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Original Articles

THE CAUSATIVE FACTOR IN THE PRODUCTION OF THE DERMATITIS OF GROUND ITCH (UNCINARIASIS).*

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In studying the inflammation produced by the larvæ of the *Uncinaria americana* in their passage through the skin, the question arose as to whether the mechanical irritation produced by the presence of the larvæ would account for the vesicular eruption and the intense swelling of the tissues. As previously reported,¹ it was noticed that the eruption of ground itch, while very angry looking, showed very little tenderness on pressure, but was accompanied by an excruciating itching, and the inflammation did not appear to be due to bacterial infection. After considering the eruption and the accompanying symptoms, it appeared that possibly the eruption, the swelling and the intense itching might be due to some substance secreted by the larvæ and poured out into the skin. If such a substance were excreted, might it be present in the bodies of the larvæ before they begin to make their way into the skin, or are they stimulated to secrete this substance after entering the tissues?

If an irritating substance exists in the body of the larvæ before they enter the skin, then might it be possible to extract this substance from the larvæ (provided they can be obtained in pure culture and in considerable quantity) and produce the eruption by placing this substance in contact with the skin or by injecting it subcutaneously?

Even if an irritant existed in the body of the larva, when we remember that the larva is such a minute organism, barely visible to the naked eye when placed on a transparent substance and viewed in a strong light, it would not appear to be a simple matter to attempt the extraction of such a substance, which must necessarily exist in extremely small amount, and the larvæ must be obtained in pure culture to be sure that any substance which might be obtained had come from them. To hatch the eggs and obtain the larvæ mixed with the soil is, as I have previously shown,¹ comparatively easy; and when the eggs are hatched in Petri dishes the larvæ crawl up on the under side of the lid of the dish where there is slight precipitation of moisture.²

Bearing this fact in mind, it was decided to take ad-

vantage of this trait and to endeavor to obtain great numbers of the larvæ in pure culture. As only a comparatively small number of the larvæ can be hatched in the Petri dishes, and as it would require too great a number of Petri dishes to hatch a quantity of the larvæ, it was determined to employ large specimen jars and hatch the larvæ on a large scale. Therefore, a quantity of sand was obtained and thoroughly washed so as to free it of all fine sediment, and it was then thoroughly baked to be sure that it did not contain any living organisms. This sand was then mixed with semi-liquid feces containing great numbers of the eggs of the *Uncinaria americana*, and the mixture placed in the bottom of the specimen jars.

In this connection I wish to state that the thorough mixing of the feces with the soil (which is necessary for the hatching of the eggs) is greatly facilitated by the larvæ of flies. This was first called to my attention by my friend, Dr. H. F. Harris. I found that the larvæ of the flies would mix the feces and soil far more thoroughly than I could do, and so I made use of them to a great extent. If the feces are left in an open vessel for a short time, even where no flies appear to be present, yet a few are almost invariably attracted to the spot, and there they deposit their eggs, and as they hatch out they begin their almost ceaseless crawling through the mixture. After crawling through the soil in every direction for a few hours and thoroughly mixing it, they usually crawl up on the sides of the jar, and they can then be transferred to another jar, where they will repeat the performance in this second jar. As a result air is carried to all parts of the mixture and all of the eggs hatch at the same time. The mixture of soil and feces was placed in the bottom of eight or ten specimen jars to the depth of one to three inches (Fig. 1). The sides of the jars above the soil were then cleansed of any small particles of soil or sediment so that when the larvæ should begin to climb the sides of the jar they would be uncontaminated.

The larvæ are very sluggish when first hatched, and they are not very lively until about the fourth day, when the first sheath appears, and so do not appear on the sides of the jar until about the fourth or fifth day, as I have explained elsewhere.² To be sure that the larvæ will climb up the sides of the jar, certain points must be borne in mind. The jars are closed with tight fitting tops so that the moisture will not pass out of them. The jars must then be placed where they will be in a cool draft of air. This draft will precipitate a thin film of moisture on the sides of the jar, and in this film of moisture the larvæ are able to crawl up the sides. If too much moisture is precipitated it will collect in drops and run down the sides, washing the larvæ back into the soil. If the jars are not placed so as to precipitate this moisture, the larvæ can not be coaxed from the soil, as they are unable to climb the sides of the jar where the

* Read in the Section on Pathology and Physiology of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.

1. JOURNAL A. M. A., vol. xlv, Oct. 14, 1905.

2. THE JOURNAL A. M. A., vol. xliii, Aug. 27, 1904.

glass is dry. Where the proper amount of moisture is precipitated the larvæ will begin to swarm up the sides of the jar about the fourth day, and the masses and network which they form can readily be seen with the naked eye (Fig. 2).

When they have collected on the sides of the jar in this way, if one end of a probe is wrapped with a small piece of gauze and this moistened with water, the larvæ can easily be scraped from the sides of the jar, and if the end of the probe is then shaken into some water in a test-tube, the larvæ are easily washed off into the water. When all of the larvæ have been collected in the test-tube, if the tube is put aside for about an hour, at the end of that time all of the larvæ will have sunk to the bottom of the tube and are readily seen as a flocculent mass. The clear water above this mass can then be removed with a small pipette. The larvæ are thus col-

Fig. 1.—B, black paper to serve as background for sides of jar; L, larvæ crawling up the sides; S, sand in bottom.

lected in a small amount of water, free from all sediment. Masses of the larvæ were collected in three or four test-tubes.

TREATMENT OF WRISTS.

The next step was to see if it were possible to extract any substance from them which would produce an eruption when placed in contact with the skin. The contents of one test-tube were emptied in a small glass dish, and this was placed in an open window where there was a strong draft of air, and all the water rapidly evaporated. When dry the larvæ formed a thick film over the bottom of the dish. A small amount of absolute alcohol was next added to the dish, the cover was placed over the dish and put aside for a few hours. When the alcohol was poured into the dish it was noticed that the film of

larvæ remained tightly stuck to the bottom of the dish, and was not dissolved loose by the alcohol. The alcohol was next poured over a small piece of absorbent cotton, just enough to absorb all the alcohol, and this cotton was placed on the wrist, covered with a small piece of rubber, and wrapped with gauze to hold it in place. After an hour's time this was removed, and the area covered by the rubber was found to be reddened in spots. There was very slight itching. After removing the application the redness disappeared to a certain extent. The application appeared to have very little effect until about twenty-four hours after applying it, when small pimples appeared over the area covered by the rubber, accompanied by a very decided itching. By the third day there was a slight tendency toward vesicle formation. While this was very slight the elevations could be distinctly felt by passing the tips of the fingers over the area. The irritation reached its height about the fourth day. There did not appear to be any swelling of the subcutaneous tissue. The eruption had practically disappeared by the sixth day.

A larger mass of larvæ than the foregoing was dried

Fig. 2.—A, closer view of masses of larvæ on side of jar; S, sand.

and then ground up in a small mortar, treated with absolute alcohol as before, and then the entire mass taken up on a small piece of gauze and applied to the other wrist. The result was the same as in the first experiment, except that after twenty-four hours the papulo-vesicular eruption was more pronounced and itching much more intense, the papules being closer together and a much larger area involved. By the fourth day there appeared to be a slight thickening of the subcutaneous tissue and the epitrochlear gland was slightly enlarged and somewhat tender. After the fifth day the eruption rapidly disappeared and was practically gone by the eighth day. Figure 3 is from a photograph of this eruption as it appeared on the fourth day.

As a control the plain absolute alcohol in a bit of absorbent cotton was placed on the wrist, covered with rubber, and wrapped with gauze, but when removed after an hour's time had not produced any effect on the skin. This would indicate that the irritating substance in the first two experiments was extracted from the larvæ of the uncinaria. A mass of larvæ was treated

with ether and the ether then applied to the skin in the same way as was the alcohol, but without result. Larvæ which were treated with water also gave negative results.

SUMMARY.

From these experiments it would appear that the larvæ of the *Uncinaria americana* produce some substance which is very irritating to the skin, producing severe itching, with a tendency toward vesicle formation.

The eruption produced by these experiments was not so severe as that produced when the living larvæ penetrate the skin; there is not the extreme swelling of the subcutaneous tissues; the itching is not excruciating; there are no severe constitutional symptoms; the eruption disappears in a shorter time. It appears to be a mild form of ground itch, and the two can readily be differentiated when we remember that in these experiments the substance was simply placed on the surface of the skin, while when the living larvæ penetrate the skin they evidently secrete this substance directly into the subcutaneous tissues, as well as into the skin; and while in the experiments the substance was applied only once

Fig. 3.—Fourth day of an eruption on the wrist produced by alcoholic extract of *uncinaria*.

and was not replenished from time to time, on the other hand the larvæ probably continue to excrete this substance for some time, and thus produce the excruciating itching.

Nature appears to supply this substance to be used as an irritant to the tissues so that the patient will continue scratching the area as long as the larvæ are in the immediate locality, and the scratching and rubbing of the area no doubt facilitates the passage of the larvæ through the tissues.

The eruption produced in these experiments resembles very closely the mild form of ground itch, when only a few larvæ penetrate the skin, producing the discrete form of the eruption, the difference being readily accounted for by the continued activity of the living larvæ.

The substance which produces the eruption has not as yet been obtained in sufficient quantity to attempt to recognize it. It appears to act somewhat as the toxicodendrol which was isolated from the *Rhus toxicodendron* by Professor Pfaff, Harvard University.

THE EXAMINATION AND SURGERY OF THE UPPER END OF THE ESOPHAGUS.*

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Owing to its nature and position, the surgery of the esophagus is limited. In many conditions all treatment is simply palliative. The distress caused by interference with the functions of the esophagus, however, is so great that palliative measures are worth while and we should welcome any increase in their efficiency. Until recently the diagnosis of diseases of the esophagus has been made from the patient's history and the general symptoms, supplemented by the findings obtained from passing bougies. The treatment has been along restricted lines, and consisted of the use of bougies, with an occasional operation through the front or the side of the neck on the only accessible part of the esophagus, the upper half. Since the introduction of light-bearing tubes the diagnosis of diseases of the esophagus is no longer made by inference, but by sight and the removal of suspected tissue for the microscope.

Fig. 1.—Cross section of the neck through the sixth cervical vertebra: C, Cricoid cartilage. E, Esophagus. V, Sixth cervical vertebra.

This paper will take up briefly certain necessary points in the applied anatomy of the esophagus and will present a speculum and a set of instruments for examining the upper end of the esophagus and the larynx, and for working in this locality.

APPLIED ANATOMY.

Congenital Anomalies.—The esophagus may be divided or double. It may open into the trachea; the lower part being absent. Fistulas between the trachea and the esophagus occur and annular strictures which are congenital are found. True diverticula are acquired. In the upper part of the esophagus they are due to a hernia of the esophagus through the inferior constrictor muscle. They may be due also to the contraction of scar tissue which joins the esophagus to neighboring structures.

* Read in the Section on Laryngology and Otology of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.

* Models made in the Anatomic Laboratory of the Harvard Medical School.