The Importance of Tropical Taxonomy to Modern Botany

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EFFORTS TO LEARN about plants are called botany, when they are sufficiently rational. Efforts to grow plants and make new ones and to destroy the harmful and unwanted are parts of agriculture and sylviculture, when they are sufficiently profitable. Our enjoyment of plants, wild or in the garden, has no name, but it is an aspect of civilisation as essential as art and literature; and horticulture is a sign of progress. Thus, in concourses of men, the academic, the applied, and the recreational sides of plant-lore have developed into the botany schools of universities, the plant-breeding stations of agriculture, the research institutes of forestry, the nature-reserves of wild-life services, the parks and botanical gardens of cities, and the flower-beds, window-boxes, vases, and books of the home. Wretchedly barren is that community unmindful. In this concrete age, which hardens our lives, we should reflect upon the appeal of kampong, sawa, pasir panjang, gunong hijau, sungei berassau, and kayu chondong. The beauty of Rio de Janeiro, so inspiring to the visitor, is the city in the bay of forested mountains. Seeing then that botany, if we use that word for all ways in which plants enter our lives, is a subject vital to learning, practice, and recreation, let us consider the harder word taxonomy.

Taxonomy. All sciences split up as particular methods are used in their study. Botany, too, is sundered into an increasing number of "-ologies", many of which require not a knowledge of plants so much as of other natural sciences, and an electron-microscopist or radiographer may be a botanist. One of these divisions is now called taxonomy. It is the old core of professional botany, derived from the herbalists through the systematists who variously improved the classification of plants. It is regarded as old fashioned, being the parent, but rather is it the trunk to the branches, ever swelling as they multiply, gathering the information, and, I believe, still the core and heart of botany. Several "-ologies" and "ographies" are indeed, attributed to taxonomy, which means the method of orderly classification but we can understand better what it is from its outcome. Nowadays taxonomy is the classification of plants according to their evolution. The early botanists and zoologists

discovered that plants and animals were constructed in definite ways, from which an orderly classification could be thought out and named, so as to give a better and international understanding of biology. A good classification is needed in science to pigeon-hole the enormous and ever-increasing number of facts: that it is objective and satisfactory, international recognition proves. Until a hundred years ago, however, this classification was an enigma because there was no adequate explanation of the expanding, varying, and yet coherent, marvellous pattern of life which it revealed, or why it should have been satisfactory. Darwin's theory of evolution was not a flash in scholastic darkness, but the sun which rose on biology. The orderliness of classification was seen to express the evolution (and extinction) of plants and animals in the past. They were being classified on the peculiarities of their various lines of descent, or heritages; being founded on "raison d'être", this was the order so satisfactory. The sun, I think, was the spontaneous combustion of taxonomy, but that is another story. To appreciate the importance of taxonomy, as evolutionary classification, we must consider a method of scientific enquiry which it has introduced. This is the distinction between homology and analogy. The method is most useful in other branches of biology which have not been able, because of the baffling complexity of protoplasm, to advance as far as morphology, or the study of structure, on which taxonomy is based. I refer particularly to physiology, genetics, biochemistry, and other experimental subjects which are incapable of classifying living things, of correlating the facts of biology, and of organising biological thought.

Homology and Analogy. There are two ways of studying plants and animals, namely the particular and the comparative. In the particular we investigate one kind of plant or animal, or one part of it, intensively. Thus, we may study the respiration of a root or muscle, or the absorption of mineral salts by root hairs, or the inheritance of certain characters such as flowering-time, grain-size, or seed-production in a plant such as the rice-plant. As any of these subjects, or the means by which they are studied, can be developed into a particular branch of science, it can be seen how these branches multiply in modern research. Sooner or later comparison must be made with other plants or animals, but what ones? Obviously comparison of objects superficially similar, as fish and whales, or ferns and palms, may be exceedingly misleading, for their similarities are analogous, not fundamental; and, as we are dealing with the minute and intricate behaviour of this exceedingly complex, largely unknown, protoplasm of living things, we must avoid as

many unknown quantities as possible. The best comparison, therefore, will be between species which have been shown by modern taxonomy to be closely allied: their protoplasm will differ the least from each other and these slight differences may be exactly what the researcher needs. Basically, plants have a certain and not impossibly large number of properties, or things which they can do. Respiration, photosynthesis, cell-differentiation, and reproduction, for instance, are essentially the same in all green plants, but the species differ in the way in which these processes are variously amplified, side-tracked, baffled, distorted, suppressed, and so on. This baffling of living processes, as we may call it, occurs largely through the solid parts of the plants making up their visible structure, on which morphology, and so taxonomy, are built. Now any one living process consists of many steps. One species of plant may have steps A—D, another A—H: one may exaggerate B—D at the expense of A and E, or *vice-versa:* another may add N—Z, and another eliminate A—P: some steps may be passed over so rapidly as not to be detectable, and so on in endless variation. Thus, when we study one plant in particular, we cannot know how the process under investigation is baffled: probably we have only part of the picture, and we do not know which part. To understand more fully we must compare taxonomically related species (of the same general heritage) which will, through the very fact that they are not the same species (or genus) and have not precisely the same protoplasm, reveal other parts of the picture. This is homologous comparison as distinct from the artificial and analogous comparison which will introduce a multitude of unknown quantities; and homologous comparison depends on good taxonomy: it is, in fact, taxonomy. Obvious and simple as this important method of enquiry seems, it is far from being generally appreciated, and a great deal of botany is confused by analogous comparison. Nevertheless, it is being tacitly adopted because it works, and it is my purpose in this article to make sure that we understand why it works. Thus, comparative cytology, dealing with chromosome-numbers, structure, and behaviour, could never have been developed if there had not been the taxonomic work for it to follow: the tendency is to extol the new cytology and forget, if not to ridicule, the service of taxonomy. Laboratories have begun to look for new "guinea-pigs": hitherto they have adopted what was at hand, but they should be advised to enlarge their stock-in-trade taxonomically. Plant-breeding is scouring the world for wild species allied to crop-plants, whereby to breed new strains. Sylviculture is considering other timbers as world-demand exhausts supply. Horticulture is experimenting with the vigour and novelty of hybrids. In every case the

guide to requirements is in the pages of taxonomy, wherein the world's supply of species are catalogued for ready reference on the principle of hereditary construction. When we consider that this research demands taxonomic information from microscopic plants, as algae and yeasts, to timber-trees, orchids, and grasses, the importance of taxonomy can be understood. It has well been called the hand-maid of biology: in my experience, the higher the office, the greater the servant, and that applies both ways to taxonomy.

Tropical Taxonomy. I have assumed that our evolutionary classification is perfect. Of course it is not. Much is indisputably true, such as the recognition that aroids are not orchids, or casuarinas are not pines, but there are many plants, including casuarinas, the proper position of which in classification we do not know. In many groups, such as orchids, grasses, sedges, palms, and many trees, we do not know how to draw generic limits and, often, we have not the species properly arranged in the genus. We have no satisfactory classification of the orders of dicotyledons, and that of the larger fungi is extremely empirical. There are four great difficulties: firstly, the multitude of organisms is almost inconceivable: secondly, there have never been enough taxonomists to do the work thoroughly: thirdly, the material on which the taxonomist has to work is too often insufficient: and, fourthly, it is extremely difficult to distinguish analogy from homology, or, as we say, parallel from phyletic evolution. The result is that, when a new taxonomist has enough material to re-examine a deficient group, he almost invariably discovers that previous classification has mistaken analogy for consanguinity. One of the greatest revisions in this respect was the re-classification of the algae towards the end of last century: though scarcely mentioned in the history of botany, it has revolutionised the teaching. Now, nowhere are these defects so numerous as in the tropical countries. Fungi, ferns, and flowering plants have their headquarters in the tropics because here the broad-leafed trees have built up the richest biological environment of all—the tropical forest—wherein tens of thousands of flowering plants, ferns, and fungi dwell. You may think that north temperate students of fungi have a good knowledge of Boletus, but if we knew the boleti from Assam to New Guinea we would re-do the classification of Boletus! The "mushroom-soup" of Europe, which is a prized and limited commodity, is made from *Boletus edulis,* many allies of which grow in Malaya. If we understood the tropical polypores, which abound on wood from rubber-roots and tea-bushes to meranti and oil-palm, and in thousands in the forests, we would entirely revise the present artificial classification of these

fungi, with results of great significance for research: in fact, research on these fungi is baulked through lack of satisfactory classification. If we could revise the classification of the trees and lianes of the tropics from living plants and bring this improved knowledge into general botany, we could resolve many of the major problems of flowering plants. Living plants? So far, botany has had to deal mainly with dried specimens and pickled flowers of tropical plants; and more than half the plants of the world are known, accordingly, fragmentary and dead. There is the practical difficulty how to study these plants nearer to the places where they grow than the museums, herbaria, and botanic gardens of Europe and North America. The interest of most of these plants may be only academic, but we do not know which may not become a subject of intense laboratory or commercial interest. Thus Rauwolfia sprang to fame, and luckily it had been studied taxonomically. It has been said that, as timber supplies dwindle, bamboos of rapid growth will be required, and how many of us feel content with the meagre knowledge of bamboos? Indeed, with new methods of fibre-boards, sylviculture may turn to entirely new practices with the small quick-growing trees of the tropics and the manager, or taxonomist, of these plants will be needed to advise. Most tropical fruits could be improved and diversified, but nearly all the general of tropical fruits need taxonomic revision for adequate research. The cultivated banana has demanded extensive botanical exploration in the last twenty years to collect as many wild species of its genus, Musa, as could be obtained. Solanaceous fruits, particularly of tropical America, may be called upon next, but we have no modern guide to the genus Solanum. In contrast, the durians have recently been monographed and here is the prospect for the improvement of this popular fruit.

Tropical Botanical Institutes. There is no fundamental difference between tropical and temperate botany, but the richness of the tropical flora means so much more to be discovered and the expansion of our thoughts. As rubber, coffee, cocoa, banana, and other tropical commodities in daily life, botany also should thrive on tropical ideas. Our textbooks, however, written from the north temperate angle, seem to me like the splendid treatises the Romans could have written about the world, ignorant of three-quarters of it; and it was the "barbarians" who took over! In tropical botany we are passing from the era of exploration, when we had to be content with the dead records of expeditions, to that of the scientific appreciation of the living plants now made possible by expanding civilisation. The former has still much to contribute, which tropical countries cannot by themselves achieve, as may be learnt from the

Flora Malesiana and similar works on Africa in process of publication. But, for the taxonomic progress with living plants and all the impetus to botany, theoretical and applied, which will follow, we must look to the botanical institutes in tropical countries. I am impressed by the growing number of young students in the tropics. The thirst for knowledge cannot be quenched. They will build, and civilisation will expect it. Western science has led the way to a better appreciation of nature, but the tropical countries must now help their eager students to extend this knowledge in their own rich heritage for the benefit of mankind. I have often thought that what has been started in botany in Europe and North America will eventually have its headquarters in the tropics where the plants themselves orientate thought. On the tropical students now falls the responsibility for writing their biological floras, as is the newest taxonomic development in Europe. Theirs will be the responsibility of preserving the native vegetation and the beauty of the country by wayside and in national park, and of collecting the living assemblage of economic, ornamental, and rare plants for research and recreation in botanic gardens. Theirs will be the opportunity to step up all botany by study of new sorts of protoplasm. It is a hopeful glimpse. At present they may lean on outside support, but I look to the time when students from outside will learn in the tropical institutes.

In conclusion, tropical countries have a duty to promote botany. They inherit a rich share of plant-evolution, which has yet to be incorporated into the wisdom, practice, and enjoyment of civilisation. Their students will expect intellectual progress. In practice, success will depend on taxonomic efficiency, which is the chief scientific work of botanic gardens; other subjects will be developed by universities, special institutes, and amateur societies. It is not a pole or bush to be grown, but a tree of knowledge, the trunk whereof is taxonomy.