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REPORTS
TO THE
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ON
PUBLIC HEALTH AND MEDICAL
SUBJECTS.

(NEW SERIES NO. 66.)

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2. British Flies which cause Myiasis in Man: by
Ernest E. Austen, F.Z.S.
3. An Account of the Bionomics and the Larvæ
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and *F. scalaris* Fab., and their relation to
Myiasis of the Intestinal and Urinary Tracts:
by C. Gordon Hewitt, D.Sc., F.E.S.



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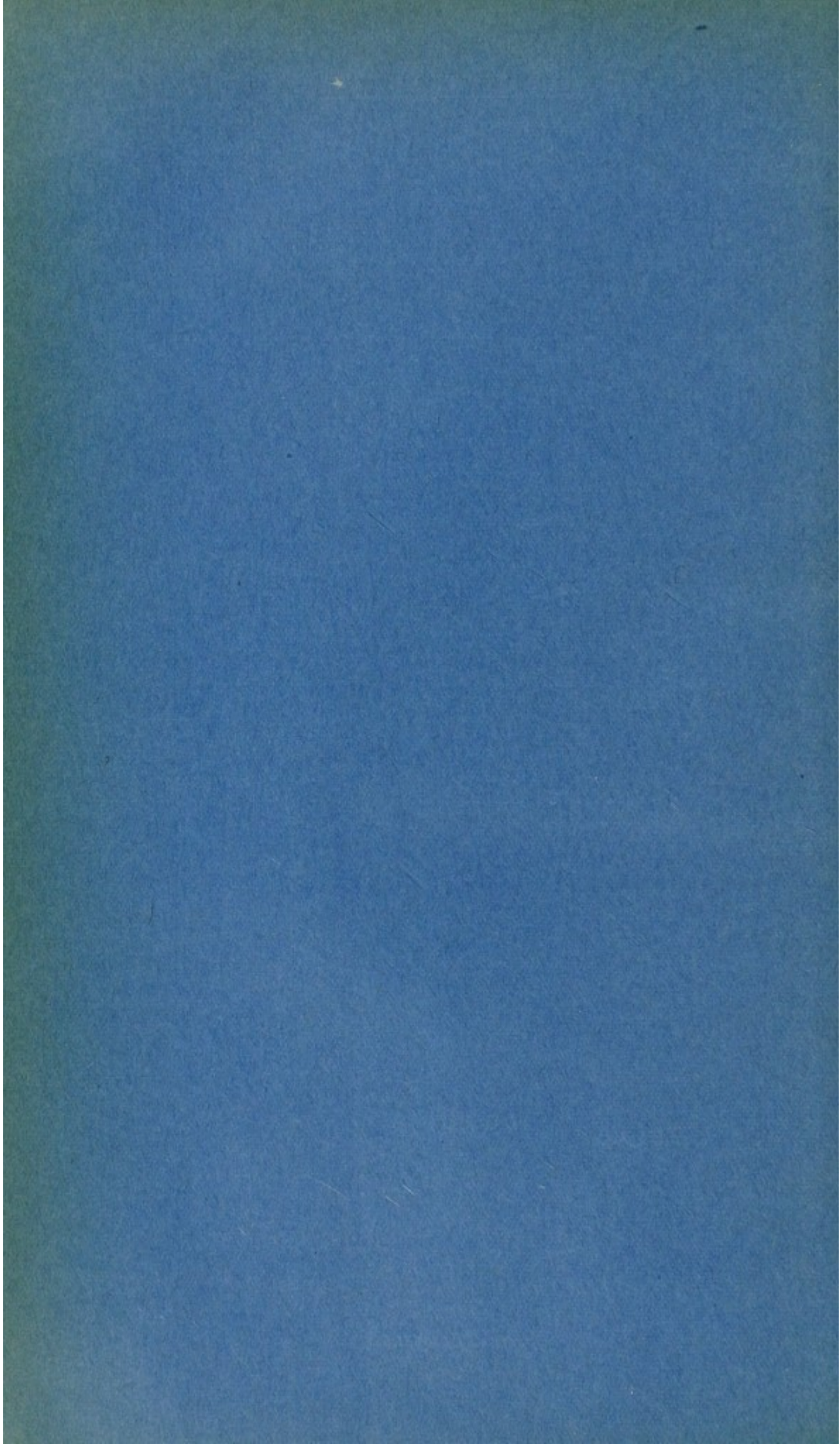
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Myiasis of the Intestinal and Urinary Tracts :
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THEODORE THOMSON,
Assistant Medical Officer,
1st April, 1912.

(1.) OBSERVATIONS ON THE RANGE OF FLIGHT OF FLIES. BY C. GORDON HEWITT, D.Sc., F.E.S.*

The importance of accurate information with regard to the distance that flies can travel, either by their own exertions or with the aid of the wind, is realised by those who have under consideration the question of the carriage of infection by these insects and also of the danger and nuisance due to the proximity of breeding places. Attention was called to this question in my monograph on *M. domestica* (1909, pp. 364-365) ⁽¹⁾† where the discovery of *M. domestica* $1\frac{1}{2}$ to 2 miles from any house or likely breeding place was recorded and also the occurrence of *M. domestica* at an altitude of 80 feet above the ground. Reference was made to Dr. M. B. Arnold's experiments in 1906⁽²⁾ in which three hundred flies were caught and marked with a spot of white enamel on the back of the thorax; these were liberated and five were recaptured at distances varying from 30 to 190 yards from the point of liberation.

An extensive series of experiments were more recently made by Dr. Monckton Copeman and Messrs. F. M. Howlett and Gordon Merriman and recorded in Report No. 4 of this series of reports on "Flies as carriers of infection."⁽³⁾ These experiments were carried out in the neighbourhood of a small village, Postwick in Norfolk, where an unusual plague of flies was experienced. The flies to the number of several hundreds at a time were caught in a net and were marked by being placed in a paper bag containing finely powdered coloured chalk of which that of a yellow colour was found to afford the best results. After liberation they were recovered from human habitations at various periods within forty-eight hours, and at distances ranging from 300 to 1,700 yards from the point of liberation, the location apparently

* NOTE.—Shortly after undertaking work in connection with the Board's inquiries as to Flies in relation to Disease, Dr. Hewitt (formerly lecturer on Zoology in the University of Manchester) was appointed Dominion Entomologist at Ottawa, Canada, where his investigations and reports have been completed.

† The numbers refer to the list of "references" at the end of this paper.

depending, to a considerable extent, upon the direction of the prevailing winds. The locality in which these experiments were carried out was of a rural character and consisted of open country.

Dr. Howard⁽¹⁾ records an experiment of J. S. Hine who caught 350 flies and marked them with gold enamel before liberation. Flies so marked were observed about dwellings from 20 to 40 rods (600 to 1,200 yards) from the point of liberation up to the third day. Hine states: "It appears most likely that the distance flies may travel to reach dwellings is controlled by circumstances. Almost any reasonable distance may be covered by a fly under compulsion to reach food or shelter. When these are close at hand the insect is not compelled to go far and, consequently, does not do so." The experiments recorded in this paper, however, show that flies will travel a considerable distance even where houses occur. The same author also mentions that Prof. S. A. Forbes had experiments carried out in which it was shown that marked flies spread naturally for at least a quarter of a mile.

In view of the results of these experiments it seemed advisable that others should be carried out under city conditions, where so many factors are present which may affect the flies' ability and desire to travel. The following is an account of a short though interesting series of experiments which were carried out in the city of Ottawa, Ont., under my direction, by Mr. G. E. Sanders, B.S.A., Field Officer of the Division of Entomology, who also devised the excellent method of marking the flies.

Locality of Experiments.—By way of introduction it may be remarked that an important reason for the choice of the locality in which these experiments were carried out was that the results might be useful as indicating whether the presence of a small-pox hospital on the island upon which the flies were liberated constituted a menace to the public health of the neighbouring district.

The point of liberation of the flies was on Porters Island, a small island, about 1,100 feet long, lying in the Rideau River, which runs through a part of the city and is a tributary of the Ottawa River which it joins a short distance further along its course. The surrounding district forms a portion of the north-eastern part of the city and consists chiefly, especially on the northern side of the river which is known as New Edinburgh, of working-class dwelling houses. On this island, which is connected with the bank by a small bridge, small-pox cases are isolated in a small wooden house used as a hospital, or in tents. The land rises gently from the river on the southern side.

Method of obtaining and marking the Flies.—Stable refuse, in which the larvæ were found in large numbers, was placed in breeding boxes, provided with a circular aperture at the top, and balloon fly traps were placed over these apertures. The flies, on emerging from the pupæ, entered these cages and were thus obtained in a healthy and uninjured condition. They were marked by spraying them while in the wire cages with a solution of rosolic acid (Rosaurin or methyl-aurin $C_{20}H_{16}O_3$) in 10 per cent. alcohol, applied by means of a fine spray. This method of marking insects was devised by Mr. Sanders, who first used it

in experiments with ants. It is simple and harmless and reliable as a means of detection. The presence of a marked fly on a sticky fly-paper is indicated by its producing a scarlet colouration when the paper is dipped into water made slightly alkaline. In these experiments the flies were reared and marked in the Division of Entomology, which is situated about three miles from Porters Island, to which they were carried in the cages and liberated on arrival. "Tanglefoot" fly-papers were placed in as many as possible of the houses in the neighbouring district on both sides of the river. The papers were placed chiefly in the kitchens of houses and were collected one or two days after being distributed. They were usually collected in that portion of the district towards which the wind had been blowing from the direction of the island, as it was found that the wind was the chief factor in determining the direction of distribution from day to day.

EXPERIMENTS.

Flies liberated on Porters Island.

Date.	Number of marked flies liberated.	Number of marked flies recovered.	Place of Recovery.	Distance in straight line from point of liberation.
August 29, 1911...	8,000	—	—	
August 30, 1911...	4,000	1	647 St. Patrick St.	180 yards.
September 1, 1911	1,000	1	35 Cobourg St.	
		1	106 Cobourg ...	600 yards.
		2 marked flies observed.	{ 37 Cobourg St.	
			{ — St. Patrick St.	
September 3, 1911	100	1	38 Beechwood Ave.	520 yards.
September 6, 1911	500	—	—	
September 7, 1911	—	43	647 St. Patrick St.	
		12	612 St. Patrick St.	
		4	681 St. Patrick St.	
		21	619 St. Patrick St.	
		3	565 St. Patrick St.	
		2	559 St. Patrick St.	
		2	553 St. Patrick St.	
		5	35 Cobourg St.	
		8	19 Cobourg St.	
		1	106 Cobourg St.	
		1	608 Rideau St. ...	700 yards.
		1	55 Augusta St. (Butcher's shop.)	
		3	4a Anglesea Square (Grocer's shop.)	
		6	355 Mackay St.	
		12	337 Mackay St.	
		16	305 Mackay St. (Grocer's shop.)	
		7	316 Crichton St.	
		16	197 Crichton St.	
		2	143 Crichton St.	
		2	134 Beechwood Ave.	
		1	— Stanley Ave. ...	600 yards.

As will be seen from the dates given, these experiments extended over a short time only, having been terminated by the

advent of a period of cold weather which checked the flies' activity. Nevertheless they are of value as indicating the possibilities in the way of the range of flight of flies under normal city conditions. There is no doubt that given the necessary conditions with regard to wind and elevation above the ground the range would be considerably greater than was actually found in these experiments. The greatest range of flight obtained in these experiments, namely, 700 yards, represents an actual flight of considerably greater distance than is represented by a straight line from the place of liberation to the point of capture.

Chief Breeding Places of Flies in the District.

The chief breeding places on a large scale are shown on the map as shaded areas. The western extremity of Porters Island was used as a garbage dump (C) until June, 1911, this being about 170 yards from the isolation tents and hospital. Between the end of Water Street and the Rideau River garbage was being dumped (A), a large proportion of which consisted of stable refuse (horse manure). At this place, which is about 530 yards from the hospital, flies were found breeding in considerable numbers. At the foot of St. Andrew Street, adjoining the river and about 270 yards from the hospital, about 100 tons of horse manure and compost had been dumped (B). There were in addition numerous breeding places apart from an unusually large number of unprotected heaps of horse manure in stable yards. Consequently, flies were extremely abundant on the island and throughout the district.

The relation of the Range of Flight of Flies to the situation of the Isolation Hospital.

The significance of the question of the range of flight of flies as bearing upon the position and protection of isolation hospitals is too obvious to require further explanation. In the present instance Porters Island is used for the isolation of small-pox cases. The hospital consists of a wooden house capable of accommodating a few cases only; during a slight epidemic which occurred in the past summer cases were isolated in tents. There was no possibility of protecting the patients from the attentions of flies, or of mosquitoes which also occurred in enormous numbers and may be even more potent than flies as carriers of the causative organism of small-pox, whatever it may be.

Isolation hospitals should be carefully screened in hot weather, and every effort made to prevent the access of flies either to patients or to infective matter, especially as so little effort is made at present to protect food and infants from the attentions of flies.

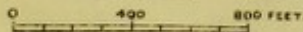
(EXPLANATION OF FIGURE.)

Map of portion of the City of Ottawa. The numbers in circles indicate the points at which the flies were captured and the number of flies captured. The isolation hospital is situated a few yards from the point of liberation X on Porters Island.

MAP OF PORTION OF THE CITY OF OTTAWA, TO ILLUSTRATE DR^R HEWITTS' PAPER ON "OBSERVATIONS ON THE RANGE OF FLIGHT OF FLIES".

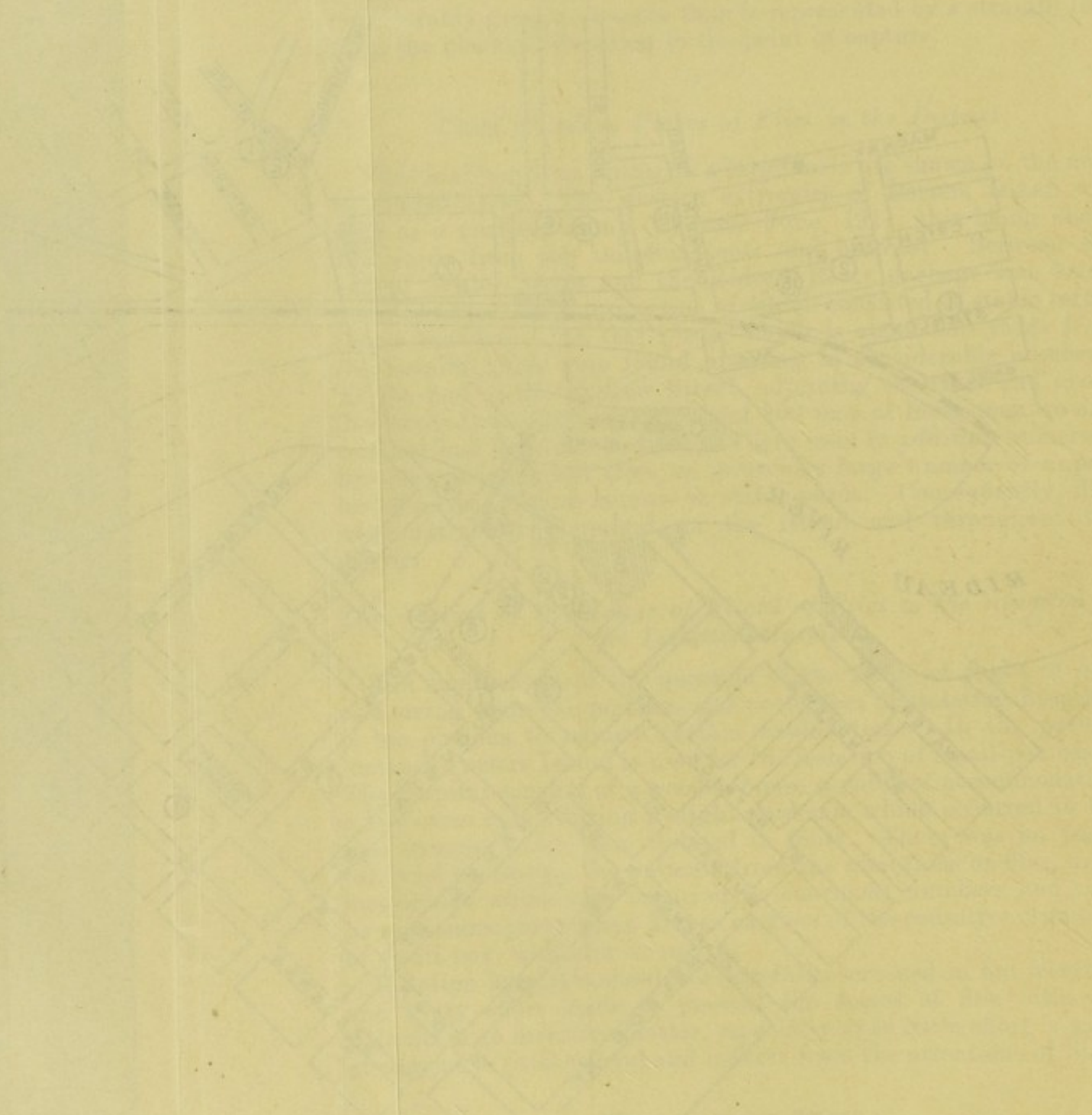


SCALE.



X. Point where marked flies were liberated.
 Shaded portions A.B.C. etc. indicate breeding places of flies.

PAPER ON OBSERVATIONS ON THE RANGE OF FLIGHT OF
MAP OR PORTION OF THE CITY OF OTTAWA, TO ILLUSTRATE DR. HORTON'S



Scale 1:50,000
Published by the Government of Canada
Ottawa, Ontario, Canada

REFERENCES.

- (¹) "The Structure, Development, and Bionomics of the House-Fly, *Musca domestica*, Linn., Part III.; The Bionomics, Allies, Parasites, and the Relations of *M. domestica* to Human Disease." *Quart. Journ. Micros. Science*, Vol. 54.
- (²) Recorded on page 262 of the "Report on the Health of the City of Manchester for 1906." By James Niven.
- (³) "Reports to the Local Government Board on Public Health and Medical Subjects," New Series, No. 53. "Further Reports (No. 4) on Flies as Carriers of Infection: I. An Experimental Investigation as to the Range of Flight of Flies." By S. Monckton Copeman, F.R.S., F. M. Howlett, and Gordon Merriman, pp. 1 to 10, with map.
- (⁴) L. O. Howard. "The House-Fly—Disease Carrier," 312 pp., 1911.

(2.) BRITISH FLIES WHICH CAUSE MYIASIS IN MAN. BY ERNEST E. AUSTEN, F.Z.S.

MYIASIS, a term coined from the Greek word *μῦια*, a fly, signifies the presence of Dipterous larvæ (*i.e.*, in ordinary language, the maggots of flies) in the living body, whether of man or other animals, as well as the disorders, whether accompanied or not by destruction of tissue, caused thereby. Although fortunately far less common than in the Tropics, or even than in some parts of continental Europe, such as European Russia, cases of Myiasis in human beings are nevertheless by no means rare in the British Islands, and it may therefore prove not unprofitable briefly to discuss the species of flies most usually concerned in these attacks, and to give details of cases with which the various species have been connected.

The form of Myiasis most commonly met with in the United Kingdom is that of the alimentary canal, as the result of which living larvæ or pupæ, greatly to the distress and alarm of the patient, are discharged from the bowel. Cases of Myiasis of the nasal passages and frontal sinuses, the external auditory meatus, the subcutaneous tissue, and the urinary passages are apparently of quite exceptional occurrence in the British Islands, although numerous enough in the medical records of other countries. In the following pages it is intended chiefly to deal with those flies and their larvæ that, as causing Myiasis in man in the United Kingdom, have been submitted to the author for determination during the last two and twenty years. Subjoined is a classified list of these species, arranged in order under the families to which they belong.

Family THEREVIDÆ.

Thereva sp. incert. (? *nobilitata*, F.).

Family SYRPHIDÆ (Hover-Flies, &c.).

(Subfamily Syrphinæ.)

Syrphus or *Lasiophticus* spp. incert. (Hover-Flies).

(Subfamily Eristalinæ.)

Eristalis tenax, L. (The Drone-Fly).

Family MUSCIDÆ.

(Subfamily Muscinæ.)

Musca domestica, L. (The House-Fly).

(Subfamily Anthomyinæ.)

Fannia canicularis, L. (The Lesser House-Fly).*Fannia scalaris*, F.*Anthomyia radicum*, L.

Family TACHINIDÆ.

Subfamily Calliphorinæ.

Calliphora or *Lucilia* sp. (Blow-Flies or "Green-Bottle" Flies).

Family SEPSIDÆ.

Piophilæ casei, L. (The Cheese-Maggot Fly).

It will be observed that the above list includes no representatives of the Bot- and Warble-Flies, which in the larval stage are normally parasitic in domesticated and other mammals. No British cases of Myiasis in man certainly due to these flies are known to the writer, although the occasional infestation of human beings by the larvæ of various species of Bot- and Warble-Flies has frequently been recorded on the continent of Europe, in Algeria, and in North and South America. Human Myiasis in the British Islands must be regarded as being for the most part of accidental occurrence, being due to larvæ which are not habitual parasites but wont to lead a free and independent existence, in many cases living and feeding in dead, decaying, or fermenting animal or vegetable matter, or in excrement. The species mentioned in the foregoing list will now be considered in detail, in connection with cases of Myiasis in which their larvæ were concerned.

Thereva sp. incert (? *nobilitata*, F.).

The genus *Thereva*, which has no English name, though eight recognised species are known to occur in the British Islands, consists of medium-sized, dusky flies, with rather elongate bodies somewhat pointed at the posterior extremity, and clothed, especially in the male sex, with outstanding, furry hair, which varies in hue according to the species and may conceal the ground colour. The adult insects, which feed chiefly on other flies, are found on the leaves of bushes, on the foliage of large-leaved plants, or resting on earth or sand, and two species, *T. plebeia*, L., and *T. nobilitata*, F., are not uncommon in gardens. The larvæ, which are very active, glistening white, slender, worm-like creatures, with small dark brown heads, may measure about an inch in length; owing to a series of peculiar constrictions encircling the body, they apparently consist of nineteen or twenty segments. They live in garden mould, earth, sand, or decaying wood, where they are said to feed upon other insects or upon vegetable matter, &c., so that their occasional transference to the human alimentary canal, doubtless through the medium of uncooked vegetables, is not difficult to understand.

On July 22, 1904, the author received for examination from a medical man in Hampshire a living larva of a species of *Thereva*—very possibly *T. nobilitata*, F., accompanied by the statement that the specimen had been coughed up by a man who had

“complained of a bad throat” for about a week. Further details were unfortunately not forthcoming. As bearing upon this case, however, it is perhaps worth mentioning that at Leipzig, in Germany, in the spring of the year 1830, a living larva of *Thereva nobilitata* is stated to have been vomited by a youth who had been unwell for a fortnight, but made an immediate recovery when the intruder was expelled.^{(1)*}

Syrphus or *Lasiopticus* spp. incert. (Hover-Flies).

Everyone must be familiar with the flower-haunting, yellow-banded or yellow-spotted Hover-Flies of the genera mentioned, which are common in gardens and open spaces in woods, and derive their popular name from the habit—shared by other members of their family—of remaining poised apparently motionless in the air for many seconds at a time, supported on rapidly beating wings. The larvæ of these flies are soft-bodied, greenish, greyish, or whitish grubs, flattened on the ventral surface, and with the dorsal integument marked by numerous transverse wrinkles. They are good friends to garden-lovers, since they feed on the juices of Aphides, which they destroy in large numbers. From the normal mode of life of Hover-Fly larvæ, it would seem in the highest degree improbable that they should ever be associated with Myiasis, and their presence in the human body must be regarded as purely accidental. Yet on two occasions within the last ten or eleven years a single Syrphid larva, nine or ten millimetres in length, and apparently belonging to one or other of the genera under consideration, has been submitted to the author by different medical men, accompanied by the statement that the creature had been discharged *per rectum* by a patient; while in a third instance a similar larva was removed from the external auditory meatus. In the latter case, which occurred in June, 1909, the patient (a messenger-boy in a Government office) suffered from deafness and pain in the ear, and the symptoms were stated to have commenced two days before the larva was removed.

Eristalis tenax, L. (The Drone-Fly).

Eristalis tenax, the popular name of which is due to the well-known resemblance of the insect to the male of the Hive-Bee, is found in many parts of the world, and is common everywhere in the British Islands, especially in autumn, when it is frequently to be met with on ivy flowers. It is a large dusky brown or blackish brown fly (often with conspicuous orange markings on the sides of the abdomen in the male), measuring rather more than half an inch in length, and distinguishable from other species liable to be confused with it by the fact that each of the eyes bears a double vertical ridge of dark brown hairs, which, when the insect is closely examined from above, stand out conspicuously from the general hairy covering of the eyes. Like the other species of its genus, the Drone-Fly breeds as a rule in water charged

* The numbers refer to the list of “References” at the end of this paper.

with decomposing organic matter, and its larvæ may be met with in ditches containing sewage, in tubs of liquid manure in gardens, and in similar situations. The chief characteristic of the larvæ of species of *Eristalis*, which is also exhibited by those belonging to allied genera, is the prolongation of the hinder end of the body to form a long, extensile tail, at the end of which are situate the apertures of the two main respiratory trunks, this arrangement enabling the larva to breathe atmospheric air while its body is buried in mud several inches below the surface of the water. It is this peculiarity that has gained for the larvæ of *Eristalis* and its allies the popular designation "Rat-tailed Maggots." The larva of the Drone-Fly is a fat, whitish, semi-translucent grub, measuring when adult at least three quarters of an inch in length exclusive of the tail, which, when fully extended, may measure two and a half inches or more. On the ventral surface certain of the body-segments are provided with protrusible pro-legs, which assist the larva in its movements.

During some four weeks in September and October, 1907, a number of larvæ of the Drone-Fly were passed *per rectum* by a woman in Hampshire, who had recently arrived from France, where she had eaten a considerable quantity of watercress. According to the statement of Dr. H. McQuade, Eling Lodge, Totton, Hants, who forwarded specimens for identification to Mr. S. G. Shattock, Royal College of Surgeons, by whom they were submitted to the author,—twenty or thirty larvæ (? pupæ) "without any tail" were first passed, and "after few days interval others came singly—all with tails." As was only to be expected, the appearance of the larvæ had thrown the patient into a "dreadful state of fear," but it was stated that otherwise she had "suffered no inconvenience." The statement as to the previous consumption of watercress by the patient would in this case seem to afford a reasonable explanation of the origin of the larvæ, though, if this hypothesis be correct, the conditions under which the watercress was grown must have been decidedly unsatisfactory. It is noteworthy that the larvæ were observed for about four weeks, and that those first passed had apparently already assumed the pupal state, so that the total time during which larvæ were present in the patient's intestine was in all probability considerably longer than the period during which they were actually seen. It is of course possible that successive infestations may have taken place; this is indeed rendered probable by the fact that the specimens submitted to the author, which were passed on October 1, included a pupa as well as two adult larvæ, and that the pupæ (?) first seen had been passed some three weeks earlier.

In March, 1865, a case somewhat similar to the foregoing occurred at Fulda, in Germany,—also in a woman. In this instance some half-dozen living larvæ were voided on March 5th, as the result of the administration of a dose of rhubarb to the patient, who believed herself troubled by intestinal worms. Dr. B. Wagner, by whom the case is recorded,⁽²⁾ gives reasons for thinking that the eggs from which these larvæ originated must have been swallowed by the patient with polluted drinking water. From one of the larvæ thus discharged a male fly was duly bred

out twenty-five days later (March 30th). The species proved to be that known as *Eristalis arbustorum*, L., which is much smaller than *E. tenax*, and very common in all parts of the British Islands.

In the United States of America the discharge from the human bowel of larvæ of *Eristalis tenax* and *E. dimidiatus*, Wied., has been recorded by the late Professor Riley.⁽³⁾ In the latter of the two cases the patient was also a woman, and it is perhaps worthy of note that, although the recorded instances of intestinal Myiasis due to larvæ of species of *Eristalis* at present number only some five or six, at least three of these have been in women.

That Dipterous larvæ belonging to various families exhibit extraordinary powers of resistance to unfavourable conditions is well known; but that larvæ which live normally in cold water, and possess a respiratory apparatus of the peculiarly modified type prescribed above, should be capable of withstanding, and even existing for weeks in the temperature and other conditions obtaining in the human intestine seems truly remarkable.*

Musca domestica, L. (The House-Fly).

Myiasis due to the house-fly would seem to be rare, or at any rate seldom reported, since only two instances—both intestinal and both in infants—have come under the author's notice. In one of these cases, which occurred in September, 1903, and from which specimens were submitted to the author for determination by Dr. Hubert Armstrong, Honorary Assistant Physician to the Liverpool Infirmary for Children, larvæ of *Musca domestica* of different ages, together with others belonging to *Fannia canicularis*, L. (the Lesser House-Fly—see below), were "voided from the alimentary canal of a male infant aged seven months."

As stated in the author's "Table" published in Report No. 5 of this series,⁽⁴⁾ the House-Fly larva—a white footless maggot of the usual Muscid type—is distinguishable from similar larvæ by the shape of the respiratory clefts in the stigmatic plates at the broader (posterior) end of the body. In the case of the larva of *M. domestica* these clefts, instead of being straight or

* As illustrating the remarkable power of resistance to apparently unfavourable conditions possessed by the larvæ and pupæ of *Eristalis tenax*, it may be mentioned that some years ago the British Museum (Natural History) received a series of living pupæ of this species, accompanied by the statement that the pupæ had been found in numbers in new sheepskin rugs, purchased from a well-known London furnishing firm. In reply to enquiries, the firm in question stated that they obtained the rugs direct from the manufacturers in Bermondsey, taking them immediately they were dyed, so that it was clear that the pupæ, if not the larvæ, must have passed through the somewhat severe ordeal of the dyeing vats.

An almost equally striking instance of indifference to the medium in the case of an allied species was recently recorded by Mr. C. G. Lamb, who stated that he had found living larvæ of *Eristalis aeneus*, Scop., in rock pools containing salt water and rotting seaweed, and filled only at spring tides, at the north end of Constantine Bay, St. Merryn, Cornwall. "The habitat," wrote Mr. Lamb, "is such that the pools are exposed for many consecutive days to the hot sun without any chance of replenishment of the water, so that the salinity must vary considerably, and this is apparently without harm to the larvæ" (*cf.* C. G. Lamb, *Entomologist's Monthly Magazine*, 2 Ser., vol. xxii., September, 1911, p. 215).

nearly so, or S-shaped, are *very sinuous*, each cleft forming a number of loops in alternating directions, so that its shape is quite characteristic.*

Fannia canicularis, L. (The Lesser House-Fly), and *F. scalaris*, Fabr.

In the British Islands, as also in North America, intestinal Myiasis is perhaps most frequently produced by the peculiarly unpleasant-looking larvæ of *Fannia canicularis*, with which the equally repulsive larvæ of the second of the two species mentioned are sometimes found associated. For a brief description—accompanied by illustrations—of the perfect insect, larva, and pupa of the Lesser House-Fly, the reader may be requested to refer to the "Table" mentioned above.⁽⁴⁾ *Fannia scalaris*, which is less common in houses than the other species mentioned, in the male sex at any rate, is a blacker and usually somewhat larger fly than *F. canicularis*, while the ochraceous-buff patches, which are so conspicuous on each side of the basal half of the abdomen in the male of the latter species, are wanting in the case of the male of *F. scalaris*; in the female sex both species resemble one another so closely as to be indistinguishable except by specialists. The larva of *F. scalaris* differs from that of *F. canicularis* by the bristle-like processes, to which the objectionable appearance of these larvæ is chiefly due, being more feathered at the base and consequently appearing broader than in the larva of the Lesser House-Fly. § Both species breed normally in decaying vegetable or other organic matter, and at Washington, U.S.A., individuals belonging to both have been reared by Dr. L. O. Howard from human excrement:⁽⁵⁾ in this country a similar observation has been made at Liverpool by Professor Newstead, in the case of *F. scalaris*.

Fannia canicularis, L.

Several instances of intestinal Myiasis due to larvæ of this species—none of them, however, very severe—have come under the writer's notice: to one of these cases, in which the patient was an infant of seven months and the larvæ were associated with others belonging to the house-fly, reference has already been made in dealing with *Musca domestica*. It may be of some interest to refer to a severe case of Myiasis caused by *Fannia canicularis*, which occurred a few years ago in the United States. According to a published report of this case:—"The symptoms consisted of abdominal pain and distention, and bloody diarrhœa followed by constipation. Treatment of many kinds was tried, but after eating raw pumpkin seeds on an empty stomach for three days, a saline purge was administered,

* By inadvertence, in the Table referred to, each stigmatic plate was stated to enclose a *pair* of clefts. In the adult House-Fly Larva, as in that of all other Muscidae (*sens. lat.*), each posterior stigmatic plate bears *three* respiratory clefts, though in the case of the House-Fly Larva the adjacent ends of two of the clefts are often so close together that the division between them is difficult to distinguish.

§ See the plate in this pamphlet, Figs. 2 and 3.

when the fæces of a bulky stool were found alive with the larvæ—between 1,000 and 1,500 in all. A few larvæ continued to come away for a few weeks.”⁽⁶⁾

It is noteworthy that many cases of intestinal Myiasis due to *Fannia* larvæ, such as those recorded by Mr. Jenyns and Dr. Cattle (*see below*), have occurred in country districts, where sanitary conveniences are usually of an extremely primitive type. Now, both *Fannia canicularis* and *F. scalaris* are often common in and about privies, in the contents of which they frequently breed, and it seems to the present writer not impossible that some of these cases of Myiasis owe their origin to the parent flies having oviposited on the anus while the patient was at stool.

Fannia scalaris, Fabr.

What may almost be regarded as the classical instance of intestinal Myiasis caused by *Fannia* larvæ is that recorded by the Rev. Leonard Jenyns,⁽⁷⁾ so long ago as 1839.* The patient in the case in question, to which reference has frequently been made in papers on the subject of Myiasis, was an elderly clergyman living near Cambridge, whose symptoms prior to the appearance of the larvæ were “general weakness, loss of appetite, and a disagreeable sensation about the epigastrium, which he described as a tremulous motion.” “These symptoms,” writes Mr. Jenyns, “commenced in the spring of 1836, and it was not till the summer and autumn of that year that the larvæ were observed in the motions. They then passed off in very large quantities on different occasions, the discharge continuing at intervals for several months. According to the patient’s own statement, the chamber-vessel was sometimes half full of these animals; at other times they were mixed with the stools. He thinks that altogether the quantity evacuated must have amounted to several quarts. The larvæ were all nearly of equal size, and, when first passed, quite alive, moving with great activity.” From the careful description and figures of the larvæ accompanying Mr. Jenyns’s account, it is evident that the species concerned in this case, which is remarkable owing to its severity and duration, was not *Fannia canicularis*, as was supposed, but *F. scalaris*, Fabr. At least two cases of intestinal Myiasis due to larvæ of this species have come under the notice of the present writer; in connection with one of these the medical man who forwarded specimens for determination wrote:—“A patient of mine (a drinking man aged about 50) showed me some of his motions, with about a dozen of the enclosed animals on it. He declares he has them constantly on his motions when he passes them.”

A case somewhat similar to that of the old clergyman referred to above, except that in this instance the patient was a youth of 19, was published in 1906 by Dr. C. H. Cattle.⁽⁸⁾ The patient consulted Dr. Cattle in September, 1905, “stating that he had a ‘nest of insects’ in his inside, of which he had passed *per anum* a basinful at one time.” “For some weeks previously,” writes Dr. Cattle, “he had not been feeling well. He now complained

* See also page 19.

of abdominal discomfort, but his symptoms were chiefly the result of alarm at the discovery of living grubs in the fæces. He had many fantastic ideas about the insects, such as 'they were living on his food and taking his strength,' and 'that he felt them crawling about.'" Dr. Cattle adds: "From what I have since been able to learn, I have no doubt whatever that the parasites were capable of causing considerable irritation, which probably accounted for his lively imagination respecting their behaviour. He had no vomiting or other gastric or intestinal symptoms." The treatment adopted consisted in the administration of various drugs, such as santonine, turpentine, and calomel in 5-grain doses, though we are told that these "did not seem to have much effect": it would appear that the larvæ gradually left the patient of their own accord, although so late as March, 1906, one or two at a time were occasionally seen. Dr. Cattle was, unfortunately, misinformed as to the true nature of the larvæ, but it is evident from figure 2 in his article that they belonged to a species of *Fannia*—apparently *F. scalaris*, Fabr.

Those who happen to be interested in Myiasis of the urinary passages should consult the important paper on the subject published some three years ago by Chevrel.⁽⁹⁾ The only instance of urethral Myiasis in this country known to the author is that referred to by Dr. J. Foster Palmer, at the meeting of the Chelsea Clinical Society, held on February 19, 1901. In this case a Dipterous larva, subsequently submitted to the writer and found by him to be that of *Fannia scalaris*, was passed *per urethram* by a male patient.⁽¹⁰⁾

Anthomyia radicum, L.

This species breeds normally in the roots of vegetables, such as cabbages and radishes, and also in horse-droppings. It is a small fly of about the same size as *Fannia canicularis* or *F. scalaris*—blackish in the male and olive-grey in the female sex, in which the upper surface of the head between the eyes usually bears a conspicuous orange patch: the larvæ are whitish maggots of the ordinary Muscid type. For permission to refer to a case of intestinal Myiasis due to larvæ of *A. radicum*, the author is indebted to Dr. F. W. Andrewes, of St. Bartholomew's Hospital, who has kindly supplied the following particulars:—"The case occurred some four years ago, in the practice of the late Dr. J. D. Rawlings, of Dorking. The patient was a child, who, without any other sign of ill-health, passed the larvæ in the fæces in some numbers for a few days. Under simple treatment, probably the homely but efficacious castor oil, the larvæ soon disappeared." The flies were bred out from a specimen of the stools forwarded to St. Bartholomew's Hospital, and were submitted by Dr. Andrewes to the writer for determination.

Calliphora or *Lucilia* sp. incert.

Calliphora erythrocephala, Mg., is the common Blow-Fly, the larvæ of which—known to anglers as "gentles"—are the large

shining white maggots, rather more than half an inch in length when full-grown, found in "fly-blown" meat, dead birds and other animals, and dead animal matter generally. The genus *Lucilia* consists of the brilliantly metallic "Green-bottle" Flies, which are common in the country, and are found on flowers as well as on ordure; *Lucilia sericata*, Mg., is the well-known "Sheep-maggot Fly," which in the summer months is often a pest of farmers and flock-masters. The larvæ of species of *Lucilia* closely resemble those of the Blow-Fly.

For details of a serious case of subcutaneous Myiasis which, although specimens of the maggots were unfortunately not preserved, was undoubtedly due to either *Calliphora* or *Lucilia*, the author is again indebted to Dr. F. W. Andrewes, who has been good enough to furnish the following statement, and has most courteously consented to its publication:—"The case occurred in the summer of 1889 or 1890. The patient was a destitute person suffering from chronic Bright's disease and dropsy, who also had a chronic ulcer over the lower part of his leg. He slept out in Hyde Park, and the ulcer became fly-blown. When I saw him in the Surgery at St. Bartholomew's Hospital, the larvæ had made a pretty clean dissection of the tibialis anticus and other muscles over the floor of the ulcer, which was some three or four inches in diameter. They had devoured the connective tissues, but spared the muscles and tendons. Whether they ate the tissues or subsisted on bacterial decomposition products I cannot say. The ulcer was very foul, and there were hundreds, perhaps thousands of the maggots which, as I remember them, seem about the size of Blow-Fly larvæ. The man was admitted to hospital, but died shortly of septicæmia."

Piophilæ casei, L. (The Cheese-Maggot Fly.)

Piophilæ casei is a little, narrow-bodied, shining black fly, about one-sixth of an inch in length or rather less, with an orange-coloured patch on the head above the base of the antennæ, and with glassy, iridescent wings. The larvæ, well-known on account of their remarkable power of leaping, are slender, shining white maggots, measuring about one-third of an inch (five millimetres) in length when full-grown, which normally live in cheese, ham, or bacon, and often do much damage in bacon factories. In leaping, the larva bends itself into a loop and seizes with its mouth-hooks the posterior, truncated end of the body, pulls hard, and then suddenly releases its hold.

So far as the writer's investigations have gone, the following is the only case of Myiasis in the British Islands due to the Cheese-Maggot Fly which has yet been recorded. At the meeting of the Laryngological Society of London, held on March 11, 1896, Dr. J. W. Bond brought forward a case of larvæ in the nose in a woman, aged forty-nine, who "had attended the Throat Hospital for some eighteen months for chronic pharyngitis, &c. In May, 1895, she noticed a profuse watery discharge from the nose for three weeks, and sharp shooting pains

in the left frontal region. The discharge was never purulent. . . . For about six weeks various lotions were used without good result. Then, after using a dilute Mandl solution ($\text{m xv in } \bar{5} \text{ j}$) twice, four grubs came away from the nose, and she was relieved. She remained quite well for another two weeks, during which she attended the hospital. . . . There was no particular smell noticed likely to attract the fly. The case seems to have been very readily cured, no doubt because the accessory sinuses were not invaded."⁽¹⁾ Specimens of the perfect insects bred from some of the larvæ were examined by Mr. C. O. Waterhouse, late Assistant-Keeper, British Museum (Natural History), who pronounced the species to be *Piophila casei*, L.

In Italy larvæ of this species have been expectorated by a patient suffering from an affection of the chest,⁽¹²⁾ and the author has examined specimens of the fly bred from larvæ from a case of intestinal Myiasis at Lisbon.

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- (1) Cf. FR. BOIE, *Isis*, 1830, p. 256.
- (2) DR. B. WAGNER, "Die Made von *Eristalis arbustorum*, L., als Parasit im menschlichen Darmkanale": *Stettiner Entomologische Zeitung*, Bd. XXXI., pp. 78-80 (1870).
- (3) *Insect Life*, Vol. II., pp. 261, 262 (1890).
- (4) "Table Showing the Distinctive Characters of the More Important Species of Flies Found in Houses, in their Various Stages," by E. E. AUSTEN: *Reports to the Local Government Board on Public Health and Medical Subjects* (New Series No. 5), 1909.
- (5) Cf. L. O. HOWARD, *Proceedings of the Washington Academy of Sciences*, Vol. II., pp. 581-582 (1900):—In "A Contribution to the Study of the Insect Fauna of Human Excrement." [With Especial Reference to the Spread of Typhoid Fever by Flies.] By L. O. HOWARD, Ph.D.: *ibid.*, pp. 541-604, Plates XXX., XXXI., and 22 figures in the text.
- (6) Cf. H. C. BLANKMEYER, *Journal of the American Medical Association*, May 4, 1907.
- (7) REV. LEONARD JENYNS, M.A., F.L.S., &c., "Notice of a Case in which the Larvæ of a Dipterous Insect, supposed to be the *Anthomyia Canicularis*, Meig., were expelled in large quantities from the human intestines; accompanied by a description of the same": *Transactions of the Entomological Society of London*, Vol. II., pp. 152-156, Pl. XV., figs. 1-8 (1839).
- (8) C. H. CATTLE, M.D., M.R.C.P., "A Case in Which Large Quantities of Dipterous Larvæ Were Passed per Anum"; *British Medical Journal*, July 14, 1906, p. 77, figs. 1 and 2.
- (9) RENÉ CHEVREL, "Sur La Myase des Voies Urinaires"; *Archives de Parasitologie*, T. XII., No. 3, February 10, 1909, pp. 369-450 (figs. in text).

- (¹⁰) Cf. The British Medical Journal, March 9, 1901.
 (¹¹) Cf. The Journal of Laryngology, Rhinology, and Otology, Vol. X., pp. 236, 237 (1896).
 (¹²) Cf. C. RONDANI, Atti Soc. Ital. Sc. Nat., VIII., pp. 191-195 (1865).

(3.) AN ACCOUNT OF THE BIONOMICS AND THE LARVÆ OF THE FLIES *Fannia** (*Homalomyia*) *canicularis* L. AND *F. scalaris* Fab., AND THEIR RELATION TO MYIASIS OF THE INTESTINAL AND URINARY TRACTS. BY C. GORDON HEWITT, D.Sc., F.E.S.

The two flies *Fannia canicularis* Linn. and *F. scalaris* Fab. are, on account of their habits, of considerable economic importance in their relation to man. It is therefore desirable that those engaged in public health and medical work should be acquainted with the breeding and other habits of these flies which they are certain to meet in their work under circumstances of varying importance. The inquiry of which this account is the result was undertaken for the Local Government Board but, owing to my removal from England to Canada in 1909 and subsequent pressure of work, its completion has been delayed.

These two species of flies belong to the dipterous family *Anthomyidæ*, many of which resemble the house-fly (*M. domestica*) in appearance. They are characterized chiefly by the contiguity of the eyes of the male, the comparatively large squamæ, or lobes, on the posterior sides of the bases of the wings, and the open first posterior or apical cell of the wing.† Most of the larvæ, or maggots, feed upon decaying vegetable or animal substances.

Without close examination the two species under consideration are liable to be mistaken for the same species but such an examination will serve to separate them. The abdomens of both species are conical but the basal segments of the abdomen of *F. canicularis* (in the male) are partially translucent and the abdomen of *F. scalaris* is black overspread with bluish grey; the mid tibiæ of the latter species bear a distinct tubercle which is not found in *F. canicularis* (Fig. 1^a).

The Lesser House-Fly, Fannia canicularis L.

This species is the less common of the two species of flies usually found in houses during the summer months. Its occurrence and frequency are, however, very variable and no valid explanation has been found so far in my investigations to account for this variability. *F. canicularis*, however, is more abundant

* By the rules of priority the generic name *Fannia*, of Robineau Desvoidy 1830, which he gave in his "Essai sur les Myodaires," will have to replace Bouché's genus *Homalomyia*, to which genus these species are usually referred but which was not created until 1834.

† See Fig. 4 in "First Report on Flies as Carriers of Infection." (Reports on Public Health and Medical Subjects, New Series No. 5.)

than *M. domestica* for a short time during the early part of the summer, especially in May and June. With the beginning of the hot weather the numbers of the latter increase enormously and replace the Lesser House-Fly. In many cases which were observed the latter seemed to retreat in small numbers to rooms of the house not devoted to cooking and they may be frequently found flying in a characteristic jerky and hovering manner around chandeliers, &c., in the living and bed-rooms. In country houses, however, they frequently occur in numbers in the kitchens as an examination of fly traps and papers in such places indicates.

The numerical abundance of *F. canicularis* in comparison with *M. domestica* varies considerably. In a collection of nearly 4,000 flies which was made in different situations such as kitchens, restaurants, bed-rooms, &c., in 1907, this species formed 11.5 per cent. of the number. In 1900, Howard (U.S.A.) found that only about 1 per cent. of a collection of over 23,000 flies made in rooms where food was exposed were *F. canicularis* and over 98 per cent. were *M. domestica*. Hamer, in 1908, in collections made in kitchens and "living rooms" of houses in London, near depôts for horse manure, found that the percentage of *F. canicularis* varied from 17 to 24 per cent. Niven gives the results of collections made at six different stations in Manchester. The total number of flies caught was 8,553 of which 8,196 were *M. domestica*, 293 *F. canicularis* and 64 were other species. Thus, *F. canicularis* constituted 3.4 per cent. of the total fly population. Robertson gives the results of similar collections made in Birmingham where, of 24,572 flies caught, 91 per cent. were *M. domestica* and 4.7 per cent. were *F. canicularis*. From observations that I have made in many localities in different neighbourhoods, I do not think that this species would often form more than 25 per cent. of the total fly population. After *M. domestica*, however, it is the next fly of importance inhabiting houses and well deserves the title of Lesser House-fly. It is known in Germany as "die kleine Stubenfliege."

For a brief technical description of this species the Table by Mr. E. E. Austen in the first of the series of Reports on "Flies as Carriers of Infection" may be consulted.

Proportion of sexes.

Great disparity in the proportion of males to females is found in this species as it occurs in houses. Hamer showed in 1909 that the males constituted from 75 to 85 per cent. of the total flies of this species caught in balloons and on fly papers. This, however, does not indicate a disparity in the proportion of males to females in the species, as I have found that the females are more commonly found out of doors, especially in the neighbourhood of the breeding places.

Breeding habits.

The breeding habits of this species are somewhat similar to those of the House-fly, *Musca domestica*. The eggs are laid in decaying and fermenting vegetable and animal matter and also

in excrementitious matter. In 1848, Heeger recorded the larvæ as living in the caterpillars of *Epischnia canella*; Roth found them in the nest of the humble bee *Bombus terrestris* and Schiner observed them in the bottom of a box in which a dormouse had been kept. Taschenberg also records the larvæ as being found in snails, in old cheese and in pigeon nests; he reared the flies from sugar beet, and Brischke found the larvæ in the stalks of rape. I have found them commonly in human excrement and in a variety of decaying vegetable substances, even in rotting grass. In England the larval stage of this species may be found from May to October. Howard has reared the fly from human excrement during the same period in the United States. The eggs are white and cylindrically oval.

Larva of F. canicularis.

The larva of *F. canicularis* (Fig. 2) is wholly different from that of *Musca domestica*; its body being provided with a number of appendages or spiniferous processes. These are arranged in three pairs of longitudinal series and there are in addition two pairs of series of smaller processes.

The body is compressed dorso-ventrally and the surface is rough. It consists of twelve segments of which the first is often withdrawn into the second as shown in the figure. The posterior end of the body is very obliquely truncate. The full-grown larva measures 5-6 mm. in length.

On the ventral surface of the body and extending posteriorly from segment III there is to be found a series of pairs of small spiniferous papillæ. Between these there is on each segment a tranverse row of four groups of spines.

The spiny character of the flagelliform appendages and body of the larva causes particles of dirt to adhere readily to them. In consequence, the larvæ have a very dirty appearance and their external features are almost hidden by the accumulated particles of dirt and filth adhering to them. When fully-grown the larva is covered fairly thickly with dirt.

The larval period may extend over a week, or it may last for three or four weeks if the substances in which the larvæ are feeding become rather dry.

In changing into the pupa, the cephalic region is retracted and the length of the larva is thereby decreased. The larval skin, with its covering of dirt particles, forms the pupal case. Before pupating the larva leaves the moist substance in which it may have been living and seeks a drier situation. The pupal period extends over a period of seven to twenty-one days, or longer, and it is not unlikely that larvæ, which have developed very late in the season, pass the winter in the pupal state, as is the case in certain other species of Anthomyid flies. The adult fly emerges by pushing off the anterior segments of the pupal case.

The Latrine Fly, F. scalaris Fab.

This species which, on account of its most usual breeding habits, may be called the Latrine Fly, is very common both in European countries and in North America. Owing to its general similarity it is often confused with the Lesser House-fly *F. canicularis*, but the chief differences have already been indicated.

In the adult *male* of *F. scalaris* black is the prevailing colour; but the humeri are light-coloured. The legs are black and the middle femur is swollen ventrally, bearing on its broader side a group of brush-like bristles as will be seen from Fig. 1, *a*. The middle tibia is provided, as shown, with a distinct tubercle near the distal end.

The colouring of the *female* is more distinctly grey with a faint longitudinal striping on the thorax.

F. scalaris is slightly larger than *F. canicularis*, measuring up to 6 mm. in length.

The habits of this species are somewhat similar to those of *F. canicularis*, but it prefers excrementitious matter as a nidus for the eggs and is very commonly found breeding in human excrement. It has been recorded breeding in human excrement by Schiner, Taschenberg, Howard and Newstead, and I have also bred it from this material in England and Canada, both in privies where the excrement was found in a semi-liquid condition and on rubbish tips or dumps where it was mixed with ashes or clinker. Taschenberg also refers to its breeding in mushrooms. In 1908, Dr. David Sharp submitted the larva of this species to me for examination. He had found it in rotting fungus in the New Forest in September, 1905, and noticed its similarity to Swammerdam's "Latrine Larva." The larvæ emerge as early as eighteen hours after the deposition of the eggs and the larva becomes full-grown in six to twelve days. The shortest time which I have recorded for the pupal stage was nine days, which was in the month of August, but I believe that under very favourable conditions the pupal stage would be passed in a shorter time.

The larva of F. scalaris.

The larva of this species (Fig. 3) has a general resemblance to that of *F. canicularis*, but a closer examination will reveal the very marked differences and a number of distinguishing characters. In shape it is similar to the larva of *F. canicularis*, being compressed dorso-ventrally. The appendages, or processes, however, are very different. The pair of antenna-like processes at the anterior and upper edge of the second segment are much shorter than those of *F. canicularis*, as will be seen from the figure where they are shown dorsal to the oral lobes. On the dorsal side of the larvæ, from segment III. to segment XI., is a series of nine pairs of short and somewhat thick processes of a very spiny character; the first two pairs being little more than spinous tubercles. Viewed from above the larva is seen to be surrounded by a fringe of feather-like processes.

The anterior, or prothoracic spiracular processes are six to eight-lobed; the usual number of the lobes being seven. The posterior spiracular processes are very similar to those of *F. canicularis*.

The feathery character of the processes of *F. scalaris* is probably associated with the fact that the larvæ usually live in substances of a semi-liquid character where such processes will be more advantageous than those of *F. canicularis* for life in such a medium. It may be of interest to note here that the spiniferous and branched lateral appendages of the larvæ of the genus *Fannia* were considered by Walsh (1870), and not improbably by other entomologists, to be "branchiæ" or gills. Walsh (l.c.) stated: "The larvæ . . . wallow in moist decaying matter, whether animal or vegetable; and as in such situations they would be sometimes stifled for want of air, if they breathed through the spiracles or breathing holes with which all air-breathing insects are supplied, nature has replaced the spiracles by lateral 'branchiæ' or gills, by means of which they are able, after the manner of a fish, to extract the air from the fluids around them," and he compares them to the gills of the Ephemeroïd larvæ.

Prior to pupation the larva leaves the moist situation for one of a drier character, and the pupation is similar to that of *F. canicularis*.

F. scalaris is more commonly found than *F. canicularis* as the cause of intestinal myiasis, and in its development it specially affects human excrement. These facts make its economic relation to man one of not a little importance.

The Relation of F. canicularis and F. scalaris to Myiasis of the Intestinal and Urinary Tracts.

For many years cases have been recorded of the presence of dipterous larvæ or "maggots" in the human intestine from which they have been expelled either by vomiting or through the anus. Their presence in the human body has frequently resulted in more or less serious intestinal troubles. The records of these cases are widely scattered through medical and other scientific journals and reference will be made to a number of the more important and typical cases.

Occurrence in the Alimentary Tract.

The presence of these larvæ in the stomach is usually indicated by nausea, vertigo and violent pains; the larvæ in many cases are expelled by vomiting. If they occur in the intestine they are expelled with the fæces, and their presence is signalled by diarrhœal symptoms, abdominal pains, or hæmorrhage caused by the traumatic lesions of the mucous membrane of the intestine which the larvæ effect.

In 1839 Jenyns recorded the case of a clergyman* of about 70 years of age who complained of general feebleness, loss of appetite and a disagreeable epigastric feeling of a tremulous character. These symptoms began in the spring of 1836, and it

* This case is also referred to in Mr. Austen's paper above (p. 11).

was not until the autumn that the larvæ were observed. They were expelled repeatedly in large numbers, and their expulsion in this manner continued for several months. The larvæ were about equal in size and extremely active on their appearance. The malady did not recur and the evacuation of the larvæ ceased shortly; the patient's health gradually improved, but not completely. The author calls attention to the fact that the symptoms made their appearance in the spring but the larvæ were not expelled until the summer and autumn following. It would appear, therefore, that they entered the stomach in the egg state and after hatching passed into the intestine where they completed their growth.

In 1876 Judd describes the discharge of the larvæ of *F. scalaris* from the intestine of a boy in Kentucky, U.S.A.

Stephens (1905) records the larvæ of *F. canicularis* as having been passed *per rectum*. Cattle (1906) refers to a case in which large quantities of *Fannia* larvæ occurred in the intestine, there were few symptoms and the larvæ were being discharged *per anum* seven months after he first saw the patient. The writer (1909) has also recorded the occurrence of *F. canicularis* in the stools. Recently, Saltau (1910) has recorded the occurrence at Plymouth on the 28th of May of the larva of *F. canicularis* in the stools of a man who had no previous intestinal pains. The occurrence in September, 1909, in the fæces of a boy aged 12 of the larvæ of a species of *Fannia* has been described by Garrod (1910).

Occurrence in the Urinary Tract.

It would appear most unlikely that the larvæ of these insects should be discharged from the urinary tract and yet there are a number of records of such occurrences. These have been excellently summarised by Chevrel (1909), who, in addition, reports a case of the occurrence of the larva of *F. canicularis* in a woman of 55 who suffered from albuminuria and urinated with much difficulty. Eventually, thirty to forty larvæ of *F. canicularis* of different sizes were passed from the urethra.

Method of Infection.

The larvæ of the flies belonging to the genus *Fannia* inhabit, as has been seen from the preceding account of their breeding habits, excrement and decaying vegetable products and the female flies, guided by their sense of smell and impelled by their maternal instincts, seek such substances. They are attracted to excrement, decaying, putrefying or purulent substances. These facts render several methods of infection possible.

In the case of intestinal myiasis, the flies may have deposited their eggs in rotting or decaying fruit, vegetables or other food which may be eaten in a raw state and thus the eggs or young larvæ will be taken into the digestive tract; or, the flies, which are generally to be found depositing their eggs in the old style privies, may deposit their eggs in or near the anus, especially if the person is somewhat costive. The larvæ, on hatching, make

their way into the rectum and thence to the intestine. This latter mode of infection is probably the common one in the case of infants belonging to careless mothers. Such infants are sometimes left about in an exposed and not very clean condition in consequence of which flies are readily attracted and deposit their eggs.

The infection of the urinary tract is more difficult to understand. The flies are no doubt attracted to the genital apertures by the different albuminous secretions, spermatic, menstrual, gonorrhœal or leucorrhœal. The larvæ would feed upon the muco-purulent secretions of the urinary tract. It is easier to understand the infection of the urinary tract of a woman rather than that of a man. The case recorded by Chevrel indicates fairly clearly how the female urinary tract may become infected during the continued or prolonged exposure of the person. As the flies are frequently found in bedrooms the infection of both sexes during hot weather is sometimes rendered possible.

The whole subject of the relation of these flies to myiasis of the intestinal and urinary tracts is one which has received comparatively little attention. Certainly not the attention it deserves on account of the complications incident to such infections that may arise.

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EXPLANATION OF FIGURES.

- Fig. 1. "Knee" joints of second (right) pair of legs.—
 (a) of *F. scalaris*,
 (b) of *F. canicularis*.
- Fig. 2. Larva of *Fannia canicularis* Linn.
- Fig. 3. Larva of *F. scalaris* Fab.
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Fig. 1.

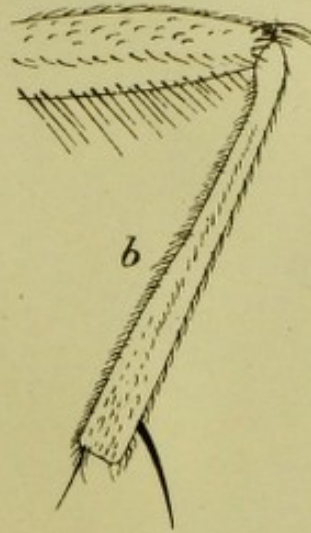
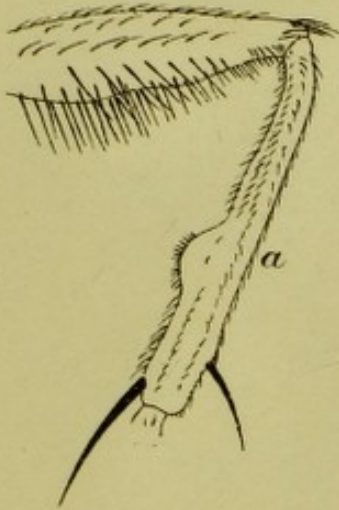


Fig. 2.

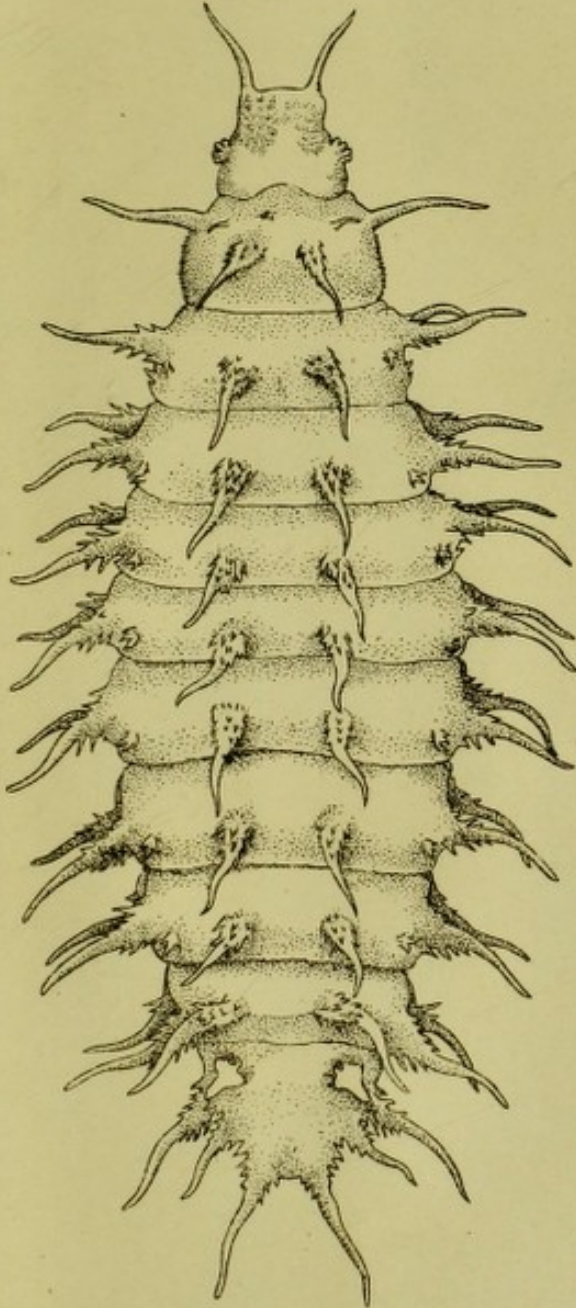


Fig. 3.

