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WITH DISCUSSION ON THORACIC SURGERY

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BY

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THORACIC SURGERY; EMPYEMA.

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It is safe to assert there are few lesions where the physician and surgeon are called upon to assist each other in diagnosis and treatment more interesting, and at times more difficult, than effusions within the pleura. Plastic pleurisy may have its surgical complications, but it is largely a medical condition, and one wherein the surgeon is not so much concerned. The serous effusions, however, present an entirely different history and line of procedure. Few conditions give so entertaining a solution of questions that, seemingly, forty-five years ago, were so hidden and mysterious, studied at that period, and even for two decades later, with the firm belief that surgical intervention was too dangerous to undertake. As one recalls these early impressions one cannot but feel encouraged over the fact that in this line of investigation operative surgery has made advances commensurate with the pathology and technique of other important branches of our art. It is not my province to discuss why a serous effusion in one case, where one-fourth, one-half, or even more of one side of the chest may be involved, may continue for months, or even years, without any evidence of pus being present, and yet another case with the same clinical history may in a few weeks or months terminate in pus and present the condition we term empyema. The only argument I have to offer in presenting this paper is my personal, practical experience. The point I wish to bring out is the change, in my time, and in the memory of many members of our profession here today, in the surgical treatment of these cases. The willingness with which the general practitioner encourages the surgeon to approach these cases today, compared with four, three, or even two decades ago, is comparable only to the advance that has been made in the treatment of lesions of the appendix, the gall-bladder, and other organs

within the abdomen; yet it cannot be said that this change is entirely due to the aseptic surgery that has permitted us to invade the peritoneal cavity so boldly, for the technique of the two operations is very different. My early recollection of surgery of the chest presents a strong contrast with what we are now doing so fearlessly. Then, when once it was determined to evacuate fluid from the pleural sac, almost invariably pus, what precautions were demanded! We had had it impressed upon us, by such splendid men as Trousseau and others, as early as 1846, and again in 1864, that the operation for paracentesis was an exceedingly grave one, and should be had recourse to only "when there is danger to life from immediate suffocation, or when the effusion is very large." Marrote, writing at the same time, gives a clear distinction between serofibrinous and purulent effusions, and states "that the radical operation of incision is the only one in purulent effusions that is at all likely to lead to a cure;" and he was right; yet how slow were our surgeons in following this advice! How well do I call to mind the discussions in our societies well on up to 1880, as to the manner of treating effusions within the chest in reference to evacuation, the entrance of air, and the fear of producing pneumothorax. In my early years of practice I had read Bowditch's discussion of the subject, presented as early as 1852, in which he advocated aspiration and its application to all thoracic effusions; later, another paper published by him in the *American Journal of the Medical Sciences*, in 1864, in which he denies "that any ill results are likely to follow, or that purulent effusions cannot be effectually withdrawn through the capillary tubes provided for that operation." These were convincing contributions, yet how many suggestions were made at this time controverting his views! One very ingenious method was that of fastening about the cannula a portion of rubber tubing, or carefully prepared intestine, or rubber dam, in such a manner that a trocar could be introduced and withdrawn under water, and the operation performed in such a way as to exclude the entrance of air into the chest cavity. This was a method that was advocated with a good deal of earnestness. My study of Bowditch's papers and the experience I had had during the Civil War led me to believe that these cases required free

drainage, and that this fear on the part of the physician and his unwillingness to yield to the advances of the surgeon's experience would pass away; yet how slow was the progress! The method of simple aspiration carried with it such a high mortality that aseptic surgery was hailed as a factor of great assistance, and incision was encouraged, but only with the employment of the strong carbolized spray. I have often seen this used, and compelled myself to make use of it because of the pressure brought to bear by the attending physician, who wanted Listerism carried out to the utmost, and yet how clearly would Nature demonstrate her ability to take care of the chest cavity if only a free opening were provided! In 1864 Dr. Howard, of the United States Army, was permitted to go to the front to treat gunshot wounds of the lung by immediately sealing the wounds of entrance and exit with collodion, then applying firm compresses over the chest, the object being to exclude the air. I had an opportunity of witnessing this procedure in several cases, and in every instance if the effusion of blood did not force the dressing the accumulation of pus would be such that the dressings would become saturated and Nature would assert her desire for free drainage. At that time I considered thoughtfully the *few* remarkable cases, such as that of General Shields, during the Mexican War, and others, in which it was said a silk handkerchief was passed from one opening to the other, and recovery followed; but it seemed to me that Dr. Howard's method would soon be counted a failure, which it was within a very short period. However, I did not make use of my impressions afterward, in civil practice, for the opinion of the general practitioner with whom I came in contact was opposed to any such procedure as a free opening into the chest, but Dr. Bowditch's views were gaining ground and were bound to prevail.

Among the number of gunshot wounds of the chest and perforation of the lung, treated successfully by myself during the Civil War, the following is most typical.

Lieut. A. N., 66th N. Y. Vols., aged twenty-one years, June 21, 1865, while with his company, in trying to control a riot, was struck by a Minie ball, which entered the cavity of the thorax between the sternal end of the left clavicle and the second rib without fracturing

either. The wound was received while advancing toward the person firing, who was not more than fifteen feet distant. This bullet passed directly through the apex of the lung, making its exit just above the spine of the scapula, fracturing the latter bone severely. He was wounded at 6 P.M., and I saw him about half an hour later. The patient was bleeding very freely, expectorating blood; respiration extremely difficult; pulse rapid and hard to count; pupils largely dilated; suffering much pain. I immediately gave him ¼ grain of morphine, continuing the same as needed, at the same time giving as much brandy as he could swallow—in all about six ounces during the night. Ice compresses were placed to anterior wound, and hard linen ones to posterior exit of ball. Two minims of tincture of aconite were given every two hours next day, with small pieces of ice in mouth to allay thirst, and patient kept absolutely quiet on back. Apparently little hemorrhage, and no blood expectorated; no color in face or lips; very anxious expression; passed urine in small quantities and infrequently. More comfortable during second night, but somewhat delirious. Pulse 102 to 130, short and quick, feeling the effect of the stimulus; catheter necessary to relieve bladder of a large quantity of urine; no desire to move bowels; very restless third night, starting suddenly and saying he would die if something were not done for his relief. Under assuring words and medicine he quieted down. Complained of bed feeling hot; changed same, but not the shirt in which he was wounded. He had bled sufficiently to saturate two thick hair mattresses, and blood was beginning to drop to the floor. Fifth day expression improved somewhat, and pulse, under aconite, reduced to about 100; respiration easier. Air passed in and out through both wounds when compresses were removed. Evidently a large branch bronchial tube had been injured. Same general treatment continued until June 28, eighth day, when aconite was discontinued. Bowels moved and patient passed urine freely in normal manner. Appetite good; partook freely of beef tea, soft cooked eggs, etc. Patient had been a prisoner for several months in rebel prison in 1864 and 1865, and we feared a return of the chronic diarrhea he then suffered from. Free discharge commenced at this time, June 28,

from both wounds, at first clotted blood, then pus. Wound was kept clean by frequent washing with soap and warm water and a weak solution of chlorinate of soda, also the use of a silver drainage tube posteriorly. July 12, general condition much improved; no secondary hemorrhages; treatment continued about the same; very small amount of stimulant given; anterior wound healed; pus still discharging from posterior wound. There seemed no way of measuring the quantity, yet it saturated a large pad and the back of his woollen shirt twice in twenty-four hours. Morphine in divided doses given during the night to make him rest easily; tincture of iron continued, and some color in lips, but not much in face, and hands were pearly white. On the morning of July 15 he had a decided chill, not very free perspiration following; entire loss of appetite, with some looseness of bowels; reason to fear pyemia. Gave free doses of quinine and stimulants. Chill did not return, and in a few days he felt better. July 28 I removed several portions of the necrosed scapula; respiration good in lower lobe of left lung; lack of it, with entire dulness, on percussion, of upper lobe. Discharge from posterior wound enormous. August 3, patient could now sit up in bed and was able to be moved to his home in Westchester. The journey did not seem to exhaust him a great deal. He did well for about a week, when a severe attack of dysentery came on and reduced him rapidly. This yielded to treatment, and without further hindrance he continued to improve, and in a month was able to leave his bed. The discharge of pus continued quite freely for a time, but gradually ceased, and on October 15 the posterior wound had healed entirely. Marked depression under left clavicle and some drooping of left shoulder; auscultation and percussion showed little use of upper lobe of left lung. He began a gradual course of exercise, continued his good diet, and improved very rapidly.

July 4, 1866, I was surprised to see what a complete recovery he had made. He had entire use of the lung, except a small portion of the apex, apparently just above the track of the ball.

There are some points of particular interest in this case:

1. As to the great amount of blood lost, and the probable result had the wounds been closed in accordance with Dr. Howard's

method, and the blood allowed, or forced, to remain in the cavity of the thorax.

2. The enormous quantity of pus discharged, and in spite of this the ability of the patient to keep up.

3. The entire recovery of lung after it had been so long out of use, or in a state of collapse. In this case there was marked empyema. We attempted relief from this condition by using a silver tube and keeping the wound in a dependent position, which I think was most beneficial.

In January, 1909, I had an opportunity of examining this wound in Los Angeles, California. The Major had been living in Southern California for two winters, the climate appealing to him as affording more comfort than that of New York. Scarcely a scar could be seen at the points of entrance and exit. He had perfect use of his arm, and Dr. Poddinger, who was so kind as to examine him, assured me the lung was quite normal in its function.

This case in my earlier years gave me much comfort in the treatment of cases of empyema, traumatic or otherwise.

As late as 1878, Powell, who was one of the best authorities at that time, in writing upon the subject of empyema, said: "As it is clear that we cannot empty the pleura even in recent cases without admitting air in place of fluid, we must adopt one of three methods: (1) Either to disinfect the air admitted into the pleura, and having inserted a cannula to close the wound with antiseptic dressings, to be renewed with the same precaution every three or four days; (2), to make a double opening and introduce a drainage tube, so as to permit the escape of pus as rapidly as formed; (3) to make a single incision or free opening, and insert a tube through which the pleura can be daily washed out with some disinfecting fluid." Of these three methods, he says the first is to be preferred. At this period, or about 1880, and for the next five years, the discussion that older physicians gave the treatment of empyema, either by tapping or drainage, and finally, much later, by resection of the ribs, was most strenuous. My own experience with individual and older physicians was most emphatic. Occasional reports of a single case, by earnest operators, such as Martindale, of Port Richmond, presented in the *American Journal of the Medical*

Sciences, July, 1881, were well worth studying, and illustrated the good effect of through and through drainage. In the *Medical News*, May 7, 1887, Dr. Strickler, of Colorado Springs, presented a most interesting paper on resection of the ribs and the treatment of empyema, but even at this late period the old theories were in his mind, for here he states "that no disturbance was caused by the admission of air into the chest cavity."

In my own mind the decade from 1880 to 1890 presented a period of time when I had worked out the treatment of pleuritic effusion, and it has been my guide since then. Antiseptic surgery, by means of the carbolized spray and aspirator, was not practicable in the treatment of such cases, and this became my formula: In a diagnosis of pleuritic effusion, when the temperature and pulse indicated that the fluid was yet sterile serum, I have insisted upon a very thorough effort at medical treatment being made, such as the use of a thoroughly dry diet, local application of blisters, free evacuation of the bowels, diuretics, out-door exposure, plenty of sleep, and I have seen many happy results, both in children and adults, the latter more particularly. When there is a rise in temperature, increase in the pulse rate, perhaps a chill, later a marked leukocytosis, and the suspicion arises that pus may be present, I have always insisted upon a free evacuation, but I have had strange experiences occasionally. The evacuation of pus by means of the trocar would occasionally result in the recovery of the patient, and this case would be held up as an illustration by many conservative physicians in the neighborhood as one in which even drainage by means of the rubber tube was not necessary. Any excuse was offered for non-operative intervention. This, however, was finally the ground of compromise: That if the trocar and the drainage tube did not bring about a good result within a reasonable time, I was not willing to yield any further to the conservatism of the good and respected family physician. If, however, the fluid remains sterile, I believe a small percentage of these cases will recover by judicious, repeated use of the aspirator; but when once pus is discovered the use of the trocar and the introduction of the rubber drainage tube is admissible, having the opening as low down as possible and keeping the tube within the pus cavity. This

treatment in cases under twenty-one years of age gives a very large percentage of recoveries. Failing, however, at this time of life, and particularly after the age of twenty-five, in this line of treatment, then resection of one, two, three, or four ribs, two to five inches, becomes necessary.

I have a record of cases of pleurisy associated with malignant conditions, not only of the lung, but of growths elsewhere, in which the patient suffered from associated attacks of pleurisy, and where I have seen marked relief from simple aspiration, going no further in other cases than to introduce the rubber drainage tube.

Cases of double empyema have, in my practice, been very rare. Much has been said regarding the danger of syncope and death, in the evacuation of pus, in all cases, either double or single, but the only fatal case I have encountered was that of a boy, aged four years, who was suffering from double empyema, who had little breathing space left, and was very nervous and frightened at the thought of having anything done. Local anesthesia was attempted, but his struggles were so great we were finally forced to give him a general anesthetic, and just as I was puncturing the right chest the little fellow collapsed and expired. It has been my custom to evacuate the chest with great care, always insisting upon the horizontal position of the patient, and I have seldom seen a case of syncope. This case was a sad one in many ways, and was not infrequently quoted by friends when a similar line of procedure was suggested.

The use of the rubber drainage tube as the sole dependence in the treatment of cases of empyema, especially in adults, cannot be considered as a successful method. In children it is likely to produce more serious deformity, and adults, if they do not recover at once, undergo a prolonged illness. Unless the patient's surroundings are especially good, and the previous family history above all possible suspicion, I have noticed that tuberculosis, in many instances, presents as the final condition.

It is interesting to note how the cavity of the pleura is disturbed and the distressing cough and irritable condition that presents when the loss of the drainage tube takes place. I have been called to see these cases, and have noticed the great disturbances

that presented in a train of symptoms having a most depressing, unpleasant effect upon the patient and friends, but I have not yet met with a case in which a foreign substance eluded resection, an accident that ought not to occur.

That empyema has claimed many methods and a great variety of operations for its relief cannot be denied, but like many surgical questions the solution has been delayed through the tenacity with which the family physician would, in former days, adhere to milder surgical procedures, this, however, finally passing away. Their views were greatly to be respected, and their arguments for a conservative line of treatment of these cases met with some success, but I am convinced that there can be no longer any doubt that the sooner a case of empyma is relieved the better, that in a number of cases resection of the rib becomes really necessary, and this line of treatment must prevail to a greater degree in the future than it has in the past.

In the washing out of the cavity after resection, and when employing simple drainage by means of the rubber drainage tube, I have had my attention called to the unpleasant effect of the use of peroxide of hydrogen. This is to be expected, and long since I have counselled against this antiseptic, employing much milder preparations which do not give the patient so much distress.

I have observed with much interest the cases that have come to me, and in which I have been called in consultation, where the patient had a rapid change from the formation of serous effusion into that of pus, and the general infection of the system, as illustrated by the following case:

M. R., aged four years, history of tuberculosis on maternal and paternal sides. Case came under observation July 3, 1908. Previous history: Supposed to have had enteric fever when an infant; a year ago suffered from quite a severe attack of whooping cough; ten weeks ago had an attack of measles, later followed by pneumonia. In the early part of the attack of measles the patient had otitis media of right ear, and which soon discharged quite freely. About this time left knee began to swell, and a week later there was swelling of the right shoulder. At the end of five weeks a drainage tube was introduced and pus drained from bursa of left knee

and abscess about right shoulder. Two weeks later empyema presented and trocar used, with introduction of drainage tube in right pleural cavity. Knee and shoulder improved, but drainage from side not satisfactory. July 3, 1908, two ribs were thoroughly resected, and an abscess containing about 500 c.c. of purulent fluid escaped. Drainage continued very profuse. From this time on patient improved rapidly and has made a splendid recovery. That repeated cases of pneumonia often deceive the general practitioner, regarding the complication of empyema, and as to the possibility of tuberculosis being present, is, in my mind, a fact.

I have sometimes witnessed a very earnest discussion, on consultation, as to whether the case was one of simple plastic pleurisy, one of chronic consolidation, or one of true empyema, and I have no doubt in my mind that there are many cases of pneumonia associated with pleurisy in which an unexpected condition of empyema creeps in and is present without being recognized as promptly as it should be by the family physician. The following case, one of many, is of some value in illustrating this point:

Mr. J. W., aged forty-five years, farmer by occupation. May 8, 1908, suffered from pain in right side, and in June had an attack of pneumonia, same side. This was followed by attacks of coughing and pain on inspiration. Cough paroxysmal, which had persisted since onset, usually occurring during morning hours, at which time patient expectorated freely, coughing up profuse secretion, described as resembling oyster juice, with sweetish taste, but free from odor. At times he had expectorated a quart of this material, and not infrequently a pint or more. During attacks pain was present on right side of chest. Had lost in weight and strength. No history of night sweats; otherwise history negative. There was much discussion as to the case being one of tuberculosis, or consolidation from pneumonia, possibly plastic pleurisy, but with no admission as to empyema being present. Blood count did not show a leukocytosis above 6250. Frequent examination of the sputum showed an enormous amount of pus cells, but no tuberculosis. June 14 1908, I believed the patient was suffering from empyema, and did a thorough resection of the fifth and sixth

ribs, opening into a large abscess cavity with an adhesion to the fourth and fifth ribs and to the pleura, that acted, as the lung had contracted, to give it the appearance of an hour-glass contraction. These adhesions were loosened and revealed a free opening into a large bronchus, also marked necrosis of the ribs. This cavity was well packed with three large tampons of sterile gauze and around a large rubber drainage tube. The patient made an uninterrupted recovery, cough abating at once, expectoration ceased, he gained rapidly in flesh, and has made a good recovery, with the exception of a small sinus, about two or three inches in depth, which remained when he was last examined, April 1, 1909. The lung had returned to its normal condition regarding function. It is very impressive to note how cases of empyema will go on, the patients remaining invalids and being treated for one condition or another, but when at last reached are not unlike those of neglected appendicitis.

For some time I have discouraged the use of iodoform gauze as a dressing, and for treatment of the large cavity that remains after resection of the ribs I make use of either vioform or just plain sterilized gauze. I believe it is well to pack the cavity somewhat firmly at first, so that the lung is not embarrassed by the lack of support, the patient is made more comfortable, and then, at the end of forty-eight hours, remove this dressing and pack much more lightly.

The use of the hypodermic syringe as a means of diagnosis is of vast help; the use of the aspirator in evacuating a chest that contains aseptic fluid is to be commended, and the use of the instrument can be repeated a number of times, but great care should be exercised in the laboratory examination of the fluid withdrawn, the least indication of pus that presents being a warning for the abandonment of this method.

I have been greatly impressed with the reports coming from the laboratory regarding the mixed infection that presents in cases of empyema, and how very seldom the bacilli of tuberculosis are to be found.

I have also been very much impressed regarding the length of time that pus has existed, or where the condition of empyema has been present, in the cases that have come under my observation, and of which the following are but illustrations of others:

Mr. G. F. C., aged thirty-nine years, salesman by occupation, came under my observation November 7, 1904. Patient had had diseases of childhood, during which time he was supposed to have suffered from pleurisy. Present illness: Four years ago was ill for three days, with a diagnosis of pleurisy of right side. Recovered and was apparently well for two years, when an abscess presented to the right of right nipple, which was lanced, discharged quite freely, healed for some time, formed again later, and discharged for six months. Then another abscess formed nearer nipple, which was also lanced. This has been discharging ever since, and has been particularly profuse for the last four weeks. Patient's weight had remained about the same. This abscess was very annoying in getting about to his business. I advised resection of ribs, which was done November 8, 1904, resecting about four inches in length of fifth, sixth, and seventh ribs, when an abscess was opened into connecting with the sinus, abscess extending from apex of lung to the diaphragm and having a capacity of about thirty fluidounces. Lung completely walled off, and surface of the pleural cavity lined with a thick calcareous coating. The latter dissected out as much as possible and cavity then packed with plain gauze around a large rubber drainage tube. Gauze gradually removed and drainage tube relied upon, through which irrigation was kept up, patient making a good recovery. January 6, and March 12, 1905, family physician, as well as patient, reported a steady improvement. Again, in the spring of 1906, report came that he was doing well, but a short sinus persisted. Lung had expanded well.

I have been interested in noting the phosphatic deposits that are found in long-standing cases of infection of the pleura, and I believe that better results come from attempting to dissect out, as carefully as possible, that portion of the thickened pleura that can be reached somewhat after Fowler's method.

Cases of empyema, or multiple abscess, particularly in children, are the ones to watch with prompt care, and we should not fail to make our operations thorough. I fear that at times we fail, perhaps, in giving full relief, as the following case illustrates:

M. H., aged six years, came under observation February 12, 1904. Principal symptom, that of a persistent cough and evening temperature. Family history negative. Whooping cough at the age of three years, followed by measles in the winter of 1901. This followed in turn by what was believed to be bronchitis, which left her with a cough resisting all treatment, and which has persisted ever since. May, 1903, had bronchopneumonia, but recovered, and apparently well except for the cough. About four weeks ago the child's temperature would rise at 3 P.M. to 102° to 103°. This would persist until nearly 7 P.M., when it would gradually abate. Has been greatly weakened by a persistent diarrhea. Appetite not good. In coughing raises nothing but white, mucus-like substance; no tubercle bacilli present on examination. About this time an abscess formed in right side of chest and discharged quite freely. There was much dulness on percussion, with zones of respiratory murmur. The case believed to be one of empyema unrelieved by the sinus, and an operation advised. Sixth and seventh ribs resected, one and one-half to two inches in length, and abscess cavity opened into just above the termination of the old sinus. Quite an amount of pus escaped, and cavity packed with iodoform gauze. Operation fifteen minutes under chloroform. Bacteriological examination at the Bender Laboratory showed cocci and bacilli, and cultures showed Diplococcus pneumoniæ. Patient improved somewhat at first, was much more comfortable, but temperature gradually increased, reaching 107.6°, then declined to 105°, when she died somewhat unexpectedly. No autopsy. I believe this patient was suffering from multiple abscesses, and entire relief was not afforded.

The next case is somewhat in contrast:

I. E., aged six years, came under observation January 9, 1905. September 21, 1904, had suffered pain in chest, vomiting, fever, loss of appetite, and severe cold. Child treated for typhoid fever for five weeks. Previous history had always been good. Now another physician called, who diagnosed empyema. Patient was sent to a local hospital, where two incisions were made in side, but with negative results. January 9, 1905, patient was brought to the Albany Hospital and resection of ribs determined upon,

believing the child was suffering from empyema. Thorough resection of fifth rib done and cavity opened into very promptly. In introducing fingers two or three cavities were distinctly located and opened. Gauze tampon used for drainage for some few days, then rubber drainage tube and irrigation. Respiration had been rapid, but gradually dropped to 24. Temperature for first few days between 100° and 100.5°, then gradually came down to about normal. This patient made a good recovery.

As a contrast to the first case of gunshot wound reported in this paper the following is somewhat interesting:

Mr. P. S., Hungarian, aged twenty-seven years, during a quarrel on the night of November 2, 1908, was shot in the right side and fourth rib severely fractured. He was brought to the hospital at once, and the same day my son, Dr. Edgar, opened the wound freely, removed a good portion of the rib, recovered the bullet, found pleura quite badly lacerated, some considerable hemorrhage, and packed wound with plain gauze around rubber drainage tube. Patient somewhat uncomfortable for a few days after the operation; some difficulty in breathing; temperature at one time 103°; some purulent discharge, but all of these conditions abated gradually and patient made a good recovery.

In the study of cases that have come to me, and in some of my own, I have been somewhat disconcerted by having them go on nicely after thorough resection of the ribs, but finally ending in a sinus that was exceedingly troublesome and difficult to close. For instance, Mr. D. gives a good representation of this condition, and upon this point I trust we may hear some discussion:

Mr. M. M. D., aged thirty-four years, agent by occupation, had typhoid pneumonia ten years ago, followed by empyema. An abscess followed later, and for eight years sinus in right side had persisted, which led from pleural cavity and discharged very slightly. April 24, 1907, patient very anxious for permanent relief, his condition incapacitating him for work, and he wanted to get well. Otherwise, general condition very good. He entered the Albany Hospital, and resection to the extent of three inches was done in sixth, seventh, and eighth ribs, in axillary line, right side, and quite an extensive abscess cavity was opened into. Patient went

on to complete recovery, gained in flesh, returned to his work, and was able to do as much as ever, but December, 1908, there was yet a sinus about four or five inches in length which would hold about one-half ounce, and would not heai under any form of treatment followed out.

In the chronic state of these sinuses I would be glad to hear from any of our associates who may have had experience in the use of paraffin in the treatment of these cases.

In the treatment of sinuses I am quite sure that the drainage tube, or method of drainage, is somewhat responsible; that at times the packing is too earnest and the tube is left in too long, not granting sufficient opportunity for the expansion of the lung. Where the lung does expand rapidly a sinus is not so likely to form. This is one point, I believe, in favor of an early operation, therefore I use it as an argument with the family physician to avoid delay in these cases. In the study of my cases of empyema I have been greatly impressed to note what a large proportion occur on the right side.

As remarked, it is most impressive to note the duration of the history of cases of empyema and their association with what might be termed a tubercular predisposition.

Mr. J. W. B., aged thirty-nine years, a bottler by occupation, came under observation May 18, 1903. One sister had died of tuberculosis. Sputum thoroughly examined and negative for tuberculosis. Blood examination: Leukocytosis, 8000, and many polynuclear leukocytes present. Patient gave a history of cough and expectoration of blood for fifteen years. Four years ago had a distinct pleurisy in left side, since which time noticed respiration had been difficult and somewhat rapid. November, 1902, contracted a severe cold, and since then unable to work. His family physician made the diagnosis of empyema and did two aspirations, but with little benefit. May, 1903, an abscess was opened between eighth and ninth ribs, under ethyl chloride, and a large amount of pus evacuated. On May 19 another incision was made, with a somewhat similar result, but his symptoms did not improve, temperature did not lessen, and he was advised to enter the Albany Hospital. May 27 I did a thorough operation, and found a sinus that extended to the intercostal space between the eighth and ninth

ribs, which was carefully dissected out, and which had communicated with the pleural cavity. Seventh and eighth ribs resected to the extent of nearly four inches, this opening into a large abscess cavity, from which a pint of pus was evacuated. A large rubber drainage tube inserted and packed about with iodoform gauze. Gauze removed at the end of forty-eight hours and abscess cavity irrigated with boric acid solution, a dram to the pint. After this operation his temperature became normal, cough ceased, appetite returned, general functions of the body became normal, and patient left the hospital at the end of the third week, improving in every respect, and ultimately making a good recovery. I regret to say that the hospital record fails to note and report on examination of sputum, on his discharge, for tuberculosis. His clinical history and appearance was that of tubercular trouble.

In a number of my operations for the relief of empyema I have seen good results follow the spirometric method of exercising the lung to produce expansion.

Summary. 1. That the hypodermic syringe with a long needle is of value for exploratory purposes.

2. That the repeated use of the aspirator is not to be condemned so long as the fluid remains sterile, and is the preferable method of treatment in malignant cases.

3. That the use of the trocar and drainage tube is advisable after it is shown that the aspirator is no longer affording benefit.

4. That resection of the ribs is absolutely necessary when no improvement takes place with the use of the ordinary drainage tube.

5. The latter operation to be done early in order to protect the lung from unnecessary pressure, and to relieve the adhesions that, in the young, become so detrimental in causing spinal curvature.

DISCUSSION.

Dr. John E. Owens, of Chicago.

I wish to report a case which comes under the head of thoracic surgery, but while I was interested in this case it was not under my care, but under that of Dr. H. G. Ristine, of Fort Dodge, Iowa. An engineer, with his hand on the lever, struck a car on an adjoining track. A piece of

moulding having become detached, or partially so, passed through the window of the cab and struck the engineer over the third rib, just external to the heart. It passed upward and inward, coming out through the back at the second rib. This threw him from the seat. His hand was loosened from the lever, and he fell in a twisted manner to the floor, and at the same time the throttle was opened to the full. The engine started through the yards and was only stopped partially by a collision. The piece of moulding was 12 feet long, and before the patient could be taken from the cab 5 feet were removed by a saw. Finally, they got the patient to the hospital, laboring under profound shock. Hemorrhage was not a marked feature; lung collapsed. In the course of seventy-two days, during which time Dr. Ristine had the care of this patient, he had a temperature not exceeding 102°, free suppuration, and in the course of a month or two a very free hemorrhage from the kidney. Daylight could be seen through the opening in the chest. He ultimately recovered and returned to work. The stick, which I show, is a portion of that which went through the upper third of the lung. There is another feature of interest in this piece of moulding to which I would like to call attention, and that is, that this twenty-penny nail bent down in this way, the point coming in the direction in which the stick was being withdrawn. It was necessary to cut the muscle and skin in order to free the tissues from the nail. A piece of gauze was tacked to the end of the stick and pulled through, and thus lodged in the track of the canal made by the wounding body. The case was treated by drainage, by means of gauze for a time, and later by a drainage tube. Once in endeavoring to clean the wound and the tube by irrigation, the patient was almost drowned. The stick was of hard wood, two sides were each two inches, and two were each one and seven-eighths inches.

DR. A. G. GERSTER, of New York.

I believe all the Fellows of this Association must consider themselves very fortunate to have had the opportunity of being present at this most memorable meeting, both as regards the number of those present and the quality of the papers presented, especially this morning on this most interesting subject which interests all the surgical world of the present day. As regards the subject presented by Friedrich, I think that by the methods introduced by him really a very valuable new road has been cut open for the treatment of pulmonary diseases. I beg to use this opportunity simply to emphasize one of the points regarding the technique of the procedure that he has proposed.

Within the last three or four weeks I have had to treat a case belonging to this class. The patient, having had a pulmonary tuberculous cavity of the apex, suffered a perforation into the pleural cavity, an empyema, and mixed infection, for the relief of which an ordinary incision into the

thoracic cavity was done, with a limited removal of one or two ribs, followed by some general improvement in the patient, but with no effect upon the local disturbance whatever. On account of the fact that the lung was extensively adherent at the time, the case being one of long standing, and because of the fact that the ribs were exceedingly rigid, the compensatory expansion of the lung or the falling down of the thoracic cavity was impossible. In order to bring about a cure, as it was to be expected that the advanced disease would cause amyloid changes in the large glands, radical measures had to be adopted. I adopted the resection of ten ribs, beginning from the first to the tenth, the approach to the cavity being in the scapular line, and this line was, as it were, pointed out by the preceding operation, which greatly facilitated the performance of this second one. The main difficulty was the approach to the upper portions of the thorax, the resection of the four or five upper ribs. That approach was accomplished by complete detachment of the scapula by free incision through the soft parts down to the ribs along the margin of the scapula, and the reason why I got up and addressed the assembly was practically this, to indicate that the resection of the first rib, if approached posteriorly, is easy. In this case we had not the slightest difficulty in removing the first rib. I consider that important in this case, as, the cavity being in the apex of the lung, we considered it necessary to bring about a collapse of the lung in that vicinity. The patient is doing well, and I am hoping for an ultimate recovery.

Dr. John B. Murphy, of Chicago.

It is impossible in the time allotted for discussion to consider even a few phases of the many splendid papers that have been presented here this morning. The proceeding began in reverse order to the pathological conditions; that is, Dr. Friedrich's paper was brought in first, using the extreme operation that is necessary in the extreme pathological conditions which develop with tuberculosis, then leading down to the simpler forms of procedure.

What are the principles underlying every one of these operations? They are pulmonary rest and drainage of cavities. The essential factor in the repair of tuberculosis is that of rest, first, by the simpler means of compression with strapping; second, the removal of the ribs—excision of ribs; third, by removal of portions of the chest wall; and finally, fourth, as suggested by Dr. Friedrich, the removal of a very large part of the bony chest wall.

Fortunately, eleven years after our original paper, the principle of rest in the repair of tuberculosis of the lung has taken the place which it deserves, though the American medical profession has so long overlooked it. Eleven years ago today, at the Denver meeting of the American Medical Association, I brought out the fact that compression, rest,

and drainage were the important factors in the repair of pulmonary tuberculosis. How can these be secured? In the early stages always by intrathoracic compression with air, or nitrogen, or any gas one may select. It can be completely effected in all of the cases except the few that have primary pleuritic adhesions.

What is the result of pulmonary compression? In over 1700 injections by my colleague, Dr. A. F. Lemke, now dead, he had a uniform dropping of the temperature, increase in weight, suppression of hemorrhage, and improvement in the patient's condition, with hundreds of cases living today that have been cured and have remained well from that time. When I returned from a month's vacation after the Denver meeting I found my library floor covered two feet deep with mail from patients asking me to take their cases. I refused every one because it would have driven me out of general surgery.

The compression is easy, and, what is more, it is effectual. The result is that if one can put the lung at rest cicatrization takes place and thus repair is completed. Let us mention a few practical points in thoracic surgery. How can the hemorrhage that occurs in the early stage be stopped? Here there is no cavity, just a tubercle eroding the wall of a vessel. Insert a large exploring hypodermic needle, No. 5, through the fifth intercostal space in the mammary line into the pleura. When the patient inspires, the air rushes into the pleura. Put your finger on the needle end when he expires, and one can soon pump the pleura full of air by using the finger as a valve, and you can stop this hemorrhage in two to five minutes without any trouble. The outer end of the needle should be covered with sterile cotton to filter the air. You can compress the lung in tuberculosis by that simple means, which is at everybody's command. The older cases are not relieved as readily by this means. The management of them with the compression which Dr. Friedrich has outlined is a long stride in advance, and should lead to good results. Where there is a cavity which is not draining, and where there are pleuritic adhesions, these cases cannot be relieved by compression of the lung through pneumothorax, but must have a thoracoplasty. There is little to be feared from pneumothorax unless we make a pneumothorax with a small opening and do not let out as much air as we let in. In this event we have dyspnœa, cyanosis, and death, but with a closed chest pneumothorax we can have the thoracic viscera of one side pushed clear over into the other without interfering with the respiratory exchange. The opening of one side of the chest with collapse of one lung is not a dangerous or even serious step.

Let us next speak of the management of pleuritis. All of the methods mentioned have been for the treatment of empyema as a late disease, not in its early stages. What we must learn to do, and what we should

and must do, is not to let these evil late conditions develop. You can say that particularly of tuberculous empyema. *No surgeon is justified in opening the thorax for empyema unless he has figured out just how he can obliterate the pus cavity.* It is easy to open the thorax and insert a drain, but how difficult it often is to close the sinus can be judged from the papers read. Dr. Beck has rendered us great assistance in these discharging sinuses and large cavities, and we hope these good results may be uniformly secured.

I want to speak of a type of empyema not communicating with a bronchus. The pus in empyema does not absorb because it has in it none of the polymorphonuclear leukocytes and therefore no enzymes. If one puts into that pus the trypsin enzyme, or induces the formation in the cavity of many polymorphonuclear leukocytes, as one can by injecting turpentine, formalin, and preparations of mercury, absorption will take place. The 2 per cent. solution of formalin in glycerin injected into the pleura gives a rapid production of polymorphonuclear leukocytes; these liberate trypsin, and thus a rapid change of albuminoids into albumose and peptones is effected and the latter are readily absorbed. The original experiments made a little over thirty years ago in the production of pus by the injection of turpentine were used to controvert the bacterial theory of pus production. This was a sterile pus that was only a solution of the polymorphonuclear leukocytes in serum. It was not a verile pus, and in that serum we have the trypsin, and this enzyme is now being used as an injection into pleural and other chronic pus cavities for the purpose of producing a change in the albuminoid bodies. Turpentine is a dangerous material to use, as it often congests the kidneys. Mercuric preparations also intoxicate. What we use and have used for four years without a single failure has been the injection of a chemical material, a 2 per cent. solution of formalin in glycerin which has been mixed at least twenty-four hours before its employment. You will find when you examine the leukocytes in the pus after two or three injections that there is little less than 100 per cent. of the polymorphonuclear type, while the pus before the injection has only an occasional one.

From four drams to two ounces may be injected after aspirating as much pus as can be withdrawn without causing dyspnea. The injections should be repeated every two to seven days, depending on the reaction, until the pus changes to a serosanguinolent fluid; then every two to four weeks, unless the fluid remains serous or sanguinolent. It often takes months for this fluid to disappear, but it does no harm after it is rendered sterile. It will absorb as rapidly as the lung can expand or the chest wall collapse. The patient fats up and feels as well as though the fluid were not there.

If this plan is followed the chest wall will not need to be opened, a most important matter for the patient.

Dr. George Tully Vaughan, of Washington, D. C.

I have been especially interested in the surgery of the heart, and I was very much entertained by Dr. Peck's paper, and desire to congratulate him on having operated successfully on a case. About a year ago I had occasion to look into this subject, and I collected all the cases I could from the domestic and foreign literature from the Surgeon-General's library. I only took those cases operated upon and sutured, throwing out a great many because they were not sutured, only operated upon, tamponed, or drained, or treated in some other way than by suture. In that way I collected 150 cases. Most of them were done abroad, only 15 in this country. I am glad to see that Dr. Peck has added about ten cases to my list, although I am not sure he has excluded all cases not treated by suture. A great many mistakes have crept into these tables during the last twelve years, and cases of operation on the pericardium have been reported as operations on the heart. I had the pleasure myself of operating on my first case eight years ago, it being the second operation done in America, Nietert having preceded me by a few weeks. The patient died on the table. I had another case this last year which recovered. There are a great many things to be said about heart suture. For exposing the heart the method of Lorenz is undoubtedly the best, and I should try that if I had occasion to do the operation again, namely, the incision through the third intercostal space, across the sternum, and through the fifth intercostal space, making a flap longer on the left of the sternum, and turning back on a hinge on the right costal cartilages, exposing the front of the heart and giving a better view of the entire organ than any other method, and it also has the advantage of not opening the pleural cavities. While this may not be considered of importance if only one side is opened, yet if both of the pleural cavities were opened it might be disastrous. There are some very interesting points in regard to the mortality. This is just the same, according to my table, as it was twelve years ago; each table has shown about the same mortality; there has been no improvement so far as I know. My table gave a mortality of 65 per cent., and Dr. Peck's gives a mortality of 64 and a fraction per cent. Gunshot wounds of the heart showed a smaller mortality than stab wounds, which is surprising. The mortality of gunshot wounds was about 10 per cent. lower than those of stab wounds. The mortality of the various chambers, too, differed very much. At one time it was the impression among surgeons that wounds of the auricle were more serious and had a higher mortality than those of the ventricle; but this was not true, according to my table. Of 8 cases of suture of the auricle there were only 3 deaths, or

40 per cent. instead of 65 per cent. mortality of the entire list. The highest mortality followed wounds of the right ventricle, 70 per cent. Wounds of the left ventricle gave 62 per ecnt. I think there is a great deal of room for improvement in these operations. Naturally, they are done in a hurry without much preparation, and that is one cause of the high mortality. We have so many cases of infection, yet I think improvement will probably lie in the direction of preventing infection and by using drainage only when it is needed.

DR. RICHARD H. HARTE, of Philadelphia.

I have listened with a great deal of interest to Dr. Peck's paper on wounds of the heart, and I would like to say that we have had in Philadelphia 7 cases of stab wound of the heart which have been successfully sutured, 5 being treated at the Pennsylvania Hospital. Our mortality rate has been excellent, 4 cases recovering. So far as the character of the wounds is concerned, I think there is no question that penetrating punctured wounds of the auricle are more fatal than those of the ventricle. Owing to the anatomical conditions, wounds of the ventricle have a greater tendency to take care of themselves. There is not the disposition to hemorrhage, as in the auricle. In a case which I had a year or two ago, of the auricle, the wound entered through the pleura and just escaped a portion of the lung, and that case lived twenty-four days, dying from septic pneumonia, and, as both Dr. Peck and Dr. Vaughan have said, that is one of the difficulties in dealing with these heart wounds. We are obliged to operate very rapidly, and cannot follow out the technique that one would wish. In the act of suturing the technique is often very difficult, owing to the very rapid action of the heart after the opening of the pericardium. I do not know anything that expresses it better than trying to introduce a stitch into the back of a fish just as you pull him out of the water. I experienced the greatest difficulty in introducing the sutures. Although in my case I used a small curved needle and a fine gut suture, I had, after insertion of the suture, not only one wound, but two, that of entrance and that of exit of the needle. Then I had to put in extra sutures to control the small bleeding points coming from the suture itself. Many of these cases are brought to our hospitals and seen by our house officers. We have now at the Pennsylvania Hospital a case which was recently operated upon by our senior house officer, who very wisely operated immediately on admission rather than send for the chief. Time is the great factor in dealing with these cases, because they will not wait; often the bleeding is in the pericardium, as in my case. There it was greatly distended with blood and the heart was overpowered by a large clot around it. Another curious feature: after introducing my sutures and controlling the bleeding there was violent action of the heart,

due to a partly collapsed lung. In that case I controlled it by placing around the pericardium a large mass of hot, moist, sterile gauze. As soon as the heart felt the pressure from the gauze it immediately slowed its action, allowing the gauze to remain for a considerable length of time until the patient reacted.

DR. JOSEPH RANSOHOFF, of Cincinnati.

The morning has been the most valuable one I have ever had occasion to assist at. With regard to the subject of empyema, the most essential thing presented is the report made by Dr. Meyer on the treatment of the acute cases. In a conversation with him, he tells me he does no longer inject the acute cases. These are the very cases that do not become chronic if drained early. I know of no class more satisfactorily treated than the acute empyemas in young subjects, which usually heal very promptly and do not become chronic unless allowed to do so before operation. The difficult ones are the neglected cases, and when Dr. Murphy closes the discussion I would be glad to hear if he has patients recover in the simple cases where the empyema has continued for a year or two. These are the ones which give us trouble, do not heal very kindly after operation, and require numerous operations. I have reported cases a number of times, and have had others since in which, the extensive resection of the chest wall having been performed, the lung would not expand. Then came the question of removing the pleura from the surface of the lung, first devised by Fowler, but credited for the most part to De Lorme, I think unfairly. I have found it is not necessary to remove the pleura, and I happened to notice that as soon as the enormously thickened pleura was incised it spread. One could see under the wound that the bluish lung would become wider and wider. I made another incision and found that another strip of lung became wider and wider and more exposed to view. By gridironing the pleura a large part of the lung can be exposed without exposing the pleura itself. This is called the discision of the pleura. With regard to operating under differential pressure, I have no doubt there is a great future for it, but, in my judgment, it can never become the subject of universal or general application. It is a very cumbersome apparatus, and can only be handled in clinics, and with the multiplication of hospitals we have all over the world it is not likely that each little hospital will have this expensive and large apparatus installed. Is it absolutely necessary to have this apparatus? There are other methods; for instance, I have seen the following performed in a number of cases of resection of the chest wall for tumor: Grasp the lung as soon as the chest wall is opened, bring the lung into the wound and attach it to the wound with sutures, and as you go along attach more and more to the margin of the incision. I do believe, notwithstanding the remarks

made, that a suddenly developed pneumothorax is an exceedingly serious thing. It is not to be looked on lightly. A suddenly induced pnemothorax causes death; how otherwise can we account for these deaths which do occur not infrequently if the patient is in a wrong position the moment the chest wall is opened? I have had one occasion to sew the heart, and I have experienced the difficulty mentioned by Dr. Harte, of putting a suture through the apex of the heart. It was a case of gunshot injury. I had no difficulty in closing the wound, but the patient died, not from the wound of the heart, but from the tremendous hemorrhage coming from the root of the lung, which was beyond my control.

Dr. Joseph A. Blake, of New York.

I wish to say a few words in regard to the technique of operations upon the thorax. We have been experimenting for several years in our laboratory at Columbia University upon dogs, excising the lungs, operating upon the esophagus, uniting it with the stomach, and have developed one or two points of interest. This work has been almost entirely done by Drs. Green and Janeway. Dr. Green commenced with an intralaryngeal tube, and respiration was carried out by an artificial apparatus, with intermittent pressure. With that apparatus the operations were successful, and both pleural cavities could be opened at the same time without fatal result. The work in its development was carried along, and finally the positive pressure apparatus was taken up, and operations were done upon the esophagus, uniting it to the stomach. Some very satisfactory results were obtained by anastomosing the esophagus to the stomach by an artificial button without opening the esophagus, and thereby contaminating the pleura. In carrying out the work of the positive pressure apparatus the idea was suggested that the old intralaryngeal method had advantages, in that an artificial apnea could be induced, inhibiting the patient's respiratory movements so that the operator would not be embarrassed by the excursions of the diaphragm. In carrying this out Dr. Janeway devised a valve which works rhythmically, and the pressure is increased to 8 to 10 mm. in the chamber and then interrupted, so that the patient soon stops breathing of his own volition, and the respiratory movements of the chest become quiet. This apparatus has been put in use successfully in dogs, and yesterday I used it on a human being and it worked very successfully and very smoothly. The respiration in the patient operated upon, a child suffering from empyema, stopped entirely when the valve was used, and the apparatus became one of artificial respiration, and not a positive pressure apparatus. I think that this procedure is well worthy of further experimentation, which we are going to do. The apparatus is much smaller than a differential apparatus. It only requires a chamber in which the patient's head is

enclosed, and the anesthetic is administered through armholes on the side. The box is portable, and, therefore, meets the objection of the cumbersomeness of the differential cabinet.

Dr. Samuel Robinson, of Boston (by invitation).

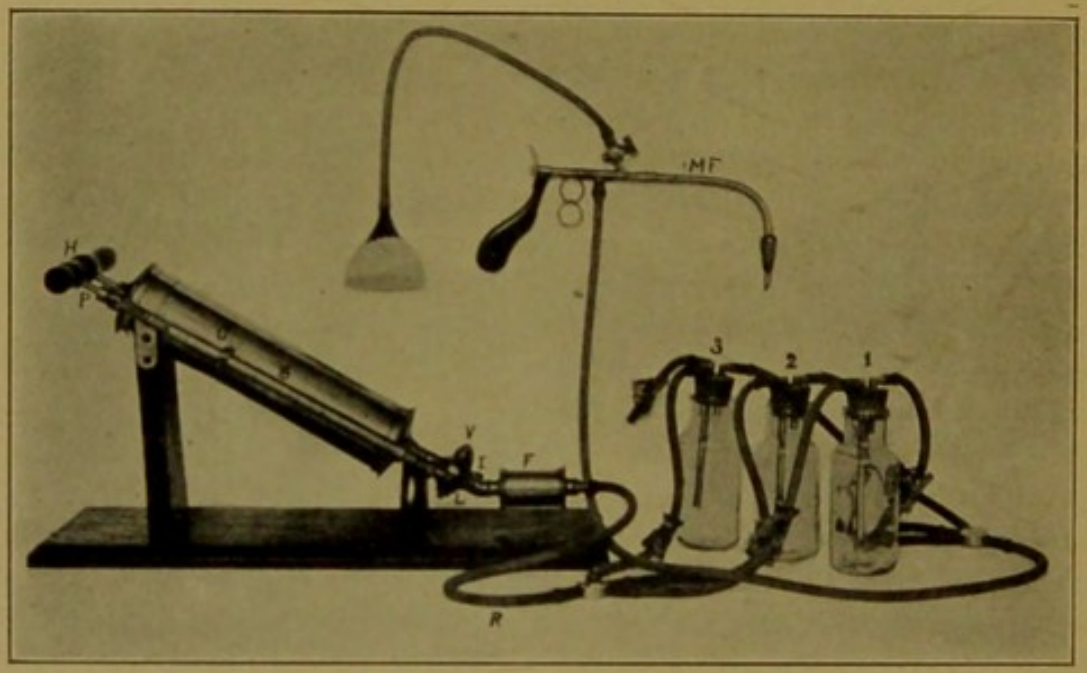
It has been my good fortune to be in Germany for the last three months for the study of thoracic surgery. Most of the time was spent in Marburg, for there I found the greatest interest and activity in this branch of surgery. I have listened with great interest to the valuable paper of Professor Friedrich, and I may say that it was through his courtesy that I was enabled to perform certain experiments with Dr. Sauerbruch in the Surgical Clinic. I was also given an opportunity by Prof. Brauer, of Marburg, to study with fluoroscope and physical examination cases which had been previously treated by the artificial pneumothorax nitrogen injection method; likewise two cases operated by Prof. Friedrich by the thoracoplastic method of collapse. In Dr. Friedrich's summary of operated cases he has ascribed death to the presence of tuberculosis of the unoperated side. I am of the opinion that he has not laid sufficient stress on the other dangers of the operation. If the thoracic wall is rendered movable by the resection of ribs, its tendency is to deviate toward the mediastinum at inspiration, and in the opposite direction at expiration. If the collapsed wall may thus oscillate, the mediastinal partition will do likewise and dyspnea follows the incomplete air exchange. Brauer states that he has seen such symptoms come on within a few days, and certain observations which I made in Marburg during a series of 26 thoracoplastic operations in dogs has further convinced me that the cause of death in Dr. Friedrich's cases may also have been due to this factor of oscillating mediastinum. The animal experiments were difficult because of the difficulty in avoiding puncture of the normal thin pleura. After such accident, although repaired, it was evident that a closed pneumothorax plus a collapsed chest wall was an invariable cause of death. In certain operations I resected the whole of each rib, in others two segments of ribs were subperiosteally excised in the mammary and axillary lines; in another series the remaining rib ends were wired together. From these experiments it was evident that the less flexible was the collapsed wall the more favorable was the convalescence. I conclude, therefore, that an improvement in the technique for the observance of this feature will tend to diminish the fatalities.

Dr. John Smyth, of New Orleans, La. (by invitation).

I wish to exhibit to you the apparatus for direct insufflation of the lungs, devised by Dr. Matas and me in 1901, shown by him at the meeting of the American Surgical Association of that year, and described in an article by Dr. Matas, entitled "Artificial Respiration by Direct Intra-

laryngeal Intubation, with a Modified O'Dwyer Tube and a New Graduated Air Pump, etc.," published in *American Medicine*, January 18, 1902.

This apparatus has since been improved, and can be used by tracheotomy, but is intended to be used chiefly by laryngeal intubation.



H, handle common to *P* and the pump piston; *P*, accessory piston for automatic cut-off; *S*, sliding tube for automatic cut-off; *C*, adjustable collar for automatic cut-off and regulating stroke; *I*, inlet for air; *L*, compound lever for automatic cut-off; *V*, valve or stopcock for automatic cut-off; *F*, cylinder containing absorbent cotton for filtering air; *R*, rubber tube to intubation cannula (through bottles 1, 2, and 3, for ether, chloroform, and air or oxygen, respectively); *M*, *F*, modified O'Dyer intubation cannula with stopcock attachment and funnel of Trendelenburg type for anesthesia independent of the pump.

We claim for this pump the following advantages:

1. Any amount of air from 10 to 700 c.c. can be given.

2. The automatic cut-off prevents leakage of insufflated air into the pump on the back stroke.

3. The air filter prevents noxious material from the pump entering the air passages.

4. The modified cannula has the pistol grip, which makes it easy to hold; the intralaryngeal extension tube which lessens the danger of slipping out of the larynx, as has frequently occurred with the O'Dwyer tube, and the guarded outlet to control the air escaping from the lungs.

5. The lungs can be inflated to any degree desired and the respiratory wave kept up, and its rhythm can be readily controlled.

6. The lung can be held to the chest wall, which prevents pneumothorax, and facilitates suture to the chest wall if required.

7. The respiration can be controlled intelligently, as cannot be done by any automatic machine.

8. It does not damage the lung by producing lacerations, emphysema, etc., because the intrapulmonary pressure can be regulated and adapted to each individual case, and in open pneumothorax, no injury can be done the lung as long as it is not herniated or forced beyond the chest wall.

9. It is possible to administer oxygen mixed with anesthetic vapors, as ether, chloroform, etc., or pure air, as desired. (In our experiments we have used only ether.)

10. The apparatus is so constructed that the change in the material insufflated can be made by the assistant at any moment.

11. The apparatus is simple, compact, portable, does not get out of order readily (as shown by the apparatus that has been used for demonstration to students at Tulane, as well as all of our experiments over a period of more than one year without repairs).

It has no belt to slip or fuse to burn out; it is under the control of intelligent help, and its working may be promptly modified to meet certain conditions during operation.

The experiments on dogs undertaken so far with this apparatus are as follows:

1. The pleural cavity has been opened with observation of the working of the lungs and heart for one and one-half hours.

2. The upper portion, or about one-fifth of the lung has been excised.

3. A large portion of one side of the chest wall has been excised, leaving only the skin, and lung sutured to the margin of the opening, to close the thorax.

4. Excision of considerable portion of the chest wall, with suture of lung to margin, and a pedicle skin flap from abdomen and the other side to cover.

5. Stab wounds of both ventricles, varying from 1 to 2½ cm., have been made and sutured.

6. Osteoplastic flap of anterior chest and simultaneous direct sphygmometric observations have been made of relative pressure in right ventricle and left carotid.

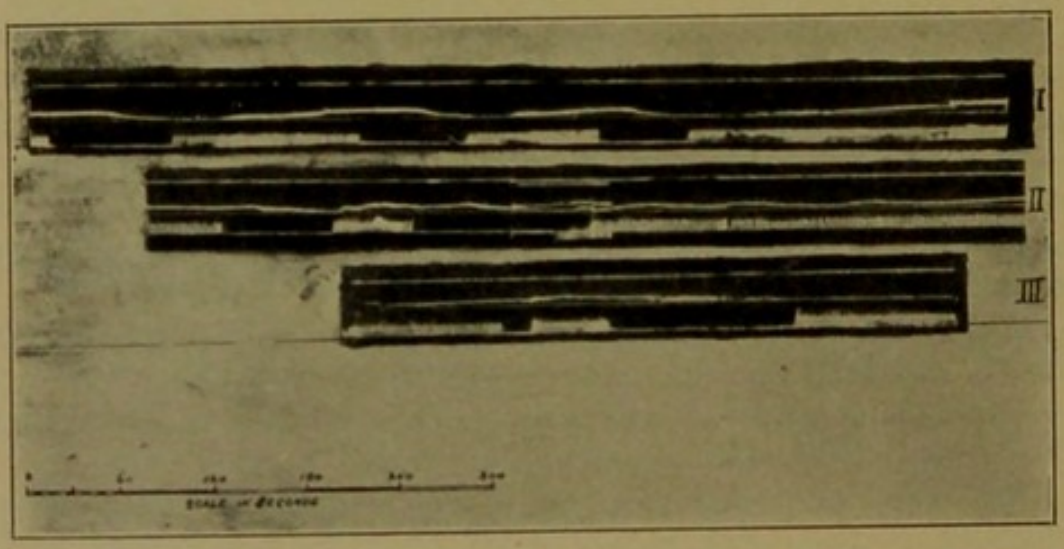
7. Resection of fourth, fifth, and sixth ribs, left side, in part, and simultaneous observations of relative blood pressure by the direct method in right and left ventricles were made, with lungs in collapse, and in artificial respiration, to determine effect, salutary or otherwise, of collapse of the lungs in perforating wounds of the heart.

In all of these experiments, in 11 cases we have lost 3 dogs. One from pyothorax, five days after operation, due to lack of asepsis, in

having to go back into the chest, for which we were not prepared; one from embolism of pulmonary artery, resulting from clot about the cannula, introduced into right ventricle; the third, two and one-half hours after closure of the chest, due to filaria immitis, 60 to 70 in number, blocking the right heart and termini of the venæ cavæ.

A second series of experiments was undertaken to test the efficiency of the apparatus in restoring the heart beat after its failure from asphyxiation. The results are shown in the tracings of blood pressure taken in the carotid of the dog, three of which are appended.

Chart I shows three periods of heart failure in the same dog, which was complete in each case in about three-fourths of a minute after artificial respiration was stopped, but the heart commenced to beat again



Tracing of blood pressure taken in the carotid of the dog, showing heart failure from asphyxia due to open pneumothorax, and the recovery of the heart action upon resuming artificial respiration with the graduated air pump.

about twenty to thirty seconds after artificial respiration was resumed, except in the third period, when cardiac massage was instituted after forty seconds repose, after which heart resumed apparently its normal function and the blood pressure recovered its orginal level. This dog's chest was closed after being open fifty-five minutes, and the dog recovered from the anesthetic and appeared normal, but was killed intentionally later with chloroform.

Chart II shows similar demonstrations though less uniform, the blood pressure resuming its normal level, during artificial respiration at the termination of the experiment.

Chart III shows failure of the heart to recover after it once stopped from asphyxia, notwithstanding artificial respiration, cardiac massage, lowering of head, etc. Autopsy disclosed numerous filaria in right heart and venæ cavæ.

In no instance could death be attributed to causes resulting directly or indirectly from the pump.

In conclusion: We do not claim that artificial respiration by pumps, billows, or other aid is essential to the successful performance of intrathoracic operations in every case, or that surgical pneumothorax is always an obstacle in dealing with unilateral thoracic lesions. We do claim that this apparatus, devised by Dr. Matas and me, will inflate the lungs, maintain artificial respiration, and, while subject to improvement, meet all the indications of positive pressure methods with certainty and simplicity.

Those who are interested in the origin and evolution of this apparatus, as well as the history and principles of artificial respiration by direct intralaryngeal insufflation as applied to medical and surgical practice, are referred to the following contributions by Dr. Matas:

1. "The Surgery of the Chest," etc., *Transactions of the Louisiana State Medical Society*, May 10 to 12, 1898; also *Annals of Surgery*, 1899, xxix, 409 to 434.

2. "Intralaryngeal Insufflation for the Relief of Acute Surgical Pneumothorax," etc., *Transactions of the Southern Surgical and Gynecological Association*, November, 1899; also *Journal of the American Medical Association*, June 9, 1900.

3. Contributions to the TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION, May, 1901.

PROFESSOR P. L. FRIEDRICH, of Marburg a. d. Sahr (by invitation).

Dr. Halsted's experiments deal with an important problem which, as I have stated in previous papers, is the most important in extensive ablations of lung tissue, viz., the problem of effecting satisfactory *occlusion of the bronchi*. It would be most gratifying if a solution of this problem had been brought about by Dr. Halsted's experiments. I desire to call special attention to Dr. Robinson's experiments. He did a great deal of very accurate work when he was with us in Marburg, and his results have yielded much valuable information bearing on the subject of the present discussion. Dr. Murphy's suggestion with reference to empyema (of the pleura) is quite in harmony with our modern views on general pathology, and I intend to make some experiments for the purpose of confirming his results. So far I have always given the preference to the method of valve-drainage advocated by my former master, Thiersch, and have found that this method usually gives very prompt results in cases of postpneumonic empyema, without resorting to resection of ribs. I am particularly pleased to find that the conservative treatment of empyema has such prominent adherents in this country, because I have for years *always* advocated that method of treatment in my relations with students and physicians.

In answer to the question whether I have always found it possible to effect extensive deossification of the chest wall without injuring the pleura, I may say that I have succeeded in doing so in *all* cases of *total* thoracoplastic pleuropneumolysis. (The technique was once more described in detail.) The most dangerous spot is, of course, the vertebral or sternal extremity of the rib. In only one case of *partial* ablation of the ribs, a slight tear resulted in front. As in these cases the patient's condition is always serious, I consider the occurrence of pneumothorax a very grave complication. One should never attempt, in these cases, to remove the lung from the costapleura, and then treat the resulting pneumothorax. Possibly we may, in the future, succeed in a few cases in attacking tuberculous lung tissue, or a cavity, through a deossified chest wall. In my case, No. III, I employed this method after rupture of an apical cavity following a paroxysm of cough, and obtained a perfect result by a course of silver-nitrate injections extending over a number of weeks. The time has not yet come for pneumonectomy in pulmonary tuberculosis, and, considering the mode of extension of the morbid process, it is hardly to be expected that the procedure will be justifiable in the future, except in very rare cases. The great vascularity of lung tissue offers the best possible conditions for spontaneous recovery, if healing is not rendered impossible by mechanical obstacles, such as rigid chest walls and the like.

In answer to Dr. Halsted's question as to which procedure is to be preferred, I believe I am justified in saying that there is no difference on physiological grounds, and that the choice of apparatus depends chiefly on technical details, such as the comparative ease or difficulty of anesthetization and the like.

With regard to the question of approaching the right half of the heart through a partial resection of the sternum, I am in accord with the view of Dr. Peck, and I should always be inclined to get along, if possible, with resection of one rib and part of the sternum, rather than employ large osteoplastic flaps. For obtaining access to the left ventricle, an intercostal incision suffices. For exposing the mediastinum, I recommend my transverse sternothoracotomy, which will be described in the paper that I expect to read at the meeting of the American Medical Association.

Dr. Charles A. Powers, of Denver.

In the investigation of the subject of surgical interference in pulmonary tuberculosis, I have been much impressed by the work which has of late been done abroad in nitrogen insuffiation in suitable cases. During the past few years all forms of operative interference in cases of pulmonary tuberculosis have been practically at a standstill in our country. I believe that there may be more of promise in this region than we have heretofore thought.

Dr. Albert Vander Veer, of Albany.

In a paper by me on this subject some years ago, I referred to several conditions that were spoken of by those reading papers this morning, and also with regard to the formation of sinuses, in which I mentioned several cases. I was very much pleased to hear from Dr. Ochsner his treatment of these. Also in regard to the very thick pleura, and Dr. Fowler's method of removal. I had a case two years ago in which this thickened pleura was dotted here and there quite extensively with phosphatic deposits, and I was able to remove almost completely the pleura, making it an unusually interesting case.

Dr. Alexander H. Ferguson, of Chicago.

Regarding visceral pleurectomy I have nothing to add to what I said in my paper. It is my wish to mention and emphasize the value of "capillary drainage" in pleuritic effusions, and also in empyema. The material used for this purpose is silkworm gut. One or two dozen strands are inserted through a cannula, one end extending liberally into the pleural cavity, and the other protruding externally on the skin. By this means either the effusion or the liquor puris, as the case may be, finds its exit into a large sterile dressing aseptically applied. In acute cases of pleurisy with affusion, capillary drainage has obvious advantages over aspiration. The fluid seeps away in response to intrathoracic pressure so gradually that the patient suffers no inconvenience whatever. The silkworm gut is left in situ as long as there is any serous effusion to escape. When the dressings are being changed, as they are whenever saturated, the drainage should be worked in and out to insure efficiency, for sometimes lymph gets between the strands and interferes with capillarity. In all cases in which the lungs readily expand, capillary drainage is all sufficient. A trocar and cannula should be always available, and if silkworm gut be not at hand, catgut, silk or linen threads may be used instead. Care must be taken to prevent the drainage material from slipping within the chest wall, and the ends of the silkworm gut should be burned to prevent them from sticking into the lung. In empyema, when the patient's life is in danger from overdistention, the aspirating needle is, as you all know, not always free from danger, and a repetition of its use is usually dreaded by the patient, and, indeed, may have to be used at an inconvenient hour. Here capillary drainage is much more efficient, less annoying, and safer. I have seen the temperature fall from 105° F. to 100° in a single night by this means, and the patient placed in a safe condition for the establishment of a permanent drainage when necessary. This simple method of drainage is a life-saving one. I have employed it extensively for over five years, and without a disappointment. I have used capillary drainage very extensively in surgery; *e. g.*, in clean

wounds, joints, cystic tumors (ovarian), etc., to prevent complications and to afford immediate relief.

Dr. Willy Meyer, of New York.

Regarding empyema, after having heard the very interesting treatment proposed by Murphy, by the means of formalin solution, and Friedrich having emphasized the old Thiersch method, it is most difficult to speak of an operative method. Yet I believe that the old resection operation will continue to be practised, very especially in children. The operation under pressure will be a great help in simplifying our treatment. I have lately had one child, aged six years, in whom I immediately blew up the lung with the positive pressure apparatus after a purulent effusion into the total left cavity had been evacuated. Later on breathing under differential pressure was instituted daily, and this resulted in curing the entire cavity under four dressings. So far I have only treated five cases by differential pressure, but I believe we will use it as well as other methods.

With regard to lung extirpation, I have found in my experimentation on dogs that the principal point is the proper treatment of the stump of the bronchus. I also believe Dr. Halsted's method will be very useful. We have treated the bronchus stump on the basis of the appendix stump; we have first ligated the accompanying vessels of the bronchus, then crushed the cartilages of the bronchus with a Doyen forceps, tied and divided the bronchus, inverted the stump, and stitched it over with silk sutures. Our records show that of 18 total left pneumectomies, 15 have recovered, the 3 deaths being due to accidental conditions, and that of 3 total right pneumectomies, 2 recovered, or in 21 total unilateral extirpations of the lung there were 17 recoveries and 4 deaths. In the removal of the lobes in 6 cases we had 5 recoveries. This record proves that the treatment of the stump in this way is a useful method.

One word regarding the esophagus, particularly with regard to the maintenance of asepsis, than which nothing is more difficult. I believe all methods demanding lateral approximation by means of suture are to be excluded in future. Also the use of the Murphy button or the modification of the Murphy button is dangerous, because of the difficulty we have in maintaining asepsis when introducing the button into the esophagus. We have tried to avoid absolutely ever opening the esophagus, except dividing it when it has been tied before, and even the little bit of mucus which then leaks out is immediately mopped away, first with dry gauze and then with lysol. I believe our efforts should be directed to the implantation of the esophagus into the stomach with needle and thread rather than to bringing it into apposition with the stomach by means of the button, except in cases of emergency.