

It would seem as though the motor impulses in this case had been transmitted from the healthy side—a sort of overflow of volitional energy from the sound side which is not restrained by the ordinary inhibitory force; the removal of this inhibitory force being due to the lesion in question. From all of which we make the very natural deduction that the two halves of the central nervous system in health coöperate by antagonizing each other's forces, each half in health placing a check upon the supernumerary energy of the other.

The preceding communication will serve to illustrate the following points:

1. The slow onset of oculomotor symptoms associated with ataxia and vomiting point to a neoplasm in the vicinity of the corpora quadrigemina.

2. The diagnosis of polio-encephalitis superior (Wernicke) should not be made unless tumor of the quadrigeminal region can be positively excluded.

3. Paralyses of one or more muscles, and not of all muscles supplied by the oculomotor nerve, do not necessarily imply a nuclear lesion. This is particularly true of syphilitic cases, in which an affection of the nerve rootlets may give rise to symptoms exactly like those of nuclear disease.

4. Post-hemiplegic ataxic movements may result from lesion of the crus, and probably from lesion in any part of the motor tract.

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THE TREATMENT OF PENETRATING GUNSHOT WOUNDS OF THE ABDOMEN,

WITH AN ANALYSIS OF ONE HUNDRED AND SIXTY-FIVE CASES
TREATED BY LAPAROTOMY.

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In the *Revue de Chirurgie* of February, 1890, in an elaborate article fifty-three pages in length, two well-known French surgeons, M. Reclus

and M. Nogués, make a vigorous attack upon what they are pleased to call the "American" method of treating gunshot wounds of the abdomen. In a long argument, supported by eighty-eight tabulated cases treated conservatively, the old "Laissez-Faire" doctrine is again preached with an enthusiasm which will be sought for in vain in the writings of its earlier advocates; for while these (the earlier advocates) clung to the principle of non-interference, most of them did it as the drowning man clings to the straw—not because he believes it has power to save, but because it is the only thing he can lay hold of. But here we have the principle set forth in an entirely new aspect, and if the bold claims which are advanced in support of it are true, then, indeed, are the laurels which American surgeons have won in this department of their art destined to be short-lived.

The penetrating shot-wound of the abdomen, so dreaded by the surgeons of the past—and justly, too, it would seem, when the highest authorities place the mortality between 80 and 90 per cent.—is now, for the first time, shown to be a comparatively insignificant injury, with a mortality of only 25 per cent.

We naturally expect these brilliant and extraordinary results to be accredited to some newly-discovered method of treatment, but finding the old method of non-interference carried out in every case, we are forced to look for some way of explaining the lack of harmony in the results.

In the *Med. and Surg. Hist. of the War of the Rebellion*, Part II., vol. ii. p. 202 (Otis), we find 3249 cases of penetrating shot-wounds of the abdomen treated expectantly; of these, 88 per cent. died. In the Franco-Prussian War, 1870, 1600 cases of penetrating wounds of the abdomen were reported, with a mortality of 69.47 per cent. (*Centralblatt für Chirurgie*, Dec. 1889).

Still later are the statistics of the Tonkin War—72 cases, with a mortality of 75 per cent. (*Archiv de Méd. et Pharmacie*, 1889).

If to the foregoing we add the New York statistics reported by Dr. Lewis A. Stimson (*N. Y. Med. Journ.*, Oct. 22 and Nov. 2, 1889), we have a total of 4958 cases of penetrating wounds of the abdomen treated according to the method of abstention and showing a mortality of 81 per cent.

In spite of these figures, believed by many of the best authorities in abdominal surgery to be too low rather than too high an estimate of the mortality of penetrating wounds of the abdomen—at all events, high enough, it would seem, to convince anyone of the inadequacy of the method of non-interference—its new defenders and champions have given us a table containing 88 cases of shot-wounds of the abdomen, with signs sufficiently pathognomonic in their opinion to warrant their being considered as penetrating, with a mortality of only 25 per cent.

This brilliant record they point to as proof of the superior results of abstinence.

In my former paper (published Oct. 18, 1888, *Boston Med. and Surg. Journ.*) in reference to this very point, viz., the large number of cases of recovery without operation, cited by M. Reclus in a previous article, I said: "More light must be thrown upon some very important omissions of M. Reclus before he can have good ground for expecting American surgeons to accept his views. Suppose we accept his 50 cases of recovery without operative interference as authentic, what do these prove? Absolutely nothing, until we are told how large a number of cases that did not recover were found before getting the 50 cases that did recover."

In his recent tables containing 88 cases with only 22 deaths, the author evidently considers this point satisfactorily disposed of, and would have us believe that out of 88 cases of penetrating shot-wounds of the abdomen, 75.7 per cent. recovered under conservative treatment.

Without in any way casting the slightest suspicion upon the trustworthiness of the statistics or the conscientiousness exercised in the selection of the cases, I think it can still be claimed that the tables prove *absolutely nothing* as regards the comparative merit of the two methods of treatment. The cases referred to are either cases which have been collected from published reports in the various medical periodicals or cases which have come under the immediate observation of the writers themselves. Now, as a matter of fact, a very small proportion of the fatal cases would naturally find their way into medical journals, while there would be every reason for bringing to notice a case of recovery from an injury that had come to be regarded, in the light of the best surgical opinion, as almost universally fatal.

In this way the large number of recoveries in the table can be easily explained; far more easily than by supposing that the unanimous opinion of the most renowned surgeons for generations as to the high mortality of this class of injuries has been totally without foundation.

It might, however, be said on the other side that the same objection would apply to the statistics of cases treated by laparotomy, but a moment's thought will convince one that this is not so.

While there are a few scattered cases before 1883 and 1884, not until then did the brilliant successes of Kocher, Bull and Hamilton bring the operation prominently before the surgical world. It soon became a leading subject of debate in nearly every surgical society of this country, and a glance at the reports of European societies will show that the interest in it was not confined to America alone. Every new case in which the operation had been performed was eagerly sought for, and whether successful or otherwise its result, with rare exceptions, was soon made public.

Again, it has been objected that the opinion as to the high mortality of this class of injuries is based upon military statistics, and that in consequence of the larger size of the bullets in these cases the mortality would necessarily be much higher than in cases occurring in civil life. A glance at my tables will show that the severity of the lesion and the mortality bear no direct ratio to the calibre of the weapon, and that even the smallest bullet has caused extensive visceral injuries. Dr. Stimson, in his very admirable monograph already referred to, says in regard to this point: "The size of the opening, while corresponding in a measure to that of the bullet, is yet so seriously affected by other circumstances that no favorable prognostic influences can be safely drawn from the small size of the hole. Thus, in Kocher's case, a 0.22 calibre bullet made an opening in the stomach $1\frac{1}{2}$ centimetres in diameter, and a small ball entering obliquely¹ or cutting along the convexity of a loop of intestine has made an opening an inch or more in length."

In their efforts to detract from the success of the operative method of treatment, M. Reclus and M. Nogués object to the tables of the "interventionists," and accuse them of placing to their credit cases of simple enterorrhaphy practised upon a single coil of wounded intestine protruding from the wound—a simple operation, not dangerous, and in no respect resembling a complete laparotomy, with careful examination of the entire intestinal tract; and they further say that these cases cannot be counted among those "saved by laparotomy," nor likewise can those in which there was no visceral injury and the intestines were not perforated, and with this assumption they at once proceed to exclude in a wholesale manner the cases of Sevastopoulo, Skelly, Smartt, Murphy, Barker, Brown, Cahot, Jalaguier, all of which recovered under operation, thus reducing the number of cases in Class I. (operation performed within first twelve hours of the injury) from 55 to 47, and increasing the mortality from 63 per cent. to 76 per cent. The cases in Class II. (operation after twelve hours) are dealt with in the same way, and the cases of Bull, Andrew, Frick, Newald, Gaston and Hillmantel (4 recoveries and 2 deaths) are ruled out, raising the mortality to 90 per cent.

Before dealing with the question as to the propriety of excluding the above-mentioned cases, there are a number of cases in M. Reclus's tables (103 cases treated by laparotomy, *Revue de Chirurgie*, May, 1890), the removal of which admits of no question. First, the two cases accredited to Hillmantel (both fatal) are duplicates, appearing a second time under the name of Fenger, who performed the operations, Hillmantel simply assisting and reporting the cases, as may be seen by referring to the original reference (*Journ. Amer. Med. Assoc.*, July 21, 1888).

¹ The recent experiments of Schachner bear out the same conclusion.

Again, the cases of Larry, 1799, Jndson, Bently and Gill (*War of the Rebellion*, see Otis's *Hist.*) were all cases of "simple enterorrhaphy," the wounded gut protruding, and in none of them was a true laparotomy performed. It is singular that these cases, the very ones which Reclus claims should be excluded from the tables of the "interventionists," should find a place only in his own tables.

As late as 1877, "Bauden's enlargement of the parietal wound remained unique," Stimson (*loc. cit.*). Thus 6 cases, 5 deaths and 1 recovery, should undoubtedly be excluded, thus reducing the total mortality of M. Reclus's tables to 64 per cent.

Now a word in regard to the 12 recoveries which M. Reclus says should not be counted among those saved by laparotomy.

The cases of Cahot and Jalaguier were both perforating wounds of the stomach.

The cases of Vaslin and Sevastopoulo, multiple wounds of the small intestine, and in both resection of a portion (2 to 4 centimetres) of the small intestine was performed.

The cases of Smartt, Murphy, and Barker had extensive wounds of liver and blood in abdominal cavity.

In the case of Bull, operation was done twelve and a half hours after injury. There was profound shock, surface of body cold, temperature 94°, and evidence of internal hæmorrhage. Operation was done to control hæmorrhage, if possible, but patient died one-half hour after ether was started. Would abstention have given any better chance of recovery?

The cases of Brown, Andrews, and Skelly showed a considerable quantity of blood in the abdominal cavity. The abdomen was washed out and the patients recovered.

The cases of Gaston and Frick are the very cases in which Reclus himself advises laparotomy, viz., where well-marked signs of peritonitis have developed. The case of Gaston was operated upon at the end of the fourth day (surgeon not called before). The intestines were found greatly distended and there was a large quantity of decomposed blood and pus in the abdominal cavity. The patient died two hours after the operation; the autopsy showed *no wound* of the intestinal tract, and only an abrasion of the colon.

In the case of Frick the patient was not found until twenty-five hours after injury; was brought to camp hospital two days later, and signs of peritonitis having developed, operation was performed on the sixth day. A large lacerated wound of the liver was found and a deep abscess had formed along the track of the bullet. A six-inch abdominal incision and free drainage; patient made a good recovery.

M. Reclus, in all his writings on this subject, argues upon the assumption that a penetrating wound of the abdomen is serious and likely to be followed by fatal consequences only when perforation of the intestines

exists, and rarely then unless fecal extravasation has taken place. In other words, that the chief and almost only cause of death (aside from hæmorrhage) is peritonitis. That this is a false assumption was very ably and conclusively proven by Dr. J. Marion Sims in his well-known paper ⁽¹¹⁾ published in the *Brit. Med. Journal*, 1882. He says: "When I went to Sédan, in 1870, as surgeon-in-chief to the Anglo-American Ambulance Corps, I went in the hope that I might do something to elucidate the subject of the treatment of gunshot wounds of the abdomen. I learned this great truth—that all the cases died of septicæmia. The post-mortem examination showed large quantities of bloody serum in the abdominal cavity. In every case there was this evidence of blood-poisoning, and there was not the slightest evidence of peritonitis. There was not a single exception to this rule. Bloody serum is an ordinary result of any gunshot wound of the fleshy parts of the body, and it is not unnatural that it should be found in wounds of the peritoneum. It is possible that an escape of flatus or of contents of the intestine may give intensity to the poisonous quality of the bloody serum in the abdomen."

That perforation of the intestine is by no means necessary to render the wound fatal, is not only shown by the case of Gaston which I have already cited, but is proved in a very striking manner by the four cases of Dr. Hunter McGuire ⁽¹²⁾ reported at the meeting of the American Medical Association, 1881. These cases were all shot-wounds of the abdomen (2 military, 2 civil), but the ball passed transversely through the abdominal wall without penetrating the parietal peritoneum, simply bruising it. All the cases died, and a considerable amount of bloody serum was found in the abdominal cavity in every case; in reference to these cases Dr. Sims says: "Death resulted practically as it would have done had the peritoneal cavity been penetrated and the intestine perforated."

Enough has been said, I trust, to show that wounds of the abdomen to be fatal do not require perforation of the intestine, and enough to justify the right to place the 12 recoveries above referred to to the credit of operative interference. Taking for granted the proposition which I shall attempt to establish later on, that operative interference in penetrating shot-wounds of the abdomen produces results superior to those obtained by abstinence, one very important point still remains to be decided, viz., Shall the principle of interference be subject to more or less narrow restrictions, or shall it be regarded as a principle of universal application? Upon this point the advocates of laparotomy are divided.

Dr. Stimson, in the paper already referred to, says: "Between the two parties—those who would operate in every case, and those who would operate in none—stands a third, those who would operate only when symptoms indicative of dangerous processes have appeared; but I believe this plan the most dangerous of all, and if it were generally

followed would lead to the entire abandonment of the operation. We know that an individual in fairly good health can have his abdomen explored without very great risk, and one who has received an abdominal wound not necessarily fatal ought at the moment, or shortly after, to be able to bear an exploration equally well. In such cases the risk of operation, when performed under the proper safeguards, is, I believe, less than that which the bullet has probably inflicted, and it is in such cases that I believe the operation is capable of valuable and superior results."

Dr. Stimson then goes on to say that if several hours, or perhaps a day, has elapsed and the patient is doing well, it might be better to abstain from interference; while if the condition has decidedly changed for the worse and signs of peritonitis have developed, the indications for refraining from operation are even stronger, and though the case may be considered hopeless without it, it is all the more hopeless with it.

To take these two classes of cases in order: first, a word in regard to those cases in which, after the lapse of several hours, the patient is apparently "doing well." Dr. Bull's first case is in point—seventeen hours had passed. There was some pain and tenderness, but pulse and temperature were normal, and patient was "doing well." Laparotomy was performed; seven wounds of the small intestine were found and two pints of bloody serum and clots were found in the abdominal cavity. The wounds were closed, the abdomen washed out, and the patient recovered. Can anyone believe that the case could possibly have recovered without operation? The case of Lange is likewise in point. Twenty-four hours after the injury the condition of the patient was as follows: No shock. Pulse 112. No pain. Abdomen tender and some tympanites. Laparotomy disclosed seven perforating wounds of the small intestine. Wounds were closed, and patient recovered without a bad symptom.

In regard to the second class of cases, when the condition of the patient has become much worse and symptoms indicative of dangerous processes have developed: in addition to the case of Frick, already cited—operation on the fifth day, recovery—I will mention that of Priddy, in which the operation was done 108 hours after the wound had been received, and showed a wound of the colon six inches long; a wound of the mesentery and of the jejunum, and in addition a considerable quantity of bloody serum and pus in the abdominal cavity and well-advanced peritonitis. The wounds were closed, the abdomen washed out with warm 1:10,000 bichloride of mercury, and the cavity drained. The patient made a good recovery.

These cases are cited, not to lessen in any way the belief in the great advantage of the early operation, for that has been conclusively proved by the history of the first class of cases, but to show that those cases which have gone on until *dangerous symptoms* developed before they

came into the hands of the surgeon, and are "hopeless without operation," are *not more* hopeless with it.

Sims, in reference to late operation, when signs of peritonitis have already developed, says: "Nature cures peritonitis in the early stages by uniting contiguous inflamed surfaces by the intervention of plastic lymph; but if the inflammatory process has gone further, and the plastic exudation has terminated in pouches of pus in the folds of the intestines, or purulent effusion in the peritoneal cavity, then death follows from the absorption of the fusiform collection. In this stage why should we not open the abdomen before it is too late, liberate the adhesions, and remove the matter which is imprisoned in pouches or free in the cavity?"

This can be done, and will be done, for it is but the imitation of Nature's clumsy efforts in this direction. It is true that these conclusions of Sims are entirely theoretical, arrived at by inductions based upon his experience in the operative treatment of ovarian disease. To show that they were well founded I need only to call attention to the constantly-increasing number of recoveries from general septic peritonitis, treated by laparotomy and drainage. The case of Sands, following perforation of the appendix (*Medical Record*, February, 1888), was considered almost unique, but the number of cases since recorded shows a brilliant outlook for the operation in the future.

Within the past six months there have been two cases of recovery from acute septic peritonitis treated by laparotomy at the New York Hospital, by Dr. W. T. Bull, the one from the perforation of a gangrenous cæcum, and the other consequent upon the rupture of a suppurating Fallopian tube. Dr. Stimson himself has very recently had a similar case in private practice following a perforating appendicitis, in which he operated more than twelve hours after the acute symptoms had developed, and found a considerable amount of seropurulent fluid in the abdominal cavity. The patient made a rapid recovery. The experience of Tait still further confirms us in the opinion that operative interference should be resorted to in the desperate cases we are considering. Writing in 1885, he says (") that since Wiltshire first did a laparotomy for acute peritonitis in 1868, and the patient recovered, he himself has opened the abdomen forty-four times for peritonitis, and forty-one of the patients recovered; that he began by operating for peritonitis following ovarian disease, but soon became convinced that there was no reason whatever for thus limiting the operation, and since then he has never allowed a patient to die from peritonitis without opening the abdomen, provided the consent of his colleagues and of the friends of the patient could be obtained. That this principle is rapidly gaining ground, not only in England and America, but also on the Continent, is shown by the recent paper of Krecke (1), "On the Surgical

Treatment of Peritonitis," in which he says: "The treatment of peritonitis, following perforation of the appendix is *operative*, and no other means are for a moment to be considered. When the knife is used promptly the most hopeless cases may recover."

And still again, if further proof were needed, by the excellent contribution entitled "The Surgical Treatment of Peritonitis," read at the last Congress of French Surgeons, by Professor Demosthene (""), of Bucharest.

Before concluding my defence of the "American method" of treating gunshot wounds of the abdomen, I will quote a few lines from a well-known French authority on this subject.

Verchère, in a most admirable and exhaustive monograph on "Wounds of the Intestine by Arms of Small Calibre," published in the *Revue des Sciences Médicales*, 1888, page 297, after having gone over the whole literature of the subject, from Hippocrates down, carefully reviewing the thesis of St. Laurens, and analyzing the cases of recovery that form the basis of M. Reclus's argument, says: "From this we conclude, with the *Americans*, that every penetrating wound of the abdomen is a perforating wound, and that every perforating wound of the small intestine is fatal, and, save with very rare exceptions, followed by death."

Referring to the cases of recovery treated by abstention, he adds: "By the same method of reasoning one might prove that falling from a seventh-story window was a comparatively trifling matter, for it would not be impossible to collect a certain number of recoveries from such an accident."

But these so-called recoveries will hardly stand the test of rigid analysis.

Of the 34 recoveries of St. Laurens, Verchère finds that only 7 can be regarded as wounds of the intestine; and, after searching through all the publications that he could find, he was able to collect only 18 recoveries out of a very large number of cases—several thousands.

In the recent experiments of Schachner, of Louisville, upon dogs, we find that in 32 cases treated by laparotomy the mortality was only 45.1 per cent., while of the 5 cases treated without operative interference only 1 recovered, and in this case there is "strong probability that very slight, if any, injury occurred."

HYDROGEN-GAS TEST.—Three years ago, rectal insufflation by hydrogen gas, as a means of ascertaining whether or not the alimentary canal had been wounded, was proposed by Dr. Senn, of Milwaukee. Dr. Senn's brilliant work in the field of abdominal surgery, both clinically and experimentally, was sufficient reason for its early recognition and almost general acceptance. While some of the more enthusiastic surgeons admitted its claim to "infallibility" without question, others were more conservative, and, while not denying its advantages, reserved their

opinion until its merits had stood the test of actual experience. A few others openly objected to the test. Dr. Arthur T. Cabot, of Boston,¹ was among the first to formulate these objections. In the course of his remarks he says: "Dr. Senn's other work in abdominal and other branches of surgery has been so full of practical suggestions that a surgeon having a perforating wound of the abdomen, and neglecting to apply a test so highly praised by him, is open to the charge of a disregard of necessary precautions, if he cannot show good reason for his neglect. Further experience may show the objections I shall state to be purely theoretical, but until this is demonstrated I shall prefer to treat wounds of the human abdominal cavity in a less experimental way."

The chief objections to the test are briefly these:

1. The test is not an "infallible" index of the condition of the alimentary canal.
2. The danger of producing infection of the peritoneal cavity.
3. It shows nothing as to the condition of other viscera, wounds of which frequently demand operative interference.
4. It prolongs the operation; interferes with respiration; adds to the shock.
5. It increases the liability of the sutured wounds to give way.

These objections are theoretical, perhaps, at first, but it would seem that at the present time a sufficiently large number of cases are on record to make it possible to draw some definite conclusions as to the value of this method.

In an exhaustive paper read at the International Medical Congress at Berlin, August 8, 1890, on the "Diagnosis and Treatment of Penetrating Wounds of the Abdomen,"² Dr. Senn discusses the question at considerable length, and to strengthen the argument in favor of the test, he gives in detail a report of six cases that had come under his personal observation as "A Clinical Contribution in Testimony of the Value and Reliability of the Hydrogen-gas Test in the Diagnosis of Penetrating Gunshot Wounds of the Abdomen."

Of these 6 cases, 3 recovered and 3 died. One, in which the test gave a negative result, was not operated upon, and, in spite of the fact that there was moderate hæmaturia for two or three days, the patient recovered.

In one other case that recovered, the gas-test gave a negative result, but, owing to some defect in the bag, thorough insufflation could not be obtained. The stomach and large intestine were distended, but showed no perforation. Owing to the doubt as to the condition of the small

¹ Boston Med. and Surg. Journ., 1889, ii. 81.

² Journ. of the Amer. Med. Assoc., Aug. 30, 1890, p. 311.

intestine, laparotomy was performed. *No wound* of the alimentary canal was found, but some blood and *pieces of clothing* were found in the abdominal cavity. It would seem that in this case recovery was due to the fact that the bag leaked, for, had the apparatus been in perfect order, the test would have shown the intestinal tract intact, and there would have been no indication for interference, the patient's general condition being (as it was) very good.

The third case of recovery happens to be the only case on record in which the intestine had been wounded (and hydrogen-gas test used). In this case thorough irrigation was employed and a drainage-tube left in the abdomen. On the fourth day a fecal fistula appeared at the site of the drainage-tube.

I have been able to collect a series of 14 cases in which the hydrogen-gas test has been resorted to (including Dr. Burrell's case, in which air was used instead of hydrogen gas) as a means in diagnosing shot-wounds of the abdomen. A careful analysis of these cases shows that 11 cases died and 3 recovered.

The 3 recoveries were Dr. Senn's cases, and were referred to at length above. In the 11 fatal cases the cause of death was peritonitis in 10 cases, hæmorrhage and shock in 1. The total mortality in the 14 cases is 78.5 per cent.—surely not a brilliant showing.

Dr. Senn has attempted to answer the principal objections to the test, but are the answers satisfactory?

The infallibility of the test is no longer claimed, even by Dr. Senn himself, and in giving up that point the test has suffered greatly, for, if it is not *infallible*, how is the surgeon to act when it gives a negative result? The unfortunate experience of Dr. Dalton,¹ of St. Louis, in two successive cases, proves the objections to the test not merely theoretical, but painfully practical.

In one case, a careful application of the test failed to show any perforation of the stomach or intestines. Dr. Dalton said that his faith in the test was so great that he was satisfied they were uninjured. The patient died twenty-eight hours after the injury, and the autopsy showed two holes in the stomach (each one-half inch in diameter) and a large, lacerated wound of the left kidney.

In the second case the test gave positive evidence of perforation, but the distention was so great that it interfered seriously with the respiration; added to the shock, made the restoration of the intestines to the abdominal cavity almost impossible, and caused a rupture of some of the sutured wounds, causing fecal extravasation. The patient died, and, to quote the words of Dr. Dalton, "here was a case in which Senn's method not only did no good, but absolutely did a great deal of harm."

¹ Weekly Medical Review, 1889, 23, 243.

Another very instructive case is a case of Fenger's.¹ The external wound was a little to the right on a level with the umbilicus. Thorough insufflation with hydrogen gas gave *negative* result, which, in spite of the fact that the abdomen showed a "changing line of dullness," was thought to be a sufficient reason for non-interference. The wound was dressed on the sixth day, and an area of well-marked induration found. Signs of suppurative peritonitis quickly developed. Laparotomy was performed and eight ounces of purulent fluid, having a fecal odor, were found in the abdominal cavity, along with other evidences of a well-advanced peritonitis. The patient died eight hours after the operation. The autopsy failed to disclose any perforation of the intestine, and Dr. Fenger goes so far as to cite this case as "an illustration of the proficiency of the gas-test in a case where there is no perforation," and he goes on to say, "we may safely say that one unnecessary laparotomy was prevented."

In view of the fact that of the nine cases in which the abdomen has been opened and the viscera found intact, six of the cases operated upon early recovered, while in two of the fatal cases laparotomy was not performed until the fourth and sixth days, and then for an already developed septic peritonitis, is it not possible to arrive at a different conclusion from Dr. Fenger's? The case not only "illustrates the proficiency of the hydrogen gas test," but it illustrates still more forcibly the danger in relying upon it as an index as to the necessity of operative interference. Had the wound been enlarged and cleansed, laparotomy performed, and the blood removed, there is good ground for believing the patient would have recovered. There is another source of danger in the gas-test, and that is the increased liability to septic infection. It is true that Dr. Senn denies this, and he cites the results of a large number of experiments on dogs to prove that fecal extravasation is exceedingly rare; but the fact that ten of the eleven deaths in which the test had been used at the operation were the result of septic peritonitis, surely does not tend to lessen our fears. Much is made of the fact that hydrogen gas is aseptic. Such may be its character when it enters the rectum, but it is difficult to see how it could remain so after having traversed the intestine, and it might readily introduce into the abdominal cavity a sufficient number of germs to produce infection, without causing any *visible* fecal extravasation. While the gas-test is to be condemned as a means of *diagnosis*, there remains a field wherein it may prove a useful adjunct to laparotomy, and that is to detect perforations that might otherwise be overlooked. For this purpose hydrogen gas has no advantage over atmospheric air. Even this limited use of the gas-test has its disadvantages, and it is still open to doubt whether the risk of having

¹ Journ. Amer. Med. Assoc., July 21, 1888.

left an undetected perforation is not more than counterbalanced by the dangers arising from distending the intestines and increasing the liability of the wounds already sutured to give way.

At present the observations are too few to determine this point. Since the publication of my former paper, October, 1888, containing 74 cases of penetrating shot-wounds of the abdomen treated by laparotomy, I have been able to collect 91 additional cases, making a total of 165 cases. The greatest effort has been made to obtain all the cases that have been operated upon, without regard to result. My tables contain a large number of unpublished cases, obtained from hospital records or from personal notes from the surgeons who performed the operations.

Of the total number, 165, there were 54 recoveries and 111 deaths, giving a mortality of 67.2 per cent. Of this number there were 81 cases of wounds of the *small intestine*, with 25 recoveries, or a mortality of 67.5 per cent.; 24 cases of wounds of stomach, 6 recoveries, mortality 75 per cent.; 36 cases of wounds of colon, 12 recoveries, mortality 66.6 per cent.; 19 cases of wounds of liver, 8 recoveries, mortality 58.7 per cent.; 11 cases of wounds of kidney, 1 recovery, mortality 90.9 per cent.; 50 cases, carefully analyzed, showed a mortality of 66½ per cent. for wounds of the *small intestine* uncomplicated with other visceral injuries, and 70 per cent. when other viscera were wounded.

Wounds of the stomach, liver, and colon all showed the same mortality in *uncomplicated* cases, 66½ per cent.

In the 81 cases of wounds of the *small intestine* there were 439 perforations, or an average of 5.4 for each case.

Laparotomy was performed in 9 cases in which no viscera were wounded; of these 9 cases, 6 made prompt recoveries, and in 2 of the fatal cases the operation was delayed until the fourth and sixth days, and then performed with the patient *in extremis* for septic peritonitis.

There were 25 cases in which the alimentary canal was found intact; of these, 12 recovered and 13 died; mortality 52 per cent. (this includes many of the fatal kidney cases); 16 cases of resection, 3 recovered.

Hydrogen gas-tests were used in 13 cases; of these, 11 died, 2 recovered; mortality 81 per cent. (The test was used in one other case in which operation was not resorted to, and patient recovered.)

Of the total 165 cases, in only 9 instances did the operator fail to find all the perforations.

In 48 cases, where the causes of death were given, 25 were assigned to septic peritonitis, 19 to shock, 4 to hæmorrhage.

In 16 cases, where drainage was used, 6 recovered and 10 died; mortality 62.7, slightly below the average.

CONCLUSIONS.—Given a shot-wound of the abdomen, the indications are:

1. *Exploratory incision* in the region of the wound to ascertain whether or not it is *penetrating*.
2. If *penetrating*, *median laparotomy* as soon as possible after the injury has been received unless suffering from severe shock.
3. Signs of a *peritonitis*, just beginning or well developed, while diminishing the chances of success, are by no means a contra-indication for *operative interference*.

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THE ANATOMY AND PHYSIOLOGY OF THE FAUCIAL TONSILS WITH REFERENCE TO THE ABSORPTION OF INFECTIOUS MATERIAL.¹

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ALTHOUGH very much has been said and written about the diseases of the tonsils, but little attention, comparatively, has been given to their normal structure and to the rôle which they play in the animal economy.

The descriptions of their minute structure in most text-books of anatomy and histology, and even in special treatises on the throat and nose, are exceedingly meagre. This would account in part, at least, for the considerable diversity of opinion which exists concerning their pathological conditions. We have little definite knowledge of their functions. Certain theories have been propounded, but none have been sufficiently conclusive as to have lead to any very general acceptance.

In view of this these studies are presented. They have involved the examination of a large number of tonsils, both human and from some of the lower animals, i. e., dog, cat, rabbit, monkey, and raccoon; and they include the results of a considerable number of original physiological experiments.

The tonsils belong to the lymphatic apparatus; and in order to make the description of them more intelligible, it seems wise to review the structure of the better known lymphatic organs before describing the tonsils in detail.

¹ Being the Alumni Prize Essay of the College of Physicians and Surgeons, New York, 1890.