## III. Botany and Zoology.

1. C. Darwin. *The Different Forms of Flowers on Plants of the same Species.* (London, Murray; New York, D. Appleton & Co. 1877.) 12mo, 352 pp.—Circumstances have prevented an earlier notice of this volume, Mr. Darwin's last work upon the fertilization of flowers, the English edition of which was issued last summer, and the American reprint was not far behind. Although we ought to call attention to it, for the benefit of our general readers, and of the numerous local botanists of our country who have little access to foreign publications, yet the duty of reviewing the present volume was not urgent, as regards scientific novelty. For it is to a great extent a reprint, with alterations and considerable additions, of articles published some years ago in the Journal of the Linnæan Society, which excited much interest at the time, and the topics have become a part of our common knowledge. Still Mr. Darwin could not take up and reprint these papers without adding something to their value, and without making emendations or indicating qualifications. He adds, moreover, succinct notices of what has been done by others in the same field.

Six of the chapters relate to dimorphous blossoms, such as those of Primrose and *Houstonia*, including also the trimorphic cases, as of *Lythrum Salicaria* and some species of *Oxalis*. The seventh chapter discusses Polygamous, Dicœcious, and Gyno-Dicœcious Plants; the eighth and closing chapter is devoted to Cleistogamous Flowers.

For the dimorphous and trimorphous forms,—which needed a general appellation, and one to indicate the difference in the sexual organs themselves (calyx, corolla, etc., being alike in the two sorts),—Mr. Darwin adopts Hildebrand's term of *heterostyled*. When this term came to our notice as one intended for settled use, we took the opportunity in this Journal, a year ago, to suggest a fitter name, one which equally avoids the ambiguity of the older term, *dimorphous*, by indicating that the difference is in the stamens and pistils, not in the floral envelopes, and avoids the erroneous implication of the term *heterostyled*, that the style is only or mainly concerned. That is, we proposed the term *heterogone* or *heterogonous*. We were too late to ensure its adoption in this work. A fairly good term once in use ought not to be exchanged for a new one without very sufficient reason; and for the present purpose the term *heterostyle* is well enough. But the time has arrived when this peculiarity of structure must be indicated in descriptive botany as a part of the character of the genera or species which affect it: and here the inconvenience or equivocation of the phrase *Flores heterostyli* will sometimes be manifest. We think it probable that our term may find its place in systematic botany, and that we shall write *Flores hermaphroditi*, *heterogoni*, *monœcei*, *dicœcei*, *gyno-dicœcei*, *polygami*, as the case may be.

One good set of terms for phytography we owe to Mr. Darwin and the present book, i. e., that of *gyno-dicœcious* and *gyno-monœ-*

*cious*, for the case of those plants which produce their two kinds of blossoms as hermaphrodites and females, either on distinct individuals or on the same plant. So, likewise, the term *andro-monœcious* and *andro-diœcious* for the case of hermaphrodite and male flowers, on the same or on separate individuals. As to andro-diœcism, Mr. Darwin remarks that, after making enquiries from several botanists, I can hear of no such cases. The last summer brought one such case to light in our Cambridge Botanic Garden, perhaps exceptionally, but it raises the inquiry whether *Diospyrus Virginiana*, our Persimmon tree, may not be of this character. A solitary female tree here, and with no male tree in the town, sets fruit more or less in most seasons; but the persimmons are undersized and seedless. This year it was loaded with full-sized fruit, well furnished with seeds, the latter with a good embryo. The female flowers always bear stamens; but these are generally thought to be impotent; perhaps they usually produce some pollen; they doubtless did so upon this occasion.

As Mr. Darwin asserts, it would be convenient, and conduce to clearness, to restrict the Linnæan (and as now used loose) term *polygamous* to the species in which hermaphrodites, males, and females co-exist. This may occur in two ways, and possibly in three. The English Ash, as he remarks, is triœcious, or has the three kinds on as many individual trees; while some Maples bear all three on the same tree.

If we rightly read a statement on p. 10, it implies that proterandry and proterogyny are known to occur only in "some few hermaphrodite plants." But it can hardly mean that, cases of it being common and obvious in many natural orders.

The first chapter of this volume is devoted to *Primula* and its allies; the second, to hybrid Primulas, mainly to the Oxlip, which is shown to be a spontaneous hybrid between the Cowslip and the Primrose. A note is added on some wild hybrid Verbascums, specially those between *Verbascum Thapsus* and *V. Lychnitis*, which cross with the greatest facility, and produce a series of forms which almost connect these two widely distinct species, yet the hybrids of the first generation are almost wholly self-sterile. Such cases as this and that of the Oxlip, which was formerly thought to prove that the Cowslip and the Primrose were mere varieties of one species, show, as Mr. Darwin remarks, "that botanists ought to be cautious in inferring the specific identity of two forms from the presence of intermediate gradations; nor would it be easy in the many cases in which hybrids are moderately fertile, to detect a slight degree of sterility in such plants growing in a state of nature and liable to be fertilized by either of the parent species."

The third chapter takes up in succession other heterogone dimorphous flowers, particularly those of some species of Flax, and of *Houstonia*, *Mitchella*, and other *Rubiaceæ*. The fourth chapter discusses the trimorphous flowers of the same category, notably of *Lythrum Salicaria*, of which we gave an abstract when this

striking case was first brought to light. Our *Nesæa verticillata* is also referred to, the trimorphous species of Oxalis considered, and finally *Pontederia*, the only monocotyledonous genus now known to be heterogone. The trimorphism in this genus was detected a few years ago by Fritz Müller in Brazil; also recently, in *P. cordata*, our common Pickerel-weed, by Mr. Leggett of New York. Chapter VI is a detailed discussion of experiments on the illegitimate offspring of heterogone flowers; i. e., offspring produced by breeding within the limits of the same form, short-styled with long-stamened, or the converse. The conclusion is that in all points "the parallelism is wonderfully close between the effects of illegitimate and hybrid fertilization. It is hardly an exaggeration to assert that seedlings from an illegitimately fertilized heterostyled plant are hybrids formed within the limits of one and the same species. This conclusion is important; for we thus learn that the difficulty in sexually uniting two organic forms, and the sterility of their offspring, afford no sure criterion of so-called specific distinctness. "If one were to cross two varieties of the same form of *Lythrum* or *Primula* for the sake of ascertaining whether they were specifically distinct, and he found that they could be united only with some difficulty, that their offspring were extremely sterile, and that the parents and their offspring resembled in a whole series of relations crossed species and their hybrid offspring, he might maintain that his varieties had been proved to be good and true species; but he would be completely deceived." The cause of this sterility between individuals which may have sprung from the very same parent or parents and from the same capsule, must evidently be in their reproductive organs only, and in some recondite incompatibility of their sexual elements, not in any general difference of structure or constitution. And Mr. Darwin effectively argues that the same holds in case of distinct species of the same genus. "We are indeed led to this same conclusion," he adds, "by the impossibility of detecting any differences sufficient to account for certain species crossing with the greatest ease, whilst other closely allied species cannot be crossed, or can be crossed only with extreme difficulty. We are led to this conclusion still more forcibly by considering the great difference which often exists in the facility of crossing reciprocally the same two species; for it is manifest in this case that the result must depend on the nature of the sexual elements, the male element of the one species acting freely on the female element of the other, but not so in a reversed direction." Sterility of hybrids ceases to be a criterion of species.

The 6th chapter follows up the subject in a series of concluding remarks. It refers to those cases of more or less marked reciprocal differences in stamens and style which are unaccompanied by any difference in size or form of pollen-grains; and it tabulates the difference in pollen-grains of the two sorts. "With all the species in which the grains differ in diameter, there is no exception to the rule, that those from the anthers of the short-styled

form, the tubes of which have to penetrate the longer pistil of the long-styled form, are larger than the grains from the other form." "This curious relation led Delpino (as it formerly did me) to believe that the larger size of the grains is connected with the greater supply of matter needed for the development of their longer tubes." But it proved that, in many cases where the pollens differ much in size, the styles differ moderately in length, and *vice versa*, and that in plants generally, there is no close relationship between size of pollen and length of style (the grains being of the same size in *Datura arborea* and in Buckwheat, while the style of the one is nine inches long and of the other very short); yet still "it is difficult quite to give up the belief that the pollen grains from the longer stamens of heterostyled plants have become larger in order to allow of the development of longer tubes." A list of the genera, thirty-eight in number, positively known to be heterogonous is given. They belong to fourteen orders; but almost half the genera belong to the order *Rubiaceæ;* with the exception of *Pontederia*, they all have regular corollas, and all depend on insects for fertilization. "Plants which are already well adapted by the structure of their flowers for cross-fertilization by the aid of insects often possess an irregular corolla, which has been modeled in relation to their visits; and it would have been of little use to such plants to become heterostyled. We can thus understand why it is that not a single species is heterostyled in such great families as the *Leguminosæ*, *Labiatæ*, *Scrophulariaceæ*, *Orchideæ*, etc., all of which have irregular flowers."

Chapter VII relates to Polygamous, Diœcious, and Gyno-diœcious plants. A few genera are mentioned which have probably passed on from the heterogone condition to the diœcious. *Coprosma* is perhaps the best marked case; and *Mitchella* and *Epigæa* show tendencies in the same direction. On the other hand, Mr. Darwin's observations on *Euonymus Europœus* are "very interesting, as showing how an hermaphrodite plant may be converted into a diœcious one." *Rhamnus lanceolatus* shows the same thing more incipiently. Of Gyno-diœcious plants, which bear hermaphrodite and female flowers, but no separate males, and which show no obvious tendency towards diœcism, the principal illustrations are from *Labiatæ*, such as Thyme, *Nepeta Glechoma*, Mint, etc.

The eighth and last chapter is devoted to Cleistogamic flowers. All ordinary cases of two kinds of flowers are evidently arranged to favor or secure cross-fertilization. But there is a good number of plants, such as most Violets, which besides their ordinary and showy blossoms, produce others which fertilize and fructify without opening. These are always small and inconspicuous; and they so much resemble early flower-buds of arrested development that we were accustomed to designate them as flowers precociously fertilized in the bud. In some if not most cases this would be a quite correct representation of them; and there are well known instances in which—at least in cultivation—the earlier

of the ordinary flowers self-fertilize without expanding or fully completing their development; but in others these comparatively minute and ever closed flowers are profoundly modified structurally in reference to their function. Dr. Kuhn, in 1867, gave them the appropriate name of *flores cleistogami*, *cleistogamic*, or as we prefer *cleistogamous* flowers. The literature of the subject may mostly be gathered from this chapter, in which all that is known of these blossoms is condensed. We cannot here attempt a recapitulation. In brief, "they are remarkable for their small size and from never opening, so that they resemble buds; their petals are rudimentary or quite aborted; their stamens are often reduced in number, with the anthers of very small size, containing few pollen-grains, which have remarkably thin transparent coats, and which generally emit their tubes while still enclosed within the anther-cells; and lastly the pistil is much reduced in size, with the stigma in some cases hardly at all developed. These flowers do not secrete nectar or emit any odor. . . . Consequently insects do not visit them; nor if they did could they find an entrance. Such flowers are therefore invariably self-fertilized; yet they produce abundance of seed." Indeed they are far more fertile than the ordinary flowers of the species, which are apt to be sterile. The latter are in most cases adapted to the visits of insects; in some, such as Orchids, they are dependent upon this agency for such fertility as they possess.

Cleistogamous flowers are known in about twenty-four natural orders, yet not in a large number of genera. The list given by Kuhn, and corrected and extended by Darwin, is likely to be enlarged; but in one particular it may be diminished, for *Ruellia*, *Dipteracanthus*, and *Cryphiacanthus* are really all of one genus. We can add another genus and natural order to the list. For, while writing this notice, Mr. C. G. Pringle, of Charlotte, Vermont, calls our attention to its occurrence in *Dalibarda repens*, of the order *Rosaceæ*, and sends excellent specimens which exemplify it. This should confirm the genus, which, as restricted to its original and proper species, and irrespective of this newly-discovered peculiarity, surely ought not to be combined with *Rubus*.

Cleistogamy is an arrangement to secure a certain and abundant supply of seeds with the least expenditure; it is a corrective of or guard against the dangers of cross-fertilization dependent on either winds or insects; but no cleistogamous species is known which has not ordinary flowers also, mostly corolliferous and insect-visited, some specially modified for such visits, either by heterogone dimorphism or by special structure such as that of Orchids and Violets, but some anemophilous, such as a few rushes and grasses. Among the latter, it is singular that one of the earliest known and strongly marked cases, that of *Amphicarpum* (*Milium amphicarpum* Pursh), should be overlooked.

Since this notice was written, Mr. Pringle has announced to us the discovery of cleistogamous flowers regularly occurring within the leaf-sheaths of *Danthonia spicata* and its allies, also in *Vilfa* and other grasses. A. G.

| $Cb_2O_5$ | $Ta_2O_5$ | $SnO_2$ | $UO_3$ | $Fe_2O_3(Mn_2O_3)$ | $Ce_2O_3$* | $Y_2O_3$ | ErO | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|
| 41·07 | 14·36 | 0·16 | 10·90 | 14·61 | 2·37 | 6·10 | 10·80 | 0·56 |

* With a little Di. =100·93

The formula deduced from the above is $8R_2Nb_6O_{21}+R_2U_5O_{21}$ where $R=Y_2$, $Fe_2$, $Ce_2(Er_2)$, each double atom having an equivalence of six ($Y=92$, $Ce=138$). The American samarskite differs from the Uralian mineral in the high percentage of tantalic acid, and of the element erbium.—*Ann. Phys. u. Chem.*, II, ii, 663.

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1. *Supplementary Note to the Review of Darwin's "Forms of Flowers."* (In January No, pp. 67-71.)—A contributor to the Bulletin of the Torrey Botanical Club, having advanced the idea that the blossoms of *Gentiana Andrewsii* were cleistogamous, because generally seen with corolla closed, we mentioned: 1, that the corolla opened in bright sunshine for a short time, also that humble bees (as others had also recorded) bodily entered even the closed flowers, and would therefore cross-fertilize them: 2, that there was a neat adaptation for ulterior self-fertilization; the pollen long remaining fresh on the ring of extrorse anthers, in such position that when the stigmas of the flower tardily matured, diverged, and became revolute, a part of the stigmatic surface commonly came into contact with the abundant pollen; but this only some time after exposure to the chance of a pollenized entering bee. In the Torrey Bulletin for December last, (vi, 189), Mr. Meehan follows this up with some observations and with other statements which, on account mainly of the singular deductions, may call for a brief remark. He states that *Gentiana Andrewsii* in his neighborhood behaves differently, and that the flowers "do not last a long while." Between this and "a rather long while," the discrepancy is not very explicit, and it is more than done away with by the statement following, that "the ovarium, however, continues to grow, and soon pushes itself through the mouth of the corolla, exposing the stigmatic surfaces which remain in a receptive condition for some time after exposure." This is equivalent to saying that anthesis lasts for a week or two, which is certainly a long while, and doubtless too long. For we are confident that when the ovary, or rather the maturing capsule, is thus exserted out of the mouth of the fading corolla, the stigma no longer "remains in a receptive condition." If it has not been cross-fertilized before this, its day is long passed.

Then follows this: "The only difficulty with me is, that I do not see where the pollen to cross-fertilize is to come from. Mr. Darwin teaches that pollen from the same plant, or from plants growing under similar conditions, is practically no cross-fertilization." This is equivalent to saying that there is no "practical" (meaning useful) cross-fertilization if the plants grow near enough for a bee to fly from the one to the other; which is making what "Mr. Darwin teaches" extinguish cross-fertilization effectually!

Then, "But with me, bees or other insects do not go into one flower on one plant, and then away to another many yards away, then returning, and again going back, continuously going and coming, as a zealous cross-fertilizer, so beautifully arranged by nature, should do, . . . whatever they may do elsewhere." Certainly only the bees in the writer's bonnet behave in this way, or were ever thought to do so.

The article continues thus: "However, it is well to recognize the fact, that plants, and no doubt insects, behave differently in different places. For instance, Mr. Darwin, from English experiments, utterly denies that *Linum perenne* can fertilize itself with its own pollen. He says we may as well "sprinkle over it so much inorganic dust. But a single plant which I brought with me from Colorado, in 1873, bears fruit freely in my garden every year. It shows that how a plant may behave in one place, is no rule as to how it will elsewhere." This extremely remarkable induction of a general rule,—that plants and insects cannot be depended upon for behavior,—is inferred from two instances, one of which has been sufficiently examined; and now a few words may dispose of the other. Mr. Meehan must have noticed (in Forms of Flowers, p. 92) that Darwin's result has been completely confirmed by Hildebrand; and he might have read, on p. 100, the statement, taken from Alefeld, that no American species is heterostyled; and on p. 100, that the Colorado plant, *Linum Lewisii*, of Pursh, the American representative of *L. perenne*, is suspected to be a distinct species, of a sort fully capable of self-fertilizing. This is what Mr. Meehan's observation goes to prove; and so, instead of showing that the behavior of species cannot be relied on, he has unwittingly brought evidence of the correctness of Mr. Darwin's surmise. We looked upon Mr. Meehan's little article as a piece of pleasantry, and should not have referred to it if it had not been noticed abroad as something serious. A. G.

2. *Historia Filicum; an Exposition of the Nature, Number and Organography of Ferns, &c.* By JOHN SMITH, A.L.S., Ex-Curator of the Royal Gardens, Kew, etc. London: Macmillan & Co., 1875; re-issued 1877. 12mo, pp. 429. And with 30 lithographic plates.—The title page proceeds to state, that this volume contains a review of the principles upon which genera are founded, and the systems of classification of the principal authors; with a new general arrangement; characters of the genera; remarks on their relationship to one another, their species, reference to authors, geographical distribution, &c. The plates, drawn on stone by Fitch, illustrate the tribes and leading genera. Mr. Smith is, perhaps, the oldest living pteridologist, and while he had his eye-sight was one of the best. No one else was so intimately and extensively acquainted with Ferns in a living state. In him unusual practical knowledge was combined with no mean talent for systematic arrangement. He was, next to Presl, the first to use the characters of venation, which Brown had cautiously suggested for the definition of genera, and he may be said