THE REPORT OF THREE CASES IN WHICH EMBRYOS OF THE STRONGYLOIDES INTESTINALIS WERE FOUND IN THE STOOL.—AUTOPSY OF ONE CASE.

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Two of the following three cases were patients in the wards of the Medical Department of the University of California in the service of Dr. Kerr. The cases are reported because of the interest in this subject aroused by the discovery of a case of the kind at the Johns Hopkins Hospital by Dr. Richard Strong, and two additional cases studied and reported in full with a history of the parasite and its pathological significance by Dr. William Thayer of Johns Hopkins. The subject has a further interest, for in addition to the fact that one of these patients was an American who probably contracted the trouble in this country, the two others were natives of Porto Rico, and were among a number of laborers who passed through this country on the way to the Hawaiian Islands, and one of them had been in the Hawaiian Islands and was returning. The commonness of the trouble in Porto Rico has been called attention to by the army medical corps. The absence of any serious symptoms even in the severest of my cases is a matter of some interest, but the extent to which the infection may spread in districts where the water supply is not the best suggests the need of considering this infection seriously. It is not at all certain that these parasites that bury their heads deep in the mucous membrane of the intestine, to which class the *trichocephalus hominis* also belongs, are as harmless as we have been led to believe. The finding of the *strongyloides* adult worms with the heads buried deep in the mucous membrane suggests the fact that they are true parasites of the host, and not a class that subsist upon the contents of the bowel. Complication of two of my cases with *uncinariasis* is interesting because of the supposed severity of the anemia which occurs with this disease. The cases are reported as follows:

CASE I.—V. M., aged eighteen. Porto Rico. Laborer. Entered City and County Hospital, Nov. 25, 1902.

Family history negative.

No alcohol. Smokes moderately. No genito-urinary history. Seven years ago in Porto Rico suffered from a fever from which he claims never to have recovered, but felt fairly well until taken with a chill a few days ago. Accompanying it were headache and general condition of prostration. Patient felt as though he must have the same fever he had in Porto Rico. He has no appetite. Pain in the right side of abdomen. No vomiting, bowels have been rather loose for some months but particularly in the last month.

Chest negative. Liver from the lower border of the fourth rib to 3 cm. below the costal margin. Spleen not enlarged. Tenderness all over the right abdomen on deep pressure not very severe except in the right mammary line below the border of the liver.

Blood examination: No plasmodia found; hemoglobin 76%; white corpuscles, 7,600; polymorphous, 67; large mononuclears, 9; small, 14; eosinophiles, 10%. Feces contained a number of larvae of the *strongyloides* intestinalis, ova of *trichocephalus hominis*, also some large oval eggs with a clear shell and a clear space inside the shell, the center being occupied by a granular mass or by what appears to be the divisions of this mass into from two to twenty cells. The character of the eggs is not definitely determined, but they are supposed to be *uncinaria*.

Patient discharged once from the hospital, but re-

turned four days later, feeling again very badly. Thymol in two doses, 2 gm. each, were given to remove the parasites if possible.

The result of the thymol was disappointing, for a search of the feces showed no adult *uncinaria* or *strongyloides*. Cultivation of the feces, however, enabled us to differentiate between the larvae of the *strongyloides* intestinalis and the *uncinaria*.

CASE II.—E. G., thirty years. Native of Porto Rico. Laborer. Complaints of vague pains throughout the body. No change in appetite. No diarrhea. No particular symptoms referable to stomach.

Leucocytes, 7,000; eosinophiles, 5%; hemoglobin, 95. Stools show large number of *strongyloides* larvae; *trichocephalus* eggs and eggs resembling *uncinaria*, from which, however, no typical larvae developed. He was a friend of case V. M., and a stool was obtained from him during one of his visits to the hospital.

CASE III.—J. P. W., age sixty-five. Pastry cook. Resident of San José, Cal. Born in Tennessee. Lived in California from 1851 to 1861, and continuously since 1868. Was in Mexico and South America in 1861, while serving on a United States warship. Got ashore on passes, and for a day or two only, about nine days in whole cruise. During Civil War he served in the army for two years, principally in Maryland and Virginia. Lived in Philadelphia three or four years just after that.

Had typhoid and malaria while a boy in Tennessee. Was very well in California except for "bilious headaches," which he has had from early boyhood. Constipated when young, more so now. Appetite generally very good. Nausea and vomiting with headaches. Never sick, except with present trouble, since he came to California. For six or eight months before this he had felt better than for many years. Bowels pretty regular. Two weeks ago had sudden nausea with vomiting. Nausea continued with less vomiting each day for four days. Vomitus was bitter and yellow, and it relieved him to get it up. No diarrhea, fever or chills. Cramps in various parts of the body when he moved. Relieved by moving about. This was only for first three days and was worse at night. Was conscious of some fever. No night sweats or cough. No history of jaundice. During bilious attacks he has had some pain in abdomen after he has vomited for a long time. Once or twice vomited a black material. No blood or coffee grounds. Never has had pains in limbs or fever before with bilious attacks.

Jan. 26, 1903, the blood showed the following condition: Red cells, 3,882,000; hemoglobin, 65%; white cells, 9,400; polymorphonuclears, 71½%; large lymphocytes, 12½%; small lymphocytes, 9½%; eosinophiles, 64%. Urine.

On account of the eosinophilia, and because stools are being examined as a matter of routine, an examination was made in this case. The single defecation was copious, dark brown in color and formed. No mucus was apparent, and the general appearance was unsuggested. Particles of fecal matter removed indiscriminately from the mass showed dozens of embryos of the *strongyloides* intestinalis in every specimen, and often as many as ten or twenty in the field of a five objective Leitz. The embryos were practically all actively motile, and about the same stage of development. No adult worms were found and no eggs. Nor were they ever found, although searched for many hours on various occasions, frequently immediately after the passage of stools following drastic purging. Thymol administered in two 30 gr. doses followed by oil seemed to have no effect on the number of embryos nor did it long affect the motility of them. For some hours after the stools were passed most of the embryos were motionless, but later a good many of them regained their normal activity. Cultivation of the stools in a constant temperature oven at 37° resulted in the development of maturer stages of the larvae, but after three or four days they all died.

An attack of pneumonia occurred while the parasite was being studied, and the patient died. An autopsy was done at the earliest possible moment.

Autopsy of J. P. W., 18th Feb., 1903.

Patient died at 9 P.M., Feb. 17, of pneumonia of five days standing. Autopsy fifteen hours postmortem, rigor mortis present. No distension of the abdomen. No external conditions of note.

Left pleural cavity filled with a fibrinous clot, slightly adherent both to the lung and the chest wall, which was very much inflamed and rough. The clot peeled off rather easily, leaving both pleural surfaces very slightly roughened. The left lower lobe was solid, contained no air. Dark red on section. The left upper lobe extremely edematous. Frothy fluid flowing freely from the cut surfaces. Few adhesions at the left apex. Right lung presents almost similar condition, except that there was no consolidation of the lower lobe, although but small amount of air was to be forced from the cut surface. The diaphragmatic surface presented the same yellow clot that the left lung showed. In addition to this there was considerable quantity of purulent material well walled off, about $1\frac{1}{2}$ oz. in all. This was broken into when the lung was separated from the diaphragm. There were firm adhesions between the pleural surfaces all over the anterior and axillary parts of the lung. Tubercular scar at the right apex.

Enlarged glands behind the aortic arch. Turbid fluid in the pericardium; small amount. Thick-walled left ventricle. Valves clear throughout. Muscle pale and brownish.

Abdominal cavity contained about 100 cc. of turbid yellowish fluid, and the right side of the abdomen particularly showed the intestines pretty well matted together by a purulent substance, and in the vicinity of the appendix were some old adhesions. The intestines were very red and the veins very much distended.

The mesenteric glands were not particularly enlarged.

The liver presented nothing abnormal on cut surface.

The gall bladder was distended with semi-fluid bile. The ducts were patent.

The spleen was double the natural size, and very soft. Readily torn in being moved.

Both kidneys were small, with quite adherent capsules, and on cut surface presented cloudy swelling of the cortex, and rather a pale appearance. There were a few pearl gray nodules scattered irregularly throughout the cortex about a pin head in size.

Pancreas apparently normal. Size of the stomach was normal, and externally presented no unusual signs. No evidence of any fresh infection from the appendix.

The diaphragmatic surface of the liver did not show extension of the process from the abscess of the pleura above.

The stomach and intestines were removed *en masse*, first having been tied off at intervals of about 2 feet and at the important anatomical points along the course, to facilitate the examination as to distribution of the parasites. The mucous membrane of the stomach was thickened, and an excessive quantity of adherent mucus lined it throughout. The reaction of the mucus was acid, as was also that of the upper part of the duodenum. No parasites or eggs were found anywhere in the stomach, but immediately below the pylorus, within $\frac{1}{4}$ inch of the stomach, where the contents were still acid, were found the parent worms of the *strongyloides intestinalis*, large quantities of embryos and eggs, not alone in the intestinal contents, but deeply embedded beneath the coat of mucus which lined the entire gastro-intestinal tract. The eggs were found particularly abundant in the deeper layers, and often apparently embedded in the mucous lining, so that removing the mucus and later scraping the lining, gave the best specimens of eggs that were found at all. It was noted also that as far down as the ileocecal valve, parent worms, eggs and embryos were found closely adherent to the mucous membrane. As the examination proceeded from the duodenum, a greater number of embryos appeared to be found in the intestinal contents, and while the duodenum and jejunum showed everywhere apparently the same extent of distribution of parasites, below this point the embryos were found in greater numbers in the intestinal contents. A single field of a Leitz microscope, number four eyepiece, number six objective, showed from ten to forty or fifty of the embryos. Parent worms were found as low down as the beginning of the ascending colon, but no eggs were found in the colon, although they were found at the lower end of the ileum. Larvæ were found in the proximal end of the appendix, but none were found in the bile or the gall duct or pancreatic duct. In the upper part of the intestinal tract one to three parent worms were found

on every coverslip. Lower down it required often the search of two or three coverslips to show a single one.

An examination of sections removed from the duodenum and hardened in formalin showed an extensive disintegration of the structural layers of the mucous membrane due to postmortem change. There was no inflammatory process in the mucous layer at all, with the single exception of the appearance of a considerable number of eosinophiles immediately around certain of the worms which were buried deep down in the mucous membrane. Neither eggs nor worms were found in the muscularis mucosa, but both were found in considerable numbers in the crypts of Lieberkuhn, the parasites often projecting into the interstitial tissue, having apparently burrowed horizontally through the layers of cells. In the accompanying photographic illustrations, the relation of the eggs and parasites to the layers of mucous membrane are shown. The worms are not always straight, but appear in a number of cases to be curled up and occupying the Lieberkuhn crypts. The division of the nucleus of the eggs is shown in a few of the sections of eggs, but this division was not seen in any eggs found in the intestinal contents.

The adult parasites that were found were all of exactly the same type and represent what I take to be parthenogenetic mother worms. No adult males were found at any time. Nor were we able to cultivate them from the feces during life or from what was removed from the intestinal tract at autopsy. The direct transformation of the radiiform embryos to filariform larvæ was the only change noted, and in spite of various means employed, these larvæ generally died on the fourth or fifth day. This transformation seems to be apparently the rule, as Leichtenstern has pointed out. This observer studied a small number of cases through many years, and points out that other forms of development do occur, but not as constantly or regularly as the direct change. The whole subject of the method of development has been gone over so well and so interestingly in the article already mentioned by Dr. Thayer,¹ that I would refer any one interested in it and for illustrations of the eggs, embryos and larvæ to that article.

As regards the symptoms produced by this parasite, two of these cases were of no avail as pictures of the trouble, because of the complication with *uncinaria* infection. But it is notable that even in these cases the diarrhea was either absent or extremely slight. In the uncomplicated case there never was at any time any history of diarrhea, although the case was certainly a severe one. And there could scarcely be said to be a severe anemia. As Nourmand in 1877 described the disease, there appeared to be mild dyspeptic symptoms, loss of appetite, pasty, frequent stools, showing sometimes mucus and blood, and in extreme cases being choleraic in character. Nourmand calls attention to the absence of any severe anemia. Thayer and Strong's cases showed a chronic diarrhea constantly, but one was complicated by amebic dysentery. One of his cases also showed a marked secondary anemia, although the hemoglobin was 57%. The absence of eosinophilia was noted in one of his cases,

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in which particular it differed from mine. The presence of the eosinophilia in some degree has been a strikingly constant symptom in every single case in which I have found intestinal parasites, and in no less than 10 or 12 cases where the trichocephalus homines alone appeared, the percentage of eosinophiles rarely fell below 5, although the total number of leucocytes was unaltered.

A CASE OF GUNSHOT WOUND OF THE STOMACH. OPERATION. RECOVERY.

BY HUGH WILLIAMS, M.D., BOSTON.

On the afternoon of August 30, 1902, I was called by Dr. Nason of Newburyport to see a case of gunshot wound of the abdomen.

The accident, as nearly as could be ascertained, had occurred at 12.30 p.m. The patient, a boy of sixteen, had been shooting on Plum Island with a friend of about the same age. At the time of the accident he was in a reclining position, and his friend, who was seven or eight feet away, in front and a little to his right, was unloading a 32-caliber revolver. Whether the cartridge exploded within the pistol, or was dropped upon some hard object, could not be determined, as the boys told different stories. The bullet from the exploded cartridge entered the abdomen, passing through cotton shirt and undershirt. The mid-day meal — consisting of apples, watermelon, and herring with pickles — had been eaten at noon, or about half an hour before the accident. The boy was taken in an ambulance from Plum Island to the Anna Jaques Hospital, a distance of four miles. He had not vomited; but had complained of severe pain in the epigastrium, and had been given morphia gr. 1-8. He was unable to urinate, and had been catheterized of eight ounces of normal urine. The bowels had moved thoroughly in the morning.

When I saw the patient — four hours after the injury — he was lying quietly on his back on the operating table, with the knees out straight. He was perfectly calm, — not at all disturbed either by his own condition or by his surroundings. He was strong, healthy, well-developed. The pulse was full, a little bounding, but of excellent quality, and the rate varied between 115 and 120. The temperature was 100°. The abdomen was practically normal in appearance, as far as distension was concerned, but the lineæ transversæ and semilunares were exaggerated, as when a strong person is contracting his abdominal muscles for show. The wound of entrance of the bullet was seen one inch to the right of the umbilicus, and about half an inch below. The track of the bullet could be seen for one inch or more, its course being at an angle from right to left, and in a direction from below, upward and inward. Except on pressure, there was no hemorrhage from the wound, which had been covered with a moist corrosive dressing. The abdomen had been shaved, and everything made ready for operation. Palpation showed general but moderate rigidity of the abdominal muscles. There was marked tenderness in the epigastrium, in the median line about two inches above the umbilicus, but there was no tenderness except as

you approached this point. This was also the point of greatest pain. The whole abdomen was flat to percussion except over the gastric area, where there was diminished resonance.

The general condition of the patient was very good. There was but little shock, and no active hemorrhage, although sufficient time had elapsed since the accident for him to have bled considerably if any large vessel had been injured. His general condition, however, did not show any such active process.

I decided to open the abdomen at once. The patient was etherized by Dr. Nason, and an emergency preparation of the abdomen made. Dr. W. B. Odiorne and Dr. Day assisted at the operation. A probe passed into the wound entered the abdominal cavity at the median line, two inches above the umbilicus. An incision was then made in the median line from the ensiform cartilage to the umbilicus, and the abdomen opened. The moment the peritoneum was incised, gas began to escape in small amounts, and the stomach near the pylorus presented in the wound. No fluid, intestinal or gastric contents or blood could be seen. As the direction of the bullet was upward to the left, I walled off the stomach with gauze, and delivered its anterior surface toward the fundus. This almost immediately brought into view in the anterior stomach wall a wound which, being in a glancing direction almost parallel to the wall of the stomach, showed that the bullet had lacerated the visceral peritoneum in the first inch of its course only. The ball had then penetrated deeper, and one-half inch further on it had turned directly backwards, making a ragged punctured wound through the stomach wall. This point was, approximately, two inches above the lower border of that organ and four inches from the pylorus. From this wound was escaping a little gas and a small quantity of liquid of the consistency of thick soup, though there was no evidence of any fluid having escaped before the manipulations began.

The stomach was found distended with a semi-solid material from the last meal. It was, in fact, so full that handling forced from the wound some of its contents. The wound was then partly closed with silk Lembert sutures, and well walled off with gauze, and a gauze pad was held by Dr. Odiorne over the opening. I then made an incision in the great omentum, between the stomach and the transverse colon, and opened the lesser peritoneal cavity. No gas, blood or gastric contents were found here, and the posterior stomach wall felt intact. The region of the foramen of Winslow and the remainder of the anterior surface of the stomach were then explored, but no hemorrhage could be found. No wound of exit from the stomach could be discovered, nor any evidence of one.

Though the patient was standing the operation remarkably well, I did not deem it safe to leave the stomach so distended with food, as my line of sutures would be three inches long, and vomiting would almost inevitably follow the operation if the stomach was not previously emptied. By removing some of the contents, I should also be able to explore the inside of the stomach. I therefore enlarged the opening in the stomach throughout its wounded surface, making the wound one and three-fourths