[S FROM THE SUPPLEMENT TO THE FIRST ANNUAL REPORT OF THE MASSACHUSETTS STATE BOARD OF HEALTH, LUNACY, AND CHARITY, CONTAINING THE REPORT AND PAPERS ON PUBLIC HEALTH.]

PAPER

ON

TRICHINÆ IN RELATION TO THE PUBLIC HEALTH.

BY

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OF ROXBURY.

BOSTON:
Rand, Avery, & Co., Printers to the Commonwealth,
117 FRANKLIN STREET.
1880.

Compliments of author

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As a contribution to the subject of diseases of animals dangerous to the public health, the following paper is offered, embracing some original investigations on *trichinæ* in hogs slaughtered in Massachusetts. The inquiry has necessarily been limited, this year, to one branch of the subject, on account of want of time and opportunity to study the others.

The literature treating of *trichinosis* or *trichiniasis* is of comparatively modern origin; but we have no reason to doubt that the disease prevailed in swine at a very early date, and the consequential disease in man must have existed for years, if not for centuries, before it was recognized, perhaps dating back as far as the use of pork as food. The principal workers in this important field of investigation have been Owen, Cobbold, Bristow, and others in England; and Leuckart, Virchow, Gerlach, Haubner, Furstenberg, Zenker, and Kuchenmeister in Germany.

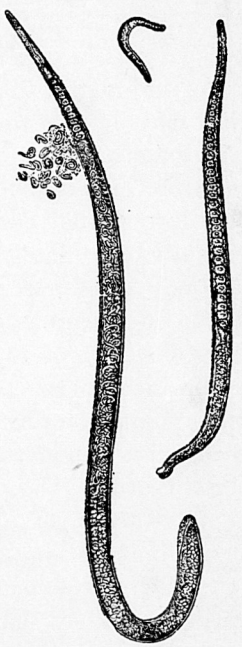

Fig. 1. Male Trichina, Female in process of giving birth to Embryos, and Embryo from Intestines. (Heller.)

"*Trichina spiralis* is 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 caudal append-

age, . . . female stouter than the male, bluntly rounded posteriorly; . . . eggs measuring $\frac{1}{1270}$ of an inch from pole to pole; mode of reproduction viviparous."[1]

The illustrations in this paper are from Leuckart and Heller.

"The ova develop into minute embryos immediately on fructification, completely filling the uterus of the female, and are born in immense numbers. Scarcely have they become free from maternal protection, before they begin their migration over the invaded organism by penetrating the parietes of the intestines, in order to settle themselves in the muscles of the same, as muscle trichinæ: here, under the protection of a gradually calcifying, structureless capsule, the emigrated embryos, or muscle trichinæ, retain their vitality for years, while the sexually matured, or intestinal trichinæ, perish, as a rule, in the course of about five weeks. The embryos, which sometimes pass away from the intestines with the fæces, may, under favorable circumstances, also give occasion to the development of muscle trichinæ in a second animal, by gaining access to its intestinal tract."[2]

FIG. 2. Calcified encapsuled Trichinæ from the muscles of man. (Leuckart.)

As said above, these parasitic pests assume two forms, i.e., they may be met with as intestinal trichinæ and as muscle trichinæ, the first representing the sexually matured, the latter the embryonal (usually capsulated), stage of their existence. In order to offer even a very condensed sketch of the evolution which these parasites undergo, it is better to begin with the non-matured, or muscle form. The parasite, in this stage of development, limits its abode entirely to the striated or motory muscles. They have not been found in the non-striated or involuntary muscles, nor in the purely adipose tissue. The capsulated parasites may be met with in the

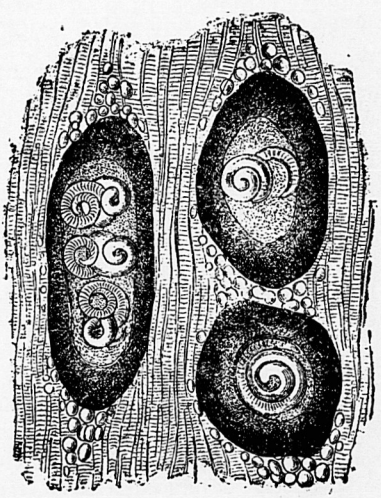

FIG. 3. Trichina Capsulès, with contents and connective tissue. (Leuckart.)

[1] Cobbold, Entozoa, p. 335.

[2] Leuckart, Menschlichen Parasiten, vol. ii., p. 512.

striated muscles of all parts of the body; the heart seems, however, to be exempt, for they have been found in its tissues only in isolated cases (Leuckart, Fiedler).

In making examinations of the œsophageal muscles of a rabbit fed with trichinous pork, I was much struck with the abruptness with which one met with the trichinæ, in passing from the involuntary muscles of the stomach to those (voluntary) of the œsophagus; in fact, trichinæ could be seen where the fibres of the two interlaced, but in no case could I find a parasite in the non-striated fibres.

These parasites are not, however, equally distributed over the muscular system, but, on the contrary, seem to have their favorite places of abode. They appear to have a predilection for the muscles of the anterior part of the body. Among these, those of the tongue, larynx, pharynx, eye, and masticatory muscles are especially favored. The muscles of the body are more frequented than those of the extremities. Very few are found in the inferior portion of the tail of any animal. In the extremities, the parasites are found to be more abundant where the muscle-fibres begin to lose themselves in their tendinous extension, than in the body of the muscle. The following interesting and valuable statistics, with reference to the dispersion of the trichinæ over the organism, are taken from the "Mittheilungen aus der Thierärzlichen Praxis im preussischen Staate," 1877–78, p. 99. Department Veterinarian Johow, and Army Veterinarian Maximilian, having four trichinous swine at their disposal, have endeavored to establish the relative dispersion of the trichinæ in the different muscles of the body. To this end they prepared a great number of microscopic specimens from the different muscles of the body, which were on an average two centimetres long and one centimetre wide.

Eighty preparations from hog No. 1 gave the following results: —

a from the pillars of diaphragm . . .	12 trichinæ
b from the muscles of diaphragm . . .	4 trichinæ
c from the laryngeal muscles	1 trichina
d from the intercostals	no trichinæ
e from muscles of the tongue	
f from muscles of the neck	
g from muscles of the eyes and humerus .	

Sixty preparations from swine No. 2: —

a from pillars of diaphragm	10 trichinæ
b from muscles of diaphragm	6 trichinæ
c from laryngeal muscles	2 trichinæ
d from intercostals, *e* from tongue, *f* from muscles of eyes, humerus, and neck	no trichinæ

Forty preparations from swine No. 3: —

a from pillars of diaphragm	40 trichinæ
b from muscles of diaphragm	25 trichinæ
c from laryngeal muscles	4 trichinæ
d from intercostals	6 trichinæ
e from tongue	8 trichinæ
f from muscles of neck, eye, and humerus	2 trichinæ

Forty preparations from swine No. 4: —

a from pillars of diaphragm	40 trichinæ
b from muscles of diaphragm	30 trichinæ
c from muscles of larynx	10 trichinæ
d from intercostals	10 trichinæ
e from tongue	6 trichinæ
f from muscles of humerus	2 trichinæ

Leuckart estimates that in some of the cases which have come to his observation, a single gram (fifteen grains) of flesh lodged from twelve hundred to fifteen hundred trichinæ. Assuming the muscles of a man to weigh forty pounds, the number of these parasites infesting a human organism, at such a ratio, would sum up some thirty millions. In Zenker's case, — to be noticed later, — Fiedler calculated that the woman lodged some ninety-four millions; and Cobbold assumes that a hundred millions may sometimes infest one organism at the same time. Leuckart says that no one would look upon the above as exaggerated estimates, who, like himself, has found some sixty trichinæ in ten millimetres of muscle. In a report of the Chicago Academy of Sciences, noticed in "The Boston Medical and Surgical Journal," vol. 75, it was estimated that one cubic inch of pork, examined under their auspices, contained some ten thousand, and that a person consuming the ordinary amount of such meat used at a single meal would introduce into his organism more than a million of these parasites. District Veterinarian Rauch[1]

[1] Preuss. Mittheilungen, l. c., p. 100.

(Wittenberg) found, in three hundred microscopic preparations of the flesh of an infected hog, that trichinæ were present in all but three. In some cases, there were thirty in one focus; in others, but five or six. In seventy specimens weighing one gram, three hundred and fifty trichinæ were found: at that rate one pound would contain a hundred and seventy-five thousand, and, if the flesh of a hog weighs a hundred pounds, it would, at such a percentage, contain seventeen million five hundred thousand trichinæ. In many cases, however, the parasites are much less frequently met with; and one has to search through many microscopic preparations before meeting any, and then only isolated examples.

When sufficient time has elapsed from the invasion of the muscles, and formation of the capsules, the latter become calcified, and may be recognized with the naked eye as small white specks, the infected muscles appearing as if sprinkled with grains of fine salt or white sand. The calcification of the capsule begins about the fifth month after the invasion of the muscles. In the ordinary pork which is generally offered for inspection, this is not the case, sufficient time not having elapsed for the calcifying process to take place, and the parasites, or, more correctly speaking, the capsules, are not to be seen with the naked eye, a magnifying power of fifteen to twenty diameters being sufficient to their recognition by the practised observer; but for exact inspection a power of fifty to seventy-five diameters is always to be preferred. The capsules do not always present the same form to the eye of the observer: sometimes they are well elongated; while at others they are more round, the usual extenuations at the ends being almost entirely wanting. Their average dimensions may be said to be 0.4 millimetre in length, and 0.26 millimetre in breadth. They not infrequently contain two, and sometimes three, parasites.

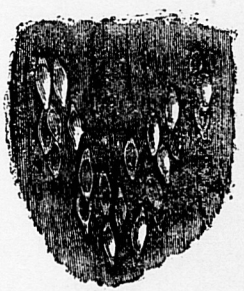

Fig. 4. Encapsuled and calcified muscle-trichinæ from man. (Heller.) × 10.

The Intestinal Trichinæ.

So long as the trichinæ are in their capsules in the fibre of the muscle, their condition remains unchanged except to die or degenerate after the lapse of a long time; they make no progress in their development. They have been seen in an active condition, — i. e., capable of progressive development under suitable circumstances, yet encapsuled, — thirteen, twenty, twenty-four years, from the time at which their invasion had taken place. In 1861 a woman was admitted into the hospital at Altona, a suburb of Hamburg, Germany, suffering from a cancer of the breast which had been developing for some twelve years. On excision of the same, and subjecting portions of its tissue to microscopic examination, the presence of trichinæ was made manifest. On inquiry, it was ascertained that in 1856 the woman resided at Davenport, Ia., where she was taken suddenly very ill; gastric and rheumatic phenomena being the most manifest, together with œdema of various parts, and loss of power of motion of the limbs. Her brother, with whom she resided, was attacked in a similar but not in so severe a form, at the same time. The woman died at the hospital in question in 1864, and the examination of her flesh revealed the presence of great numbers of encapsuled trichinæ. A cat fed with pieces of the same died after the lapse of sixteen days, its flesh being completely filled with these parasites.[1]

Virchow relates a case, where, after the lapse of *thirteen and one-half years*, the parasites moved in their capsules on prolonged exposure to the heat of the sun.

Dr. Klopsch reports a case of trichiniasis, and complete recovery, which took place in 1842. The discovery of the parasites in this case was also made at the time of excision of a mammary tumor, which took place May 6, 1863, twenty-one years after the time of invasion. At the same time that the woman was ill (in 1842), two persons in the same house presented similar phenomena, and both died.[2]

Professor Damman, formerly of the Eldena Agricultural Academy, now at the Hanover Veterinary Institute, Ger-

[1] Boston Medical and Surgical Journal, 1866, vol. 74, p. 186.
[2] Archïv. für path. Anat. u. Physiologie, vol. xxxv., p. 609.

many, reports an interesting case of the longevity and encapsuling of trichinæ in the muscles of a pig. This hog was fed by Von Behr, in Schmaldow, with trichinous pork in November, 1864, and in February, 1865, was presented to the experiment station at Eldena. Since that time the animal had been kept isolated in a pen of its own, unless taken out for examination. A second feeding with trichinous meat had never taken place. On the 3d of February, 1875, and 20th of February, 1876, he removed a small piece of flesh from the muscles near the shoulder. In both cases the microscopic examination demonstrated the presence of trichinæ. Rupture of the capsule and the application of moderate heat demonstrated that they still lived. A considerable piece of flesh was removed, and fed to two rabbits; eighteen days subsequently their muscles were found plentifully invaded. In this case we have unquestionable proof of the presence and continuance of living trichinæ capable of development for a period of eleven and one-quarter years from the time of the infection of the swine.[1]

Although the capsulated trichinæ suffer no changes while confined in the muscles of a living organism, yet the introduction of portions of such muscles into the intestinal tract of man, or other suitable animal, causes rapid changes in their condition. The processes of digestion soon set the embryonal parasite free from its capsule, three to four hours being sufficient to the purpose; the freed parasites rapidly complete their development, becoming matured trichinæ. Thirty to forty hours are in general sufficient to complete this metamorphosis. In cases of fresh invasion, when the capsules have not become hardened to any great degree, twenty-four hours have been found sufficient to demonstrate the presence of sexually matured trichinæ in the intestines of animals fed with such flesh by way of experiment. Nevertheless one often finds parasites still enclosed in their capsules on the third day after feeding such flesh to an animal. There is scarcely another worm in which the matured stage is reached in so brief a period. Under these circumstances it must be evident that the changes necessary to maturity for these parasites are not very great.

As a rule, sexual connection takes place within two days

[1] Zeitschrift für Thierheilkunde, vol. iii., p. 92.

from the time the trichinæ become free. The parasites increase in length and thickness, and, in the female, the uterus fills with fructified ova, which soon develop into embryos enclosed in the body of the female. Leuckart states that the female intestinal, or matured, parasite lives from five to six weeks, and produces at least fifteen hundred embryos. In the intestines of the animal invaded, the females greatly predominate over the male parasites.

The newly-born embryos are at first buried in the mucus which lines the intestinal tract, as free and movable parasites. They soon, however, begin their migration and dispersion, the first act being the penetration of the intestinal walls. It seems still to be a matter of discussion, as to the means or ways by which further migration takes place. Some authorities, and among them the most eminent, as Leuckart, Furstenberg, and Gerlach, favor the view that the parasites proceed by way of the mesenterium and connective-tissue tracts over the system, and penetrate the sarcolemma, or connective-tissue membrane of the muscular fibres, to lodge in the substance of the same. Here the parasite develops a capsule or bed of finely granulous character for itself, the sarcous elements of the fibres of the muscles becoming wasted, or used up, and their striation lost so far as the capsule of the parasite extends. The sarcolemma of the muscle fibres forms a thickened secondary capsule around the parasite.

Another view, the possibility of which is conceded in a minor degree by the above-named authorities, is that the parasites gain access to the circulation, and are transported over the system by the moving fluid, boring through the smaller vessels at convenience, and by this means gaining access to the muscular tissues. An enthusiastic defender of this theory is Dr. Thudichum, an English observer. Were the blood the principal path of dispersion, we ought to be able to find numerous examples of the embryonal parasite in the circulating fluid of living animals which have been subjected to feeding-experiments. This has not been the case, however.

Thus it is evident that the consumer of trichinous flesh provides the means for its own infection. While this is in general the manner by which infection takes place, it by no means excludes the possibility of the infection of an animal

by intestinal trichinæ which have passed from an already infected organism with its fæces. In this way an infected swine may infect others, or in fact give occasion to a secondary infection of itself, by rooting in the manure of its pen. In the same way swine may become infected from infected men when, as is too often the case, the out-houses for the family are placed over the piggery, or lead into it, or where the contents of the same are thrown into the piggery for the swine to work over. Thus we see the cycle of infection may frequently continue from swine to man, and from man to swine.

Trichinæ have been discovered in Germany, England, Scotland, Denmark, France, Italy, North America, and South America, Africa, India, Australia, Spain, Egypt, and Syria. They have been found infecting man, cats, rats, dogs, mice, foxes, badgers, wild-hogs, and, according to the "Gazette Medicale," a young hippopotamus which died the 10th of May, 1879, at Marseilles, France.

Trichiniasis among Swine.

Although the recorded observation of the calcified trichinæ in the muscles of man may be said to date back to about 1821 (without any knowledge of their nature, however), and although the capsule was described by Hilton in 1831, and the parasite by Paget and Owen a few years later, still it was not until 1847 that Leidy described similar formations in the flesh of swine; the connection between those of man and swine being unquestionably established by Zenker of Dresden in 1860. Previous to this discovery of Zenker, these parasites were looked upon chiefly as curiosities exciting the interest of naturalists. Their direful nature was soon, however, established beyond all question by numerous epidemics to be hereafter mentioned.

It is to German investigators that we must look almost entirely for any authoritative statistics with reference to the numerical percentage of infection with these parasites, not only in the human family, but among swine; for in no other country is there at present any thing approaching a systematic examination of pork; and even in Germany there is much room for improvement, as there is in this entire field, viz., *the relation of animal diseases to human health*

Dr. Petri of Rostock gives the following statistics[1] with reference to the swine slaughtered in that city for a number of years: —

In 1869 the number of swine examined was 5,457, trichinous, 1; in 1871, 6,520, trichinous, 2; in 1872, 6,555, trichinous, 0; in 1873, 6,441, trichinous, 3; in 1874, 6,731, trichinous, 2; in 1875, 7,222, trichinous, 5; in 1876, 7,165, trichinous, 0; in 1877, 7,562, trichinous, 2. Total examined, 53,653; trichinous, 15: infected, 1 in 3,543.

In 1872, 622 American sides were examined, and 12 were found trichinous.

For Brunswick, Dr. C. W. F. Uhde gives the following interesting figures: —

From April, 1871, to 1872, number of swine examined, 93,707, trichinous, 7; from April, 1872, to 1873, 92,605, trichinous, 19; from April, 1873, to 1874, 102,580, trichinous, 20; from April, 1874, to 1875, 105,484, trichinous, 8. Total number of swine examined, 394,376; trichinous, 54: infected, 1 in 7,303.

In Prussia, from April, 1865, to 1866, 49 trichinous swine were reported. In Brunswick, from 1864 to 1865, 17,865 swine were examined, and only 1 infected. In Blankenberg, from 1864 to 1865, 7,000 to 8,000 swine examined, and only 1 infected. In Hanover, from 1865 to 1866, 18,656 swine were examined, and 12 found infected; for the years 1867 and 1868, 40 trichinous swine were reported for each year. In Sachsen-Weimar, from March, 1868, to 1869, 19,611 swine were examined, and but 1 found trichinous. In 1872 and 1873, numerous American sides and hams were found infected at Frankfort. At Liegnitz, 26 American hams were examined, and 2 found infected. In 1873 and 1874, at Magdeburg, between 7,000 and 8,000 swine were examined, and but 2 found infected. At Stettin, Erfurt, and other places, American pork came in for its share of condemnation. In 1875 and 1876, at Frankfort, of 8,000 swine examined, 4 were found infected; at Geslen, of 1,800, 1 was found infected. In 1876 and 1877, at one place 110 swine were examined, and 10 found infected. At Minden, 59 pieces of

[1] Virchow's Archiv. für path. Anatomie, etc.; Vierteljahrsschrift für gerichtliche Medicin; Deutsche Zeitschrift für Thiermedicin; Veterinary Reports of Saxony; Magazin für Thierheilkunde, and its successor, Archiv. für Thierheilkunde, and Mittheilungen aus der Praxis im preussischen Staate.

American pork were found diseased. In Schleswig-Holstein, from 1865 to 1874, 24,690 swine were examined, and 68 found infected, — 1 in 348.

The later Prussian reports indicate that the authoritative examination of pork is becoming better organized and more systematically executed, giving the following statistics of Dr. Eulenberg for 1876 to 1877, in all Prussia: —

Number of swine examined in 1876, 1,728,595; trichinous, 800; infected American pork, 220; number of inspectors, 11,915. In 1877, number of swine examined, 2,057,252; trichinous, 701; infected American pork, 243; number of inspectors, 12,865. Total number of swine examined, 3,785,847; trichinous, 1,501. Ratio of infected, 1 in 2,522.

In 1875, at Charkow, Russia, 3,910 swine were examined, and 5 found infected. Of 210 pieces examined at Gothenburg, 8 were found infected.[1] At Elbing, two per cent of those examined were found trichinous. In Schleswig-Holstein, of 5,673 pieces examined, 47 were infected.

Examinations made in Germany in 1877 report 343 cases of infected American pork, and 183 cases of trichinosis among human beings. At Hamburg, in 1878, 297 American sides and 85 hams were found trichinous.

Statistics with reference to the percentage of infection with trichinæ among swine in England and France, as well as other Continental countries, are almost entirely wanting; at least, I have been unable to find any of value. German journals, however, are frequently enlivened with reports of the prevalence of these parasites in American pork.

Austria lays claim to a great immunity among her swine,[2] an explanation of which, it seems to me, must be sought in insufficient examination of slaughtered hogs. Professor Franz Mueller, of the Royal Veterinary Institute at Vienna, says that for years, neither in Vienna nor in its vicinity, has a single trichinous swine been found, notwithstanding investigation at the hands of experts, nor has a case of trichiniasis by man taken place.

On the 18th of February, 1879, a special meeting of the Royal and National Veterinary Association of Italy was held, to receive a communication from Signor Volanti, the muni-

[1] Heller, Ziemssen's Handbuch d. Pathologie, iii., p. 411.
[2] Oesterreich. Vierteljahrsschrift für Veterinärkunde, vol. 51, p. 176.

cipal veterinary surgeon of Turin. Volanti reported that trichinæ had been discovered in some American hams from Cincinnati, which had been sold at Turin, and that four per cent of the lot were infected. The association addressed a memoir to the Minister of the Interior with reference to a general measure towards organizing an efficient meat-inspection throughout the kingdom.[1]

The report of the Chicago Academy of Sciences gives, as the result of examinations instituted by them nine years ago among swine slaughtered at that place, that, of 1,394 examined, 28 were found infected. A recent examination,[2] instigated by Health-Commissioner De Wolf of Chicago, resulted in finding 8, of 100 swine examined, trichinous. A more detailed and laborious search among the medical journals of our own and other countries would doubtless greatly multiply these statistics.

The following interesting letter from the health-officer of Erie, Penn., shows how readily the disease may be overlooked without the careful scrutiny which he has exercised. Indeed, he says, in another note, that his finding trichinæ was for some time considered a hoax.

ERIE, PENN., Jan. 1, 1880.

DR. C. F. FOLSOM.

My dear Sir, — For six years I have examined, almost every day, pork, but could not tell the exact number of pigs examined. Since that time I am city physician and inspector of the market, &c. I had my office for eleven years just near the meat-market, which is held twice a week; and it was an amusement for me to look over a hundred farmers' teams, loaded with fresh meat. One day a butcher killed a very fine pig, in his estimate: he sold a fresh ham to a banker, who wanted me to look at it "just for fun." I put a small piece under the microscope, and found it full of trichinæ. It was a home-fed and corn-and-milk-fed pig. A German milkman killed four nice pigs, and had the meat examined: one of them was trichinous. A farmer D. sold two pigs to a Mr. K. He and the family of K. got very sick, and I found one of the pigs full of trichinæ. From a drove of Western pigs which were raised here I found several trichinous, and I think your estimate[3] is correct. I know only one case of death produced by trichinosis, — a young man nineteen years of age: others may have occurred under other names. Six years ago, at a German ball, smoked ham was served at midnight, and over a dozen people got very sick. Some blamed the beer and wine, but it was the

[1] Veterinary Journal, vol. ix., p. 286.

[2] Report of Chicago Board of Health, 1878.

[3] Somewhat less than the eight per cent observed in Chicago.

ham, full of trichinæ. In 1872 I observed two cases in Southern California: they were *rancheros*. In 1873 I found two families very sick in this city, and they recovered; also a tailor's family, who partook of the same meat. . . . From about twenty cases to my knowledge, all but one recovered, some only after a good deal of suffering.

Yours truly,
E. W. GERMER.

Dr. Germer adds, under date of Jan. 9, 1880, that he had recently examined a great many pigs without finding any trichinous. He reports a number of fatal cases in Warren, Penn., which occurred a few years ago, from frequently eating raw ham or sausages. One hundred and nine Western hogs were examined in Boston by Dr. Folsom, Dec. 24, 1879, with the result of finding none containing trichinæ.

At the request of the State Board of Health, Lunacy, and Charity, I have made an examination among swine slaughtered in the vicinity of Boston, extending over a period of five months. These examinations were not made upon any selected lots of swine, or upon those from any one place; but the pieces to be examined were collected at such days and times as I could find time and opportunity to examine them. The swine came from different parts of the country, mostly from the West, however. It is greatly to be regretted, that the exact place from which some of them came could not be ascertained, and exact examinations made as to their manner of feeding, surroundings, &c.; but such systematic work must await a future day, and abundant material support from the different State governments.

The following is the result of my examinations: —

LOT.	Number of Swine Examined.	Non-infected.	Infected.
1	47	44	3
2	48	46	2
3	72	62	10
4	60	56	4
5	226	210	16
6	192	179	13
7	100	96	4
8	81	80	1
9	95	94	1
10	93	89	4
11	98	90	8
12	300	275	25
13	201	188	13
14	192	187	5
15	200	184	16
16	257	252	5
17	238	225	13
18	163	154	9
19 [1]	26	25	1
20 [2]	12	11	1
Total	2,701	2,547	154

Percentage, 1 in 17.54.

I have also examined eighty-nine hogs' tongues, freshly pickled, with the result of finding three trichinous. The trichinæ in these tongues were found, upon careful microscopical examination, and application of heat, to be dead; but the tissues of the tongue are very loose, and more easily penetrated by the pickle than the more compact muscles.

According to the previously given statistics with reference to trichiniasis among swine, it is evident that there is an enormously greater percentage of trichina-infected swine in this country than in Germany, *if their statistics can be relied upon*. It should be remarked, however, that our investigations were made with very great thoroughness, and that those portions of the swine were examined in which trichinæ are most commonly found (see p. 27). It has been ascertained, too, in Germany, that the percentage of hogs reported trichinous is increasing in that country ("Deutsche Vierteljahrsschrift für öff. Gesundheitspflege," v. 638).

[1] Vermont hogs. [2] Swine killed for owners near Boston.

There is no doubt that the greater part of the swine which I examined were from the West; yet no one well acquainted with the circumstances would, I think, assert that the general hygienic conditions under which our Western swine are raised are not superior to those of the famed "home-fed porkers" of the small New-England farmer, raised, as they are in only too many instances, in dark, loathsome, poorly-ventilated pens, only too frequently under stables, with the house-vaults and sink-drains emptying into them.

Again, whoever has been upon a tour of observation among the agricultural districts of Germany must have been most forcibly struck with the absurd non-hygienic conditions under which not only hogs, but the majority of the domestic animals, are raised and surrounded, in comparison with those of our own country, especially of the great stock-raising West.

It is of the greatest importance to statistically establish, by means of a large number of exact examinations at the hands of competent and strictly honest observers, whether this great percentage of trichinæ-infected hogs is to be found among those fattened under the more unfavorable conditions offered by the large Western distilleries, in comparison with those offered by the open-air feeding, limited almost entirely to corn, of the Western farmer. The rigid inspection which has been begun, and is in the future to be still more rigidly executed; the numerous cases of infected American pork which are yearly being reported in Continental, especially German papers, and which are noticed in those of Great Britain; the too-numerous cases of disease among human beings traced to the same, — are gradually serving as an embargo, at least as a heavy import duty, which can but influence our foreign markets in this immense American agricultural product.[1] We have, then, as a nation, to discover why it is, that our Western swine, raised as they are under what appear to be more favorable hygienic conditions, are so much more infected with trichinæ than those of Germany, which are nearly all penned, and often given the contents of the out-house to root over.

[1] The census of 1870 gives the number of swine in the United States as 25,134,569.

It is well known that trichinæ have been found among the wild swine of Europe. It would be interesting to know the facts, in this regard, as to our own wild swine of the Southern and Western States, as well as the peccaries of Mexico and Central America.

The following[1] is given as an attempt at explaining the greater per cent of trichinæ among our swine: —

"The swine which are brought to the large slaughter-house are allowed to feed upon the refuse from slaughtered swine, and in this way have time and opportunity to infect themselves. Such infected swine are themselves slaughtered, and again infect those that may remain, or which may have arrived later. Accordingly this evil must go on constantly extending, and all persons must be earnestly warned against the consumption of raw American pork. By the so-called 'rapid smoking process,' practised in America, the trichinæ in the peripheral, or outside parts, of the hams, are doubtless killed, but those more deeply seated are not."

While the above assertion is absolutely false with reference to the large establishments, it is as strictly true, not only of many small ones where hogs are killed for home consumption, but also where they are kept, fattened, and killed by the farmer, or raiser, for the use of his family.

Dr. J. Meyer, sen., a very competent veterinarian at Cincinnati, writes under date of Oct. 16, 1879: —

"During the time that swine are quartered at the large regular packing-establishments, — which is generally from one to three days in the summer months, and one to six days in winter months, — they are fed upon corn and water exclusively. There are slaughter-houses, however, in which both cattle and swine are killed for the local trade, where the offal collected from the whole house is cast to the swine awaiting their doomed moment. This food is consumed in an uncooked state. The offal from the larger packing-houses is collected daily by the fertilizing-company, and transferred to their factory, where the fats are extracted by the aid of steam, the residue dried and made into fertilizing-material."

Dr. N. H. Paaren of Chicago writes under the same date: —

"No hogs are fed within many miles of the stockyards and packing or slaughtering establishments, except it be an occasional one kept by an Irish or German person and fed from the family kitchen. No part of the offal of the slaughtering-houses is used for feeding animals of any description."

[1] By Dr. O. Bollinger, professor in the Royal Veterinary Institute at Munich, in Deutsche Zeitschrift für Thiermedicin.

Dr. Bollinger's remarks continue as follows: —

"If we assume that one in ten thousand swine is infected, and from the refuse of the same two more become infected, the following geometric progression may take place: the first year, one swine trichinous; the second, two; the third, four; the fourth, eight; and so on, until in the course of fifteen years we have 16,384 swine infected from a single nucleus of infection. It is therefore right to warn the people against the consumption of American pork; and the microscopic examination of the same must in no case be neglected, as, in the American slaughter-houses, the breeding of trichinæ seems to be so regularly and thoroughly carried out, that no organized attempt could be hoped to equal it."

With reference to the disease itself among swine, I have taken the following from the "Magazin für die gesammte Thierheilkunde," xxxi. 6; being a report written by Professor Mueller of the Royal Veterinary Institute at Berlin, with reference to the results of a long-continued series of feeding-experiments with trichinous pork upon swine themselves. These experiments have demonstrated the fact that the consumption of trichinous flesh by swine, with the consequent development of the embryos in their intestines, and their migration and lodgement in the muscles, may indeed cause disease, but the symptoms of the same have neither that constancy nor character which will admit of their being considered as peculiar to this disease alone, during the life of swine so infected. All the swine which were fed with the trichinous flesh became ill within a few days after its consumption. The most constant phenomena presented were as follows: diarrhœa, not constant, but interrupted frequently by the passage of more solid fæces; appetite irregular, sometimes more, sometimes less, sometimes entirely wanting; indications of abdominal pains; turgidity of the lining membrane of the eyelids.

These symptoms, either singly or collectively, may appear in swine, or any other animal, entirely aside from any trichina-infection: most of them are simply evidence of the irritation caused by the parasites in the intestinal canal. Hence swine dying or killed at this stage of the invasion would present the same pathological phenomena as those suffering from an intestinal catarrh of like grade. As the migration of the embryonal trichinæ gradually ceases, so do these abdominal phenomena relax in their severity, and finally dis-

appear, unless a second invasion takes place. The invasion of the several muscular systems is indicated by pain, swelling, and disturbance of the motor functions. If these do not lead to death by exhaustion, they in their turn gradually cease with the encapsuling of the trichinæ.

The experiments of Professor Leisering, of the Royal Veterinary Institute at Dresden, entirely agree with the above. He says ("Bericht ueber das Veterinär-Wesen im Königreich Sachsen" 1862, p. 118), "One cannot speak of a trichina-disease in swine, which is characterized by distinct and pathognomonic phenomena. In this relation, the trichinæ deport themselves in a manner similar to the cysticerci (measles)." Leisering made some feeding-experiments with trichinous flesh by a horse, but the most exact examinations failed in discovering a single parasite in his flesh. It may also be casually remarked that fowls present some unknown hinderance to an invasion of their flesh by embryonal trichinæ. I made quite a number of experiments with hens, feeding them for two weeks almost entirely upon pork profusely infected, but was unable to find a single trichina in their flesh.

How do swine become infected under the natural order of things? or, in other words, whence do they derive the trichinæ? That the parasites gain access to an organism by means of the mouth and alimentary canal, is placed beyond all doubt. Notwithstanding the apparent negation of the above-quoted Berlin experiments, other authorities affirm, from positive observation, that intestinal and embryonal trichinæ do leave the invaded animal with the fæces, as is attested to by such observers as Leuckart, Vogel, Kuhn, Gerlach, and others. It is this form of migration, which under favorable circumstances also contributes to the distribution of the trichinæ. In fact, Haubner and Gerlach mention cases where they intentionally caused infection of young non-infected swine, by placing them with those known to be infected. Such embryos and pregnant females become mixed with the manure and bedding of the hog-pen, and may be taken up by any swine, even by those first invaded, thereby leading to a second infection, self-induced.

Is there no other factor in the question? We have previously remarked that wild swine have been found in-

fected with trichinæ, also cats, dogs, foxes, and other wild animals. Dr. Clendemin of Ostend examined a pike[1] caught in the North Sea, and found its flesh infested with trichinæ. He conjectured that the fish must have fed from trichinæ-infected refuse in the harbor of Ostend, and by this means have become infected. But, of all animals in which these parasites have been found, none have that interest to the hygienist and experimental pathologist which is enjoyed by the rat, on account of a hypothetical ætiological connection between the trichinæ which have been found to infest them in large numbers, and those of swine. Leisering is the originator of this hypothesis.

The following figures sufficiently prove that the rat lodges trichinæ in its flesh, even to a greater extent than any other animal which has as yet been subjected to examination. Of 704 rats from different parts of Germany, which have been subjected to examination, 59 were found trichinous, 8.3 per cent; of 208 rats from German Knackers, 46 found trichinous, 22.1 per cent; of 224 rats from slaughter-houses, 12 found trichinous, 5.4 per cent; of 272 rats from other places, 1 found trichinous, 0.4 per cent; of 326 rats from other places, 39 found trichinous, 12 per cent.

Of 51 rats caught at the Knacker establishment at Spectacle Island, Boston Harbor, 39 were found by myself to be trichinous, the tongues having been used for examination. The proprietors of this establishment kindly gave me an opportunity of examining 28 hogs which had been kept and fattened by them at the island in question. *None were found trichinous. These hogs received no city swill of any kind. What flesh they received had been subjected to the heat necessary to extract the fats; otherwise they received nothing but corn-meal.*

Forty rats caught at one of the large pork-packing houses near Boston were all found trichinous. Of 60 rats caught for me at different stables in the city of Boston, where no hogs were or had been kept, but six were found trichinous.

The results of these examinations are sufficient to strengthen my scepticism with regard to the rat-infection theory, and seem to indicate that the rats get the disease from eating pork, or from the swine, and not the swine from the rats.

[1] Archiv. für Thierheilkunde, Berlin, vol. v., p. 447.

If this is true, we are no nearer solving the question as to how swine become infected, than we were before the trichinæ were found in rats. Some hog-keepers say that they have seen swine hunt and kill rats, while others assert that such a thing never takes place; but they all admit that a hungry hog would undoubtedly eat a rat if it had it. Admitting that hogs may become infected from eating a trichinous rat, we have still before us the questions, —

1. Is this the only source from which swine become infected? 2. Is there no common source from which not only they, but wild animals, especially *omnivora* and *carnivora*, may become infected?

As American pork, and, according to my observations, American rats, are much more infected than similar animals in Germany, it seems as if here in America were the place to decide these important questions.

The Microscopic Examination of Pork.

Numerous elaborate essays have been written upon this subject, but the entire process is so easy and simple that such extended labor can well be looked upon as useless. Almost the first, and at the same time by far the most profusely infested muscles, are the so-called "pillars of the diaphragm." The same are to be always found, as two small stumps of flesh immediately above the kidneys in the dressed hog, when hung up to "cool out." If there is a single trichina in the organism, it is probably to be found there. These pieces belong to the trimmings, and are always to be had without in the least disturbing the appearance of the hog.

As nearly all our hogs are killed young, i.e., about a year old, it is seldom that one meets the capsules of the trichinæ in a calcified condition. Hence they are generally invisible to the naked eye. Of the twenty-seven hundred swine which I examined, none contained calcified capsules.

Although a power of fifteen to twenty diameters is sufficient to demonstrate the parasites to the proficient observer, still it is much better to use a power of fifty to seventy-five diameters. Good microscopes for such a purpose are to be had from American makers for from fifteen to twenty dollars. If the stand were fixed, they could be shorter and far more suitable for such purposes. A large table to the microscope

is of advantage for such examinations. Further, a few slides or object-glasses, some strong covering glasses, a pair of small curved scissors, and two teasing needles will complete the outfit.

The next step is, to take the piece of muscle to be examined, and, if at all dried, to make a fresh cut into its substance, then with the curved scissors cut one, two, or three thin slices lengthways to the fibres, i.e., with them, and with a needle place them upon the object-glass a little distance apart; the covering glass is then placed upon them, and gently pressed with a slight rolling motion in one direction and back if necessary. This will make the sections thin enough for examination. The free trichinæ, as shown in figure No. 5, are seldom found in swine, as they are not often examined after a fresh invasion.

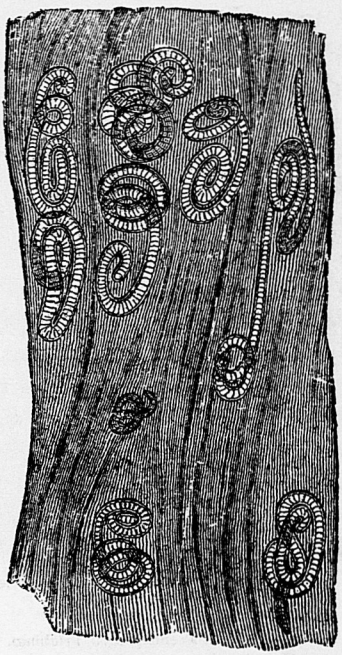

Fig. 5. Fresh Trichinous Invasion. (Heller.)

To determine if the trichinæ still live, place the object-glass over heat, a spirit-lamp, a second, and then place again upon the microscope, and they will be frequently seen coiling themselves in their capsules. It is better, however, to finely tease out the preparation first, when individuals will frequently become freed from their capsules, and their movements can be better observed by the application of heat. Salted pork is best examined by taking the cuts from the scissors, and soaking them in fresh water for a second or so before placing upon the slide. They press out much easier and thinner, when such a procedure is resorted to.

Objects which may be mistaken for Trichinæ or not recognized as Such.

There are some possible sources of mistake in examining for trichinæ, as indicated below, but which can readily be

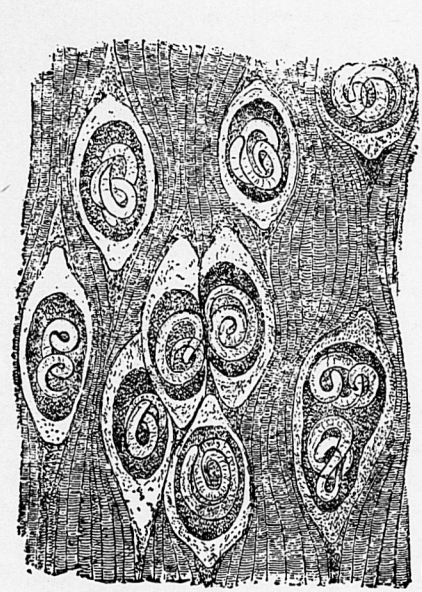

Fig. 6. Normal encapsuled Trichinæ. (Leuckart.)

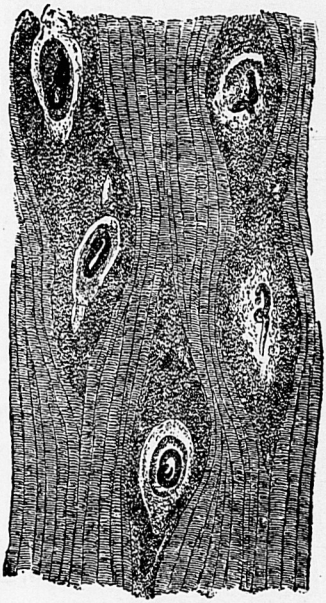

Fig. 7. Pathologically changed Trichina-capsules. Trichinæ dead. (Leuckart.)

avoided with care. It not unfrequently happens that the capsules of the parasites formed by the sarcolemma, or embracing membrane of the muscle-fibres, become abnormally thickened, the trichinæ being dead within them. These capsules do not present exactly the same appearance as under normal circumstances, as may be seen by comparing Figs. 6 and 7.

In other cases the calcification is of such a character as to almost entirely change the appearance of the capsules and contents. (See Figs. 8 and 9.)

In some cases *cysticerci* (measles) perish and become calcified; but these formations are very much larger than those of trichinæ, and are often filled with a caseous mass. The "sacks of Rainey," or, as they are sometimes called, "psoro-

spermia," are elongated bodies, like the trichinæ, situated within the sarcolemma, the true nature and pathological

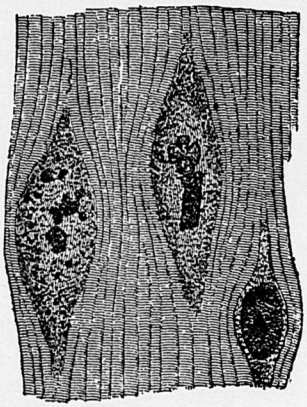

FIG. 8. Encapsuled concretions with dead Trichinæ. (Leuckart.)

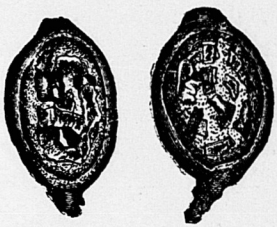

FIG. 9. Trichina-capsules, with calcified and disintegrated capsules. (Leuckart.)

importance of which are not yet well determined. Some of the points distinguishing them from trichinæ are, that by the latter the striation of the muscle-fibre, or better the plasma, sarcous elements, is destroyed within that part of the sarcolemma which is included in the capsule of the trichina: by the psorosperms, however, it is retained, and only displaced by the object itself, limiting it on each side, and continuing directly from its poles. Bruch, Virchow, and Leuckart have described peculiar roundish or oval masses of a whitish color, of variable dimensions, which occasionally appear in the flesh of hams. The same have been microscopically demonstrated to consist of agglomerates of needle-like crystals. They fill the muscle-fibres to a variable degree, without otherwise disturbing its structure, and disappear upon treatment with muriatic acid,

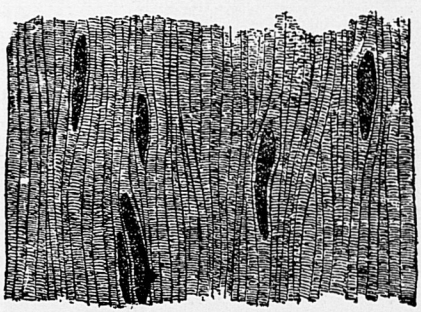

FIG. 10. Psorosperms in muscle of swine. (Leuckart.)

the normal transverse striation again becoming apparent. Figs. 10 and 11 will give an idea of these objects.

Trichinæ in Man.

It has been previously stated, that for some thirty years subsequent to the first description of the capsule by Hilton, and some twenty-five years after the identification of the parasite itself in man, the same were looked upon as mere harmless curiosities, and, that, although Leidy discovered the parasite in the flesh of swine in 1847, still it was not until 1860 that the connection was established between them, appearing, as they had, in two totally different species (men and swine). The honor of this important discovery belongs to Dr. Zenker of Dresden, Germany. The disease was discovered in a servant-girl admitted as a typhus patient to the City Hospital in Dresden. She died, and her flesh was found to be completely infested with trichinæ. At the same time that she became ill, other persons of the same family, and a butcher who had slaughtered a pig for them, were taken sick also; similar phenomena, but in a modified form, appearing in their case. An examination of the pork at the house revealed the presence of numerous trichinæ in its fleshy portions.

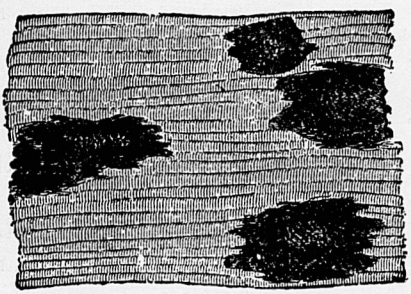

Fig. 11. Deposit of Tyrosin crystals in ham. (Leuckart.)

Dr. Thudichum (Seventh Report Med. Off. Privy Council, London, 1865) sums up the principal phenomena of trichiniasis in man as follows: "Sudden swelling of the face, particularly the eyelids, after the patient has for some days felt prostrate, and lost his appetite (this swelling causes a feeling of tension, but no pain); fever, with a quick pulse and copious perspirations, which not rarely have a repugnant odor; painfulness and immobility of arms and legs; the muscles are swelled and contracted, and give great pain when set in motion by the will or touched from without; in the worst

cases, the entire body is perfectly immovable and highly sensitive; there is gastro-intestinal catarrh (diarrhœa) with a red, somewhat covered tongue, inclining to dryness; when the swelling of the face has subsided, œdema of the feet, legs, and thighs comes on; shortly afterwards, anasarca, swelling over the trunk, makes its appearance."

From the time of the above-mentioned case of Zenker's, numerous others have been observed in different countries; and even epidemics of the disease have been reported, namely, at Corback 1860, Plauen 1861–2, Calbe 1862, Hettstadt 1862–3, Hanover 1864, Dessau 1864, and at numerous other places in Germany. The most remarkable outbreak was, however, at Hedersleben, a place of some two thousand inhabitants, of whom three hundred and thirty-seven were sick at one time, and one hundred and one died of trichiniasis.

Cobbold communicated to Heller, that the first authentic case of this disease, observed in man during life in England, was in 1871. Several most interesting examples of the discovery of the parasite in the muscles of living persons have been recorded in the annals of medicine. We have already alluded to the case of a woman suffering from cancer of the breast, trichinæ being found in portions of it on its removal (p. 30). The case of a stout and apparently healthy man entering a hospital at Calcutta with a tumor on his neck, and the subsequent discovery of trichinæ in the tissues of the same, is reported in "The Boston Medical and Surgical Journal," vol. 72, p. 167. Langenbeck of Berlin also removed a tumor in which the parasites were discovered. Professor Fitz of the Harvard Medical School lately reported to me a similar case, and remarked, that these parasites are probably more frequent in human beings in Massachusetts than is supposed.

Forty persons became diseased at one time at Bremen, from eating trichinous American pork. At Lissa five members of one family became infected from eating of a ham, which, it was said, had been pickled, then smoked, and boiled for two hours.[1] A poor woman became infected from the consumption of dog-meat, to which her necessities had driven her for nourishment.[2] At Linden, a suburb of Hanover, four

[1] Boston Med. & Surg. Jour., vol. 90, p. 491. [2] Ibid., vol. 91, p. 471.

hundred persons were infected at one time, and twenty-one died, from eating trichinous pork.[1]

Dr. Kiefer of Detroit reports a fatal case of this disease, the patient dying at the end of the fourth week: he also refers to cases reported by Dr. Kronpein of New-York State, and Dr. Dingler of Ohio. Dr. Asa Herr of Dubuque, Io., reports fifteen cases and five deaths, from eating raw smoked ham made into sausages. Several cases are also reported as occurring in Philadelphia.[2] (American Journal of the Medical Sciences for 1869, p. 565; 1870, p. 283; and 1878, p. 434.)

Dr. Sutton of Aurora, Ind., reports nine cases of trichiniasis, three of which ended fatally.[3] All of the persons had eaten uncooked smoked sausages from a pig, the flesh of which had never been examined: the sausages were found full of trichinæ.

The resemblance of the symptoms, both in the fatal and milder forms, to those of simple inflammation of the intestines, is of great moment in considering the disease in man.

The following is taken from "The Veterinary Journal," vol. ix. p. 212, but originally appeared in "The Rochester Democrat," N.Y., May 1, 1879: "Another case of trichiniasis has appeared in the vicinity of Rochester, *death* resulting from the disease. . . . The disease appeared mysterious, and baffled all remedies administered. A sister of the woman was also taken sick with symptoms somewhat similar in nature. The physician, though unacquainted with the disease, made up his mind that the patient was suffering from trichiniasis. The investigation of a portion of the muscle, removed after death, demonstrated the presence of numerous trichinæ in its fibres." Cases in Michigan, at Otsego, Detroit, and Port Huron, are recorded in the Reports of the Board of Health of that State for 1875 and 1877. Of the Port Huron cases, a mother and father in one family died.

"In Saxony,[4] from 1860 to 1875, thirty-nine outbreaks of trichiniasis have taken place. The whole number of persons diseased, reported to the officials, was 1,267; of these 19 died, or 1.5 per cent. In a proportionally small number of

[1] Boston Medical and Surgical Jour., vol. xci., p. 627.
[2] Ibid., vol. lxxiv., pp. 208, 582. [3] Lancet, vol. ii., p. 24, 1875.
[4] H. Reinard, Archiv. d. Heilkunde, 18 Jahrg. p. 241. 1877.

cases, the infection took place from eating raw pork; in most cases, however, *Knackwurst* and *Bratwurst* were the causes. The sausages are made from raw chopped meat, and smoked for one to two days, and eaten either cold or slightly fried. Of the 19 persons who died, 3 (of 8) were infected from raw meat, 2 (from 630 infected) from cold hacked sausage, 8 (from 340 diseased) from *Bratwurst* (fried sausage), and 2 (of 48) from ham: with reference to the other 4 there is no information. Of the 6,959,964 swine, which were slaughtered in Saxony during these 16 years, only 39, or 1 in 178,462, caused trichiniasis in man."

Table showing the Observed Cases of Human Trichiniasis in Bavaria.[1]

Number.	Place.	Year.	No. of Cases.	Author.	Where described.	Nature of Flesh eaten.
1	Würzburg	1853,	2	Virchow	Archiv., vol. 81, 1853,	Fresh raw meat.
2	Würzburg	1861,	1	Kölliker	Würz. Med. Zeit., vol. ii., p. 12, 1861	
3	Erlangen	1870,	8	Maurer	D. Archiv. Klin. Med., vol. 8, p. 368	
4	Erlangen	–	1	Zenker.	D. Archiv. Klin. Med., vol. 8, p. 388	
5	Zweibrücken	1870–71,	1	Friederick	D. Archiv. Klin. Med., vol. 9, p. 459	Swine from Baden.
6	Speyer	1873,	5	David	Communicated to Dr. Göring	
7	Hof	1878,	6	Roth	Ref. Aerztl. Kammer von Oberfranken	Home-made pork.
8	Bamberg	Feb. 1878,	30[2]	Roth	Ref. Aerztl. Kammer von Oberfranken	Raw home-made ham.
9	Nürnberg	May, '78,	10	Merkel.	Ref. Aerztl. Kammer von Oberfranken	Salted pork.
10		June, '78,	3			
11	Freuchtbingen	June, '78,	4	Merkel.	Ref. Aerztl. Kammer von Oberfranken	Spiced pork.
12	Marktleuten	July, '78,	19	Roth	Polizeiliche Zeitung.	
13	Burgsinn	1879,	7[3]	Roth	Polizeiliche Zeitung.	

It is much to be regretted that the statistics of our medical schools and hospitals do not give us the exact number of cases where trichinæ have been found at autopsies of human beings. Dr. Bowditch reported three cases in "The Boston Medical and Surgical Journal" of 1842–44. Turner says of Scotland, that in five years one to two per cent of the human bodies were found trichinous. Fiedler found in Dresden 2 to 2.5 per cent to be in the same condition. Wagner in Leipzig reports one to every thirty or forty as infected. Virchow reports them as quite frequently met with. Zenker

[1] Bollinger, Zeitschrift für Thiermedicin, Bd. 5, Heft. 3 and 4, p. 204.
[2] One died. [3] Three died.

reports 1.79 per cent for autopsies seen at Dresden by him. Reports of like nature come from Italy, Russia, Sweden, and other countries.

Prevention.

1. The examination of slaughtered pigs by competent persons.

2. All pens and places for keeping hogs should be definitely regulated with reference to situation, contents, cleanliness, &c.

3. All sick hogs should be properly isolated from healthy ones, under the supervision of sanitary inspectors.

4. State boards of health should seek to educate the people in a knowledge of the subject.

5. As it has been demonstrated by my examination of the rats and hogs from the Knacker establishment at Spectacle Island, Boston Harbor, that while the former were nearly all trichinous, — thirty-nine out of fifty-one, — twenty-eight hogs were entirely free from trichinæ; as they receive neither city swill nor uncooked meat, it is indicated that these two questions can be very well studied at such places, and that, at very little cost to the State, valuable experiments can be made.

6. Boards of health should instigate exact researches into the hygienic conditions under which swine are reared; and no means should be spared in the endeavor to discover the real source from which swine obtain these parasites.

7. There should be continued examinations of rats in different parts of the country, at piggeries, and at places where no hogs are, or have been kept, until this rat theory of infection is absolutely settled.

8. No contents of water-closets, out-houses for human beings, or drainage from house-sinks, should be allowed to enter hog-pens, on penalty of the law.[1]

9. Feeding the offal from slaughtered swine to other swine, cooked or uncooked, or having slaughter-houses over places where swine are kept, should be forbidden by law.

10. Competently educated veterinary inspectors should be appointed by the State boards of health of each State, after

[1] Zenker reports a case where twenty-three swine were infected with trichinæ from consuming the drainage of a sink from a castle.

having passed a special examination in the principles of preventive medicine, to see that these various regulations, and others, with reference to other diseases, as well as contagio-infectious diseases strictly limited to animals, are strictly attended to.

Leuckart's and other experiments have shown that a temperature of 140° F. is necessary to securely render trichinæ inert. Direct heat applied to the slides holding specimens of trichinous pork, by means of the Schultz heating-table, has demonstrated, under the microscope, that a temperature of 50° C. (122° F.) is necessary to the certain death of the trichinæ.

Leisering's experiments with trichinous pork, made up into sausage-meat and cooked twenty minutes, gave positive results when fed to one rabbit, and negative by another. He sums up his experiments as follows: —

1. Trichinæ are killed by long-continued salting of infected meat, and also by subjecting the same for twenty-four hours to the action of smoke in a heated chamber.

2. They are not killed by means of *cold* smoking for a period of three days, and it also appears that twenty minutes cooking of freshly prepared sausage-meat is insufficient to kill them in all cases.

The various kinds of cooking, however, are quite different in their effects on trichinous pork. Frying and broiling are most efficient, roasting coming next. Boiling coagulates the albumen on the outer surface, and allows the heat to penetrate less readily; it should be kept up therefore for at least two hours for large pieces of meat. Whether boiled, broiled, or fried, pork should always be thoroughly cooked.

Practically speaking, the cooking, salting, and hot smoking which pork in its various forms receives in the United States must be in the vast majority of cases sufficient to kill the trichinæ, and prevent infection of the persons consuming the meat. Epidemics like those reported in Germany are unknown here, and trichiniasis in a fatal form is undoubtedly a rare disease. In the vicinity of the great pork-packing establishments near Boston, the "spare-ribs," containing the intercostal muscles, are very largely bought and eaten by the people near by; and trichiniasis among them has not in a

single case been reported, so far as I have been able to learn. The *cuts* being thin and well cooked, any trichinæ in them are quite certain to be killed. Even when trichinæ are introduced into the intestinal canal, too, they are sometimes expelled by diarrhœa, and the invasion of the system by a small number does no harm.

In this connection it seems not inappropriate for me to suggest that a most useful adjunct to the Health Department of Massachusetts would be an experiment station, situated within a convenient distance of Boston, probably in its suburbs, fitted up with a stable and suitable laboratories for pathological and chemical investigations. Such a station should not be a transient, but a permanent, attachment to the Board.