

This article was downloaded by: [University of Toronto Libraries]
On: 02 March 2015, At: 09:45
Publisher: Taylor & Francis
Informa Ltd Registered in England and Wales Registered Number:
1072954 Registered office: Mortimer House, 37-41 Mortimer
Street, London W1T 3JH, UK



Annals and Magazine of Natural History: Series 6

Publication details, including instructions for authors and subscription information:
<http://www.tandfonline.com/loi/tnah12>

XIV.—How does the Ugimyia-larva imbed itself in the silkworm?

Dr. Fr. Meinert ^a

^a Copenhagen

Published online: 12 Oct 2009.

To cite this article: Dr. Fr. Meinert (1890) XIV.—How does the Ugimyia-larva imbed itself in the silkworm? , Annals and Magazine of Natural History: Series 6, 5:25, 103-112, DOI: [10.1080/00222939009460785](https://doi.org/10.1080/00222939009460785)

To link to this article: <http://dx.doi.org/10.1080/00222939009460785>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever

caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

This paper has assumed of necessity more of a controversial character than I could have desired. I trust that none of the evil spirit of controversy has found its way into what I designed to be a purely critical discussion in the interest of scientific truth.

XIII.—On a new Species of *Tit*.

Dehesa de Cologan,
Puerto de Orotava,
Tenerife,
1st December, 1889.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—I enclose you the description of a new species of *Tit* that I have just discovered in the island of El Hierro, the most southern and western of the Canarian Archipelago. It is abundant in the pine-forest there.

Yours faithfully,

E. G. MEADE-WALDO.

Parus ombriosus, sp. nov.

P. Paro tenerifæ similis, sed fortior et robustior; tergo toto olivaceo-viridescente, nec cæruleo; tectricibus alarum viridibus, majoribus angustissime albo terminatis: subtus citrinus, *P. tenerifæ* similis. ♀ haud a mari distinguenda.

Named from the ancient Moorish name (*Ombrios*) of the island of Hierro, where alone it has been found.

XIV.—How does the *Ugimyia-Larva* imbed itself in the Silkworm? By Dr. FR. MEINERT.

THE 'Bolletino della Società Entomologica Italiana,' anno secondo (1870), contains two papers concerning the *Ugimyia sericaricæ*. One is a little note only ("Sull' insetto Ugi," pp. 134–137) by Rondani, mentioning the larva and pupa of a Tachenarian which Mr. Menegazzi had discovered in Japan making its way out from the cocoon of a silkworm. In conclusion Mr. Rondani (p. 137) gives a description of the larva

and of the pupa, and, without knowing the imago, he classifies the animal as a new distinct genus and species — *Ugimyia sericariæ*. The other paper, a dissertation by Cornalia (*l. c.* pp. 217–227), gives an account of the imago, accompanied by figures exhibiting the animal in its successive stages of evolution. Prof. Cornalia further advances the theory that the fly in question, after the fashion of the common *Tachinariæ*, deposits its eggs externally on the skin of the silkworm, into whose inner organs the maggot then forces its way through the skin. Afterwards, before transforming itself into a pupa, the maggot again makes its way out from the pupa and cocoon of the silkworm.

Before, however, Mr. Rondani published his paper, the Secretary of the English Legation in Japan, Mr. Adams, had already given an account of this remarkable fly and its attacks on the silkworm (“*Deuxième rapport sur la sériculture au Japon*,” *Rev. univ. d. séricult.* Lyon, no. 36, 1 avr. 1870*). And in the interval between the publications of Rondani and Cornalia the same fly was mentioned by Guérin-Ménéville under the name of *Tachina* (? *Phorocera*) *Oudji* in his “*Observations sur la nature de l’Oudji, parasite des vers à soie au Japon, présentées à l’Académie des Sciences, dans sa séance le 17 avril, 1870*” (*Compt. Rend.* lxx. p. 844; *Rev. et Mag. Zool.* 2 sér. tom. xxii. pp. 178–181). Besides, the matter has been touched upon by Prof. Westwood (*Proc. Entom. Soc. Lond.* 1870, p. xxii), by Mr. Haberlandt (‘*Der Seidenspinner*’), and by Mr. Pryer, who, in his ‘*Catalogue of Japanese Lepidoptera*,’ mentions the *Uji* as an enemy of the silkworm, and, further, states that he “has noticed that the *Uji* . . . deposits its eggs *about the larva on the leaves, and not on the insect*.” Unfortunately these three last-named papers have not been accessible to me.

The *Ugi-plague*, however, has been more thoroughly treated in Japan, its native country, than in Europe, and principally in an excellent paper by C. Sasaki, Rigakushi (“*On the Life-history of Ugimyia sericariæ*, Rondani,” *Journ. Sc. Coll. of the Imp. Univ. of Japan*, 1886). But other Japanese savants, before Mr. Sasaki, have studied this fly, its habits, and its connexion with the silkworm. Twelve or thirteen years earlier, the father of the above author, Mr. N. Sasaki, commenced some investigations into the subject, stating that the larva or maggot of the *Ugimyia* was found imbedded in the main trunk of the silkworm’s tracheæ directly under a

* The figures accompanying this paper are styled by Guérin-Ménéville “*suffisantes*.” Sasaki, however, deems them insufficient. I have seen neither the paper nor the illustrations.

stigma, from which he concluded that the maggot entered the stigma from the outside from eggs deposited by the fly on the mulberry-leaves. C. Sasaki does not tell us whether his father published these investigations; but very similar views and opinions are set forth by the anonymous author of the 'Review of the Japan Silk Trade for the Season 1873-74.' By the great courtesy of the Danish Consul-General at Nagasaki, Mr. de Bavier, I am able to quote at some length this Review, which is very rarely met with in Europe. The author writes (p. 6) as follows:—

"In the Third Report of Japanese Sericulture, dated Yedo, August 10th, 1870, Mr. F. O. Adams, First Secretary of the British Legation, summing up his previous researches on the subject, states that the larva of the Uji, after having fed upon the chrysalis and killed it, pierces the cocoon; that the cocoon thus pierced can neither be reeled, nor, of course, be used for reproduction; and that the proportion of cocoons containing Uji varies from 10 to 80 per cent. In the absence of all reliable information on the part of the natives, who seem to have paid no attention to the matter, he was led to surmise that the larva of the Uji must in spring transform itself into a fly, and that the fly deposited its eggs under the epidermis of the silkworm. . . .

"In order to put Mr. Adams's theory to the test of experiment we reared some silkworms in a room where every precaution was taken to exclude flies and other insects. The result was as follows:—

"312, say 50 per cent., cocoons pierced by moths.

"235, say 38 per cent., pierced by Uji.

"40, say 7 per cent., unpierced either by moths or Uji.

"33, say 5 per cent., double cocoons.

". . . . This was in 1873. . . . In October some Uji on being cut open were found to contain the well-formed embryo of a fly. On the 3rd May we had the satisfaction of finding a number of flies which had emerged from the Uji prisoners under a veil of gauze arranged for that purpose; the empty shells of the larvæ were found in earth, where they had remained imbedded since their birth.

"The proportion of Uji, which, in spite of our precautions to protect the silkworms, we had found in our cocoons, was so startling, that we contrived this year to protect them still more efficiently than we had done the year before. The eggs therefore were hatched and the worms fed under a wooden framework provided with sliding doors and entirely covered with gauze. The windows of the room itself were closed with

frames covered with the same material. The result was this :—

“ 275, say 31 per cent., cocoons pierced by moths.

“ 450, say 53 per cent., pierced by Uji.

“ 135, say 12 (?) per cent., unpierced by either moths or Uji.

“ 30, say 4 per cent., double cocoons.

“ In the presence of these facts the theory that the fly of the Uji deposits its eggs under the epidermis of the silkworm must clearly be given up. Does, then, the fly lay its eggs on the mulberry-leaf? Is the food the vehicle by which the germ of the Uji finds its way into the silkworm's intestines?

“ To the kindness of a correspondent who takes a warm interest in the matter we are indebted for the following note :—‘The fly of the Uji is the *Ugimya sericaria* (sic), thus named by Rondani.’ ”

I may also quote what, according to Mr. C. Sasaki, Mr. G. A. Greeven writes in the ‘Japan Times’ of May 4th, 1878 :—“ My experiments have now shown me that the hatching of the Uji takes place in the stomach of the caterpillar, and that it immediately forces its way through the membrane of the stomach and makes a path for itself to a stigma.”

Mr. C. Sasaki commenced his investigations in 1883, and in the following year he communicated to the American periodical ‘Nature’ a short preliminary article, “*Ulschimyia sericaria*, Rond., a Fly Parasite on the Silkworm” (printed ‘Nature,’ vol. xxx. pp. 435, 436), which two years afterwards was followed by the fuller account mentioned above. From this last-named treatise I shall try to point out the principal results obtained by Mr. Sasaki concerning the evolution of the *Ugimya sericariæ* :—(1) The fly deposits its eggs on the under surface of the mulberry-leaves, generally at the end of May. (2) The silkworms being at this time of the year in their third or fourth stage of evolution, devour the eggs—often a great number of them—together with the mulberry-leaves. (3) The eggs remain from one to nine hours in the digestive canal of the silkworm, and the maggots having emerged from the double-shelled eggs, likewise remain there for from one to eight hours more before piercing through the walls of the canal. (4) Having pierced through the walls of the digestive canal, the maggots directly enter the abdominal ganglia and feed on the ganglion-cells. (5) Having devoured the ganglia, the maggots pass into the body-cavity of the silkworm, and, travelling through the mass of fat, they search for those portions of the tracheal system

of their host where the stigmata open. (6) On reaching one of these places the maggot forms a sort of cup for the reception of its body by heaping up the fats and muscular fibres of its host, and sticking them together with its saliva. (7) At the bottom of the cup an opening is left, and through this opening the maggot resting in the cup maintains its connexion with the air, while through the mouth of the cup it is able to project its head into the abdominal cavity of the silkworm, on whose fat it is feeding. (8) The cup being formed, a dark brown spot appears on the silkworm's epidermis around the stigma, continuing visible on the pupa also after the transformation. (9) When fully developed the maggot forces its way out through the skin of the silkworm, or, if the worm has been transformed into a pupa, through the pupa and its cocoon. (10) Whereupon the maggot seeks the ground, and there, in a couple of days, it is transformed into a pupa. (11) The pupa remains in the ground during the winter, and in the middle of April or at the commencement of May the fly appears.

As will be seen, some of these points have already been settled by authors of earlier date; but to Mr. C. Sasaki belongs the merit of having stated them in a way meeting some objections which might otherwise have been advanced. Thus, for instance, regarding the question how it is possible for the eggs to arrive safely into the digestive canal of the silkworms Mr. Sasaki (*l. c.* p. 16) explains:—"That the eggs do not get hurt in passing into the body of the worm is further confirmed by comparing the size of the pieces of the leaves contained in the digestive canal with that of the egg. It will be found that the size of the former is many times that of the latter." Another question, why only one or two full-grown maggots emerge from a silkworm or cocoon, although the silkworm most frequently has been infested by a much larger quantity of the parasites, Mr. Sasaki explains in the following way (p. 17):—"This is due to two reasons: 1st, the silkworm, when infected by more than one maggot, dies from not being able to endure the injuries caused by these parasites, which then perish by a kind of suicidal death; 2nd, one among several maggots infesting the same silkworm may grow more actively and rapidly than the others, which will then die from the want of requisite food."

The development of the *Ugimyia sericariæ*, as related by Mr. Sasaki, is really deserving of attention, as involving so much of interest and so many surprising points. But still I could not believe in the correctness of all his assertions, and one of them especially seemed to me to be very little

worthy of credit. I could not imagine that the point no. 6, concerning the formation of the cup and the maggot's connexion with the tracheal system of the silkworm, was in accordance with the real facts.

Therefore, deeming it possible to study these facts on specimens preserved in alcohol, I addressed myself to the Greek Northern Telegraph Company, and was met with the utmost kindness on the part of the Company's President, Mr. Tietgen. A short time afterwards I received from one of the officers of the Company, its Superintendent at Nagasaki, Mr. C. Kragh, a parcel containing, besides numerous maggots and some pupæ and imagines of the *Ugimyia*, also two specimens of the silkworm preserved in alcohol. One of these specimens was intact, but with a dark brown spot surrounding one of its stigmata; the other was cut open longitudinally, and a maggot was seen projecting its anterior end from the mouth of a sort of cup fastened to the inner surface of the silkworm's skin. I feel highly indebted to Mr. C. Kragh for his courtesy, and I beg to express my sincerest thanks.

In the first place I cut open the silkworm that was intact, and a half-grown maggot (its length being about 5.5 millim.) was found lying between the skin and the digestive canal of the silkworm. But as for the rest, nothing like a cup was to be seen, nor was the rear end of the maggot situated inside the stigma surrounded by the dark spot. On the contrary, the maggot was lying quite freely, as it were just moulded into the mass of fat, its head projecting about 1.5 millim. beyond the anterior edge of the dark spot, while its distance from the silkworm's skin was something like 2 or 3 millim. The rear end of the maggot certainly had approached one of the hindmost stigmata of its host; but the stigma in question was not situated in the centre of any spot, and no trace of a cup was to be found. Besides, a mass of fat covering the rear end of the maggot entirely closed the stigmata of the parasite.

Thereupon I turned my attention to the other specimen, with the body cut open and the maggot peeping out from the cup; but I soon observed that the maggot was glued to the bottom of the cup, a way of mounting, however, which in such preparations made for public instruction very often cannot be avoided.

This examination of the two silkworms not being sufficient to satisfactorily solve the question, I again addressed the Superintendent, Mr. Kragh, who had the extreme courtesy to send me a new supply of about a hundred cocoons with

pupae enclosed, the majority of which were supposed to be infested by maggots. For sending silkworms the season was too far advanced.

Of these pupae only a fifth, or, perhaps, a little more, were found to be in a normal condition, without any brownish spots, and not at all infested by the parasite. Among the rest something like a tenth part did not exhibit any spots; but nevertheless in each pupa a maggot was found, and in one specimen two maggots. However, though no spots were visible on these pupae, a dark lump (of compressed tracheae) was found constantly inside one of the stigmata, exactly as in the spotted specimens. Occasionally a pupa was found exhibiting brownish spots and having the dark lump inside a stigma, but without any parasite at all. Still I dare not deny that possibly a small maggot may have been overlooked by me, although I searched for it most carefully.

Generally the pupae had one or more spots around one of the stigmata (in most cases one of the first pair of abdominal stigmata), and inside that same stigma the dark-coloured lump mentioned. The maggot was found occupying a place more or less in the midst of the abdominal cavity of its host, thoroughly imbedded in a white mass of fatty structure. Exceptionally two or more stigmata were surrounded by such spots; but then also two maggots, one considerably smaller than the other, were found inside the silkworm. Twice I found three maggots, one large and two smaller ones.

As to the position of the maggot inside the pupa, it was but rarely found to be in contact with either the tracheae of its host or the stigmata, or with the dark-coloured lump, nor could I discover anything like a cup. As a rule the maggot was lying longitudinally in the middle of the pupa, having its mouth turned sometimes forwards, sometimes backwards. If two or three maggots were found the larger one held the central position, pressing the smaller ones towards the sides.

At length, having examined about fifty cocoons, I found a pupa in which the maggot was lying in a long sac, with its stigma turned towards the bottom of the sac. The outer end of the sac, which really had some connexion with a stigma and with the epidermis of the silkworm, was of a brownish colour, while the inner part was whitish, much thinner, and cut off. Twice afterwards, in other specimens, I again found a similar sac containing the maggot. And, finally, I met with a pupa in which the maggot, as usual, was found located in the middle of the body, while from its bed a short canal led towards one of the pupa's stigmata, the walls of that canal being of a brownish colour at the outer

end. The three or four cases just mentioned agree with the theory of Mr. Sasaki to a certain extent. In some important points, however, the distinguished Japanese savant may be mistaken, as I shall now try to prove.

The cup or sac is not, I should say, constructed by the maggot "by heaping up the fats and muscular fibres." It is merely a portion of the tracheal system of the silkworm swelled by the presence of the parasite and tinged brown by its excrement. Having forced its way into the trachea, the young maggot imbeds itself there, with its spiracle-plates turned towards the stigma of the silkworm and with its mouth peeping out from the trachea into the body-cavity of the host. By-and-by, as the maggot grows, the trachea expands and swells, its outer part assuming a brownish colour from the maggot's excrement, while the inner portion remains uncoloured. I therefore conclude that if a living or fresh silkworm infested by a maggot is cut open for investigation, the inner part of the trachea or sac, being thin and white, may break off, while the outer, brownish, part remains in connexion with the skin of the silkworm. *This last-mentioned brownish part of the trachea, then, is the "cup" of Mr. Sasaki.* By means of the microscope it may be clearly seen that the inner surface of the sac is formed exclusively by the inner membrane of the trachea, the tunica intima, and does not show any trace of muscular fibres or of fats. It is also observable that on the tunica intima of the main trachea forming the inner surface of the sac, as well as on the other adjacent smaller tracheæ, the brownish colour is more intense, while the muscular fibres and fats surrounding the sac are much less coloured. From the same source, viz. the excrement of the maggot, the dark spot on the silkworm's skin also derives its existence. That the sac is formed by the trachea is proved, moreover, by the fact that the mouths of the smaller tracheæ are easily distinguished on its inner surface.

As to the sticking-power of the colouring-fluid (excrement or saliva), it must be very slight indeed, or, rather, none at all; otherwise the sac or cup would adhere to the skin of the silkworm, and probably be thrown away, together with the cast-off skin, at its transformation into a pupa. But this is not the case: the sac remains inside the host, and constitutes the dark lump found behind the stigma of the pupa. With proper care this lump may be unrolled, and proved to be a sac large enough to embrace the maggot living in the body of the pupa. As will be remembered, the maggot

was found three or four times still occupying such a sac corresponding to the lump.

In connexion with what is here stated, I shall call attention to the fact that those *Tachina*-larvæ that feed parasitically on insect-imagines* in a similar way occupy a sac formed by the trachea of the host (*conf.* Chłodkowsky, Zool. Anzeig. 1884, p. 316), a fact which I have had the opportunity of ascertaining myself when examining the maggot of *Tachina pacta* infesting a *Carabus hortensis*.

When therefore Mr. Sasaki says that the maggot of the *Ugimyia* occupies a cup, I agree with him to some extent, although I deem it more appropriate to style the "cup" a sac. But, in opposition to his views, I am of opinion that the maggot only for a time occupies that place and that it leaves it, sooner or later, in order to force its way into the central part of the body of the silkworm or of the pupa. At what time the maggot emigrates from its sac I cannot say precisely; I have had too few silkworms at my disposal. But this I can maintain, that the maggot is very seldom found in the trachea of the pupa, and that it is often very young when it leaves the sac, viz. in its second larva-stage, the length of such emigrated maggots being sometimes only from 3·8 to 4 millim. Perhaps this migration may be influenced by the moultings or the pupation of the maggot.

Having at my disposal a very great number of maggots, of every length from 3·8 to 14 millim., I had a fine opportunity for studying the evolution of the spiracle-plates. I have not seen the first larval stadium of the *Ugimyia*-maggot, viz. from its leaving the egg until its locating itself in the corpus adiposum of the silkworm, but I had before me the three following stages. In the second stadium the spiracle-plates exhibit only two short, broad, thin-skinned areas ("fissures"), while in the third stadium these areas are three in number, a little longer, somewhat narrower, and already of a rather angular shape. In the fourth (or last) stadium their number continues three; but they have become long and comparatively narrow, with curved outlines. In all stages I found that the spiracle-plates were closed, the so-called "fissures" were no fissures, and the respiration takes place through the thin-skinned areas of the spiracle-plates. This remarkable circumstance, however, perfectly agrees with the fact that the *Ugimyia*-maggots are found imbedded

* With other *Tachina*-larvæ, which force their way into the body of their host through its skin, the hypodermis of this skin forms the sac (*cf.* Auth. Entom. Tidsskr. 1886, p. 191).

in the body-cavity of their host, without any communication whatever between the air of their tracheal system and the atmosphere. This state of things I have observed, however, not only in the *Ugimyia*-maggot, but also in maggots of other parasitical Diptera, of *Tachina*, *Lucilia*, *Hypoderma*, &c., the genus *Gastrophilus* alone making an exception*.

Summing up the results of my investigation, I come to the following conclusions:—(1) Mr. Sasaki is right, undoubtedly, in his opinion that the eggs of the *Ugimyia* find their way into the body of the silkworm through its mouth; and I should think that other caterpillars also are infested in the same way. (2) The *Ugimyia*-maggot for a while only is located immediately inside one of the silkworm's stigmata, and certainly does not form its bed "by heaping up fats and muscular fibres;" but the bed is a widening or swelling of the trachea itself. This fact is fully in accordance with what is known of the parasitical life of many *Tachina*-larvæ. (3) The plates of the spiracles or stigmata of the *Ugimyia*-maggot are quite closed, a fact that may be observed also in other *Musca*- and *Æstrus*-larvæ, the genus *Gastrophilus* alone excepted.

Copenhagen,
November 12, 1889.

XV.—*Description of a new Species of Dragon-fly.* By W. F. KIRBY, F.E.S., Assistant in the Zoological Department, British Museum.

DR. KARSCH has lately pointed out, in the 'Entomologische Nachrichten,' that my *Fylla exigua* is apparently identical with *Nannophya pygmæa*, Ramb. I find that I had been misled by an old label attached to a pair of an undescribed genus and species in the British Museum. These I now describe, although they are without locality, as I have already described the genus and figured the neuration under the name of *Nannophya*, and this seems to be the readiest means of preventing further confusion. I think it probable that the specimens are from some part of the Malay Archipelago.

* For further information concerning the evolution of the spiracle-plates I may refer to a little paper, "Ugimyia-Larven og dens Leie i Silkeormen," which I am publishing in the 'Entomologiske Meddelelser,' Bd. ii. 1890, with some figures.