tournefort says. So would one based upon leaves like those of *Aconitum*, for it would contain species of *Ranunculus*, *Geranium*, and other genera. Flower form alone as a criterion would be no better, for then, he observes, we would get a jumble of such things as *Cucurbita*, *Convolvulus*, and *Campanula* in the same genus; nothing could be more inept than such a composite. Likewise all the umbelliferous plants would fall together, and an equal infelicity would result from dumping into one genus all plants with papilionaceous flowers. Without laboring through this part of his argument further we may state his conclusion that similarity in two or three parts is all that is generally necessary.

Next he proceeds to show that roots and leaves together will not suffice, nor roots and flowers, nor roots and fruits. However, similarity in flowers and fruits will make the best criterion of a genus. This conclusion he proceeds to justify by saying that no one who looked at it in flower and fruit could deny the name *Viola* to *Herba Trinitatis* of Fuchs. The lack of conformity of its leaves and stems with those of *Viola vulgaris* need not disturb us, any more than the conformity of the leaves of the latter with *Asarum* would lead us to put it into the same genus with *Asarum*. He depends upon conformity of flowers and fruit as the basis for deciding what shall go into *Viola*, not leaves and stems, as Caspar

Bauhin does in the *Pinaex*. "Good God," says he, "what a lot of things have come out of Africa in the last few years, in their foliage looking like *Malva*, *Alchemilla*, *Myrrh*, *Coriander*, *Aquilegia*, *Uva crisper*, and what not, but every one, by overwhelming consensus of botanical opinion, some sort of a *Geranium*!"

Tournefort grants that any rule of thumb may be too rigidly applied, however, and so he will make exceptions when he likes, in order to maintain such natural genera as *Castanea*, distinctive by what he calls its echinate calyx. So there will be genera of two orders of distinctness, which he will call genera of the first and second order, respectively. Of the first, defined by conformity of flowers and fruits, *Aconitum*, *Ranunculus*, *Rosa*, and *Viola* may serve as examples. Of the second order an example is *Bulbocastanum*, which differs only in its tuber, he says, from several genera of umbellifers. *Lilium* is maintained as distinct from *Tulipa* and *Corona Imperialis* by its "roots" being made up of scales, whereas the related genera have tunicated "roots." It is necessary to use characteristics derived from the position of the leaves to distinguish *Abies*, *Pinus*, and *Larix*. The tubular peduncle may suffice to separate *Dens Leonis* as a genus from *Hieracium*. As a final example, showing how far Tournefort was willing to go as a generic splitter, putting most moderns to shame, he says that sometimes the bark alone will do as a generic distinction, and he forthwith follows the ancients in setting up *Suber*, the cork oak, as generically distinct from *Ilex*, the live oak, and both as distinct from *Quercus*!

Tournefort expresses his opinion of his English contemporary, Morison, in an ungentle dig when he says that botany is being involved in a new fog by those who maintain that great genera are not to be split into smaller genera, but, rather, are to be divided into minor genera (subgenera). He cites Morison's polynomially designated subgenera of *Onobrychis*, namely, (1) *Onobrychis scilicet siliquis articulatis et asperis*, (2) *Onobrychis siliquis echinatis, cristatis et spicatis*, and (3) *Onobrychis siliquis echinatis, sed in capitulum congestis, Platani pilularum modo*. Of what use, he asks, is a name which has to do service for such diverse things? If his own definitions are too narrow, if, for instance, someone protests his definition of *Mandragora* on the ground that it requires that *Mandragora* have a monopetalous (i.e., gamopetalous) corolla, whereas there is a polypetalous *Mandragora*, he retorts that if such a polypetalous plant occurs there is no doubt that a new genus ought to be established, as he has often, in fact, established other new genera.

Tournefort's idea of the full names of species of plants is of no little interest. He says they are, after a fashion, definitions. First comes the name of the genus, and then the words expressing the distinctions of the

species. As we have seen, he carries on some old binomial generic names, but most names of genera are single words. He commends Caspar Bauhin for certain neat, brief, elegant, euphonious specific names that better invite to the study of plants than *repel*. Such are *Ranunculus nemorosus vel silvaticus, folio rotundo*, and *Ranunculus pratensis erectus, acris*. To be condemned, he says, are Morison and Breynius, whose specific names can hardly be uttered with one breath, and go two or three times across the printed page. One excellent reason for small genera, Tournefort says, is that the concept of the small genus comprehends more that is common to all the species, so that the names of the latter may be brief and sonorous. Better to propose new genera with audacity than to force species into places where they do not fit. If genera thus constituted for single species appear superfluous, don't worry about the matter; exploration will sooner or later turn up others.

Tournefort's ideas of genera were clearly pragmatic in the extreme. If new generic names would be conducive to understanding the nature and affinities of plants, he had no scruples about establishing them. Nevertheless he did not do so thoughtlessly or without good reason. His criteria were generally well considered, and few of his generic propositions failed, in the long run, to win the approval of Linnaeus and his successors.

Linnaeus wrote of Tournefort's contemporary, Father Plumier: "Standing forth among all travellers as the greatest, he discovered more than 900 new plants and referred all of them to definite genera. Would that we could have more Plumiers!" This was in reference to Plumier's *Nova Plantarum Americanarum Genera*, of 1703, and is almost the only reference to genera in the *Bibliotheca Botanica* of Linnaeus.

Linnaeus generally accepted the genera established by Tournefort and Plumier, and gave all genera single names, generally very well chosen. Apropos of names, in his quaint classification of botanical authors, he provided for "Nomenclatores Criciti," those who would teach how to construct generic and specific names correctly. Of these useful persons he admitted that none had yet written on this subject and then modestly listed himself as the only one there was! The sweeping reform of nomenclature which he later initiated more than justified his confidence in himself.

In Linnaeus' *Fundamenta Botanica* he laid down the fundamental principle that the genus and species are entities of nature. This conception has been denied by some, but it has clearly been and still is the basic belief of most systematic botanists. It guided Tournefort, then Linnaeus and his followers in grouping as genera those species of plants which seem most similar to one another. Close morphological similarity, in fact, was interpreted by Linnaeus as signifying real genetic relationship. He said himself that no true genus was other than a natural genus, and he even-

tually proposed a theory by which he brought into logical agreement two at first glance incompatible beliefs, that plants are all interrelated by descent, and that species were produced by special creation. I have elsewhere called attention to the curious doctrine, which Linnaeus made public relatively late in his career, according to which it was postulated that fundamentally distinct types, produced in the beginning by fiat, hybridized by miraculous intervention in an orderly manner in all possible combinations, which process was repeated by the primary hybrids and then again by the secondary, until the genera and the species were produced. He said that the morphological combinations, if botanists were keen enough to interpret them, would indicate the true genera. We must recognize that Linnaeus was a forerunner of Darwin to the extent that he believed in the relationship of species and genera by descent.

The constantly more refined methods of systematic botany and the doctrine of evolution, toward which Linnaeus groped, have given new meaning, since the publication of Darwin's epochal *Origin of Species*, to the Linnaean conception "entity of nature." Nevertheless, the majority of modern systematists, still mainly concerned, as Linnaeus was, with morphological criteria, continue to approve the generic concepts of Linnaeus. He himself, approving in general the concepts of Plumier and Tournefort, by the uniform application of the binomial system, restored to Latin botanical nomenclature the simplicity and intelligibility of common speech. Forgetting that large genera may be quite as truly "entities of nature" as small ones, some modern botanists are making far too fine generic segregations, in violation of evidence that too many basically different words for similar things cannot be borne in mind and fall into disuse, and that from a practical standpoint too many names and too many genera obscure rather than elucidate relationships. Just as we quite naturally accept the conclusion that the concept of genus in folk botany was often too broad, and had to be narrowed, so it is quite inevitable that botanists shall continue to accept new generic segregations whenever it appears from increased knowledge and new appraisal of characters that old genera are not natural entities. But that there is any need for a general change in the generic concept, from the standpoint of inclusiveness, we may deny. A large genus may be quite as "natural" as a small one, and from a practical and linguistic standpoint may be a far more useful concept.

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