

pertains also to white light, and which produces the green coloring matter of leaves or bleaches them, according to its intensity. It is these, also, which change the coloring matter of flowers when it has been dissolved in water or alcohol. (1) Those rays called chemical, such as violet, and the invisible rays beyond violet, according to recent experiments, confirmatory of those of ancient authors—those of Sebastian Pogglioli, in 1817, (2) and of C. M. Guillemin—have but one single well-ascertained effect, that of favoring the bending of the stem toward the quarter from which they come more decidedly than do other rays; yet that is an effect perhaps more negative than positive, if the flexure proceeds, as many still believe, from what is going on on the side least exposed to the light. (3)

The effect upon vegetation of the non-visible calorific rays at the other extremity of the spectrum have been but little studied. According to the experiments we have on this subject, they would appear to have but little power over any of the functions; but it would be worth while to investigate further the calorific regions of the spectrum by employing Dr. Tyndall's process, that is, by means of iodine dissolved in bisulphid of carbon, which permits no trace of visible light to pass.

How interesting it would be to make all these laboratory experiments on a large scale! Instead of looking into small cases, or into a small apparatus held in the hand, and in which the plants cannot be well seen, the observer would himself be inside the apparatus, and could arrange the plants as desired. He might observe several species at the same time, plants of all habits, climbing plants, sensitive plants, those with colored foliage, as well as ordinary plants. The experiment might be prolonged as long as desirable, and, probably, unlooked-for results would occur as to the form or color of the organs, particularly of the leaves.

Permit me to recall on this subject an experiment made in 1853 by Professor Von Martius. (4) It will interest horticulturists now that plants with colored foliage become more and more fashionable. Prof. Von Martius placed some plants of *Amaranthus tricolor* for two months under glasses of various colors. Under the yellow glass the varied tints of the leaves were all preserved. The red glass rather impeded the development of the leaves, and produced at the base of the limb yellow instead of green; in the middle of the upper surface, yellow instead of reddish-brown, and below, a red spot instead of purplish-red. With the blue glasses, which allowed some green and yellow to pass, that which was red or yellow in the leaf had spread, so that there only remained a green border or edge. Under the nearly pure violet glasses the foliage became almost uniformly green. Thus, by means of colored glasses, provided they are not yellow, horticulturists may hope to obtain at least temporary effects as to the coloring of variegated foliage.

The action of electricity on foliage is so doubtful, so difficult to experiment upon, that I dare hardly mention it; but it can easily be understood how a building constructed as proposed might facilitate experiments on this subject. Respecting the action of plants on the surrounding air, and the influence of a certain composition of the atmosphere upon vegetation, there would be by these means a large field open for experiments. Nothing would be easier than to create in the experimental hothouse an atmosphere charged with noxious gas, and to ascertain the exact degree of its action by day and by night. An atmosphere of carbonic acid gas might also be created, such as is supposed to have existed in the coal period. Then it might be seen to what extent our present vegetation would take an excess of carbon from the air, and if its general existence was inconvenienced by it. Then it might be ascertained what tribes of plants could bear this condition, and what other families could not have existed, supposing that the air had formerly had a very strong proportion of carbonic acid gas.

Until horticulture can supply physiology with such convenient means of experiment, it, in the meantime, advances descriptive botany by the valuable publications it issues. The greater part of the old works with plates, such as "*Hortus Eystettensis*," "*Hortus Elthamensis*," &c.; also those of Ventenat, Cels, Redouté, &c.; the *Salicetum* and *Pinetum* of the Duke of Bedford; and more recently the

"*Rhododendrons of the Himalaya*," by Dr. Hooker; the works of Bateman, Peacott, Reichenbach fils, on Orchids; and many others I could name, would never have existed, had there not been rich amateurs either to edit or buy them.

It is horticulture that has given us the longest series of illustrated journals that have ever been published; and here I must do justice especially to the English horticulturists. No doubt the science of our time requires a larger amount of analytical details than is contained in the plates of the "*Botanical Magazine*," "*Botanical Register*," "*Andrews' Repository*," "*Loddiges' Botanical Cabinet*," "*Sweet's British Flower Garden*," "*Paxton's Magazine and Flower Garden*," and other English journals; but what a number of forms are thus fixed by the engravings in these books, and what a fund of valuable documents for consultation they afford. One must admire the "*Botanical Magazine*," commenced in 1793, continued from month to month with an exemplary regularity, and which is now at its 5580th plate. Not only has it always represented rare and new species, but it has ever been conducted on a simple and uniform plan, which renders it convenient to consult.

The series of plates is unique from the very beginning. Each plate has its number, and each article of letter-press refers only to one plate, by which means the quotations from the work are rendered brief and clear. Many editors have not understood the advantage of this simple arrangement. They have varied their titles, their series, their pagings; they have affixed to their plates numbers, then letters, then nothing at all; the end of which is (and this ought to serve as a warning for the future) that the more they have altered and complicated the form of their journals, the shorter time they have lasted.

How is it that these purely bibliographical details cause in us such sad recollections? Of the men just mentioned, who have rendered such eminent service to botany and horticulture, England has lost three during the year 1865—Sir Joseph Paxton, Dr. Lindley, and Sir William Jackson Hooker. (1) I should certainly fail in what is expected of me if I did not express, in the name of the foreigners attending this meeting, our deep regret at such serious losses. We know them all by their writings, and many among us have known personally the distinguished men I have mentioned. Their names follow us at each step in this the scene of their labors. If we admire the boldness of construction of the iron domes that characterize modern buildings, we think of the Crystal Palace, of Chatsworth, and of the humble gardener who became a great architect. If we visit the beautiful establishment at Kew, we see everywhere around us proofs of the indefatigable activity of Sir William Hooker. Lastly, if we ask the origin of the garden of the Royal Horticultural Society at Kensington, we are told it is only a development of that at Chiswick, where Lindley stood preëminent by his knowledge and his energy; and of that Society where botanists of my age found in their youth such valuable encouragement in their studies.

The names of Sir William Hooker and of Dr. Lindley, thanks to their special works, will ever remain distinguished in science. These two botanists have, moreover, been directors of horticultural journals, and of great horticultural establishments, and since their influence has been so fully acknowledged by practical men, I shall have little trouble in showing that science is as useful to horticulturists as horticulture is to botanists—and this will form the second part of my discourse.

2. *The advantage of Botany to Horticulture.*—The principles of vegetable physiology are what horticulturists and agriculturists usually study in books on botany. They do not always find direct answers to their questions; but they can draw from them certain rules, certain ways of experimentalizing and reasoning, which saves them from falling into many errors. Should some ridiculous idea be promulgated by some ignoramus or charlatan, it is by an appeal to the general rules of physiology that a practical man may at once reject them, or, at least, hold them in distrust. On the contrary, innovations, if in harmony with the principles, may be, and I will even say ought to be, readily accepted.

Do not let us put too much faith in the lucky results of experiments made absolutely by chance. It is with some of these experiments as with dreams and presentiments—if they come true once in a thousand times they are talked about, otherwise they are passed over and forgotten. Besides, it must be said, men nearly always are guided by theories; but the theories of the ignorant are often absurd and without foundation, while those of educated men are based on probabilities, or on an accumulation of facts.

(1) Since these lines were in the printer's hands, British science has sustained a severe loss in the death of the truly amiable and learned Professor W. H. Harvey, of Dublin, so well known by his works on *Alga*, and on the botany of South Africa. I cannot refrain from expressing our sense of this great bereavement.

(1) Sir John Herschell, *Edinb. Phil. Journ.*, January, 1843.

(2) S. Pogglioli, *Opuscoli Scientifici*, quoted by Dutochet, *Compt. Rend. Acad. Sci.*, 1844, sem. 1, p. 850.

(3) The rather confused and questionable explanations, founded on the notions of Dutochet, of the existence of a deoxygenizing power on the brightest side, clash with the fact that the blue, indigo, and violet rays, the least powerful for deoxygenizing tissues, are the most powerful in causing them to bend.

(4) "*Gelehrte Anzeige*," München, Dec. 5, 1853.