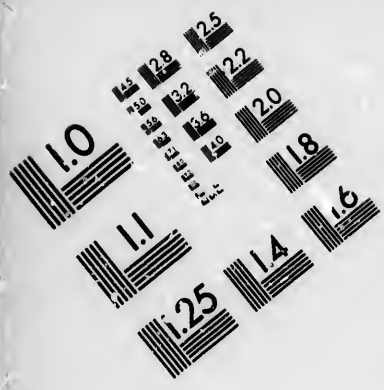

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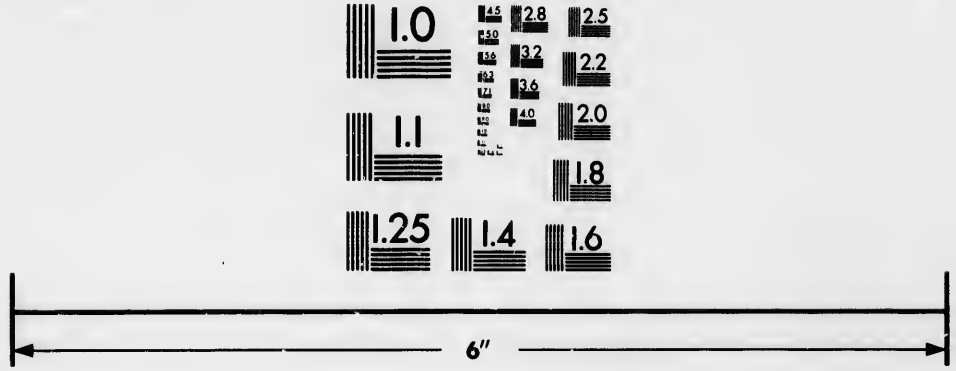

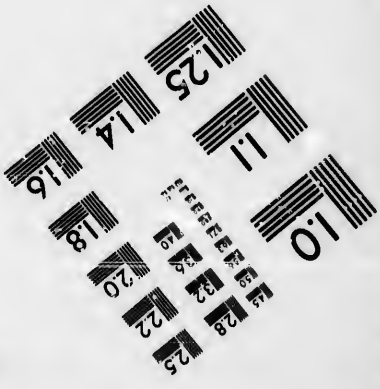

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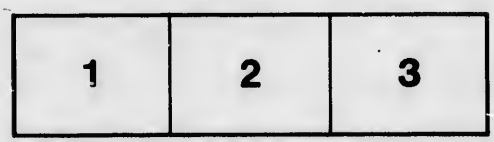

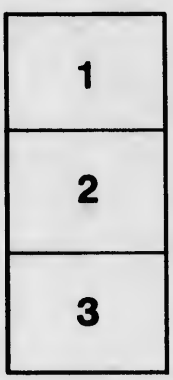

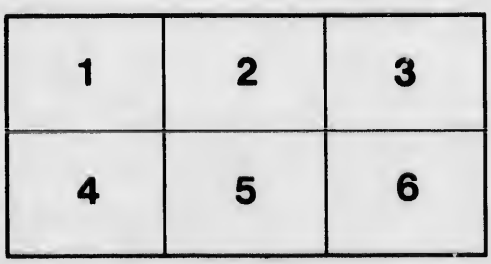

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INTO THE

PARASITES

IN THE

PORK SUPPLY OF MONTREAL.

BY

WILLIAM OSLER, M.D., M.R.C.P., Lond.,

(Professor of the Institutes of Medicine, McGill University; Lecturer on Helminthology, Montreal Veterinary College.)

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JANUARY, 1883.

AN INVESTIGATION

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In the interests of public health, it is a matter of great importance that the food supply of cities should undergo strict supervision, with a view of excluding possible sources of disease. In this country, the department of the civic governments relating thereto cannot be said to be conducted on model principles. Speaking of Montreal, meat inspection consists in the examination of the carcasses of all animals exposed for sale or killed at the abattoir, and its superficial character is clearly shown by the results of this investigation.

It is to be remarked that, in the matter of meat inspection, there are some affections in which an ante-mortem examination will be of most service, and an animal may be condemned as unfit for food, the meat of which, when dressed, might pass even a careful inspector. There are other affections which, interfering but slightly with the general healthfulness of an animal, render its flesh in the highest degree unfit for food, even though it may, on superficial inspection, look healthy enough.

* *Read before the Medico-Chirurgical Society of Montreal and the Board of Health.*

60591

The flesh of swine forms one of the great staple articles of food in the community, and, fresh or salted, constitutes a very considerable proportion of all meat eaten. The hog is omnivorous, a dirty feeder, refusing nothing, and, regarded from this standpoint, we do not wonder that in the sanitary enactments of Moses it was excluded, though cloven-footed, in the list of animals permitted to be eaten. Vile feeder though it be, the hog has the power of converting, in the laboratory of its tissues, even refuse and garbage into a flesh most wholesome as well as toothsome. Who does not remember Lamb's charming "Dissertation on Roast Pig," and though he speaks of the suckling, most of us can agree with him when he says, "Pig—let me speak his praise—is no less provocative of the appetite than he is satisfactory to the criticalness of the censorious palate. The strong man may batten on him, and the weakling refuseth not his mild juices."

The hog is not subject to many diseases which interfere with the market value of the flesh. Pig-typhoid or hog cholera is the only extensive epizootic disease among them in this country, and by interfering with nutrition and producing emaciation renders the flesh unsuitable for food. The injurious effects which follow the eating of the flesh of diseased animals are really not much known. The juices of the stomach are so powerfully antiseptic and corrective, that the meat, after cooking, is usually digested without difficulty. The Highland shepherds are stated to eat, without ill effects, the flesh of animals which have died of anthrax. In the case of pork, it is not so much the fresh or salted meat which has been known to produce sickness as when it is made into sausages and brawn (head cheese). Many cases of serious illness have been excited by eating these articles. This is not surprising to anyone who has watched their manufacture, particularly sausages. In many establishments the odds and ends go for the mince meat, and, too often, bits of old meat which is just beginning to turn. The experience is only too common of tasting in a mouthful of sausage the disagreeable flavor of a morsel which is high, *i.e.*, is in the initial stages of putrefaction. The septic matter, if abundant, or, perhaps, if produced by bacteria of a special variety, may excite severe intestinal symptoms, and even

cause death. In Whitechurch, England, there has recently been a local epidemic produced by eating brawn.

In relation to public health, the diseases of the hog are of small matter in comparison with the parasites which infest its flesh, and which, eaten by man, may produce serious or even fatal affections. It is as a protection against these that an effective meat inspector may do good service in the community, and annually prevent many cases of illness. To obtain evidence of the prevalence of parasites in the pork supply of this city, one thousand animals have been examined, with the results here stated. Of the parasites which infest the hog, only three are of importance in this connection—the *Trichina spiralis*, the *Cysticercus cellulosæ*, and the *Echinococcus*. We shall consider these in order.

TRICHINA SPIRALIS.

"An extremely minute nematoid helminth, the male in its fully developed and sexually matured condition measuring only one-eighteenth of an inch, while the perfectly developed female reaches a length of about one-eighth of an inch; body rounded and filiform, usually slightly bent on itself, rather thicker behind than in front, especially in the males; head narrow, finely pointed, unarmed, with a simple, central, minute oval aperture; posterior extremity of the male furnished with a bilobed candal appendage, . . . female shorter than the male, bluntly rounded posteriorly, eggs measuring $\frac{1}{12\frac{1}{70}}$ of an inch from pole to pole; mode of reproduction viviparous." —COBBOLD.

Since Zenker, in 1860, discovered that this worm produces a severe malady in man, a degree of interest has been attached to it, not exceeded by any known human entozoon. The record of epidemics of it sends a thrill of horror through a community out of all proportion to the gravity of the disease; and naturally enough, for the very thought of myriads of these little worms boring and eating the flesh is particularly repulsive, recalling the tragic fate of Herod, on whom the worms are stated to have held an ante-mortem feast. The hog is the natural bearer of the trichinæ, which exist in the flesh, coiled up between the muscle fibres, and are so minute that they cannot be seen on ordinary inspection, but require the use of the microscope. In this state they are undeveloped or immature sexually, and may remain for years in the muscles of the animal without undergoing de-

generative changes. Pork containing them and eaten raw, in any form, or partially cooked, produces disease in the following way: the little worms escape in digestion, pass into the small intestines, grow rapidly, become sexually mature, and assume the form of intestinal trichinæ. The females are impregnated, and the ova develop into minute embryos, which are born alive and free. This process occupies two or three days, and is usually accompanied with some intestinal irritation. The number of embryos will vary with the number of worms ingested and which reach maturity. They immediately burrow through the walls of the intestine, reach the connective tissues of the abdomen, and penetrate the muscles in all direction, and when numerous reach even those most distant. In this migration they produce irritation, fever, and constitutional disturbance proportionate to their number, and the severity of the symptoms may be such that death may follow, though the percentage of fatal cases is small, only about 1.5.

Record of Investigation.—One thousand hogs were examined, chiefly at the Dominion Abattoir, during the past six or eight months. There was no selection made, but the carcasses were taken indiscriminately, as they were found at the time of the visit.

Method.—It has been satisfactorily shown by many observers that the pillars of the diaphragm are the most suitable muscles for examination, not alone because portions can be removed without disfigurement or loss, but chiefly from the fact that here, if anywhere in the body, the parasites will be found, as these muscles lie in the direct route from the intestines. The examination was made with No. 2 Obj. (Verick) and No. 1 Ocular, magnifying about 60 diameters. Small clippings of the muscle were made lengthwise, then placed on the slide, and pressed out with the top cover until thin enough for the purpose. In only four out of the one thousand animals were the parasites present in the diaphragm, and we may take this as representing the actual ratio, though possibly they may, in one or two instances, have existed in other muscles and not in the portions examined. As to the number in the infested bits, in one case there were twelve on one

slide; in the others, not so numerous. The worms were not regularly encysted but coiled up between the fibres. When placed on the warm stage, they displayed movements.

All the animals examined were from Western Canada.

Comparison of local with foreign records.—As the following figures show, the record here, 1 in 250, is by no means high. Thus, in Boston, Mr. Billings examined over 6,000 animals, and in the different groups the ratio ranged from 1 in 17 to 1 in 44. All of these animals were from the Western States. In Chicago, one series gave 1 in 49.8. In Prussia, where a very thorough and systematic pork inspection is carried out, in the year 1876 only 1 in 2,000 was found affected, and in 1877 about 1 in 2,800.

Trichinosis in Canada.—Remarkably few cases of trichina infection are known to have occurred in this country. In 1869 nine persons were attacked in Montreal after eating of fried ham, which was ascertained to be trichinous. They presented severe gastro-intestinal symptoms, and the constitutional disturbance in moderate grade. None of them died. The diagnosis was corroborated by the microscopic examination of a portion of muscle harpooned from one of the patients.* In 1868, three members of a family in Hamilton were attacked after eating portions of an infected ham. Two of these, the mother and daughter, died; the father recovered. At post-mortems and in the dissecting-room, it is not uncommon to find the muscles full of calcified cysts containing the worms or their remnants. These little bodies had been recognized for years before Zenker's discovery connected them with an antecedent disease. Probably many isolated cases occur which are mistaken for acute rheumatism or typhoid fever. In between 800 and 900 autopsies made by Dr. Osler, four bodies have been found trichinous, the cysts in each instance calcified, and in one the worms were nearly all dead. In the other cases the parasites were still living, and with muscle from one of them the disease was artificially produced in a rabbit. So that in all only sixteen cases of the disease have been recognized in this country.

* *Canada Medical Journal*, 1870.

Summary.—So far as it is legitimate to draw deductions from the somewhat limited number of observations, we may say that trichinosis is a tolerably common affection in Canadian swine, though not nearly so frequent as in the neighboring States, still, it is much more so than is desirable in the interests of public health. Should microscopic examination of the flesh be included in the inspection? is a question which at once arises. In answering this, several circumstances must be taken into consideration. In the first place, although, per 1,000, a larger number of swine are infested here than in Germany, trichinosis in man is with us a very rare disease, while in Germany epidemics are of yearly occurrence. If we estimate that 100,000 hogs are killed annually for the local markets, that would give at least three or four hundred trichinous animals, whose flesh is consumed by the pork-eating members of the community. Then, about 3½ million pounds of American pork, representing about 15,000 hogs, have been imported into this city during the past year, and as in them the percentage of trichinæ is considerably higher than in Canadian animals, the probable number of infested carcasses consumed does not, at the lowest estimate, fall short of five hundred. Now, were the habits of the people of this city similar to those of the Germans, there can be no doubt that trichinosis, instead of being a rare affection, would be extremely common. Fortunately, raw or only partially cooked pork is not often eaten here, nor are the various kinds of sausages, so dear to the Teuton, much in vogue. *Knackwürste* and *Bratwürste*, forms of sausages which are very common, and which are eaten either raw or only warmed, have been the sources of a large proportion of the known cases of trichinosis in Germany, 970 out of 1,267. People here almost invariably fry sausages, and smoked meats are not common, nor are they eaten without preliminary cooking. In short, the prophylaxis of the pot and oven in this country and in the neighboring States does more for the public than the most stringent inspection, even as carried out in Prussia, where a microscopic examination is compulsory. If thoroughly cooked, the trichinæ are killed, and may be eaten with impunity; and, fortunately, there is a very widespread idea in the community that pork, in

all forms, should be well cooked, and to this good custom may be attributed the immunity from infection which the public has enjoyed. Still, it is by no means pleasant to think of the quantity of trichinous flesh which is placed on our markets, and which probably exceeds the entire amount of pork confiscated for other causes. The difficulties in the way of systematic inspection are now, under the Abattoir By-law, greatly lessened, but to subject the flesh of every hog killed to microscopic examination would require a staff of trained inspectors and an increased expenditure such as our civic authorities would not likely incur. Moreover, considering the rarity of cases of infection, it may be just as well to leave the matter to the cooks of the community, who have so long and so faithfully protected us, with this injunction, "See that all pork is thoroughly roasted, fried, or boiled."

CYSTICERCUS CELLULOSÆ.

This parasite of pork is not so formidable as the trichina, but is more common and a more frequent excitor of disease. It is the larval or immature form of one of the tapeworms of man, and is popularly known as the "measle" or cystic worm, and an infested animal or its flesh is said to be "measley." In this country man is infested with two chief forms of tapeworm, the *Tænia solium* and the *Tænia saginata*—the former derived from measley pork, the latter from measley veal or beef; hence the one is often called the *pork* and the other the *beef* tapeworm. The life history of the *Tænia solium* is as follows:—the adult worm occupies the small intestine of man, and attains a length of from 12 to 15 feet, or even longer. The segments of which the body is made up progressively increase in width from the head, and about the 400th become mature—*i.e.*, the male and female generative system which each possesses becomes active, and eggs are formed. In a fully grown worm it is estimated that there may be about 200 ripe segments full of ova, the number in each one reaching probably as high as fifty thousand. The hinder segments of a tapeworm are constantly shed, or, indeed, may detach themselves, at the rate of 3 or 4 per diem, and pass away in the fæces. The eggs are small, round, $\frac{1}{100}$ of

an inch in diameter, and each one contains in its interior a little body known as the six-hooked embryo. For their further growth it is necessary that they reach the interior of some animal in which they can develop. The hog is the most suitable, and usually furnishes the means for the subsequent growth of the ova, though the eggs may be accidentally ingested by man and develop within him, but this rarely happens. It is not difficult to understand how hogs become infested; they are such dirty feeders that nothing is refused, and even human excrement is greedily eaten. In country places, a single case of tapeworm may serve to infest many hogs, as the ripe segments constantly pass with the fæces, and one or two will suffice to produce the mischief. The eggs in the stomach of the pig are digested, and the little six-hooked embryos, in this way set free, immediately begin to bore through the walls, and, entering the vessels, are carried to all parts of the system, lodging particularly in the liver and muscles; others pass through the coats of the bowels into the peritoneum and omentum, and may reach the muscles in this way. In these various parts the little embryos gradually develop into cysticerci or "measles," and an animal so affected is said to be measled. It takes about three months for this process, and when completed, the cysticerci present the appearance in the flesh of greyish-white rounded bodies from one-tenth to one-sixth of an inch in diameter, situated between the fasciculi of muscles, and can be picked out, leaving little holes or depressions. When abundant, they give a very characteristic aspect to the flesh. which is quite unmistakcable. In the liver they may attain a larger size, and in the loose tissues of the omentum and peritoneum they arc often found the size of a walnut. The cysticercus or measle is enclosed in an external sheath, which, when open, gives exit to a cystic or bladder-like body, which requires careful dissection to make out the structure. It presents a head similar in all respects to that of the adult tapeworm from which the egg was derived, presenting four sucking disks and a circlet of hooklets. A narrow neck succeeds the head, and beyond this there is a bladder-like body called the caudal vesicle.

If flesh containing these " measles " is eaten raw or only partially cooked, tapeworm is liable to result. The cyst wall enclosing the cysticerci is digested away, the bladder worm set free, and passes into the intestine, where the head fixes itself firmly by means of the sucking disks and hooklets. The caudal vesicle is digested away, and by a process of budding the segments are gradually formed. In about two months the worm has attained maturity, and segments are discharged containing thousands of eggs, ready for development in the body of the first pig that accidentally ingests the segments.

Local Record.—Of 1037 hogs examined, 76 were infested—*i.e.*, 1 in 13.6. Only the livers were inspected, as it was impossible to examine the flesh thoroughly. The numbers varied from one or two to many dozen, and in most instances they were fully developed. The liver is more likely to be affected than the other parts, but the occurrence in this organ is a proof that the animal has been exposed, and should lead to a thorough examination of the flesh.

In order to obtain evidence of the extent to which " measled" meat produces disease—*i.e.*, tapeworm—in the community, we issued a circular to the city physicians asking the number of cases under treatment. Replies were returned by thirty-four doctors who reported sixty-two cases. At the Smith Worm Company's office, Bleury Street, about two new cases a week are treated ; some of these, doubtless, come from the country, but we shall probably be within the mark if we estimate the number in the city as not far short of 200. How many of these are due to eating measley veal or beef, and how many to measley pork, we cannot say, but from the specimens examined it would seem that the beef tapeworm (*T. saginata*) is the more prevalent. Not that the pork measle is uncommon ; the record above given shows just the contrary. To explain the greater frequency of *T. saginata*, we must suppose either that the beef measle occurs in greater proportion, or else the pork is more thoroughly cooked than the beef or veal. Then, too, much less pork is eaten fresh, and the salting and pickling processes are usually sufficient to destroy the measles. A point of in-

terest is the temperature necessary to kill them. The observations of Professor Perronicito prove that they are invariably killed by a heat of 50°C. or 122°F. Indeed they were swallowed with impunity by his students after exposure to a temperature of 113°F.

Fortunately, the presence of a tapeworm does not give rise to such a formidable affection as the trichina, but the amount of suffering and annoyance caused is considerable, and not infrequently an individual has to entertain the troublesome host for months or years, so difficult is it in some cases to dislodge the worm.

A thoroughly efficient inspection would diminish greatly the number of persons annually infected. Of course a hog might contain only a few "measles" deep-seated in the muscles, and these could readily be overlooked—indeed would be even on the most careful examination.

ECHINOCOCCUS.

The presence of this parasite in the flesh of pork has not the direct and close relationship to our individual welfare as the trichina or cysticercus, inasmuch as it represents a larval form of a tapeworm which infests the dog and wolf—never man. The adult worm is very small, not more than a quarter of an inch in length, with only four segments, the anterior of which forms the head, while the hinder one is mature and contains the ova, which are passed in the fæces of the dog, and if swallowed by an animal may develop in its organs or tissues into the structures variously known as echinococci, hydatids, or acephalocysts. A single egg of an ordinary tapeworm, when placed in suitable circumstances, develops into a single larva or measle (*cysticercus*), but a remarkable peculiarity in the life history of the *T. echinococcus* is that a single egg develops into a large compound and complicated cyst, which contains many thousands of larvæ—hydatids or hydatid heads, as they are called—each of which, if transferred to the intestine of a dog, might grow into a tapeworm. Man also harbors the echinococci, which may produce very serious or fatal disease. In some countries, as Iceland and Australia, this affection is very prevalent, and many deaths are annually caused by

the growth of the hydatids in the internal organs, in which they may form large tumors. Man gets infected in the same way as the hog by the accidental ingestion of the ova, and the point of special interest, in relation to public health, is that the occurrence of echinococci in the hog—and in other animals—ensures a constant perpetuation of the species among the dogs of a community and a consequent risk to the individuals thereof, which will be great in direct proportion to general insanitary condition and the liability of the eggs to get into the drinking water.

Result of Examination.—In the 1,037 hogs examined, echinococci were found in the livers of 31, or 1 in 33.4. The cysts ranged in size from a marble to a walnut, and presented an external fibrous investment, formed from the tissues of the part, within which was the cyst proper, which could be readily turned out. The ectocyst and endocyst were usually well developed, the fluid clear, but in none of those examined microscopically were the hydatid heads fully developed.

Echinococcus disease in man is in this country a very rare affection; not more than eight or ten cases have been known to occur. In the United States it is also uncommon,* and a considerable number of the reported cases have been in foreigners, who probably brought the parasite with them. The immunity from the disease which human beings here happily enjoy may be explained by the existence on the whole of such sanitary regulations as reduce to a minimum the risk of infection. Dogs are not numerous, nor are they so intimately associated with the every-day work of the people, as in countries like Iceland, where, according to Krabbe, the ratio of canine to human population is very large, and an extraordinary number of the inhabitants suffer from the affection. The adult worm is certainly rare in our dogs; we have never met with a specimen in numerous dissections, but its existence is fully shown by the occurrence of the larval form in many animals and occasionally in man.

* On Echinococcus Disease in America, by Wm. Osler, M.D., *American Journal of Medical Sciences*, Oct., 1882.

CONCLUSIONS.

1. The investigation shows that the hogs slaughtered for our markets present parasites in numbers sufficient to necessitate a more thorough inspection than is at present carried out.

2. As regards *Trichina spiralis*, which was found in the proportion of 1 to 250, we are of opinion that, considering the extreme rarity of cases of trichinosis, and the difficulties attendant upon a systematic inspection, a compulsory microscopic examination of the flesh of every hog killed is not at present called for.

3. In the case of "measles," the liver should be carefully examined, and if present in it, the flesh of the animal should receive the special attention of the inspector; if only in the liver, the entire carcass need not be confiscated.

4. Echinococcus cysts in the liver render that organ unfit for food, but in other parts, unless very numerous and disorganizing, they may be cut out, and the carcass remain marketable.

5. The public should be made aware of the possible dangers of eating, in any form, raw or partially cooked meat. The best safeguard against parasitic affections is not so much inspection of the flesh, unless, indeed, this is minutely carried out, as careful attention to culinary details.

6. To reduce the number of infested hogs, greater attention should be paid to their hygienic surroundings, particularly in the matter of feeding. The danger is not during the period when the animals are penned and fed on grain, &c., but when they are allowed to roam at large and feed indiscriminately.

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