of this fact. It is at least as easy to believe that the vascular changes are the result of the disturbance in the nerve elements as it is to regard them as its cause. The vasomotor nerves are peculiarly sensitive to sensory impressions that are felt as pain. No symptoms at all resembling those of migraine have been observed when the sympathetic system is distinctively diseased or deranged.

"The peculiar character of the visual impression affords strong reason for regarding it as the result of a tendency to functional derangement in the cells themselves. This opinion is supported by the fact that it may occur as an isolated symptom, and that it may be related to an actual visual impression, as is shown by the facts mentioned. Such an occurrence can have been due only to a primary functional disturbance of the cells themselves, and that which exists in one case probably exists in all.

"The hemiopia also is best explained by the assumption of deranged function in the occipital lobe, especially since right hemiopia may correspond to almost simultaneous aphasia, and the opinion is supported by the fact mentioned above that hemiopia is fixed by a lesion in the cuneus. When all has been said, mystery still envelops the mechanism of migraine."

Jolly,⁹ whose clinical experience with this affection is similar to mine, thinks: (1) That the seat of scintillating scotoma in its most frequent, hemiopic form in all probability is located in the primary optic channels and more particularly in the optic tract or in the region of the external geniculate body; (2) that the binocular central, and the hemiopic scotomata which cross over the median line have their place of origin in the more peripheral part of the channel, probably in the region of the chiasm; and (3) that the purely monocular scotoma originates in the optic nerve or the retina.

TREATMENT.

Gowers says in reference to the treatment of migraine: "If any errors in mode of life or defects in general health can be traced, their removal is the first and most essential step in treatment; of special importance is increased rest, regularity in meals and attention to diet; whatever is known to induce a paroxysm should be carefully avoided. Hot, crowded rooms are especially injurious. If inherited gout is probable, the regimen suitable for this should be adopted. In cases with conspicuous pallor in the early stage the drug that has most influence is nitroglycerin given regularly in the interval (migraine) twice or three times a day after food, beginning with a small dose 1/150, 1/180, 1/200 of a grain in 1 per cent. solution of alcohol."

During the attack absolute rest is essential; the recumbent posture is generally that in which the patient is most comfortable.

Some of my patients think that the attack is shortened by drinking iced water; others believe that spirits, coffee, tea and other beverages, taken immediately at the beginning of the attack produce a similar result. Others attribute the same result to taking from 10 to 20 drops of valerianate of menthol on a lump of sugar; while others, following the advice of Manz,¹⁰ believe they have shortened the attack by gently pressing the eyeballs and rubbing the lids over the balls for a few seconds. In view of the great difference in the se-

verity and in the duration of the attack at different times in the same person, it is impossible to say how much benefit was derived from any of the measures employed.

INTESTINAL PERFORATION COMPLICATING TYPHOID FEVER.*

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Perforation of the bowel is one of the most serious complications which occurs in this disease, and it demands prompt attention first from the medical man, next from the surgeon. Before proceeding with the paper proper, I desire to report, in more or less detail, 12 operative cases which have occurred in my practice in the last twenty-one months.

These cases, in conjunction with 7 previously reported,¹ making a total of 19, have given eight recoveries, making a recovery percentage of 42.10.

CASE 1.—Referred to me by Drs. T. L. Disque and Lawrence Litchfield, Pittsburg, Pa. Perforation, peritonitis, death.

Patient.—G. K. H., male, aged about 24, had an attack of typhoid fever with a relapse in December, January and February, 1902 and 1903, respectively.

History.—The initial course of the fever was mild. Dr. Disque attended him in this attack and made his last visit Jan. 4, 1903. The patient soon after was following his usual vocation.

On January 26 Dr. Disque was called again to see him and found him with a relapse of the fever. This attack was a little more severe than the first.

On Feb. 3, 1903, Dr. Disque called to see him at 12 noon and found him suffering from a pain in the abdomen. The muscles of the abdomen were slightly rigid at this time. There was no change in the pulse nor in the temperature. The onset of pain occurred about 10 a. m., and the pain and tenderness increased during the afternoon. At 8 p. m. Dr. Litchfield saw the patient, in consultation with Dr. Disque, and the diagnosis of perforation was confirmed.

Operation.—I saw the patient about 9:30 p. m. of the same day and we operated on him at 12 midnight. Fourteen hours had elapsed since the onset of the pain. The abdomen was opened, under cocaine anesthesia, in the right semilunar line. The abdomen contained a flocculent fluid and the perforation was found in the lower part of the ileum.

The perforation was closed by two tiers of continuous Lembert sutures of silk and the bowel returned to the abdomen. The abdominal cavity was then flushed out with warm normal salt solution. A large glass drain was inserted to the bottom of the pelvis and the abdominal incision closed around it.

Result.—The patient did fairly well for about forty-eight hours. He passed some gas by the bowel and the rigidity of the abdomen disappeared to some extent. On the third or fourth day, as he was not passing much gas by the rectum and as he was becoming somewhat distended, we decided to open the bowel at the site of the perforation. This was done under a little chloroform anesthesia. This did not avail, and he died on February 7th, from peritonitis.

The abdominal fluid at the time of operation contained white blood cells, a motile bacillus and a coccus. The bacilli under laboratory culture produced gas, and hence belongs to the colon group.

CASE 2.—Referred to me by Drs. A. Stanton and T. G. Simonton of Pittsburg, Pa. Perforation, peritonitis, death.

9. Jolley: Berliner klin. Wochft., No. 42, 1904, quoted from Nagel's Jahresbericht, 1902, p. 459.

10. Manz: Quoted by Schmidt-Rimpler, Die Erkrankungen des Auges im Zusammenhang mit anderen Krankheiten, p. 108.

*Read before the Allegheny County Medical Society, 1904.
1. Amer. Med., Sept. 6, 1902.

Patient.—G. S., male, aged 30; developed fever about March 4, 1903.

History.—He had one slight hemorrhage on March 18, otherwise he did not present symptoms showing anything unusual until the afternoon of March 19, when he complained of a severe pain in the abdomen. The maximum temperature had been up to this time 102 F. Dr. Stanton had insisted on the use of a bed pan, but the patient said he could not have evacuations that way, and on this date sat up to use the closet or a commode. Immediately after doing this he had the initial onset of pain, which was severe and continuous. This occurred between 3 and 4 p. m. Dr. Stanton saw him at 4 p. m. He complained greatly of the pain and was in collapse, with its accompanying symptoms, and a diagnosis of perforation was made at this time.

Consultation.—Dr. Simonton, who was called in consultation, saw the patient about 9:30 p. m., and they found the following conditions present: Temperature, 104; pulse, 100. There was severe pain in the abdomen, more acute on the right side, and much distension of the abdomen. The walls were rigid. The liver and splenic dullness was absent. The peristalsis was impaired. There was tenderness on pressure all over the abdomen, more marked on the right side. The facies were characteristic of peritonitis.

Operation.—As it was impossible to operate on him at his room, removal to the hospital was necessary. This was done, and he arrived about 12:30 a. m. at Mercy Hospital, where I saw him for the first time. The ride in the ambulance did not change his condition. At 1 a. m., nine and a half hours after the onset of pain, as near as we could determine, we opened the abdomen under cocain anesthesia. The incision was made in the right semilunar line, on a level with the cecum. The cavity of the abdomen contained much fluid. The perforation, $\frac{1}{2}$ of an inch in diameter, was found in the ileum 6 inches from the ileocecal valve. The perforation was closed by two tiers of silk Lembert sutures introduced transversely to the axis of the bowel, which was then returned to the abdominal cavity. The abdomen was then thoroughly flushed out with warm normal salt solution. A large glass drain was inserted to the bottom of the pelvis for drainage and the abdominal incision closed as much as possible by sutures. He was then returned to his bed, placed in Fowler's position. He died March 21, 30 hours after the time of the operation.

CASE 3.—Referred to me by Dr. B. M. Dickinson of the medical staff of Mercy Hospital. Perforation, peritonitis, death.

Patient.—M. G., male, aged 27, was admitted to Mercy Hospital, April 28, 1903, with typhoid fever, having been sick 7 days previous to this time. I am not able to give the medical history and the symptoms of perforation in this case, as his record could not be found. From the appearance of his temperature chart I believe his infection was rather severe. The perforation occurred on May 5, 1903.

Operation.—Cocain anesthesia. Celiotomy was done on the afternoon of May 5, 1903. The perforation was found in the lower part of the ileum. The perforation was closed by two tiers of continuous silk sutures (Lembert) and the bowel returned to the abdomen. The abdomen was flushed out with warm normal salt solution and a glass drain inserted to the bottom of the pelvis. He died on May 6, a little more than 24 hours after operation. A bacillus and a coccus were found in the abdominal fluid.

CASE 4.—Referred to me by Dr. J. A. McCullough, Steubenville, Ohio. Perforation of the appendix—recovery.

Patient.—A. L., male, aged about 30 years, had been ill with typhoid fever for about 3 weeks.

History.—On May 29, 1903, between 2 and 3 p. m., he had a sudden pain, severe and continuous, in the cecal region. He soon afterwards had a chill with a rise of the temperature. I saw the patient with Dr. McCullough about 12 midnight. At this time he still complained of the pain. There was tenderness on pressure over the cecum and the right rectus was

somewhat rigid at this point. There was no tenderness over the remaining part of the abdomen. The peristalsis was normal and the liver dullness was present.

Operation.—May 30, 1 a. m. The abdomen was opened under cocain anesthesia in the right semilunar line on a level with the cecum. The abdominal cavity did not contain any fluid nor was the peritoneum inflamed. The appendix was bound down by adhesions and when delivered it was found to be perforated. A small abscess was present around the appendix, but there had been no escape of pus into the peritoneal cavity. The appendix was removed.

Gauze was inserted to the position formerly occupied by the appendix.

Result.—He made a tedious recovery. No peritonitis developed.

If this patient had been left alone a large abscess would certainly have developed.

CASE 5.—Referred to me by Dr. B. M. Dickinson of the medical staff of Mercy Hospital. Perforation, peritonitis, pneumonia, death.

Patient.—B. G., a Pole, male, aged 21, was admitted to Mercy Hospital on Sept. 18, 1903, suffering from typhoid fever.

History.—He said he had been sick one week. On the evening of Sept. 19, one day after admission, he complained of a pain in the abdomen. This soon passed away and his history relates that he soon fell asleep. This pain occurred probably about 10 p. m., as his temperature chart shows he had a chill at this time. His temperature was then 104 and pulse 100. The next morning he again complained of pain in the abdomen. The temperature was 99, a drop of 5 degrees in 12 hours. The pulse was 100 and he was sweating profusely. His abdomen was rigid, distended, and peristalsis was absent. A laparotomy was performed under cocain anesthesia about 10 a. m. on September 20. The incision was made in the right semilunar line on a level with the cecum. The perforation was found in the ileum 8 inches from the ileocecal valve. It was closed by a purse-string suture first over which two tiers of silk Lembert sutures were introduced. The abdomen was then thoroughly flushed out with warm normal salt solution.

Result.—The hospital record of this patient is brief and I can not give the facts from memory. He was apparently doing nicely but pneumonia developed and he died on September 25, five days after the operation.

No organisms were found in the abdominal fluid and no growth occurred from culture.

CASE 6.—Referred to me by Dr. I. J. Moyer of the medical staff of Mercy Hospital. Perforation, peritonitis, recovery.

Patient.—J. N., male, aged 21, was admitted to Mercy Hospital November 19, 1903, with typhoid fever.

History.—His mother, one brother and five sisters living; his father died of heart disease and three sisters died in infancy. He had inflammation of the lungs when a boy of six and was one year in recovery. He had been ill subsequently from the same trouble and has never been strong.

Present Illness.—He was taken sick November 7, with headache, insomnia, pain in the back and in the legs, anorexia and diarrhea, having 6 or 7 stools daily. He was much emaciated. The spleen was enlarged and tender. The heart and kidneys were normal. A Widal test taken a few days after admission reported back negative. He had five or six severe hemorrhages from November 26 to November 30. At 10 p. m. November 30, the twenty-third day of the disease, he had a severe pain in the lower right quadrant of the abdomen. This man always complained of every pain very much and so little attention was attached to this important symptom. He passed a very restless night. He had a chill at 4 a. m. lasting twenty minutes. At 10 a. m. the symptoms had increased. The muscles of the abdomen were rigid but not pronounced. Peristalsis could be heard, the quality and quantity not marked. The abdomen was scaphoid,

and up to this time there had been no appreciable change in the pulse or temperature.

Operation.—December 1, 1 p. m. Celiotomy, ether narcosis. Thirteen hours had elapsed since the onset of the pain. An incision two inches long was made in the right semilunar line on a level with the cecum. The abdominal cavity contained a flocculent fluid. The perforation, $\frac{1}{8}$ of an inch in diameter, was found in the ileum, four inches from the ileocecal valve. The opening in the bowel was closed by two tiers of continuous silk sutures (Lembert), after which the bowel was returned to the abdominal cavity. Large quantities of warm normal salt solution were then used to flush out the cavity of the abdomen. A large glass drain was inserted to the bottom of the pelvis for drainage and the patient removed to his bed, which was placed in Fowler's position.

Result.—Examination of the fluid obtained from the abdomen at the time of operation showed it to contain, beside blood cells, only a micrococcus. At 7 p. m., the day of operation, the bed was placed in a horizontal position for the reason that the pulse had gone steadily upward. Five minutes after the bed was lowered the pulse came down from 138 to 124. The glass drainage tube was also removed at this time, some gauze being first inserted through the tube to serve as drainage.

Enemas given at varying intervals during the first twenty-four hours always came away with much flatus and some fecal matter.

He made a tedious recovery. When he left the hospital, Jan. 21, 1904, to go to his home in Russia, he had an abdominal sinus four or five inches in depth.

I have since heard that he had entirely recovered.

CASE 7.—Referred to me by Dr. B. B. Wood, Pittsburg, Pa. Perforation, peritonitis, death.

Patient.—F. W. M., male, aged 24, first consulted Dr. Wood Dec. 27, 1903. He had been complaining for about ten days. He had a cough, with profuse night sweats at this time. Dr. Wood is of the opinion that he was a tubercular subject.

History.—Typhoid fever developed, which ran the regular course. January 13, at 3 p. m., he had a hemorrhage, and he passed some blood during the night, having several bloody stools. At 7 a. m. on January 14 he was weak from the loss of blood. At this time Dr. Wood saw no indication of perforation. At 9 a. m. his condition was changed. The abdomen was somewhat rigid and he had the expression of one suffering from shock. I met Dr. Wood in consultation about 5:30 p. m. at the patient's home. At this time he had the signs of peritonitis. His abdomen was rigid and peristalsis was faint. His pulse was weak and he was perspiring freely. It was not advisable to perform the operation at his home, so we transported him to Mercy Hospital. It was recognized that this was not a good case for operation, but as he did not have any chances without operative interference we decided to give this chance.

Operation.—7 p. m.; celiotomy; cocaine anesthesia. Not more than twelve hours had elapsed since the perforation had occurred. An incision was made in the right semilunar line on a level with the cecum. The perforation was found in the ileum within eight inches of the ileocecal valve. It was closed by two tiers of continuous silk sutures (Lembert) and the bowel returned to the abdomen. The cavity of the abdomen was then flushed out with warm normal salt solution. A glass drain was introduced to the bottom of the pelvis and the abdominal incision closed as much as possible. He went into collapse on the table and it was necessary to give a saline transfusion. He reacted but little and died about 11 p. m.

CASE 8.—Referred to me by Dr. G. T. Ribetti, Pittsburg, Pa. Perforation, peritonitis, second perforation, death.

Patient.—S. H., male, aged 15 years, became ill with typhoid fever on June 5, 1903. He had a very mild attack.

History.—The temperature was not high at any time, and

he did not have any bad symptoms whatever until June 20, exactly fifteen days after the onset of the fever. At 1 p. m. of this date he had a severe pain in the abdomen, accompanied by some rigidity of the right rectus muscle. The pain and the rigidity disappeared within two hours. No morphia was given. He was admitted to the hospital early the next morning with the following symptoms: The abdomen was rigid. Pain was present on pressure over the abdomen. The peristalsis was not entirely absent and he had the facies of peritonitis. Nineteen hours elapsed after the onset of the pain before celiotomy was performed.

Operation.—The operation was performed under cocaine anesthesia. An incision was made through the right semilunar line on a level with the cecum. The abdomen contained a large quantity of a flocculent fluid. The perforation was found in the ileum, eight inches from the ileocecal valve. The opening in the bowel was closed by two tiers of continuous silk sutures (Lembert) and returned to the abdominal cavity. The abdominal cavity was then thoroughly flushed out with warm normal salt solution. A large glass drain was inserted to the bottom of the pelvis for drainage. He was then returned to his bed, which was placed in Fowler's position.

The fluid in the abdomen at the time of operation contained a diplococcus, many leucocytes and granular material.

Result.—The glass drain was removed the first day after operation and the head of the bed lowered at the same time. Before removing the tube a strip of gauze was inserted through the tube to act as drainage. The patient at once began to improve. He was soon passing much flatus, with and without the aid of enemas. He was troubled with some emesis for several days, but soon was able to take liquid nourishment. For ten days he did well. By this time he was gaining in weight, apparently; his color good; his bowels moved regularly and his abdomen was as soft as a baby's. On June 30 he complained of pain in the chest, and pleurisy and catarrhal pneumonia developed. Coincident with this unfortunate complication, a fecal fistula occurred, and peritonitis again became a factor in his case. He died July 2.

Autopsy.—Either complication would make the prognosis very serious. I thought, and naturally believe, that the fecal fistula was due to the opening of the perforation on account of the tearing out of the sutures, and was much surprised when a restricted autopsy, done by Dr. W. H. Ingram,² showed the cavity of the abdomen to contain fecal matter which came from a second perforation high up in the jejunum. The perforation was $\frac{1}{2}$ inch in diameter, the largest I have seen. The sutures in the bowel at the site of the first perforation were found to be intact.

CASE 9.—Referred to me by Dr. B. M. Dickinson of the medical staff of Mercy Hospital. Perforation, peritonitis, second perforation, fecal fistula, recovery.

Patient.—J. F., male, aged 29; was admitted to Mercy Hospital June 22, 1904, with typhoid fever.

History.—The fever had evidently commenced two weeks before, with anorexia and malaise. The week previous to admission he had several liquid stools daily. During the first week of treatment in the hospital he had three hemorrhages from the bowels; the last one occurred the day before the perforation. Otherwise he did not have any unusual symptoms. On July 1, at 3:45 p. m., the twenty-second day of the disease, he had a severe pain in the cecal region, which came on suddenly and was continuous. Dr. J. A. Reidy, medical resident, saw him soon after this occurred, and made a diagnosis of perforation. At this time he was tender all over the abdomen on pressure; the tenderness was more acute on the right side. The abdomen was flat but rigid. Peristalsis was present but not marked. Liver dullness diminished. I saw him between 5 and 6 p. m. and he still presented the same symptoms, but a little more marked, and confirmed Dr. Reidy's diagnosis. Soon after perfora-

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tion occurred his temperature was 96.2 degrees. At 7 p. m. his temperature was 102.6 and his pulse was 126.

Operation.—Cocain anesthesia; 3¾ hours after onset of pain we made the usual incision in the right semilunar line. The perforation, ¼ of an inch in diameter, was found in the ileum, six inches from the ileocecal valve. The opening was first closed by a purse-string suture of silk, the opening in the bowel being pushed into the lumen as the suture was drawn tight, over which two or three interrupted Lembert sutures, also of silk, were introduced.

Another ulcer, about four inches from the cecum was observed, but as the serosa over it seemed to be in good condition I did not think it necessary to invert it by suture, as is sometimes required. The abdominal cavity, which was filled with a turbid fluid, was washed out with warm normal salt solution. The portion of the bowel containing the perforation, although now closed by sutures, was anchored by a continuous silk suture to the peritoneum at the upper angle of the incision through the abdominal wall. A large glass drain was then inserted to the bottom of the pelvis. No sutures were introduced to close the abdominal incision. He was then removed to his bed with its head slightly elevated, but I did not keep him up very long, as his pulse was very weak and rapid, 168 to the minute.

Result.—The next day at 11 a. m. a strip of sterile gauze was inserted into the glass drainage tube and the tube withdrawn. I did this so early in this case for the reason that the fluid in the abdomen at the time of operation contained only blood cells and proved sterile under culture. The second day after operation I noticed that the gauze which had been introduced the day before was stained with fecal matter, and the gauze drain was then removed. This fecal matter did not come from the perforation closed by sutures, as it was intact, but must have come from a second perforation and most likely from the ulcer previously described. Although fecal matter in large quantities was constantly in contact with the site of the sutures over perforation, it never opened. The fecal fistula, which closed about October 1, opened October 18. The opening is, however, small. The resulting scar at site of abdominal incision is firm and shows no sign of hernia.

CASE 10.—The patient was referred to me by Dr. Karl Emmerling, Pittsburg, Pa. Perforation, peritonitis, fecal fistula, recovery.

Patient.—Miss A. M., schoolgirl, aged 14, was taken sick on July 3, and had an attack of typhoid fever with no unusual symptoms until July 31.

History.—The course of the fever would indicate that the infection was of a mild form. At 9 p. m. on July 31, the twenty-eighth day of the disease, she had a severe and continuous pain on the right side of the abdomen, in the region of the cecum. The pain came on suddenly and occurred just after a free movement of the bowels. At 11 p. m. I saw her, in consultation with Dr. Emmerling. She still complained of much pain and presented the following symptoms: Her features were pale and pinched. The pulse was about 120 and the temperature was 101 degrees. The abdomen was flat. The walls were rigid. Tenderness was present on pressure all over the abdomen, but it was more acute on the right side. Peristalsis of a fair character was present. Liver dullness was absent in the nipple line. The patient having the above symptoms, we did not hesitate to make a diagnosis of perforation and advised immediate operation, which we performed as soon as we could move the patient to Mercy Hospital.

Operation.—Ether. Four hours after the onset of pain we made an incision two inches long through the right semilunar line on a level with the cecum. The perforation, ¼ of an inch in diameter, was found in the ileum, eight inches from the ileocecal valve. The perforation was treated as in the previous case. The portion of the bowel containing the perforation was anchored in the upper angle of the wound, as also in the previous case. The abdominal cavity, which

contained a flocculent and turbid fluid, was washed out with warm normal salt solution and a large glass drainage tube inserted at the bottom of the pelvis. No sutures were introduced to close the abdominal incision. Patient was removed to bed, which was placed in Fowler's position. The drainage tube was removed in a few days.

Result.—From the first she did well. On the seventh day a fistula developed, caused by the opening of the sutures closing the perforation. A small amount of fecal matter escaped daily. At the present time the opening is almost closed and will be entirely so in a short time. During her convalescence she had some elevation of temperature, which lasted for three or four weeks. This temperature was most likely due to a typhoid reinfection, no other condition being present to produce it. The abdominal fluid contained a coccus and a motile bacillus. A mold grew on culture.

CASE 11.—Referred to me by Dr. J. G. Stewart, Pitcairn, Pa. Perforation, peritonitis, recovery.

Patient.—M. F., male, aged 19; the first symptoms of fever appeared on Aug. 4, 1904.

History.—He had a severe infection, but did not have any complications with the exception of three slight hemorrhages (on August 31, September 2 and September 4, respectively) until Sept. 6, 1904. On this date, at 11 a. m., he had a severe pain in the lower right quadrant of his abdomen. The pain was excruciating in character. It came on suddenly and was continuous. Dr. Stewart saw him at 12 noon. The pain was severe and continuous and was diffused over the abdomen. Morphia was administered for the pain, but perforation was suspected. Dr. Stewart saw the patient again at 3 p. m., and made absolute diagnosis of perforation. At this time the patient was in collapse. The temperature was 94 and the pulse was weak and rapid and he had the facies so characteristic of shock. I saw him, in consultation with Drs. J. G. Stewart of Pitcairn and G. H. Beswick of Wilmerding, Pa., about 7 p. m. At this time he had recovered from the shock, that is, his temperature had risen and he had a pulse of 120. He was very tender all over the abdomen. The muscles were rigid. Peristalsis was present but of no great quantity or quality. The liver dullness was absent in the nipple line. His features were characteristic of peritonitis and shock.

Operation.—8 p. m.; cocain (locally) and chloroform narcosis. Morphia, ¼ gr., had been previously given. This was the thirtieth day of the disease and nine hours had elapsed since the onset of pain. The usual incision was made in the right semilunar line. Two perforations were found, both of them in the ileum; one about eight inches from the ileocecal valve, the other about seven inches further along. A third ulcer was apparently almost through the walls of the bowel and this ulcer was inverted into the bowel by means of a purse-string suture of silk and which was reinforced by two or three interrupted Lembert sutures (silk). The first ulcer, nearest the cecum was closed as in Case 9. The second perforation was treated in almost a like manner. This one presented a peculiar appearance. When first discovered it had a white necrotic area at the apex of the ulcer, and which, on the manipulations of the bowel necessary in introducing the sutures, caused this necrotic area to become detached, leaving the opening similar to the appearance of perforations of later stages. This ulcer had not advanced to the final state of perforation, but through the necrotic area; organisms present in the bowel could easily pass and set up peritonitis.

The first perforation was one-eighth of an inch in diameter; the second perforation would have the same diameter had it gone on to the final state. The bowel at the site of perforation nearest to the cecum was anchored to the peritoneum at the upper angle of the abdominal incision, as described in Case 9. A large quantity of warm normal salt solution was then used to flush out the cavity of the abdomen. A large glass drainage tube was inserted to the bottom of the pelvis for drainage, a wick drain being used for the purpose. On September 9,

the third day after the operation, the bowel was opened to aid the escape of gas and fecal matter. He was at this time passing gas by the rectum, but he was also becoming more distended, and, as we had anchored the bowel for just such a complication following operation, the procedure was carried out.

Result.—He is making a good recovery. About three weeks after the operation he had a rise in temperature to 103 degrees, but it gradually came down and he is now convalescing. The fistula remains open. The cause of the temperature was probably due to a typhoid reinfection.

CASE 12.—Referred to me by Dr. B. M. Dickinson of the Mercy Hospital. Perforation, peritonitis, death.

Patient.—G. P. M., male, aged 24, was admitted to Mercy Hospital on Sept. 6, 1904, with the symptoms of typhoid fever well established.

History.—He had been sick for two weeks before admission. The infection was severe in this case. The nervous symptoms were pronounced at times and he had seven distinct and large hemorrhages in six days. He was troubled with emesis and hiccough, probably due to the use of morphia, which had been given to control the hemorrhages.

On September 22, about 7 a. m., he complained of pain in the lower right quadrant of the abdomen. The pain was not very severe at first and was referred to the end of the penis. There was no appreciable change in the pulse or temperature at this time.

At 1 p. m., when I saw him, in consultation with Dr. Dickinson, his pulse had increased 20 beats and was running at the rate of 130, and his temperature had gone up 1.8 degrees, being 102.2 degrees. There was tenderness on deep pressure all over the abdomen, but the pain was more acute in the lower right quadrant of abdomen. The muscles of the abdomen were slightly rigid. The peristalsis was good and the liver dullness was not obliterated. Dr. Dickinson had made a diagnosis of perforation and nothing remained to do but operate.

Operation.—Chloroform narcosis: 2 p. m. This was the thirtieth day of the disease, with the perforation occurring seven hours previous to this time, as nearly as we could determine. A two-inch incision was made in the right semilunar line, on a level with the cecum. Search was first made for the cecum and appendix, which were found not to be diseased. The ileum was next exposed and the perforation was found about twelve inches from the ileocecal valve. The perforation was closed as described in Case 9. Two ulcers in the bowel, one on either side of the site of the perforation, a few inches away, were turned in by a purse-string suture of silk.

The bowel at the site of perforation was then anchored to the peritoneum at the upper angle of incision, as in Case 9. The abdomen was then thoroughly flushed out with warm normal salt solution and a large glass drain inserted to the bottom of the pelvis. Two pieces of gauze were introduced in the drainage tube to act as a wick drain. He was then removed to his bed, which was placed in a modified Fowler's position. Immediately after operation, 3 p. m., his pulse was 140 and the temperature by the rectum was 105.2 degrees. The temperature gradually came down in 48 hours to 98.2 degrees, by axilla.

Result.—He was at times delirious and hiccough and emesis were troublesome symptoms at intervals. He was always able to pass flatus with the aid of enemas.

The temperature remained about 100 degrees all the time. His pulse averaged 120 beats to the minute. His abdomen became almost free from pain on pressure and fair peristalsis could always be heard, apparently showing the peritonitis to be lessening. He died on September 26, however, the fifth day after operation. No autopsy was obtained. The toxemia, due to the fever itself, seemed to be a prominent factor for his death.

MORBID ANATOMY OF THE ULCER.

It is obvious to all that the cause of perforation is

the penetration of all the coats of bowel wall by the ulcer, the pathologic lesion in typhoid, but I wish to present what my observation has led me to believe is the process causing the complete penetration of the bowel.

To understand the process more thoroughly a review of the morbid anatomy of the ulcer may not be out of place.

The ulcers arise from the pathologic process which takes place in the lymphatic follicles known as the solitary glands and in the agminated glands known as Peyer's patches. The process is most marked in the lower end of the ileum, but occurs also in the cecum, the appendix, the jejunum, the rectum, the colon, and, according to Pepper, it has been observed in the duodenum and stomach.

First comes the stage of infiltration of the lymphoid glands and, if resolution is not established, the stage of necrosis follows; then ulceration and cicatrization come in sequence. Wherever inflammation exists the blood vessels become enlarged, tortuous and engorged with leucocytes. This occurs around the lesion just referred to, and begins when infiltration starts. The tissues beyond the area of the lymphoid glands are involved, extending over the edges of the lymphoid follicles to the healthy mucous membrane, and even into the muscular coats of the bowel. When one of these lymphoid follicles has gone on to the stage of ulceration, and the process has extended into the muscular coats, the serosa and the remaining coats of the bowel at apex of ulcer become deficient in blood supply, gradually become necrotic, and perforation is the result.

I have observed that the coats of the intestines over the site of a non-perforated ulcer are always darker in color than elsewhere, thus showing that the circulation is impaired.

The deficiency of the blood supply is due to two causes:

1. The extreme degree of inflammation with the accompanying swelling of the tissues causing a slowing and stagnation of the blood current.

2. The position of the ulcer. The ulcer of more or less size and depth being on the free border of the bowel and opposite the blood supply, would, by its own position, retard the blood current to the thin covering of the bowel over the ulcer where it is most needed. These two conditions, always present, are factors, it seems to me, in the penetration of all of the bowel coats by the ulcer.

DIAGNOSIS OF PERFORATION.

Highly congested and inflamed tissues are always very friable and it appears strange that we do not have more perforations under such conditions. The diagnosis of perforation is usually easy. The symptoms are so characteristic that even when the patient is a foreigner or is delirious the diagnosis can be made just as well. The symptoms are, as a rule, the same.

Symptoms.—The typical symptoms are as follows: Pain comes on suddenly, and is severe and continuous, although it may occasionally be intermittent. It is first noticed usually in the right cecal region and may be referred to the external genitals. The whole abdomen is usually tender on pressure. The right rectus becomes rigid, and the rigidity later extends to the left rectus. The peristalsis is not much impaired at the time; in fact, it may be increased for a short period, but later it is lessened and finally is absent. Liver dullness in the nipple line is lost at varying times, depending on the

distension of the bowel and the amount of free gas in the cavity of the abdomen.

The facies is characteristic of one suffering severe pain and possibly shock. The shock is characterized by a blanched countenance, a pinched nose and a feeble, rapid pulse, and a subnormal temperature may be present. In my experience, in but few cases has there been a drop of temperature or a perceptible change in the pulse at the time of perforation. Slight nausea or vomiting is usually present. Whether the temperature has fallen or not it soon rises. This is due to a spreading peritonitis. The pulse increases in frequency, the rigidity of the abdomen and the tenderness is more marked, and the facies is one of peritonitis. The patient may have several evacuations of the bowels after the occurrence of perforation.

As time elapses after perforation has occurred, all the symptoms increase in severity. The symptoms are then due to a peritonitis. The leucocytic count may be of some value in making the diagnosis, but not much importance should be attached to this procedure, and, in any case, with the above symptoms, confirmation is not needed, even if the leucocytic count coincides with the symptoms.

In cases where hemorrhages occur it would be well to be on the watch for perforations. Four of the twelve cases just reported had hemorrhages.

The three cardinal symptoms are, however, the sudden pain, the rigidity and the tenderness of the abdomen to pressure. These three symptoms being present in any case of typhoid fever, operation is indicated and demanded.

Occasionally if the patient is seen soon after the occurrence of the perforation the rigidity will only be detected on deep palpation, and the tenderness will only be found over the site of the perforation. This being so, the sudden pain is the only symptom on which to make an early diagnosis unless a careful examination is made for rigidity and tenderness. These three symptoms should be firmly fixed in mind. The other symptoms, when present, should not be disregarded. They are, however, almost all due to the peritonitis.

Instructions to Attendants.—The parents, attendants or nurses who have charge of the patient should be instructed to notify the physician when any sudden, severe or unusual pain occurs in the abdomen. It is well to have a card with the symptoms of perforation on it; the card to be given the nurse or attendant of the patient.

Dr. Emmerling, in case 10, instructed the mother to notify him in case any sudden pain occurred. In this instance we saw the patient in consultation exactly two hours after the onset of pain, and the diagnosis was made at that time.

By following this plan it is possible to make the diagnosis of perforation early and to have prompt surgical intervention. Nothing is gained by waiting. Even if no cause is found for the symptom once in a while, it is better to err on that side than to lose lives by waiting for more pronounced symptoms.

Other Complications.—There are a few other complications occurring in the course of typhoid fever which give symptoms almost identical with perforation, such as the softened and ruptured mesenteric glands, softening of the spleen and rupture of the gall bladder due to ulceration. The treatment is practically the same as for perforation and will not be considered in this paper.

PROGNOSIS.

The prognosis is always serious. More so than from other causes of perforations for the reason that the complication comes in typhoid fever at a time when the normal powers of resistance are weakened by two or three weeks of previous illness. The final result, that is, recovery or death, depends on several factors.

First—The physical condition of the patient before the advent of the fever.

Second—The character of the typhoid infection, whether it is mild or severe.

Third—Other previous complications.

Fourth—The organisms found in abdominal fluid after perforation.

Fifth—The time of operation after the occurrence of the perforation.

Patients are occasionally heard of who have the symptoms of perforation and yet recover without operation, but their number is small. No one claims that more than 5 per cent. recover without operative interference.

This class of cases, "recovery without operation," can be subdivided as follows:

First—Those having abscess formation.

Second—Those without abscess formation.

Recovery at times occurs in cases of the first division. It is my belief that the abscess cases are usually the result of ulceration and perforation of the appendix. The appendix being a more fixed part of the bowel than any other in which perforations take place and so frequently the cause of abscess formation, this would seem reasonable. Of the second division, in which the patients simply recover, I believe that these are not cases of perforation and that the symptoms present are due to some other cause. When perforation occurs in any part of the intestine except in the appendix I believe they very rarely recover without operative interference. It is possible, but not likely.

TREATMENT.

The only treatment is operative. Prompt surgical intervention should be done early unless there is a great lowering of the temperature, when time should be given for the patient to react.

When the operation is done within six hours after perforation occurs it is the belief of the writer that we will have a recovery of 50 per cent.

The closing of the perforation is naturally the first thing to be done. There is usually some difficulty in this procedure because the bowel is very friable on account of the great degree of inflammation at this point. Of late I have first used a purse-string suture, over which I introduce one or two tiers of continuous Lembert sutures, always of silk.

The Lembert sutures should be introduced transversely to the long axis of the bowel. In my last four cases, after closing the perforation, I have made use of another procedure which has saved the lives of two, possibly of three, of the four patients. This procedure in dealing with the closed perforation of the intestine is original with me, although it has most likely been made use of by other surgeons. It consists in simply anchoring the bowel at the site of the perforation to the peritoneum at the upper angle of the incision through the walls of the abdomen. This should be done so that all the sutures introduced to close the perforation are extraperitoneal. The advantages of this over the old method of returning the bowel to the abdomen are great. They are as follows:

First. The bowel can not return to its normal position within the cavity of the abdomen, which, by reason of the perforation, is the site of the most intense inflammation of the adjacent peritoneum and intestines. In the old method, when the bowel is returned, it will come to rest at this point and bathe the sutures in pus, with the consequence that the sutures are more liable to pull out.

Second. Acute obstruction is not so liable to follow for the same reason.

Third. The contents of the bowel will flow outside of the abdomen and not inside in case the sutures in the bowel tear out.

Fourth. An artificial anus can easily be made should partial or complete obstruction develop.

The toilet of the peritoneal cavity is important. The constant repetition of the procedure carried out in every reported case was principally to impress this fact. Every part of the greater peritoneal cavity from the pelvis to the diaphragm should be thoroughly flushed out with warm normal salt solution. The flushing should be continued until the fluid coming out is clear.

There is always fluid in the abdominal cavity following a perforation. Sometimes it is almost amber colored, like ascitic fluid. At other times it is flocculent, dirty and bloody, and may contain bands of organized lymph and fecal matter. To leave this in the abdominal cavity is a serious mistake. It is only a pabulum for micro-organisms when present. The fluid can not be removed by sponges at all thoroughly, and flushing is the only procedure to follow. After flushing, dry the abdominal cavity by means of sponges or by means of a suction syringe, or both.

When this is done the cavity will be in as nearly a normal condition as it is possible to make it under the circumstances.

The insertion of a large glass drainage tube to the bottom of the pelvis is for the purpose of removing any fluid collecting there.

The patient being placed in Fowler's position, the fluid can not go elsewhere than in the pelvis. As a rule, there is but little fluid to remove after all of the salt solution is out.

The drainage tube or gauze is removed as soon as possible, depending on the amount of fluid and the nature of the organisms present at the time of operation.

Fecal fistulas are not pleasant nor to be desired by either the patient or the surgeon, but do not give much trouble, and usually close spontaneously.

I am deeply indebted to Dr. A. Letevec³ for the interest shown in making many microscopic examinations and cultures of the abdominal fluid. This procedure is very necessary. It aids in the after-treatment, and it also aids in making a more certain prognosis.

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Medicine as a science and as an art ranks higher than it has ever done. Physicians and surgeons win victories over disease and death of which our predecessors never dreamed. We have progressed and the future holds for us even better things. Let us have done with the prevailing pessimism; it is an infection which has been sown into our ranks from the ranks of unbelievers. We know better things of medicine than they and we must not let the unbelief of an outside few deter us in our onward and upward march.—*Western Medical Review*.

THE EXTRACTION OF THE INTRACELLULAR TOXIN OF THE COLON BACILLUS.

WITH A PRELIMINARY STATEMENT CONCERNING ITS PHYSICAL AND CHEMICAL PROPERTIES.

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INTRODUCTION.

The large tanks for the growth of bacteria in mass in use for some years in the hygienic laboratory of the University of Michigan permit the collection of bacterial cell substance in large amount and thus afford opportunity for the study of cellular chemistry not obtainable in any other way. Already several researches along this line have been carried on in this laboratory, and recently Dr. Vaughan has published his theory of the composition of bacterial cells and the principles of immunity developed from these studies. It is the purpose of this paper to detail some of the work which has been done recently in the extraction of bacterial intracellular toxins, with special reference to the toxin of the colon bacillus, and to give some preliminary statements concerning its physical and chemical properties. The method for the extraction of the toxin has been followed repeatedly and with several species of bacteria, so that now it can be given as reliable in results, and it is believed suited for general application.

EXTRACTION OF TOXIN.

The details of the method for extracting the bacterial intracellular toxins may be stated as follows: The organism to be studied is grown on 3 per cent. agar on the large tanks for from ten to fourteen days at room temperature. When the tanks are kept at 38 degrees centigrade, a shorter time may suffice to give the best yield. When the growth has ripened, the layer of bacterial substance is detached from the agar with glass rakes and drawn into flasks by means of suction pumps. Should the growth be too dry to be removed in this way, sufficient 95 per cent. alcohol is added to permit the suspended germ substance to pass into the flask. The flasks are emptied into large precipitating jars and the germ substance washed several times with 95 per cent. alcohol by decantation. It is then covered with absolute alcohol, and is allowed to stand for several hours with frequent stirring, when it is collected on a filter and all the alcohol is allowed to drain off thoroughly. Prolonged contact with absolute alcohol hardens the cell substance and renders the subsequent extraction of the toxin difficult. The cellular substance is now placed in large Soxhlets and extracted with ether, after which it is air dried, pulverized and weighed. The process thus far is preparatory. As obtained in this manner the dry germ powder kills guinea-pigs in doses of 1 to 40,000 body weight within twelve hours.

The germ substance, thus purified, is boiled for one hour on the water-bath, under a reflux condenser, with from fifteen to twenty-five times its weight of absolute alcohol, in which 2 per cent. by weight of pure sodium hydrate had been previously dissolved. It is essential that the alcohol used in this extraction should be absolute, and that every trace of water in the germ substance should be removed before the extraction of the toxin is undertaken. If this point be neglected the toxin will be obtained in a sticky, gummy mass which does not give satisfactory results. By this process the germ