SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, SEPTEMBER 14, 1906.

CONTENTS.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

BOTANY IN ENGLAND.[1]

THE period of twenty-five years that has elapsed since the British Association last met in this city all but includes the rise of modern botany in this country. During the middle decades of last century our botanists were preoccupied with arranging and describing the countless collections of new plants that poured in from every quarter of an expanding empire. The methods inculcated by Linnæus and the other great taxonomists of the eighteenth century had taken deep root with us and choked out all other influences. Schleiden's 'Principles of Botany,' which marked a great awakening elsewhere, failed to arouse us. The great results of Von Mohl, Hofmeister, Nägeli and so many other notable workers, which practically transformed botany, were at first without visible effect.

It was not that we were lacking in men capable of appreciating the newer work. Henfrey, Dr. Lankester (the father of our president), not to mention others, were continually bringing these results before societies, writing about them in the journals, and translating books. But the thing never caught on—it would have been surprising if it had. You may write and talk to your contemporaries to your heart's content, and leave no lasting impression. The

[1] Concluding part of the opening address of Professor F. W. Oliver, F.R.S., president of the Section of Botany, at the York meeting of the British Association for the Advancement of Science.

schools were not ready. No movement of the sort could take root without the means of enlisting the sympathies of the rising generation. It was only in the seventies that effective steps were taken to place botany on the higher platform; and the service rendered in this connection by Thistleton-Dyer and Vines is within the knowledge of us all. Like the former in London, so the latter at Cambridge aroused great enthusiasm by his admirable courses of lectures. Great service, too, was rendered by the Clarendon Press, which diffused excellent translations of the best continental text-books—a policy which it still pursues with unabated vigor, though the need of them is, I hope, less urgent now than formerly. Already at the time of the last meeting in York (1881) a select band of Englishmen were at work upon original investigations of the modern kind. The individuals who formed this little group of pioneers in their turn influenced their pupils, and so the movement spread and grew. It would be premature to enter fully into this phase of the movement, so I will pass on with the remark that modern botany was singularly fortunate in its early exponents.

Whenever the history of botany in England comes to be written, one very important event will have to be chronicled. This is the foundation of the Jodrell Laboratory at Kew, which dates from the year 1876. Hidden away in a corner of the gardens this unpretentious appendage of the Kew establishment has played a leading part in the work of the last twenty-five years. Here you were free to pursue your investigations with the whole resources of the gardens at your command. I suppose there is hardly a botanist in the country who has not, at some time or other, availed himself of these facilities, and who does not cherish the happiest memories of the time he may have spent there. Certainly Jodrell displayed rare sagacity in his benefactions, which included, in addition to the laboratory that bears his name, the endowments of the chairs of animal physiology and zoology at University College, London.

Sir William Thistleton-Dyer, who has so recently retired from the directorship of Kew, had every means of knowing that his happy inspiration of founding a laboratory at Kew was a most fertile one. It would not be surprising if the future were to show that of the many changes inaugurated during his period of service this departure should prove by far the most fruitful.

Another incident belonging to the early days ought not to be overlooked: I refer to the notable concourse of continental and American botanists at the Manchester meeting of the British Association in 1887. The genuine interest which they evinced in our budding efforts and the friendly encouragement extended to us on that occasion certainly left an abiding impression and cheered us on our way.

We are not forgetful of our obligations. We regard them in the light of a sort of funded debt on which it is at once a pleasure and a duty to pay interest. The dividends, I believe, are steadily increasing—a happy result which I am confident will be maintained.

But I should be lacking in my duty did I permit the impression to remain that botany is anything but a sturdy and natural growth among us. The awakening, no doubt, came late, and at first we were influenced from without in the subject-matter of our investigations. But many lines of work have gradually opened out, whilst fruitful new departures and important advances have not been wanting. We still lean a little heavily on the morphological side, and our most urgent need lies in the direction of physiology. As chemists and physicists realize more fully the possibilities of

the 'botanical Hinterland,' one may expect the conventional frontier to become obliterated. As Mr. F. F. Blackman has pointed out in a recent interesting contribution,[2] the chemist's point of view has undergone a change with the growth of the science of physical chemistry, and is now much more in line with that of the biologist than was formerly the case. This natural passage from the problems of the one to those of the other should be the means of attracting into our body recruits possessing the necessary chemical equipment to attack physiological problems.

As the position gains strength on the physiological side, it will become possible to render more effective service to agriculture and other branches of economic botany.

This is of importance for a variety of reasons. Among others it will bring public support and recognition which will be all for good, and it will provide an outlet for our students. It will also afford unrivaled opportunities for experiments on the large scale. Even should economic conditions, which compel us to import every vegetable product, continue to prevail in this country, this will not be so in the colonies. As time goes on, one may reasonably expect an increasing demand for trained botanists, ready to turn their hands to a great variety of economic problems.

From this rough sketch we see that the prevailing school of botany has arisen very independently of that which preceded it. The discontinuity between them you might almost call abrupt. All through the middle parts of the last century we were so busy amassing and classifying plants that the great questions of botanical policy were left to solve themselves. Great herbaria became of the order of things: they received government recognition, and they continue their work apart. Those who built up these great collections neglected to convince the schools of the importance of training a generation of botanists that would use them. The schools were free, and they have gone their own way, and that way does not lie in the direction of the systematic botany of the herbarium. So long as this tendency prevails the herbaria must languish. When I say languish, I do not mean that they will suffer from inefficient administration—their efficiency probably has never been greater than at the present time. But the effort involved in their construction and upkeep is altogether disproportionate to any service to which they are put. Work, of course, comes out of them; it is no question of the devotion or ability of individuals. It is the general position, the isolation of systematic botany, to which attention should be directed with a view to its alleviation.

If things are left to take their course there is the fear of atrophy through disuse. The operation of the ordinary economic laws will no doubt serve to fill vacancies on the staff as they arise, but the best men will be reluctant to enter. Of course the pendulum may begin to swing the other way, though no indication of such a change is yet apparent.

Let us now attempt an analysis of some of the causes which have led to this condition of affairs.

In the first place, our two national herbaria (Kew and the British Museum) stand apart from the ordinary botanical current. They are administered, the one as a portion of the Kew establishment under the board of agriculture, the other as a department of the British Museum under a board of trustees. Neither has any connection, direct or indirect, with any university organization. The keepers and

[2] 'Incipient Vitality,' *New Phytologist*, Vol. V., p. 22.

assistants as such have no educational functions allotted them; I mean positions in these herbaria carry no teaching duties with them. There are no facilities for teaching; there are no students. No machinery exists for training recruits or for interesting anybody in the ideals and methods of systematic botany. A recent event illustrates my meaning better than any words. My friend Dr. Rendle accepted the keepership of the botanical department at the British Museum a few months ago. Previously, as assistant, he had held a lectureship at a London college. One of the first consequences of his new appointment was his retirement from the teaching post. Now that was bad. Under the conditions which one would like to see there would have been no resignation. On the contrary, the keepership should have entitled Dr. Rendle to promotion to a full professorship. I do not mean a great post, with elementary classes, organization, and so on, but one in which he would be occupied with his own branch, giving a course for advanced students, let us say, once a year during the summer months. Nor is that all. Such are the vagaries of our university organization in London that we run some risk of losing Dr. Rendle from the board of studies in botany. Automatically he ceases to be a 'recognized teacher,' and unless some loophole can be found the connection will be severed.

Next we come to the question of routine duties. These are heavy in herbaria, and must include a great many that could be satisfactorily discharged by handy attendants. As in the case of those who work in laboratories, half a man's time should be at his own disposal for original investigations. It is important, for a variety of reasons, that the members of the staff should take a leading part in advancing systematic botany.

Then there is another way in which a great economy could be effected in effort, time and money. This is the transfer of the collections and staff of the botanical department from the Museum to Kew. This is a very old proposal, first seriously entertained some fifty years ago after the death of Robert Brown. There must be endless files of reports and blue books in official pigeon-holes dealing with this question. The most recent report of a departmental committee is known to all interested in the matter. From the character of the evidence tendered it is not surprising that no action has been taken. I am at a loss to find any adequate reason for the continuance of two separate herbaria. It has been urged, no doubt, that botany would suffer if unrepresented in the museum collections at South Kensington, and that the dried collections and herbarium staff are a necessary adjunct to the maintenance of a botanical museum. But there is little force in the contention. The specimens that go to make a herbarium are not proper subject-matter for museum display; nor is there anything about herbarium work which intrinsically fits the staff to engage in the arrangement of museum cases. The function of a botanical museum is to interest, stimulate and attract. It should convey an idea of the current state of the science, and particularly of the problems that are to the front, in so far as it is possible to illustrate them. It requires a curator with imagination and ideas, as well as an all-round knowledge of his subject. He must also be an artist. Logically there is no reason why a museum should be part of the same organization as systematic collections. There is, indeed, a danger of making the museum too exhaustive. I am speaking, of course, of a teaching museum, which belongs really to the province of a university, or university extension if you

like. Systematic collections kept exposed under glass are luxuries. All the world agrees that the museum side is admirably done at South Kensington, and most people attribute this success to the systematic element which is paramount behind the scenes. But, as we have seen, this is a fallacy, and the 'museum argument' for keeping the herbarium at South Kensington may be ignored.

By the fusion of the herbaria at Kew one would look for increased economy and efficiency, more time for original work as distinguished from routine duties, and a more complete specialization.

We now approach another aspect of the question. Much has been said on the value of anatomical characters in classification, and it is pretty generally conceded that they ought to be taken into consideration, though, like other characters, they are beset with their own special difficulties. As Dr. Scott—who has always urged their importance—says:[3]

> Our knowledge of the comparative anatomy of plants, from this point of view, is still very backward, and it is quite possible that the introduction of such characters into the ordinary work of the herbarium may be premature; certainly it must be conducted with the greatest judgment and caution. We have not yet got our data, but every encouragement should be given to the collection of such data, so that our classification in the future may rest on the broad foundation of a comparison of the entire structure of plants.

This passage was written ten years ago and we are still awaiting its realization.

It is perfectly true that in the case of a recent proposal to found a new natural order of flowering plants anatomical characters find due consideration; still, on the whole, we are content to rely on the traditional methods that have been transmitted from Linnæus and the old taxonomists. So much material is always passing under the hands of our systematists that they can not devote the time for the elaboration of a fresh method. In particular there are the new things which require docketing and provisional description. Circumstances, as ever, place obstacles in our way and tend to make us unprogressive.

Now it seems to be of the first importance that reform should come from within; that these problems, which are systematists' problems, should be solved by taxonomic specialists.

I am sanguine enough to believe that much might be done by a redistribution of duties, especially if this were accompanied by the fusion of the great herbaria, to which reference has already been made. But the greatest hope, I think, must lie in the possibility of some form of alliance or understanding between the authorities responsible for the administration of the herbaria on the one hand and the local university on the other. For directly you give the keepers or assistants in the former a status in the latter, you place at the disposal of the systematists a considerable supply of recruits in the form of advanced students possessing the requisite training to carry out investigations under direction. And if this be true of the herbaria, it holds equally in all the branches of knowledge represented in the National Museum. Really I fancy our museum is rather anomalous in its isolation. I am confident that any understanding or arrangement that might be reached would be attended with great reciprocal advantage. Nor am I speaking without some data before me. The movement towards a closer relation between the museum and the university has already entered the experimental stage. For on several occasions during the last few years members of the museum staff, from more than one department, have

[3] D. H. Scott, presidential address, Section K, British Association for the Advancement of Science (1896).

given courses of lectures in connection with the university schemes of advanced study. From all I hear, the experiment may be regarded as distinctly encouraging.

Before leaving this subject it may be appropriate to recall that the English edition of Solereder's great work on systematic plant-anatomy is rapidly approaching completion, and should be available very shortly. Its appearance can not fail once more to arouse discussion as to the importance of anatomical characters. I hope the result produced may reward the devotion and labor with which Mr. L. A. Boodle and Dr. Fritsch have carried out their task.

In another and even more fundamental branch of systematic work the future seems brimful of promise. We are beginning to recognize that a vast number of the species of the systematist have no correspondence with the real units of nature, but are to be regarded rather as subjective groups or plexuses composed of closely similar units which possess a wide range of overlapping variability. That such might be the case was apparent to Linnæus, but the proof depends on the application of precise methods of analysis.

In the year 1870 our great taxonomist Bentham happened to meet Nägeli at Munich, and, as we find recorded in Mr. Daydon Jackson's interesting life, "had half an hour's conversation with him on his views that in systematic botany it is better to spend years in studying thoroughly two or three species, and thus really to contribute essentially to the science, than to review generally floras and groups of species." Bentham does not appear to have been convinced, for his comment runs: 'He is otherwise, evidently, a man of great ability and zeal, and a constant and hard worker.' At the time of this interview Bentham was seventy years old, Nägeli being seventeen years his junior. The views of the latter are now bearing fruit, as we see in the important results already obtained by de Vries and others, who are following the methods of experimental cultivation with so much success.

The supposed slowness of change has been a difficulty to many. This was one of the 'lions' left by Darwin in the way, and it has driven back many a 'Timorous' and 'Mistrust.' Now, as we are gradually perceiving, it is only a chained lion after all; a thing to avoid and pass by. The detection of the origin of species and varieties by sudden mutation opens out new vistas to the systematist, and along these he will pursue his way. It will take many years of arduous work, this reinvestigation of the species question. The collections of our herbaria form the provisional sorting-out from which we must start afresh. In the long run it may be that our present collections will prove obsolete, but that will not deter us. The scrap-heap is the sign and measure of all progress.

The garden thus becomes an instrument of supreme importance in conjunction with the herbarium, and that is another reason for the transfer of South Kensington to Kew. The resources of the latter could then be directed more fully than ever to the advancement of scientific botany, and the gardens would be revealed in a new light. For the operations and results of experimental inquiries would form a new feature, very acceptable to the specialist and public alike. And, as I am on the subject, it may not be out of place to remark that we all look forward eagerly to the time when the multifarious activities of Kew will permit the development of other features of which traces are already discernible. The arrangement of the living collections is at present based largely on horticultural convenience, geographic origin and systematic affinity, happily sub-

ordinated to an artistic or decorative treatment. In time we shall go further than that and attempt in some degree to reflect current botanical ideas in the grouping of our plants. Let me illustrate my meaning by a good example. The succulent house is generally conceded to form one of the most interesting and stimulating exhibits to be seen at Kew—not merely from the weird and grotesque forms assumed by the individual plants, but chiefly because here you have assembled together plants of the most varied affinity having the common bond of similar adaptations to a like type of environment. The principles that underlie the arrangement of the best sort of museum may be applied with advantage in the case of a garden, and with tenfold effect; for is not a live dandelion better than a dead *Welwitschia?* This feature, introduced as it would be with moderation and discretion, would immensely enhance the value of the gardens both to the student and general visitor.

But to return from this digression: on the whole the time seems ripe for the new departure. Fresh lines are opening up in systematic botany that call for special provision. Now it was evident from the circumstances of the botanical renaissance twenty-five years ago that when it acquired strength some readjustment between the old and the new would have to be made. The thing was inevitable. The administrative acts of recent years all point in the same direction. The founding of the Jodrell Laboratory, the enhanced efficiency of the gardens, the great extension of the herbarium building, all help to pave the way. But more is wanted. Reference has been made to the advantages that would attend the migration from the Natural History Museum. But it is most important of all to devise a mechanism for securing a flow of recruits to carry on the work. This would follow in the wake of a *rapprochement* with the schools on the lines already sketched out. Difficulties, no doubt, will be encountered in the initial stages of a reorganization, but these are inseparable from our bureaucratic system. A very hopeful sign is the readiness which the government has shown in instituting inquiries in the past. That nothing has come of them may be attributed primarily to the attitude of botanists themselves. If they can unite on any common policy, there should be no serious delay in giving it effect.

THE CORRESPONDENCE SCHOOL—ITS RELATION TO TECHNICAL EDUCATION AND SOME OF ITS RESULTS.[1]

AT the 1899 meeting of the Society for Promotion of Engineering Education, held at Columbus, Ohio, a paper was presented by Professor Edgar Marburg, entitled 'The Correspondence School in Technical Education.'[2] This paper aroused considerable interest, and was discussed quite generally, with the result that a committee on industrial education was appointed, of which Professor J. B. Johnson was chairman. This committee reported at the New York meeting in the following year.[3]

At the time Professor Marburg prepared his paper the total number of students enrolled in the International Correspondence Schools was about 80,000, and at the time the committee made its report the number of students enrolled was about 181,000. It was impossible at that time to furnish reliable figures in regard to the work being

[1] Read at the Ithaca meeting of the American Association for the Advancement of Science, June 30, 1906, before Section D, Mechanical Science and Engineering.

[2] *Proceedings of the Society for the Promotion of Engineering Education*, Vol. VII., p. 80.

[3] *Proceedings of the Society for the Promotion of Engineering Education*, Vol. VIII., p. 28.