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XXXV.—*On the Life and Writings of J. P. E. Vaucher.*
By ALPHONSE DECANDOLLE.

[Concluded from p. 163.]

IN general M. Vaucher distinguishes two species of fecundation, one direct, the other indirect. In the first, the grains of pollen are immediately applied or fall from the anther on the stigma. This is the case with tulips, rushes, *Petunia*, *Myriophyllum*, &c.

In the second case, the grains of pollen at first fall on other parts of the flower, and then act on the stigma in an indirect (*détournée*) manner, which he expresses vaguely by the word *émanation*, or by analogous terms. In the indirect fecundation, it often appears to him that the hairs of the interior of the corollas contribute, with the nectar, to determine the action of the pollen. Here are some examples:—

“The bottom of the flowers of the *Lagenaria* is a melliferous basin, formed by the depression of the torus, and which supplies the honeyed matter in such abundance, that it rises between the stamens and bathes their summits. . . . Fecundation takes place more easily in the *Lagenaria* than in the other *Cucurbitaceæ*, because the limb of their corolla is horizontally disposed; nevertheless, as the anthers and the pistils continue entirely merged (*engagés*) in the tube, there can be scarcely a doubt but that it takes place by means of the glutinous and moist hairs which cover the interior part of the petals, and to which the pollen at first attaches itself, whose globules bursting transmit their *émanations* to the stigma. After fecundation the corolla closes, and the honeyed humour issues in abundance out of the cup, for the purpose of bathing the stigma entirely and accomplishing the impregnation. This manner of fecundation applies to the greater part of the *Cucurbitaceæ*.”

In speaking of the genus *Clematis*, M. Vaucher remarks a lateral rather than an extrorse position in the anthers, as is
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generally described in the true *Ranunculaceæ*. He adds that the *C. integrifolia* has introrse anthers, which is perfectly accurate. "The exterior stamens open first, and spread themselves backwards (*s'écartent*), after having scattered their whitish powder, which falls abundantly to the bottom of the flower. The others take their place and elongate in their turn. The stigma is always an enlarged ligula (*languette*), papillose and turned outwards. I am not aware that I perceived any nectariferous organ; but I have often remarked, especially in the *C. Vitalba*, *cirrhus*, &c., honeyed drops adhering to the filaments of the stamens. In those species whose styles are hairy, the hairs without doubt serve to retain and to preserve the pollen for a longer time; but in the *Vilicella* with drooping flowers, where the styles, almost always smooth, are placed in close juxtaposition, the anthers, which are exactly lateral, turn back the edges of their walls (*parois*) in order to cast their pollen on the stigmas; and gradually as they shed their pollen they fall back to make way for others situated more interiorly, which also turn themselves backwards in a similar manner. In the *Flammula* with erect flowers, whose extrorse lateral anthers do not elevate themselves above the stigmas ordinarily arranged in close juxtaposition, the fecundation appeared for a long while inexplicable, or, if I may venture so to speak, badly contrived, until I discovered the singular manner in which it was effected. The sepals are felt-like, and have their interior covered with moist and glandular hairs, which are the agents in effecting it; for this purpose they receive the pollen immediately from the anthers, which with their filaments fall after shedding their pollen; at the same time the stigmas, wonderfully papillose, cast themselves down, and turn about in different directions for the better reception of the molecules of the pollen; as may be seen in the *Flammula*, the *Vitalba*, and especially in the *orientalis*."

The flowering of the *Garidella Nigellastrum* is described in the following manner:—"At the epoch of fecundation the stamens are curved over the centre of the flower, and their anthers cover the as yet undeveloped stigmas (*stigmates non encore conformés*). In this situation they open their walls (*parois*) from bottom to top, so that their pollen, always adherent, is situated exteriorly and out of all contact with the stigmas. It can then only scatter itself on the swollen and glutinous hairs at the summit which cover the bilabiate petals or nectaries, and by which it is retained. It is then afterwards, and only when the anthers in withering have uncovered it, that the bi-

labiate and at that time papillose stigma can in my opinion receive the fecundating dust; moreover this stigma is very short."

I quote these observations on the flowers of some plants in the author's own words, not for the sake of adhering to his theory on the action of the nectar, with which I think he is rather too much possessed, but to show the use which may be made of his book. In it we find accurate descriptions of the situation of the nectariferous glands, of the evolution of the floral organs, of their relative approximation, of the epoch when the pollen issues from the anthers, &c., things very important, but until the present time little known. This is the true service which M. Vaucher has rendered to science. As to the indirect fecundation by the nectar, I confess that I feel doubts in the greater part of the cases, as he himself acknowledges with much sincerity in some of the examples* of which he speaks. I cannot comprehend how grains of pollen, opening in the nectar at the bottom of the flower, can get upon the stigma; I see that the rupture of the grains of pollen by any other liquid than the viscous humour of the stigma, for example by the rain, is a vexatious accident, which hinders the fecundation; in short, I do not comprehend why certain plants with direct fecundation, according to M. Vaucher himself, are provided with nectaries, and produce a very abundant honeyed humour†. Had we been so happy as to have had M. Vaucher amongst us after the publication of his book, I should have submitted these scruples to him, and with his usual honesty and sincere desire to ascertain the truth, he would have removed or adopted them.

The respect which I feel for his memory cannot be combined with a disguise which he detested. I therefore do not conceal my doubts. If fresh observations, directed by the work of our ingenious countryman, should lead me to his opinion, I shall hasten to avow it. However, the attention of botanists is awakened to this class of phenomena, and this alone is a service rendered by M. Vaucher.

Observations of another kind, and very various, are also to be found in his work. The following are some taken at hazard:—"When at the end of the summer we visit the running or tranquil waters which the *Myriophylla* inhabit, we see their bare stems stretched in long cords on the surface of these same waters whose level is lowered. We then find that their roots of the year are destroyed, and that others have succeeded them, and we easily recognise underneath the new stems the

* Vol. i. pp. 60, 62.

† It is the case with the tulips and the crown imperial.

point of rupture of the old ones. These plants are also reproduced in two other ways: first, by natural slips (*boutures*), as the greater part of aquatic plants; and also in the manner of the *Utriculariæ*, by their sterile stems. At the end of summer, indeed, we see the tops of these stems forming a dense bud of undeveloped leaves, destitute of stipules and scales, but copiously covered with a resinous varnish: now this bud, which we should suppose destined to prolong the stem, on the contrary becomes detached from it, and in spring-time develops on one side leaves and on the other roots."

In the *Nymphæaceæ* the seeds germinate near the surface of the water at the beginning of spring.

The *Melampyrum pratense*, *arvense* and *sylvaticum* turn their flowers towards the light, which is not the case with *Melampyrum cristatum*. There is a similar observation on the *Narcissi*, the flowers of which incline towards the light by a double movement, that of the pedicel which bends, and that of the peduncle which twists. During maturation the pedicel and the capsule become erect, but the peduncle remains twisted.

"The most remarkable characteristic of the genus *Alstræmeria* is the tendency of the leaves to twist upon their petioles; and what is singular in this is, that they have been predisposed for this arrangement, for, contrary to others, their upper surface is dull and whitish, whilst the lower surface is shining and of a fine green colour. This singularity, which pertains in different degrees to all the *Alstræmeriæ*, is so independent of temperature and of various atmospheric circumstances, that these leaves, twisted at the base, do not unroll when they are plunged into water."

The capsule of *Cerastium*, at first ovoid, lengthens insensibly, and finally becomes a tube more or less curved in the form of a trumpet, and ordinarily divided into a number of teeth double that of the styles. This singular conformation serves in the first instance to protect the seeds, and afterwards favours their dissemination instead of hindering it. The walls of the curved tube are in fact so thin and so elastic, that on the least agitation of the air, and sometimes even in the calmest weather, the seeds may be seen to escape by sliding rapidly along the tube, whose structure increases the movement. I have often tried to follow them with a magnifying glass, but they always escaped me by their extreme rapidity. We may assert that they are projected by an unknown power.

"The bulbs of *Orchis* are placed alternately right and left, so that they cannot be truly said to advance always on the same side, since, on the contrary, they constantly occupy the

same place. The gemma, or point whence the new plant proceeds, is situated near the summit, and at the side or rather at the summit of the bud of the year; thus the *Orchis* is a plant which never dies.

"The *Neottia nidus-avis* often grows in the midst of the remains of half-decomposed leaves, and this is the reason it was for a long time considered a parasite; but I found its form of reproduction in the middle of the plexus of its cylindrical radicles. In fact, when we examine these roots, which in their general appearance resemble a bird's nest, we see some amongst them lengthen and branch out in the form of a star at the summit, in order to put forth from this star-shaped centre a small conical stem entirely covered with undeveloped radicles; it is this stem, already swollen into a bulb and remarkable for its whiteness, which is destined to form the new plant of the new year, and this is the reason why the *nidus-avis* grows several together, and does not remain solitary as do most of the *Orchideæ*. From the month of August we see its dried-up stem ruptured at the base, and its non-proliferous radicles perished, whilst the others elongate and grow. From this dead plexus in short proceed one, two, three, or even four new gemmæ destined to flower the following year. Independently of this reproduction by the roots, the *nidus-avis* often sends forth a leaf-bud at its base, which is to produce a new stem."

I might multiply these quotations, but I am averse to mangle a work which forms a whole, and I prefer inducing botanists to consult it. At first they will find that the new facts are scattered in the midst of things known and of descriptions or characters borrowed from other writings; but they will soon remark how much the order followed by the author, and the tables which he has added, render inquiry easy. We ought to premise that M. Vaucher does not strictly limit himself to the plants of Europe, and that he also frequently speaks of cultivated genera, particularly those in the Botanic Garden of Geneva.

The varied observations of M. Vaucher, on the successive phenomena of the vernalion of the leaves, of the flowering or of the dissemination of the seeds, often tend in their results to confirm the division of genera into natural sections. These groups, which the author sometimes calls types, sometimes according to general custom sections, appear to him as a necessity proceeding from physiological facts. Descriptive botanists establish them according to the configuration of organs, which it is easy to ascertain in the herbarium. It is not surprising that the same results should be obtained from these

two points of view apparently so different. The functions, indeed, result from the presence and from the nature of the organs. If the causes differ between two groups of species, the effects must also differ. Two groups may therefore be recognised as well by the effects as by the causes, by the successive development of the phenomena as well as by a careful analysis of the internal organization*. M. Vaucher's mode of procedure, which consists in observing the physiological actions of the organs, possesses the advantage of confirming, by a process inverse to the ordinary one, the greater part of the sections proposed by M. DeCandolle in the 'Prodromus,' and by other botanists who have imitated his division of genera into natural sections. When M. Vaucher has distinguished two groups or types amongst the species corresponding to one of the sections of the 'Prodromus,' which occasionally happens, botanists should pay attention to this: more probably there exist differences of structure evidenced by the two modes of fecundation or of dissemination, and consequently another section to be distinguished in the genus. In this point of view the perusal of M. Vaucher's book deserves to accompany that of works of descriptive botany. It should confirm or invalidate our classifications by indications which the sight of herbaria cannot give, and which the observation of living plants has not as yet sufficiently confirmed.

The method employed by M. Vaucher will, we hope, elicit further results. It will certainly be used by persons who have a taste for botany, but who do not possess the necessary resources in books and herbaria to enter upon every part of the science. Agriculturists residing in the country, sedentary persons or invalids, who are obliged to concentrate their observations on the plants of their garden, will find great interest in this mode of study, and will be enabled to contribute their contingent of new observations to botany in general. In the immense picture of nature there is as much to see in the depth as on the surface. Subjects of study are not wanting, and in natural history a good observation is always useful. Without doubt the crowd of amateurs will always content themselves with the names of plants, because inferior minds are satisfied with words in all things; but a certain number of more inquisitive men will be disposed to follow M. Vaucher over the ground of his detailed physiological observations. To them we will recommend the following questions, which require neither herbaria, nor a considerable library, nor a mi-

* These remarks of M. Alph. DeCandolle are particularly deserving of the attention of the student.—Ed.

croscope, and which nevertheless are not yet solved, or have not even been touched upon.

1. To sow varieties of pears, apples, vines, &c., well known, well verified and protected from increase by transfer of pollen, in order to know which are the qualities that are preserved by seed, during how many generations, and with what degree of constancy they keep themselves distinct. It is clear that complete descriptions of the plant must be made at each generation, and that drawings or models in wax of the fruit obtained must be preserved. The young and persevering, or those who leave after them children endowed with the spirit of observation, may study this important question, the consequences of which in natural history, both theoretical and practical, are incalculable.

2. To make similar observations on cultivated annual or biennial species, when there is no hope of seeing the fruit of sown trees ripen.

3. To verify the duration of the faculty of germination in seeds, not only in the air, but also in fresh and in salt water. Experiments made in sea-water would possess great interest, by showing what plants may possibly have been transported by marine currents to great distances, and what plants must have originally sprung up in the isles wherein they now grow. It would be necessary to extend these experiments to a great number of species of different families.

4. To describe plants in the following manner, which would complete existing botanic works. On the examination of each species to read the description of two or three of those classical works which are in every amateur's library, and at the same time M. Vaucher's book; then to add all that is wanting. It would be seen that in general the most common species are not known in all respects; that, for example, the veneration of the leaves has been overlooked, or their disposition on the stem according to the modern methods, or their inflorescence, or æstivation, or any other of those characters on which attention has been fixed since the time of the publication of certain fundamental works.

5. To note down every year not only the period of flowering which has often been remarked, but also that of the foliation, of the ripening of the fruits, of the fall of the leaves, and even, when it is possible, of the ascending sap in spring and in summer. Good and long-continued observations of this kind would approximate to tables of temperature; in short, we should know the heat necessary for each function in each species, and thence many applications to agriculture and to geographical botany.

Some of these questions comprise several others. To solve them two things only are necessary, accuracy and perseverance. M. Vaucher has afforded us an example of both these qualities. His history of the *Confervæ* is remarkable for its precision in the explanation of new and delicate facts. His last work required the average duration of man's life, and we may say, in general, that during sixty years M. Vaucher rarely turned aside from botany. From it he derived lively gratification; the result of his works has enriched the science; let us hope that others may endeavour to imitate him, and let us ever religiously preserve the memory of a philosopher so well entitled to our respectful recollection. ALPH. DEC.

XXXVI.—On some hitherto unnoticed peculiarities in the Structure of the Capsule of *Papaveraceæ*; and on the Nature of the Stigma of *Cruciferae*. By J. W. HOWELL, Esq., M.R.C.S.

THE capsule of *Papaver* apparently bears so close a resemblance to that of *Nymphaea*, that it forms one of DeCandolle's reasons for considering the *Papaveraceæ* and *Nymphaeaceæ* to be allied*. The capsule in each genus is syncarpous, with ovuliferous dissepiments, and is crowned with a many-rayed stigma, the number of rays corresponding to that of the dissepiments. The chief structural difference hitherto observed between these capsules consists in that of *Nymphaea* being composed of several carpels surrounding the axis, and having the dissepiments formed by the juxtaposition of the ovuliferous sides of the perfect cells with intermediate plates of connecting cellular tissue; whilst in *Papaver* the inflected sides of the conjoined carpels not being continued to the axis, the imperfect ovuliferous dissepiments project only midway into the cavity of the capsule, and thus leave it one-celled.

On a more attentive examination, however, a difference will

* "Ob structuram fructus et stigmati *Papaveri* valde similem."—Regni Veget. Syst. Nat. vol. ii. p. 42.

This similarity of structure is repeatedly alluded to by this author; thus, in "*Nymphaeaceæ*—Styli * * * connati stigmatibus supra urceolum peltatum (exactè ut in *Papavere*) radiatis basi connatis apice liberis," vol. ii. p. 39. Again: "* * * structura fructus *Papaveris* parum recedit a vera *Nupharis* structura," p. 43. Again: "*Papaveraceæ* accedunt hinc mediante *Papavere* ad *Nymphaeaceas*," p. 68.

In 'Flora Franc.,' DeCandolle included *Nymphaea* and its immediately allied genera in *Papaveraceæ*, in which this great botanist followed the example of Linnaeus, who had previously referred *Nymphaea* to his twenty-seventh Order, *Rhæadeæ*, which very nearly corresponds with the *Papaveraceæ* of modern authors.