

provoked by the use of the hot pack, catharsis with calomel or other rapidly acting and non-exhausting purge, and diuresis with diuretin or some similar agent are all to be employed as promptly as possible. The few remedies that have been tried and recommended in this disease can not be very highly lauded. They have been tried in far too small a number of cases or else they have been given on too much of a mere empirical basis. Such remedies, however, are the salicylates, benzoate of sodium and large doses of ergotin (gr. ii every hour). As might have been expected, mercury and the iodid of potassium have been experimented with. With a history of syphilis, they are, of course, indicated. Soltman reported a case in a 11-year-old girl cured by vigorous inunctions. Less desirable, if not positively irrational, would seem to be such violent measures as strong counter-irritation to the spine with mustard and the actual cautery. Such have been tried, however, and found wanting. Special symptoms, such as the dysphagia, for instance, call for special measures, such as the rectal or nasal tube. In fine, the treatment of Landry's form of intoxication of the nervous system narrows itself down to careful stimulation, rapid, non-exhausting elimination and increased nutrition with absolute rest in bed for a more or less prolonged period.

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SURGERY OF THE STOMACH.*

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We have learned from recent surgery of the upper abdominal cavity that in very many cases diagnosed chronic dyspepsia, and treated hygienically, dietetically and medicinally without permanent relief, the symptoms are not the result of functional trouble or of chronic gastritis that changes the chemistry of the gastric secretions, but are the result of pathologic conditions that interfere with the normal physics of the stomach and duodenum, because of organic and mechanical changes in these organs, caused by gastric or duodenal ulcer, with frequent perigastric inflammation, adhesions and contractions, which predispose to the development of cancer.

While our learned pathologists, in necropsies of patients dying in the large hospitals of the world, tell us that about 5 per cent. have active gastric ulcer, or the scar of an old one, and that in 50 per cent. of these there are perigastric adhesions, that from 1 per cent. to 3.5 per cent. of all deaths are caused by gastric cancer, and that approximately 40 per cent. of all cancers occur in the stomach, they are silent when we inquire, how are we to prevent this intense suffering and these untimely deaths?

It seems that this has been left to the combined surgical pathologist and clinician, who has learned more from *sectio in vivo* than from necropsies. He has learned, by timely operation for gastric ulcer and perforation, pyloric retention and obstruction, and perigastric adhesions, that he may not only cure his patient of gastric hemorrhage, perforation, intense pain and dyspepsia, but may prevent the development of cancer of the stomach, to which these irritations, by interfer-

ing with nutrition and resistance, predispose. Notwithstanding these facts, the life-saving principle of early diagnosis of organic lesions and timely surgical interference is not generally appreciated by most of our good surgeons and physicians, the work in its excellence being mainly confined to but comparatively few men (Robson, Mayo, Murphy, Ochsner, Mikulicz, Czerny, Moynihan, etc.), and even with those who are doing most to evolve what is in the interest of the immediate relief and subsequent life of the patient, there is no consensus of opinion in all instances as to when an operation should be performed, or which of the many operations devised accomplishes the most satisfactory results.

Professor von Mikulicz operates on about four times as many cases of cancer of the stomach as he does of gastric ulcer, while the reverse is practically true of Dr. Mayo; hence von Mikulicz takes this as the measure of the relative number of benign and malignant diseases of the stomach in Germany and the United States. In view of the fact that about 5 per cent. of all necropsies show active gastric ulcer, or the scar of an old one, while in the Vienna Hospital in 61,287 necropsies gastric cancer was found in but 1.5 per cent., I am inclined to the opinion that von Mikulicz's operations are not always timely, cancer having developed in an ulcer or about its cicatrix, for the cancer is usually the subsequent change in the ulcer.

Experience in gastric surgery, when the profession practically appreciates the significance of early diagnosis and timely operation, will convince us that in all countries there is about the same relative ratio in the number of cases of gastric ulcer and gastric cancer. Dr. Mayo diagnoses his cases and operates in the pre-cancerous stage, while von Mikulicz often loses the golden opportunity and operates after cancerous invasion; hence his immediate and subsequent mortality is much greater than in Mayo's cases.

Gastric and duodenal ulcer, with the numerous and varied complications, will finally sustain the same comparative relation to the surgeon and physician that appendicitis does to-day, and the same benefits will be derived from early diagnosis and timely operation. Only a few years ago, most patients with appendicitis refused to be operated on, having been told by many of our physicians and surgeons that the disease could be cured by saline purgation, opium and hot or cold applications. The reverse is true now, and in the near future the same will apply with equal emphasis to surgery of the stomach.

While gastric ulcer and cancer may occur in any part of the stomach, they are usually found in the pylorus, where there is an abundance of lymph vessels and glands, the cancer succeeding the ulcer, though often it does not do so for several years, many cases of ulcer being apparently cured. In the upper or lesser curvature of the stomach the lymph spaces and glands are abundant, and extend through the base of the gastrohepatic omentum and in the stomach tissue to the cardia, with the current from right to left, but in the lower or greater curvature, the lymphatics do not extend far to the left through the gastrosplenic omentum, and the current is probably toward the pylorus, as seems to have been demonstrated by Cunco. It is important that we should know, in pylorotomy and partial gastrectomy, how much of the stomach and the omenta to remove to destroy the cancer-bearing areas and infected lymphatics, except the isolated area of lymphatics in the dome above the gastro-

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splenic ligament; for the exact line of separation between gastric ulcer, with infiltrated or scar tissue, and cancer can never be positively known.

Until recently and even now, with few exceptions, nearly all chronic diseases of the stomach and upper abdominal cavity have been treated empirically by giving such medicinal, dietetic and hygienic treatment as the subjective symptoms seemed to indicate, occasionally analyzing the stomach secretions so as to supply any absent chemical constituent. Hence the frequent organic lesions that yield only to surgery were not diagnosed until advanced cancerous development, or until the disease had progressed too far to be cured by either the physician or the surgeon; and as we daily see in our mortuary reports, these patients fill an untimely grave. In the diagnosis of disease of the stomach, analyses of its contents are never conclusive until we have a correct appreciation of the value of the subjective and physical symptoms, caused by organic lesions and mechanical changes, both gastric and perigastric, including diseases of the gall bladder, bile ducts, duodenum and pancreas. We must learn to make a pathologic and surgical diagnosis, such as we are now able to do in diseases of the fallopian tubes and other pelvic structures, and the appendix; and this the abdominal surgeons will very soon teach us. The excellence of the work in pelvic surgery made possible the grand achievements of surgery in the lower abdominal cavity, including diseases of the appendix, and the perfection of this work has extended to and is perfecting the surgery of the upper abdominal cavity. From the pelvis we have gone to the appendix and to the intestines, kidneys and ureters, then to the gall bladder and bile ducts; and now we have reached the stomach and the pancreas with more encouraging results than when we approached the other organs and structures.

While a knowledge of the pathologic changes in any disease is necessary to enable us to obtain the best results in the surgical treatment, time will not permit me to enter into an extended discussion of the symptoms and physical changes that indicate the necessity for a surgical operation in diseases of the stomach, so I will briefly mention but a few facts that may enable us to make an approximately correct diagnosis, and to judge of the necessity for surgical interference.

In acute ulcer, hemorrhage or repeated hemorrhage may occur with or without premonition, sometimes causing profound shock and alarming symptoms, from which the patient usually quickly recovers without medical or surgical aid. The blood is vomited and also passed through the bowels in the feces, which confirms the diagnosis. The hemorrhage may continue in diminished quantity and frequency, and the ulcer assume the chronic form; it may then entirely cease or become profuse and quickly fatal by the necrosis of a large gastric or perigastric artery. Gastric perforation may occur in the acute, subacute or the chronic ulcer. If in the acute ulcer the perforation is sudden, of large size, allowing the stomach contents to pass freely into the peritoneal cavity, causing profound shock and intense pain, with board-like rigidity of the recti muscles, such as we have in acute appendicitis; even when the pain and shock are relieved by morphia, the rigidity of the muscles remains. We may have similar symptoms in duodenal perforation, gall-bladder rupture or acute pancreatitis, but a differential diagnosis is not essential, for in either instance a surgical exploration should be promptly instituted. Perforation in the subacute ulcer

may show more premonitory symptoms, or may penetrate the walls as quickly, but as the opening is small, inflammatory exudation and plugging usually prevent the extravasation of stomach contents, and very soon the opening is closed by firm adhesions, often leaving the stomach in a permanently crippled condition, such as we find in most cases of chronic gastric ulcer. A rupture through the posterior wall may not be followed by extravasation of the stomach contents, because the anatomic conditions admit of quick adhesions, the peritoneal surfaces being in apposition, but in these cases we may have subphrenic abscess. We have retention in chronic gastric ulcer, because the circular fibers of the pylorus spasmodically contract, when pain is induced by the efforts of the stomach to force the food into the duodenum; or because of organic changes that contract the opening at the gastroduodenal union; or because of cicatricial contraction in the body of the stomach, or perigastric adhesions that interfere with its normal motility. In either of these conditions the stomach will probably become dilated and may be hypertrophied, caused by the greatly increased labor entailed on it.

Pain will be a frequent symptom. The macerated food that the stomach can not force into the duodenum will decompose and cause painful irritation, and vomiting often results because of reversed peristalsis, such as we find in any part of the alimentary canal when an obstruction is not overcome by the normal peristaltic force. A stomach that at all times contains residual food in a decomposed condition can not be restored to its normal function except by a surgical operation that will cause free drainage. The diagnosis may be made positive by giving the patient no food for many hours, and then removing the stomach contents through a tube. If there is no interference with drainage, the stomach will be empty, otherwise there will be retained decomposed and bad-smelling residuum. Dilatation of the stomach and hourglass contraction may be outlined, and a correct diagnosis made by inflating the cavity with air pumped gradually in through a bulb syringe watching the changes that occur as the stomach is distended; and well-developed single or multiple hourglass contraction with pyloric stenosis may also be diagnosed by filling the stomach with water and then removing it. If 30 ounces be used, probably not more than from 20 to 25 ounces will come away through the tube, the other being left in the pyloric sacculus; or if the stomach be thoroughly cleansed by lavage, and within thirty minutes the tube be again introduced, there will be an offensive discharge which had returned to the cardiac sacculus from the pyloric end. While an excess of hydrochloric acid in the gastric secretions may be the cause of gastric ulcer, and while the hydrochloric acid may be diminished or absent in cases of cancer of the stomach, hyperchlorhydria and hypochlorhydria are of secondary importance as diagnostic factors.

In cancer of the stomach, chemical and microscopic examinations of stomach contents, of feces, urine and blood, are only of greatest value when the disease has passed the operable period, and often the beginning or the extent of cancerous invasion can only be positively known by an exploratory incision. The well-trained surgeon will commit no evil here, for if the disease is in the inoperable stage, the incision will cause but little trouble, and if not, there will be a malignant or other organic involvement that indicates the necessity for surgical treatment. The incision for exploration should

be short, and if the peritoneum be sutured by fine catgut, the fascia by silver wire or silk, and the skin also by fine catgut, the patient may leave the hospital in a few days and not remain in bed.

Osler recommends that an exploratory operation should be more frequently advised by the physician, and his opinion on this subject is entitled to much consideration, because of the extent and excellence of his work in cancer of the stomach.

Pain and vomiting and the perception of a tumor in the stomach are frequent symptoms in gastric cancer, Mayo Robson's statistics showing pain in 86.6 per cent., vomiting in 85.3 per cent., and tumor in 76.6 per cent.; and Fenwick says a tumor may be palpated in the body of the stomach in 81 per cent. of cases, in the pylorus in 71 per cent., and in the fundus in 55 per cent. While gastric ulcer may cause rigidity of the recti muscles, this is not true of cancer, and if the tumor is not situated too high, or can be forced down by full inspiration, it may be palpated with comparative ease. A well-defined tumor of the stomach does not always indicate malignancy, for patients with tumors at or near the pylorus have been permanently relieved of symptoms by a gastroenterostomy, and tumors attached to the abdominal walls with infiltration have disappeared when adhesions were separated, though a diagnosis of cancer had been made before and after the operation. The surface of a benign gastric tumor is regular and even, but the malignant tumor is irregular and nodular. Gastroenterostomy or the removal of adhesions never cures cancer, but may cure patients supposed to be suffering with cancer, who may otherwise have finally died of this disease. This error in diagnosis may explain the false assumption that gastric cancer is relatively increasing in frequency, for many of these patients having died without operation, were recorded cancer, no necropsy being made.

The following summary will indicate most of the diseased conditions of the stomach and duodenum, with their varied complications, that may be treated surgically:

1. Hemorrhage from ulcer.
2. Gastric or duodenal perforation.
3. Chronic gastric or duodenal ulcer.
4. Benign pyloric stenosis and retention.
5. Perigastric adhesions and contracted stomach.
6. Gastric cancer.

Hemorrhage in acute gastric ulcer, though profuse and with alarming symptoms, is usually self-limited and needs surgical treatment only when continued repetition shows that it will not be controlled by treatment of the physician. In such event, the bleeding may yield to stomach drainage at the most dependent part, which may be best accomplished by gastroenterostomy. The treatment applied immediately to the ulcer after opening the stomach, or by excision of the ulcer, has not been successful, and is also contraindicated because of the relatively high mortality, and because the ulcer is often multiple.

While some of these patients may permanently recover, other cases pass gradually or imperceptibly into the chronic stage, and we may find them many years later with chronic gastric ulcer or cancer, with abundant perigastric complications. But in acute ulcer, a far greater danger than hemorrhage is the large perforation that may occur, through which the contents of the stomach or duodenum may freely flow into the peritoneal cavity, causing death by diffuse suppurative

peritonitis, unless promptly operated on. These patients should be operated on both promptly and quickly, for they will not recover from a delayed or prolonged operation or a too profound anesthetic. Any stomach contents or pus that may be in the immediate vicinity of the perforation should be gently sponged away, but I doubt if further sponging will benefit the patient, and its employment may greatly impair the peritoneal resistance. If the infection is streptococcic, the patients will all die under any treatment; otherwise many cases with diffuse suppurative peritonitis may recover, if, after suturing the perforations, a stab opening be made in the lower abdomen and drainage instituted through a tube introduced into the uterorectal pouch, or the vesicorectal pouch in the male.

Any attempt to cleanse the peritoneal cavity by persistent sponging may so destroy the protecting endothelium as to encourage rather than prevent the growth of pathogenic bacteria, and thorough irrigation with saline solution may do no good, and may do much harm. If the infection is not streptococcic, it may not be primarily virulent, and the pus may soon become practically sterile if the cavity is allowed to drain itself from the most dependent part, and we do not irritate and impair the resisting powers of the peritoneum.

In chronic gastric ulcer, with or without pyloric stenosis, we should establish drainage that will allow the stomach contents to pass freely into the intestine with the least possible effort, and great relief will promptly follow. If there is no organic obstruction in the pylorus, but retention of stomach contents because of spasmodic contraction caused by ulcer in this locality, then the only method we can logically employ is gastroenterostomy, but when the ulcer soon heals, complications may arise when the food again passes freely through the pyloric opening. The gastrojejunal opening may then contract, leaving the intestine attached with impaired peristalsis.

In organic obstruction in the pylorus, free stomach drainage is also the only rational treatment, and of the various methods practiced, gastroenterostomy is the one generally accepted by our best surgeons, and seems to have given the best immediate and subsequent results, with the lowest mortality. Theoretically, we might prefer drainage at the pyloric end of the stomach by some of the various operations devised, but the results are not in harmony with the theory. Pyloric divulsion by the method of Loreta and Hahn has proven unsatisfactory, and the results are never permanent; nor do we feel much encouragement from the results of the Heineke-Mikulicz pyloroplasty, or its modification by Richardson, or of the submucous pyloroplasty of Koepelin and Jaboulay, where the incision is made to but not through the mucosa; or the gastroduodenostomy of Jaboulay and its modifications by Duranti and Henle. Probably the operation by Finney, for drainage at the pyloric end, known as Finney's pyloroplasty or gastroduodenostomy—which should be more correctly called pylorogastroduodenostomy—will give better results; but this is not suited to many cases, because of the necessity of dealing with the frequent perigastric adhesions, to enable the operator to unite the surfaces without tension. As this operation was performed only a few years ago, more time is needed to prove its continued success in drainage.

While gastroenterostomy, devised by Nicoladoni in 1881, is now the operation of general election, there is no consensus of opinion of just how and where the anastomosis should in all cases be made, but good results are

only obtained by drainage through a gastrojejunal opening. It is agreed, however, that the union should be made at the bottom of the stomach, just anterior or posterior to the attachment of the gastrocolic omentum, equally good results having been claimed by either method. The anastomosis may be made by the suture or the Murphy button, the same operator sometimes using one and again the other; but the tendency is in favor of the suture, except in specially selected cases, Murphy uses the button; Ochsner and Mayo have used both button and suture, but generally the latter. Czerny uses the button, and believes it is efficient in preventing the vicious circle. The bone-bobbin of Robson, and other similar devices, are seldom of any use when the surgeon becomes adept in using his needle.

In anterior gastroenterostomy, where an immediate gastrojejunal opening is not required, I believe the McGraw ligature method will finally be recognized as the simplest and the best, and there is no reason why the opening should not be as large as by other methods and remain as long patulous. It can be done quickly, and the danger of infection is reduced to a minimum, neither the stomach nor intestine being incised.

The retention of the Murphy button in the stomach will seldom occur if the incision be correctly made at the base of the stomach and its retention in the bowel is infrequent. The German "circulous viciosus," for the prevention of which we formerly did a jejunojejunostomy, is generally prevented by our modern methods, as we now seldom do the enteroenterostomy of Wölfler, or the modification of Roux between the afferent and efferent limbs of the attached intestinal loop, or its modification by Fowler, who occludes the afferent limb with silver wire. The Mikulicz and Czerny recent modification in posterior gastroenterostomy, by which they eliminate the afferent loop, may yield excellent immediate and subsequent results, as the jejunum is attached to the stomach only three or four inches below its emergence under the mesocolon and on a level with the base of the stomach. If this operation is to be finally the operation of election, it may not only eliminate the possibility of a vicious circle, but also prevent jejunal ulcer by alkalinizing the gastric contents with the bile and pancreatic secretions. While gastroenterostomy is indicated in hour-glass contraction of the stomach, the operation alone will not be successful unless the pyloric sacculus is very small, but it should be preceded by a gastropasty or a gastrogastrostomy, and then the attachment of the intestine must be made to the pyloric end, otherwise drainage can never be complete and there will be retained in the stomach decomposed and foul-smelling food and secretion.

In all operations for gastric contractions, the stomach should be carefully examined to its fundus, for we may have a sacculus at the dome, and then drainage from the pyloric sacculus may not greatly, if at all, benefit the patient.

As these contractions may be caused by perigastric fibrous bands, the deformity may be removed by dividing them or dissecting them off. Perigastric adhesions may change the normal relation and physiologic action of the stomach, duodenum, gall bladder and bile ducts, and should be separated or divided as completely as possible, so as to establish an approximately correct relation. While the separated adhesions may possibly re-form, they will not do so to the same extent, nor will the new adhesions as greatly interfere with the

physics of these organs. In rare instances the separation of adhesions may cure the patient without stomach drainage, as in a patient I recently operated on. He had several years previously suffered with either gastric or duodenal ulcer, and had symptoms of obstruction and adhesions, which caused constant pain. No evidence of the scar of an old ulcer could be found, and the gall bladder and bile ducts were normal, but extensive gastroduodenal adhesions had caused partial pyloric obstruction by drawing the upper part of the duodenum against the pyloric end of the stomach, the normal relation being restored when the adhesions were removed.

In considering the surgical treatment for cancer of the stomach, we must not be influenced by the results of Billroth or his immediate followers, or, in fact, by any results except in patients recently operated on; nor must we see any value in the older statistics, further than to show by comparison with present methods and results, an evolution that has removed most of the former dangers. Billroth's operations for pylorotomy and gastrectomy were bloody and prolonged, most of his patients leaving the operating table in profound shock, from which but few recovered. But, then, the histology, physiology and anatomy of the stomach and perigastric structures were not practically appreciated. This is especially true in relation to the blood vessels and lymphatics of the stomach and the gastrohepatic and gastrocolic omenta; hence we did not know how easily pylorotomy and partial gastrectomy could be made nearly bloodless operations, or how much of omenta and stomach should be removed or the direction of the line of incision in resections, or the value of closing the end of the duodenum and the stomach, and establishing drainage through a gastrojejunal opening. Mayo's mortality in the various operations for cancer of the stomach in 109 cases is 15.5 per cent.; and in 41 radical operations on the pyloric end of the stomach, 4 for ulcer and 37 for cancer, 8 died, but in his last 11 he has had no death.

In many cases of cancer of the stomach, the disease is so extensive and so many complications have developed that a radical operation for permanent relief is contraindicated, but in these cases much relief may be afforded by a gastroenterostomy, where enough healthy stomach tissue can be utilized, or, if this is not possible, pain may be greatly relieved and life prolonged by a gastrostomy or jejunostomy, putting sufficient food in the jejunum through a Jaques catheter. The mortality in gastrostomy and jejunostomy is practically *nil*, and Mayo Robson's recent mortality in posterior gastroenterostomy for simple diseases is 3.9 per cent and for cancer but 5 per cent. In pylorotomy or partial gastrectomy in benign pyloric obstruction, gastroduodenostomy can never be an operation of general election, and in cancer it should never be attempted. Theoretically, it would seem to possess some advantages over gastroenterostomy, but practically it does not, and the increased mortality contraindicates the operation. While the open end of the duodenum may sometimes be brought without tension to the lower part of the remaining stomach and be anastomosed, this is seldom possible because of the firm inelastic adhesions which can not be entirely removed, and where there is tension there can be no safe union. These objections do not apply to gastroenterostomy, and the gastrojejunal opening will remain permanently patulous in either anterior or posterior union. Patients have recovered from the operation for total gastrectomy and lived for one

or two years, but I do not believe the operation is justifiable, based on our knowledge of the location and behavior of gastric cancer. Cuneo's observations on the lymphatic currents were utilized by Hartman when he fixed the line of section in partial gastrectomy, and these facts have been accepted by our best surgeons.

In the radical operation for simple pyloric stenosis with hypertrophy, it has been suggested by Rodman that extensive resection beyond the lymph nodes may give better permanent results, because of the removal of pyloric ulcer and cancer areas, except in the dome and cardia. In cancer of the dome of the stomach or the cardia, total gastrectomy is a difficult and dangerous operation, with nearly 100 per cent. mortality, and if primarily successful will not give more continued relief than gastroenterostomy. In cancer of the body of the stomach a gastropasty may be indicated if seen in the earlier stages. While the stomach is as abundantly supplied with blood vessels as any organ of the body, and anastomosis as perfect as in the vessels supplying the uterus, and in a degree similar, hemorrhage is easily controlled in radical operations by ligating the principal branches beyond the lines of incision. If the coronary branch of the gastric, the pyloric branch from the hepatic and the right and left gastroepiploica be ligated at the correct place, hemorrhage will not be profuse in radical operations at the pyloric end of the stomach extending up the lesser curvature nearly to the cardia. It must be remembered that the blood is derived from each of the three branches of the celiac axes—the gastric, splenic and hepatic. In partial gastrectomy I see no advantage in Mayo's curved incision with the convexity toward the dome, but prefer using the long straight forceps, and making a direct incision from the greater to the lesser curvature. This as successfully removes the infected area, and gives a broader and better stomach surface for jejunal attachment.

THE PREVENTION OF TETANUS.

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Much has been written during the past ten years concerning the symptoms and treatment of tetanus, and especially the frequency with which it followed all varieties of punctured wounds. Little, however, has been written as to definite methods for the prevention of this dread disease, and it has always seemed to me that this aspect has not been sufficiently dwelt on. We usually associate tetanus with Fourth of July wounds, but it is almost as frequent after punctured wounds received by rusty nails or pitchfork injuries as after blank cartridges. Why these three classes of injuries should be followed by tetanus can not be explained on any other ground than that in the case of blank cartridges the latter itself is free from tetanus, but that the hand or foot or face, which are the most frequent sites of infection, are more or less covered with street dirt containing tetanus bacilli, and that the blank-cartridge wound furnishes the ideal conditions for the development of the tetanus bacilli. These conditions are a more or less completely closed wound, containing a foreign body in the shape of a portion of the cartridge.

It has been shown experimentally that the pathogenicity of the tetanus bacillus is increased by irregular wounds where there is more or less necrosis, or in the

presence of a hematoma, especially if a foreign body be present. In the case of rusty nails one does not have to seek far to explain the origin of tetanus after such wounds. It is not the rust on the nail, as has been generally thought, but the fact that the nail is covered more or less with dust and street dirt, and that the sole of the foot or the palm of the hands are, as in the case of a blank-cartridge wound, in none too clean a condition, being almost invariably covered with dirt at the time of the reception of the injury. In the case of pitchfork wounds a somewhat similar origin can be demonstrated. It is well known at the present time that the tetanus bacillus is found under normal conditions in the intestines of horses, and that the spores are present in horse dung, manured gardens, street dirt and poorly built wells. It does not require a great stretch of imagination to see how a pitchfork, either covered with street dirt or horse dung or garden earth, can carry into a punctured wound many tetanus bacilli. It has been amply shown that the blank cartridge itself does not contain tetanus bacilli. In the exhaustive article on "Fourth of July Casualties," published in *THE JOURNAL* of the American Medical Association, Aug. 29, 1903, five investigators are quoted who have examined 759 blank cartridges, bacteriologically, without finding tetanus bacilli in one.

My principal reason for writing this article has been to call attention to the fact that if a punctured wound which has been inoculated with tetanus bacilli be treated sufficiently early by methods which are based on the knowledge of the bacteriology of the disease, we can absolutely prevent the development of tetanus in every case. The tetanus bacillus, I need scarcely mention, is an anaërobic organism, and is surrounded by ideal conditions for its growth in punctured wounds. After the foreign body, whatever it may be, has penetrated the skin and underlying soft parts, the edges of the wound of entrance are rapidly closed by wound secretion, and we have a closed cavity, as I have been able to demonstrate on a number of occasions, devoid of oxygen, and an ideal place for the development of the tetanus bacillus. Add to this the necrosis and blood clots, and it requires only a short time before the symptoms of tetanus appear. When we consider that human beings, mice and guinea-pigs, are exquisitely sensitive to the toxins of tetanus, and that it requires only 1/100,000 to 1/10,000,000 of a cubic centimeter of tetano-toxin to kill a mouse, we can readily understand how a few tetanus bacilli can produce the necessary amount of havoc within a comparatively short space of time.

The period of incubation varies somewhat, according to the severity of the infection. According to Bruner, when the incubation period was one to five days, nine cases died and one recovered; when the period of incubation was five to ten days, eighteen died and eight recovered; when it was ten to twenty days, none died, and six recovered. From this we can deduce that the longer the period between the infliction of the injury and the appearance of the symptoms, the less severe the case. Many of the cases of tetanus which have responded to the tetanus antitoxin have belonged to the subacute variety.

In regard to the prospects of recovery after the development of tetanus, one needs only to bear in mind the large percentage of deaths, even after the use of antitoxin and medicinal remedies, such as morphin, bromids, chloral, etc. Ullrich has lately collected 19 cases, in which the Behring tetanus antitoxin was injected between the second and the fifth days. Of the nineteen,