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THE MODERN SYSTEMATIST[1]

WE are still engaged in exploring the earth, that we may understand it. We can not understand any part of the surface of the earth until at least three persons have studied the area carefully: the geologist, the physiographer, the recording biologist. We shall never cease to explore the earth, in old places as well as new. We can never dispense with the recorders.

The older systematic zoology and systematic botany fell into disrepute with the competition of the exacter studies in morphology and physiology, and they have been overshadowed by the interest centering in evolution and its derivative subjects. On the botanical side, the naming of specimens as an exercise in education in schools and the making of a so-called herbarium of snips of plants, have still further discredited whatever seems to be related to systematic work.

Although it is not the purpose of this paper to discuss the educational aspects of the subject, it may nevertheless be said that, so far as one can determine, this school herbarium work did not make botanists, on the one hand, nor lead to an appreciation of nature, on the other, and it would be difficult to trace contributions to science from its suggestion. As an educational method it was faulty because it did not connect plants with either function or environment, nor call for continued application on the part of the pupil. The intensive laboratory course that succeeded it developed exacter methods, more sustained

[1] Before National Academy of Sciences, Philadelphia, November 20, 1917.

application, closer scrutiny or observation and related the exercises to function. It has failed, however, in not educating in terms of the vegetable kingdom. We now see that the best educational procedure for botany in schools is a good combination of intensive laboratory work indoors, with carefully planned field and systematic work. The field naturalist contributes the factor of leadership in addition to drill with subject-matter; under his care, the environment of both men and other organisms begins to express itself. This, of course, is as true in zoology as in botany; in fact, good field work is both zoology and botany. This kind of field and collecting work provides the best approach to nature. To know a cell or a spore is of much less significance to the major part of mankind than to know a plant.

Some of the disdain of descriptive and taxonomic effort is due to the feeling, which is not without justification, that much of the so-called systematic work is little more than the personal naming and re-naming of specimens, without the addition of new knowledge or the expression of new meanings; the work is therefore likely to be disregarded, as irrelevant and not worth the while.

The systematist has also lost sympathy with many of his compeers because of the controversies over nomenclature. The impression has gone abroad that he deals only with names. The controversies in this field issue from two mistaken premises on the part of nomenclatorialists—the assumption that nomenclature can be codified into invariable law, and the practise of making rules retroactive. Varying practises in language tend in these days toward agreement and unification, the persisting variations being mostly in minor matters; as soon, however, as any superimposed authority undertakes to enforce rigidity, rebellion is invited and differences are likely to be organized into counter codifications. It is probably not even desirable to have rigidity in binomial nomenclature for plants. The reactionary nature of the rules is their greatest fault, however, and is responsible for most of the mischief. It upsets good practise, on which the literature rests, even as far back as Linnæus. Acts of legislatures, regulations of government, ordinances, entrance requirements to colleges and other enactments, become operative at a specified future date. The names of plants are vested rights to the users of them in literature, and there is no moral warrant for changing those of times past merely that they may conform to a rule of the present. If the practise were in the realm of enacted law involving property, any court would declare it illegal. I introduce this discussion to say that the changes in nomenclature are not a necessary part of systematic work except in so far as they result from changed biological conceptions of genera and species.

THE WORK OF THE SYSTEMATIST

With this preface, I may enter my subject, which is the place of the systematist in present-day natural history. I shall naturally speak in terms of plants, but I trust that some of you will make the extension to terms of animals.

To know the forms of life is the primary concern of the biologist. This knowledge is the basis of all study in morphology, physiology, heredity and phylogeny. Undoubtedly much of the looseness of statement and incorrect inference in writings on variation and heredity are due to the very inexact definition of the forms about which we talk. Much of the *non sequitur* lies here. Literature is undoubtedly full of examples. Every discouragement of the

systematist reacts on the conclusions of those who cite the names of plants.

So fundamental is this contribution of the systematist that we should now be very cautious in talking of heredity in plants at all until we have redefined their forms. The records of variation, as such, do not constitute definitions, but only departures from assumed norms.

The definitions of the systematist, who critically surveys a wide range of material for comparison rather than for divergence, apply not only to the assemblages we know as species, but also to the minor forms that seem to have descriptive unity. If I were now working with any group of plants in an experimental way touching development and evolution, I should want first to turn the whole group over to a conservative systematist for careful review.

I had hoped that, in the beginning of the plant-breeding studies, the breeder would also be a pronounced systematist that he would aid us in the definition of the forms of plants, and bring his experimental studies to bear in tracing the probable course of evolution up to this epoch, that is, that he would contribute more freely to the knowledge of origins. I still think that we shall find the experimenter relating his work more closely to systematic botany as soon as the systematist takes cognizance of the plant-breeder, and the plant-breeder is satisfied that he must analyze his measurements in terms of biological definition and classification. I doubt the adequacy of some of the biometrical computation, and I regret the frequent neglect of herbarium studies whereby vegetation-factors rather than measurement-factors may be strongly emphasized.

It is not unlikely that the ecologist falls into false comparisons by carelessness in identification, or by inattention to critical differentiations. It really matters very much whether a given distribution represents one specific type, or two or more very closely related types; in fact, the significance of an ecological study may depend directly on allied taxonomic relationships.

Certain phases of the intermediate field between taxonomy and genetics I discussed two years and more ago in this city before the American Philosophical Society, and suggested a definite program of combined systematic and experimental work; therefore I shall not enlarge on this subject here, although it merits further attention. It may be noted in passing, however, that the more enthusiastic definition of forms demands a refined and more exact art of phytography, and it should lead also in the direction of classification. The marked variations may well find place in a taxonomic treatment rather than to be studied merely as separates. The remarkable mutations of *Nephrolepis*, for example, afford excellent material for systematic descriptive study.

Much of the earth is yet to be explored for the forms of life. There are fertile regions yet untouched. One collection in Papua yielded some 1,100 new orchids. Remarkable collections of novelties continue to come to our herbaria, many of them from regions not very remote. Not nearly all the plants of the globe are known. The systematist must continually be better trained, for he has the task of understanding the older accumulations as well as adjudging the new. He makes increasing contributions to plant geography and distribution, and gives us an enlarged judgment on the character of the countries of the earth as indicated by their vegetation. In fact, we never understand a country before we know its plant life. The contributions made recently by Forrest, Wilson, Purdom and others to the geography

and resources of western China are good examples.

Yet it is in the old regions as well as in the new that novelties still come to the hand of the systematist. Every edition of the manuals of the plants of the northeastern United States, for example, contains large additions. These acquisitions are in some part the result of new introductions, running wild; in an important part the discovery of species heretofore overlooked; in large part, also, the results of redefinition, known as "splitting" of species.

This splitting is not alone the result of a desire to "make new species," but is the operation of a new psychology. In everything we are rapidly becoming particularists. In the time of Gray we studied plants as aggregates, trying to make them match something else; now we study them as segregates, trying to make them differ from everything else. This diversity in process accounts for the extension of *Œnothera, Carex, Rubus, Malus, Cratægus.* Whatever may be said of the relative ranks of the newly described species in a scheme of coordination, we should thereby nevertheless understand the forms better than heretofore and refine both our discrimination and our definition. Probably we do not yet really understand any one of the more representative genera of plants of the northeastern United States.

In making these remarks I am not commending the practise of those who would divide and redivide minutely, and who would carry descriptive botany to such a point of refinement that only the close specialist can know the forms. Under such circumstances, systematic work defeats its own ends.

It is, after all, to the plants of the older lands that the systematist must constantly bring his closer observation, new measurements, accumulation of facts, keener judgments, truer interpretation of environment, profounder estimation of relationships that can be expressed by classification. He is not merely a describer of novelties, giving new names; he discriminates, re-defines, applies the results of latest collateral science, suggests new meanings. His studies, as any others, must be kept alive and up to date. He must continually better serve any student of plants. There is no more end to the work of the systematist than to that of the geneticist.

Every large or variable group needs to be reworked at least every twenty-five years. In fact, it is an advantage to have a group worked simultaneously by separate monographers, that we may have more than one method and more than one judgment brought to bear on the problem. We must outgrow the idea that there is any finality in even the best monograph. Frequent review and sifting of evidence are as necessary in systematology and taxonomy as in morphology.

We do not realize that there is now appearing the modern systematist, who is not an herbarium hack, but a good field man, an evolutionist and plant geographer, one highly skilled in identification, and reinforced by much collateral training of a highly specialized character. This man has come quite unaware to most of us. Among the phytographers are those who are primarily cataloguers, sorters and bibliographers, of great skill; but the real systematist is a highly trained scientist.

I regret that the contribution of this man is frequently so little evidenced in the processes of college teaching. Graduates may be sent forth to instruct in botany so innocent of kinds of plants and of the means of finding them out as to be lost when placed in a strange country, wandering blankly among the subjects they are supposed to teach.

I have said that the systematist is specially needed in the older lands. I wish now to press this remark still farther by saying that he is much needed in the oldest and best known genera. What are known as the older species, as well as older genera, are likely to be least understood, for knowledge becomes traditional and they pass unchallenged. It is exactly in the old and supposedly well-known species that we are now making so many segregates.

It may be difficult, in any given monography, to express these different aptitudes of the systematist. Some subjects or problems do not exhibit the features that I have suggested nor admit of the application of such broad and deep investigations, even though the study and publication of them may be very much worth doing. Yet, the field of systematic work may be indicated, as an aim.

THE SITUATION IN THE CULTIVATED FLORA

No plants go unchallenged so completely as those of widespread, common and ancient cultivation. The treatment of them is particularly traditional. There may be no "types" representing them in herbaria. Origins may be repeated, perhaps even from the days of the herbalists. Statements are passed on from book to book and generation to generation. The plants are taken for granted. Yet when we come to study them critically we find that they may contain "new species," those that have passed all this time unrecognized. Any field that has been long neglected is sure to yield new harvests. The cultivated plants now provide some of the best botanizing grounds.

A few examples will illustrate what I mean. As a very simple illustration I may cite the case of the plant cultivated as *Malvastrum capense*. The species (as *Malva capensis*) was founded by Linnæus. The description in the books has been correct; but when the horticultural material was critically examined in 1908 it was found be an unrecognized new species, although cultivated for more than a century. It is now named *Malvastrum hypomadarum* Sprague. Another new species has recently been separated by Sprague in the material commonly grown in greenhouses as *Manettia bicolor*. The cultivated stock is clearly of two species, *M. bicolor* being Brazilian, and the new *M. inflata* being Paraguayan and Uraguayan. A case may be cited also in one of the commonest abutilons. The plant grown as *A. striatum* Dicks, is found to be really *A. pictum* Walpers, with the true *A. striatum* probably not in cultivation; and part of the greenhouse material, long cultivated, was separated as a new species, *A. pleniflorum*, as late as 1910 by N. E. Brown. Moreover, the plant still grown as *A. Thompsonii* is found to be not that plant, the material now cultivated in England under that name being recently described as *A. striatum* var. *spurium*, and that in America being apparently of several unidentified forms. In the meantime, the original *A. Thompsonii* appears to have been practically lost. Now, this situation directly involves the integrity of the so-called bigeneric graft-hybrid *Kitaibelia Lindemuthii*, one of the parents of which is recorded as *Abutilon Thompsonii*.

These are cases of erroneous determination and of confusion in forms, representing one of the commonest kinds of puzzles in the study of cultivated plants. The difficulty lies in the fact that systematists have not taken the trouble to look the cases up, accepting the plants from literature, and also in the fact that herbaria usually do not adequately represent such plants. The student may search in vain for authoritative early material of most long-cultivated plants, even in the best herbaria.

One of the present necessities is to collect the cultivated plants in their different forms from many localities, and representing the stocks of different dealers, in precisely the same spirit in which feral plants are taken for herbaria. Without such sources of information, we can neither understand the systematology of the plants themselves or bring the best aid to the student of heredity.

[The speaker here mentioned the lack of record material in studies of the systematology of *Coleus* and other groups; and explained also the unsatisfactory practise on which descriptions of large numbers of cultivated species still must rest.]

Excellent illustration of the confusion in cultivated plants, even of relatively recent introduction, is afforded by the velvet-beans now grown in the southernmost states. These plants have been referred indiscriminately to *Mucuna pruriens,* long cultivated in the tropics. On careful recent study, however, the American planted material is found to be so different from *Mucuna* as to necessitate generic separation, and the genus *Stizolobium* has been revived to receive it. The common cultivated velvet-bean is found by Bort to be an undescribed species, probably of oriental origin, and it has been named and described *Stizolobium Deeringianum.* Subsequently other species have been newly described in the cultivated stocks. One need not go far for many comparable illustrations of the confusion in which cultivated plants have lain. Americans are now specially active in resolving these complexities. As a running random comment may be cited the work of Rose in the cacti, Swingle in *Citrus,* Rehder in *Wisteria,* oriental *Pyrus* and others, Wilson in Japanese cherries, Safford in Annonaceæ. It is not too much to say that any of the important groups of cultivated plants will fall to pieces as soon as touched by the competent modern systematist.

The systematist who works in these domesticated groups must first make large collections of new information and material. It is becoming a habit with him to travel extensively to study the plants in their original countries, and to bring history and ethnography to bear on the problem. He is not content until he arrives at sources.

[The speaker discussed, and illustrated with herbarium material, the recent studies in the cultivated poplars, whereby the subject has been opened for discriminating investigation.]

Nor does the confusion lie only with plants of ancient domestication or with those native to countries which have not yet been well explored. The horticultural blackberries have been brought into cultivation from American wild stocks within seventy-five years or less, they have been accorded careful study by several specialists, yet no one is ready to name the species from which the different forms have come. A number of systematists are working on them, and yet they are in need of further study, both in the wild and in cultivation. In *Prunus* is a comparable case, horticultural forms in many named varieties of native plums having come into cultivation within fifty years. It fell to my hand to attempt the first critical taxonomic writing of these native plants, in 1892; but in 1915 Wight completely recast the treatment, in the light of accumulated experience. This illustrates my earlier remark that every group should be newly monographed at frequent intervals.

Perhaps we do not sufficiently realize the great numbers of species of plants now in cultivation. We may have in mind the 247 species studied by DeCandolle in his

"Origin of Cultivated Plants." These are only food plants, and the treatment does not pretend to be complete. In the Standard Cyclopedia of Horticulture, the entries of plants described in cultivation exceeds 20,000, although not nearly all these species are domesticated. About 40,000 Latin names are accounted for. This treatment does not cover the cultivated plants of the world, but those of the United States and Canada and those readily drawn from the European trade, with the most prominent species in the island dependencies of the United States. Probably never have species new to cultivation been introduced so rapidly as within very recent years. For example, in the treatment of *Primula* in the Cyclopedia of American Horticulture in 1901, I described twenty-seven species; in the Standard Cyclopedia in 1916, I described 200. All this phalanx comprises in itself a large section of the vegetable kingdom, perhaps as much as nearly one sixth of the Spermatophyta, and it demands the attention of the best phytographic and taxonomic investigation.

The long-repeated statements of origins of cultivated plants are challenged whenever the systematology is seriously attacked, or when the subject is examined under botanical investigations. The case of maize is a striking example; although always explained on the basis of American origin, the reported pre-Columbian references in China need further investigation. The same kind of puzzle associates with many plants, wild as well as domesticated, that are prominent subjects in early travels and writings. Thus Fernald concludes that the wine-berries of the Norsemen were not grapes found on the shores of the present New England, as we have always assumed, and that they were probably mountain cranberries found in Labrador or the St. Lawrence region. The result of contemporaneous studies is that, from both the historical and biological sides, the foundations are being shocked. Most of my life I have given special attention to the botany of the domesticated flora, yet I should not now care to hazard a pronouncement from this platform on the specific natural-history origin of any one of the more important widespread species of cultivated plants.

THE SYSTEMATIST IS A BIOLOGIST

Whether he works with feral or domestic floras, the systematist of whom I speak is a real investigator. He studies the living material so far as he is able, perhaps growing it for this purpose; tries to understand the influence of environment, the rôle of hybridization and mutation, and preserves his records in the form of ample herbarium sheets. He relates his work to morphology, and desires to arrange it as an expression of lines of development. He may study his material for years before he ventures to describe. It follows that the systematist necessarily, in these days, becomes a specialist; and it further follows that we should encourage, in addition to the few very large and comprehensive establishments, the making of many herbaria and growing collections strong in special lines.

L. H. BAILEY

PATENT REFORM PROSPECTS

THE Patent Office Society is permitted to announce that a composite committee has been created, upon request, by the National Research Council, to make a preliminary study of the problems of the U. S. Patent Office and its service to science and the useful arts. This committee, which is expected to meet in Washington shortly after the middle of December, is understood to comprise, at the outset, the following: Leo H. Baekeland, Wm. F. Durand, Thos. Ewing, Frederick P. Fish, Robert A.