SCIENCE.—SUPPLEMENT.

FRIDAY, MAY 14, 1886.

CROSS-FERTILIZATION OF PLANTS BY BIRDS.

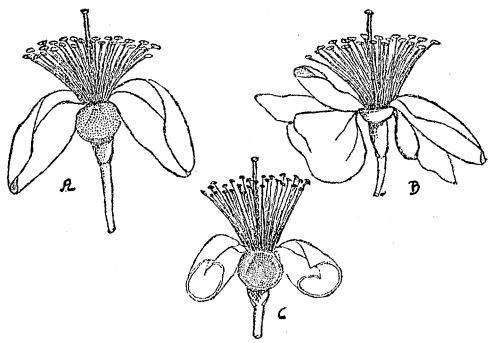
ADAPTATIONS for cross-fertilization exist in an almost endless variety throughout the vegetable kingdom, and have afforded a wide field for study and speculation to biologists. Many of great interest have been described by Hermann Müller as occurring in South American plants; and now the well-known South American naturalist, Fritz Müller, adds in *Kosmos* (1886, i. 93–98) a very remarkable discovery of adaptation to cross-fertilization by birds, — the first case of the kind, it is believed, that has been observed in the vegetable kingdom.

The flowers of the common European myrtle, with their delicate white corolla and crown of white stamens and simple pistil, are familiar to all. Very similar are the white flowers of the trees and shrubs belonging to the numerous species of the genera Campomanesia, Psidium, Myrcia, and Eugenia of the same family (Myrtaceae), occurring in great abundance in South America. Many of the species blossom in such profusion that the trees appear nearly white, and the pleasant odor that not a few give off attract bees and other insects in great numbers; and while in many others the flowers are not so conspicuous, and the perfumes not so evident, yet the pollen is easily transferred from flower to flower, and tree to tree, by the agency of insects.

In this uniformity among the genera and species a singular exception is found in the 'goiabo do campo,'— a not uncommon tree in the higher lands of Brazil, and widely known for its excellent fruit. The single species belong to the genus Feijoa; and its popular name, as well as its mode of growth and its foliage, recalls the wide-spread common guava-tree (Psidium pomiferum).

The flowers are found usually at the extremity of the twigs, or more rarely in the axils of the leaves, in groups of from two to five, on short stems. The leaves in whose axils the flower-stems, or the twigs bearing them, occur, are reduced to rudimentary bracts; and the flowers, for this reason, are more conspicuous than they would be were they enveloped by leaves, as is usual in the allied genera. A yet more especial adaptation to the means by which they are fertilized is the duration of flowering, which extends for months, during the entire spring, single blossoms appearing here and there over the tree.

The sepals form two pairs, — those of the one about six millimetres in length, and of equal breadth; of the other, twice as long and a little wider. In the unfolding of the blossom they are turned downwards, and present only the dark reddish-brown inner side. The petals at first are



BLOSSOMS OF FEIJOA, FIVE EIGHTHS NATURAL SIZE.

about fifteen millimetres long and as many broad, firm and leathery, and arched outwards; the inner side, of a purplish-red color. Within a day they grow to double the length and breadth, and so roll up longitudinally that they form a tube not more than one-third of the width, the leaves of the two pairs rolling or turning in opposite directions.

Together with these changes in size and shape, there are others in color and taste. The external side of the petal, all that is now visible, becomes pure white, contrasting with the dark background of the sepals; and instead of being thickened and tasteless, or with a slight acrid taste, as is usual in so many of its congeners, like the clove and other species, it has now become soft and very sweet, and without any acridity.

The dark blood-red stamens, to the number of about fifty or sixty, are about eighteen millimetres in length, thickened and stiff, and expanding above into a crown more than an inch in diameter. The anthers lie horizontally, and liberate their bright yellow pollen nearly at the same time that the petals reach their complete development. The single pistil is likewise firm and stout, and extends above the plane of the anthers. As an unusual occurrence, there were found at one time

flowers in which one or more of the sepals had been transformed into petals, as shown in fig. B; and, from their evident relation to each other, the author notices the fact as deserving the attention of those who would speculate upon laws of variation and heredity.

From the description it will be seen that the flowers are conspicuous, having deep-yellow pollen, dark blood-red stamens and pistil, snow-white petals, and dark sepals, all unhidden by the foliage. But, notwithstanding this conspicuousness, the flowers are seldom visited by bees, there being, as was found, little or no nectar or honey to attract them. Even in cases where bees were observed upon the flowers, the prominent pistil did not readily admit of fertilization. The author was surprised, however, to find that soon after blossoming very many of the petals were severed near the middle, or at the base, by a single strong incision. By watching he soon discovered the cause to be birds of the genus Thamnophilus. These birds, of which the male is black and the female brown, alighted usually upon a branch above the one on which a flower was in bloom, and, reaching downward, bit off the petals; but, in so doing, either the neck or forehead invariably came in contact with the anthers, and brushed off the pollen, leaving the flower as seen in fig. C. Whether birds of this genus, especially in the more normal habitat of the tree in the higher lands of Brazil, are the only agency of cross-fertilization, or whether other birds share in it, remains to be discovered.

In Europe it is only exceptionally that birds are attracted by flowers. Sparrows sometimes bite off the flowers of the yellow crocus, and the bullfinch will pluck with inherited dexterity that portion of the under part of the primrose which contains honey. No adaptation has hitherto ever been observed where such mutilations of the blossom were of direct advantage to the plant, and the present example of Feijoa is therefore the more remarkable for the high degree of perfection which this adaptation has reached. Instead of the sweet petals being spread out for ornament alone, out of which the bird could pluck but a small portion, they become rolled up, thus permitting a larger part to be bitten off, and presenting greater attractions. The stout, firm anthers, and pistil, are likewise adaptive, insuring the clinging of the pollen to the feathers of the bird, and thus its ready transportation from one blossom to another.

How these adaptations have been brought about can scarcely be conjectured, as the genus is widely removed from the allied genera, and there are no intermediate forms.

PROFESSOR HUGHES ON SELF-INDUCTION.

THE recent researches of Prof. D. E. Hughes, president of the Society of telegraph engineers and electricians, have been extended by him, and his latest results will be published in a forthcoming number of the *Society's journal.* We are enabled to give some account of these researches from an account published in *Engineering.*

The extra resistance of a wire during the 'variable period,' that is to say, when the electric current entering it is rising to its normal strength, has been shown by Professor Hughes to proceed from an extra current of opposite name self-induced in the wire. He finds, however, that there are cases in which this effect is reversed, so as to produce less resistance in the wire during the variable period. Such cases occur when extremely fine wires are being tested with powerful currents; for the steady current heats the wire, thus introducing an extra resistance. The induction-bridge of Professor Hughes enables him to study and analyze these effects, tracing them to their true cause.

Professor Hughes has lately been investigating the self-induction of coils, as well as of straight wires, and the following table gives his result:—

Coils formed of 3 metres of silk-covered copper wire 1 millimetre in diameter, each coil being 3 millimetres in diameter.	Comparative force of the extra currents.
One coil alone	100
Two similar coils in series	174
Two similar coils in parallel, but separated 5 centimetres from each other	55
Same two coils in parallel, but superposed	81
One single coil of thicker wire of exactly the same form, length, and resistance as the two coils in parallel	75

This table shows an increase of the self-induction when the two coils are in series, but not quite double the effect, as there is an increased or added resistance. This result is well known; but a more interesting result is obtained where the two coils are parallel and separate, giving 32 per cent less self-induction than when they are superposed, and 26 per cent less than that of a single coil of the same resistance. Professor Hughes traces this result to the reaction of contiguous coils on each other.

With regard to the self-inductive capacity of non-magnetic wires of different metals, but of the same lengths and diameters, Professor Hughes finds that when non-inductive resistances, say, of carbon, are added to the wires to bring them to equal resistance, there is apparently no difference in the self-inductive capacity of all the metals he has yet tried; but if, instead of adding a supple-