MYIASIS INTESTINALIS DUE TO INFECTION WITH THREE SPECIES OF DIPTEROUS LARVÆ*

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Infections of man by the larvæ of dipterous insects (myiasis) are very infrequent, although such infections have been known to occur since the early history of medicine. Gilbert¹ reviews the history of infections of this kind in a recent article and calls attention to some of the earlier observations.

Myiasis occurs both within the body and on its external surfaces. Thus we have myiasis interna and myiasis externa. In the former should be included those cases in which the fly larvæ invade the dermis and subcutaneous tissues (myiasis hypodermatis) and those in which they invade the intestines (myiasis intestinalis).

Larvæ isolated from case of myiasis intestinalis; (1) *Musca domestica*; (2) *Anthomyia canicularis*; (3) *Eristalis tenax*.

In the latter should be included those cases in which the larvæ invade wounds and open abrasions of the epidermis and dermis (myiasis dermatosis).

REPORT OF CASE

The case which we report is one of myiasis intestinalis from which three separate and distinct species of larvæ were isolated and is the only one in medical history, as far as we can determine, in which a mixed infection has occurred.²

History.—Mrs. McL., native of Ohio, resides on a farm, widow, mother of ten children. With the exception of two, all her children are deceased, some dying of infantile infections and two in later life of tuberculosis. The patient was in good health until the age of 57 (fifteen years ago), when she developed an acute catarrhal gastritis. The gastric trouble has since persisted. The patient has been under medical treatment

almost continually since. At the age of 65 she began to pass "millions" of small green larvæ and a smaller number of white jointed larvæ which, the patient states, are similar to those recently passed. This attack of myiasis lasted about one year and the patient noticed nothing more of the larvæ until the age of 70 (two years ago), although there was no improvement in her health. She became very much emaciated during this period of five years. The larvæ have been intermittently passed in large numbers during the last two years and still persist. The patient noticed that during the last two years much larger organisms were passed in addition to those noted five years previous. She describes these organisms accurately and states that they are frequently twice the size of those which we have recently obtained. The patient states that she has had a continual feeling of distress in the abdomen since the attack of gastric trouble at the age of 65. The abdomen frequently becomes distended and colicky pains in the epigastrium have occurred at irregular periods. The larvæ, she states, are usually passed in a watery discharge and few, if any, have ever passed in the ordinary stools. Attacks of nausea and vomiting have occurred at irregular intervals since the gastric disturbances at the age of 65. She has never observed any of the larvæ in the vomit. The patient states that at the age of 65 her weight was 180 pounds. She does not associate the infection with the eating of any food and states that she always eats thoroughly cooked and fresh food. She states that the water which she has used has always been pure well-water. The surroundings of the home of the patient show nothing more insanitary than is usually noted about the average farm. Manure piles and flies are abundant.

Present Condition.—The patient, aged 72, weight 90 pounds, is distinctly neurotic, anemic and much emaciated. The abdomen is slightly distended and tender on deep pressure. The patient states that there is a constant ache throughout the abdomen. The pain seems to be partially localized in the epigastrium. Occasional colicky pains occur. The patient is constipated and does not have intestinal passages unless induced by cathartics. For this purpose she has used Epsom salts almost exclusively. At irregular intervals she passes large numbers of larvæ (250 to 500 c.c. fluid containing as many larvæ as possible). The larvæ are not passed in the usual stools but in a watery discharge. The patient states that a great amount of abdominal pain precedes the passage of the larvæ. Cathartics and aperients have failed to eliminate the larvæ from the intestines. Examination of the circulatory system shows a well-marked mitral lesion and rather advanced arteriosclerosis. The respiratory system is negative except for a slight nervous dyspnea; respirations, 25; pulse, 90. Genito-urinary system and urine are negative. The patient is easily nauseated and frequently vomits. She is confined to her bed the greater part of the time and is quite weak. The appetite is absent and the diet almost entirely liquid. Well-marked mental aberrations in regard to the activity of the larvæ within the intestines are noted.

Parasites.—The larvæ which we have examined, some of which were still alive, were passed three days previous to the time we obtained them. They proved to be those of the following species of dipteræ: *Anthomyia canicularis*, the small black flower- or house-fly; *Musca domestica*, the common house-fly; *Eristalis tenax*, the drone or flower-fly.

As myiasis has been noted due to each of these species they will be briefly considered.

THE INFECTING ORGANISMS

Anthomyia canicularis.—This is the common small black house-fly or flower-fly. The family of flies to which this species belongs (*Anthomyiidae*) is composed of a large number of species and the larvæ feed almost universally on decomposing vegetable matter, growing plants, and some few species on the eggs of the grasshopper and locust. In Europe *Anthomyia canicularis* has been noted frequenting vaults and is often spoken of as the "privy-fly." The larvæ are elongated in shape, composed of ten segments and measure 1 to 1.5 cm. in length. They are rounded posteriorly and narrow

* From the Pathological Laboratory of the University of Chicago.

1. Gilbert, N. C.: Infection of Man with Dipterous Larvæ, Arch. Int. Med., October, 1908, ii, 226.

2. For the opportunity of study and subsequent diagnosis of this case we are indebted to Drs. V. B. Weller and W. F. White.

toward the anterior end. Each segment possesses a pair of lateral branchiæ, which are used for respiration while the larvæ are in fluid media. Each segment possesses also a pair of prolegs. This species of larvæ were the most prevalent of any passed in the case which we report.

The larvæ of *Anthomyia canicularis* have been reported as parasitic in man probably more often than any other of the dipterous insects. They have been noted to occur in the intestines, ear, vagina, and female urethra. A review of the literature shows about thirty cases of infection with anthomyid larvæ. In about twenty-five cases of these the intestines were infected. Of the total number of cases reported five were in the United States. It is impossible to state just how many of the cases were due to *Anthomyia canicularis*, as frequently the exact species was not determined. It seems that there are about twenty authentic cases of myiasis due to this particular species.

Musca domestica.—This is the common house-fly. The eggs (120 to 150) are deposited in horse-manure almost exclusively, but also occasionally on other excreta and decomposing vegetable matter. After the hatching of the eggs, which occurs in from six to eight hours, the larvæ feed on the decomposing animal and vegetable material. The larvæ are white pointed maggots 1 to 2 cm. in length and composed of nine or ten well-defined segments. Around each segment are a number of short branchiæ, which serve as respiratory organs. The larvæ grow rapidly, molt twice, and reach full size in from four to five days. The pupæ which follow persist for four or five days and from these the adult fly emerges, making a total of eight to ten days for the entire cycle. These flies are thought to pass the winter in the pupal stage.

Comparatively few larvæ of this species have been passed in the case reported. Cases of myiasis with the larvæ of this species are rare, there being only five or six authentic cases in the literature. Some of the other members of the family *Muscidæ* frequently infect wounds, ulcers, the nasal sinuses, ear and occasionally the intestine.

Eristalis tenax.—This is the so-called drone-fly. It is somewhat larger than the honey-bee and shows a marked protective mimicry for this last-named insect. It is a flower-fly and very active. It belongs to the family *Syrphidæ*, of which there are 2,500 species, 300 having been described in the United States. This fly is occasionally observed within doors in the late autumn. The larvæ are famous for their "rat-tailed" appearance. They are found on decomposing animal and vegetable matter and in soft mud. The larvæ measure 2.5 to 3 cm. in length and consist of seven segments, each bearing a pair of tubercles or prolegs. A well-defined head and mouth parts are absent. The anterior end possesses two pairs of hooklets. A long slender projection 2 to 3 cm. in length extends from the posterior portion of the body and this contains a small, contractile tube with breathing pores at the end. This appendage is projected up and is used by the larvæ to obtain air when buried or in fluid media. At times the larvæ are quite active and crawl about.

Cases of myiasis with *Eristalis tenax* larvæ are extremely rare. No cases are recorded in which accurate data are given. It is the rarest of the three species considered in this report.

GENERAL CONSIDERATIONS

The source of the infection in this case of myiasis intestinalis can not be definitely determined. The pa-

tient possibly ate the eggs or newly hatched larvæ with food materials. It is not probable that adult larvæ were ingested without the patient's knowledge and we do not think from the examination of the patient that the larvæ or eggs were purposely ingested. Finlayson's³ suggestion that the eggs which may be deposited around the anus and the larvæ, after the hatching of the eggs in from six to eight hours, invade the intestine from this source, is credible. We are of the opinion that there has been only one, with a possibility of two, infections in this case. We think that the primary infection occurred seven years ago when the larvæ were first observed. If there was a second infection it must have occurred two years ago at the time the occurrence of the large number of the larvæ was noted. We do not know but that larvæ may have been passed during the interval. At the time the larvæ were first noted and since there has been gastric trouble. This is a common observation in cases of myiasis. The cases are too rare to assume that the patient has been continually reinfected.

In reviewing the literature from an entomological standpoint we were surprised to note that comparatively nothing has been done in the study of the metamorphosis of the various insects. The bluebottle fly (*Calliphora erythrocephala*) is practically the only species which has been studied.

The following facts may be noted in regard to flies: Some lay no eggs, living larvæ issuing from the female (viviparous). It has also been noted that when certain of the dipteræ become parasitic no wings are developed. Nothing seems to be known as to whether the larvæ may reproduce, as has been noted in the embryonic types of some other low forms of animal life. The sexual organs in the larvæ, according to most entomologists, are not completely developed until after the adult fly stage is reached. The larva is entirely different from the adult fly and during the pupal stage which intervenes all the organs of the larva, except the reproductive, undergo degeneration and are regenerated. Such an arrangement suggests a very high specialization of these organs and it may be possible that when these larvæ become parasitic within the body reproduction may take place. It seems positive that the eggs can hatch and the larvæ grow to full size in the intestine of man. It has also been observed that larvæ may exist for very long periods of time within the body.

There seems to be four possible explanations for the continued presence of the larvæ within the body.

1. Persistence of the larval state for two to seven years. It must be assumed that very large numbers of eggs or very young larvæ were ingested, bearing in mind the number which have been passed. There is one case in the literature of twelve years standing.

2. The reproduction of the larvæ within the intestine. This would most easily account for the large numbers passed for a series of years.

3. The completion of the cycle by the hatching of the larvæ into the adult parasitic fly (wingless) and the laying of eggs by these flies in the intestines. We have observed no adult flies or remnants in the excrement.

4. The continued reinfection by the eating of eggs or larvæ or the deposition of eggs around the anus and their subsequent invasion of the intestine. There is the possibility that this patient was infected twice, once seven years ago and again two years ago. There is also the possibility in this case that the patient purposely ingests the larvæ. We think that this possibility has been excluded.

3. Finlayson: Brit. Med. Journal, 1889, 1, 1285.

Of the four possibilities we are inclined to believe that the first, with possibly the second, furnish the most logical explanation for this interesting case of myiasis.

Experiments will be made and reported on later as to the effect of the various digestive enzymes on the larvæ and their activity.

PREVENTION OF MALARIA *

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Statistics show that malaria prevails in every state in the union except Wyoming; but because of climatic, meteoric and geologic conditions favorable to the growth of the anopheles mosquitoes, the southern states and the states adjacent to the Mississippi, Missouri and Ohio rivers show the greatest mortality from the disease.

Statistics compiled from the last census¹ show that there died, from malaria, in the United States in the year 1900, 14,909 persons, distributed by states as follows:

Alabama	1,055	Montana	5
Arizona	17	Nebraska	32
Arkansas	1,730	Nevada	10
California	119	New Hampshire	18
Colorado	21	New Jersey	110
Connecticut	110	New Mexico	89
Delaware	19	New York	308
Dist. of Columbia	63	North Carolina	527
Florida	366	North Dakota	4
Georgia	1,011	Ohio	156
Idaho	4	Oklahoma	134
Illinois	497	Oregon	23
Indiana	340	Pennsylvania	140
Iowa	84	Rhode Island	24
Kansas	261	South Carolina	749
Kentucky	344	Tennessee	987
Louisiana	1,030	Texas	1,331
Maine	16	Utah	6
Maryland	131	Vermont	9
Massachusetts	70	Virginia	409
Michigan	168	Washington	13
Minnesota	9	West Virginia	34
Mississippi	983	Wisconsin	5
Missouri	965	Wyoming	0

Of those who died from malaria in 1900, 9,320 were white and 5,589 colored. In the last census the colored population was approximately one-ninth of the whole, while more than one-third of the deaths from malaria were among the negroes. This high death rate from malaria among the negroes, who were formerly supposed to be more or less immune to the disease, may be accounted for by the fact that the negro population, in the states showing a high death rate from malaria, is large, and the negroes, representing the laboring and poorer classes, live in insanitary surroundings and, either from poverty or neglect, do not take treatment for the disease.

I have seen anopheles mosquitoes breeding in Central Park in New York; I have seen the plasmodium of malaria in blood obtained from the child of a millionaire residing on Fifth Avenue, and it is the same variety of mosquitoes, and the same type of protozoon, that I have seen in the swamps of the rural districts of the far south.

The problem of malaria, since it affects all sections of our country and all races and classes of our citizens, is a national one, and I shall discuss it from that point of view, though I admit that the section of country which I represent is vitally interested in this subject. In this connection I submit a few paragraphs from my address² as chairman of the section on medicine of the Southern Medical Association, delivered in Atlanta last November.

Perhaps the most important health problem which affects the prosperity of the south is malaria. One has but to travel in the eastern, northern and western states to find that in those sections the south is regarded as a hotbed for malaria. No doubt thousands of settlers have sought homes in the west and elsewhere in preference to the south, because they feared to take their families to a section which they considered so unhealthful. Many travellers avoid the south, and capitalists have been deterred from making investments in our section because of the fear of malaria. I realize that such impressions are largely due to prejudice and to ignorance of the health conditions of the south, but it is also true that we have more malaria than we should have because, with our present knowledge of the disease, it should soon be stamped out of our towns and cities and made a rare disease in the country.

I have not statistics to show how much malaria has decreased in the south in the past two or three decades, except in the state of Maryland,³ but its prevalence has been wonderfully lessened and it has become a much milder disease, so that to-day the severe types are rarely seen.

The south is enjoying splendid prosperity in all lines, and she should erase from her fair name the blot of malaria, because it is a disease which can be prevented, and which interferes very materially with her industrial development.

Malaria destroys more lives every year than have all the epidemics of yellow fever in the past half-century, and there are several millions of our citizens in the United States to-day whose wage-earning capacity is limited because of the mild and chronic forms of the disease; yet malaria is preventable, and quinin is a specific for the disease.

In my opinion, malaria is a much more serious disease than yellow fever for the reason that one attack does not confer immunity, as in yellow fever, but predisposes to subsequent attacks; and because malaria is considered such a mild disease it is not properly treated and often assumes a chronic form which saps the vitality of the individual, thereby rendering him more susceptible to all other diseases, which are made more serious by the complication of malaria. The effects of yellow fever are soon over, while the victim of malaria may have the disease for years. I believe that the high death rate from nephritis in the southern states may be largely accounted for by chronic malaria.⁴

The existence of a few cases of yellow fever in a city causes a panic which destroys its commerce; there is an exodus of a large portion of its population, and cities, states and the nation will spend thousands of dollars in quarantines and in stamping out the disease; yet in the same city there may be thousands of cases of malaria—nothing is thought of that—and there has never been any organized effort to stamp out malaria because its ravages are “seen so oft” and we are so “familiar with the monster’s face” that we endure it as if conditions could not be remedied.

2. Harris, Seale: Some Problems in Medicine which Affect the Prosperity of the South, Jour. South. Med. Assn., April, 1909.

3. Thayer, W. S., and Hewetson, J.: The Malarial Fevers of Baltimore, Johns Hopkins Press, 1895, Baltimore. The Present Decline of Malaria in Maryland, Maryland Med. Jour., 1905, xlviii, 289.

4. Marchiafava and Bignami: In Twentieth Century Practice of Medicine, New York, 1900, William Wood and Company.

*Read in the Section on Preventive Medicine and Public Health of the American Medical Association, at the Sixtieth Annual Session, held at Atlantic City, June, 1909.

1. Twelfth Census of the United States, 1900, Vital Statistics, Vols. 1 and 2.