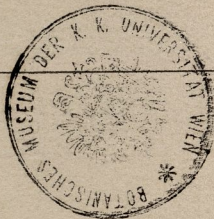


BOTANISCHES MUSEUM
der k. k. Universität.

J. N^o 11929

B

0121/35



The Botanical Outlook

By
John M. Coulter, Ph.D.
President of
Lake Forest University

An address delivered before the
Botanical Seminar of the University of Nebraska
May 27, 1895.

Lincoln, Nebraska, U. S. A.
1895
Published by the Seminar.



The Botanical Outlook

By
John M. Coulter, Ph.D.
President of
Lake Forest University

An address delivered before the
Botanical Seminar of the University of Nebraska
May 27, 1895.

*Lincoln, Nebraska, U. S. A.
1895
Published by the Seminar.*

THREE HUNDRED AND SIXTY-THREE PRINTED.

No. 166

THE BOTANICAL OUTLOOK.

I must first congratulate you upon the large development of botanical activity to which the existence and work of the Botanical Seminar abundantly testify. You have become a notable factor in the progress of American Botany, and your work is proving a stimulus to regions of less kinetic energy. It is a pleasure to acknowledge this fact, and to wish for your organization a long and increasingly useful existence.

*

Upon this occasion it might seem natural for me to present either some line of research or a summary of progress in some important field of work. I shrink from the former, however, as my researches recently have been peculiarly technical, and hence unintelligible, and from the latter, because summaries of knowledge are abundant and well known to all diligent botanical students. It is my purpose, therefore, to presume upon a somewhat long and general botanical experience and present some desultory remarks upon the botanical outlook, which may be of service to the eager young botanists who have just enlisted, which may not lack interest to the veterans, and which I

hope will be intelligible to those who have merely a general interest in the subject.

The history of Botany as a science is full of interest and suggestion, and its advance from its first simple stages to its present fullness and complexity is like the story of the advance of a savage tribe to extreme civilization. First studied as things of utility, plants presently were regarded as things of beauty, and the "*scientia amabilis*" counted its votaries by thousands. Recommended especially to ladies as a harmless pastime, not overtaxing to the mind, and called even by Goethe the "loveliest of sciences," it was an emasculated science, which regarded merely the cut of the clothes rather than the man beneath. In spite of the subsequent revelation of the botanical man, the capacity of plants for usefulness in the domain of aestheticism still brands botany in certain quarters as an emotion rather than a study, a view which brings some such shudder to the modern botanist as is experienced by the modern astronomer when informed that "it must be lovely to trace the constellations!" But the botanical man has been liberated, and his virile strength is becoming daily more evident. In this presence it is not necessary for me to magnify the great modern science of botany, with its tremendous reaches, its deep insight into the very secrets of life, its masterful problems that call for the highest expressions of diligence and genius. This you have already done for me, and

I find the ground prepared and fertile for such seeds as I may have to drop into it.

An "outlook" implies a command of the whole horizon—that part of it from which we have just emerged, as well as that to which we are bound. I wish first, therefore, to speak of certain tendencies that have been developed by our past progress that seem to me objectionable and that must be corrected if our further progress is to be strong and unimpeded.

1. *The tendency towards narrowness.*

There was a time when a man could be not only a "botanist," but a "scientist," his only necessary botanical acquisition being a certain amount of familiarity with the higher plants of his vicinity. Presently botany became large enough to demand all of his energy, and if he was professor of "natural science" he taught botany and let the other sciences shift for themselves, which was far better than undertaking to interfere with them. Now even botany has become too large for individual grasp and is a composite of many sciences. Instead of attempting to cultivate the whole prairie each man selects his own garden patch. He does not run over so much surface, but he gets a more valuable crop. Botanical sod has long since been broken, and it is only intensive cultivation that pays. This being true, botanists are becoming narrower with every succeeding generation, and, as you know, it is an annual crop. We are becoming moles in

our individual burrows, and are in danger of losing sight of the landscape. It is a most dangerous tendency, developed from the necessities of the case. How to cultivate a sharp cutting edge, without permitting it to bury us beneath the surface, is the problem that confronts every specialist to-day. This narrowing process cultivates lack of perspective, self-conceit, contempt for other kinds of work. It is clearly impossible now for any one to be merely a general botanist and at the same time a factor in botanical progress; but it is equally clear that botanical science is an organism, and the proper study of any one organ involves its relations to all the rest. A successful student of the eye is sure to know something concerning the structure of the body outside of that one organ. My plea is for a broader botanical training, which will put our botanical eyes on elevations, rather than at the bottom of ruts. I must say that the tendency of the German schools, magnificent as they have been in research and in inspiration, has been to intensify the evil referred to. This has not been the fault of the universities, but of the students who were not ready for the university atmosphere. This country is full, and becoming more full, of botanical moles who can see only their own burrows. To my mind it is a god-send to American botany that botanists here are, for the most part, compelled to be teachers, compelled to keep in view the general domain.

2. *The tendency towards certainty.*

It may be that this is an outgrowth of the narrowness referred to, but certain it is that there is creeping into the botany of to-day more and more the air of infallibility. Previous work and previous workers seem to be passing into greater disrepute, and are referred to in a way suggestive of mild wonder at their crudity. There is a spirit of intolerance abroad which can only come from an absolute conviction of infallibility. As a cure for this the history of Botany should be read more carefully. The self-gratulation of one age has always been the wonder of the next. Theories group themselves about the facts in hand; and as facts multiply theories are fractured. The expression of knowledge to-day is not the expression of ultimate truth, and never will be, but simply of current knowledge. Our gropings after affinities and functions, upon both of which we pride ourselves, will look crude enough presently, but they will make fuller knowledge possible. As Kerner puts it: "Only a narrow mind is capable of claiming infallibility and permanence for the ideas which the present age lays down as the laws of nature. Consciousness of the limitations of our knowledge of nature, and of the variability of our theories, should moderate, on the one hand, the exuberant hopes raised by the belief that the great questions connected with the phenomena of life will be solved, and to correct, on the other, the habit of not appreciating

impartially the various methods which have been and are still employed by different botanists. For the up-building of the science of Botany everything relating to the subject has its value, and is capable of being turned to account. Whether the materials are rough or elaborated, massive, fragmentary, or merely connected, howsoever and whensoever they have been acquired, they are all useful. The study of dried plants made by a student in a provincial museum, the discoveries of an amateur regarding the flora of a sequestered valley, the contributions of horticulturists on subjects of experiment, the facts gleaned by farmers and foresters in fields and woods, the disclosures which have been wrested from living plants in university laboratories, and the observations conducted in the greatest and best of all laboratories—that of Nature herself—all these results should be turned to account, and the motto of the botanist should be

“Prove all things; hold fast that which is good.”

3. *The tendency to mistake power of acquisition for power to do something.*

I believe that this is one of the prominent characteristics of our present stage of progress. Every experienced teacher in the laboratory has observed that his good students may be divided sharply into two groups: those who can only acquire and those who can also do something, and the first class is far more numerous than the second. If you should review the well-nigh

endless botanical productions of the last few years, you would be impressed by the fact that by far the greater portion of the writers had come into contact with facts that they knew neither how to interpret nor to properly relate. Instead of grasping the facts, the facts had them by the throat. The ability to grind out sterile facts is of the machine kind, is like solving problems by the rule. If you knew the number of these Gradgrinds who, under the direction of an instructor, have obtained a collection of facts, have been helped to knit them together, have thereby achieved a thesis and a doctorate, and have then quietly disappeared beneath the surface of botanical notice, you would be amazed. This is an age of theses, of germinating plantlets, not one in a thousand of which develop any farther. I suppose that the principle of natural selection may be left to do its benign work in these cases, but unfortunately such corpses are embalmed in literature, and the mummy is always in evidence. I know that in Systematic Botany it is our constant wish that of those who have written before us at least one-half had never seen a plant; and at the same time we are fully conscious that the same thought will be in the minds of our successors. I do not object to the multiplication of botanists, for they cannot be multiplied rapidly enough; but I do seriously object to the multiplication of botanists who only know how to publish, but not to work. This has all sprung from the

development of our modern university methods, and I know of no way of checking it except by impressing teachers with the serious responsibility they assume in urging born hod-carriers to become architects.

4. *The tendency to immature research.*

This is an age of precocity, and nowhere is it more evident than in laboratories. The American boy wishes to become a man at once; he no sooner becomes acclimated to the atmosphere of the laboratory than he wishes to undertake the responsible business of investigation. The same tendency is expressed in his confidence that he can manage a newspaper, or a railroad system, or, as I have had immediate occasion to know, a university. This confidence is natural, and it is hopeful. Properly directed, it is of immense benefit. The teacher who is weak enough to yield to it, however, is doing a serious wrong. Botany is a tremendous science, with a very long history. Its facts have been the accumulation of centuries; its present ramifications run out endlessly, and to project effective work upon this great background demands a wealth of knowledge and of experience that takes both time and patience to acquire. It means a long apprenticeship, and the guiding hand of a wise master. Modesty is not a characteristic of youth or always of old age, but it is usually developed by a large acquaintance with facts. I imagine that the first attempts of botanists are often their most ambitious ones. I have

met very few beginners, who, in the first flush of dawning strength, did not have in mind, or perhaps undertake, a recasting of the whole plant kingdom. To attack the largest problems first is as natural as youth itself; and I speak of this, not only as a generalization, but also as reminiscence. The botanist who publishes nothing that he afterwards regrets is either a transcendent genius or a simpleton. My plea for greater maturity of preparation before independent research and publication are attempted will meet a strong response in the later thought of all botanists who have begun precociously. Youth is not a crime, but poor preparation is.

5. *The tendency to ritualism.*

This may be an ecclesiastical term, but it has a botanical application. Ritualism cries for uniformity, and inclines to elevate the form above the substance. There are certain mechanical minds coming forward that desire to see the whole of botanical science laid off in regular blocks, with streets all named and houses all numbered, and botanists compelled to keep in rigidly prescribed paths. Individuality must give place to dead monotony, and personal opinion fettered by prescribed form. There are certain customs of society which indicate good breeding; there are others which are pure formalism; and the two are sometimes at variance. As you have already surmised the spirit of ritualism is just now manifesting itself most strongly

in Systematic Botany, as evidenced by the nomenclature discussion now to the front. Far be it from me to enter with you this troubled field, for I am not a botanical ecclesiastic. A contest over non-essentials is always apt to wax violent, like the ancient religious wars. We have an old ritual and a new ritual struggling for supremacy, and in the meantime the plants are in danger of being lost sight of. Not many years ago, those of us who were in the first fight which the new botany was making against the old, insisted that there was something to a plant besides its name, and that the end of botany was not to discover the names of plants. The illustration that the ancient method of studying botany was like chasing a woodchuck into its hole—there was nothing but the hole to show for all the effort—became a classical one. It is somewhat confusing now to many of us to find ourselves in full cry again after the woodchuck. Nor is this all. In the olden days the hunt for a name involved at least the superficial examination of a plant, but now it has become the examination of literature. There is not even a living woodchuck in the hole, but we are examining a set of ancient holes. To some the present one is good enough, to others an older one seems better, and so the contest goes. I must be pardoned if I regard such things as unessential and as matters of ritual, convenient enough and useful enough if properly subordinated, but, when they involve a contest, tre-

mendously wasteful of energy that should all be directed to the study of plants. It is not the names of plants that will confuse us, even if we never agree upon a uniform label, but the varying opinions as to their relationships and generic and specific limitations, concerning which there can be no concensus of opinion until all human minds are cast in the same mold. As a botanist must always be free to regard a certain group of plants as representing one genus or several genera, or certain forms as varieties or species, however great the resulting confusion may be, it will be a minor matter what names he may employ to designate them. We should sympathize with every reform, even if it only concerns the cut of a coat, but we should not treat it as though it were a question of life and death. Other regions of botany are also in danger of an excessive ritualism, and the individual judgment is likely to be called upon to surrender its autonomy. I do not anticipate any lasting trouble from these flurries, for the deep currents of botanical investigation are sweeping steadily on, but they form an interesting study in the history of the science. There was just such a nomenclature flurry in the fourteenth century, and you will find in the old herbal of Hieronymus Bock the following sentence: "Be our heath called *Erica* or not, it is in any case a pretty and sturdy little shrub, beset with numerous brown rounded branches, which are clothed all over with small green leaves," and then he declares

that the proper thing would be to lay aside all disputes concerning the nomenclature.

With these statements concerning certain tendencies which seem to be natural outgrowths of our recent progress, let me turn your attention to certain hopeful tendencies which seem to contain the promise and potency of strong future development.

1. *The tendency to regard Botany as a biological science.*

The botanical standpoint has been slowly shifting throughout the history of the science. The first impulse was the natural one—the collection and systematizing of material, the development of description and label. It *was* fascinating, and *is* fascinating, for it is superficial, involves rapid shifting of the scene and so holds attention, and appeals to our love of accumulation. The spirit of the collector seems to be congenital with most of us, from the age of marbles and postage stamps onwards. All this work in Botany, however, was necessary to its later development, and still remains necessary. Our stone age is likely to be ever present with us, but it none the less represents a period in general development. When knowledge of external form and its description became fairly well organized, the study of minute structure had its birth, and the botanical standpoint shifted from the species to the cell. The elaborate mechanism of structure was gradually unfolded, but biological significance was still lurking in the somewhat distant background. It

takes a long time and many workers to provide facts enough for profitable organization. When knowledge of mature structure began to assume form, the *development* of structure attracted attention, and the botanical standpoint, as it had shifted from species to cell, again shifted from cell to history. It may be fairly said that we are still living in the period of Comparative Morphology. Its subject matter is too vast, in spite of the wonderful multiplication of workers, to organize it in a generation, although the feeling of sufficiency is among us, as witness the numerous recent publications. They are to be regarded, however, not as goals of effort, but as stimuli to further effort. Under the influence of comparative morphology, genetic relationship is being traced and plant genealogy written. The historical standpoint, including the individual as well as the race, has not only developed its own results, but has vivified the work among cells and among species.

But forces are gathering which will presently again shift our standpoint, and many are looking upon plants not merely as forms, or as elaborate structures, or as factors in a wonderful history, but as expressions of life. We are on the fringes of a great subject. Physiological Botany is still a promise, and has not fairly stretched into the region of performance. It is collecting facts, and our best treatises are little more than catalogues of facts. These are being variously sorted

and systematized, and a terminology devised. All this is prefatory to the real business. External conditions are being listed, and their individual effects on plant activity noted. Apparatus is being perfected for the measuring of results. All this, however, is superficial and largely mechanical, and very much like making a house ready for occupation. The true physiology is to deal with cause and purpose as well as results. Besides, causation is both superficial and deep-seated. For instance it is superficial and fragmentary to ask what is the cause of the positive heliotropism of stems and the negative heliotropism of roots; and we cannot yet answer even such questions. These fragmentary conditions applied to fragmentary structures always indicate embryonic stages of a subject. Back of all this lie the deep-seated questions of physiology, the questions of the future, the new botanical standpoint, what has made this whole organism what it is, and what are the adaptations to its necessities? The organism as a whole, a resultant of external forces and internal tendencies, is the vast problem that confronts us, and in its attempted solution Botany will become in truth a biological science.

2. *The tendency to study in the great laboratory of Nature.*

The first material of botanical laboratories was the plant mummy, preserved with more or less of art. For study of external form it answered and still answers the purpose well. Herbaria will be necessities, so long

as the idea of species is a necessity. For many they carried with them also the flavor of field and forest, but this flavor was an emotion, a sentiment, delightful but not scientific. The emotion of the field collector, elevating, fascinating as it is, must never be confounded with scientific work. It was devotion to this phase that made Botany only the *scientia amabilis*. The compound microscope brought the reaction, and botanists forsook herbaria and contact with field and forest, became closet students, and the modern laboratory had its birth, aquaria and bottles supplying materials, no longer mummies, but plants in prison or pickle. This has brought vast results and has made possible the next advance. Now, we are taking to the field again, but with a far different purpose. Our college laboratories have raised questions that compel us to visit the laboratory of Nature. The ultimate problems are waiting our solution there. The race of collectors is being replaced by field observers. Plants have no longer intrinsic worth as specimens, but are valuable only as related to their environment. Environment means not simply soil and altitude and season, but also distribution, conditions of variations, light and heat and moisture relations, methods of development, in short, all those multitudinous questions which physiology has suggested.

A race of field observers is to be trained, possessing all the niceties of accurate observation, just as there

has been developed a race of topographers. The old-fashioned collection of plants will hold no more relation to the new field work than the old geology, with its scattered collection of fossils, holds to the topographic geology of to-day. Collecting trips are being replaced by biological surveys, a proper outgrowth from every university laboratory, such an outgrowth as your own Botanical Seminar has been early in exemplifying. In such study, the scientific temper, so far as Botany is concerned, will have the best opportunity to express itself. From an educational standpoint science has been persistently misunderstood, often by its votaries. Within a few weeks the fundamental distinction between the so-called classical and scientific training has been given as being that the former brought the mind in contact with the best that has been thought or done in the history of the race; while the latter taught the methods of the laboratory. I grant that the former is a worthy statement, but the latter is totally inadequate and misleading. Facts and methods are no more science than words and grammars are literature, or than crayon and blackboards are mathematics. Science concerns itself with facts in their relation, resulting in a formula. I grant that the bulk of scientific publication is merely the publication of "studies," such as an artist may make before he presents the finished picture. The artist, the author, does not publish his "studies," the scien-

tific man does. There are so-called classicists who never get beyond grammar and dictionary; just as there are so-called scientists who never get beyond the collection of unrelated facts, but neither of them has touched the full significance of the materials they are handling. The true classicist through these superficial symbols is brought into the region of feeling, of what is known as "appreciation;" his ultimate purpose may be broadly called æsthetic. He reads himself into his material and decides what is best in thought. The true scientist through his superficial symbols, spoken of as facts, seeks to reach a formula. His constant endeavor is to keep himself out of his material, to eliminate the personal equation, to relate his facts so as to include nothing of himself. Personal injection on the one hand and personal elimination on the other represent the ultimate difference in the two cases, and two more complementary kinds of training could not be imagined. It is such an expression of scientific training that I have in mind when I hail the development of a tendency in Botany to go beyond analysis, which accumulates material, and to begin a synthesis, which is to relate separated facts into an organism. To be truly scientific is to become synthetic, and that which is too often regarded as science is but the brick and mortar and scaffolding. The genuine teacher of scientific botany gives glimpses of the re-

gion of synthesis throughout his work; but botany as a science is just entering upon this stage, and the study of the whole organism in all its relations to its natural environment is a step out into the great botanical future.

3. *The tendency to specific demonstration.*

When the permanency of species was the dominant idea, the discovery of a species seemed to be a discovery as definitely bounded as that of an oceanic island. Now that we know that species do not have any such autonomy, but are rather expressions of botanical judgment concerning relationship, we are learning to have less respect for them. I sometimes think that those of us who make species have reason to have the least respect for them and are "making" them in more senses than one. A student of the genus *Aster* is apt to be convinced that any attempt to break it up into species is about as arbitrary as running streets. The student of *Cactaceae* does not even find genera. Our oceanic islands have mostly become simply elevations on the surface of a continent. The elevations give very little trouble, but the intermediate territory is exasperating to those who would discover topographic lines where none exist. When species are regarded historically, they seem but as waves that rise from a general level and sink to it again. We have been studying, describing, cataloguing waves that are inextricably related, and are only beginning to catch glimpses of the deep-

seated currents that run steadily beneath the surface. The general laws governing waves, however, are interesting and valuable, but to exactly and individually delimit them seems hopeless. But the most hopeless task of all is to make and unmake species, elevate and depress and transfer varieties, by looking at the forms of isolated specimens. An herbarium, useful and necessary as it is, is apt to become a most prolific source of the juggling of genera and species and varieties. The possible permutations of relationships and rank are endless when one is able to do little more than guess, and opinions are apt to be as variable as observers. I must confess that I do not regard such work as scientific, simply because it is not possible to eliminate the personal equation. We take testimony and weigh the evidence, but the conclusion is an inference rather than a demonstration. We have established certain arbitrary criteria of genera and species and varieties for our convenience in handling material, and then make these criteria a matter of opinion rather than of experiment. To me much herbarium work looks like little else than an amusement, where we have taken "delight in now including a group of forms as varieties of a single species, now dividing some species as described by a particular author into several other species, now subdividing genera, now combining them." Students of Thallophytes have taught the rest of us a lesson in introducing the method of culture. Why

juggle endlessly with species and varieties when simple cultural experiments will determine the fact of the constancy or variability of the forms in question? The time that has been devoted to threshing the old straw over and over again would have long since determined most of the critical specific and varietal questions of the higher plants. If one thinks a form is a good species rather than a variety, or the variety of one species rather than another, why not demonstrate the opinion rather than publish it? The trouble has been that in the compilation of manuals and lists the material is too abundant and the time too limited to undertake such demonstration. Manuals and lists are not only useful but necessary, but there must be a race of cultural botanists at work whose demonstrations will gradually enrich and render permanent the compilations. I know just now of two botanists at work on the same large genus. One is examining herbarium material, and is multiplying species at a prodigious rate. The other has seen most of the species in their native haunts, and is doing an equally prodigious amount of reduction. Both are guessing, for neither has seen what even a generation or two will reveal. Observation of mature forms in the field is not much more of a guide to genetic relationship than the study of the same forms preserved in the herbarium. The sole advantage of the field is the greater number of apparently intergrading forms.

By means of culture I recently succeeded in developing two herbarium species and one variety from the same stock. In another case two species had been pronounced by a field observer as the same, the difference being due to differences in soil and exposure. I persistently reversed the conditions, but the forms continued to come true from seed, and it was evident that the differences were deeper than such as are induced by differences of exposure. Enough such problems are awaiting us to satisfy the ambition of all the young botanists we can produce. Do not understand that I mean to undervalue the grand work that has been done, and necessarily done, with insufficient data. I mean simply to urge upon your attention that there is no special value in doing this work over and over again with exactly the same data, and that the time has come for us to enrich our data in systematic botany by the method of cultures.

4. *The tendency to use the imagination.*

This may have a strange sound coming from one supposed to be a devotee of pure science. It is vital, however, to the progress of science and has been in danger of elimination. I refer not to that youthful tendency which seeks to construct a theory of the universe upon every new observation, or to that too common tendency to marshal facts to the support of some preconceived idea; but I do refer to that use of the imagination which sees in facts a suggestion which

stimulates to further question, an imagination which asks questions rather than constructs systems. As teachers we have been in danger of crushing out this tendency, of clipping wings that would seek a higher flight. Rightly impressed with the danger of immature flight, we have almost atrophied the organs of flight. As Kerner puts it: "In the mere act of linking ascertained facts together, and in the creation of ideas involving interdependence among the phenomena observed, there lies an irresistible charm which is a continual stimulus to fresh investigations. Even though we be sure that we shall never be able to fathom the truth completely, we shall still go on seeking to approach it. The more imaginative an investigator the more keenly is he goaded to discovery by this craving for an explanation of things and for a solution of the mute riddle which is presented to us by the forms of plants. It is impossible to overrate the value and efficiency of the transcendent gift of imagination when applied to questions of Natural History. Thus when we inquire whether certain characters noted in a plant are hereditary, constant, and inalienable, or are only occasioned by local influences of climate or soil, and hence deduce whether the plant in question is to be looked upon as a species or a variety; when we conclude from the fact of a resemblance between the histories of the development of various species that they are related, and place them together in groups or

series; when we unravel the genealogies of different plants by comparing forms still living with others that are extinct; when we try to represent clearly the molecular structure of the cell-membrane by arguing from the phenomena manifested by that membrane; when we investigate the meaning of the peculiar thickenings and sculpturings of the walls of cells; or when we discover the strange forms of flowers and fruits to be mechanical contrivances adapted to the forms of certain animals, and judge the extent to which these contrivances are advantageous, or the reverse, to the plants; in all these and similar investigations imagination plays a predominant part. Experiment itself is really a result of the exercise of that faculty. The fact that when the imagination has been allowed to soar unrestrained, or without the steadying ballast of actual observations, it has frequently led its followers into error, does not detract at all from its extreme value as an aid to research." This faculty, repressed for a time, is beginning to reassert itself, and in this fact lies the promise of rapid development.

5. *The tendency to regard plants as resultants.*

This leads us at once within the domain of evolution, a truth of which we are fully conscious, but which in the very nature of things it seems impossible to demonstrate, the finest expression of the imaginative faculty that biology shows. When Geoffrey St. Hilaire, Goethe, and Erasmus Darwin began the scien-

tific statement of the doctrine of evolution for biology by general statements concerning the effects of environment; when Lamarck and Treviranus proposed their theory of "appentency" (which is practically the law of use and disuse); when Darwin and Wallace announced the epoch-making theory of "natural selection"; when numerous writers since have made suggestions, either vital or mechanical, as to the method of evolution—they have all seemed to regard the organism as under the impulse of a single force, moving straight ahead towards perfect adaptation. There was no thought, apparently, that Lamarckism and Darwinism could co-exist, or that the factors discovered later could but contradict the earlier suggestions. It is coming to be thought that there is truth in them all, and that while under certain conditions one of these factors of evolution may be more dominant than the others, yet all enter into the problem, and the organism is a resultant. The genealogical pathway of every existing organism seems to have been a very complex one, directed in a general way towards the region of adaptation, baffled at every turn by its own rigidity, carried out of its course by hereditary momentum, achieving a structure of relative safety by calling in every influence that could effect structural change. No single factor of evolution has yet been proposed which seems adequate to explain the observed results, and the best that we can do is to add

them all together and wish for more. Simple, sexless plants become sexual, and the gametophyte appears, containing within itself the potency of extensive changes; from its own body the sporophyte is born, at first indistinct and dependent, presently worked out into distinctness and independence, assuming ever increasing work, overshadowing its parent gametophyte, which presently in turn becomes dependent upon it, and finally even indistinct. In the course of this wonderful history of the sporophyte in its relations to the gametophyte, this history of birth and successful usurpation, the epochs have expressed themselves in forms that are our materials for study, forms so numerous and diverse that we are still at the work of discovery. So vast a history, with a definite motive that has defied all changes in environment, cannot be explained by the touch of external conditions. On the surface of the movement there are thrown up the bubbles, the waves which we call species. Wind and the mobility of the water itself may explain the waves, but the great currents beneath demand a larger explanation, an explanation which shows a wider range, a steadier impulse. It is my impression that we are still playing upon the surface of the subject, and that the deep currents still remain in the regions of mystery. It is a hopeful sign, therefore, that we are leaving the region of dogmatism which asserts that this or that is the only way of evolution, and which requires a larger

measure of faith than has ever been demanded of man, and are entering a region of doubt, where all doctrines seem helpful but unsatisfactory, where they all seem to contain truth, but not the final truth, and where we are in the attitude of waiting for a larger revelation.

It would be possible to enumerate other hopeful tendencies in the Botany of to-day, but those that have been given, very general though they be, will serve my purpose in illustrating the claim that is made that we are entering upon a period that may be styled the botanical renaissance.

Fortunate are the young botanists before me that their lot has been cast in such a time of awakening. Entering as they do into all the results and mistakes of their predecessors, breathing an atmosphere surcharged with freedom, I can wish them no better fate than that their work may be commensurate with their opportunity.



