

followed, until the notions which represented Goethe's superlative are now the commonplaces of science—and we have a super-superlative of our own.

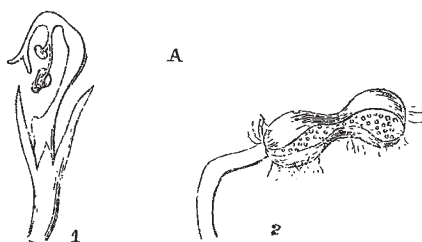
When another half-century has passed, curious readers of the back numbers of NATURE will probably look on our best, "not without a smile;" and, it may be, that long after the theories of the philosophers whose achievements are recorded in these pages, are obsolete, the vision of the poet will remain as a truthful and efficient symbol of the wonder and the mystery of Nature.

T. H. HUXLEY

ON THE FERTILISATION OF WINTER-FLOWERING PLANTS

THAT the stamens are the male organ of the flower, forming unitedly what the older writers called the "androcium," is a fact familiar not only to the scientific man, but to the ordinary observer. The earlier botanists formed the natural conclusion that the stamens and pistil in a flower are intended mutually to play the part of male and female organs to one another. Sprengel was the first to point out, about the year 1790, that in many plants the arrangement of the organs is such, that this mutual interchange of offices in the same flower is impossible; and more recently, Hildebrand in Germany, and Darwin in England, have investigated the very important part played by insects in the fertilisation of the pistil of one individual by the stamens of another individual of the same species. It is now generally admitted by botanists that cross-fertilisation is the rule rather than the exception. The various contrivances for ensuring it, to which Mr. Darwin has especially called the attention of botanists, are most beautiful and interesting; and the field thus opened out is one which, from its extent, importance, and interest, will amply repay the investigation of future observers. For this cross-fertilisation to take place, however, some foreign agency like that of insects is evidently necessary, for conveying the pollen from one flower to another. The question naturally occurs, How then is fertilisation accomplished in those plants which flower habitually in the winter, when the number of insects that can assist in it is at all events very small? I venture to offer the following notes as a sequel to Mr. Darwin's observations, and as illustrating a point which has not been elucidated by any investigations that have yet been recorded. I do not here refer to those flowers of which, in mild seasons, stray half-starved specimens may be found in December or January, and of which we are favoured with lists every year in the corners of newspapers, as evidence of "the extraordinary mildness of the season." I wish to call attention exclusively to those plants, of which we have a few in this country, whose normal time of flowering is almost the depth of winter, like the hazel-nut *Corylus avellana*, the butcher's broom *Ruscus aculeatus*, and the gorse *Ulex europæus*; and to that more numerous class which flower and fructify all through the year, almost regardless of season or temperature; among which may be mentioned the white and red dead-nettles *Lamium album* and *purpureum*, the *Veronica Buxbaumii*, the daisy, dandelion, and groundsel, the common spurge *Euphorbia peplus*, the shepherd's purse, and some others.

During the winter of 1868-69, I had the opportunity of making some observations on this class of plants; the result being that I found that, as a general rule, fertilisation, or at all events the discharge of the pollen by the anthers, takes place in the bud before the flower is opened, thus ensuring *self-fertilisation* under the most favourable circumstances, with complete protection from the weather, assisted, no doubt, by that rise of temperature which is known to take place in certain plants at the time of flowering. The dissection of a flower of *Lamium album* (Fig. A) gathered the last week in December, showed the stamens completely curved down and brought almost into contact with the bifid stigma, the pollen being at that time freely discharged from the anthers. A more complete contrivance for self-fertilisation than is here presented would be impossible. The same phenomena were observed in *Veronica Buxbaumii*, where the anthers are



A. LAMIAM ALBUM.

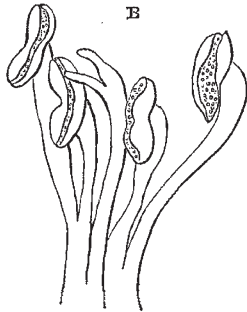
1. Section of bud, calyx and corolla removed.
2. Stamen from bud, enlarged, discharging pollen.

almost in contact with the stigma before the opening of the flower, which occurs but seldom, *V. agrestis* and *polita*, the larger periwinkle *Vinca major*, the gorse, dandelion, groundsel, daisy, shepherd's purse, in which the four longer stamens appear to discharge their pollen in the bud, the two shorter ones not till a later period, *Lamium purpureum*, *Cardamine hirsuta*, and the chickweed *Stellaria media*, in which the flowers open only under the influence of bright sunshine. In nearly all these cases, abundance of fully-formed, seed-bearing capsules were observed in the specimens examined, all the observations being made between the 28th of December and the 20th of January.

In contrast with these was also examined a number of wild plants which had been tempted by the mild January to put forth a few wretched flowers at a very abnormal season, including the charlock *Sinapis arvensis*, wild thyme *Thymus serpyllum*, and fumitory *Fumaria officinalis*; in all of which instances was there not only no pollen discharged before the opening of the flower, but no seed was observed to be formed. An untimely specimen of the common garden bean *Faba vulgaris*, presented altogether different phenomena from its relative the gorse, the anthers not discharging their pollen till after the opening of the flower; and the same was observed in the case of the *Lamium Galeobdolon* or yellow archangel (Fig. B) gathered in April, notwithstanding its consanguinity to the dead-nettle.

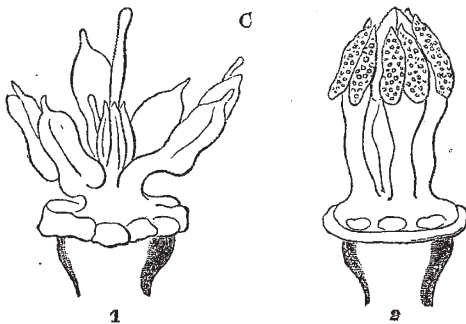
Another beautiful contrast to this arrangement is afforded by those plants which, though natives of warmer climates, continue to flower in our gardens in the depth of winter. An example of this class is furnished by the common yellow jasmine, *Jasminum nudiflorum*, from

China, which does not discharge its pollen till considerably after the opening of the flower, and which never fructifies in this country. But a more striking instance is found in the "allspice tree," the *Chimonanthus fragrans*, or *Calycanthus præcox* of gardeners, a native of Japan, which,



B. *LAMIUM GALEOBDOLON*.—Pistil and stamens from open flower; the latter discharging pollen.

flowering soon after Christmas, has yet the most perfect contrivance to prevent self-fertilisation (Fig. C). In a manner very similar to that which has been described in the case of *Parnassia palustris*,* the stamens, at first nearly horizontal, afterwards lengthen out, and rising up perpendicularly, completely cover up the pistil, and then discharge their pollen outwardly, so that none can possibly fall on the stigma. As a necessary consequence, fruit is never produced in this country; but may we not conjecture that in its native climate the *Chimonanthus* is



C. *CHIMONANTHUS FRAGRANS*

1. Early stage of flower, calyx and corolla removed.
2. Later stage, stamens surrounding the pistil, and discharging their pollen outwardly.

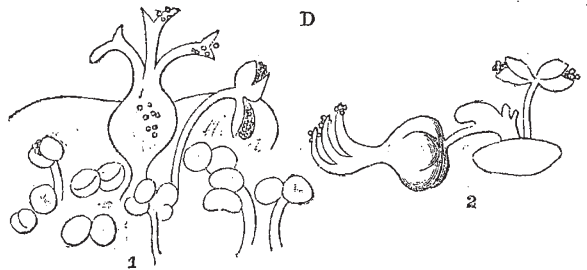
abundantly cross-fertilised by the agency of insects, attracted by its delicious scent, in a similar manner to our Grass of Parnassus?

The description detailed above cannot of course apply to those winter-flowering plants in which the male and female organs are produced on different flowers; but here we find commonly another provision for ensuring fertilisation. In the case of the hazel-nut the female flowers number from two to eight or ten in a bunch, each flower containing only a single ovule destined to ripen. To each bunch of female flowers belongs at least one catkin (often two or three) of male flowers, consisting of from 90 to 120 flowers, and each flower, containing from three to eight anthers. The pollen is not discharged till the stigmas are fully developed, and the number of pollen-grains must be many

* Journal of the Linnean Society for 1868-69, Botany, p. 24.

thousand times in excess of what would be required were each grain to take effect. The arrangement in catkins also favours the scattering of the pollen by the least breath of wind, the reason probably why so many of the timber-trees in temperate climates, many of them flowering very early in the season, have their male inflorescence in this form.

The *Euphorbias* or spurges have flowers structurally unisexual, but which, for physiological purposes, may be regarded as bisexual, a single female being enclosed along with a large number of male flowers in a common envelope of involucral glands. Two species are commonly found flowering in the winter, and producing abundance of capsules, *E. peplus* and *helioscopia*. In both these species the pistil makes its appearance above the involucral glands considerably earlier than the bulk of the stamens (Fig. D).



D. *EUPHORBIA HELIOSCOPIA*

1. Head of flowers opened, pistil and single stamen appearing above the involucral glands.
2. The same somewhat later, with the stigmas turned upwards.

A single one, however, of these latter organs was observed to protrude, beyond the glands simultaneously, or nearly so, with the pistil, and to discharge its pollen freely on the stigmas, thus illustrating a kind of quasi-self-fertilisation. The remaining stamens do not discharge their pollen till a considerably later period, after the capsule belonging to the same set has attained a considerable size. In *E. helioscopia* the capsules are always entirely included within the cup-shaped bracts, and the stigmas are turned up at the extremity so as to receive the pollen freely from their own stamens. Now contrast with this the structure of *E. amygdaloides*, which does not flower before April (Fig. E). The heads of flowers which first open are entirely male, containing no female flower; in the hermaphrodite heads, which open subsequently, the stigmas are completely



E. *EUPHORBIA AMYGDALOIDES*.—Head of flower, pistil appearing above the involucral glands, all the stamens still undischarged.

exposed beyond the involucral glands long before any stamens protrude from the same glands. Here, therefore, complete cross-fertilisation takes place, the pollen from

the first-opened male heads no doubt fertilising the stigma from the next-opened hermaphrodite heads, and so on. In this species the bracts are not cup-shaped, but nearly flat; the stigmas hang out very much farther than in *E. helioscopia*; and the styles are perfectly straight.

The above observations are very imperfect as a series, and I can only offer them as a contribution towards an investigation of the laws which govern the cross-fertilisation or self-fertilisation of winter-flowering plants. On communicating some of them to Mr. Darwin, he suggested that the self-fertilised flowers of *Lamium album*, and other similar plants, may possibly correspond to the well-known imperfect self-fertilised flowers of *Oxalis* and *Viola*; and that the flowers produced in the summer are cross-fertilised; a suggestion which I believe will be found correct.

In conclusion, I may make two observations. The time of flowering of our common plants given in our textbooks is lamentably inexact; for the hazel, March and April for instance! and for the white dead-nettle, May and June! according to Babington. Great care also should be taken to examine the flowers the moment they are brought in-doors; as the heat of the room will often cause the anthers to discharge their pollen in an incredibly short space of time. This is especially the case with the grasses.

ALFRED W. BENNETT

PROTOPLASM AT THE ANTIPODES

THE Protoplasm excitement seems to have died away in a great measure in this country; and it is probably no loss to science that the matter has ceased to be a prevailing topic of conversation at dinner tables. We learn, however, from the Melbourne papers, that the arrival of the February number of the *Fortnightly Review* in the Australian colonies gave rise to an epidemic there of controversial science in a very alarming form. The description they give of the intellectual condition of Melbourne in June and July last, in fact, reminds us of that famous time at Constantinople, when a cobbler would not mend a pair of shoes until he had converted his customer from a Homousian to a Homoiousian, or *vice versa*. The *Melbourne Daily Telegraph* is proud to think that a city which a few years back could only be stirred by a "Jumping Frog," is now agitated by proteinaceous theories; and this, too, in spite of the fact that they had previously been warned by the scientific correspondent of the *Melbourne Leader* of Mr. Huxley's gross ignorance and sensational superficiality. It is perfectly well known that at home here Mr. Huxley has been refuted many more times than there are copies of his article; but in Melbourne he was refuted over again afresh. We learn that the Rev. H. Higginson, "in a singularly able discourse at the Unitarian Church, tore the theory to shreds in a way"—reports the *Argus* with felicitous dubiety—"which showed the preacher to be as keen a humorist as he is a subtle logician." So able was the discourse, and so humorous, that it was repeated shortly afterwards as a lecture at the Mechanics' Institute. Here, however, the lecturer stated that it was a mistake to suppose that he had in the sermon either torn the theory to shreds or treated it in a humorous way; and the report of the lecture lends great support to the statement.

It may be perhaps gratifying to Mr. Huxley, to think that he has stirred men's minds in a place which was

almost a *terra incognita* when the unknown young assistant-surgeon of the *Rattlesnake* looked upon it; but the papers tell us that a reprint of the *Fortnightly* article has been the first instance of infringement of copyright in that colony; and when the learned anatomist was speaking at Edinburgh he probably little thought that materialism would take its revenge on him by producing the following exercise in applied Biology:—

THE PHYSICAL BASIS OF LIFE.

Huxley's celebrated Essay on this subject is lectured on daily, by

WILLIAM BARTON,

who has made the matter a life study. It is also illustrated daily at his tables, where the "physical basis" can be laid in from 11 to 3, in the best cooked and most varied

HOT LUNCHEON

in the city.

The first feeling which comes to the mind after such things as these is an unbounded belief in the wisdom of those old teachers who kept esoteric and exoteric doctrines wide apart, and who laid bare the workings of their minds to trusted scholars only, and never to the vulgar gaze. We begin fervently to wish that our illustrious biologist had not, by the dress and mode of his lecture, so laid great biological truths before the public as to excite those especially ignorant of the science of life to try and trample them under foot, and then leave them for a vulgar tavern-keeper to hang up for a sign.

Second—better—thoughts, however, remind us that men of science work not for themselves, or for their scientific fellows, but for mankind; and that only mischief can come of it if they whose business it is to ask Nature her secrets are hindered from telling the world all that they think they hear. It is impossible to separate science from other knowledge and from daily life: all new discoveries especially must have ties with every part of our nature. It is not the business of the biologist to enforce on others what he believes to be the consequences of his biological discoveries; but it is certainly not his duty to withhold his facts from the common people because of the results which he thinks will follow.

And in regard to Australia in particular, we have this reflection, that the plough is needful for the seed; heavy land wants well turning up. There are not wanting signs that a national character is beginning to form among the inhabitants of that country; and we trust that scientific zeal will be one of its chief features. We hope that science even in a controversial form will never again give way in Melbourne to the vain delights of the "Jumping Frog;" and that the protoplasm which Mr. William Barton so admirably cooks will reappear in the nerve cells of Australian brains, and give rise to that love of truth, apart from gold or gain, which is the "moral" basis of "national" life. We may add that we hope not without confidence; for a bright example of conscientious truthfulness appeared in the midst of this small biological tempest. Many of our readers may remember the abundant fervour with which Prof. Halford, some years since, attacked Mr. Huxley's "Man's Place in Nature." At the end of Mr. Higginson's lecture the talented Melbourne anatomist courageously told the meeting, that he had seen reason to change his opinions. Every one here will rejoice to receive from the Antipodes a lesson of self-denial and moral daring, not too common amongst ourselves.