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# A BOTANICAL PROBLEM[1]

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"CONSIDER the lilies how they grow." Thus spake the great Master now just nineteen hundred years ago. And this statement from Him is prima facie evidence that the people of this period knew something of plants and of their growth. For it was the habit of this Teacher to base His lessons on the known and familiar. But we have evidence from many other sources that the study and observation of plants was at this time by no means new. When one searches the records for the beginnings of man's interest in and work with plants, one finds the story extending back not only to the earliest days of recorded history but far into those more remote times regarding which the archeologists have as yet found only the most fragmentary evidence, and then on into the mists of the past where conjecture alone can guide us. There is very general belief that the plants of the open plains and of the forests were one, doubtless the most potent one, of the factors influencing primitive man as he started on the long trail upward to civilization and his modern supremacy. We know that Neolithic man grew cereals, raised flax and cultivated plants bearing fruit and nuts. Moreover we find his grains such that they must have been the result of long ages of cultivation and improvement. With those still earlier practices, which must have antedated by many epochs those of Neolithic man, one's imagination may play at will.

Whatever the first abodes of man, whether caves or the sheltering branches of trees, the fact of a more or less fixed habitation, a pausing in his wanderings at some definite point, was undoubtedly a most significant step in that progress which led eventually to man's present estate. We know that two factors

[1] Address of the retiring president of the Botanical Society of America, read at Cleveland, December 31, 1930.

must have been of paramount importance in selecting these stations—the presence of water and land bearing plants suitable for man's need at this time. At first man used only what the land about his temporary abode naturally produced of herbage and fruitful plants. But presently he came to gather seed and to grow those plants which he most desired, thereby reducing or eliminating others for which he had no need. Thus very early in his history man began that ever-continuing process of changing the flora of the lands on which he squatted. When at times he yielded to that roving spirit which was still strong within him, he would move on, and sooner or later he came to take with him seeds of the plants most prized and to plant these seeds about the new habitation in places where each kind of plant would best thrive. This must have been so, else whence came the improved fruits and seeds used by Neolithic man? It thus becomes evident that those prehistoric workers with plants were not only agriculturists, they were also ecologists, a branch of botany so recently organized in its modern form that many of us here present remember when the word ecology was not in the dictionaries. But the fundamental conception of this phase of botany has undoubtedly influenced man's operations since his first feeble reachings out as an economic being. Not only were these primitive peoples agriculturists and ecologists, but we find, very early in the upward climb, indisputable evidence that they were also plant breeders. Neolithic man continued to improve, doubtless unconsciously through selection, the cereals which he inherited from earlier races of men. He seems also to have learned something of anatomy, for in his attempts to satisfy new needs that he came to sense in the early dawn of that higher social life toward which he was groping, we find him cultivating hemp and using the fibers thereof in the weaving of fabrics. It is thus clear that man's first intelligent reactions to the plant kingdom were from the standpoint of what is known as economic botany. Unquestionably his practices were crude and his apprehension slight. But they mark the beginnings of the growth of our knowledge of plants along some of the most important lines of botany extant to-day. To be sure there were, so far as we know, for long ages after man became interested in using and cultivating plants, no organized schools or centers for the dissemination of knowledge. But must we therefore conclude that man's mind during this period was totally untrained? We are too prone to accept the idea that "all learning is confined within our academic halls." There is another and I venture to think a greater school—the school of experience. And it was in this school that man learned his first lessons in botany.

Most historical writers of the subject during the last century place the beginnings of botany with the writings of Aristotle and Theophrastus. We would not discredit their contributions, but if we accept theirs as the beginning what shall we do with such evidences as those already referred to, or with those other records which indicate that the Egyptians were intelligent observers and growers of plants more than 3,000 years before Christ? What of those interesting slabs which depict King Ashur-nasir-pal and his attendants, almost a thousand years before Christ, artificially pollinating the date palm and thus apparently appreciating, and for all that we know understanding, something of the fact of sexuality in plants? And again there are the descriptions of plants written by Hippocrates, an early taxonomist, who was over seventy years old when Aristotle was born. Have not these and other studies and practices with plants, that might be mentioned, as just a claim to recognition by botanists as have Aristotle's more philosophical writings regarding plants? This great scholar passes over the idea of sex in plants with the statement that it is against their nature, thus ignorant of or ignoring the practices of the early Assyrians as illustrated in those bas-reliefs, just referred to, which are now in the British Museum.

The answer to these questions depends naturally on what one means by the term botany. If one consults various dictionaries, encyclopedias, histories of botany and etymological works, one finds two very distinct conceptions as to just what the word connotes. Certain of us would accept Professor A. B. Rendle's definition, as recorded in the Encyclopedia Britannica, that "Botany is the science that includes everything relating to the vegetable kingdom." This is practically in accord with, though less explicit than, the description of the subject to be found in the New Standard Dictionary. Here botany is defined as "the science which treats of plants," and is divided into eleven, apparently coordinate, branches. Among the branches recorded is economic botany, which the writer says "includes agriculture, forestry, horticulture, floriculture, and cognate subjects." Surely one could not hope for any conception more all-inclusive than are these. Others of us, and I suspect the larger group, would accept the view most frequently given and well illustrated by Professor Coulter's description of botany as outlined in the New International Encyclopedia. He places the beginnings of what he calls "scientific" botany with the classification of plants, citing Hippocrates as the first writer or student of "scientific" botany. He states that botany has become a very diversified subject, but, according to the classification which he gives, he would limit the use of the term to those aspects of the subject

which have no immediate application whatsoever to problems of utility. That is, he would make botany strictly a pure science and relegate all phases of the science which are directly concerned with practical problems to other, or what he calls "related" sciences, as agriculture, horticulture, etc. It would appear then that we have among botanists in general, as have the taxonomists, the "lumpers" and the "splitters."

There is fairly good evidence which I shall not attempt to detail here that up to the sixteenth century, botany included, as Rendle says, "everything relating to the vegetable kingdom." At the same time it is evident that the great diversity of approaches to the subject, its many-sidedness, were fully recognized long before the beginning of the Christian era; and that it very early became divided, *not broken up,* into several branches. To this day the branches are increasing in number and the number will continue to increase as modern research extends the boundaries of botanical science. The educational value of those branches which deal with the more practical aspects of the subject were early recognized in formal education. Chrysippos, of the School of Cnidus, wrote a book in the fourth century B. C. on the various kinds of vegetables grown in the garden of the school at Cnidus. And a little later we find Theophrastus basing many of his conclusions on observations made in the botanic garden of the Aristotelian lyceum. He further records his discussions in the classroom regarding the significance of grafting, budding and other horticultural problems. Much later, about 1650, we hear the great educator, Comenius, declaring that there should be gardens in connection with the universities that the sons of noblemen might be trained in the art and science of horticulture. Such was the broad field covered by botany from the earliest time. But about 1600 there began, in certain quarters, a slow but effective process of reduction in the scope of the subject-matter included in the science of botany. In his classical history of botany, Sachs speaks of the botanical writings of Aristotle, Theophrastus, Pliny and Dioscorides. But he places the foundations of modern botany in the sixteenth century with the works of Brunfels, Bock and Fuchs, and in this year (1875) he divides the science of botany into three great departments—morphology and classification, vegetable anatomy, vegetable physiology. Botany, then, at this time is strictly a pure science shorn of all applied phases or branches included in the earlier conceptions of the botanical field. Strictly economic in its beginnings, it is, as discussed by Sachs, no longer in any sense a humanistic subject.

As one contemplates the history of our science from its first inception to the present day, one is forcibly reminded of that remarkable theory of evolution formulated by Empedocles. It will be remembered that in the century before Aristotle he conceived of a method of evolution which consisted first in the establishment on the earth of fairly complex plants. Then there followed a budding off from these plants of parts of organisms, now one part and now another—arms, legs, trunks, ears, eyes, and whatnot, sent off into space. These ejected parts, however, did not remain isolated but tended to come together and to unite. In this reassembling very grosteque animals were built up. Witness the centaurs of Greek mythology. But these misfits were unable to reproduce and hence their kind was not perpetuated. After many trials, animals fit to survive and therefore capable of reproduction were formed. So during the latter days of the Renaissance, or about the close of the sixteenth century, when the science of botany was fairly well established and had sent its branches out in many directions, a budding-off process began. This reached its climax, let us hope, in the latter part of the last century. First one branch and then another became detached until the subject was so depleted or reduced in scope that in the opinion of many to include in the concept of botany, or to refer in the teaching of botany to anything that was grown in the field or that smacked in any way of the nearby and familiar was to debase the pure science of botany.

During the very last years of the last century there were here and there signs that the later stages of the process outlined by Empedocles, that of reassembling the severed parts, was setting in. It began to look as if botanical science was not only to be restored to its primordial scope but, as a result of the unparalleled development of all its parts during the century, it was to take a more significant place among the physical sciences than had heretofore been allotted to it. But, alas, the movement did not project itself into the new century with the vigor that some had anticipated. To-day those who believe in the more comprehensive organizations are more or less quiescent while here and there the budding off continues and it has not stopped with the various phases of applied botany. The tendency at present, however, is not so much a budding off as the result of normal growth, but rather a deliberate self-severing of the buds, perchance those of pure botany—too often it is feared neither to the advantage of the parent stock nor to that of the scion or severed branch.

I well remember the white rage, I know no better phrase to express it, with which one of our most highly esteemed botanists observed in 1900 certain

illustrations in an elementary text-book of botany that had just come from the press. These illustrations were some of the first evidences of a tendency among certain botanists toward reunion. On two pages of the open book there appeared on one a drawing of a properly clothed man's leg, from the knee down, with the trousers well covered with various kinds of hooked and barbed fruits and seeds; and on the opposite page was to be seen a picture of the posterior portion of a cow's body with the tassel of the tail filled with burdocks. "Such a cheapening of our science was not to be tolerated. It was coarse and disgusting." But I submit, what better illustration of the dissemination of fruits and seeds by means of the clothing of animals could Professor Bailey have found? Had he used the picture of a wild lion tearing through the forest with its tail and mane well filled with the fruits of *Harpagophytum procumbens* and a drawing of the orang-outang striding forth with the fruits of *Durio zibethinus* in his hands and various burs of his native haunts clinging to his hairy body, I am positive our distinguished protector of pure botany would have been entirely satisfied, yes, delighted. At about this time another leading botanist of the period was heard discussing with concern the fact that certain practices from the field and garden were creeping stealthily into our college classrooms. And he warned his hearers that this must be guarded against for eventually it could mean nothing less than a lowering of standards. Such were the extreme "splitters" at the close of the last and the beginning of the present century.

Undoubtedly there are many to-day who feel that such a view-point is justifiable. But were it best at this time, I believe arguments could be presented to show that largely because of this narrower view the science of botany has failed, in a degree, to measure up to the large place which it should hold in modern life and thought. When one compares the field of botany, using the term in its broadest sense, with that of other disciplines, one is inevitably led to the conclusion that the subject-matter of no other department of knowledge is more significant in its relations to human life and progress, is more multisided in its appeal or presents a greater challenge to the intellect or to the imagination. But these values can be fully realized only when there is the greatest possible cooperation between its several branches, and the subject stands in the solidarity of organic union of all its parts. The whole realm of the plant kingdom is intrinsically one. No part can be segregated without mutual loss to all. The problem that confronts botany in the twentieth century is inherent in the very nature of the subject itself. It is inevitable that so diversified a field should have a tendency to break up into smaller units. As a result of this very natural tendency, botany is to-day so split up into parts, each trying to stand alone, that she falls somewhat below the high place that is rightfully hers among the scientific stars of the first magnitude. You recall the story of the day laborers who were asked what they were doing. One replied, "I am cutting stone," another, "I am carving wood." Both facts were perfectly obvious to the questioner. But a third, the man of vision, answered with pride, "I am building a cathedral." Even so, when cordial and vital unity has been established among all members of the botanical body, may the student of plants say in lofty and justifiable pride, "I am a botanist. I am helping to make the world better."

That the lines of cleavage that have been set up are largely artificial is constantly becoming more and more apparent. I listened one day at the *Horticultural* Congress in London last August to two very interesting papers. These papers lost something of their interest for me when I heard them again, given so far as one could judge in the hearing, verbatim, the following week before the *Botanical* Congress meeting in Cambridge. A survey of the programs of the two congresses suggests that these were doubtless not the only instances of repetition. Why then two congresses? Applied and pure botany—can we separate the two? It is a commonplace that the discoveries in pure science to-day become the practices of the shop and of the field to-morrow. But is their value thereby lessened? There seems still to linger with us that "ancient fear of humanizing knowledge." But is not one of the glories of botany the fact that it is constantly making the world a better place to live in? The time is ripe, yes, overripe, when we scientists should abandon, wholeheartedly, the academic tradition that "polite learning and true culture admit no contact with utility."[2] But this is not all, there is another and even more pernicious tendency which is increasingly evident among us. It has nothing to do with utility or applied science. It strikes deep into the roots of the botanical tree. I refer to the breaking-up of pure botany itself into independent non-affiliated groups. Such a process must eventually spell disintegration all along the line.

May I reiterate, we in botanical science shall find our greatest power in the largest unity—a union in organization and in spirit. Let us be parasitologists, pomologists, mycologists, algologists, dendrologists, thremmatologists or any other sort of a botanical ologist, but let us first be *botanists*. The hand can

[2] C. M. Woodward, SCIENCE, December 28, 1906.

not do the work of the eye nor the eye of the foot. Neither can these several organs perform each its own function except as properly joined to the body by means of which they are correctly assembled and their activities coordinated. In like manner should the various branches of botany be united in one great central body—this body big enough, and strong enough, and flexible enough not only to include every phase of botany but to give freedom and inspiration to every one of its numerous ramifications. Such an organization I believe we already have in the Botanical Society of America. If not let it be so changed that it may be fit for the larger responsibility. Or if best discard it, which let us hope will not be necessary, and build up a new organization under whose banner all may enlist. Every student of plants should then be first a member of the great all-inclusive parent organization and secondly a member of the section or branch wherein his own particular field of endeavor lies. Thus united we shall stand in the power and dignity that so great a science deserves; but separated, we shall ever fail to measure up to the high destiny that may be ours. I repeat Professor Arthur's statement made in an address given before this society just ten years ago. "The botanists' realm is the vegetable kingdom."

Is not this then our theme this evening? The scope of botany, unrivalled by that of any other science, and botanical unity. Only, we believe, by the force of such a unity as has been suggested shall botany fulfil, in largest measure, its high mission in the commercial, the intellectual and the cultural life of the world. It is to this larger fraternity that I would call every student of plant life.

# HERBERT HOOVER AND SCIENCE

By Dr. VERNON KELLOGG

PERMANENT SECRETARY, NATIONAL RESEARCH COUNCIL

As a boy preparing for college Herbert Hoover decided to go to a university which paid especial attention to science. He went to Stanford University, took major courses there in geology and mining, graduated in 1895, and began at once a successful career as mining engineer. This lasted up to the beginning of the World War, when he gave it up and became known to all the world as relief worker, Food Administrator, Secretary of Commerce, and President of the United States. In all these capacities he has shown a notable appreciation of science and the scientific method, and he has helped materially to support and extend scientific knowledge.

As mining engineer in charge of very large enterprises in Australia, China, Burma, the Ural Mountains, Mongolian Siberia, South Africa and elsewhere he attacked with success various scientific mining and metallurgical problems. Most notable, perhaps, was his success in Australia in advancing the flotation process and in working out means of profitably recovering the zinc content from low-grade silver ores.

In the prosecution of his large mining operations he successfully met important social problems arising from the gathering together of communities of thousands of workmen and their families in parts of the world distant from civilized regions. His great Kyshtim project in the Ural Mountains, for example, maintained a community of 70,000 people who were lifted by him through his scientific and social work from poverty and squalor to a high state of comfort and prosperity.

He is the author (with specialist collaborators) of "Economics of Mining," published by the *Engineering and Mining Journal,* New York City, 1905; also of "Principles of Mining," 199 pp., 1909, McGraw-Hill Book Company, used in mining schools; also of "De Re Metallica," by G. Agricola, founder of the modern science of mineralogy, translated by Mr. Hoover and his wife from the first medieval Latin edition of 1556. To the original text the translators added an important biographical introduction and an invaluable host of annotations and appendices about the development of mining law and mining and metallurgical methods from the earliest times to the sixteenth century. He also is the author of numerous addresses and papers published in mining and engineering magazines and elsewhere. He has lectured on engineering at Stanford and Columbia Universities, and has been president (1920–1921) of the American Institute of Mining and Metallurgical Engineers; president (1920–1921) of the American Engineering Council (federated American engineering societies); chairman of the Advisory Committee of the Food Research Institute, Stanford University (1921– ); president (1927) of the International Radiotelegraph Conference; trustee (1920– ) of the Carnegie Institution of Washington; trustee (1912– ) of Stanford University, and officer or member of various other major national engineering and scientific societies and organizations.

He has been given honorary academic degrees by twenty-five universities, and has been awarded the following medals for scientific merit: