

ART. IV.—On the 'Measle' of the 'Pig,' and on the Wholesomeness, as Food for Man, of 'Measly' Pork. By ALEXANDER FLEMING, M. D., Professor of Materia Medica, Queen's University, Ireland.

THE following Report was furnished to the Committee of the provision merchants of Cork, who applied to me for information on the subject to which it refers, in January, 1856. Stated briefly, the questions submitted by the Committee were:—1. What is the nature and origin of 'measle' in the pig? 2. Are all pigs 'measly'? 3. Can pork be 'measly,' and that condition be invisible to the naked eye? 4. Is there any analogy between 'measles' in the pig, and the disease known by that name in man? 5. Is fresh 'measly' pork wholesome? 6. Is cured 'measly' pork wholesome? 7. What is the chemical composition of the 'measle'^a?

Twenty-one specimens were supplied to us, viz.:—

Seven of fresh healthy pork, from different parts of different pigs; six of fresh pork, 'slightly measled'; seven of fresh pork, 'badly measled'; one of cured pork, 'badly measled.'

"The 'measle' of the pig is an animal parasite, the *Cysticercus cellulosæ*, or bladder flesh-worm. It infests the muscles of all parts of the body, but is found most frequently in those of the tongue, loin, and neck, and is often seen in the muscular substance of the heart, lying between the fibres of the muscle. It is seen as an ovoid bladder, from two to four lines in length, formed by a thin, transparent membrane, and enclosing at one extremity an opaque body, of a white colour. This is the worm coiled up, but which, when unfolded, exhibits a head, neck, and pear-shaped vesicular tail. The head is armed by a crown of barbed hooklets, around which are placed four sucking mouths, and the neck is formed of a series of rings, which gradually lose themselves posteriorly on the dilated and bladder-like tail. In the interior of the worm are a number of microscopic corpuscles. The average diameter of these bodies is 1-1500th of an inch, and their usual form that of a flattened, circular disc; but they vary both in form and size^b.

* I was requested to associate with me in this inquiry my colleagues in the Chairs of Natural History and of Agriculture, and the Report in the text was prepared by me to embody the joint results of our investigations. It was signed by me and Professor Smith. Mr. Murphy sent in a separate Report, but his views are substantially the same. Drawings of some of the parts of the *Cysticercus* are given by Gulliver, in the London Medico-Chirurgical Transactions (vol. vi., second series). See also Huxley's Lecture on the *Teniade*, in Medical Times for August, 1856.

^b These cellules were regarded as eggs by Klencke and Gulliver, but are now con-

During the life of the pig, the bladder enclosing the worm is fully distended with a pellucid fluid, but after the pig's death, a portion, or all, of the contained fluid escapes into the surrounding tissues.

"In the specimen of cured pork sent to us, the bladders were empty of fluid, and the microscopic corpuscles in the body of the worm presented a central granular opacity, instead of being clear and transparent, as in the fresh specimens. *We believe that the life of the parasite is destroyed by the process of curing.*

"It is now maintained by several eminent physiologists, that this fleshworm is the *scolex* or imperfect condition of the tapeworm or *Tænia solium*, and that, when passed alive into the intestinal canal of man and other mammalia, it assumes there a higher degree of development, and becomes a tapeworm—a troublesome parasite—often causing distressing symptoms, and impairing the health. The organization of the fleshworm, as now described, goes far to establish this opinion, if, indeed, it be not already placed beyond doubt by the results of experiments in which it was shown that dogs fed on fresh measly pork became affected with tapeworm. With us the parasite is killed by cooking, but where the flesh is eaten raw, as in Abyssinia, tapeworm is very common.

"*All pork is not 'measly.'*—In the specimens of healthy pork we found no trace whatever of the parasite in any stage of development.

"In the specimens of both 'slight' and 'badly measled' pork submitted to us, the worms were all visible to the naked eye. All appeared to have reached the same degree of organic growth, and in none of the specimens, healthy or otherwise, could we find eggs or the slightest trace of the parasite in an earlier stage of development.

"This parasite has been found in the muscle, brain, and eye of man; but *there is no analogy whatever between 'measles' in the pig, and the disease known by that name in man.*

"It is highly probable, if not quite established, that 'measles' originate in the eggs of the tapeworm which infests the bowels of the dog. Each mature joint of the last parasite contains many thousand eggs. These, when voided by the dog, are resolved into a fine dust, and are scattered by the wind, and thus, mixing with the food or drink of the pig, enter its body,

sidered to be organs of assimilation. The four raised discs around the head are not mouths, as was formerly supposed, but rudimentary suckers, by which and the hook-lets the animal is enabled to attach itself to the adjoining tissue. The same organs attach the full-grown tapeworm to the intestinal mucous membrane.

and are there converted into the 'measle' or fleshworm, which, as already stated, is an imperfect condition of the tapeworm. 'Measles' may not form in every hog that has swallowed tapeworm eggs; while a feeble digestion and constitutional debility may especially favour their hatching in some pigs.

"If this view of the origin of 'measles' be correct, it will be an important and rational guide to the prevention of the disease, and which will consist in *providing the pig with thoroughly clean food and drink, promoting its general health, and removing it from the neighbourhood of dogs affected with tapeworm.*

"When only a few of the parasites are scattered in the body of the pig, the flesh does not differ from that of healthy pork in its ordinary characters or minute structure, and the general health of the pig is not affected. When used as food, it must be so rare that the vitality of the worm can escape cooking, mastication, and digestion, that we believe the risk of tapeworm from its employment to be very small; and, on the whole, *we see no valid reason for regarding 'slightly measled' pork as unwholesome*; but it must be well cooked, and never eaten raw or underdone^a.

"On the other hand, when the parasite is thickly distributed throughout the muscle, the flesh is pale, soft, and watery, and the muscular fibre near the worm loses its healthy structure, and exhibits evidence of the condition known to pathologists as fatty degeneration. The health of the pig is much impaired, and in the worse forms of the affection we may have inflammation, and suppuration in one or more parts of the body, with general fever, wasting, and weakness. The pig is seldom permitted to see this stage, and almost never to survive it.

"When the disease proves fatal, according to Mr. Martin, the animal loses appetite, blisters form under the swollen tongue, the skin ulcerates, and death occurs amidst extreme debility and emaciation^b.

"'Badly measled' pork is insipid when cooked, and in boiling loses more weight than healthy pork. It is more difficult to dry, and exhibits greater proneness to putrescence^c; while, respecting its use as food, we must not forget the possibility of its causing tapeworm, nor the risk of some portion of the animal having undergone during life changes of a truly morbid nature, as inflammation and suppuration. Taking account of

^a The process of curing is fatal to the parasite, and removes all risk of tapeworm.

^b Farmer's Library, vol. ii. p. 491.

^c These facts were determined by repeated comparative observations with healthy pork.

all these circumstances, we cannot regard 'bad measly' pork, fresh or cured, as wholesome food for man.

"This opinion may be assailed on the ground that 'bad measly' pork is consumed to a large extent, and that no hurtful effects have been traced to its employment. But we cannot trust to common experience in a question of this nature. Putting aside the ordinary sources of fallacy, the poor consumer of such meat is rarely capable of tracing the relation of cause and effect between bad food and its evil consequences. He would conclude meat to be wholesome which failed to produce some striking bad symptoms soon after a meal, and would be unable to refer to its true cause the injurious influence, slowly and silently, but not less certainly, wrought upon his system by the long-continued use of an unwholesome article of diet.

"Chemical analysis could not aid much in this inquiry, but, were it otherwise, the time allowed us did not permit of its employment."

The 'measle' in the hog is more observed in Cork than elsewhere in these islands. This is in part due to its being more carefully sought for; but chiefly to its greater frequency, caused, I apprehend, by inattention to the cleanliness of the pig's food and drink, and by the circumstance of its being reared in the peasant's cabin, where it has very generally a dog (untaxed in Ireland) for a companion. This dog, for the most part, has tapeworm. Nor must we forget the influence of our low marshy grounds and warm humid climate, in favouring the production of parasites, and especially of worms. These conditions may induce a state of constitution in the pig favourable to the reception of the parasite, and we can readily understand that a warm and moist air should favour the incubation of the tapeworm egg and development of the young *tænia* outside the body.

I am informed that in Cincinnati, the largest pork-market in the States, the 'measle' is unknown. If this be the fact, it would be interesting to know whether the pigs brought to that city, and which are fed chiefly in the forests of Ohio, Kentucky, and West Virginia, are kept apart from dogs having tapeworm. Perhaps some of our American readers could inform us on this point. Dr. Wood, of Philadelphia, says that tapeworm is comparatively rare in the natives of the Union.

The researches of Kuchenmeister, Röhl, Leuchart, Von Siebold, and Van Beneden, leave no doubt of the connexion between the cystic and cestoid entozoa. Experiment shows that the 'measle' is generated in the muscle of the pig by feed-

ing it with ripe joints of the dog's tapeworm (the *Tænia serrata*, now considered to be the same as the *Tænia solium*, or human tapeworm), and that the same tapeworm is developed in the intestines of a dog fed with fresh measly pork. The 'measle' is not generated in the dog by feeding it with the tapeworm eggs.

Leuchart has traced in the rabbit the passage of the embryo tapeworm into the bloodvessels. The eggs are quickly hatched in the stomach, and the young *tæniæ* bore their way with their lancet-armed heads through the mucous membrane, and into a bloodvessel. With the blood they are carried in the rabbit to the liver, to be there arrested and developed into hydatids or *Cysticerci*. In the lamb, the young *tæniæ* are carried with the blood to the brain, where they fix and grow into the cystic parasite named *Cœnurus cerebralis*, and within two weeks of the commencement of the experiment the lamb is affected with the 'staggers.'

The cystic entozoa or hydatids do not form a separate class of parasites, but are merely the cestoid entozoa or intestinal worms in a degenerate state; and the same embryo tapeworm produces different forms of hydatid, according to the species of animal and part of the body in which it may chance—or rather, I should say, mischance—to be developed, for the hydatid is essentially abnormal both in form and site, and these entozoa obtain their perfect growth only in the intestinal canal—their proper dwelling-place. The young tapeworm, swimming in the blood, is fixed probably by getting into a capillary too small for its passage; and the reason of its being arrested by preference in the muscle of the pig, brain of the sheep, and the liver of the rabbit, may perhaps be found in the relatively small size of their capillaries.

As the egg of the same tapeworm develops both the 'measle' in the pig and the 'staggers' in the sheep, the means of prevention suggested in the Report, for the former disease, will apply equally to the latter. In addition to the means of prevention there mentioned, it might be well to reduce the number of dogs in the country, and to diminish the frequency of tapeworm among them by not feeding the healthy with raw flesh, and by the vigorous treatment of the diseased. The excrement of dogs should not be mixed with the manure for pasture fields.

There is more hope of preventing measles than of their cure. I made many inquiries as to the treatment of the disease, but without obtaining information of much value. The farmers generally are sceptical as to cures being ever obtained, but a few

have faith in treatment; and, of the several remedies employed, the internal use of sulphur is most relied on. Two or three cases were mentioned to me by trustworthy persons, in which cures appeared to have been made by this drug. It is probably converted in the pig's body into sulphurous acid, and poisons the 'measle.' This acid is a most efficient parasite-killer. Alcohol, iodine, camphor, turpentine, and nitrate of silver, are actively poisonous to the cystic parasites, and their internal use may be tried.

In Cork the pig is examined for 'measle' by official persons, both in the living and dead markets. The parasite shows itself at a very early stage of the disease in the tongue, and this organ is inspected in the living market. The pig is placed on its side and the mouth opened. The tongue is then drawn forward and pressed firmly between the fingers in its whole length. The 'measle,' if present, is felt by the finger, and withdrawn through a scratch in the mucous membrane. If none are felt, the pig is passed as healthy. This test is the best known, and is very useful, but the worm may be absent from the tongue and present elsewhere in the body; and a more certain means of detecting the disease in the living animal is to be desired.

In the wholesale dead market, the inspection is made by making a free cut lengthways into the inner loin muscle at the side of the spine, and by cutting across the neck. And, should the purchaser desire it, cuts are made into the flesh elsewhere, as the back of the neck and shoulder. If one 'measle' only is found, the price is lowered 5s. per cwt., and if more are seen, a larger reduction is made, varying from 5s. to 15s. per cwt., according to the number. The worse forms are not sold in this market.

Respecting the origin of tapeworm in man, from the 'measle' of the pig, a case in favour of this view has been recently reported by Dr. Gairdner. It is that of a female in Edinburgh, who was in the practice of eating raw fresh pork, and is now affected with tapeworm,—the more curious, as the habit of eating raw flesh, and the disease, are both rare in that city.

The process of *curing* destroys, as we have shown, the vitality of the parasite, and to this circumstance the immunity from tapeworm, enjoyed by the inhabitants of Cork, must be attributed. The poor of this city, among whom tapeworm is very rare, undoubtedly consume a large quantity of 'measly' pork, but always salted. The freedom of seamen in the navy from tapeworm admits of the same explanation. Much of the pork formerly used in the navy was measly, but it was well

cured. At the present time, the naval contracts are inspected with care, and 'measly' pork is rejected^a.

The use of raw 'measly' flesh cannot, however, be the only source of tapeworm in man. This parasite occurs among the very poor, who scarcely eat flesh of any kind, and it plagues the Hindoo, who lives almost exclusively on rice. It may, perhaps, originate from the direct introduction of the tapeworm eggs or young *tæniæ* with the food or drink into the stomach. Klencke, many years ago, asserted that he had found microscopic young *tæniæ* in ditch-water, and the frequency of tapeworm in Vienna has been attributed to the water of that city, in which young tapeworms have been detected.

Why, when thus introduced into the stomach of man, the dog, pig, and sheep, respectively, they should cause tapeworm in the first and second, and pass into the blood of the third and fourth to grow cyst-worms, may be explained by supposing that in the carnivore's stomach the mucous membrane is tougher, or that the young *tæniæ* are destroyed by the strong, acid, gastric juice, except on rare occasions, when they slip alive into the intestines to grow tapeworms; while in the herbivorous^b stomach, where the food lies long, they escape digestion, the gastric fluid acting feebly on animal matter, and, piercing the softer mucous coat, make their way into the circulation.

These remarks have brought me to difficult, and as yet obscure ground, and, in truth, although great progress has been made of late years in our knowledge of intestinal worms, much remains to be done as well for their natural history as for those important questions in hygiene and pathology to which they give rise, before we can attain to clear views and definite conclusions.

^a While engaged in this inquiry, my friend, Dr. John Burns, of H. M. S. Hastings, communicated with several of his brother medical officers to learn their experience of the use of 'measly' pork in the navy. Tapeworm had not been traced to its employment. During the summer of 1855, Dr. Burns states that the provisions issued were uniformly of good quality.

^b *Cysticerci* infest the flesh of several vegetable feeders, as the ox, deer, sheep, hare, rabbit, and mouse.