President, supported by the Vice-Presidents, Mr. Solly and Sir William Ferguson, and many members of the Council and past Presidents, as Messrs. Hilton, Partridge, and Quain. The veteran artist, Mr. George Cruikshank, Mr. Hepworth Dixon, and other literary celebrities, were also present. At the conclusion of Professor Wilson's course he will be followed by Professor Flower, F.R.S., Conservator of the Museum, who will deliver eighteen lectures introductory to the study of the anatomy of the class Mammalia.

# ORIGINAL COMMUNICATIONS.

[Under this head we propose to publish Papers communicated specially to the pages of this Journal.]

## BRIEF REMARKS ON THE BIOLOGY AND GENEALOGY OF THE MARANTACEÆ.[1]

BY FEDERICO DELPINO.

IN TWO PARTS.—PART I.

DR. FREDERICK HILDEBRAND, Professor of Botany in the University of Freiburg (Baden), to whom we owe the discovery of many remarkable floral apparatus for the effectuation of Dichogamy,[2] writes, in his letter of the 8th of August, as follows:—

"I have been able to discover several novelties in the study of Dichogamy. For example, a very singular apparatus for the impollenization of *Maranta Zebrina*, where the pollen, before the opening of the flower, is deposited in a concavity which is found at the apex of the style. After the flower opens the style is found in such a position that when the petal which wraps it round is pressed, it bursts loose suddenly; and thus the pollen is carried on to the body which caused the pressure, and is afterwards rubbed off by the stigmas of the subsequently visited flowers during the same sudden escape of the style."

In consequence of this interesting notice, I proposed to study *M. Zebrina*, but could only get specimens of *M. bicolor* and *M. cannæfolia* in flower.

In both species I observed the sudden escape of the style, which is effected in identically the same manner as that described by Professor Hildebrand.

The apparatus, according to my observations on these two *Marantaceæ*, merits careful study and circumstantial description, which I shall attempt in the following pages.

The flowers of the Marantaceæ have become extremely irregular. Irregular flowers ought to be at least laterally symmetrical; but the Marantaceæ have lost all symmetry.

We adopt the term irregularity to follow common usage, but we entirely repudiate the signification of the word, as so-called irregular flowers constantly show signs of an extreme degree of morphological and biological perfection. And if this may be said of symmetrical irregular flowers, still more is it the case with those that have lost symmetry also. Therefore we may be prepared to find a singular biological perfection in the Marantaceæ.

When we consider them purely under a material and organographical point of view, we shall nowhere in the whole vegetable kingdom find flowers more transformed and extraordinary; therefore the right morphological interpretation of the parts is extremely difficult. The insertion of the organs is profoundly disturbed; to this is added an unequal adherence and fusion of the organs; and this again is complicated by the abortion of organs and parts of organs; and to crown this confusion there are petaloidal degenerations in all the stamens.

Comparative morphology, assisted by the doctrine of the variability of species, enables us to throw light on the morphological interpretation of the flowers of the Marantaceæ. We must compare the flowers of Strelitzia, of the Zingiberaceæ, of the Marantaceæ, of the Cannaceæ, and of the Orchidaceæ.

In the genus Strelitzia it is not difficult to see the order of the flower as it preserves perfect symmetry and a certain simplicity. Three sepals alternate with three petals, one of the latter being transformed into a cover for the nectary (*nettarotegio*), the other two forming a singular pollenical sheath or box, which can be opened only by the insect fertilizer. Five stamens, normally anthered, and a long style are situated lengthways within this sheath.

We must bear well in mind that in the Strelitzia, as well as in the other Musaceæ, there do not exist more than five stamens, one being completely aborted. Remembering this fact, we need not give ourselves the useless trouble of trying to find six stamens in the families which descend from the Musaceæ (that is, in the Orchidaceæ, Zingiberaceæ, Cannaceæ, Marantaceæ); and the attempt of those botanists who will insist upon finding hexandria in the type of the above-mentioned families—that is, a character which is not found even in their parent stock—appears fruitless.

This premised, let us pass to the Zingiberaceæ; let us, for example, examine the flowers of the *Kœmpferia longa*, Jacq. It is not difficult to find perfect homology in the flowers of the Kœmpferia with those of Strelitzia; that is so say, morphological, not biological, homology, since the dichogamical apparatus is quite changed.

The three sepals are distinguishable at first sight. The three petals are quickly recognized, if in no other way, at least by their perfectly alternate insertion with the three sepals. But in the Zingiberaceæ, as these petals do not serve the special biological purpose of those of the Strelitzia, they reacquire a quasi-normal form, whilst in the Strelitzia their forms are extremely abnormal. In Kœmpferia and in the other Zingiberaceæ we find the five stamens strangely metamorphosed, which, on the contrary, in the Strelitzia are normal. Four assume the form, the appearance, and the function of petals. Two of these four are united to form a kind of labellum,[3] often bilobed. The fifth stamen is much elongated, and is profoundly furrowed, not only along the whole filament, but along the connective. The whole length of the style is enveloped in this profound furrow in such a way that the stigma emerges from the extremity and is placed above the apex of the anther, thus making impollenization impossible without the intervention of special insect fertilization.

We thus show that not one of the floral organs of the Strelitzia and other Musaceæ is wanting in the Zingiberaceæ.

The morphological and genetical transition from the Zingiberaceæ to the Marantaceæ and Cannaceæ can be seen without difficulty. In this genealogical research, moreover, to those who have set out in the true road, a most beautiful teratological case has been offered in a flower of *Alpinia nutans*.

The Alpinia, like all the Zingiberaceæ, has a bilocular anther. Now, in the above-mentioned monstrous flower, one lodge is aborted, and the corresponding part of the connective is extraordinarily elongated and dilated, assuming a petaloidal form. In short, that which has happened accidentally in this flower, takes place normally in the Cannaceæ and Marantaceæ, *where one of the five stamens inherited from the Musaceæ becomes petaloidal like the other four, one lodge of the anther*

[1] "Breve Cenno sulle Relazione Biologiche e Genealogiche delle Marantaceæ," di Federico Delpino (*Nuovo Giornale Bot. Ital.*, vol. i. No. 4, 1869).

[2] This term, Dichogamy, was first used by C. C. Sprengel to express the remarkable fact, that in many hermaphrodite flowers the male and female elements are not matured at the same time, so that these flowers must be crossed with another flower on the same plant, or on a distinct plant. The anthers are generally mature before the stigma; but in some few cases the stigma is mature before the anthers. The crossing is usually effected by insects, and such flowers are called by Delpino Entomophilous.—ED.

[3] Properly speaking, according to the data of the biological and dichogamical doctrine which we are defending, the labellum serves at once a double function, that of signal-flag (to attract the insect-fertilizers with the brightness of its colour), and the function of support (to give them a convenient landing-place for sucking the honey).

This labellum might be taken for a single organ in the Zingiberaceæ; but, after having indicated the origin of it in the *Globba bracteolata*, we may be sure that it is double in reality. Wherefore, it ought to be still considered as two stamens metamorphosed into petals and united laterally.

*aborts, the other lodge develops, folds longitudinally, and in its folding embraces the style.*

It is only with these premises that we can give a satisfactory explanation of the true morphological signification of the floral organs of the Marantaceæ, notwithstanding the extreme perturbation to which they have been subjected.

Coming first to *Maranta bicolor*, we find that its flowers and all its floral parts preserve a complete morphological homology with the flowers of Strelitzia.

Three petals always alternate with the three sepals, though distortedly. We find again the five stamens, but they are all, including the polleniferous one, petaloidal. Besides this, they differ extremely from each other. Two are dilated and soft; one is fleshy and rigid; the fourth is folded, and on one side carries a callosity surmounted by a tooth; the fifth is semi-anthered.

With considerable trouble I discovered the morphological value of these greatly metamorphosed parts; but if I should ask a morphologist pure and simple to explain the why of this metamorphosis, I know I should cause him great embarrassmennt. But for the biological morphologist it is quite apparent, and a most singular dichogamical apparatus is revealed.

The flowers of the *Maranta bicolor* have assumed the general character of the papilionaceous type.[4]

The two petaloidal and expanded stamens, inclined towards the lower lip, have the functions of signal-flag and landing-place; the stamen, having a thick and rigid consistency, is situated at the upper lip, and forms a kind of vault, marked across with a particular dark spot (the guide to the nectary, according to C. C. Sprengel), and has thus taken the function of indicating and constituting the entry to the nectary.

The nectary is formed by a tube proceeding from the soldering of all the floral parts at the base. The nectary gland is a salient glandulous point, which lies in the bottom of the nectary.

The fourth stamen, folded along its whole length, and unilaterally provided with a callosity surmounted with a tooth, has an extremely important function, which comprises in itself the soul of the apparatus.

The style when very young and still growing is straight; but by degrees, as it develops, the cells of the upper part increase somewhat differently from those of the lower part, acquire an extreme tension, in such a manner that its natural position would be, if at liberty, a spiral coil in one plane. But as it is closely embraced by the above-mentioned fourth stamen, which has the function of a retainer and keeps it extended, it is therefore obliged to remain in a straight position.

The callosity, which the fourth stamen carries at one side, is chiefly of use to maintain the style in this forced position. This callosity is placed astride on the style, and prevents it escaping and coiling in a spiral. The fact that this callosity is surmounted by a tooth must be kept in mind.

The fifth stamen, which bears half an anther, finishes its work before the opening of the flower. It is applied in an early stage to the neck of the style, where a small depression is found; the half-anther, which is dehiscent before the opening of the flower, sheds all its pollen into this same depression. The stigma is lateral, but, although close to the depression in the style for collecting the pollen, is separated from it by a short space, which is covered with white viscous matter.

After the flower is open, the apparatus is all ready. The landing-place for the approach of the insects, as well as the style, bound and incarcerated by the fourth stamen, are situated in the lower part. The stamen, which is metamorphosed into an entry and indicator to the nectary, at this time abounding in honey, is situated in the upper part.

An insect on alighting drives its head into the aperture of the nectary to suck the honey, presses with its abdomen on the style (which increases the tension), and moving the tooth before mentioned somewhat with its proboscis, dislodges the callosity, and thus causes it to lose hold of the style. The style, henceforward free and unbridled, bursts loose with violence, strikes against the abdomen or the sternum of the insect, smears it with viscid matter, and deposits its pollen on the viscous matter; the stigmatic orifice, opportunely open, receives the pollen deposited by a like process on the insect's body from flowers visited before.

In this species of Maranta, the stigma in escaping winds itself rapidly into a flat spiral, and thus obstructs the way to the nectary, so that the flower cannot be visited more than once, and the cession of its own pollen, as well as the reception of foreign pollen, takes place at the same moment.

The apparatus of *Maranta cannæfolia* is identical, with the exception of some slight variations. The style in escaping does not form a spiral, but simply curves, and remains pressed with great force against the entrance of the nectary, henceforward preventing access to it.

Besides this difference, the flowers are more regular, in consequence of the abortion of one of the five petaloidal stamens. This abortion relates precisely to that petaloidal stamen which in the preceding species is of the least utility. In the *Maranta bicolor* the functions of signal-flag and landing-place were accomplished by two petaloidal stamens. Now an advantage is gained by these functions being accomplished by one organ alone. This, also, denotes progress in the evolution of the biological idea, being a more perfect division of labour, and numeral correspondence of the functions with the organs. Thus in the *Maranta cannæfolia* and the allied Marantæ we have one stamen with the function of signal-flag and landing-place, another with the function of door and guide to the nectary, a third with the function of pistil-retainer, and a fourth with the polleniferous function.

If a virgin flower of this Maranta is examined, the stigma will be found to project from the extremity of the inclosing and retaining staminodium with the mouth wide open ready to gather heteroclinous pollen. A short ridge of this staminodium is bent like a hook, and is attached to one of the margins of the stigmatic cavity, in order to aid the function of bridle.

In the genus Calathea, as far as one can judge from the figure which is given in the *Botanical Register*, the apparatus, particularly in the singular arching of the style, must be identical with that above described. But in the *C. flavescens* of Rio Janeiro (*Bot. Reg.* t. 932), the long and narrow floral tube would indicate its insect-fertilizers to be Lepidoptera and humming-birds; whereas, in other species, *C. grandiflora*, *C. violacea*, &c., and in the above-mentioned Maranta all the structure points to apiferous insects.

The *Phrynium coloratum*, if the figure of the style given by the table 3,010 of the *Bot. Mag.* can be trusted, must likewise possess an identical apparatus. This Phrynium appears to us a plant exactly intermediate between the genera Maranta and Thalia. The genus Thalia now alone remains to be examined, to verify whether or not the apparatus primarily discovered by Professor Hildebrand in the *Maranta Zebrina*, is common to all the Marantaceæ.

Florence, Sept. 7, 1869.

[4] Irregular flowers, for the most part, are neither erect nor pendulous; but are more or less conspicuous (*patenti*), and then they commonly conform, by the design of the entomophilous structure (that is, a structure requiring the aid of insects for fertilization), either to the labiate or papilionaceous type. The general characters of the labiate type are the situation of the bait at the inferior part, and the anthers and styles in the superior part; thus the insect-fertilizer effects the transference of the pollen with its back. The general characters of the papilionaceous type are the situation of the bait in the superior part, and of the generative organs in the inferior part; so that the insect effects the dichogamy by means of the abdomen and sternum.

**Observatory on Mount Ararat.**—We learn from the *Journal of the Society of Arts* that the Russian Government have resolved to establish an astronomical and meteorological observatory on this mountain, situated near Tiflis, in consequence of the excellent report given by M. Piazzi Smyth of the fitness of such high situations, deduced from his experience in the Pic de Teneriffe.

in the Christ Church Laboratory on Tuesdays and Thursdays at 10 o'clock. These lectures will be experimental, and are intended for those who are commencing the study of mechanical philosophy. The first lecture will be given on Tuesday, February 15. A fee of £1 for each course is required from those who are not members of Christ Church.

A NEW illustrated monthly journal is announced to come out on March 1st, entitled the *Photographic Art Journal*, which will be illustrated with photographs printed in permanent pigments. Mr. Thomas Sutton is to be the editor.

AN Aurora of considerable beauty was visible on the evening of February 1st. A description of it appears in our "Correspondence." One writer notes a point of interest, namely, that both this display and the one on the 3rd ult. occurred shortly after the breaking up of a sharp and continued frost.

SIR JOHN LUBBOCK is now engaged on a work on the origin of civilization and the primitive condition of man. The first volume, on the moral and social condition of savages, is in the press, and will shortly be published by Messrs. Longmans.

THE education question still excites great interest. Several important meetings have been held during the week in different parts of the country. The proceedings were in all cases of the usual preliminary nature.

MOVING bogs are no novelty. We may however, chronicle the fact that nearly an acre of one of the Tipperary bogs became detached a few days since and floated to a distance of eight or ten perches.

DR. OLDHAM, the director of the Geological Survey, has given so favourable a report on the extent of the Chanda coal-deposits, as certain to supply the railway for 250 miles from Nagpore to its junction with the main line at Bhosawul, that a railway is to be surveyed from Wurdah to Chanda and the Godavery, so as to render the expense of cutting the third barrier of that river unnecessary.

MR. R. J. WATSON, senior in the Natural Sciences Tripos, December, 1869, has been elected to a studentship in Natural Science, at Queen's College, Cambridge.

THE new Barbette gun-carriage, made on the model of Captain Moncrieff, for a 12-ton gun, in the Royal Carriage depot of the Arsenal, Woolwich, was tested at the Arsenal proof butts in the presence of a host of military and scientific gentlemen interested in gunnery, amongst whom were Major-General Sir Hope Grant, Major-General Sir D. Wood, Major-General Sir J. Simmons, &c. Three rounds were fired with 240 lb. shot, viz., 30 lb., 40 lb., and 43 lb., all being effected with satisfactory results; and the inventor, at the close of the experiments, received the congratulations of the Ordnance Committee and the officers present.

AT its last meeting the Metropolitan Board of Works passed a resolution approving the report of the Royal Commission on Water Supply, and requesting the Chairman to seek an interview with the Home Secretary in order to ascertain whether the Government intend to move in the matter.

OWING to the state of the weather, telegraphic communication had practically ceased yesterday morning throughout the United Kingdom. Nottingham, Leeds, Sheffield, Hull, Newcastle, Brighton, and Southampton, were the only stations in communication with London. The Irish and Scotch wires had broken down. Liverpool and Manchester could not be reached. The fifteen western wires had been cut between Holborn and Paddington, and on an attempt being made to carry on communication from the latter station, it was found that no message could get beyond Reading. The Atlantic cable was out of order also.

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## BRIEF REMARKS ON THE BIOLOGY AND GENEALOGY OF THE MARANTACEÆ.[1]

BY FEDERICO DELPINO.

IN TWO PARTS.—PART II.

WE must premise that for at least three years we attempted to decipher the biological signification of the floral structure in *Thalia dealbata*, and always without result. Finally, the discovery of Hildebrand placed us in the true road, and although, owing to the advanced season, we had only two or three flowers of the *Thalia dealbata* at our disposal, we succeeded in understanding its construction.

In this species the bursting loose of the style happens in an analogous manner to the above-described cases, and the difficulty of understanding the phenomenon consisted in the fact that, whilst in the Maranta the escape of the style is easily understood—as the style is sufficiently external—in the *Thalia dealbata*, on the contrary, it is somewhat turned inwards, and its escape happening in the interior of the flower cannot be easily understood except by one who anticipates a structure of this nature.

The differences offered by the flowers of the *Thalia dealbata* are slight. The apparatus may be considered as doubled. The inflorescence consists of a panicle terminating in bifloral spikelets, where the two flowers, wrapped up by a common bract (gluma) and by a bicarinate opposite bract (glumella),[2] flower contemporaneously, the one on the right the other on the left. These twin flowers, each of which taken separately is not symmetrical, are when taken together in perfect symmetry, as the parts of the right flower are inversely disposed to the homologous parts of the left flower. This would appear to point to unity of conception, and thus we should have in each spikelet of Thalia a true bifloral composite flower, and a double or bilateral dichogamical apparatus.

Hence the Thalia would occupy a higher rank in the scale of organical composition and of biological perfection than the other Marantaceæ. The structure of the style and the stigma is also somewhat more elaborated. The cavity in which the anther deposits the pollen is better marked, the viscid region is more extended, and the stigmatical cavity is deeper.

Finally, the style in escaping does not bend either into a curve or into a flat spiral, but coils into a helix.

The *Thalia dealbata*, which we have already observed for more than three years, matures seed in abundance at Florence, and its flowers are frequently visited by the common bee.

The Cannaceæ are closely allied to the Marantaceæ. Here also the pollen is deposited on an expansion of the style; but the dichogamical apparatus in the Cannaceæ is entirely changed, as it conforms to the labiate type.

The Orchids, however, show great marks of affinity with this group of plants. The most probable conjecture is that they

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[1] "Breve Cenno sulle Relazione Biologiche e Genealogiche delle Marantaceæ," di Federico Delpino (*Nuovo Giornale Bot. Ital.*, vol. i. No. 4, 1869).

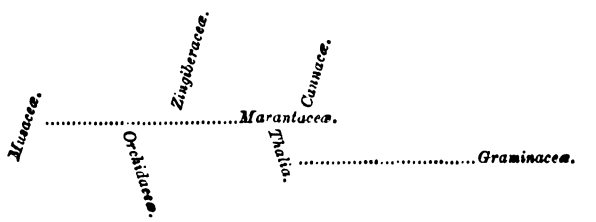
[2] We have the most profound conviction that the Graminaceæ are one of the descendants of the Scitamineæ, and, more precisely speaking, the descendants of a stock related to the type of the Thalia. In the organs of vegetation the most surprising conformity is found. After comparing the Graminaceæ and the Zingiberaceæ, the following common characters are observed:—*Nodous rhizoma, contorted in a similar way, leaves identically sheathed, ligulate* (!), *convoluted before foliation* (!), *distichous* (!). The culm, then, of *Thalia dealbata*, its panicle and bracteæ, are evidently the culm, panicle, and bracteæ of the Graminaceæ.

Then, in speaking of the Thalia, it may be permitted to use the expressions—culm, ligula, bifloral spicule, glume, bicarinate glumella.

We must not conceal the enormous differences which are met with in the flowers; but we ought to remember that the Zingiberaceæ are eminently entomophilous, whilst the Graminaceæ are become purely anemophilous—that is, feecundated exclusively by the wind; whence it is rational that with regard to these last, the coloured *involucres* should be quite aborted, and the stamens should have acquired long filaments.

Dichogamy would explain such differences up to a certain point.

are descended from a type till now unknown, which ought to reunite some of the characters of the Zingiberaceæ and of the Marantaceæ; that is to say, ought later to be the progenitor of both. In truth, the Orchidaceæ have a bilocular anther, like the Zingiberaceæ; a gynostema and a stigma somewhat analogous to that of the Marantaceæ and Cannaceæ.[3] Wishing to represent in a just and graphic manner our method of looking at the conjectural parentage of these plants, we give here a sketch of a genealogical tree, where the intermediate unknown types (true hypothetical roots, comparable to those which are of so much use in the study of organic chemistry) are shown by a linear series of dots.




Comparing these plants under the biological aspect of their dichogamical adaptations, they present enormous differences. If we take a flower of *Strelitzia regina*,[4] a flower of an Orchis,[5] a flower of Alpinia and of Hedychium,[6] a flower of Maranta, and finally a flower of Canna,[7] we shall find that the dichogamical apparatus differs fundamentally in each form; but it is remarkable that, notwithstanding this extreme diversity, there is something common to all, namely, the part which viscosity takes in securing dichogamy.

In the Strelitzia the pollen grains are united by viscous threads, in an analogous manner to that which happens in many Onagrariaceæ and Ericaceæ.[8] The stigma also is extremely viscid. In the Orchidaceæ viscidity is the means by which the pollen grains are united into pollen-masses and caudicles, and by its agency, the pollen-masses adhere in so strange a manner to the body of the insect-fertilizer. In the Zingiberaceæ the viscidity is produced from the margin of the dehiscent anthers, and causes the pollen to adhere to the back of the insects.

In the Marantaceæ viscidity is produced by the style in the narrow space which separates the depression where the pollen is deposited, from the stigmatic cavity.

Finally, in the Cannaceæ viscidity is entirely transferred to the pollen; in fact, the pollen adheres to the greatly polished surface of the style, on which it is temporarily deposited, until it is carried away by the insect-fertilizer.

The dichogamical apparatus of the Marantaceæ resembles in certain points that of the Cannaceæ. Whilst in the case of the Musaceæ, the Zingiberaceæ and the Orchidaceæ, the pollen is immediately ceded by the anthers to the insect-fertilizers; in the Marantaceæ and the Cannaceæ it is previously deposited on an expansion of the style. If we review the flowers of phanerogamic plants, we find such expedients repeat themselves in various families; that is to say, in the Campanulaceæ, in the Goodenoviæ, in the Brunoniaceæ, in the *Spigelia Marylandica*, and in the Proteaceæ. As might be expected in all these plants, the dehiscence of the anthers and the shedding of the pollen takes place before the opening of the flower, whilst it is likewise logical that in the case of all other plants it happens after the flower is open. To this *à priori* speculation the facts correspond, and with the above-mentioned plants, where the pollen is provisionally deposited from the anthers on the style, the dehiscence of the anthers always happens before the flower opens.

But neither the viscidity, nor the pollenical deposition constitute the most wonderful adaptation in the floral apparatus of the Marantaceæ. The fundamental adaptation which modifies all the other characters is the springing forth of the style. It forms, so to say, the soul of the apparatus. Elasticity which, in human industry, is employed with such frequency and profit, has been also made use of in the vegetable kingdom for biological aims or those belonging to the external life of plants.

We will not discuss the different kinds of elasticity employed for the purpose of dissemination (for example, in the genera Geranium, Oxalis, Momordica, &c.), and we will only mention some of the kinds which are employed in cross-fertilization.

In the family of the Orchids there is a trimorphic genus, of which one form is called Catasetum (masculine form), another Myanthus (hermaphrodite form), and the third Monachanthus (feminine form), in the erroneous belief that they form three distinct genera. Now, in the form Catasetum, if two irritable filiform processes, which exist in the flower, are touched, they cause the pollen-masses, which are extremely elastic, and are held for this purpose in a forced position to be ejected and shot against the insect-fertilizer, which has irritated the said processes, and by means of their viscous glands stick fast to a certain part of its body. This singular phenomenon, which has been described by C. Darwin, in his work on *The Fertilization of Orchids*, cannot be compared to that of the Marantaceæ, as it relates to the elasticity of the pollen-masses, not of the style.

Neither can it be compared with the elasticity of the ten stamens in the genus Kalmia, where the insect-fertilizer, entering the flower to suck the honey, and drawing the filaments somewhat backwards, causes the anthers to burst over it, and thus, strikng on its body from ten different sides, must cover it well with pollen, and necessitate promiscuous nuptials which otherwise could not take place.[9]

Professor Hildebrand has described and figured a case which is less dissimilar, in the *Bot. Zeit.*, August, 1866, pp. 75-76, tab. iv., figs. 10, 11, 12, 13. The *Lopezia coronata* is diandrous, or possibly monandrous, possessing a vertically projecting stamen with a well-developed anther, and from the lower part a staminodium which has a function precisely identical to that

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[3] The semi-anthered stamen of the Cannaceæ and the Marantaceæ is fused below its middle with the style: whence it represents a true gynostema, comparable to the more evolved and perfect one of the Orchidaceæ. The short viscid region of the style of the Marantaceæ is homologous with the viscid rostellum of the Orchidaceæ, under the morphological, as well as the physiological and biological aspects.

[4] See Hildebrand, *Bot. Zeit.*, July 30, 1869, pp. 508-509; and my publication, *Ulter. Osserv. sulla Dicog. a* pp. 222-223, vol. xii. *Degli Atti della Soc. It. di Sc. Nat. in Milano*, 1869. The observations on the flowers of Strelitzia come from Professor Hildebrand, as well as facts and figures contemporaneously and independently collected by me.

[5] See Charles Darwin, *On the various Contrivances by which Orchids are Fertilized*. London: 1862.

[6] See my publication, *Sugli Appar. della Fecondaz. nelle piante Antocarp.*, pp. 22, 23. Firenze: 1867. The Alpinia is a type of the floral structure which requires fertilization by bees. In the Hedychium, instead of the Zingiberaceous apparatus, we find adaptation for the action of lepidopterous insect-fertilizers. In fact, in nearly all the stigmas of old flowers of several Hedychiums, I noticed that some scales of Lepidoptera had stuck.

[7] See *Sugli Appar. della Fecondaz.* &c., p. 23.

[8] This phenomenon is most evident in the species of Œnothera, the flowers of which are nocturnal, and open in the evening, indicating thus their exclusive fecundation by means of nocturnal or semi-nocturnal moths. One of these insects flying over a flower, and driving its proboscis into the honey-tube cannot fail to collect great festoons of pollen, part of which will be gathered by the humid and viscous stigmas of the flowers which are subsequently visited.

It is singular that this arrangement of viscous pollenical festoons, which constitutes the principal adaptation of the dichogamical apparatus of *Œnothera biennis* should have totally escaped C. C. Sprengel, notwithstanding his having perceived, with marvellous sagacity, the other relations both of the fecundation and dissemination of this species. (See *Entdeckte Geheimniss d. Nat. im Bau und in d. Befruchtung der Blumen*, pp. 217-223. Berlin: 1793.) In page 221, *loc. cit.*, Sprengel writes:—"I have never observed diurnal insects on its flowers" (of *Œ. biennis*) "except ants. But these cannot fecundate them. One rainy day, however, when the weather was dull, I perceived in my garden, at 11 o'clock a.m., a tolerably large crepuscular moth, which visited the flowers of this species and of *Œ. muricata*. His trunk was straight and nearly as long as his body. He drove it in the honey receptacle" (*Safthälter, nectaroconcha*), "remaining, by means of the rapid beating of his wings, free, suspended, and immovable in the air, in such a way that he sucked the honey without danger of being bathed by the drops of rain which were in the petals. I tried to catch him, to see if his body, and especially the wings had gathered pollen, but I could not manage it."

Let it be observed that without examining the insect, it suffices to imitate the action of the sucking trunk with a small thorn or bristle, to see large festoons of pollen adhere to it.

[9] See *Atti della Soc. It. di Sc. Nat. di Milano*, vol. xii., 1869, pp. 121, 122. In this genus, if insects do not aid, neither dichogamy nor homogamy can take place.

of the Marantaceous staminodium which acts as a retainer. In fact, instead of the anther, a petaloidal cochleariform ridge is developed. This ridge embraces the anther of the superior stamen, which remains thus constrained in a forced position, and sub-tense towards the inferior part. When an insect strikes the cochleariform ridge, this escapes from top to bottom, whilst the anther escapes from bottom to top, and covers the insect-fertilizer with pollen in the corresponding part, when it will be placed in the mature flowers precisely at the point where the stigma is developed, for the Lopezia is eminently proterandrous [*i. e.*, the stamens mature before the stigma—Ed.]; the cross union between the stigmas of the mature flowers and the pollen of the young flowers by means of such elasticity is thus secured. Therefore this apparatus differs from that of the Marantaceæ, as the elasticity is in the stamens, not in the style.

But in several Leguminosæ we finally meet with an apparatus which repeats in a marvellous manner the general and special adaptation of the Marantaceous flowers.

Professor Hildebrand (*Bot. Zeit.*, 1866, p. 74) and ourselves (*App. fec. nelle antoc.*, 1867), with little divergence of view, and not knowing the one of the other, observed the said apparatus in the Medicago. But it also exists in the Indigofera, in the *Cytisus canariensis*, *C. albus* (Hildebrand, l.c.); in the *Genista pilosa*, *germanica*, *genuensis*, in the *Spartium junceum* (see *Atti della Soc. Ital. della Sc. Nat. in Milano*, 1868, vol. xi., pp. 311-317).

A few days ago in the botanical garden of Boboli, I noticed a similar and equally perfect apparatus in several species of Desmodium.

The apparatus for allowing the escape of the pistil, in almost all these Leguminosæ, offers surprising analogies with that of the Marantaceæ. The situation of the nectary (when it exists) at the base of the upper lip, the situation of the landing-place on the lower lip, the manner in which the style is forcibly retained, the escaping of the latter, the projection of the homoclinous pollen against the abdomen of the visiting insect, the simultaneous abrasion of heteroclinous pollen by the stigma, are all facts which occur from the same cause and with like effects in the above Leguminosæ as in the Marantaceæ.

In the genera Medicago and Indigofera, besides the bait of pollen, there is also the bait of honey; when the escape of the style has happened, the stigma rising up to the upper lip, closes definitively the access to the nectary; wherefore its flowers cannot be visited by insects more than once. We see the very same thing in the flowers of the Marantaceæ.

Thus these wonderful congruities are revealed in plants so different as are the Marantaceæ and the Papilionaceæ—congruities which confirm the real and not fantastical existence of this which we denominate "the papilionaceous dichogamical apparatus."

Florence, Sept. 7, 1869.

## ON ORGANIC MATTER IN THE AIR.

BY DR. ANGUS SMITH, F.R.S.

I HAVE worked and written so constantly on impurities in air and water that last year I was told by a periodical of high position that I was quite regardless of the impression made on timid persons, and I began to compare myself to a collector of "varieties," who is often obliged to bring up his curiosities every five years. When I read of the new experiment by Professor Tyndall, showing to the naked eye the numberless bodies in the air, I was abundantly gratified, as I obtain them only by a laborious although simple process. When, however, Dr. Tyndall began to show the character of these bodies it "smote the chord of self," as I imagined that I had long ago proved that not only organic and inorganic, but organized forms exist in the atmosphere. Neither do I claim this as my original idea, looking rather to the fulness of proof and quantitative results as mine. I think, therefore, I may remind my friends of some of my work, as I find that they forget, and even I forget, the exact words used by myself, and must read up.

But as people don't read much on a subject, I will begin at the end. I have been for two years attempting to measure the amount of putrescible matter in the air of the towns and country places, and I have succeeded to a considerable extent. I also measure the amount that has putrefied and left its remains in the air—the sewage of the atmosphere. Some of my results are published; I have promised some very soon, and some have been ready for printing, under the head of *Chemical Climatology*. The proof of organic matter is old. I seek the quantity in various towns and parts of towns.

I shall not here give a history of the inquiries. So many people claim to have something to say in the matter, that I might amuse myself, if not the public, by a long account. At present I profess to keep almost entirely to my own work. The knowledge of organic matter in the air has never been absent entirely from men's minds in historic times; but the words of Bishop Berkeley are so clear that I prefer to quote them. Besides, he is far enough back for the purpose. He says in *Siris* (par. 140):—

"Nothing ferments, vegetates, or putrefies without air, which operates with all the virtues of the bodies included in it, that is, of all nature. . . . . The air, therefore, is an active mass of numberless different principles, the general sources of corruption and generation; on the one hand, dividing, abrading, and carrying off the particles of bodies, that is, corrupting or dissolving them; on the other, producing new ones into being, destroying and bestowing forms without intermission."

And in paragraph 141 he says:—

"The seeds of things seem to be latent in the air, ready to pair, and produce their kind whenever they light on a proper matrix. The extremely small seeds of ferns, mosses, mushrooms, and some other plants, are concealed and wafted about in the air, every part whereof seems replete with seeds of one kind or other. The whole atmosphere seems alive. There is everywhere acid to corrode and seed to engender. Iron will rust and mould will grow in all places."

No man has before or after him expressed this truth more completely and beautifully. It is hard to improve it by one word. Still, this age demands more detailed knowledge and exact theory; besides, the work of every few years requires to be done again to suit modern methods, although it must be confessed that there is room for the cynic to say that Bishop Berkeley and all the ancients and moderns might be classed with Topsy, who think they have explained all by saying, "It grows."

I began to examine the air in 1846, and I brought a short notice before the Chemical Society: a simple mode of obtaining organic matter in the condensed breath on windows is recorded in their *Transactions*. On account of this commencement which promised favourably, the British Association requested me to report on the subject. My report, published in 1848, was considered to have made advance, and was marked out for special mention by the president of the succeeding year, so that the words were not hidden. I quote a part. "That animals constantly give out a quantity of solid organic matter from the lungs may readily be proved by breathing through a tube into a bottle, when the liquid, or condensed breath, will be collected at the bottom of the bottle; or by breathing through a tube into water, when a solution of the same substance will be found in the water. This would scarcely require proof if we consider that breath so frequently has an organic smell."

"If this condensed breath be put on a piece of platinum, or on a piece of white porcelain, and burnt, the charcoal which remains and the smell of organic matter will be conclusive. If it be allowed to stand for a few days (about a week is enough), it will then show itself more decidedly by becoming the abode of small animals. These are rather to be styled animacules,