e disease. The objects de, and certainly not to ice" which, as has been ing often in a hunt, and turn. These objects. I justing the service line; n Marshall and by other s much more extended

be arrived at by making er consecutive or not—wins the science. under the cumulative h. then serves another n. I think this might g the service line. At ood players think it a t yet been sufficiently

course of experiments ears to me that just ne such method. Mr statistical results of sed on disputed points, oughly and practically desire to legislate for ws which are carefully having been well conade, numerous experiture to think that laws ons will eventually be blic matches.

CAVENDISH.

n tennis as at present ervice.

but three courses by ice line nearer the net. e the net a stroke. Mr but it would seem that, so handicap the service, it ould not be altered from ained. Public opinion r Julian Marshall and service into the net a determined upon, that e a stroke against the altogether; and if, on ld be found to handicap ated by removing the

be adopted, and which I rule that a good service ecoring to serve in one g, each Vault in turn may not alter this rule, so her consecutive or not, uld have the effect of e used in conjunction Cavendish." H. B.

following propositions: plicit code of rules than nis" system of scoring

C.C. committee leads me persevere in the task to ion, and that after the y issue rules on a per- adopted by the A.E.C. re nearly identical with committee, and I for one s meeting. As regards as generally considered inciples, I believe these Julian Marshall, who is n able exponent of the now tolerated, easy; ethod of handicapping the opinions expressed , though open to con- e line the attention it y opinion and that of out of court shall be borne in mind, that it precision, and I think future time have to be " will have an undue ne matter the analogy is with the more prac- the inevitable result of o lay down a hard-and- desirable that courts of single matches; and it ally adopted by some g down ball after ball retched as nearly hori- within reasonable limits. members of the M.C.C. wishes and opinions of

J. M. HEATHCOTE.

ote if he would favour tered service line" "a riance from that of the nt repetition of such of cricket law in defer- n thousands, of good, Roberts, Bennett, and udgment on a point of econd and third-class particular point with ught certainly to rest, rs, but with the small y be very sure that the igorously upholding, a nanimous, voice of the

hether service into the ility than service beyond s are irreconcilably at on follows that no code present time, unless it t both racket scoring the former including court is hand out, the every service not ful- onfusion there could be se, be acquainted with to the one or to the the present dead-lock that we may wait inde- laws. D. J.

per court reduces the an equality. Besides, es with a four match ut of court, and this hich, to my mind, spoils

A SOLDIER.

or any other of your equality between the e ever played in courts be net. If they will do rvice, such as is usual nowadays, there is no choice whatever in favour of either side (balls served into the net being counted against the server).

A court 35 yards by 12 is not suited to ladies, but I think I may venture to say that a player of Mr Marshall's calibre, having once tried it, will not care to go back to a shorter court.

It is also only suited for the best and hardest balls; but, so played, the difference between this and the common game is almost one of kind—not much so, that I could name a dozen excellent players who hold it to be as that between billiards and bagatelle. W. S. B.

[It is impossible to cover so large a court.—ED.]

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FORMS OF FLOWERS.

The Different Forms of Flowers on Plants of the Same Species. By Charles Darwin, M.A., F.R.S. London: Murray. 1877.

MR DARWIN does well in bringing together in a consecutive and connected form the essays which he has from time to time contributed to the *Journal of the Linnean Society*. It is not long since we noticed a volume* in which this distinguished author reprinted, with additions, his essay on the movements and habits of climbing plants: since then another work, embodying the results of laborious investigation, has come under our notice; and now we have before us a third, which is in the main a reprint of already published papers, which are here given in a connected and corrected form, with the addition of many hitherto unpublished observations. In its present form the work is likely to come into the hands of many who have hitherto been unacquainted with it; while those who possess the papers on which it is based will be interested in seeing in what respects the author has modified his views, after an interval of from fifteen to nine years; the first essay on dimorphism in primroses having appeared in 1862, and the two last in 1868.

Almost the first thing that strikes us in this, as in so many other of Mr Darwin's works, is the fact that so large a proportion of his observations have been made upon common British plants. For instance, four out of the eight chapters into which the book is divided are devoted almost exclusively to primroses, cowslips, and oxlips, and the common loosestrife (Lythrum salicaria); while the other chapters abound with references to equally common wild flowers. During all the years which have elapsed since plants began to be observed and studied, it was open to anyone to have initiated researches similar to those of Mr Darwin; the plants themselves are common enough, and their differences, although slight, are sufficiently obvious, now that attention has once been directed to them. In some instances at least, these differences were noticed and commented on. Mr Darwin, who is always prompt to acknowledge the labours of fellow-workers in the same field, tells us that Vaucher in 1841, and Wintgen in 1849, observed the three forms of Lythrum salicaria; but these botanists, "not being guided by any theory or even suspicion of their functional differences, did not perceive some of the most curious points of difference in their structure." There is, indeed, plenty to explore and investigate in our commonest plants. For example, who will discover for us the reason why the flowers of primroses in gardens are so frequently attacked and destroyed by birds? We were this spring visiting a house, in the garden of which was a border of handsome single red primroses, which had hardly opened their flowers before they were systematically picked to pieces by small birds, principally sparrows. The wild primroses in a neighbouring wood showed no signs of a like visitation; yet, when some of these were transplanted to the same garden, they too were similarly treated, showing that colour, at any rate, had nothing to do with it. It may be that the young germen has a sweet flavour which is agreeable to birds, for we observed upon the same occasion that a tame bullfinch found great delight in dexterously nipping off primroses just above the stalk, and eating a very small portion of the base of the flower; but this does not explain the manifest preference for garden over wild specimens. No one has yet so far as we know, found out why birds similarly attack and destroy the flowers of spring crocuses, but it is probable that with persevering observation this might be discovered.

To return to the book under notice, we find it occupied for the most part with the investigation of heterostyled and cleistogamic flowers, especially the former, and these terms require explanation. Heterostylism in this volume is substituted for dimorphism—a term which Mr Darwin had rendered familiar, but which he now abandons in favour of the first-named, which is more definite as well as more comprehensive, including as it does not only dimorphic, but also trimorphic plants. A heterostyled plant may be defined as one producing flowers which, though hermaphrodite, are adapted for reciprocal fertilisation, the pistil of one form requiring to be fertilised by the pollen of another—or rather, being fully fertile only when so fertilised; and, unless this is proved to be the case, the plant is not certainly heterostyled. Cleistogamic plants are those which produce two kinds of flowers, "the one perfect and fully expanded, the other minute, completely closed, with the petals rudimentary, often with some of the anthers aborted, and the remaining ones, together with the stigmas, much reduced in size; yet these flowers are perfectly fertile." Besides these principal divisions, there are others of almost minor importance, which approach them in certain points. One such group consists of certain plants, some individuals of which bear conspicuous flowers adapted for cross-fertilisation by the aid of insects, and others much smaller and less conspicuous flowers, which have often been slightly modified so as to ensure self-fertilisation. "The smaller and less conspicuous flowers are not closed, but as far as the purpose which they serve is concerned—namely, the assured propagation of the species—they approach in nature cleistogamic flowers; but they differ from them by the two kinds being produced on distinct plants."

The four Linnean groups of flowers, so far as their sexual relations are concerned—namely, hermaphrodite, monœcious, dioecious, and polygamous—are adopted by Mr Darwin; although, as he observes, this classification is artificial, and the groups often pass into one another. We have at present only referred to the first of these, to which indeed the bulk of the volume is devoted, but the others demand a passing note. The monœcious species, having their sexes borne in different flowers on the same plant, include a few plants which "consist of two kinds of individuals, with their flowers differing in function, though not in structure; for certain individuals mature their pollen before the female flowers on the same plant are ready for fertilisation, and are called proterandrous; whilst conversely other individuals, called proterogynous, have their stigmas mature before their pollen is ready. The purpose of this curious functional difference obviously is to favour the cross-fertilisation of distinct plants," just as a similar difference in the hermaphrodite flowers of the same plant among hermaphrodite species also favours cross-fertilisation. Mr Darwin proposes to limit the term polygamous to those species which "co-exist as hermaphrodites," and he divides them into "two sub-groups, according as the three sexual forms are found on the same individual or in distinct individuals. Of the latter or trioicous sub-group, the common ash affords an illustration; while of the monoicous sub-group an equally well-known tree, the common maple, offers a good instance. Besides these plants, which are polygamous in the restricted sense, there are some which, although generally ranked as polygamous, "exist under only two forms—namely, as hermaphrodites and females; and these may be called gyno-dioecious, of which the common thyme offers a good example . . . . Other species, for instance several kinds of Atriplex, bear on the same plant hermaphrodite and female flowers; and these might be called gyno-monoecious, if a name were desirable for them. Again there are plants which produce hermaphrodite and male flowers on the same individual; for instance, some species of Galium, Veratrum, &c., and these might be called andro-monoecious. There exist plants the individuals of which consist of hermaphrodites and males, these might be distinguished as andro-dioecious; but, after making inquiries from several botanists, I can hear of no such cases." The Linnean class Polygamia may therefore be thus tabulated in accordance with Mr Darwin's division of it.

I. Species with male, female, and hermaphrodite flowers	Polygamous.
(a) On same plant	Monoicous.
(b) On different plants	Trioicous.
II. Species with male and hermaphrodite flowers:	
(a) On same plant	Andro-monoecious.
(b) On different plants	Andro-dioecious.
III. Species with female and hermaphrodite flowers:	
(a) On same plant	Gyno-monoecious.
(b) On different plants	Gyno-dioecious.

These terms being new, and the differences they indicate not very generally known, this method of contrasting them may be of service.

Returning now to the heterostyled hermaphrodite plants, we note a large number of additions to the species which were brought forward in the first instance in the Linnean Society's *Journal* among both the dimorphic and trimorphic groups. More or less detailed observations among dimorphic species are here given with regard to representatives of seventeen genera of Rubiaceæ—an order which contains a greater number of heterostyled genera than any other, so far as at present known—two species of Ægiphila (Verbenaceæ), three of Polemoniaceæ, three of Gentianaceæ, two of Linaceæ, and one each of Hypericineæ, Cordiaceæ, and Thymeleæ. To these must be added the common buckwheat (Polygonum fagopyrum), which deserves notice as being the only heterostyled species, so far as known, in the very large genus Polygonum; and two Pulmonarias, which are treated of at considerable length. These last are the more interesting because several other Boraginaceæ which were mentioned as dimorphic by Mr Darwin in his original paper, proved, on further examination, not to be heterostyled. It will be seen that heterostylism is no peculiarity of any group of plants, or even of closely-related species, although it is remarkably noticeable in certain genera. The genus Primula is a case in point. Here no fewer than thirty-six species are ascertained to be dimorphic, and more will probably be found to be so; although a few, on the other hand, are certainly homostyled, *i.e.*, not under one form. Other Primulaceæ, such as our water violet (Hottonia palustris) and the pretty little alpine Gregoria (or Androsace) vitaliana, are, as was originally ascertained by Mr John Scott, heterostyled dimorphic plants. About half the known species of Linum (which Dr Alefeld, who has made a study of the genus, reckons at sixty-five in all) are heterostyled; although two of our British species (L. angustifolium and L. catharticum), as well as the flax of commerce (L. usitatissimum), are homostyled.

There can be little doubt that the object of heterostylism is to favour cross-fertilisation—a condition which is now generally understood to be beneficial to the species. In the cowslip, as well as in many other species of Primula, there are two forms of flower, differing most in the length of the style, this difference being accompanied by others, which are thus summed up by Mr Darwin: "The long-styled plants have a much longer pistil, with a globular and much rougher stigma, standing high above the anthers. The stamens are short; the grains of pollen smaller and oblong in shape. The upper half of the tube of the corolla is more expanded. The number of seeds produced is smaller, and the ovules larger. The plants tend to flower first. The short-styled plants have a short pistil, half the length of the tube of the corolla, with a smooth depressed stigma standing beneath the anthers. The stamens are long; the grains of pollen are spherical and larger. The tube of the corolla is of uniform diameter, except close to the upper end. The number of seeds produced is larger." These two kinds of flowers are about equally common; they are never found upon the same plant. Nor has Mr Darwin ever met with any transitional states between the two forms in plants growing in a state of nature. Four essentially different unions are possible between these forms, namely, "the fertilisation of the stigma of the long-styled form by its own-form pollen, and by that of the short-styled; and the stigma of the short-styled form by its own-form pollen, and by that of the long-styled." It is, of course, not our intention to enter into the various experiments which Mr Darwin and others have instituted with a view to ascertaining the relative fertility of these different unions. Their result is to show that complete fertility is obtained by the fertilisation of a long-styled plant by pollen from a short-styled plant, and *vice versâ*; while if a long-styled plant be fertilised by pollen from a plant of its own form (*i.e.*, long-styled), or a short-styled one be impregnated with pollen from its own form, the result is only incomplete fertility. This demonstrates clearly enough that cross-fertilisation is essential to the well-being of the species; and hence Mr Darwin applies the term legitimate to the first class of unions, and that of illegitimate to the second.

Passing to the heterostyled trimorphic plants, of which Lythrum salicaria is the species originally shown to be such by Mr Darwin, we find large additions in his previous publications on the subject. Two other genera of Lythraceæ furnish examples of similar trimorphism; it seems to be the rule in the genus Oxalis, although our common woodsorrel (O. Acetosella) furnishes an exception; and two or three Brasilian species of Pontederia (a monocotyledonous genus, nearly allied to Liliaceæ, and the type of the small order Pontederiaceæ), are also heterostyled and trimorphic. "This case is an interesting one, for no other monocotyledonous plant is known to be heterostyled; moreover, the flowers are irregular, and all other heterostyled plants have regular symmetrical flowers." It is impossible even briefly to indicate the many remarkable points presented by the common purple loosestrife (Lythrum salicaria) and in the plants named which are fertilised in a similar manner—a manner "more remarkable," says Mr Darwin, "than can be found in any other plant or animal." But we may just glance at the singularly complex structure of the species just mentioned. The purple loosestrife presents three forms, which "may be conveniently called, from the unequal length of their pistils, the long-styled, mid-styled, and short-styled. The stamens also consist of unequal length, and these may be called the long-, mid-length, and shortest. Two sets of stamens of different length are found in each form." This one species thus includes three female organs and three sets of male organs, all as distinct from one another as if they belonged to different species. "If smaller functional differences are considered, there are five distinct sets of males. Two of the three hermaphrodites must co-exist, and pollen must be carried by insects reciprocally from one to the other, in order that either of the two should be fully fertile; but, unless all three forms co-exist, two sets of stamens will be wasted, and the organisation of the species, as a whole, will be incomplete. On the other hand, when all three hermaphrodites co-exist and pollen is carried from one to the other, the scheme is perfect, there is no waste of pollen, and no false co-adaptation. In short, nature has ordained a most complex marriage arrangement, namely, a triple union between three hermaphrodites—each hermaphrodite being in its female organ quite distinct from the other two hermaphrodites and partially distinct in its male organs, and each furnished with two sets of males." The three unions which are perfectly fertile are:

Longest pistil × pollen from longest stamens;
Mid-length pistil × pollen from mid-length stamens;
Shortest pistil × pollen from shortest stamens.

To arrive at this conclusion with certainty, it was necessary to make eighteen distinct unions in order to ascertain the relative fertilising power of the three forms; and those who wish to form some adequate notion of the labour bestowed by Mr Darwin upon this point alone will do well to read his account of his observations, which he is quite safe in saying "will not probably be soon repeated." The counting under the microscope of more than 20,000 seeds of this species is but an illustration of this labour. The manner in which the necessary cross-fertilisation is carried out by the insects which visit the plants is most remarkable, and we regret that we cannot quote it at length. But space, or the want of it, compels us to pass it by, as well as any reference to the important chapter on the illegitimate offspring of heterostyled plants, *i.e.*, such as are fertilised by pollen from flowers of similar form.

The cleistogamic flowers, to which reference was made at the commencement of this notice, demand at least a passing word. They are especially remarkable on account of being necessarily self-fertilised, owing to the fact that the flowers never open, thus forming a striking exception to the prevailing rule of cross-fertilisation. Fifty-five genera are enumerated in which these insignificant yet all-important flowers are known to occur, distributed widely among both dicotyledons and monocotyledons. "They are more common in family of the Leguminosæ than in any other, and next to it that of the Acanthaceæ and Violaceæ and Euphorbiaceæ. A large number, but not all the species, of certain genera, as of Oxalis and Viola, bear cleistogamic as well as ordinary flowers. A second point which deserves notice is that a considerable proportion of the genera—thirty-two out of the fifty-five—produce more or less irregular flowers." A readily-found example of a plant producing cleistogamic flowers is afforded by Viola canina (more especially the plant usually distinguished as V. sylvatica). Here the cleistogamic flowers are produced some weeks later than the ordinary showy ones; they are abundant, and produce capsules freely and rapidly, so much so that branches may be found in June with fully developed though not ripe capsules below, and the apetalous flowers on the upper portion. It must not, however, be supposed that the ordinary or perfect flowers are always barren, though this is frequently the case. The capsules produced by the cleistogamic flowers of the

* *The Field*, Dec. 4, 1875.