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A CRITICAL STUDY OF A CASE OF MYIASIS DUE TO *ERISTALIS* *

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Sept. 2, 1912, one of us (Muir) was called in to see a boy, J. H., 5 years old, who had been ailing for about ten weeks and who was under medical treatment for indigestion and obstinate constipation for about five weeks of that time. The child was emaciated and anemic. Very striking symptoms were the constant and pronounced twitching of the eyelids and other nervous movements. He gritted his teeth in his sleep at times, and made convulsive movements of the limbs. When awake he complained of pain in the limbs and of headache. The emaciation seemed to be due to the fact that the boy had for some time vomited almost everything he ate. The breath was very bad, "worse than rotten eggs," according to his parents.

On the basis of the nervous and digestive disturbance and the general debility, a diagnosis of worm infestation was made. The mother was told to call and get some medicine, but instead of doing so she bought a bottle of a proprietary worm remedy, on the advice of a neighbor, and gave the child a dose, according to the directions, at noon of September 3. The stool was passed at evening into the slop jar which was in regular use. The jar had been rinsed with city water from the hydrant in the morning and allowed to dry during the day. There is no water on the place except that of the Colorado Springs water system, available at a hydrant in the yard and a sink tap in the house. On looking at the stool immediately after its passage, the boy noticed a strange object moving around in it and called the father and mother to see it. They found the object wriggling around vigorously in the feces and urine, and attempting at times to climb up the sides of the jar. The specimen was removed and put in water, in which it thrashed around for a time, and was then put in alcohol, in which it shriveled considerably, according to the mother and father. The specimen was turned over to Muir, who referred it to Dr. Trossbach of Colorado Springs. It was sent by him to Mr. W. W. Cort of Colorado College, who referred it to Hall, then in Colorado Springs on government field work, for identification.

The specimen is one of the "rat-tailed larvae," a larva of one of the family *Syrphidae* of the order *Diptera* or flies. The mother states that

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*From the U. S. Bureau of Animal Industry, Washington, D. C.

the larva was originally yellowish with three brown stripes, but when it came into our hands it was black over the entire body except for a little brownish coloring on the "tail." The anterior part, or body proper, is 1.55 cm. long, while the "tail" is 1.65 cm. long, a total length of 3.2 cm. This "tail" is really the breathing tube of the animal. These larvae live in soft mud, wet manure, privies and other places where there is plenty of sufficiently moist food, and the "tail" is a stigmatic tube which is held projected upward at the angle necessary to keep the tip above the wet material in which the larva lives, thereby enabling it to bring down a supply of air for breathing.

Williston (1886), in his synopsis of the North American *Syrphidae*, describes the larvae as follows:

> The larvae are usually not very elongate, with firm, sometimes tough skin, the head segments small and extensile. Like the other families of the *Cyclorrapha*, the larvae of *Syrphidae* do not have a distinctly differentiated head. The external mouth-parts are either wholly wanting, with only a soft fleshy opening, or there are two or four outwardly directed hooklets. There are also short, small, one- or two-jointed fleshy antennae. The body is smooth or provided with soft, conical projections and bristles: below usually with seven pairs of abdominal feet. At the posterior end, the body terminates in a more or less elongate tube, single or double—the stigmata. This sometimes forms a short, almost chitinized, tubercular projection on the dorsal part of the last segment; at other times it is very long, longer than the body, slender, composed of two joints, the one sliding within the other, like the joints of a telescope. It is never divaricate, or forked at the tip, as in many of the other tailed larvae in the allied families.

Supposed cases of gastric or intestinal myiasis should always be given very careful consideration and investigation. Our actual knowledge of the subject is limited. To what extent various dipterous larvae, commonly occurring as free-living forms, can survive the digestive processes of the alimentary canal and pass out in the feces undigested and even alive and uninjured, is something of which we have too little information. How long such larvae could persist in the alimentary canal, deriving their nourishment from the digested food of the host, and their air supply from the ingested atmospheric air, can not yet be said. We may surmise, and plenty of surmising has been done, but the fine field for experimental investigation which the subject affords is untouched except for such few records as those of Alessandrini (1909), who has fed the cheese skipper, *Piophila casei*, to dogs, and finds that it passes through the digestive tract alive and uninjured, causing intestinal lesions in the dog. Even the information which would be furnished by the publication of carefully investigated cases is, to a large extent, lacking. Banks (1912) quotes Walsh as follows:

> Taking everything into consideration, we doubt whether, out of ten thousand cases where the larvae of two-winged flies have existed in considerable numbers in the human intestines, more than one single case has been recorded in print for the edification of the world by competent entomological authority.

In addition to our lack of adequate knowledge of the possibility of facultative parasitism on the part of various fly larvae, there is the certainty of error in some cases, due to deliberate fraud on the part of hysterical patients or to accidental contamination of the stool. So many things are sent to specialists for identification as parasites, which prove to be free-living forms incapable of parasitic modes of life, that anything other than an obligate parasite demands a careful investigation. When a farmer states that he defecated in or near the stable and found worms in the stool, and the worms prove to be "rat-tailed larvae," it is much more likely that the larvae were already in the manure at the place of defecation than that they were actually passed. And even when such larvae are found in the slop jar where the jar has been rinsed with water from an open spring, the possibility of the larvae having been in the spring and having remained in the jar after rinsing must bring the find under suspicion.

Dr. Albert Hassall of the Bureau of Animal Industry has related to one of us (Hall) an instance which indicates the need of care in passing on cases of myiasis. He states that on one occasion he saw a slop jar, kept in a privy during the day and only brought in for use at night, with a larva of *Eristalis* hanging over it, just ready to drop, while it was in the privy. Had the larva fallen unobserved and been found at the appropriate time, it would have been ample evidence to most persons that it had been passed into the jar by the persons using it.

Of myiasis in general, Banks (1912) says:

> There is a considerable number of flies whose larvae either regularly or occasionally live in substances used by man as food. The great majority pass through the intestinal tract without our knowledge, for most of them cause little or no trouble. But sometimes with patients in hospitals or asylums, or in private practice, the physician discovers these maggots, and often suspects them of causing the malady or weakness of his patient.
>
> Many such specimens have been sent to entomologists, but owing to the fact that no one had studied these forms, their characters were little understood, and the identifications have not been of much value. Most of these larvae belong to a few closely related families of flies that were formerly covered by the name *Muscidae*. The arrangement of the flies has been the subject of much diverse opinion, while the knowledge of the larvae is very fragmentary.
>
> When we consider that these dipterous larvae occur in decaying fruits and vegetables and on fresh and cooked meats; that the blow-fly, for example, will deposit on meats in a pantry; that other maggots occur in cheese, oleomargarin, etc., and that pies and puddings in restaurants are accessible and suitable to them, it can readily be seen that a great number of these maggots must be swallowed by persons each year, and mostly without any serious consequences. Besides these there are the fruit-flies, whose larvae live in apples, cherries, gooseberries and oranges; and the pomace-flies that hover around grapes, pears, and other fruits.

So far as we have been able to locate it, the literature relating to the subject of myiasis due to larvae of the *Syrphidae,* is as follows:

Odhelius (1789) records a case from Carlstad, Sweden, in which fly larvae, determined as those of *Musca pendula,* were claimed by Dr.

Flanck of that place to have been passed by a 17-year-old girl patient. The patient had been in good health until three years previous, and then became sickly, complaining of severe pain in the stomach, of giddiness and headache, inflammation of the throat, and such great weakness that she was often compelled to go to bed. In the summer of 1787 she had to have medical treatment. At that time mineral waters were prescribed, jalap, aloes and calomel were administered, and as a result these larvae were dislodged and the patient returned to her former health after some weeks. The patient's diet previous to the time she became sick consisted largely of milk, and included occasionally sour curdled milk from the country. She was very fond of cheese rind or the outer part of cheese. Odhelius suspects that the patient became infested by ingesting eggs laid by the fly either in the cream on the sour milk or on the surface of the cheese.

Joseph (1887) notes this case and parenthetically notes that the larvae were probably *Homolomyia canicularis,* but since Odhelius specifies them as rat-tailed larvae there seems to be little warrant for Joseph's assumption. It seems probable that this is the case referred to by Gilbert (1908) as a record of *Eristalis pendulus,* by Brumpt (1910) as one of *Helophilus pendulinus,* and by Gedoelst (1911) as one of *Tubifera pendula.* It appears from Coquillet (1910) that the correct name is *Helophilus pendulus,* the type species of *Helophilus* being *Musca pendula.* According to the same authority, *Eristalis,* type *Musca tenax,* is merely a synonym of *Tubifera,* but in a paper of this sort we have thought it better to adhere to the commoner and more generally used name.

Wagner (1870) records a case of infestation with *E. arbustorum.* One of four to six specimens was sent to him by Dr. Kind and the adult fly was bred and determined by him. The larvae were passed, following a dose of rhubarb, by a woman who imagined she had worms. Dr. Kind had carefully examined the feces of the patient every day since the beginning of March, the larvae being passed on March 10, and had also made such careful examination of the other circumstances in the case as to leave no doubt as to the origin of the larvae. The circumstance which makes the finding especially plausible is that only an occasional pupa, and never a larva, survives the winter. The previous winter had been very severe and he surmises that it would require some explaining to clear up the question as to where this larva had come from at the beginning of March if this was not a good case of myiasis. Wagner points out that the conditions in the digestive tract simulate closely the ones in which the larva lives in Nature; that there is plenty of air, warmth and food, and even such mephitic gases as those with which the larva is usually surrounded. He is of the opinion that probably the larvae were located

in the stomach after the habit of *Gastrophilus,* rather than in the intestine. He notes that he has not infrequently found rain water draining from compost heaps into inadequately protected springs, and considers it very probable that *Eristalis* eggs from compost heaps and the like would be ingested in drinking water.

Brumpt (1910) has erroneously referred this case to Joseph (1887). Joseph merely quotes Wagner's case.

Leidy (1874) has the following note:

> Prof. Leidy * * * remarked that Dr. Keyser, of this city [Philadelphia], the evening previously had brought to him for examination a worm, which was stated to have been removed from the cavity of the nose of a patient. He recognized the worm as a rat-tailed larva apparently of the genus *Eristalis,* and inquired of those members interested in entomology, if they had ever known this insect to be found as a parasite in the human body. Both Drs. Le Conte and Horn said that they had never heard of this genus being parasitic.

Riley (1890) notes "the sending of *Eristalis dimidiatus* in the larva state by Dr. J. W. Compton, of Evansville, Ind., who stated that they were passed from the bowels of a young woman," and "the recent sending of larvae of *Eristalis tenax* by Dr. J. A. Lintner, to whom they had been sent as having been found under similar circumstances."

Riley and Howard (1890) quote the following from a letter from Dr. Frontis, of Johnston, S. C.:

> I send by mail to-day a specimen of a small worm that infests a well at this place. Ordinary cleaning of the well does not get rid of them, but they are quickly redeveloped, so that one bucket of water will frequently contain three or four. As a matter of course the water is not used for drinking purposes, but the proprietor would like to use it and be freed from these pests.

A similar case is noted in the files of the U. S. Bureau of Entomology of specimens received from Lime Rock, R. I., in December, 1894, with a report that there were millions, apparently all dead, in a well.

The "worms" in both cases were determined as *Eristalis,* probably *E. tenax.* This, of course, indicates at once one source of human infestation.

Shattock (1908) has an observation on the larvae of *Eristalis tenax,* three specimens of which were sent in from Totten, Hants (England), with the statement that twenty or thirty had been passed at one time and some others singly after a few days' interval. "Full doses of santonin, and of mercury, and other intestinal antiseptics had been given." The collector, Mr. H. McQuade, writes: "There is not the smallest doubt but the specimens were passed by the bowel; the whole length of time they were observed was about four weeks, and none have been seen since those which I sent were passed." The patient had recently arrived from France, where she had eaten a good deal of watercress. In comment, Shattock says:

In the present case the ova were most probably taken by the patient concealed in watercress, and subsequently underwent development into larvae in the intestinal canal. When it is remembered that sewers constitute one of the habitats of the larvae there is nothing surprising in the presence of the latter in the contents of the intestine. The oxygen for respiration during their development would be furnished, one must believe, by the air naturally swallowed.

McCampbell and Corper (1909) report a mixed infection with *Musca domestica, Anthomyia canicularis* and *Eristalis tenax,* and say of the last-named: "Cases of myiasis with *Eristalis tenax* larvae 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." Their critical study of their case is not convincing and such hypothetical explanations of the abundance of larvae as due to the reproduction of the larvae within the intestine, or the development of the adult fly and subsequent oviposition in the intestine, are quite at variance with known facts. They state that cathartics and aperients have failed to eliminate the larvae. In this connection it may be noted that in our case an anthelmintic seems to have been satisfactory.

From the general statements of Brumpt (1910) and Gedoelst (1911) one would infer that the larvae of *Eristalis dimidiatus* and of *Helophilus pendulus* have been observed in several cases, but we are unable to locate any published records other than those given here.

Gilbert (1908) says of the *Syrphidae*:

But few cases are recorded of infection by larvae of this family and these all by larvae of the genus *Eristalis*, which are found in decaying vegetables and fruits, and in decaying organic matter of all kinds, or in water saturated with organic remains. The following species are reported to have been passed from the bowels, but no definite history of the manner of infection or of the duration of their parasitic existence is given: *Eristalis dimidiatus, Eristalis tenax, Eristalis arbustorum, Eristalis pendulus.*

Banks (1912) says:

There are other flies whose larvae are sometimes reported as swallowed by persons, particularly the rat-tailed larvae of *Eristalis*, which sometimes gets into drinking water.

In the Bureau of Animal Industry collection of parasites there is a specimen of *Eristalis* larva collected in Portland, Me., in 1899, and said to have been passed by man. There is no further information in regard to the case. There are also eight *Eristalis* larvae sent in from Laurel, Md., in 1909, with the statement that they were passed in a jelly-like substance from the vagina of cattle. In correspondence relative to these specimens, Dr. B. H. Ransom suggests to the sender:

Probably a diseased condition of the organ in which you found these larvae created an odor which attracted the flies to this particular place with the result that they have deposited their young in the unusual location.

Through the courtesy of Dr. L. O. Howard and Mr. R. S. Clifton, of the U. S. Bureau of Entomology, we note the following records from the files of the bureau:

A larval specimen of *Eristalis sp.* was received from a physician in Adell, Wis., in September, 1910, with the report that it was passed by a patient.

A similar specimen was sent in from Syracuse, N. Y., in October, 1906, with a statement that it was supposed to have been vomited by a woman suffering from vomiting of pregnancy.

A larva of *Eristalis sp.* or *Helophilus sp.* was sent in from Bessemer, Ala., in October, 1905, with a statement that twenty-four of them had been passed by a colored child 19 months old after severe intestinal irritation.

Another larva of *Eristalis sp.* or *Helophilus sp.* was sent in from Pittsburgh in October, 1905, with the report that it was taken alive from the stool of a man who had just returned from a hunting trip and who had drunk stagnant water on the trip.

It appears to be customary to refer most cases of rat-tailed larvae to *Eristalis tenax.* An examination of the available entomological literature does not furnish us with an adequate description of the larvae of the various species of *Eristalis,* and in fact indicates that these, like many other of the *Diptera* larvae, are not well known. The very useful paper on diptera larvae by Banks (1912) unfortunately does not deal with the *Syrphidae.* The fact that *E. tenax* is very common and widely distributed is possibly the warrant for many of these identifications. For ourselves we are unable to identify our specimen closer than to say that it is a larva of *Eristalis,* and possibly of *E. tenax* for the reason given—that this is a common species.

The mother of the boy from whom our specimen was obtained states that a second larva was passed the morning after the first, but that it was dead, and as it was injured in getting it from the feces it was thrown away. Two days later a third specimen was passed and was kept. This was later turned over to us and proved to be a curd of some sort, a spurious parasite superficially resembling the first. It is possible that the second specimen, which was thrown away, was something similar.

Since the passage of the first larva the child has improved in health considerably and his appearance is now that of the normal healthy child. The nervous symptoms have disappeared and the persistent vomiting has ceased. Food is retained and digested, and the breath is no longer unpleasant.

The boy has lived in Colorado Springs for four years, so that the infestation, if genuine, must be referred to this place. He had been ailing for several weeks, becoming worse July 28, 1912. The previous evening he had eaten some peaches which his mother says were over-ripe. The day following the eating of the peaches the boy did not feel well and asked to be taken for a car ride to Stratton Park, an outlying city park. On the way out he vomited repeatedly, and as the vomiting continued

after they arrived at the park, they returned home. From that time the vomiting persisted, accompanied by an obstinate constipation and loss of weight, until the passage of the larva.

Not far from the house, perhaps 150 yards away, is an irrigation ditch which has running water in it part of the time and standing pools of water when the headgate is shut. Quite a little trash and refuse, including kitchen refuse, rotten vegetables, and even dead animals, are dumped in this ditch by careless persons. The boy and his companions play in this ditch and the boy says he has drunk of the water in the ditch. He also plays around a neighbor's stable and during the very rainy July of this year the stable manure would have afforded an excellent place for the breeding of rat-tailed larvae.

There are, then, three apparent chances for infection—the stable, the ditch and the over-ripe peaches. The onset of the vomiting following the eating of the peaches points to them as a possible source. "Overripe" is, of course, merely another word for decaying, and these larvae live in decaying vegetable matter among other things. The fact that the boy had been ailing before eating the peaches, suggests that the infestation antedates the eating of the peaches. The ditch is another likely source of infestation, as a larva breeding in the soft mud of the pools may have been ingested by the boy in water from the pools or in the muddy ditch water as the larva was swept along by the current. There is no obvious way in which the boy would get the larva from the stable except by eating it. While we do not think this likely, it is a possibility that must be kept in mind. Cases of children who have deliberately eaten insects and their larvae are by no means unknown.

As intimated earlier in this paper, there are three possibilities as to the truth or falsity of this case as one of myiasis. Either there was deliberate fraud on the part of the child or its parents, or the stool was contaminated, or the case is a genuine example of gastric or intestinal myiasis.

All the evidence is against the idea of fraud. The parents appear to be rational, sensible and respectable people. They are hard-working persons with no evidence of hysterical tendencies or nervous disorders. They had looked on the specimen as an intestinal worm and were inclined to be incredulous when told that it was a larva or maggot; they had never seen maggots with "tails" before and volunteered that they would look for them after this. They further exhibited an astonishment that was not simulated when told that other cases of the sort had been reported, so they were not imitating other cases. No attempt was made to advertise the find or to excite surprise or sympathy with it. They had looked on it as a banal case of "worms." We consider it out of the question that either of them should have deliberately put the larva in

the slop jar. The preservation of the third specimen, a spurious parasite, argues against the idea. At the time the boy defecated, the entire family was undressed ready for bed, a thing which eliminates the idea of the boy's deliberately contributing the specimen at that time. There is no reason to suspect the boy of such a thing, and no likelihood that a 5-year-old child could successfully, or would, carry around a large, violently wriggling larva for the purpose of fooling anyone in this way. It is extremely unlikely that he would do so during the afternoon and out of the question that he could do so when undressed and ready for bed.

The possibility of contamination of the stool, so far as we can see, is entirely a question of whether the larva was bred in or washed into the Colorado Springs water system, passed its screens, survived the pressure, entered the slop jar when it was washed and rinsed out in the morning, remained there all day, alive and unnoticed, after the jar dried, as it very quickly would in the dry air of Colorado Springs—the actual atmospheric humidity being low even on rainy days—and was then found after defecation. This seems very unlikely and even, in our opinion, out of the question. The water supply of Colorado Springs comes from deep alpine lakes, down a mountain stream, then through pipes to deep reservoirs on a high mesa, and then through pipes to the city. None of these would serve as breeding places for these larvae, and larvae which might wash into any of them—an unlikely thing of itself—would be drowned long before reaching the patient's residence. Moreover, to suppose that such an extremely rare thing as a rat-tailed larva in the city water system could perform the practically impossible feat of coming through that system alive and would show up at precisely the right time following the taking of a vermifuge at a particular residence, is to strain even the very common credulity which people manifest in regard to coincidences as explanations of unusual things.

While we have no such conclusive evidence as would be afforded by a case where the slop jar had actually been examined by a competent and skeptical person just before defecation, nevertheless, it seems more reasonable to regard this case as one of gastric or intestinal myiasis than as one of fraud or contamination. The child had three good possible sources of infection and, by his own admission, habits that could easily lead to infection. Carelessness in eating and drinking is more or less characteristic of children. Flies of the family *Syrphidae* are abundant around the streets of Colorado Springs, and the following adult flies were collected there or nearby by Hall and Mr. Horace Ragle, of Colorado Springs, during the summer of 1912 and determined by Mr. Frederick Knab, of the U. S. National Museum: *Eristalis tenax, E. hirtus, Syrphus sp.,* and *Eupeodes volucris.* The relief after the passage of the larva is additional evidence and there is no possibility that the child was malingering. Five-

year-old children could not and would not "fake" vomiting, restlessness in sleep, and loss of weight, or recover from these by suggestion, especially as the suggestion has not been emphasized by anyone.

We consider this as probably gastric rather than intestinal myiasis on account of the persistent and prompt vomiting after taking food, and regard this as due to irritation from the spiny-footed larva and its movements. It is likely that a large, active larva would succeed in evading the pylorus. Such related dipterous larvae as *Gastrophilus* live in the stomach as obligate parasites and carry on stigmatic breathing successfully. Most cases of myiasis are reported as intestinal rather than gastric when larvae are found in the feces, but this seems to be as much a matter of habit as of investigation and careful decision. *Pollenia rudis* is listed by Gedoelst (1911) as found in gastric myiasis. A larva supplied with the stigmatic apparatus of *Eristalis* would apparently be fitted for life in a stomach with a small amount of food and plenty of the atmospheric air which is swallowed in eating and drinking and at other times. Such a condition would simulate the normal life conditions fairly closely. That the stomach would not fill to the point where it would drown the larva might be insured by the vomiting, perhaps automatically, the activity of the larva increasing as the stomach filled to where it threatened to cover the rising stigmatic tubes, and so setting up an irritation leading to vomiting. The mother states that the child's stomach was extremely intolerant of milk and that drinking milk was promptly followed by vomiting. This suggests that milk, usually taken in long drinks and considerable quantities, quickly threatened the larva with drowning and set up such activity as promptly to cause vomiting.

In conclusion, it will be noted that the evidence in favor of this case as being an actual case of myiasis, while not conclusive, is nevertheless more nearly conclusive than that of any case involving the larvae of the *Syrphidae* which we have found recorded. A summary of the seven published cases known to us is as follows: Odhelius's case of *Helophilus pendulus;* Wagner's case of *Eristalis arbustorum;* Leidy's case of *Eristalis sp.* [nasal]; Riley's case of *Eristalis dimidiatus* and case of *E. tenax;* Shattock's case of *E. tenax;* and McCampbell and Corper's case of *E. tenax.* To this should be added the case recorded in this paper, the four cases from man recorded in the files of the Bureau of Entomology, and the one case from man and one from the cow [vaginal] recorded in the files of the Bureau of Animal Industry.

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