The Life-History and Habits of Diaxenes dendrobii, Gahan, with Notes on Prevention and Remedy.

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With Plates I. and II.

It is safe to say that scarcely a year passes in which our country does not receive from other countries accidental additions to its insect fauna, these additions being either individuals of an already native species whose numbers are thus swelled, or perhaps quite new species. Such insects as aphides or scale-insects, which feed externally, may be introduced on nursery-stock or fruits, to which they are securely anchored by a proboscis. Apart from these, many insects pass a part or much of their life in the various stages of egg, larva, pupa, or adult, under the bark of trees, or in the wood itself, or sunk in the tissue of smaller plants; hence driftwood and imported timber and plants are fertile sources of the new insect additions above mentioned.

In my notes of the last two years, I have mention, as taken from driftwood, of living adults of such destructive forms as *Hylesinus piniperda*, *Pissodes notatus*, and *Bostrichus stenographus;* also of the living pupæ (the beetle being afterwards bred out) of *Lamia ædilis*, the Timberman, a coleopterous insect not common in our country. Again, a few months ago, in a piece of timber imported from America, I found on examination a living specimen of *Goes tigrina*, a North American longicorn beetle.

Notes, R.B.G., Edin., No. 1, 1900.]

Whether such new species on issuing continue to live and gain a footing will depend on climatic and other reasons.

Our purpose at present, however, is not to discuss the possibility of the acclimatisation of such insects as live in the open, but rather to emphasise the likelihood of damage and loss consequent on the presence of new injurious species of insects introduced with such plants as orchids, which are protected under glass and kept in a temperature resembling that of their native habitat—such surroundings favouring the chance of the parasitic insect obtaining a foothold.

One such imported orchid-pest—unfortunately now only too well known in our orchid-houses—is a species of *Xyleborus* which is injurious to the genus *Dendrobium*. More than once I have had the attacked pseudo-bulbs sent to me with the insect *in situ*, in all stages of development, the last case being one of an attack on *Dendrobium eburneum* from an orchid-house at Pitlochry, Perthshire, the plants having been supplied by a dealer in the middle of England.

Another such pest (also coleopterous) is *Baridium aterrimus*, a native of the Straits Settlements. I have received it along with damaged orchids from Penang, where it is especially harmful to *Cypripedium* and *Saccolabium*. There is at least one record of the presence of Baridium in England, a specimen having been determined by Mr. Waterhouse of the British Museum. This specimen was taken at Torquay on a species of *Phalænopsis*.

A third pest whose capacity for destructive work makes it much to be feared is *Diaxenes dendrobii*, the subject of this notice. Through the courtesy of Mr. Waterhouse, I am informed that since 1894 at least eight specimens of D. dendrobii have been sent to the British Museum from different parts of England and Scotland for determination.

Late in December, 1896, I was asked to visit an orchid-house in Midlothian where a number of the plants had been ruined by some agency or other, insects being suspected. Attracted by discoloured patches on the pseudo-bulbs of some of the plants, I cut these open, and in each case found the larva of a longicorn beetle.

The larvæ were of all sizes from very tiny up to evidently

full-grown ones. Some of these last I carried away with me, and at the Royal Botanic Garden, Edinburgh, bred out the imagines (six in number), these proving to be, as suspected, *Diaxenes dendrobii*. The adult beetles issued on

March 2nd, 1897.	March 15th, 1897.
„ 6th, „	„ 18th, „
„ 8th, „	„ 20th, „

With the six beetles thus won, I proceeded to work out the details of the round of life of the pest in one of the glass-houses at the Royal Botanic Garden.

POSITION OF DIAXENES AMONG THE COLEOPTERA.

The beetle is a longicorn belonging to the family Lamiidæ and the sub-family Apomecyninæ. The genus *Diaxenes* was founded in 1884, the type being a beetle found in a Chelsea nursery on *Dendrobium Plalænopsis;* this beetle was named *Diaxenes taylorii, W.* The only other species of the genus is our pest.

DESCRIPTION OF IMAGO.

I quote in full the description given in the "Annals and Magazine of Natural History" for 1894 :—

"Strongly and rather closely punctured, with the punctures partly concealed by the close pubescence, this is mostly of a fulvous-brown or drab colour, but there are darker brown areas on some of the interspaces between the whitish lines; the pronotum bears three white lines—one median and one towards each side, the two latter converging anteriorly. Each elytron has about six lines of a slightly yellowish tint, of which one lies along the outer margin; the second sets out just below the shoulder and is continued in a nearly straight direction along the side of the elytron; the third proceeds from the upper part of the shoulder and joins the second a little before the apex; the next two lines are dorsal in position, they are sub-parallel to one another in the anterior fourth of the elytron, behind which they rather abruptly converge. after again diverging slightly they converge to join one another about the beginning of the apical fourth, whence they are continued as a single line up to the outer angle of the oblique apical truncature: the sixth is a very short line passing back from the base. In addition to these six lines, an ashy-grey streak may be seen along the suture, with a

rather faint and broken white line limiting it on the outer side. The body underneath has a drab pubescence with dark brown areas. The prosternum and mesosternum and the lower part of the sides of the prothorax are almost black in colour. The legs and antennæ are covered with a nearly uniform drab-coloured pubescence, but in some examples the intermediate joints of the antennæ are more or less dark brown towards the tip. The front of the head is also, in some examples, of a dark brown or nearly black colour, but this is partly due to the rubbing away of the pubescence."

The darkening in colour is occasionally very marked. One of the females used in my experiment was after a few months quite black all along the dorsal surface. The specimen from which the above description was taken measured $16\frac{3}{4}$ mm., and this is an average size. One imago I possess measures 17 mm., but I find a number smaller—thus, 14 mm., 12 mm., and one specimen is just 10 mm., but this small size was due, I think, to the poorness of the food on which the larvæ had to subsist.

DISTRIBUTION.

It was suspected, and indeed stated, that the natural home of *Diaxenes dendrobii* was Burmah, and during the year I had an opportunity of proving it. In the month of March, at an orchid sale in London, a number of plants of *Dendrobium nobile* were bought for the Royal Botanic Garden. These plants were imported for the sale from Burmah. When they reached the Botanic Garden, before being added to the collection, they were examined carefully, and in some of the pseudo-bulbs larvæ were got which were bred up to the pupa stage, the resulting imagines being of *Diaxenes dendrobii*.

THE EGG.

The egg is like a very tiny sausage, rounded off towards the ends. It measures $3\frac{1}{2}$ mm. in length, and is 1 mm. broad at its widest part.

There is a well-marked areolation on the thick shell, giving to the egg examined under the microscope a honeycomb-appearance. The pattern is hexagonal and pentagonal, but this becomes modified at the ends of the egg. In colour the egg showed a pale whitish-green tinge as it lay in the tissue of the pseudo-bulb.

THE LARVA.

The larva is a legless grub, convex on both dorsal and ventral surfaces. It is jawed, and has a chitinised head. Very short antennæ may be seen on careful examination. Here and there over the body are bristles. The larva is to begin with whitish in colour, but later, and especially about the time of making its cocoon, yellowish. The stigmata along each side are well marked. It measures from 20 mm. to 22 mm.

THE PUPA.

A general knowledge of the form of the pupa will be obtained from the figures, where it will be noted how the femur and tibia of the first two pairs of legs form a sort of knee which projects slightly above the edge of the dorsal surface. The long antennæ pass back, held at the edge of the dorsal surface by the two "knees" of the first and second pair of legs. Half-way down the body of the pupa the antennæ curl round between the second and third pair of legs and, crossing the ends of the wings, run forward on the ventral surface to the tarsi of the front pair of legs. Measurements of different pupæ gave from as small as 11 mm. up to 16mm.

LIFE-HISTORY AND HABITS.

The beetles rest during the day, sometimes at the base of the plant, with their heads, it may be, buried in the moss of the pot in which the plant is growing; sometimes on the under surface of a leaf; but the favourite place was between two almost touching pseudo-bulbs. Now and again we got them moving on the plant in the daytime, but typically they are night-feeders. Often, after dark, on going into a glass-house with a lantern, I found them browsing on the leaves or pseudo-bulbs with extended waving antennæ.

The beetles are very sluggish, remaining in the same place for long. Even a gentle prodding failed to make them move much, but never failed in drawing from the beetles a curious scraping sound like the creaking of a saddle or the noise made in cutting a cork. The sound was produced by the beetles rubbing the

front part of the mesothorax against the hind part of the prothorax. With reference to this noise—not an unusual one among the longicorn beetles—the gardener in charge of an orchid-house where *Diaxenes* was captured informed me that, not liking to take the beetle in his hand, he had picked it off "with a small pair of tongs, on which the poor creature began squeaking."

I was much struck by their protective colouration. When resting on a withered root, or on the moss of the pot, or near a withered bulb where only the whitish-grey fibres remained, it was almost impossible for a stranger to pick out the beetle, so accurately did the colour of the beetle—especially on account of the longitudinal light lines down its back—harmonise with these surroundings.

The death-feigning instinct of the imagines was also very noticeable.

The adult beetles eat greedily and are very destructive. They feed upon and destroy :—

(1) *The Pseudo-Bulbs.* Out of these they gnaw large pieces. If the pseudo-bulb be a small one it may be entirely eaten away; specially would the beetles take the youngest growth. If the pseudo-bulbs were long and narrowish they would be gnawed at one place till the weight of the upper part would break the pseudo-bulb in two. This was the case, for example, where a species of *Phajus* with a single pseudo-bulb was used as food.

(2) *The Leaves.* These were not bitten from the edge ; but the surface, either upper or lower, would be gnawed until holes appeared. If the leaves were very tough—as in the case of *Lælia anceps*—a hole might not result, but the scraped surface remained to testify to the work of the feeding beetles. Often a leaf would be bitten and gradually thinned away near its place of attachment to the pseudo-bulb, and the leaf, becoming top-heavy, bent over and broke or hung down.

(3) *The Rhizome.* Sometimes the exposed part of the rhizome would also be eaten away.

(4) *The Roots.* Several times in the course of the experiment fairly thick roots were bitten through ; but a commoner damage to the root was the gnawing away of the external parts into the central cylinder (as shown in one of the figures).

The effect of all the above destruction was evidenced by the

poorness of the plant. Pseudo-bulbs that normally would have borne three flowers only produced one, and sometimes none at all. The young pseudo-bulbs, following attack on the plant, were only half the size compared with the growth made in a previous year.

The females after copulation lay their eggs in the pseudo-bulbs, often at the apex from where a leaf springs. I believe, from the amount of food a larva eats, that, unless the pseudo-bulb be a very large one, only one egg will be laid in a pseudo-bulb. I certainly found two eggs laid in the pseudo-bulb of a *Coelogyne cristata*, and also two in one pseudo-bulb of a *Coelogyne flaccida*, but this I feel sure was due to the beetles not having a sufficiently large number of plants to lay on. In both of these cases I had to remove one larva and place it in another pseudo-bulb.

The eggs hatch in less than a fortnight, and the grubs feed greedily. They bore a tunnel down the pseudo-bulb from the place of hatching, the surrounding tissue browns, and soon all down one side of the pseudo-bulb the decayed brown-blotched channel invites the attention of the observer to the destructive work of the enclosed larva. All the soft parts are then mined away, so that nothing is left of the pseudo-bulb save the outer epidermal rind and the strands of fibro-vascular bundles which run longitudinally down the hollowed-out pseudo-bulb from end to end like strands of fine string.

The larvæ wriggle about very actively if laid on the ground or held in the hand, while in their tunnels they move as easily and as readily backwards as forwards.

If the pseudo-bulb has been too small and has not afforded enough food to the larva, the latter immediately proceeds to mine through the rhizome until it reaches another sound pseudo-bulb, into which it enters. One such larva that did not find enough to satisfy it in one *Coelogyne cristata* pseudo-bulb tunnelled through $3\frac{1}{2}$ cm. of rhizome and up into another, which it completely gutted. This method of leaving one pseudo-bulb and entering another was often observed during the experiment. I may add that larvæ removed from their tunnels and placed by themselves alongside a broken-off pseudo-bulb were quite able to make an entrance. On an infested plant the pseudo-bulbs may

show all stages from still healthy not yet attacked ones to others beginning to brown and to others more than half brown, up to the perfectly withered and blotched pseudo-bulb which gives to the slightest pressure.

The full-fed larva makes a cocoon by weaving together the fibres of the hollowed pseudo-bulb. The larvæ do not immediately pupate on the formation of the cocoon, but lie as larvæ on it may be for a lengthened period. One such larva, watched through a little chink cut in the cocoon, lay for twenty-three days before pupating, but others lay very much longer. In one experiment where the plant was *Odontoglossum citrosmum*, the larva had made its cocoon by December 17th, 1897, and the imago did not issue till April 24th, 1898. I did not wish to disturb this cocoon, and therefore cannot add the date of the change to the pupal condition.

Once the larva becomes a pupa, the pupal stage lasts on an average twenty-four or twenty-five days. Here is a Table showing some of the times, where the changes were watched through a chink purposely made in the cocoon :—

Pupa.	Beetle issued.
October 11, . . .	November 4.
January 27, . . .	February 26.
February 6, . . .	March 2.

The escaping imago bites a little round hole in the cocoon and walks out, or, if the pseudo-bulb be unbroken, through pseudo-bulb as well.

Development from egg to imago can take place in three and a half to four months, but may take much longer. Thus, in a *Coelogyne cristata* the beetles had an opportunity of egg-laying from June 10th to July 27th, and I had issue of imagos on October 11th, October 18th, and the beginning of November. If a long time be spent in the cocoon before the larva pupates the above developmental period will correspondingly be lengthenend out ; the character of the food and the temperature will also each have an effect.

The following Table shows some of the results as regards variation in length of the life cycle :—

Plant.	Time during which Beetles had opportunity to lay Eggs.	Time of Issue of New Brood.
Coelogyne cristata.	June 10—July 27, 1897.	October 11, 1897. October 18, 1897. Beginning of Nov.
Coelogyne flaccida.	July 27—Aug. 9, 1897.	April 7, 1898.
Odontoglossum citrosmum.	July 27—Aug. 24, 1897.	April 24, 1898. May 2, 1898.

It may be interesting to note how long my six imagines lived.

Issuing as imagines between March 2nd and March 20th, 1897—

The 1st died on April 8th, 1897.
„ 2nd „ May 28th, „
„ 3rd „ July 5th, „
„ 4th „ October 5th, „
„ 5th „ „ „ „
„ 6th „ Nov. 18th, „

Although *Diaxenes dendrobii* is called the "dendrobe-orchid beetle," I am sorry to add that it does not content itself with infesting the *Dendrobium nobile* from Burmah. I have not found any orchid with marked pseudo-bulbs refused as food. In the following orchids my six insects bred, the feeding larvæ quite ruining the plants :—

Lælia anceps.
Coelogyne cristata.
Coelogyne flaccida.
Odontoglossum citrosmum.

The orchid-house where I obtained my original material was quite ruined by the insect, and I took young or old larvæ from the following orchids :—

Dendrobium Farmerii.
„ *Griffithianum.*
„ *thyrsiflorum.*
„ *formosum.*
Lælia anceps (several varieties).
Cattleya Mossiæ.
„ *Trianæ.*

The day temperature of the orchid-house referred to was never below 60 degs. F., and the night temperature never below 55 degs. F. The temperature of the house where my experiment took place was higher than this.

Besides the species named above as plants in which my beetles bred, the following other orchids were used as food :—

Dendrobium nobile.	*Cattleya* sp.
,, *cariniferum.*	*Phajus* sp.
,, *Wardianum.*	*Oncidium* sp.

PREVENTIVE AND REMEDIAL MEASURES.

Unfortunately in connection with this pest, there seems to be every possible combination against the plant and in favour of *Diaxenes dendrobii* :—

The beetle breeds in a number of genera.

Many genera can be used as food.

The beetles, owing to their colour and their being night feeders, escape notice.

The length of development from egg to imago is not excessive.

The imagines have a fairly long life.

From what I have seen of the work of this beetle, I have no hesitation in saying that *Diaxenes dendrobii* is the very worst of orchid-pests, and yet, with reasonable care, successful war can be waged against it.

1. Let all imported plants before being added to a collection be carefully gone over. Any brown discoloured pseudo-bulbs should be suspected and examined for the larva. Perfectly sound pseudo-bulbs have a firm feel to the fingers ; infested pseudo-bulbs "give" a little on being pressed.
2. Owners or cultivators of orchids should keep a careful look-out for the work of the imago. Its damage is not to be mistaken for any other—how characteristic it is the figures show. Any found beetles should be destroyed. They must be searched for, however, after nightfall with a lamp or lantern.
3. That the larva has got to work may be known by a gradual discolouration down one side of the pseudo-

bulb; this will spread over the whole. The enclosed grub must be cut out, or, if the pseudo-bulb is far gone, let it be cut off bodily and the whole destroyed.

BIBLIOGRAPHY.

Woodward, in Gardeners' Chronicle, 1883, mentions receipt of a larva taken from an orchid. It was dead and could not be identified, but I am satisfied the insect was a species of *Diaxenes*.

Gahan, C. J. Description of a new longicorn beetle of the genus *Diaxenes*, in Ann. Mag. Nat. Hist., Ser. 6, xiii (1894), p. 520.

Donge, E. Exhibited a larva and imago of the insect taken from the conservatory of a horticulturist in Paris. See Ann. Soc. Entom. France, lxiii (1894), also, Bull. Soc. Entom. France, 1895, p. vii.

Xamben, Capt. Supplies notes on larval habits and upon metamorphosis in Ann. Soc. Entom. France, lxiv (1895), also in Bull. Soc. Entom. France, 1895, p. ccxlix.

EXPLANATION OF THE FIGURES

in Plates I. and II.

Illustrating Dr. Stewart Macdougall's paper on *Diaxenes dendrobii*, Gahan.

Fig. 1.—Imago from life. Natural size.
„ 2.—Egg from side. Greatly magnified.
„ 3.—End view of egg-shell, showing characteristic areolation. Greatly magnified.
„ 4.—Full-grown larva. Slightly magnified.
„ 5.—Pupa removed from cocoon, ventral surface. Twice natural size.
„ 6.—Pupa removed from cocoon, dorsal surface. Twice natural size.
„ 7.—Pseudo-bulb of *Dendrobium* with larva (not full grown) that has been mining, as shown by the dark discoloured tissue. Natural size.
„ 8.—Cocoon enclosing larva, in hollowed-out pseudo-bulb of *Coelogyne cristata*. Natural size.
„ 9.—Cocoon showing escape-hole, in pseudo-bulb of *Dendrobium*. Slightly reduced.
„ 10.—Three beetles seen on plant of *Dendrobium cariniferum*. Slightly reduced.
„ 11.—Adult beetle on *Dendrobium cariniferum*. Magnified.
„ 12.—Under-surface of leaf of *Lælia anceps* gnawed by imago. Two-thirds natural size.
„ 13.—*Coelogyne cristata*, showing leaves characteristically injured by imago. Half natural size.
„ 14.—*Cattleya*, showing pseudo-bulbs and roots gnawed by imago. Natural size.

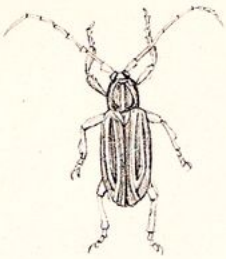

Fig. 1.

Fig. 4.

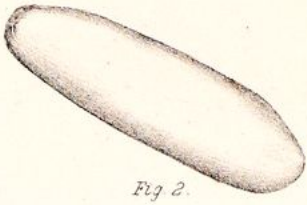

Fig. 2.

Fig. 5.

Fig. 6.

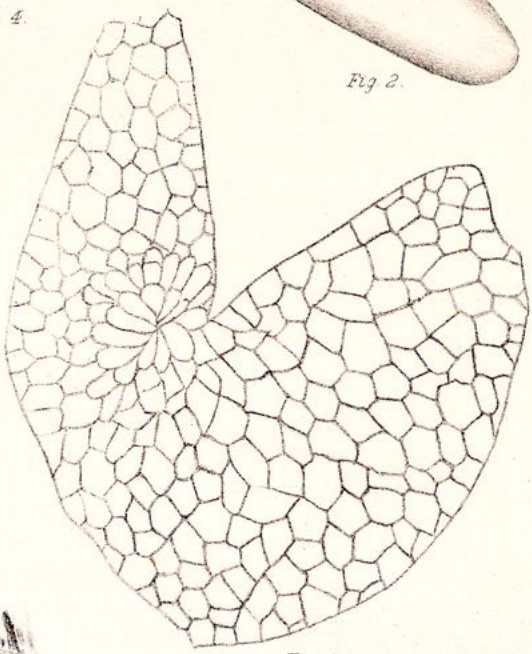

Fig. 3.

Fig. 7.

Fig. 9.

Fig. 10.

PLATE II.

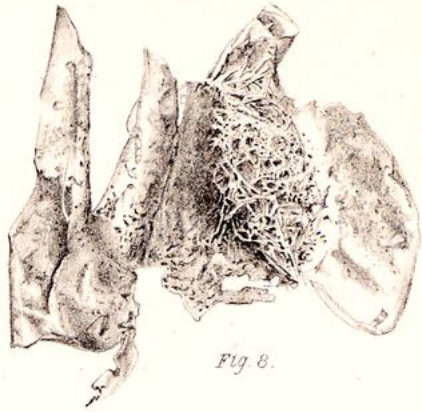

Fig. 8.

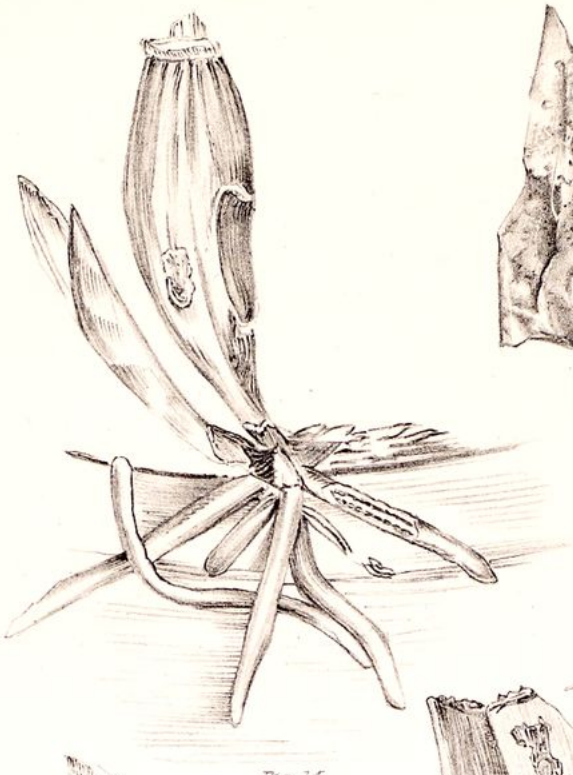

Fig. 14.

Fig. 11.

Fig. 13.

Fig. 12.