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 supplementary resistance of carbon, the wires are taken of the same length and resistance, their diameters being different, he finds a marked difference in their inductive capacities. For instance: a pure copper wire, compared with a brass one of double the diameter, shows a much higher self-induction; and Professor Hughes remarks in this connection, that, as the diameter increases, the reactions of the current in the contiguous parts of the wire on each other become less. The following table gives some fresh values of the electromotive force of self-induction currents in wires and strips one metre long, that of a chemically pure copper wire one millimetre in diameter being taken as 100:—

Wires of the same diameter, but of different resistance, 1 metre in length.

Soft Swedish iron	500
Copper	100
Brass	65
Lead	50

Wires of the same resistance, but of different diameter, 1 metre in length.

Soft Swedish iron	400
Copper	100
Brass	88
Lead	81

Strips of the same width and thickness, but of different resistance, 1 metre in length, 12 millimetres wide, 1-10 of a millimetre thick.

Copper	60
Brass	48
Iron	45
Lead	85

Strips of the same resistance and thickness, but of different widths, 1 metre in length, 1-10 millimetre thick.

12 millimetres wide (copper)	60
42 " " (brass)	45
72 " " (iron)	39
96 " " (lead)	29

In the above table, wires of the same diameter follow in the order of their resistance, iron alone being the exception. The same order is preserved in wires of the same resistance, but of different diameters. In the latter case there is a nearer approach to equality, but they still show a difference of from 12 to 19 per cent; and, while the non-magnetic metals have increased their inductive capacity with increased diameter, iron has fallen 20 per cent: consequently wires of different metals of the same resistance have not the same inductive capacity, owing, probably, to the action of contiguous portions of the current, as Professor Hughes has already shown.

If we reduce the extra currents by employing thin sheets or strips, there is, in the case of iron, a still more remarkable difference, for in strips of different metals of the same width the force of the extra currents in iron is actually less than that in brass; and if we compare an iron strip with an iron or copper wire of the same resistance, we have, iron 500, copper wire 100, and an iron strip 45, or 55 per cent less than the copper wire.

In the case of wires a nearer approach to equality in inductive capacity is shown when they are of the same resistance, but in strips this is reversed; for here, when equality in resistance is produced by wider strips, the difference becomes greater, iron then having actually less inductive capacity than a lead wire of the same resistance. Professor Hughes attributes this remarkable result not only to the reactions of contiguous portions of the current being less in sheets or strips than in wires, but also to an imperfect formation of the circular magnetism which takes place in iron wires on the passage of an electric current. He has tried all forms of conductors, such as those of square, stellar, and tubular section; and all of them show a diminution of inductive capacity as compared with wires of solid circular cross-section. In solid conductors the maximum self-induction appears in those of circular section, and the minimum in wires formed into a flat strip.

While re-affirming his statement that the best lightning-rod is a flat strip of copper, or a galvanized iron strand wire, Professor Hughes has made experiments with American compound wires consisting of a steel core coated with copper, or a copper core coated with steel. He finds that the copper coating has an enormous influence in reducing self-induction in the steel. Without it the self-induction was found to be 350 as compared with a copper wire giving 100, whereas with it the self-induction was only 107, or 7 per cent more than copper alone. This effect is explained by the fact that the circular magnetism created by the passage of a current through an iron wire is produced chiefly on the exterior portion of the wire; and if this is of copper, it is practically suppressed. On the other hand, copper wire coated with steel has a greatly increased self-induction as compared with copper wire uncoated. It even has a higher self-induction than a solid iron wire, and its resistance in the variable period is proportionally greater than that of a soft iron wire. Professor Hughes has made numerous experiments on this point; and they all show, that, while copper in a straight wire or a single *wide* loop has a far lower inductive capacity than iron, it has, on the other hand, the property of being far more excited by the reaction of iron, so that a straight copper wire can be excited by this reaction to a degree greatly exceeding that of a straight iron wire under precisely the same conditions. Some of Professor Hughes's experiments illustrating this point may be cited, as they are of much practical importance. A copper and an iron wire of equal resistance, 1 metre in length, were measured for inductive capacity and resistance, the capacity of the copper wire being taken as 100, and the iron being 400. The copper wire showed an increased resistance, during the variable period, of 8 per cent, as compared with 128 per cent for iron; but a great change took place when each of these was placed in the interior of an iron gas tube of sufficient diameter to allow of the wire being insulated. The force of the extra currents in the copper wire then increased 350 per cent, while in the iron they increased 8 per cent, the force of the extra currents being now, for copper 450, and for iron 433.

The influence of an iron tube on the resistance of the variable period was still more marked. The copper wire which, without the exterior iron tube, had only 8 per cent increase, now showed 934 per cent; or, by direct measurement, 1 metre of this wire, during the rapid rise and fall of the current in the variable period, had a resistance the same as 10.34 metres in the stable period, — a much greater difference than was obtained with iron wire, which only showed an increase of 22 per cent. Thus copper shows three times the sensibility to an iron sheath which iron does, a fact of importance in electrical engineering. Iron is much less affected in self-induction by exterior influence than copper. Copper coils are much more sensitive to iron cores within them than iron coils, and the resistance of a copper coil may be in the variable period far more than that of an equal iron coil, if an iron core react within it. It is this fact, however, as Professor Hughes points out, which enables copper coils to be so effective in transforming energy in 'secondary generators;' and he remarks that a dynamo having its electro-magnet and armature wound with insulated iron wire, would, irrespective of its resistance, have an extremely low efficiency as compared with one wound with copper. As regards the resistance of either of those wires, Professor Hughes observes that there can be no doubt that the resistance of the armature of a dynamo, or, in fact, of any coil of wire, as measured during the stable period, gives no approximate indication of what its real resistance is during the period in which it is doing work. This remark bears out a recent suggestion to the effect that the resistances of conductors, apparatus, and standards, as measured by battery currents in the stable period, differ to some extent from their values when traversed by the rapidly fluctuating currents of a dynamo. A further investigation of the matter is required in order to find out its practical importance, if any.

The following table shows the influence of an iron tube surrounding a straight iron or copper wire compared with compound wires: —

WIRES IN IRON TUBE, EACH 1 METRE IN LENGTH.	Comparative electromotive force of the extra currents.	Approximate comparative increased resistance during the variable period (that of the stable period being taken as 1.)
Copper wire 2 millimetres diameter, alone	100	1.08
Same wire insulated in the interior of the iron tube	450	10.34
Same joined in the tube at both ends	275	10.00
Same in contact with the tube throughout its length	200	7.83
Compound wire (copper interior with steel exterior)	325	4.35
Soft Swedish iron, 2 millimetres diameter, alone	400	2.28
Same wire insulated in the interior of the iron tube	433	2.78
Same joined to the tube at both ends	240	2.70
Same in contact with the tube throughout its length	215	2.60
Compound wire (steel interior, copper exterior)	107	1.20

This table shows that the iron tube has a much greater effect on the copper wire than on the iron wire, the effect in both cases being at its maximum when the tube is insulated from its central conducting wire; for, while the wire is in contact with its tube, there is evidently a shunt action, or eddy current, between the outer coating and the central portion. This Professor Hughes has measured by means of a telephone between the wires and its sheath, and also between two concentric sheaths. When the sheath is joined to the wire at both ends, the electromotive force of the extra current is reduced, but the resistance during the variable period is little altered. If, however, as in a coated wire, the wire and sheath are in contact throughout, there is a marked decrease in this resistance. Thus Professor Hughes is of opinion that the shunting effect takes place locally and probably transversely. The passage of an electrical current then takes place with less opposing resistance from self-induction than would be the case if there were no internal partial neutralization of the extra currents.

ORIGIN OF FAT IN ANIMALS.

SINCE the researches of Dumas, Milne-Edwards, and others on insects, and those of Persoz and Boussingault on geese, it has been established that the animal organism has the power of elaborating fatty matters. It was formerly believed that such