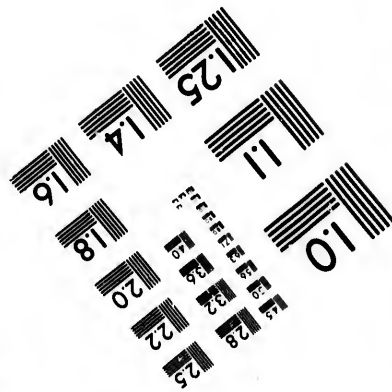
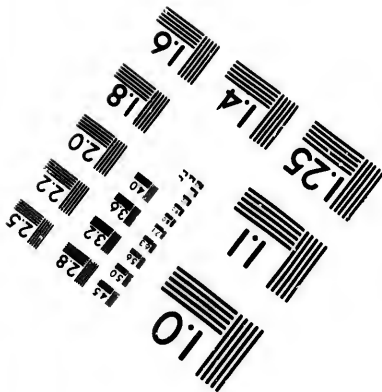
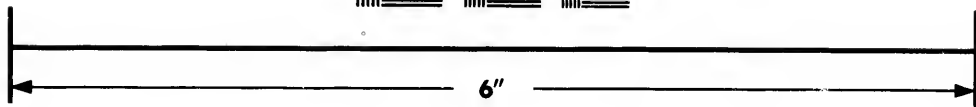
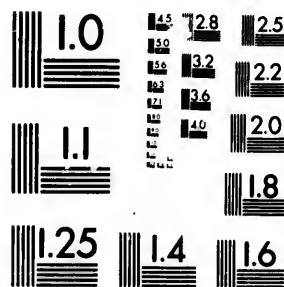


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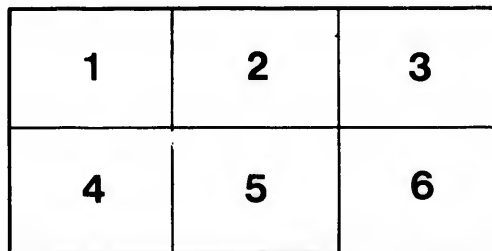
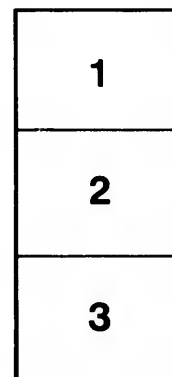
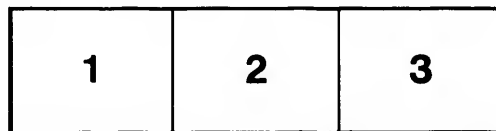
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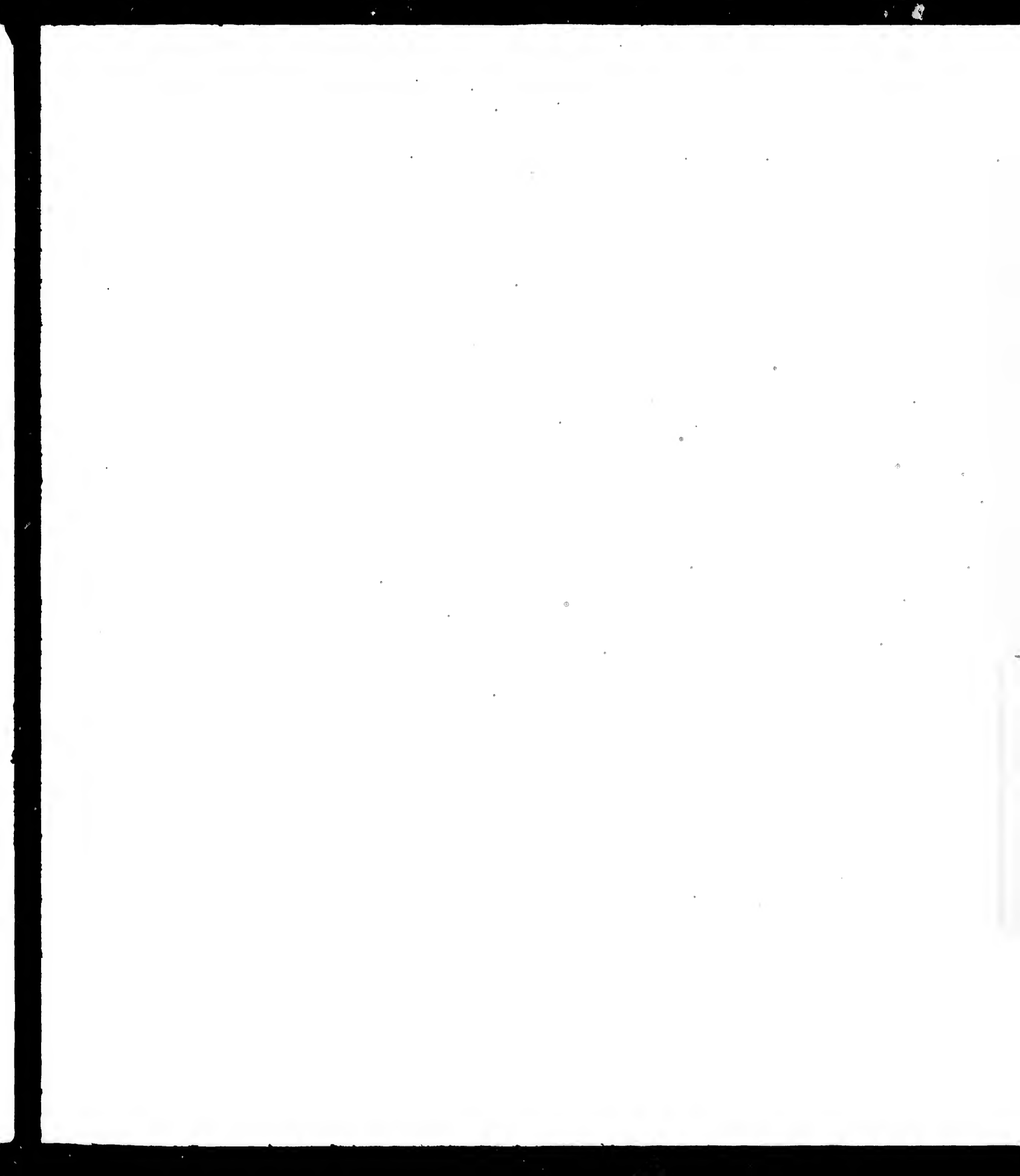
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ON  
TRICHINA SPIRALIS.

✓ BY  
J. BAKER EDWARDS, PH. D., F.C.S.

(Late Lecturer on Chemistry and Medical Jurisprudence at the Royal Infirmary  
School of Medicine, Liverpool, England.)

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## ON TRICHINA SPIRALIS.

By J. BAKER EDWARDS, Ph. D., F. C. S.,

(Late Lecturer on Chemistry and Medical Jurisprudence at the Royal Infirmary School of Medicine, Liverpool, England.)

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The occurrence of two fatal cases of Trichiniasis at Hamilton, Ont., and the successful treatment of several cases in Montreal, have drawn fresh attention to the parasite causing this disease; and as the researches into its natural history are somewhat scattered, it is thought a short *resumé* may not be uninteresting to our readers.

The cysts containing this parasite, and forming its sarcophagus in the flesh, were observed and examined microscopically by Tiedman, in 1822. These were found in human muscle after death, and occasioned much speculation as to their real nature. In 1835 they were minutely examined by Mr. James Paget, and described and named by Professor Owen;\* but as there then existed no clue to their natural history, they for some years possessed no interest beyond the fact of their existence in human muscle, and their classification as a genus of Entozoa; belonging to the order, Cœlmintha; family, Nematodea. Herbst found, in 1841, that dogs, when fed upon parts of a badger containing these worms, became infested with them in their muscles. But it remained for Zenker, in 1860, to show that the human body becomes infected with these parasites in

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\* Trans. Linnean Socy., LXXX., LXXXIV.



consequence of eating pork already containing them. Since this time, thousands of deaths have been traced to this cause, which would previously have been attributed to typhoid, gastric, or rheumatic fever, paralysis, poisoning, or atrophy. Further researches by Virchow of Berlin and Leuckart of Giessen, added greatly to our knowledge of the natural history of the species, and Prof. Dalton has elaborately studied cases of the disease in New York.

*Trichiniasis* is now fully established as one of the "ills which flesh is heir to." In several hospital examinations of human bodies after death from various causes, from 2 to 3 per cent. of adults are found to contain old encysted capsules containing these worms, thus bearing evidence of the existence of this disease at some former period. In the Chicago market a medical commission found in the pork offered for sale 2 per cent. of flesh thus infected.

From these facts it may be inferred that the disease occurs much more frequently than has heretofore been supposed, but that it is only under peculiar circumstances that the worm breeds with such excessive rapidity as to cause fatal or even serious results.

The cases of the disease which have recently occurred on this Continent have caused still further investigations to be made as to its character, the probability of its detection, and the means of cure. Of these cases, those which occurred in the west were fatal, but those in Montreal, being of a slight nature and speedily diagnosed, were treated successfully. The whole literature of the question has been searched for an explanation of the facts which presented themselves in the Montreal cases, and whilst they are found to be in general accordance with cases on record, in some respects they may be considered unique. The history of the Montreal cases may be concisely stated thus:

On Wednesday, the 24th of March, a family in a boarding-house partook of some hastily-fried ham. Within an hour afterwards two of the adults felt nauseated and had some pain in the stomach. One took a large dose of brandy, and vomited his dinner; the other felt only abdominal pain, spasms, and faintness. He returned from his work and went to bed. During the night his wife and wife's mother felt ill, and suffered from pains in the bowels, together with great feverishness and thirst. During the following day, five other persons, who had partaken of the same

meal, suffered more or less from similar symptoms, and in the evening of Thursday called in a physician, who, after careful enquiry, diagnosed Trichiniasis, and called in a second opinion on the case. On Good Friday a slice of ham was submitted to me for microscopic examination, in which I discovered, after some hours' investigation, several characteristic specimens of *Trichina spiralis*. By Monday morning, with the assistance of my friend Mr Ritchie, I had found several groups of *Trichina*, both in the free state and partially, as well as fully, encysted. These were during the same day shown to a considerable number of medical friends.

Mr. C. Baillie kindly placed his micro-photographic apparatus at my disposal, and during the week produced some excellent negatives of the worms "*in situ*" in the pork muscle.

No. 1.—This photograph (reproduced by Mr. Inglis) shows a group of *Trichinae* in very close proximity, travelling up a line of muscular tissue, or rather between the muscular bundles.

No. 4 shows an individual worm surrounded by a gelatinous cyst, protruding his head therefrom, apparently in search of food, for his head and mouth can be distinguished under the microscope in the dark mass of muscle to the right of the field. Above, around and below are the worms not encysted, but curled up in the band of muscle, so that thirteen may be counted on a field of view not exceeding the tenth of an inch in diameter.

No. 5 shows what appears to be a lateral section of the worm fully encysted, but the worm is really whole, and the section only optical, the cyst being so transparent as to allow focusing through it. The cyst, although perfect, is not calcareous, and in no case did any calcareous cysts present themselves. The above were found in the slice of ham in question, and, indeed, in one particular muscle of that ham, of which the horizontal section did not exceed one-quarter inch in thickness. It is evident, therefore, that the disease was recent in the young pig from which the ham was taken, and that, being in the free and semi-encysted condition, the worms were in a condition to be aroused into action and activity in a much shorter time than had they been fully and calcareously encysted. According to Virchow\*

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\* Virchow's archives, 1850, vol. xxxiii, page 535.

and Zenker the period of incubation of the cyst in the stomach is from six to eight days. This has been erroneously interpreted to mean that such a period must elapse before any marked symptoms can be recognized. Such a period of time however, is meant to be inclusive of the reproducing power of each individual, from whose body successive broods of young, numbering from 100 to 200, are discharged. Dr. T. S. Cobbold\* has found a period of sixty-nine hours amply sufficient for the development of the young muscle flesh worms of the human subject into the sexually mature adult *Trichina* of the dog. If all the worms were calcareously encysted a delay of from three to six days might be expected before intestinal irritation was a marked symptom. But in cases where the worms are young and free in the muscle, development may take place in a few hours, and rapid multiplication take place before other encysted worms were released from their capsules.

Thus a succession of fresh irritations to the muscular and nervous system may be expected from the first few hours to a period of eight or ten weeks. In the fatal cases examined in Chicago and Hamilton no single case of encysted *Trichina* was found in the flesh, but in the Montreal cases one or two distinct and complete cysts were extracted from the man's leg. This was eight weeks after eating the pork, and when the symptoms had somewhat abated, but considerable pain still felt in the muscles. The great shock to the system, which frequently terminates fatally, appears to result from excessive generation of the worms at any one period;—thus young and healthy persons are frequently killed sooner than older and more feeble individuals, the reason being that in the former case probably more food is eaten, digestion is more rapid, nausea more readily overcome by active exertion, and the breeding of the worms becomes excessive and continuous. In the Hamilton cases the young woman died in three weeks, whilst her mother survived six weeks, after eating the fatal repast. Nos. 2 and 3 in the photograph show examples of the worms in the latter case. In No. 2 the worm is carefully picked out from the muscle. No. 3 shows the muscle containing the worms in various postures on a line of muscle, it also

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\* Journal Linnean Society, vol. ix, page 209.

shows two generations on or near the same line of muscle. The faint curve near the edge of the margin being a larger and older worm than the other three, it is but partially in focus, and only about one half is, therefore, seen.

These worms have been generally figured in works on Physiology in two conditions, viz., encysted in the muscle, and sexually developed in the intestinal canal. The appearance of the young sexless worm *in transitu* in the flesh has not been carefully described. Some observers have, therefore, mistaken it for another species, whilst others have overlooked it altogether. The photographs Nos. 1, 3, 4 and 5 show fairly the varied forms in which the worm may be expected to be found in flesh during periods of from one to six weeks after ingestion. After a period of from six to twelve months the cysts become covered with a phosphatic opaque deposit, and the worm can only be seen by dissection or by solution of the coating in weak acid. These old cysts are sometimes found empty.

The best medium which I have found for mounting recent muscle for the examination and extraction of specimens, under the microscope, is a mixture of one part glycerine and one part aqueous carbolic acid. The muscle may be conveniently examined by a two-third object glass, and a B. or C. eye piece with the smallest aperture in the diaphragm. The extracted worm is best seen under a  $\frac{1}{4}$ -inch objective, with a small pencil of light, or by polarised light. No. 1 is magnified 100 diameters; Nos. 2 and 3, 150 diameters; Nos. 4 and 5, 50 diameters.

In 1866 some valuable experiments were conducted, in reference to the propagation of these worms, by Dr. T. Spencer Cobbold,\* whose researches on Cestoid Entozoa place him at the head of English authorities on such subjects.

After feeding animals with trichinous food, seven experiments on birds all proved negative. Three sheep, two dogs, one pig and one mouse gave also negative results.

Nine cases were successful, viz., four dogs, two cats, one pig, one Guinea pig and one hedgehog.

While we may, therefore, conclude that birds and herbivorous mammals are very unlikely subjects for infection by this

\* Journal of the Linnean Society, Zoology, vol. 9, p. 205.

means; it is also found that other animals, as the dog and pig, for instance, may partake of the food and yet escape infection. This helps to explain the recorded facts that large parties have eaten of trichinous food in company, and some have been killed, others suffered slightly, and again some escaped altogether.

Moreover, in the human subjects examined *post-mortem*, where the disease has not proved fatal, in some cases, the cysts were by no means numerous, whilst in others they have been estimated at from forty to one hundred millions. The excessive alarm which is apt to seize the public mind by the discovery of a case here and there is not, therefore, justified by the facts when properly understood. At the same time, whatever means can be adopted by the public authorities to prevent its becoming a familiar disease in our new Dominion should be forthwith adopted.

*Causes of the disease in 1891-1892*

*Causes of the disease in 1893-1894*

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