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P. M. 109
ON POISONING BY DISEASED PORK.

BEING

AN ESSAY

ON

TRICHINOSIS,

OR

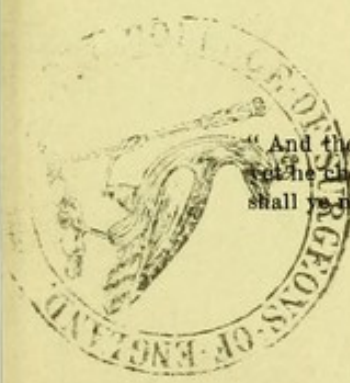
FLESH-WORM DISEASE:

ITS PREVENTION AND CURE.

BY

JULIUS ALTHAUS, M.D., M.R.C.P., LOND.,

PHYSICIAN TO THE ROYAL INFIRMARY FOR DISEASES OF THE CHEST.



“And the swine, though he divide the hoof and be cloven-footed,
yet he cheweth not the cud; he is unclean to you. Of their flesh
shall ye not eat, and their carcase shall ye not touch.”—

LEVITICUS xi. 7—8.

LONDON:

JOHN CHURCHILL AND SONS, NEW BURLINGTON STREET.

MDCCCLXIV.

ON POISONING BY DISTILLED WATER

AN ESSAY

THE CHINESE

THEIR MANNER OF DRINKING

ITS PREVENTION AND CURE

BY JAMES ALTMAN, M.D.

LONDON

JOHN CHURCHILL AND CO. NEW BURLINGTON STREET

TO

PROFESSOR RICHARD OWEN, F.R.S.,

THE DISCOVERER OF TRICHINA SPIRALIS,

THESE PAGES ARE INSCRIBED

BY

THE AUTHOR.

PROFESSOR RICHARD OWEN, F.R.S.

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P R E F A C E.

THIS Essay is partly reprinted from the *Medical Times and Gazette*, in the hope, that the importance of the subject of which it treats will be a sufficient excuse for its publication in a separate form. In the interval between the appearance of the former and the present paper, several new facts concerning Trichina Disease have come to light; and I have thus been able to make numerous additions, especially from Dr. Rupprecht's valuable account of the Hettstädt Epidemic, which has just been published. Although up to the present time Trichina Disease in the living subject has not been recognised in England, yet there can be no doubt, from the results obtained in the dissecting-rooms of the London and Edinburgh hospitals, that it frequently occurs here, and that a great amount of suffering may be prevented, and, perhaps, many lives saved, by attention to a few facts and simple rules which may be learnt not only by medical men, but equally well by the public. Here there is a disease which is more fatal than typhoid fever; but which may with absolute certainty be prevented, if proper precautions are taken. It is, therefore, the duty not only of the medical profession, but also of the municipal authorities, to take the subject into serious consideration.

18, BRYANSTON STREET,
PORTMAN SQUARE.

TABLE

This Essay is partly extracted from the Medical Treatise and
inserted in the place that the importance of the subject of
which it treats will be sufficiently known for its publication
in a separate form. In the interval between the appearance
of the former and the present paper, several new facts con-
cerning the nature of the disease have come to light; and I thought
it my duty to add them to the former, especially those which
have been discovered by the late Mr. Keene, of the Hospital, London,
which has just been published. Although up to the present
time I have not known of the living subject, but have
examined in England, and there are in no doubt, from the
reports obtained in the Hospital, of the nature of the disease and
the manner in which it is attended, that it is attended with
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18. Keene's Essay
19. Keene's Essay

ON TRICHINOSIS,

OR

FLESH-WORM DISEASE.

THE danger attending the use of diseased meat, has rarely been exemplified in so striking a manner as by the discovery of *Trichina* Disease. Within the last few years, numerous cases of illness have occurred in various parts of Germany, which, although resembling certain complaints with which we have been long familiar, yet presented so many peculiarities, as to attract considerable attention on the part of the medical profession. In 1860, it was discovered, by the aid of the microscope, that the distemper was due to the immigration into the system of a very minute worm, which occurs chiefly in the flesh of pigs, and which has long been known to zoologists by the name of *Trichina spiralis*. Although the disease may seem new, there is strong reason to believe that it has always existed; but was not recognised as such by the medical profession. There are, in fact, many cases on record in medical literature, which were at the time believed to be such, of gastric, rheumatic, or typhoid fever, or in which even poisoning with criminal intent was suspected; but which we may now safely claim as instances of *Trichina* disease.

Two cases in point may be mentioned, one of which occurred in Germany, the other in England. In 1863, Professor Langenbeck, of Berlin, excised a tumour which had grown on the neck of a man. During the operation he noticed that the muscles which were laid bare contained a number of encysted trichinæ. The patient being questioned whether he had not at one time or another been afflicted with a remarkable illness, related the following history:—In 1845, a committee of eight gentlemen, being engaged in the inspection of schools in Saxony, dined together at an inn, and partook, amongst other dishes, of ham and sausages. They all, with the exception of one who merely drank a glass of claret, fell ill, and four died. Suspicion fell upon the meal and the host. The wine from which they had

drunk was analysed; and, although no poison was found, the host continued to be suspected, and was at last obliged to emigrate.

The second case in point has been described by Mr. Henry Wood, of Bristol, in the *London Medical Gazette* for 1835. A man, aged 22, was admitted to the Bristol Infirmary *with a violent attack of acute rheumatism*; the pain and tenderness of his limbs and trunk were so great as to render him unable to support himself. He was brought into the house on the back of his father. He was a stout athletic-looking man, and was stated by his friends to have been, up to the time of his illness, very healthy and powerful. A fortnight previous to his admission, he showed signs of indisposition which were attributed to an ordinary cold; the pain in his limbs increased rapidly; he was much troubled with cough and dyspnoea, and he kept his bed six days before his admission into the hospital. He died seven days afterwards, and it was found that there were pneumonia and pericarditis; while in the muscles were seen appearances, in many respects similar to those described by Mr. Owen:—"The trichinæ were confined to the interfascicular membrane of the large muscles, and principally to those of the chest and shoulder; being most apparent in the pectoral and deltoid, less so in those of the arm, and becoming still fewer in the legs." Mr. Wood concludes his very interesting paper by stating, that he endeavoured to gain assistance from some members of the profession in making further observations at the time; but he was foiled, as it appeared to him, from the want of proper value being attached to the microscope as a means of pathological research. The symptoms described by him are those commonly observed in Trichina Disease.

Trichinæ were first noticed in England, where in 1832, Mr. Hilton, of Guy's Hospital, noticed in the pectoral muscles of a man aged 70, who had died of cancer, the cysts in which the worms are generally found enclosed, and which appear to the

FIG. 1.



naked eye as small white specks. Mr. Hilton believed these corpuscles to be dependent upon the formation of very small cysticerci.

The muscles of bodies dissected at St. Bartholomew's Hospital, had also been more than once noticed by Mr. Wormald, then Demonstrator of Anatomy at that establishment, to be beset with minute whitish specks; and this appearance having been again remarked in the body of an Italian, aged 45, by Mr. Paget, then a student of the hospital, who suspected it to be produced by minute entozoa, Mr. Owen was furnished with portions of the muscles. He discovered a nematoid worm enclosed in the cyst, and called it *Trichina spiralis*, on account of its resembling a hair in its minute filiform size and its being coiled up into spiral turns. This name has been generally accepted by

FIG. 2.

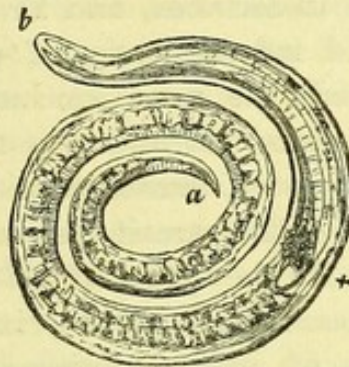


FIG. 2.—Female trichina from the muscle of a man; the cyst is removed, but the spiral turns are preserved. *a* is the head, *b* the tail. The alimentary canal begins at *a*; its structure is cellular, and it fills up the whole of the inner part of the body from *a* till †, while from † to *b* it is reduced in thickness.

zoologists, and it is only quite recently that M. Davaine, the author of a well-known treatise on entozoa, has proposed a different name for it, viz., *Pseudalius Trichina*. The only reason that can be given for this innovation is, that the tail of the male trichinæ which are found in the human intestines is divided into two horns or cones, and that the same peculiarity exists in *Pseudalius Duj.*; but since, in every other respect, the structure of trichina entirely differs from that of *Pseudalius*, it is by no means probable, that M. Davaine's innovation will find favour with zoologists, as it would only lead to confusion; and, no doubt the worm in question will always be called by the name first given to it by Professor Owen.

Since its discovery in 1835, *Trichina* has been frequently noticed, more especially by German and English anatomists. In the anatomy rooms of the Universities of Berlin and Edinburgh, trichinæ have been found in 2 or 3 per cent. of the subjects

dissected. Mr. Curling found them in the muscles of two robust men who were killed while in the apparent enjoyment of good health; one by fracture of the skull, the other by fracture of nearly all the ribs. The first was 58 years of age, the other 60. They were also noticed by several observers in Denmark, France, and the United States. The animals in which they have been found are the cat, the crow, the jackdaw, the hawk, the mole, the frog, the eel, the badger, the hedgehog, and the pig; but it is not yet settled whether some of the worms found in the former of these animals do not rather belong to a different species, viz., *Trichina affinis*. It was, however, only in 1860, that more minute investigations concerning the nature and development of trichina were undertaken, and Professors Virchow and Leuckart, who worked independently of one another, simultaneously come to nearly the same conclusions as regards the natural history of the worm. Zenker was the first to find, in a girl who had died at Dresden, numerous trichinæ in the striated muscles, and to recognise the parasite as cause of the illness and death of the patient. In the spring of 1862, about thirty cases of trichina disease occurred in Plauen, in Saxony. In some patients, small pieces of muscular tissue were excised and examined by the microscope, and thus, for the first time, the diagnosis of trichina disease was made in the living subject. Since then numerous cases of it have been observed, especially in Saxony, Prussia, and Brunswick. From the end of October to the middle of December, 1863, there was a true epidemic of this disease in Hettstädt, near Eisleben, in which 158 persons were affected, and twenty-eight of them died. It is, however, certain that the disease is not confined to the countries just mentioned; and no doubt many cases of it have occurred and do still occur in all parts of the world.

Dr. Tüngel has described an epidemic of trichinosis which occurred on board a merchant vessel, bound from Valparaiso to Hamburg. On leaving the former place, the cook of the ship bought a pig which was slaughtered, and part of which (about thirty pounds) was eaten by the crew; the rest of the animal was salted. Most of the crew fell ill, and two of them died. In a boy who died, and where an autopsy was made, numerous live trichinæ were found in the muscles. A piece of the salted pork was sent for examination to Professor Virchow, of Berlin, who

discovered in it a number of trichinæ, all of which were dead.

With the sole exception of Mr. Henry Wood's case, all observations made on human trichinæ until 1860, concerned those instances only in which the trichinæ disease had healed, that is, in which the worm had been seen in the encysted, not in the free state. We now know that, at least, two months are necessary for the production of a complete cyst, and that men or animals, which live so long that the trichinæ existing in them may become encysted, are likely to survive the disease. Before this was known, the opinion therefore gradually gained ground that trichina was a harmless animal, and more a curiosity than a source of danger. On this account, the practitioners and clinical observers took no further interest in the worm, which was left to the care of zoologists and anatomists. In a purely scientific point of view, however, trichina soon proved to be a problem of surpassing interest, as nobody knew whence it came, nor how it could migrate into the flesh of living men, nor how it was generated, for no organs of generation, no ova, no progeny had been found. It is, therefore, scarcely surprising that even good observers resorted to the old hypothesis of spontaneous or equivocal generation in order to explain the origin of trichina. Thus, Dr. Bristowe and Mr. Rainey believed that trichina was generated from fat formed between the muscular fibres, and that the nuclei, which became visible after the fat had gradually vanished, played an important part in those intermediate changes which occurred between the appearance of the animal and the disappearance of the fat.

In many respects trichina resembles cysticercus, which is most frequently found in pigs (measly pork), but is by no means rare in man. It is true, that cysticercus is larger than trichina; for while the former is of the size of a pea, or even of a small cherry or bean, the latter appears only as a little white speck, even if the cysts are taken together with the animal. On the other hand, however, cysticercus is, just as trichina, destitute of organs of generation and of ova; it often occurs in large numbers, and it is also found in the flesh. We know that cysticercus cellulossæ is the larval state of *tænia solium* (tape-worm); that, in fact, the same worm lives for some time as cysticercus, and is afterwards changed into *tænia*; that *tænia* produces not

only ova, but also living progeny, which first become cysticerci, and afterwards are again metamorphosed into tæniæ. These facts, which went far to render the theory of spontaneous generation untenable, soon led zoologists to inquire whether or not similar processes might take place with regard to trichina. Virchow was the first who succeeded in showing, by experiments, the existence of alternate generation in trichina. He fed a dog with *encysted*, but still living, trichinæ, taken from a man, and found, four days afterwards, numerous *free* trichinæ in the intestines of the dog. These animals were seen to possess generative organs, containing ova and spermatozoa. He also showed that the cyst in which the animals are enclosed, when found in muscles, is nothing but a changed muscular fibre; and it thus became evident that the animals did indeed penetrate from without into the structural elements of muscles. These and other experiments of Virchow, which were confirmed by those of Leuckart, Claus, and others, have led to the conclusion, that there exists alternate generation for trichina as it does for cysticercus; that if animals are fed with trichinæ taken from the muscles, intestinal trichinæ are formed, which produce ova and living progeny; that these latter, without leaving the animal in which they have been generated, immediately penetrate the coats of the intestines and migrate into the body, more especially into the striated muscles, where, unless the animal in which they are contained should previously die, they are, after a time, encysted, and wait for the moment when they may be eaten by another man or animal, to undergo the same changes as before.

It thus appears, that the danger which may accrue to man from trichina is far greater than that with which he is threatened by cysticercus and tænia. While the latter require to be eaten on two several occasions, the former only requires to be eaten *once* in order to produce a progeny which infects the whole system. Moreover, cysticercus and tænia scarcely ever cause a fatal result, while even within the last three years a large number of deaths is known to have been brought about by trichinæ. A knowledge of the nature of the worm, of the symptoms of trichina disease, of the way in which this is brought about, and of the means by which we may hope to prevent or cure it, is, therefore, of considerable importance for the Medical Practitioner.

If men or animals have eaten meat infected with trichinæ, this is dissolved by the gastric juice, and the trichinæ become freed from their cysts. With a magnifying power of 200, we are

FIG. 3.



FIG. 3.—Magnifying power, 200.

FIG. 4.



FIG. 4.—Magnifying power, 150.

then able to distinguish their alimentary canal, which begins at the somewhat sharp anterior extremity of the animal; it is at first a narrow tube, but soon widens and appears as a broad cellular body, which fills up more than one-half of the whole length of the animal, while, at its posterior third, the tube again becomes narrow, and at last opens outside at the posterior extremity. When once in the stomach and freed from their cysts, the trichinæ awake from the torpor in which they were held previously. They begin to move about; they lose their spiral figure, and become stretched, so as to appear somewhat similar to ascarides. They soon grow rapidly, so that while a trichina musculorum is only from two-fifths to three-fifths of a millimeter long, the trichina intestini is no less than from one to three millimeters long. At the same time, generative organs are developed.

The male trichinæ may be recognised, by containing, in the posterior third of the body, glands with excretory ducts (Fig. 3, 2), and by having at the posterior extremity two prominences similar to thorns or cones (Fig. 3, *b* and Fig. 4, *b*). A full grown male trichina is from 1 to 1.5 millimeters long, and from 0.03 to

0.04 millimeters wide. It is probable that the males die soon after connexion has taken place; for while at first their number almost equals that of the females, it soon decreases, and from the tenth to the fourteenth day after the trichinous meat has come into the stomach only females are observed, which live longer than the males, as they require more time for maturing ova and producing progeny. Six weeks after feeding, no trace either of males or females is to be discovered in the intestines.

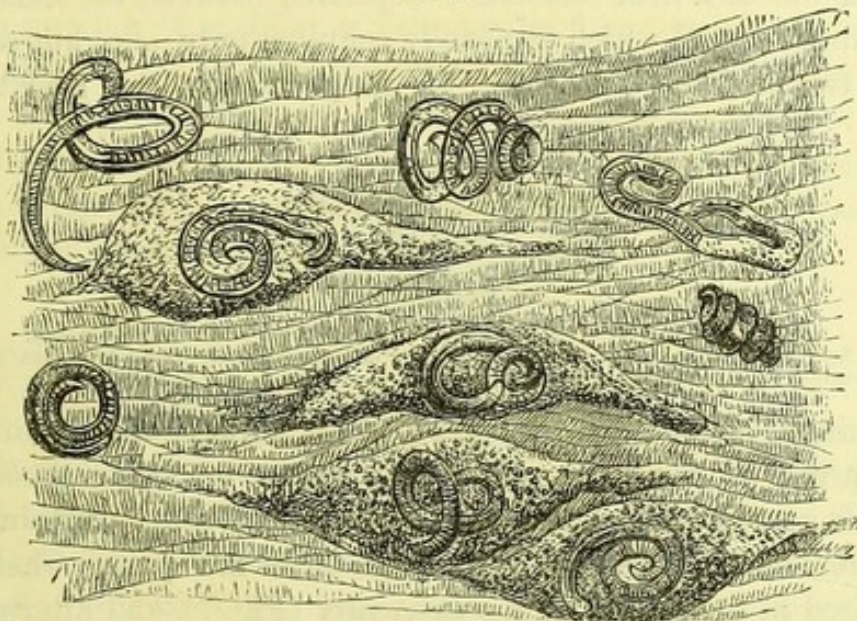
The full-grown females are considerably larger than the males, viz., from two to three millimeters. This is owing to the greater development of the posterior part of the body, the ovaries and Fallopian tubes being much more extensive than the testicles. The posterior extremity is more rounded than it is in the males, and is devoid of the cones found in the latter. Copulation takes place a few days after the animals have arrived in the stomach. In each ovum after a time an embryo is formed, which becomes free by rupture of the membrane enclosing the ovum, and travels towards the anterior part of the Fallopian tube (Fig. 5, 4—5). As soon as the embryo has arrived at the opening of that tube (5) it goes out and begins its individual existence. At this period, the embryo is very small and quite transparent; it is 0.05 millimeters long and 0.005 millimeters wide, and devoid of any special organs. The time required for the intra-Fallopian development of the embryo varies, according to Vogel, from two days to six weeks, the difference being obviously due to two causes. In the first instance, it appears that the development lasts longer if the trichinæ that have been eaten were very young; in the second place, the number of ova contained in one female must be taken into consideration. Most females contain from 300 to 500 ova, which only gradually advance towards the anterior opening of the Fallopian tube; and it is therefore evident, that more or less time must elapse between the birth of the first and the last of the progeny.

FIG. 5.



Soon after birth, the trichinæ leave the intestines and migrate into the peritoneal sac. For this they have to perforate the coats of the bowel, which, on account of their minute size, they probably accomplish without tearing the membranes, but merely driving them, as it were, asunder. This process is facilitated by the shape of their head, which may under certain circumstances become sharply pointed. From the peritoneal sac they proceed to all the striated muscles, excepting only the heart, in which they are scarcely ever found. They arrive in the muscles about ten days after their parents have been eaten, and penetrate through the sarcolemma into the interior of the muscular substance, which is, by their invasion, considerably altered. In moving through the fibres, the worms cause,

FIG. 6.



according to the researches of Virchow and Colberg, an acute parenchymatous inflammation of the muscular tissue; the fibres lose their stripes and gain a homogenous appearance; in others, the substance is changed into fine granules, small cells are formed in rapid proportion, and the nuclei increase in number and size. It is, however, only the fibres actually invaded by trichinæ, which undergo these modifications, while adjacent fibres, not touched by the worms, remain perfectly normal. If animals or men thus trichinised survive these multiple inflammations, convalescence sets in towards the fourth week from the commencement of the disease. The formation of small cells and nuclei gradually diminishes, new capillary vessels are formed, and from the nuclei even new muscular fibres may be generated,

so that a nearly complete recovery may ensue. In cases of great severity where numerous trichinae migrate into one muscular fibre, no regeneration can take place; in such cases there is fatty degeneration, not only of the contractile substance, but also of the nuclei of the muscles.

The parasites take their nourishment from the muscles in which they have taken up their abode. When they arrive in the muscles, they are furnished with a mouth, œsophagus, and intestinal canal; within a week, they grow so much that they attain thirty or forty times their previous size, which would be impossible if they did not assimilate a large amount of nutritive material from the man or animal which they have invaded. They then gradually become enclosed by a thick cyst, which is formed out of a firm substance deposited between the nuclei of the muscles, and which generally contains only one, but sometimes two or three, trichinae. In proportion to the growth of

FIG. 7.



FIG. 7.—Magnifying power, 120. Trichina from the muscle of a dog, five months after the animal had eaten trichinae. Earthy deposits at the upper extremity of the cyst, within which the worm is still visible.

the animal, it gradually assumes a spiral form similar to that of the spring of a watch. The time taken for these processes extends generally from the third to the fifth week. Within the next few months, further changes go on in the cysts. Chalk is deposited in them, first at one extremity (Fig. 7), and afterwards in the whole of the cysts (Fig. 8). This latter is then no longer

FIG. 8.

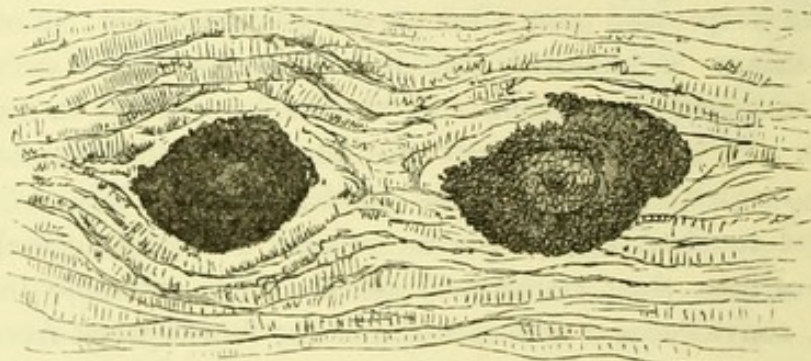


FIG. 8.—Magnifying power, 120. Piece of trichinous muscle from a human subject. Cysts completely calcified. The trichinae within them only become visible after the lime has been dissolved by the addition of acetic acid.

transparent, and its coat appears very much thickened. In this state, it may be seen with the naked eye (Fig. 1). The flesh has a sandy feel, and on cutting it through with a knife it grates. The animal is now enclosed in a shell, like the egg of a bird. According to Vogel, the deposition of lime begins towards the fifth month. In those trichinæ which have been so frequently observed in the dissecting-rooms of Edinburgh, Berlin, etc., the cysts are generally completely calcified. Years may elapse before this occurs. In most cases, the trichinæ contained in these cysts still preserve their vitality, and are capable of development; if the lime is dissolved, and they are gently heated, they begin to move about; if given to animals to eat, they undergo all those changes which have been related above. Sometimes, however, the worm itself is calcified and dies.

The number of trichinæ which may be found in muscles varies exceedingly. In some cases, there are not many of them; in other instances, a piece of flesh not larger than a pin's head contains twenty or more. The sum total to be found in a man or an animal may amount to several millions. Six thousand millions of trichinæ only weigh one pound.

How should suspected Meat be examined for Trichinæ? From which Muscles should Specimens be taken?

I have already mentioned, that the cysts are visible to the naked eye as whitish, round, or ovoid specks, with which the surface of the muscle is sprinkled. If these are touched with a drop of acetic acid, or, better still, with diluted hydrochloric acid, the lime is dissolved and the white colouring disappears. This experiment is, however, not perfectly reliable, if larger pieces of flesh are examined; for the acid then produces a deposit from the muscular juice, whereby the whole surface becomes indistinct and turbid. It is, therefore, the best plan to cut off a very small piece of flesh with a fine pair of scissors, to tear this assunder with needles, and to free the cysts as much as possible from the flesh. If this is done on a glass resting on a dark object, the cysts may be clearly distinguished as whitish grains, and the dissolving power of acids becomes quite apparent. If the spots retain their colour, it is probable that small pieces of fat, nervous fibres, or similar formations are present. But as

pieces of fat may be connected with the cysts, a negative result is not so decisive as a positive one ; and it is, therefore, in doubtful cases always better to use the microscope in order to decide the point.

It does not matter very much from which muscles the pieces to be examined are taken. Even if there are only a few trichinæ present, they generally exist in all the muscles of the body, excepting the heart. The heart of pigs may therefore be eaten with impunity. Trichinæ are, however, more numerous in the tendinous extremities of the muscles, which is probably due to the circumstance, that a large number of trichinæ penetrate as far as possible in the muscular tissue, and only stop their progress if certain impediments (as tendons) offer. If we, therefore, wish to make the diagnosis of trichinosis in man, it is best to excise a little piece of flesh close to the insertion of a muscle.

Trichinæ which have not yet become encysted can only be recognised by means of the microscope. A thin layer of flesh should be cut out with a sharp scalpel, spread over a glass plate, and moistened with a drop of water. If it is then covered with a thin sheet of glass, we may distinguish trichinæ, if there are any, with a magnifying power of 50. Their intimate structure, however, can only be recognised with a power of 300.

Up to 1860, the diagnosis of Trichinosis had never been made in the living subject. In that year, however, Dr. Zencker, of Dresden, recognised an epidemic of this disease in the town and neighbourhood of Dresden, and showed the existence of trichinæ in a ham and several kinds of pork sausages of which the persons affected had eaten. The pig had been slaughtered at a country house near Dresden. The butcher and others who ate of it fell seriously ill ; and one case, which was that of a servant-girl who had been quite well up to that time, ended fatally. At the autopsy, an immense number of trichinæ were discovered in all the muscles of the body. Dr. Zencker sent specimens of the ham, as well as of the muscles of the dead body, to Professor Virchow, of Berlin, who made a series of important experiments with them. A rabbit was fed with the trichinous meat, and died a month after. The autopsy showed that trichinæ had become developed in the muscles of the rabbit. Another rabbit was then fed with flesh from the first ; and it also died a month after.

Flesh was again taken from the latter animal, and three other rabbits fed with it; two of these died in three weeks, the third a month after. From the latter, another rabbit was infected; it died six weeks after. In all of them the muscles were crowded with trichinæ, so that in every piece of flesh, however small, several worms were found. In order to be quite sure that there were no trichinæ in the rabbits before they ate the trichinous meat, Professor Virchow examined their muscular tissue before feeding them, and did not find a trace of trichinæ, which are, in fact, never observed in rabbits unless they are previously fed with trichinous meat. He also found trichinæ in the lymphatic glands of the intestines, the peritoneal sac, and the pericardium. Since then, numerous evidences of trichina disease have been recognised in Germany.

Symptoms of Trichina Disease.

The morbid symptoms caused by the immigration of trichinæ are interesting in a practical as well as in a scientific point of view. There are, in fact, few internal diseases where the cause of the disorder is so manifest, and where its action on the system may be so distinctly traced in all its successive stages.

Trichinosis is a more or less severe affection, according as few or many parasites are eaten, and a small or large progeny is produced. Thus, in the epidemic of Burg, near Magdeburg, a woman who had eaten a quantity of raw pork with bread, fell ill and died. Her child who had sucked a spoon used by the mother, had symptoms of mild trichinosis, and recovered.

Three stages of the distemper may be distinguished: the *first* of which comprises the time from the arrival of the worms in the intestines until the birth of the first of the progeny. This lasts from four to eight days; and its symptoms are, in certain cases, by no means remarkable, there being only loss of appetite and general *malaise*. But where the affection is severe, the patients suffer from considerable indigestion a few hours after the meal. There is a feeling of prostration, pain in the back and the stomach, fulness in the head, giddiness, aversion to food, sickness, and heat alternating with chills. On the second day vomiting and copious diarrhœa ensue, which latter continues for several days. The patients are laid up, and fever sets in towards the end of the first week.

The *second* stage is the most important one, and lasts from the time when the embryos commence their migration from the intestinal canal into the muscles, until they have taken up their permanent abode in the muscular tissue. The symptoms in this period vary a great deal according to the nature of the cases. Where the affection is severe, that is, where a large quantity of trichinous meat has been eaten, high fever and œdematous swelling of the face are the most striking symptoms. The latter sometimes affects the eyelids only ; but in many cases it extends over the whole face, and is most considerable in women and children. At the same time, the conjunctiva is inflamed, the pupils are somewhat dilated ; the faculty of accommodation is diminished ; there is photophobia and pain on moving the eyes, especially on looking upwards. The fever is sometimes very high, even in the commencement of the second week. The pulse rises to 100 or 120 ; there are thirty-two or more respirations in the minute ; the temperature is increased to 100° and more ; the skin which was dry at first, becomes moist ; there is profuse perspiration, and the patient complains of intolerable heat and thirst. Sleep is either wanting or much disturbed ; the tongue is coated and rather dry, and the appetite quite gone. The urine is highly coloured, and contains sediments of uric acid ; the quantity of urinary water is much diminished, the whole amount that is discharged within the twenty-four hours not exceeding eight ounces. There are from four to six motions during the day, but without pain or tenesmus ; the abdomen is sensitive to touch, and there is a certain degree of meteorism. In women, the catamenia appear prematurely within the first few days of the second week ; and if pregnant women are infected, miscarriage may take place. The temper of the patients becomes very irritable ; towards night, there is increase of fever and slight delirium.

The symptoms caused by the parasites in the muscles themselves are not less striking. The muscles of the neck, back and limbs are rigid and swollen, the affection proceeding, in the majority of cases, in the direction from the centre towards the periphery ; so that at first those of the arms and thighs, and afterwards those of the fore-arms and legs, hands and feet, become affected. Their bulk is increased, but pressure of the finger leaves no mark in the skin and cellular tissue. Pain is

most severe if the patients attempt to extend the muscles; and it is more considerable at the first attempt to move, after they have been quiescent for a certain length of time. In cases of great severity, the muscular irritation is so considerable, that the patients lie flat on the back, without venturing to change their position, the extremities being slightly flexed. Muscles, which have special functions, are affected in a special manner. Thus, dyspnoea and singultus may be produced by trichinous infection of the diaphragm, the intercostals, and other muscles of respiration. If the muscles of the larynx are affected, there is hoarseness and loss of voice. By trichinosis of the tongue, and the muscles of mastication and deglutition, the processes of speaking, masticating, and swallowing, are impeded or rendered impossible; and sometimes there is true lock-jaw. The patients cannot laugh, yawn, or sneeze; and may be deaf in one or both ears.

The swelling of the face generally lasts only for one week, and then disappears without leaving any further traces; in a few cases, however, eruptions resembling urticaria, erythema, or rubeola have been observed to follow.

At the commencement of the fourth week, the severity of the fever increases still further; the pulse rises to 140 or more, the temperature to 104° , the number of respirations to 44 per minute. There is constant sleeplessness with great anxiety, fainting fits, and delirium; the perspiration continues profuse; miliary vesicles appear on the surface; meteorism, hæmoptysis, lobular pneumonia and effusions in the pleura may be observed. The pain is excessive, and twitches occur in the muscles; lock-jaw is severe, and the tongue cannot be protruded. At last the pulse becomes innumerable; and death ensues, with all the symptoms of complete exhaustion of the nervous centres. A fatal issue may take place four or five days after the commencement of the illness; but it mostly occurs during the third or fourth week.

In other cases, recovery sets in towards the fifth week. This is the *third stage* of trichina disease, and it commences as soon as the parasites have taken up their permanent abode in the substance of the muscles, and have coiled themselves up and become encysted. The fever then diminishes, the pulse falls to 96 or even 84; the number of respirations to 32 or even 24, the

temperature to 99°. Perspiration becomes less profuse, diuresis is increased, there is less thirst, the tongue becomes moist, the patients are again able to sleep, and the pain gradually disappears. The appetite returns slowly, but sometimes the patients are so voracious, that they require many meals in the day as well as at night. They soon gain flesh, the skin peels off, the body-weight increases, and they begin to walk about again. The pupils still remain dilated, the conjunctiva inflamed, the faculty of accommodation diminished; and œdema in the lower extremities, occasional pain in the chest and dyspnœa are troublesome. About the seventh week, most patients are able to return to their business. Depilation, however, begins at the eighth week, and in women amenorrhœa, and murmurs in the jugular veins, show that health is, even then, not entirely re-established. Where inflammation of the lungs has occurred, and the result has not been fatal, recovery may be protracted to the tenth week, and even longer.

In certain mild cases, the first symptom of the *second stage* of trichinosis is violent palpitations of the heart, but no other striking appearances. In other instances, œdema of the face, a feeling of great weakness, pain in the muscles, and impaired digestion are observed towards the end of the second week. Such patients are not even laid up; yet the affection may be insidious, and death ensue of pneumonia or peritonitis three or four weeks after the commencement of the disease.

A curious fact is, that children, especially those under 14 years of age, suffer far less than adults. This may be partly due to the circumstance, that less meat is given them, and, consequently, a smaller number of parasites immigrates into their system; but it is, no doubt, also in great part owing to the higher sensibility of the stomach and bowels. After the unclean meal, children frequently vomit or purge, whereby the dangerous substances are evacuated soon after having been introduced; so that there is not sufficient time allowed for the worms to infect the system.

But even where the affection is severe, children do not actually suffer so much as adults, as regards pain, thirst, and sleeplessness. The œdema of the face is generally very extensive, and there is a high degree of mydriasis which lasts for two months; but children mostly sleep the disease off, as it were, being scarcely ever awake; their appetite is not quite gone, and

recovery sets in sooner. In the Hettstädt epidemic, only one child died, and she had obstinately refused to take medicine.

Post-Mortem Appearances.

There is much emaciation ; the muscles are moderately rigid ; hypostatic swellings are observed, especially at the neck ; and a certain degree of decubitus at the sacrum. The muscles are pale and dry, and contain, according to the period in which death resulted, either free or encysted trichinæ. The blood in the heart and great vessels is dark and thin ; clots may be found chiefly in the saphena, basilic, and cephalic veins. There is moderate aqueous effusion in the pericardium. In the right ventricle, firm clots of fibrine two or three inches long may be present, and extend into the pulmonary artery. The heart itself is soft and flabby, and the mucous membrane of the respiratory organs pale. The posterior and inferior parts of the lungs are hyperæmic, and, in cases where pneumonia has been recognised during life, the usual signs of metastatic (embolic) inflammation are present. In the pleural sac there is, in such cases, a sanguineous effusion, and fibrinous clots adhere to the visceral pleura, as far as it covers the inflamed portion of the lung. There is a firm reddish-brown cuneiform infarctus in the pulmonary tissue looking with its base towards the periphery, and with its apex towards the centre. The branches of the pulmonary artery which proceed to this infarctus, are blocked up with embolic clots. Where death is not the result of pneumonia, but of paralysis of the respiratory movements, portions of the lung are in an atelectatic condition. The peritonæum shows no traces of inflammation ; the spleen is not enlarged, but soft ; the liver anæmic ; the gall-bladder flabby and full of bile ; the stomach is flabby, its mucous membrane pale, and it sometimes contains ecchymoses. There is no swelling of the solitary follicles of the intestine, nor of Peyer's glands. The kidneys are anæmic and soft, the bladder normal. The state of the nervous centres has not yet been examined.

*Remarks on some Special Symptoms of Trichinosis, and their
Physiological Explanation.*

One of the most important symptoms is, as I have already

stated, the œdematous swelling of the face, which is mainly produced by trichinous inflammation of the muscles of the face and the eye, and their interstitial connective tissue. By this the circulation of the blood in the skin and the cellular tissue is disturbed, just as is the case after external injuries, etc.; and this continues until the cysts are formed. The muscles of the eye are almost always full of trichinæ. In one specimen taken from the obliquus inferior muscle, Dr. Rupprecht found no less than forty-nine of them. In the majority of cases, the œdema commences on the seventh or eighth day after infection; from which it would appear, that the velocity with which the worms move within the system, is about one-third of an inch per hour; the migration being commenced on the fourth day from the bowel, and having reached the eyes at the end of the first week. If the eyes are examined with the aid of the ophthalmoscope, it is seen that there is also œdema of the optic nerve and its papilla; the vessels of the retina are enlarged and may be seen pulsating, even in anæmic patients; the macula lutea is not visible, and the edge of the papilla is very indistinct. At the same time, there is mydriasis, and the eyeball is softer than usual.

The diminished state of the faculty of accommodation, and the pain attendant on movements of the eyes, arise from the same cause. Towards the fourth week, there may be almost complete paralysis of the faculty of accommodation, which latter returns to its normal state only within the third month, or even later.

The œdema of the lower extremities is, if it occurs at an early period, due to the same cause as above; but if observed at a later time, it arises from the formation of clots in the veins, which is promoted by the long inactivity of the muscles and consequent disturbance of venous circulation. In certain cases, small pieces of these clots are torn off and lodged as emboli in the branches of the pulmonal artery, whereby fatal inflammation of the lungs may be produced. In the Hettstädt epidemic this occurred in one case out of sixteen; and it has also occurred elsewhere. Mr. Henry Wood's patient (p. 8), and Zencker's patient (p. 18) died of it; other such instances have been observed in Plauen and Blankenburg.

Towards the fourth week, extensive œdema of the neck is sometimes suddenly produced, and threatens life by causing hyperæmia of the brain. In the Hettstädt epidemic, three

patients died in consequence of this. They were all well-fed, stout persons.

Edema of the glottis may ensue by trichinous infection of the crico-thyroid and crico-arytænoid muscles. If deafness is present, it arises from infection of the salpingo-pharyngeus and pharyngopalatinus muscles, whereby œdema of the mucous membrane, and closure of the Eustachian tube, are caused.

We know that any stimulus applied to a living muscle produces contraction. It is, therefore, only after the inflammatory symptoms have subsided, that relaxation of the muscles occurs in trichinous patients. In certain cases, there is true trismus and tetanic rigidity. It has not yet been explained why, in this affection, adults always lie on the back, and children on the side, both without changing position.

The great acceleration of respiratory movements is partly caused by the fever, and partly by trichinous affections of the intercostal muscles, the diaphragm, and other muscles of respiration. Coughing, sneezing, yawning or laughing are sometimes prevented, while, in other cases, singultus and fits of yawning and sneezing take place. These symptoms are, however, by no means constant, and, if present, only occur during the fourth week.

The palpitations of the heart, which are in certain cases, of exceeding violence at the commencement of the second week, are probably caused by a temporary trichinous infection of the pericardium and the heart. They occur in about one case out of thirteen. It seems, however, that the trichinæ soon leave the heart, for these palpitations generally cease in the course of the second week; and in autopsies, it is quite exceptional, that any worms are discovered in that organ.

By immigration of trichinæ into the abdominal muscles, constipation and diminished power of discharging the urine may be caused.

Perspiration is mostly profuse for several weeks; and it may continue in certain parts of the body—such as the neck, the left arm, etc., after the general perspiration has ceased. It seems that those parts are chiefly subject to it, the muscles of which are extensively infested.

Premature appearance of the catamenia is the rule, but miscarriage not the necessary consequence of trichinosis. A

case occurred in the Hettstädt epidemic, where a fœtus six months old was born a few hours before the death of the mother, which was caused by peritonitis. In this case, a post-mortem examination was made, and no trichinæ were found either in the womb, or in the muscles of the fœtus. It is, therefore, probable, that the effects on the womb are caused by irritation of the adjacent organs.

Causes of Trichina Disease.

Trichinosis in man is probably always caused by eating raw or underdone pork, ham, and sausages. Beef, mutton, poultry, game, etc., never contain trichinæ, and those other animals in which the parasites have been found (viz., the cat, mole, crow, hawk, and jackdaw, etc.), are scarcely ever eaten. In Paris, however, where cat's flesh is notoriously served up in certain *cabarets*, men may become infected with trichinæ by eating such ragouts.

The wisdom of Moses in forbidding the Jews to eat pork * has thus received an additional striking proof. It may be that Moses forbade pork to be eaten because pigs take unclean and putrid food ; but it is just as possible that he may have done so after having observed people fall ill and die after eating pork. In the less complicated conditions of social life at that time, observations on the effects of poisonous meat could be made with far greater facility than is possible now ; and if a large number of persons fell ill or died after partaking of meat from one slaughtered animal, the cause of the accident must needs have struck an accurate observer.

Some years ago, when it was shown that tapeworm in man is caused by eating pork containing cysticerci, it was believed that Moses' law regarding pork was made for the prevention of tapeworm ; but tapeworm seldom causes considerable illness : it is not really dangerous to life ; and if pork was forbidden from a knowledge that it produced disease, it is far more probable that the law was meant for preventing that disease which is now known to us as trichinosis.

* Leviticus, xi. 7—8: "And the swine, though he divide the hoof and be cloven-footed, yet he cheweth not the cud; he is unclean to you. Of their flesh shall ye not eat; and their carcase shall ye not touch." The same is repeated, Deuteronomy xiv. 8.

Diagnosis.

The *diagnosis* of flesh-worm disease may, in somewhat severe cases, be easily made during life. The course and the symptoms of the distemper are, in fact, very peculiar. In mild cases, there are gastric disturbances, pain in the muscles, and œdema of the face. In severe cases, there are, besides these symptoms, swellings of the muscles, fever of a typhoid character, but no tumour of the spleen. There is, moreover, dyspnœa and hoarseness. If, under such circumstances, the patient admits of having a short time ago eaten raw or underdone pork, ham, or sausages, and especially if several patients are affected at the same time in the same house, or in the same neighbourhood, there is every probability of the disease being trichinosis. Absolute certainty, however, is only to be acquired by finding trichinæ either in the evacuations or in the muscular tissue.

To show trichinæ in the evacuations is very troublesome to the Physician, and to show them in muscular tissue not very pleasant to the patient. If the fæces are not fluid, water must

FIG. 9.

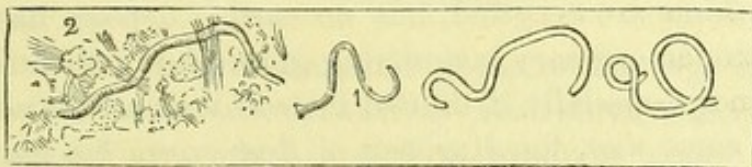


FIG. 9.—Intestinal trichinæ from a young dog five days after having been fed with trichinous meat. 1 is a male trichina, with cones at its posterior extremity; the others are females. At 2 the parasite is surrounded with fæcal matter.

be added to them, and the matter is then brought, drop by drop, upon the object-glass. With a magnifying power of 20, we may be able to find intestinal trichinæ; but the examination takes several hours to accomplish, and often yields no result, although the patient is infected with the parasites.

For showing the presence of trichinæ in muscles, it is necessary (unless there should be, by chance, an open wound in which a muscle is laid bare) to take out a small piece of any muscle and examine it. The operation may be done by Middeldorpf's harpoon, or a small incision may be made at the lower portion of the deltoid, where issues are usually made, and a piece of

flesh the size of a lentil may be cut out by a pair of scissors. If there are any muscular swellings, it is best to take the specimen from the muscles thus affected, and examine it with the

FIG. 10.

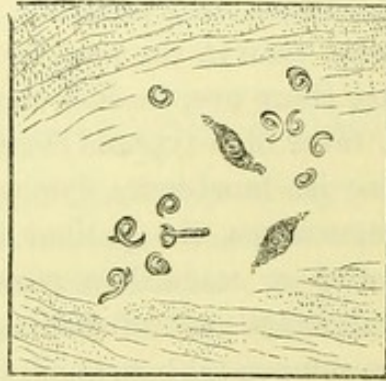


FIG. 10.—Magnifying power, 19. A piece of muscle rendered transparent by the addition of acetic acid. There are two encysted trichinae in the middle; the others are free.

microscope. Such a proceeding is by no means dangerous, and quite justifiable. If the disease is severe, the first specimen taken generally contains trichinae. If certain muscles are more swollen than others, it is best to take specimens from the former. Where the cysts are calcified, no magnifying power is necessary. If the trichinae are encysted, but no earthy deposit has as yet taken place, an ordinary magnifying-glass shows them in a distinct manner, especially if diluted hydrochloric acid is added.

In the same way, the diagnosis of flesh-worm disease may be made long after it has healed in persons who have recovered from the affection. A curious fact of this kind has been recorded by Dr. Griepenkerl. From 1859 to 1862, an epidemic occurred in Blankenburg, in the Duchy of Brunswick, which the medical men of the place believed to be one of gastro-rheumatic fever. Some time afterwards, when public attention had been directed to the occurrence of trichina disease in other parts of Germany, the similarity of the latter distemper and the epidemic just mentioned, struck the doctors of Blankenburg; and a gentleman who had fallen ill there in 1859, but had recovered, after a very protracted illness, was informed by his medical attendant that the disease from which he had then suffered, had, probably, been trichina disease, and that traces of it might yet be found in his body. The gentleman then offered to have a small piece of muscle cut

out, and on this being done, and the specimen being examined by the microscope, no less than seven encysted trichinæ were found in it. It was thus satisfactorily shown that the Blankenburg epidemic, in which no less than 278 soldiers, and a corresponding number of civilians had fallen ill, had, in reality, been nothing but trichina disease.

It has been asserted, that trichinæ might be most readily recognised in the mucous membrane of the tongue of trichinous patients. This, however, is erroneous; for neither with the naked eye, nor with an ordinary magnifying glass are we able to distinguish the worms, even if they should exist in that part. It is only long after the disease has healed, and when the diagnosis has no longer any immediate practical interest, *i. e.*, after the complete formation and calcification of the cysts, that we might be enabled to distinguish these latter in the tongue, with the naked eye or a magnifying glass.

The only formations which may possibly be confounded with trichina-cysts are the so-called Rainey's corpuscles, which are

FIG. 11.



sometimes found in the muscular fibres of the pig, and have received their name from having been first described by Mr. Rainey. They consist of a dark granular mass, enclosed by a transparent ovoid cyst, and are found imbedded in the interior or primitive muscular fibres, which are thereby somewhat dilated. The nature and mode of development of these formations are at present unknown. It is only certain that they have nothing to do with trichinæ, and they never enclose a worm; so that an accurate observer will always be able to distinguish them from trichina-cysts. Rainey's corpuscles are never found in human muscles.

The *prognosis* of a case of trichinosis depends upon the circumstance whether the person affected has eaten few or many trichinæ. Where few have been eaten, the patients may feel unwell; but they soon recover. Even in cases of medium severity, a fatal issue is rare, and after an illness of a few weeks convalescence sets in. Cases of great severity either end fatally,

or the patients very slowly recover, after having been dangerously ill for weeks, and they remain weak and out of health for months afterwards. Of special importance for prognosis are the muscular pains and the fever; if both are severe, the prognosis is bad, or at least doubtful.

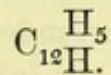
The average rate of pulsation in this disease is from 84 to 96, that of respiration 32, the average temperature 100°. Any increase in these numbers forebodes evil. If the pulse is 120 at the commencement of the disease, and remains so for a certain length of time, the patients are generally doomed. Where, however, this pulse is only observed for a few days, and the patients are not laid up at the same time, it is not a dangerous symptom. If the temperature suddenly falls to 98° on the 28th or 35th day of the disease, the patients may be said to be in a fair way of recovery. But, where they lie motionless on the back; where a sensation of tingling is felt in the extremities; where there is tetanic rigidity of the trunk; and where delirium, and sopor and coma supervene, death is approaching. Pneumonia in the fourth week of the complaint is mostly fatal, but pleurisy is devoid of danger. Trichinosis proves more fatal to women than to men and children. The third and fourth weeks are those in which a fatal issue is most frequent.

Convalescence is often exceedingly slow, and protracted by diarrhoea and blennorrhoea of the lungs. Patients once affected by the disease, are not in any way insured against a future infection. Whether the encysted trichinæ, which must always remain in the system, if it has once been infested by them, may, at a later period of life give rise to other disorders, we have, as yet, no sufficient data to decide. It is a curious coincidence, that the patient in whose body Mr. Hilton first discovered trichina cysts, had died of cancer; that the patient on whom Professor Langenbeck operated (p. 7) suffered from a similar tumour; and a third instance is on record where Professor Blasius, of Halle, found trichina cysts in the muscles of a man who had died of epithelial cancer. It is, however, at present impossible to say, whether this is a mere coincidence, or whether there is any connection, as between cause and effect. It would, at all events, be worth while to examine the muscles of patients who have died of cancer, in order to ascertain whether there is a frequent coincidence. As any mechanical

irritation, especially if long continued, is liable to cause cancer, the innumerable trichina cysts, which are interspersed between the muscular fibres, may possibly produce analogous effects.

Treatment.

As regards the *treatment* of trichinosis, the results have, up to the present time, not been very satisfactory. Many patients have died in spite of treatment; and those who recovered would probably have done so without special treatment. Professor Friedreich has recommended using the picro-nitrate of potash, which, in a case he had under his care, appeared to exercise a most beneficial action; but further experiments by Dr. Fiedler and Professor Mosler have shown that this substance, even if given in large doses, kills neither the intestinal nor the muscular trichinæ, nor does it prevent the immigration of the parasites into the substance of the muscles; so that a further use of that remedy in trichinosis does not appear justifiable. Arsenic has been given, but without success. On the other hand, Professor Mosler has found, as the result of careful experiments, that benzine (or benzole) is a poison for trichinæ. Benzine was discovered by Faraday, in 1825, and is represented by the formula



It rapidly kills lice and other vermin, and seems to have the same effect upon cysticercus and trichina. But benzine is also a powerful poison for large animals and man; and, if used in the treatment of trichinosis, should be employed with special caution. A rabbit can take ten grains, a pig thirty grains, and a cow half an ounce of benzine per diem without its producing alarming symptoms of poisoning. From thirty to forty drops may be given to an adult man *pro dosi*, and, as the smell and taste of this substance are peculiarly nauseous, Professor Mosler has recommended it to be given in the form of "*capsules gélatineuses*," each capsule to contain ten drops, and one to be taken every two hours. Up to the present time, benzine has not yet been employed in trichinosis in man; but its use in the more severe forms of this affection seems justifiable. It would, however, be most desirable to discover an efficacious drug which is less noxious to the system than benzine.

In most cast cases, a symptomatic treatment must be resorted to. If the practitioner should be called in soon after the taking of trichinous or merely suspicious meat, an emetic should be given at once. At a later period, neither emetics nor purgatives seem to do much good. The experiments of Fiedler go far to show, that even large doses of purgatives have no influence in removing trichinæ from the intestinal canal, nor to prevent the development of the embryos and their immigration into the muscles. On the other hand, Dr. Rupprecht has seen relief following the administration of calomel in scruple doses, and has discovered one female trichina and two embryos in the fæces of a patient who had previously taken calomel. He also mentions, that the fever was not so severe if this treatment was resorted to in the beginning; and the diarrhœa was often stopped by it. He follows the calomel up by an emulsion of sweet oil of almonds, with arabic gum and laurel water, which he believes to be noxious to those trichinæ which may still be present in the bowel, and at the same time to soothe intestinal irritation. At the commencement of the third week, he recommends half a grain of hydrochlorate of quinine, in solution, every two or three hours. By this remedy, the temperature and perspiration were much diminished, and the vital powers roused. Mineral acids and digitalis have been recommended by some observers, but forbidden by others. A free administration of milk, beef-tea, and alcohol, if it is borne, should, in all cases, be resorted to. Liebig's extract of meat has, in some cases, proved very useful. Animals infected by trichinæ seem to die chiefly in consequence of being, by the painful affection of the muscles of mastication and deglutition, prevented from taking food; and they live much longer, if milk and other nutritious fluids are injected into the stomach. The same holds good for man, especially in cases where high fever exhausts the frame. To most patients, the idea "of being eaten alive by worms" is so revolting, that it is better to keep them in ignorance of the nature of the complaint.

Amongst the several symptoms of trichina disease, which require relief, sleeplessness is one of the most troublesome. Morphia fails to afford benefit, and only increases the restlessness and diarrhœa. In certain cases, enveloping the patients in wet sheets has done good, and the rooms should always be kept very cool. Bromide of potassium has not yet been tried, but would pro-

bably do good. Diarrhoea often continues throughout the disease, and resists opium and astringents ; an occasional dose of castor oil is sometimes beneficial. If there is constipation, castor oil may also be given. For perspiration which is very profuse, wet sheets and quinine, or fomentations with vinegar have been beneficially employed. If œdema is troublesome, and diuresis much diminished, juniper oil or turpentine may be administered. For the muscular pains, tepid fomentations, or frictions with oil of hyoseyamus or benzine, should be used.

In the third stage of the affection, the patient should be treated according to general rules. If anæmia or hydræmia is present, tonics, especially iron, should be freely given ; if there is stiffness, weakness, and atrophy of the muscles, tepid baths and Faradisation are to be employed.

The old adage that *prevention is better than cure* was never more applicable than to trichinosis. This disease would, in fact, never occur, in the human species, were pork eschewed. This being one of the cheapest meats, it is not likely that its use will be discontinued by the poor ; but they might at least be taught the necessity of taking every precaution against the ill effects which may ensue. It has been shown that if pork, ham, or sausages are thoroughly well roasted, boiled, smoked, or salted, all trichinæ which may be present are destroyed. A temperature at which albumen coagulates (144° to 164° F.) kills the parasites ; but it is often only the external layers of the joint or the cutlet which undergo this or a greater heat, and the inner fibres generally remain underdone. In these latter, therefore, the blood and albumen are not coagulated ; they are soft and of a pinkish hue, and may contain a large number of live trichinæ. On the other hand, it has been shown by the experiments of Küchenmeister, that if pork is salted for a certain length of time, or if sausages are subjected to hot smoke for twenty-four hours, the trichinæ are killed. Cold smoking does not kill them unless it is continued for a long period ; but when sausages which have been subjected to cold smoking are kept for a long time, the life of the parasites generally seems to be extinct.

It now only remains to be seen, what measures of precaution should be adopted by communities against trichinous infection. The following points are the most important for this consideration :—1st. Great cleanliness of the sties in which

pigs are kept should be observed ; and, as pigs can only become infected by eating meat or fæces containing trichinæ, they should, as far as possible, be prevented from taking suspicious animal substances. 2nd. A microscopical examination of pork should be made before it is offered for sale, either by Medical men, Veterinary Surgeons, or Naturalists, who should be paid for their services either by the pork-butchers or by the municipal government. In large towns, each district should have a special slaughter-house for pigs, to which a microscopist should be attached, and no pork should be allowed to pass out without a certificate of its being uninfected. A full examination of one animal may be made in ten minutes by a good observer. In small country places, curates, schoolmasters and others conversant with the use of the microscope, might undertake the office.

Pork-butchers should not oppose such examinations, as it is they who are in the first instance exposed to the danger. In almost all epidemics which have occurred in Germany, pork-butchers, their wives, children, and servants were the first to suffer. In several German towns, pork-butchers therefore employ competent observers to examine all animals before offering them for sale ; and the meat is therefore guaranteed pure to the public.

In concluding this paper, I have much pleasure in stating that the Medical Department of the Privy Council are fully alive to the importance of the subject, and are taking it into their serious consideration.

THE END.

By the same Author.

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