ANNALS *of* SURGERY

VOL. LXXV MARCH, 1922 No. 3

RESECTION OF THE LUNG FOR SUPPURATIVE INFECTIONS WITH A REPORT BASED ON 31 OPERATIVE CASES IN WHICH RESECTION WAS DONE OR INTENDED

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IN the literature of surgery there is little to be found on resection of the lung for what may be called suppurative bronchiectasis. In a recent search there were found less than thirty cases. The majority of surgeons appear to have been content with palliation, and in most instances the patient goes about during his periods of remission merely waiting for the next exacerbation and not able to count on any particular period of uninterrupted usefulness. Occasionally an individual coughs his way through life—never a long one—and manages to exist as a semi-invalid, the copious, foul expectoration which no medicine can control being a handicap difficult to bear. Patients have even threatened suicide if refused the chance for cure by operation though they knew that the danger was great.

It is not a simple matter to decide what to do. To refuse to operate upon a wretched patient, otherwise incurable, merely because the statistics may be unfavorable, seems hardly fair; yet, one of the functions of our profession is the prolongation of life and what we call an operative death is always a calamity. The first important problem, then, is to determine what class of cases is suitable for the radical step of lobe resection. If anything less dangerous promises a cure † or a tolerable existence with the ability to earn a livelihood, lobectomy should be abandoned in its favor. But it must not be forgotten that any operation which glues the diseased lung to the chest wall over a wide area will, in case of failure, prevent subsequent lobectomy. I say this judging by my own experience. Robinson, Sauerbruch and others appear to recommend extirpation of a lobe in several stages even after bronchial fistulæ have formed. The difficulties and dangers of this procedure, however, are probably greater than those of a one- or two-stage typical lobectomy.

I feel that it is time I reported my experience in this field of surgery. My first case of lobectomy bears the date of February 27, 1914. Counting out a year's absence (1918) this leaves six working years with 31 cases.

* Read before the New York Surgical Society, December 14, 1921.

† No method known to me.

In 14 of these, in which a single lobe was removed for disease limited to that lobe, six died, or 42.8 per cent. In 10 cases, in which the disease was not limited to a single lobe and in which more was done than the removal of a single lobe, there were seven deaths, or 70 per cent. In the remaining seven cases lobectomy had been intended but could not be completed, sometimes nothing but an exploration having been made. Five of these patients died although there was no fatality on the table. One seems absolutely well (Case No. 31) one and a half years after thoracotomy and mobilization, and the other (Case No. 12) has a bronchial fistula and is in the hospital.

While the mortality rate seems high, it must be remembered that there are included all cases in which at operation lobectomy was performed or intended, not necessarily even attempted. The cases have been unselected except that they were all supposed to have been unilateral. In all except two of my finished cases the patient, if he survived, may be considered cured; which means that all wounds are healed and that the patient is able to live a normal life, working and exercising as usual, although no one has thus far engaged in occupation involving heavy manual labor. One of these patients (Case No. 21) still has productive cough, but without odor and the presumable cause, nasal pansinusitis, is still present and under treatment. The other (Case No. 3) is working at his occupation, that of secretary, and has been continuously thus employed since he left the hospital. (Reported in *Surgery, Gynecology and Obstetrics,* November, 1919.)

These apparently modest statistics are presented because I believe that I have here enough cases to form the beginning of a working basis in determining the danger of operation in the various forms of lung suppuration which are here represented. It appears to me, then, that in selected cases we may count upon the survival of 50 to 60 per cent. of the patients, nearly all of whom will have been actually restored to health by surgery. And this percentage is by no means discouraging. Compared with those in which palliation, so-called, has been secured and compared with the mortality rate of other surgical diseases of like gravity, and considering the present stage of this newly developed side of thoracic surgery, any percentage of cures over forty may be considered excellent.

As an example of an unsuccessful operation intended for relief I will cite the case of *Mrs. J. P.* After a year of misery following a post-tonsillectomy lung infection, an abscess was drained in two stages, but little relief followed. Four years later she came to me, a frail little woman, with clubbed fingers, fœtid breath, with cough and foul sputum, and with a discharging wound in her back from which escaped pus as foul as that which was expectorated. Surely this attempt at palliation had not been worth the effort. Before reaching my present conclusion in regard to resection of these suppurating lungs, I myself have operated upon patients by this attempted drainage. I saw my patients die of hæmoptyses, or of sepsis without relief. I also succeeded in securing

some drainage with limitation of cough by means of bronchial fistula formation, but here also there were exacerbations with cough and fetor. The only patients who appear to be happy, normal beings, are those who have recovered after radical resection.

Indications and Contra-indications.—First: Children and young adults are by far the best subjects. After the age of thirty-five the operation becomes extra-hazardous because the resiliency of the patient is impaired. With or without sepsis it is the power of the heart to adapt itself which is perhaps the greatest factor in determining resistance. While this is practically so in all surgery it appears to be more striking in resection of the infected lung. This is of importance in regard to prognosis. It does not mean that we should deny older persons the benefits of surgery in incurable disease, but it does mean that we must frankly make known the added risk when the patient is more than, say, thirty-five. In any event, digitalization should be accomplished in the forty-eight hours preceding operation.

Second: The distribution of the morbid process. For example, a patient with a bilateral suppuration would be considered an unsuitable subject. Cases in which there is dense infiltration close to the mediastinum are extra-hazardous, and while suitable for exploration will probably not come to resection. (See Case No. 31.)

Third: An individual thirty-five years of age or more, who has been previously operated upon with resulting dense adhesions and perhaps fistulæ, would be almost an unwarrantable surgical risk. If palliation can be secured through drainage by bronchial fistula, the time might come, perhaps, for eventual resection; but I have not succeeded in saving one of these patients. (See Case No. 9.)

Fourth: The coexistence of other serious disease, such as cardiac, renal, or grave metabolic disturbances. In a syphilitic, lobectomy should not be performed until the Wassermann examination is negative and has been so for months.

This Wassermann examination must be made in every case in which another exciting cause, such as aspiration of a foreign body, tonsillectomy, etc., cannot be assigned. Or even as a routine in every case. Syphilitic deposits pressing upon one of the branches of the bronchial tree may be the cause of a bronchiectasis which can be relieved by anti-luetic treatment. In one of my patients there were for years the characteristic symptoms of suppurative bronchiectasis confirmed by X-ray; there were lesions in both lungs. Finally an empyema developed from the perforation of one of these bronchiectatic abscesses into the pleura. Following the surgical treatment of the empyema, combined with anti-syphilitic medication, this patient made a complete recovery.

Fifth: Systolic pressure of less than 100, while not a contra-indication for ultimate operation, would make postponement advisable.

When a patient has suffered for more than six months on account of

suppurative bronchiectasis, suppurative pneumonitis, or multiple parenchymatous lung abscess with cough and foul, copious expectoration, with febrile exacerbation and sepsis, it is probable that nothing short of the actual removal of the diseased portion of the lung will restore health. Also, the so-called drainage operations, in any except a few discreet or single abscesses of the lungs, probably parenchymatous, promise little. Palliative measures should be reserved for those absolutely unsuitable for radical surgery, such as persons in advanced age or with bilateral disease. According to Sauerbruch, it is desirable to close the thoracic bronchial fistulæ if the patient has been otherwise well for a long time; but he admits that this is by no means a simple procedure or devoid of danger.

As a rule the patient will not come for radical treatment until he has been ill for many months, or even years, and has become heartily tired of his condition. In my cases the mean duration of the illness before coming to operation has been one year.

Typical lobectomy in acute gangrenous conditions is little known. Perhaps the case of *Gertrude K.* should fall under this head. Here, immediately following tonsillectomy, the patient had what was supposed to be an "ether pneumonia." It proved to be a left lung suppuration. Although this particular patient died from sloughing of a vessel wall, perhaps we shall find that in the lung as in other parts of the body moist gangrene is best treated by ablation. If operable pulmonary suppuration were as common as gangrenous appendicitis, surgeons would learn how to deal with it; and I may say by the same means, extirpation.

Management of the Case.—Before accepting the case for operation, the state of affairs is fully explained to the patient and his family and the operative risk is gone into in detail. They should request me to operate; I do not try to persuade them.

Date of Symptoms.—A superstitious person might find an excuse for his infirmity in the large number of post-tonsillectomy lung infections in which cough and foul expectoration first occurred on the thirteenth day after operation. Rarely have I observed the beginning of the symptoms before the fifth day; still more rarely after the eighteenth day. In from ten to fourteen days in most of these cases the disease has declared itself.

Extent of the Disease.—The size of the lesion is not always indicated by the daily output of sputum. I have seen a quart of foul mucopus issue daily from a middle lobe bronchiectasis without remission for many months, while in other cases an upper or lower lobe had been the seat of extensive suppurative bronchiectasis with only ten to twelve ounces a day, and with remissions during which there was little or no sputum.

Bronchoscopy and X-ray Examination.—Within limits, the more one knows of the location and character of the disease before operating the better. But though I heartily favor bronchoscopy, it need not be employed in every case. After all, the chest is to be opened, and opened widely, and conditions may then become apparent that could not possibly have been predicted. The

really necessary things to know are (1) whether the disease is in the upper or the lower part of the chest; (2) whether it is near the hilum or near the periphery; and (3) whether there is perhaps a foreign body or a tumor present in the bronchus as a cause of the suppuration.

The X-ray may show all these things. In making radiographs in all chest cases, the upright position is the best for completeness. The diaphragm is low and the chest capacity greatest. In the prone or supine posture the diaphragm is crowded upward by the abdominal viscera and in its turn distorts the appearance of the thoracic organs. Level lines in the presence of air and fluid cannot be seen when the patient is recumbent with the rays passing from front to back or vice versa. When the patient cannot be placed upright, the exposure may be made anteroposteriorly while he lies on his unaffected side. Fluid levels may thus be demonstrated, and by taking the picture in both positions the size of the cavity can be estimated and unsuspected ones may be discovered.

Sometimes, however, bronchoscopy will reveal what the X-ray cannot disclose. For instance, the X-ray may show a triangular shadow and the history may indicate the presence of intrapulmonary suppuration; but the bronchoscopist may find and remove an aspirated lemon seed, radiotransparent, which caused all the trouble. Also, it may be convenient to know whether the pus is coming from one or more lobes when the X-ray shadow leaves one in doubt—this more as a matter of prognosis than influencing technic.

Examination of Sputum.—Examination of the sputum for tubercle bacilli is a necessary precaution. It occasionally happens that a few scattered acid-fast bacteria have been observed on one or two slides only, with numerous negative tests between. When there is a large quantity of sputum and concentration tests fail to show tubercle bacilli, in the majority of examinations, their absence may be assumed. In the cases in my list in which occasional bacilli have been found, I have an idea that there was an error in technic. Possibly the slides of two patients were confused; perhaps even the positive slide may have been a dirty one. It does not take much dirt to carry eleven bacteria, such as were found on a solitary occasion in the case of *Mrs. E. M. B.* (Case No. 1.)

Preoperative Preparation.—Two days of postural preparation are desirable excepting in the rare cases of emergency. The patient usually knows how to empty out the bronchial passages when there has been a considerable daily discharge. Sometimes the pus is more easily expelled when the patient inverts himself in the prone or in the supine position; sometimes when he lies upon the unaffected side and rarely when he lies upon the diseased side. If he has not made these observations, better take an extra day to experiment. At any rate it is best to have the lung as empty as possible so as to minimize the danger of overflow into the healthy side, especially as the patient must lie on the sound side on the operating table. The emptying should be done at least twice daily and also an hour before the operation.

As mentioned before, it is advisable to digitalize for forty-eight hours.

Three-quarters of an hour before operation a full dose of morphine and atropine should be given.

The patient's blood must be grouped and a suitable donor secured.

Precautions Against Hemorrhage.—The method of saving blood by segregating it in one or more extremities is an old one. Its practical application to surgery, however, was emphasized by the late R. H. M. Dawbarn, of New York. At the suggestion of Dr. A. J. Bendick and with his assistance the writer, some years ago, made observations with the syhygmomanometer which showed that in normal individuals the blood-pressure may be lowered by 40 to 60 millimetres of mercury following the segregation of blood in the legs brought about by ligating both thighs close to the body. We used elastic bandages and the pressure applied was just sufficient to impede the venous return, causing a swelling and cyanosis of both extremities. The blood-pressure, as shown in the pulse readings, falls rapidly, and faintness may even be induced on account of the bleeding of the subject into the veins of his legs. On removing the constriction it takes about one hour for the normal pressure to become reëstablished. According to Doctor Dawbarn, this blood segregation with its attendant lowering of pressure is of great value in preventing the loss of blood from the smaller vessels during an operation, and the writer has many times demonstrated the truth of this observation. Still, there is always the danger of recurrent hemorrhage when the normal pressure returns, because sufficient time has not elapsed for firm coagulation in the vessel-mouths. In my later cases, therefore, I have feared to employ this method and have relied more upon the intramuscular sodium citrate injections of Neuhof and Hirschfeld. When injected into the glutei just before the operation begins, while the patient is anæsthetized, a great drop in the coagulation time is noted within twenty minutes. For an average adult, 15 c.c. of a 30 per cent. solution of sodium citrate in sterile water is thrown into each buttock. The effect continues for about twenty-four hours and by that time firm coagulation has taken place. Perhaps in exceptional cases both methods might prove valuable.

Selection of Team, Anæsthetist, Assistant and Nurse.—An anæsthetist, especially experienced in this class of work, will save the surgeon much anxiety during the trying time on the table. These operations must be performed quickly and the surgeon's attention should not be distracted unnecessarily by the alarms of the inexpert.

Whenever possible the first assistant should be a man of mature experience and a good operator who knows what to do and how to do it without being told.

I know of no class of cases in which the result is more surely influenced by the nursing than in the post-operative period of lung resection for suppuration. Mt. Sinai Hospital has been most generous in furnishing special nurses for all of these cases, and also in securing donors for blood transfusion. The changes from hour to hour, and sometimes from minute to minute, are often tremendous, the patient's condition swinging from apparent well-

being to the picture of impending death. The nurse who knows surgical thoracic cases will be prompt to sense danger; she will at once summon the surgeon, tiding over the interval with a sedative hypodermically administered.

Anæsthesia.—After consciousness has been lost following nitrous-oxide and oxygen anæsthesia, ether should be used to secure complete relaxation and deep narcosis, then nitrous oxide, using a little ether according to necessity. In spite of what we have heard from certain eminent operators from abroad as a result of their observations in the War, I know from civil as well as war experience, that when there are few or no adhesions differential pressure nearly always is an absolute necessity. I have abandoned the intratracheal for the simpler and less dangerous intrapharyngeal method. When the more healthy part of the lung happens to be adherent to the chest wall, ordinary inhalation anæsthesia may suffice, but no matter how extensive or virulent the lung infection is, unless there has been perforation into the pleura, or numerous preoperative exploratory punctures have been made, astonishingly few adhesions will be observed. In the paragraph on two-stage versus one-stage lobectomy, this matter will be discussed.

As to the apparatus required, it is of the simplest. To be sure, a nice little electric contrivance with pump and suction silently running, such as the one devised by Doctor Branower, may be a luxury, but the ordinary dental foot bellows or at a pinch even a Paquelin bulb will furnish all the air pressure necessary. A manometer when the chest is open is unnecessary because the operator can easily determine by the appearance of the healthy lung when dangerous force is being used. The pneumatic chamber is here unnecessary.

The anæsthetic, gas or vapor, passes through a rubber tube of size about 14 French for an adult, placed through one nostril, just as far as the pharynx (about 3½ inches), the distance being clearly marked on the tube. Through too long a tube air may be forced into the stomach, a most disagreeable accident. To increase the amount of pressure, the anæsthetist places his hand over the closed lips of the patient with one finger shutting off the opposite nostril. Differential pressure may also be secured with an ordinary well-fitting nitrous-oxide mouthpiece without the nasal tube, the gas as it comes from the tank having all the necessary pressure and the balloon acting also as an indicator. Should vomiting occur, however, or should suction be required to empty the pharynx or trachea, the gas mask must be removed, thereby permitting lung collapse. I therefore prefer the tube method.

If it seems desirable to distend the healthy lung at the close of the operation, this can easily be done just before the last stitch is tied.

Posture on the Table.—The patient lies upon the unaffected side, but slightly prone, a pillow beneath the head, the back bowed forward, the thighs flexed and a thin pillow between the knees. There should be a sandbag front, or front and back as required. Belting or bandages are used around the table, taking in the patient's thighs and legs to preserve the attitude. The arm of the affected side is raised and drawn forward so as to pull the

scapula as far out of the way as possible. The position on the table should be such that the elevating bridge comes beneath the lower ribs, and when the bridge is raised a degree of scoliosis is produced with widening of the intercostal spaces.

Should There Be One or Two Stages?—The decision between a one-stage, a two-stage, or a many-stage operation for the resection of a suppurating pulmonary lobe can be made only after the chest is opened. Here are the arguments:

First: The mere exploration of the thoracic cavity through a long intercostal incision with rib-spreading is not a shocking thing. The patients are usually out of bed in three or four days. There is no embarrassment either of respiration or of heart action, and this is true in older patients as well as in more youthful ones. But the operation takes time, and time is probably the most important element in thoracic surgery. If, now, immediately after our exploration we proceed to perform a lobe extirpation, the fifteen minutes more or less may have proved to be just enough to turn the scale.

Second: After a one-stage lobe resection, there are important changes in what may be called the balance of the heart. This is further accentuated when there is a collapse of the healthy part on the same side; and even when at the end of the operation the lungs have been distended by the differential pressure, a certain amount of collapse will quickly occur because of the rapid outpouring of exudate into the pleural sac. In young and vigorous individuals the circulation adjusts itself and the immediate danger from the operation gives place to the more remote one of infection.

Third: Suppose that at the primary operation we find numerous old inflammatory adhesions between the healthy lung and the chest wall, or suppose even that the entire pleural cavity has been obliterated by such adhesions; it is obvious then that so far as the danger of lung collapse or mediastinal commotion goes, we may as well proceed at once to complete the operation. Differential pressure is not needed; the patient breathes as quietly as if the chest had not been opened. (See case of *David J.*, No. 14.)

Fourth: It may become a matter for fine decision, however, when we find at the first operation a few adhesions of healthy lung to the chest wall. One should then observe how much collapse occurs when the differential pressure is intermitted. If the collapse seems too great, it would be better to prepare the patient for a second stage by Robinson's method (see technic); if not, the lobectomy may be done at once.

Fifth: Given a patient in good general condition with few adhesions in the chest, with practically none around the diseased lobe, and with the lobe easily removable, the decision to finish the operation at once may be made provided the entire procedure can be finished in half an hour.

Sixth: When in doubt, choose the two-stage method, but remember that the finished lobectomy means the removal of a septic focus and the instant cessation of productive cough.

The Operation.—No one will deny that in any operation unnecessary loss

of time is an evil only. Deliberateness is always justified, but it does not necessarily mean slowness; rash haste must be avoided, but steady progress with little lost motion and with quick decision means safety for the patient.

I have a feeling which is more than a mere impression, that any longer than forty-five minutes used in performing lobectomy means the almost certain loss of the patient. This has been more than once brought to my attention by Doctor Branower, my anæsthetist. Here we have one of the strongest arguments in favor of the two-stage operation, for at the second stage the removal of the sutures and the preparation for lobectomy takes only a few minutes, while the exposure alone in a one-stage lobectomy will occupy from seven to fifteen minutes. Even in suturing these wounds it is better to make a less neat closure than to lose valuable time in perfect approximation. In the checking of hemorrhage, however, there must be no careless haste.

Instead of going over the evolution of the operation as worked out in my cases, I am here describing the procedure as I carry it out at present.

Technic.—The primary incision in the 7th or 8th interspace from just behind the angle of the ribs almost to the costal cartilages should be made through the skin with a free hand. The slant of the ribs in almost all cases is much more oblique than one would imagine. Be sure, then, to keep the fingers of the left hand on the intercostal space so that the line of incision will fall correctly. Now, beginning anteriorly, the muscles are quickly divided, the first assistant taking up the bleeding points and also the uncut vessels which cross the line of incision. The muscles divided are, posteriorly, the lower part of the trapezius, the latissimus dorsi, the serratus magnus. There are formed roughly two layers of muscles, the serratus and the latissimus. The clamping of the vessels should be done quickly, taking in bits of the surrounding muscle rather than picking out the bleeding points too minutely. We now come down to the intercostal tissues and here a short incision is made in the most easily accessible part of the wound, hugging closely the upper border of the rib just below the proposed entrance into the pleura. The anæsthetist is notified that the pleura is about to be opened so that he may be ready with his differential pressure, and with the knife a small pleurotomy is made. There should be no in-and-out rush of air, the pneumatic pressure taking care of this. The pleural opening is lengthened with scissors and the ribs are drawn apart a little by blunt retractors. With strong scissors the pleural opening is rapidly enlarged to the full extent of the incision, when with steady traction the ribs are separated enough to permit the introduction of the blades of the rib-spreader, which in turn are slowly separated until in one or two minutes the widest possible space has been secured. Often six or seven inches separation may be easily obtained, and even without cutting a rib exposure enough for the purpose of the operation may sometimes be had. If the space does not widen sufficiently it is possibly because the posterior intercostal structures require further division. For a lung resection, it is necessary to have a very wide approach, especially when we are dealing with the upper lobe. Then the 7th, or even the 6th space intercostal incision will have to be supplemented by continuing its posterior end upward parallel with the posterior border of the scapula and about one inch or more from it. The rhomboid muscles must be divided and three or four ribs cut through with heavy bone forceps without taking the time to peel away the periosteum. A spinal forceps or a heavy Liston's bone forceps will be found convenient for this purpose and the cutting edge should

be in a plane at right angles with the plane of the rib instead of parallel with it. The cutting is done very slowly so that the intercostal structures are crushed before they are divided, thus minimizing the chance of hemorrhage from the artery. This rib division goes straight through into the pleura. Should there be bleeding from the intercostal when the rib first cut is severed, ignore it and proceed quickly to cut the next rib, at the same time separating the blades of the rib-spreader farther. This will give easy access to the bleeding point. When a sufficient number of ribs have been divided, a second rib-spreader may be placed in the vertical part of the wound; or a single blunt retractor placed anteriorly will draw the ribs forward. This incision is the one devised by Torek in his operation for the transpleural exposure of the thoracic œsophagus.‡

When the operation is to be divided into two stages the making of this vertical part of the wound may be postponed according to the condition of the patient. If during the first spreading of the ribs, particularly in older subjects, a fracture occurs no harm will come of it. The accident is an unusual one. Sharp points should of course be trimmed away.

As soon as the exposure is made, a glance will show the gross pathological relations between the lungs and chest wall, and also the condition of the lung itself. The intermission of the intrapharyngeal pressure will cause the healthy lobe, and in a measure the diseased one, to collapse, indicating the location of adhesions. These are of two kinds; either the broad, dense variety which often signify pus beneath, or the more attenuated, cordlike kind which can easily be divided between catgut ligatures. It is best not to disturb adhesions of presumably healthy lung to chest wall.

The diseased lung may be bluish, brownish or, rarely, pale. It is most often solid and liver-like in feel, and is in sharp contrast with the healthy pulmonary tissue.

If this is to be the first stage only, the healthy, non-adherent lobe and also the costal pleura with which it is normally in contact should be briskly rubbed with gauze and then the lobe should be surrounded with several single layers of iodoformized gauze, about 3 inches wide, placed one beside the other, the ends long enough to reach outside the wound in the chest wall. This employment of gauze to form adhesions I learned in a personal communication from Dr. Samuel Robinson. These pieces of gauze are transfixed in one mass with a safety pin which is left outside the muscular layer of the chest. The place where the safety pin lies should be marked on the skin so that two days later it can be quickly found on the removal of one or two cutaneous sutures. This gauze must be withdrawn in 48 hours. Its extraction is sometimes quite painful, and if the patient is nervous it can be done under light nitrous-oxide anæsthesia. It takes only a few seconds. If it seems desirable the diseased lobe may be surrounded with a large piece of rubber dam to prevent the formation of adhesions. This rubber dam need not be led out at the wound. It is not to be removed until the second stage of the operation. The entire wound is now closed, as will be described in speaking of this stage of the completed operation, excepting that the skin is sutured covering in the gauze, safety pin and all.

One week after the first operation the second stage may be undertaken. By this time firm adhesions will usually have formed between the healthy lung and the thoracic wall, and with the danger of post-operative lung collapse, the danger of mediastinal flapping is also banished. The necessity for differential pressure no longer exists, so that the second stage of the operation, the lobectomy itself, can proceed with the least possible respiratory embarrassment, and even with ordinary inhalation anæsthesia.

‡ The cutting of the intercostal nerves is sometimes followed by pain in their distal distribution. Neuhof has used alcohol injections to combat this.

The Lobectomy itself; Primary or Secondary.—The pulmonary ligament, that fold of the pleura between the pericardium and the lower mesial part of the lung, contains no vessels of importance and it can be quickly divided with scissors. The pedicle of the lobe is now isolated and carefully palpated. In the chronic inflammatory cases this structure is densely infiltrated and its texture is almost that of solid rubber. To separate this pedicle into its elements of bronchus, blood-vessels and nerves would take too long, even if it were possible. Therefore, the pedicle is to be secured with chain ligature sutures of stout, but not too thick silk. In some cases the pedicle can be first crushed with a powerful clamp; in others it is too thick and tough for any clamp, but even here it can be crushed in sections, each section being caught immediately after crushing with a large hæmostatic needle and firmly ligated. The placing of these chain ligatures, taken one next to the other so that no part of the pedicle can escape ligation, is the most important part of the operation; for if one of them slips or breaks there will be such a rush of blood that the vessel lying at the bottom of the opaque pool can never be secured. A large stump should be formed by sectioning the lung tissue, whether diseased or not, an inch or even more distal to the ligatures in the pedicle itself. This should be done slowly with scissors or knife, an assistant wiping away discharge or using suction so that there shall be a minimum spilling from the distal part of the lung. When the ablation is complete the stump must be carefully inspected and all apertures, especially the bronchial openings, wiped out with pure phenol.

Thus far I have assumed that infecting the pleura at the time of operation is unavoidable. Packing off with gauze is only a makeshift and cannot be carried out as it is done in the peritoneum where the viscera have a natural tendency to crowd toward the wound. In the thorax the lung tends to fall away from the wound and infected fluid exudate can hardly fail to become pretty freely disseminated. Following the slow perforation of a lung abscess we often see the formation of sacculated or localized empyema. In the sudden breaking of an abscess, however, a general rapidly forming empyema results; so in these operations when a bronchus or an abscess filled with septic fluid has been entered there is a great gush of pus with immediate extensive soiling of the pleura. Or if there is a protective packing it becomes infected and it is almost impossible to remove it without contact with the pleura. Then, also, it has not been possible actually to sterilize the stump because it is nearly always composed of grossly infected tissue which is supposed to slough off later on. To keep this sloughing stump from the uninfected pleura during the ten to fourteen days before it is cast off appears to me to be at present beyond our skill. The most that we can hope to accomplish is to minimize the soiling so that the invasion of the infection may be slower, permitting the patient sufficient time to acquire resistance.

Following the suggestion of Doctor Neuhof, in some of our cases I have tried to accomplish this temporary protection with the aid of rubber dam. For many years I have made use of rubber dam in my gastro-intestinal work, with great satisfaction. In the lung surgery, however, I have not tested it out sufficiently to know its possibilities. Perhaps if a device can be found for completely isolating the diseased lobe before ligating and ablating it good might be accomplished. I shall continue to experiment along these lines.

The ends of the silk ligatures will have been left long so that they form a bundle of ten or twelve strands that should be tied together with another piece of silk placed so that a large transfixing safety pin will lie upon the chest wall beneath the level of the skin, causing just enough tension upon the pedicle to steady the mediastinum when the patient coughs or strains.

The anterior portions of the cut ribs should now be shortened about an inch

for two reasons: first, to prevent their grating during the early part of convalescence—a disquieting sensation for the patient; and second, to leave room for the bundle of ligatures and for the removal of the stump when it shall have sloughed away. The ligatures and stump are drawn through a hole in the center of a piece of rubber dam which is now slipped down over the stump and embraces what may be called its neck. This rubber dam now forms a sac with the stump at the bottom, and within this sac down to the stump is placed a packing of iodoformized gauze. The rubber dam with the gauze and ligatures in one mass is led out through the upper part of the thoracic wound and marked with a safety pin. In addition to this opening for drainage another smaller one is made through the lower chest wall posteriorly, with or without resection of a small piece of rib; and this opening is made before the closure of the chest and under the guidance of the hand within the thoracic cavity. It should come just above the diaphragm and should be large enough to take a tube of about 28 French. If necessary, a suture of the skin alongside the tube should be made for the sake of airtight fitting. The intrathoracic portion of this tube should have several fenestræ and should be long enough to reach almost to the level of the pedicle (see Fig. 21). The chest is now closed with three or four pericostal sutures of heavy chromicized catgut or kangaroo tendon and one row of chromicized catgut interrupted sutures for each layer of muscle. In closing the chest this muscle suture will be rendered much easier by lowering the bridge and placing the patient's arm down against his side. The drain, rubber dam, etc., with the safety pins is buried beneath the sutured fascia to be removed for drainage on the removal of these sutures in two days.

Under no circumstances, no matter now tempting, should the skin ever be sutured after lung resection for suppuration. The danger of anaërobic infection is great and I have seen more than one patient die of a gas phlegmon beneath what looked like a perfectly clean and innocent cutaneous suture line. The wound in the skin should be packed with iodoformized gauze. In a few days, if all is well, the gauze may be removed and the skin edges strapped.

The tube from the lower part of the chest is clamped after the lobe of lung has been distended by the intrapharyngeal pressure, and as soon as the patient is in bed this tube is carried beneath the surface of antiseptic liquid in a vessel on the floor. Kenyon's drainage.

Dressing.—It has been my rule to forbid an encircling bandage to be placed around the chest immediately after this operation. The gauze is held in place with broad adhesive strips, going not more than two-thirds round the body. These patients must have rest; to encircle the chest with a bandage, gauze, or plaster, means an unnecessary effort with each respiration.

After-Treatment.—Considerable shock usually follows the operation with rapid pulse and respiration. To combat this, morphine in large doses should be administered, regulating the quantity according to the rapidity and character of the breathing and striving to reduce the rate to something under 30. A rapid pulse is not in itself a sign of immediate danger provided its volume remains sufficient, but respiratory distress, either with or without cyanosis, is a cause for alarm.

Transfusion.—After almost every lobectomy there is a large outpouring of bloody serum into the pleura. This serum is intensely stained, looks almost like fluid blood, and I have known it to show as much as 11 per cent. hæmoglobin. Therefore, unless the patient is in exceptionally good condition, with normal blood pressure and hæmoglobin, I think it is well to, as the financiers say, "discount the condition" by a timely blood transfusion. I have usually done this immediately after the operation, and indeed, as I have before stated, I will not prepare for a lobectomy unless the patient has been grouped and the appropriate donor is pres-

ent. If during the operation much blood is lost and the patient is in shock from acute anæmia, a transfusion with citrated blood may be performed because the method is quick and easy. If there is plenty of time, however, I prefer one of the more direct syringe methods instead of the citrated blood. The citrated blood sometimes causes a sharp reaction with chill and hyperpyrexia. In such a grave operation as lobectomy, all the resisting powers of the patient must be conserved, and I feel that in certain of my cases we cannot be sure that the reaction chill did not contribute definitely toward a fatal termination.

After-care and Post-operative Phenomena.—One of the most dangerous complications following an operation upon the lung itself, especially in suppurative cases, is infection by anaërobic organisms. It occurs in nearly every case and often there is a condition greatly resembling the gas gangrene of war wounds. Very little has been done toward the cataloguing of these various organisms. Through research in this field we may hope for the discovery of vaccines which will minimize the risk from infection. On the assumption that anaërobes abhor oxygen, surgeons in the past have made use of the open treatment of infected wounds of other regions, exposing them to the air; and in later days peroxide of hydrogen has been employed. I have frequently used oxygen in open infected thoracic wounds, placing a small catheter in the chest and permitting the gas to bubble through continuously for two or three days, the great size of the wound preventing the danger of tension. I have never considered it proven that this procedure has actually shortened the time of anaërobic infection, but it can do no harm, and when our figures are large enough we may learn more about the value of this form of therapy.

Tension Pneumothorax.—This variety of pneumothorax in which there is progressively increasing pneumatic pressure may occur from within or from without. It usually means that during respiratory effort, whether in breathing, coughing or straining, air enters the pleural cavity which is retained there and prevented from escaping by the valve action of the opening through which it entered. The tension may increase rapidly or slowly according to the amount of air which enters at each cycle, but sooner or later, either in minutes or hours, the pressure becomes so great that the organs of the mediastinum are displaced, that the flow in the veins is impeded, and that respiration gradually becomes impossible. To relieve the condition, it is only necessary to open the tense chamber, equalizing pressure without and within. This had better be done slowly at first so that there may not be too sudden a swinging back of the mediastinum to its normal position. If the pneumothorax is general, relief may be had by opening a part of the wound. If it is sacculated and cannot be reached by way of the wound, puncture should be made through the unopened part of the chest where the physical signs indicate the trouble. A fine trocar and cannula is the proper instrument, and with the aid of an attached rubber tube, its end under water, the bubbling of the escaping air may be observed. If it is desired to secure a negative pressure within the chest, the patient should be requested to strain repeatedly, the

tube being pinched with each inspiration until no more bubbles appear on expiration; then the needle should be quickly withdrawn. What we have accomplished can often be determined by means of the X-ray. The relief afforded is striking. A tension pneumothorax may overflow into the external tissues or into the mediastinum through small openings, causing subcutaneous or mediastinal emphysema; and if this becomes in itself alarming it can be relieved by suction with a cupping glass, or Bier's apparatus, through incisions in the skin. Another danger of this pneumatic tension in the thorax is air embolism.

For the first twenty-four hours after the initial reaction following the operation, there is little to do. The patient seems surprisingly well and breathes easily. Any sudden dyspnœa in this period would probably signify the slipping of a bronchus from its ligature and a tension pneumothorax.

Hemorrhage will be recognized by the classic signs.

In forty-eight hours the wound should be inspected, and in not more than three days the muscle sutures covering the ligature bundle are removed and this part of the wound examined. The gauze within the rubber bag is loosened, but should not be removed unless it comes away with great ease. The lower drainage tube is cut off short and secured with a pin in the usual manner. Anaërobic infection with its gangrenous stench becomes evident. There may be some marginal sloughing. This foul odor will persist until the stump comes away—in ten to eighteen days, occasionally still longer. Then the bronchial fistulæ will appear with their whistling which often annoys or alarms the patient. Rarely, even at this date, there may be distress from mediastinal motion which can be relieved by an occlusive wet dressing. The chest being now wide open, the danger of tension pneumothorax is past. Rarely tension pneumothorax may even then occur as a sacculated form behind adhesions.

Gradually granulation sets in and the wound heals down to two fistulæ, one above, and the other where the tube is. The upper wound may be permitted to close as soon as it will, but the lower should be kept open until it has become a mere track, when the tube may be removed, the bronchial fistulæ having usually closed by this time. Dakin's fluid cannot be used with safety in these chest wounds with their wide-open bronchi. Yet an aseptic pneumothorax may form and the X-ray may reveal this condition months after the patient has fully recovered.

In nearly all my cases there have been occasional slight hæmoptyses weeks or even months after complete external healing has taken place. I have never had one of these patients bronchoscoped, but I believe that the source of the bleeding is probably granulation tissue at the site of the closed bronchus. These hæmoptyses have never been serious, and it is my custom to warn each patient when he is discharged that he may expect occasional slight blood spitting. Otherwise he is apt to become panic-stricken and to feel that his case is a failure. There is no fever, and I have never found it necessary to demand even rest in bed when such a little hæmoptysis occurs, but I do advise

a radiographic examination. Thus far, no patient who has shown this symptom has developed any recurrence or other serious complication in consequence.

A day or two after the safe sloughing off of the stump, the patient may sit out of bed. He will not be actually healed, however, short of two or three months, and cannot be considered well for a much longer time. I have seen moderate cough at intervals even with a little sputum for the greater part of a year, yet with complete final recovery. In most of the cases, during the period of healing and until the wound is entirely closed, it has been found that the slightest disturbance in the patient's general condition has been followed by a rise of temperature. Even a little unusual exercise has been followed by slight fever as in tuberculosis. The greatest patience and attention to detail, with frequent visits of the surgeon, are necessary to success. And above all price is a tried and experienced nurse.

I have carefully read what Sauerbruch has to say on suppurative bronchiectasis in his 1920 work on thoracic surgery—a scholarly and beautifully made book. As to the merit of his methods of treatment, however, including his technic of lobectomy, I am far from convinced. Persistent bronchial fistulæ, deforming thoracoplasties, probably no patient actually cured—these results do not appeal to me. It would almost be better not to try to do a radical operation. He reports (*loc. cit.*, pp. 588–589) three cases of lobectomy for bronchiectasis based on animal experiments. The operations were done through intercostal incisions, the vessels of the pedicle were ligated, and the bronchi were closed by ligature and inversion. The chest was closed without drainage. No wonder all three patients expired from tension pneumothorax six days later. The same results followed a case similarly treated by Friedrich. Sauerbruch, from his experience, rashly concludes that one-stage lobectomy should be abandoned. He might, perhaps, have saved all three of his patients by a more surgical technic. These cases cannot be treated by attempting permanent closure of the bronchi at the time of resection, as might be feasible in the aseptic cases, such as the removal of tumor-bearing portions of lung. In the suppurations the bronchi will surely reopen a few days after operation, and this should be expected and provided for.

Sauerbruch also (*loc. cit.*) extirpated a lobe in nine other cases by the many-stage method. *There were no cures,* five were considerably improved, two were slightly improved, and two died. Again he reaches the unwarranted conclusion that a cure in the true sense of the word cannot be accomplished.

Robinson's technic is founded on correct surgical principles and promises good results. Its outstanding disadvantage is the approach by rib resection which leaves an unnecessary degree of contracting deformity. Some contraction of the chest is unavoidable after the removal of an entire lobe, but much of the dead space should be filled by the other lobe which becomes hypertrophic, and perhaps what might be called physiologically emphysematous, and also by the compensatory raising of the diaphragm on the same

side. The surgeon need not provide for this filling of space for Nature is able to take care of it.

Post-mortem Examinations.—Even when an operation through an ample incision has made us believe that we have noted all gross pathological conditions relating directly to the operative part of the case, a carefully performed autopsy will often bring out unrecognized or even unsuspected facts from which much can be learned. Through a so-called " wound inspection," when the opening has been large enough, an almost complete autopsy may be performed. It omits, however, the cerebrospinal system, in which secondary or metastatic foci are peculiarly apt to appear in pulmonary operations.

We have been recently especially fortunate at Mt. Sinai Hospital in having for our assistant-director, Dr. E. M. Bluestone. He comes in contact with the families of the patients and he has the necessary tact to deal with the situation so that through him we have secured 80 per cent. of autopsies. His example may well be called to the attention of those in charge of similar institutions.

Cases of resection of the lung for suppurative disease are the most trying ones in all surgery. The high mortality, the sudden and often disappointing changes, the repeated crises, the numerous complications, and the prolonged convalescence with no feeling of security until long after the wound is healed, would hardly be worth the tremendous effort were it not for the unequalled gratification in the final success. To have been the instrument of restoring one of these wretched beings to blooming health after months or years of revolting illness with the constant fear of fatal pulmonary hemorrhage is the richest reward that surgery can offer.

CONCLUSIONS

1. Chronic pulmonary suppurations wholly or partially of the bronchiectatic type are rarely curable without the extirpation of the pathological focus.

2. The surgical removal of a single pulmonary lobe for chronic pus infection has a mortality of about 42 per cent. The danger is much greater when more than one lobe is infected or in the presence of other complications.

3. Remissions of weeks or even months may occur spontaneously.

4. Palliative operations may be followed by improvement, rarely by apparent cures.

5. The commonest cause of the disease is infection due to the aspiration of infected material during tonsillectomy.

6. Radical operation should not be undertaken short of several months after the onset unless the disease is obviously spreading.

7. The proper type of operation should be determined only on full exposure by thoracotomy.

Here are brief abstracts of the histories of all my patients. All have been followed up to date except Case No. 14 (David J.), who was followed for two years, and at last account was well. Pathological study of all speci-

mens has been made by Dr. Paul W. Aschner, Adjunct Surgeon and Assistant in Pathology, Mt. Sinai Hospital, and the results are here reported by him. It is most interesting that in going over the material together, the histological findings placed the cases in the same group in which they had been put by me immediately after operation. The literature was searched by Dr. S. Hirshfeld who furnishes references and brief abstracts of interest.

CASE I.—*Suppurative Bronchiectasis Following Tonsillectomy; Lobectomy; Middle Lobe.* This case has been reported in the ANNALS OF SURGERY for July, 1916. The following is a brief abstract:

Mrs. Elizabeth M. B., age thirty-three, came to me twenty-two months after her tonsillectomy in general anæsthesia. Characteristic symptoms of lung abscess had appeared ten days later. When I saw her in October, 1915, I found her general nutrition good in spite of frequent attacks of fever. There was clubbing of the finger tips and a productive cough with as much as a quart of stinking secretion in twenty-four hours.

Operation.—On October 18, 1915, in nitrous oxide, oxygen and ether administered by Doctor Branower, in a little less than an hour the middle lobe was extirpated. Loss of blood slight. Pulse after operation 140.

Post-operative Course.—The day following the operation there was considerable shock, respirations up to 60, pulse 144. This was probably owing to the accidental omission of morphine during the night. Almost immediately after giving a hypodermic of one-fifth grain of morphine and one-two hundredth grain of atropine the respirations dropped to 30 and the pulse to 120. This medication was repeated every four hours. The usual bronchial fistula appeared, but closed spontaneously and the patient was discharged well on December 20, 1915. A few times after her discharge there were slight hæmoptyses, but the patient may be considered perfectly well and leads a normal life.

CASE II.—*Lung Abscess Following Tonsillectomy—Resection of the Left Upper Lobe.* Mrs. C. M., twenty-eight years old, came to me July 10, 1917. Tonsillectomy in general anæsthesia had been performed about April 1, 1917. The operation was difficult owing to the friability of the tissue and it lasted about three-quarters of an hour. Ten days later there was cough followed by profuse, foul, purulent expectoration. When I first saw her she was coughing twelve ounces of foul mucopus a day and three days before there had been an hæmoptysis of about eight ounces.

X-ray examination in the recumbent position resulted in a diagnosis of single abscess in the left upper lobe. After the patient had entered the hospital, however, a second X-ray examination was made in the upright position and another with the patient lying on her sound side. These showed "a dense infiltration which extends from the left apex down to the level of the third rib anteriorly, involving approximately the left upper lobe. This has the appearance of a pneumonic consolidation. Just beneath the middle of the left clavicle there is an oval cavity about one and one-half inches in diameter which is half-filled with fluid. It shows a fluid level which shifts on change of position. The heart is somewhat displaced toward the right. The remainder of both lungs appears to be uninvolved" (Wessler).

In this case, on account of the tendency to hemorrhage, it was decided to dispense with bronchoscopy and to proceed at once with the surgical therapy.

Operation.—Operation was undertaken on the inauspicious day of Friday, the thirteenth, in July, 1917, in the Private Pavilion of Mt. Sinai Hospital, Dr. Martin W. Ware and Dr. A. O. Wilensky assisting. The anæsthetic, given by

the intrapharyngeal method, was ether and oxygen administered by Doctor Branower. A preliminary ligation of the upper part of the thighs reduced the systolic blood pressure from 125 to 115 by blood segregation. A long incision was made at the sixth interspace with removal of six or seven inches of the sixth rib with its periosteum. The sixth, fifth and fourth ribs were divided near their angles through an incision carried upward along the border of the scapula. A rib-spreader was put in. No adhesions were encountered in the lower chest, but upper and lower lobes were adherent to each other and the lower lobe slightly adherent to the posterior chest wall. The abscess was quickly identified by the dark color and liver-like consistency of the lung. A small abscess was entered in peeling away the lower from the upper lobe, and going a little further the main abscess was entered and found to be much larger than would have been judged by the X-ray, much of the opacity having been due to the presence of pus without air and also to the great density of the surrounding infiltrated pulmonary tissue. Most of the adhesions between the upper lobe and the parietes were easily broken down, but a few had to be ligated. The upper lobe was nicely mobilized and its apex found to be apparently healthy. The main abscess, which was now widely opened, was disinfected with phenol, and all inflamed and infected tissue was excised between ligatures of chromicized catgut. Hemorrhage was not great but the blood-pressure during the operation gradually fell to about 60, even after both ligatures had been removed from the thighs, letting in the segregated blood. The diseased part having been removed Doctor Branower was able to demonstrate the permeability of the bronchi to the upper and lower lobes by inflating them with his intrapharyngeal apparatus. Other suture ligatures were placed around small parts of the uninvolved upper lobe and were sutured to the chest wall in order to steady the mediastinum. The stump was also sutured to the parietal wound and its hollow packed with iodoformized gauze. At the ninth interspace posteriorly a small incision was made into the thorax and a rubber drainage tube fastened there airtight. The wound was now closed throughout by muscular and then cutaneous sutures in such a way as to close the chest, entirely burying the tube, gauze and drainage material. This was done so as to make respiration easier for the first forty-eight hours, when it was intended to reopen the suture line at suitable points for drainage.

Post-operative Course.—Following the operation there were many days of anxiety. The respirations, however, averaged only about thirty-eight and the pulse about 134. Four days after the operation the anterior part of the wound had to be reopened to drain the thoracic wall, which was filled with foul pus, the product of infection by anaërobic organisms. There was also some subcutaneous crackling on palpation. The thorax had been opened for drainage two days before and more than twenty ounces of intensely bloody serum evacuated. This serum measured up to ten per cent. in hæmoglobin but there were no clots. Because of the anaërobic character of the infection I passed oxygen through the chest for several days by attaching a drainage tube to the oxygen tank and permitting the gas to flow through at the rate of about two bubbles a second. Eight days after operating the packings were removed from the upper part of the chest and this was followed by slight, though annoying, cough which continued in scattered paroxysms for four more days, when a bronchial fistula appeared and the cough ceased. There was continued general improvement, however, and the patient sat out of bed for the first time twelve days after the operation, although she was still very weak. The pulse was 120, the temperature running to 101 and the respirations to thirty. About four weeks post-operative the healing process had divided the chest into two distinct chambers, an upper and a lower one. The upper discharged foul pus, the lower non-odorous. The upper wound was packed daily with iodoformized gauze. The ligatures came away about three weeks

after the operation, carrying with them a large pulmonary slough, and there was an immediate change for the better. Anaërobic infection, subcutaneous in character, appeared and the anterior part of the wound had to be opened. This pocket was in the chest wall only. It was quickly disinfected and healed nicely under the Carrel-Dakin treatment. The pulse at this time was usually below 100, respirations about twenty and temperature in the neighborhood of 100½° to 98.4° and the patient was walking about.

Mrs. M. was discharged from the hospital the latter part of August with a tiny thoracic fistula from the lower drainage opening. It soon closed spontaneously and has remained closed.

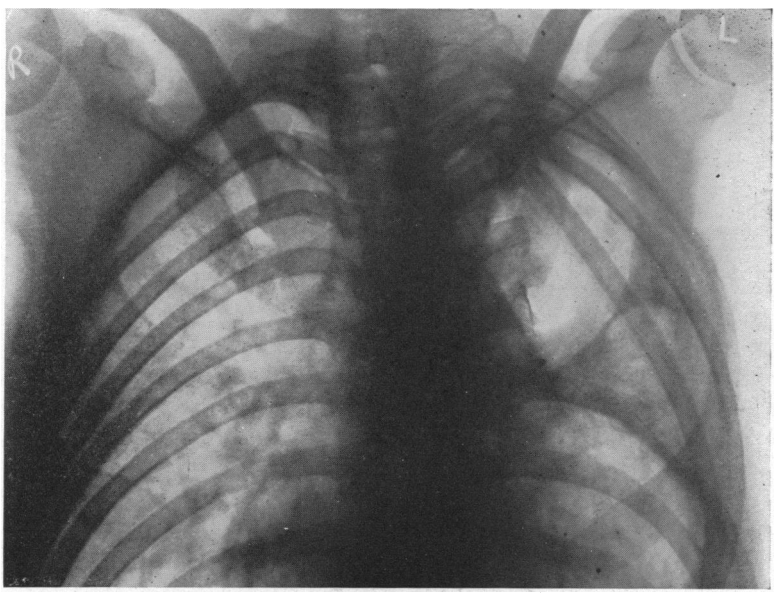

FIG. 1.—Case 2. Mrs. C. M. Resection of left upper lobe, four years after operation. Patient well, all wounds closed for nearly four years. Function of arm and shoulder perfect. Small aseptic pneumothorax. Upper ribs contracting upper part of chest. Bridge of new bone connecting rib stumps.

For more than a year there were occasional exacerbations with cough and slight expectoration, not foul in character. Each of these appeared as the result of a "cold" and finally ceased altogether. Recently this patient went through a severe typhoid fever with intestinal hemorrhage, for which a blood transfusion had been necessary. There was also a little cough, and her physician, Doctor Hanan, feared that the cicatrix in the lung might be breaking down. An X-ray examination was made. The lung did not necrose, however, and the patient made a splendid recovery from her typhoid and is well at the present time with no indications of active thoracic disease. (See Fig. 1.)

CASE III.—*Bronchiectatic Lung Abscess Following Tonsillectomy—Sub-total Pneumectomy.* This case has been reported in Surgery, Gynecology and Obstetrics for November, 1919. A brief abstract follows.

W. A. B., a man twenty-six years old, had had his tonsils removed in general anæsthesia and there developed a suppurative bronchiectasis with abscesses of the right lower lobe, the middle lobe and part of the upper lobe. I first saw him fifteen months later, on March 14, 1917, in the private ward of Mount Sinai Hospital. The case had been steadily progressive, the first symptoms appearing

about a week after his operation. At my first examination this patient looked almost moribund. His temperature was 104° and his appearance was that of a person in the last stages of tuberculosis. I hesitated to operate. He and his family, however, begged for relief and were willing to accept almost the worst possible prognosis if only something could be done, for it was recognized that he would die perhaps in a few days longer.

The X-ray examination showed lung involvement from the second rib down to the base where the diaphragm was drawn up by adhesions. There were a number of cavities with fluid levels. The left chest was apparently normal. In spite of the long duration of his illness there was but little clubbing of the fingers. Blood-pressure was 100 over 65.

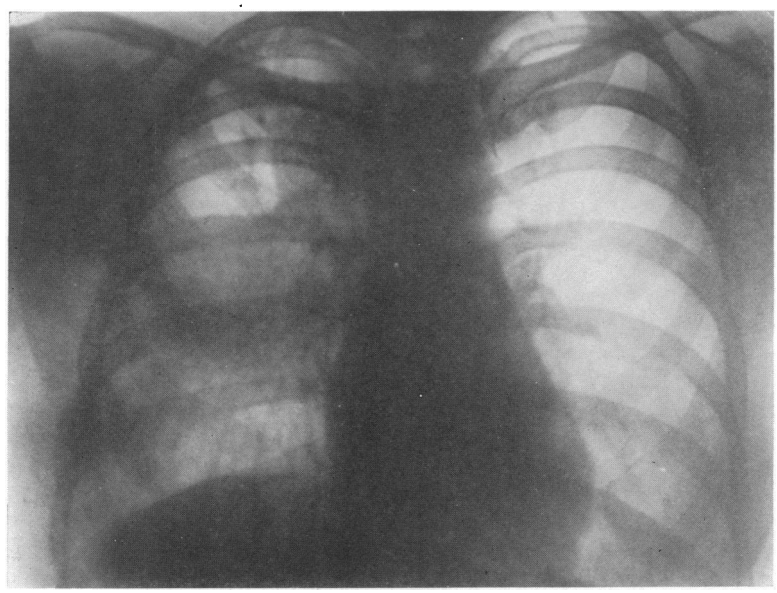

FIG. 2.—Case 6. Miss J. K. Preoperative. See history. Upper and lower lobe disease.

On March 16th, Doctor Yankauer bronchoscoped the patient in general anæsthesia with nitrous oxide and ether and I was in hopes that it might be possible to wash out some of the pus prior to operation. Owing to the patient's wretched condition this attempt had to be abandoned but the procedure consumed about fifteen minutes. I then operated, Doctor Branower continuing the anæsthesia and Doctor Ware assisting at the wound. The thighs were ligated with elastic ligatures to segregate the blood during operation.

Operation.—A long seventh interspace incision was made with resection of the greater part of the seventh rib and section of the sixth rib posteriorly. The chest contained straw-colored fluid and covering a part of the posterior portion of the upper lobe there was a coating of lymph. In peeling away the lower from the upper lobe a large abscess cavity was entered. The lower and middle lobes were removed beyond mass ligatures of chromicized catgut and heavy silk. Very little hemorrhage occurred. The chest was temporarily closed with drainage after about a pint of paraffin oil had been poured into the thoracic cavity and left there. The stump was carbolized and iodoformized gauze placed against it. Immediately after operation 500 c.c. of citrated blood were transfused by Doctor Wilensky. A gangrenous condition of the wound developed and it had to be

opened widely. Oxygen in a slow stream was passed through the thoracic cavity for two days but without appearing to influence the anaërobic infection. The wound was then packed lightly with iodoformized gauze and improvement followed. With the chest wide open it was seen that we had evidently included much—if not all—of the pedicle of the upper lobe in the ligatures and that this upper lobe had so far contracted that it could not be seen. The usual bronchial fistulæ formed, but gradually the patient picked up and was finally sent to his home with a thoracic sinus which I feared to permit to close on account of the open bronchi. It closed spontaneously, however, and the patient was shown before the American Society for Thoracic Surgery at its meeting in Atlantic City on June 9, 1919, apparently entirely well and with the thorax firmly closed. The general condition was excellent. He was working and said that he could exercise without undue fatigue and mentioned particularly that he had danced seventeen

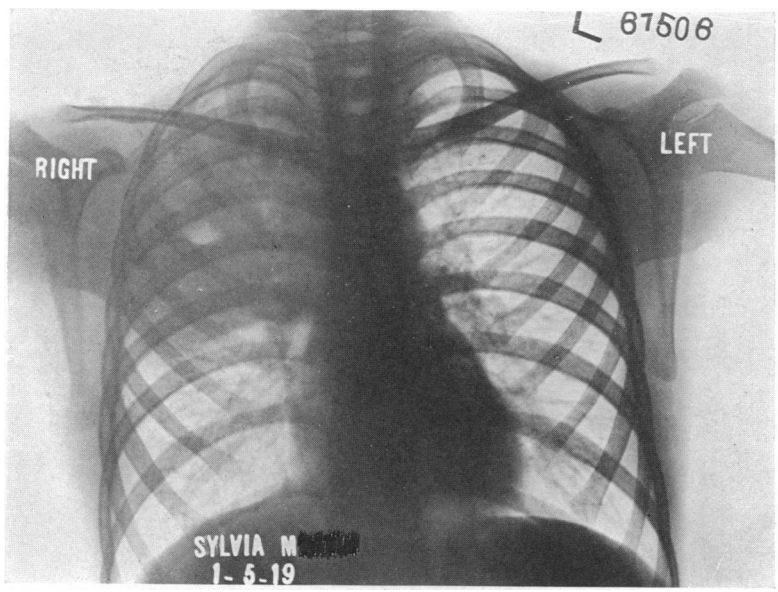

FIG. 3.—Case 7. Sylvia M. Preoperative. Right upper lobe bronchiectasis with cavitation.

dances in succession without distress. Since that time the wound reopened twice and the patient, who is very intelligent, preferred the presence of a small tube in his thoracic sinus rather than the annoyance of the occasional fillings. The discharge is very slight and the patient with this exception may be considered entirely well. He has married twice since his operation.

CASE IV.—*Post-Tonsillectomy Lung Abscess (Bronchiectatic)—Two-stage Lobectomy—Death.* Miss S. K., sixteen years old, was admitted to the Medical Service at Mount Sinai Hospital on May 7, 1917. About April 15th of the same year tonsillectomy in general anæsthesia had been performed and there developed fever, cough, pain in the chest and purulent expectoration.

X-ray examination showed a cavity two inches in diameter in the right lower lobe with a beautifully marked fluid level.

Under medical treatment this cavity became much smaller, the symptoms were relieved and the patient was discharged on April 10th and sent to the country. A month later she was readmitted to Doctor Manges' service with her symptoms just as bad as ever. She was transferred to me on June 3rd and I

operated the same day in local anæsthesia. An abscess was found in the upper part of the right lower lobe. Adhesions were separated but nothing further was done.

June 6th, the patient going down-hill rather rapidly, I removed the right lower lobe, and during the operation she received 600 c c. of blood by the citrate method. She died two hours after the operation.

The specimen showed an abscess one and one-half inches in diameter in the right lower lobe.

CASE V.—*Bronchiectatic Lung Abscesses Following Tonsillectomy—Extirpation of Right Upper and Middle Lobes—Death.* Miss E. B., thirty-three years old, was brought to me on July 11, 1917, by her physician, Doctor Chappell, of Middletown, N. Y. About two years before her tonsils had been extirpated under general anæsthesia, and thirteen days later there was cough with foul

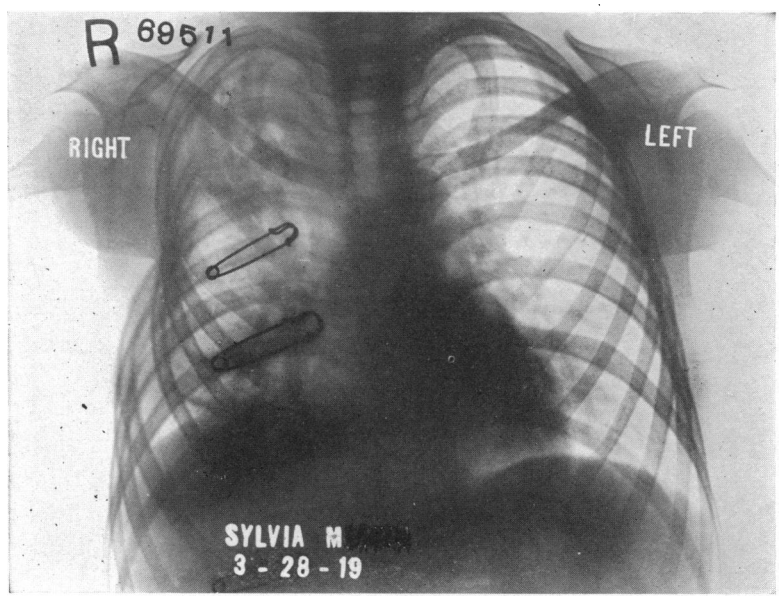

FIG. 4.—Case 7. Same patient, 38 days after operation. At the present writing chest is clear.

expectoration and fever. Thereafter with brief periods of remission the symptoms had been practically unchanged. Her temperature ranged between 100° and 105°. She stated that she sometimes expectorated as much as one and one-half pints during one emptying. There were repeated hæmoptyses. The fever in this case was high during the periods of greatest expectoration.

The X-ray showed apparently an abscess of the middle lobe.

This patient had been at Saranac Lake, although no tubercle bacilli had been found. The other lung was healthy.

Bacteriological examination showed the continuous presence of streptococcus. After admission to Mount Sinai another X-ray picture was made and Doctor Wessler reported abscess of the upper lobe.

Because of the unbearable condition, together with the danger from frequent hæmoptyses, I decided to operate. The patient entered the Private Pavilion of Mount Sinai Hospital, and on July 17th in nitrous oxide and ether anæsthesia by Doctor Branower (intrapharyngeal method) I operated. Doctor Ware and

Doctor Wilensky assisted at the operation. Blood segregation had been secured by means of elastic ligatures placed about the thighs.

Operation.—A long sixth interspace incision was made and a long piece of the seventh rib was at once resected. The fourth and fifth ribs were then divided posteriorly. It was at once seen that although the lower lobe was apparently healthy the middle and upper lobes were diseased. They were dusky and hard to the touch, expanding and contracting little with respirations. There were numerous dense adhesions above but none below. In one mass the upper and middle lobes were ablated beyond ligatures of chromicized catgut with two of silk. Hemorrhage was inconsiderable but the patient's condition was poor, although the systolic pressure did not go below eighty. It had been 125 before operation. The stump was carbolized and fastened to the chest wall. A counter-incision in the ninth interspace behind was made for drainage and the wound was temporarily closed without drainage. She received 300 c.c. of citrated blood. There was cyanosis but no embarrassment of respiration. Six hours after operation the condition appeared good, the pulse was 160, but of fair quality. Fifteen hours after operation, however, there came a change for the worse, with cyanosis and weak and rapid pulse. One hundred and fifty c.c. of citrated blood which had been saved from the first transfusion were now put in. The patient did not rally, and died thirty-one hours after the completion of the operation with a sharp rise of temperature to 105°. No autopsy permitted.

CASE VI.—*Bronchiectatic Lung Abscesses of Upper and Lower Lobes following Tonsillectomy. Extirpation of Lower Abscess.*—Miss J. K., thirty-two years old, was sent to me on September 8, 1917, by Doctor Waring, of Denver. Tonsillectomy had been performed three years before in general anæsthesia. The tonsils were imbedded and the operation difficult. Thirteen days later there appeared cough, fever and the other usual signs of lung abscess. The fever became remittent with attacks every two or three months accompanied by foul expectoration. There was clubbing of the fingers. No tubercle bacilli were found upon repeated examination. Patient's general condition appeared to be good and there was no organic disease other than that mentioned.

X-ray pictures taken in Denver and retaken by Doctor Wessler in New York, showed what appeared to be an abscess near the hilum of the middle lobe partly involving the upper. Adhesions to diaphragm were evident. (See Fig. 2.)

The patient had been unable to work for three years and both she and her family were willing to take the chance of an operation.

She entered the ward of Mount Sinai Hospital, and on September 20, 1917, I operated. Intrapharyngeal anæsthesia by Doctor Branower. Segregation of blood was attained by ligation of the thighs. The blood-pressure before operation was 122 systolic, 88 diastolic.

Operation.—A sixth interspace incision was made and large parts of the seventh, sixth and fifth ribs were resected posteriorly. The rib-spreader was put in and it was then found that the middle lobe was the only one of the three which was absolutely unaffected. In the lower lobe a dense abscess was adherent to the posterior chest wall near the spine and there was another in the upper lobe. The two lobes, however, could be easily separated by loosening the attenuated adhesions. General adhesions about the upper lobe held it to the chest wall so that it did not collapse. The adhesions to the diaphragm were now cut loose and the abscess of the lower lobe was extirpated in the usual manner with chain ligatures of chromicized catgut. Soon after the operation began the blood-pressure commenced to drop and the ligature about one thigh was loosened. Even after this, however, the blood-pressure was under eighty. The operation up to this point had been quickly done, but it was decided not to disturb the upper lobe abscess at that time, the patient's condition not warranting it. Because of the

adhesions of the upper lobe there was little danger of mediastinal flapping; however, the ligatures were all left long and fastened to the chest wall. The wound was closed by muscular and cutaneous suture with drainage anteriorly and large drainage posteriorly with gauze down to the abscess stump. A third small incision was made low down posteriorly to make sure of good drainage by tube. Hemorrhage was slight.

Eight hours post-operative the patient's condition was good; the pulse was 120 and respirations were forty. After that, however, there was rapid deterioration of the heart action with weakness and irregularity, although the rate did not go higher than 160. There was much cough with expectoration of very foul pus, evidently from the abscess of the upper lobe. Twenty-four hours post-operative because of the progressive cardiac failure, a transfusion of 360 c.c. of citrated blood was made, but she continued to lose ground and a few hours more death occurred.

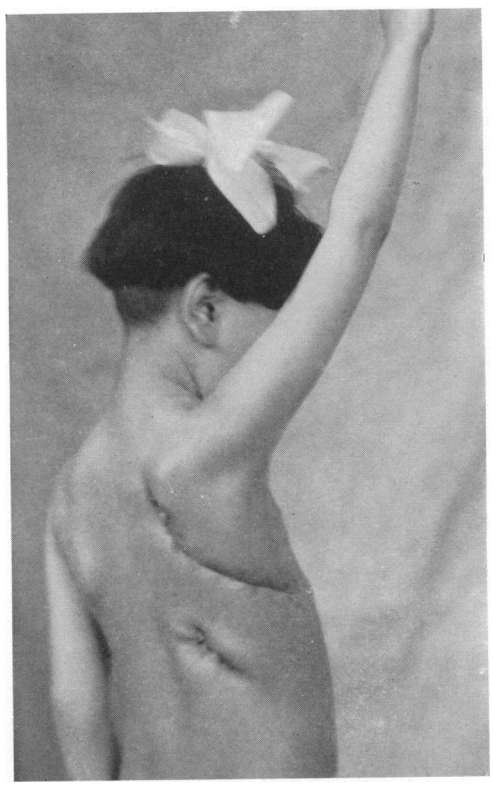

FIG. 5.—Case 7. Patient well, showing use of arm.

CASE VII.—*Chronic Bronchiectatic Abscess of Right Upper Lobe Following Tonsillectomy.* Sylvia M., eight and one-half years old, was admitted to the Medical Service of Mount Sinai Hospital on January 23, 1919. Temperature, 105°; pulse, 140; respirations, forty. Nine months before tonsillectomy had been performed in general anæsthesia and about two weeks later there was coughing with foul expectoration and irregular fever. Four weeks before admission the child had spit a little blood and there were occasional night sweats.

Physical examination showed the right tonsil absent. In the right lung from the apex to the second rib were signs of cavitation, while there were many fine moist râles over the entire upper lobe. Urine negative. Fingers clubbed. Blood showed 17,600 white cells with ninety-seven per cent. polymorphonuclears, twenty-one lymphocytes and two eosinophiles. Hæmoglobin sixty per cent. Blood-pressure 95–65.

X-ray examination showed dense consolidation of the right upper lobe in the centre of which was a circular cavity an inch in diameter at the level of the second space anteriorly.

On February 17th the chest was punctured with a small trocar and cannula below the diseased part in presumably normal pleura with the idea of admitting air so that a subsequent radiograph would show the character and location of adhesions. This examination was satisfactory and indicated that there were no

general adhesions in the upper part of the chest. The diseased area was much more easily seen than before the air had been admitted.

Operation.—On February 18, 1919, in intrapharyngeal gas and ether anæsthesia by Doctor Branower, a seventh interspace incision was made and carried upward posteriorly parallel with the scapula. Small sections of the sixth and fifth ribs were removed. Rib-spreader exposure. There were a few adhesions at the apex, one of which required ligation. A dense adhesion between the upper and lower lobes posteriorly was also ligated and divided. Other adhesions were broken down digitally. The upper lobe was then removed beyond serial chromicized catgut suture-ligatures. A separate drainage opening was made in the lower part of the chest posteriorly into which a tube was inserted to the dead space above. Through the upper posterior wound a small gauze packing was led down to the carbolized stump and then both wounds were sutured, closing the entire chest—skin and all.

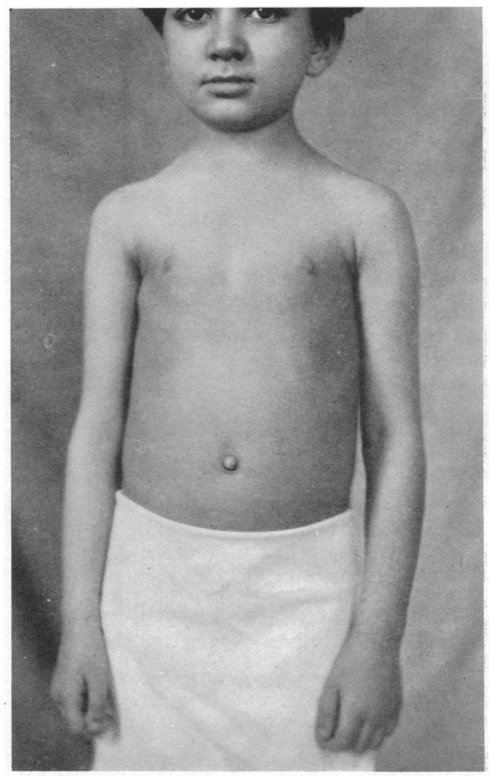

FIG. 6.—Case 7. Patient well, showing symmetry.

Post-operative Course.—Immediately after the operation, although the patient's general condition was excellent, 200 c.c. of citrated blood were infused intravenously. Morphine and codein were ordered in sufficient quantities to keep the respirations below thirty-five and tincture of digitalis five mm. was ordered every six hours for two days. The respirations had been sixty immediately after the operation but were reduced by the medication to twenty-six. Reaction temperature to 105° dropped to 101°. Pulse immediately after operation 160, but in twenty-four hours the rate was 120. Patient's morale excellent.

Forty-eight hours after operation the drainage openings were exposed. There was no great tension within the chest and comparatively little fluid. The lower tube did not drain satisfactorily. The gauze was removed from the upper opening and there escaped several ounces of foul thin fluid. Since the lower drain was unsatisfactory a tube of large calibre was inserted through the posterior part of the upper wound and the foot of the bed was elevated. On March 3rd the temperature began to mount slowly and five days later it reached 104° and there was rapid pulse and general deterioration. X-ray examination was not helpful but retention was suspected, and on withdrawing the lower tube a few drops of thick pus escaped. Therefore in gas and oxygen anæsthesia the adjoining rib was resected and the chest explored with the finger. No pus, however, was

encountered and the tube was replaced. This operation was not followed by relief, but twenty-four hours later there was a sudden discharge of a quantity of pus from the upper wound and the patient's condition became critical. March 19th, after a stormy period, the little girl was considered out of danger. On April 21st she was discharged well, having gained much in weight and with perfect function of the arm. The case has been followed up carefully and recovery seems to have been perfect. (Figs. 3–6.)

CASE VIII.—*Bronchiectatic Lung Abscess—Post-tonsillectomy. Pneumectomy —Death.* Rose F., twelve years old, had her tonsils removed in gas anæsthesia in August, 1918. About two weeks later the usual symptom complex of bronchiectatic lung abscess appeared. I first saw her as a patient on the medical side of Mount Sinai Hospital in February, 1919.

Preoperative Condition.—There was clubbing of the fingers and toes, periods of high fever with remission and much coughing with copious expectoration of foul mucopus. The right lung was much contracted; the right diaphragm was adherent and drawn upward. The progress of this condition was followed up by means of X-ray study, which clearly indicated a steady extension of the disease. (Figs. 7–11.)

On February 28, 1919, I operated; Doctor Branower administered the anæsthesia (gas, oxygen and ether).

Operation.—A long seventh interspace incision with resection of the seventh, sixth and fifth ribs posteriorly. The skin wound was extended vertically to permit of rib sections. There were numerous adhesions to the chest wall, the posterior ones being very dense. The entire right lung was hopelessly diseased and it was removed by the chain ligature method, each part ligated being previously clamped. Toward the end of the operation, on lifting the lung outward, a sudden hemorrhage occurred from a large vein. The opening in the vein was secured with clamps, which were left in place, owing to the patient's desperate condition. Citrated blood transfusion was immediately performed and the wound was partly closed by suture. The patient left the table with a rapid but easily countable pulse, but she died six hours later, apparently from œdema of the opposite lung. The specimen showed extensive suppurative bronchiectasis throughout the greater part of the right lung.

CASE IX.—*Abscess of Lung Following Tonsillectomy—Partial Extirpation and Drainage—Death.* I first saw Mrs. J. P. in the Private Pavilion of Mount Sinai Hospital on March 16, 1919. About five years before she had had her tonsils removed in general anæsthesia and the usual symptoms of lung abscess appeared about two weeks following the operation. There had been a gradual progression of the symptoms with occasional small hæmoptyses, expectoration of about ten ounces of pus per day and pain in the left chest. The abscess was opened about a year following her tonsillectomy in a two-stage operation with resection of the eighth rib posteriorly and suture of the lung to the parietal pleura followed by opening and drainage of an abscess. She was unrelieved.

On my examination I found a frail, little woman, thirty years old, with clubbing of the fingers, fetid breath and signs pointing to consolidation posteriorly in the left chest. The temperature was 100°. The urine was normal. Blood-pressure was 130. The heart action was normal as to strength but was not regular.

X-ray examination by Doctor Wessler demonstrated a shadow, presumably a lung abscess of large size, either in the lower part of the upper lobe or the upper part of the lower lobe.

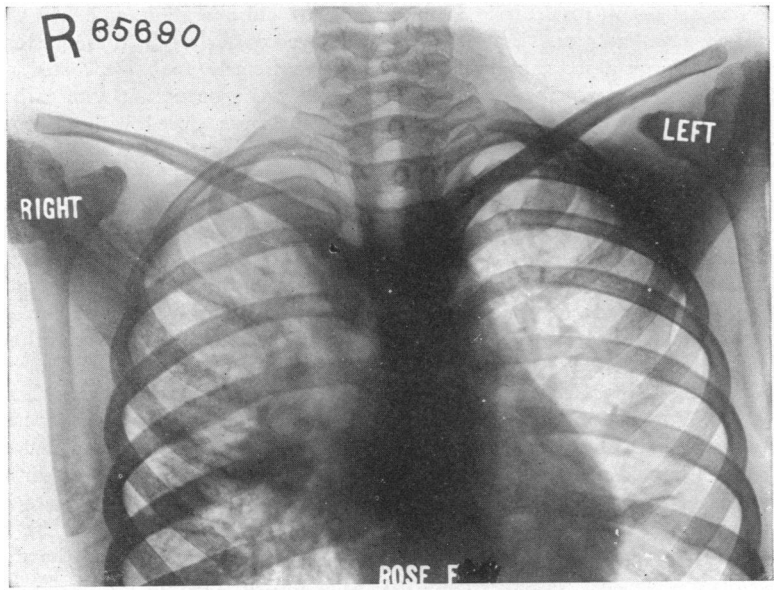

FIG. 7.—Case 8. Rose F. These five pictures taken at intervals during three months show progress of the disease. Operation should have been performed earlier.

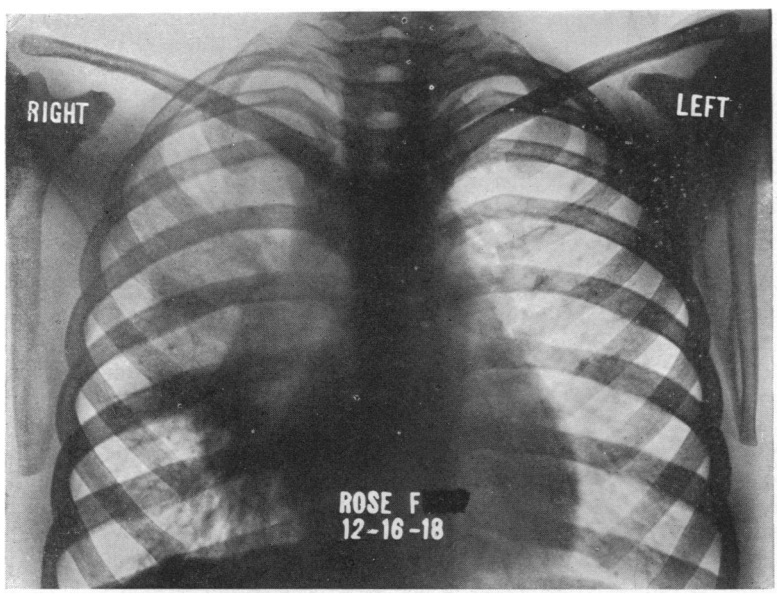

FIG. 8.—See legend on Fig. 7.

Digitalis stimulation was administered for the twenty-four hours before operation. On March 29th I operated, Dr. Martin Ware assisting, anæsthesia by Doctor Branower.

Operation.—An incision was made above the old scar with a long resection of the seventh rib and division of the sixth and fifth ribs posteriorly. There were

numerous adhesions, particularly at the site of the old operation, and they were divided between ligatures. Both lobes were involved posteriorly and the posterior wall of the large abscess, containing putty-like, extremely foul, inspissated pus, was resected. The remainder of the abscess wall was sponged out with carbolic and packed with iodoformized gauze. The wound was closed with pericostal sutures, suture of the muscles and suture of the greater part of the skin. A wet gauze dressing was applied and retained by adhesive strips placed so as not to confine the opposite chest. During the latter part of the operation the patient's blood-pressure fell to seventy-five and immediately more than 400 c.c. of citrated blood were transfused.

Post-operative Course.—The patient's condition at the end of the operation was apparently good; her pulse, however, became weaker in spite of the fact that there was no hemorrhage, and more rapid, and death occurred twelve hours after completion of the operation.

CASE X.—*Bronchiectatic Lung Abscess Following Tonsillectomy—Lobectomy.* M. V., age fourteen, had had her tonsils removed in general anæsthesia in August, 1919. Diphtheria was said to have followed this operation and the patient was treated with antitoxin. About four weeks later there began cough and symptoms of progressive lung suppuration with fever and putrid expectoration. A radiograph by Dr. James A. Miller, to whom she had been taken by her physician, Doctor La Fetra, showed a shadow at about the middle of the right chest which apparently indicated pulmonary suppuration either in the middle lobe or upper part of the lower lobe.

I saw her first on February 12, 1920, at the Park Hospital. I found a well-nourished child who was running a temperature up to 104° and who expectorated large quantities of extremely foul pus.

She entered the Private Pavilion of Mount Sinai on February 19, 1920, where another X-ray picture showed opacity of the lower two-thirds of the chest, completely obliterating the original abscess shadow. Aspiration with large needle was performed on February 20, 1920, with the idea that an empyema existed also. No pus was obtained, however. As the needle was withdrawn, a small quantity of two per cent. lysol solution was injected into the tract to prevent, if possible, infection of the chest wall.

The same day she expectorated an enormous quantity of pus, which was blood-stained, but another X-ray failed to show any change in spite of this emptying.

On February 21, 1920, in gas and oxygen anæsthesia by Doctor Branower, Doctor Aschner assisting, I operated.

Operation.—A long seventh interspace incision was made with resection of a small piece of the posterior part of the seventh rib, and rib-spreader exploration. was done. Dense adhesions existed posteriorly between the dark red solidified lower lobe and the chest wall. The middle and upper lobes looked normal, but the upper lobe was adherent posteriorly. There was no adhesion between the lower lobe and the diaphragm. With the intention of performing a lobectomy at another sitting, gauze packings were placed between the upper lobe and the chest wall to cause adhesions here and a piece of rubber dam was laid between the middle and lower lobes to prevent adhesions in this part. The wound was then closed with two kangaroo-tendon pericostal sutures and two layers of chromicized catgut muscle sutures, completely covering in the gauze and making the chest airtight. The skin edges were approximated—but not united—with three silkworm-gut stitches.

Post-operative Course First Step.—Forty-eight hours later the gauze packings were removed and about thirty ounces of bloody serum escaped. The wound was then firmly closed with broad adhesive strips. The pulse was still rapid (150),

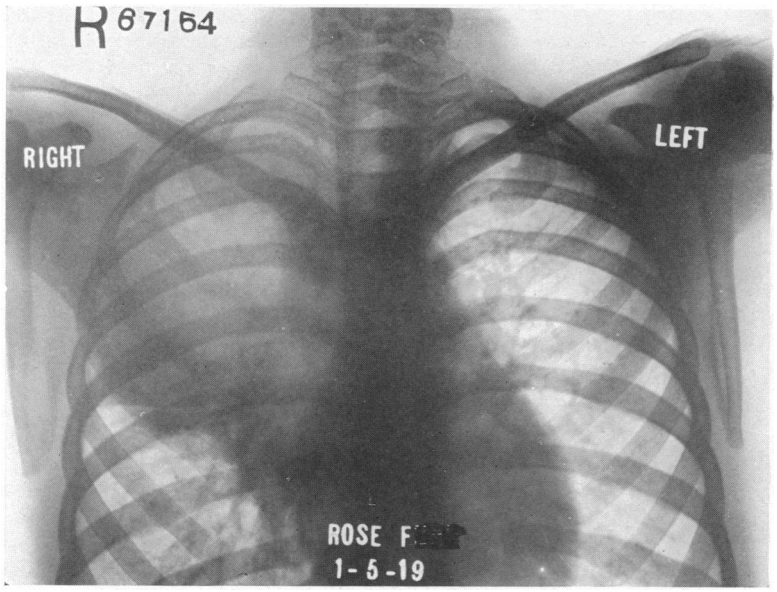

FIG. 9.—See legend on Fig. 7.

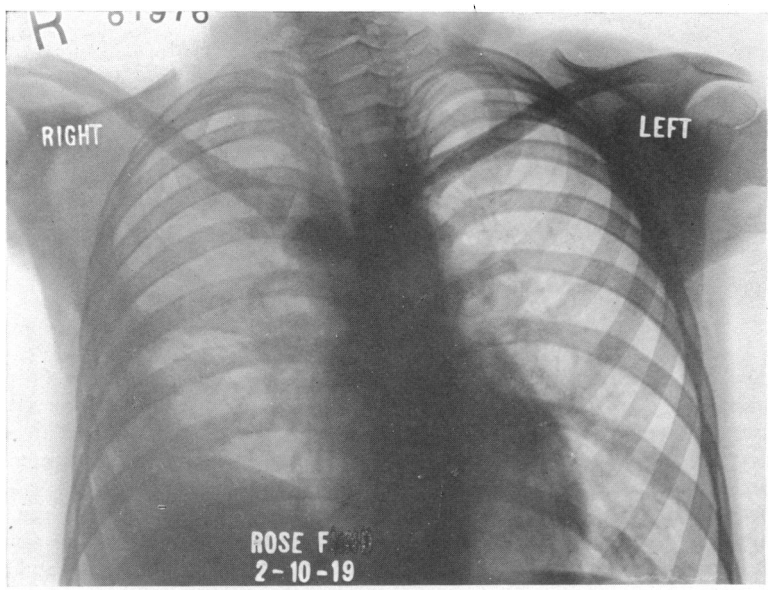

FIG. 10.—See legend on Fig. 7.

but the conditions generally looked not unfavorable. On February 28th, one week after the first operation, the lobectomy was performed. There had been digitalis therapy and the pulse was between 140 and 150, but of fair quality. The temperature had ranged between 101° and 104°. One hour before the operation eight mm. of Magendie's solution were given hypodermatically. Doctor Branower again anæsthetized with a little ether, followed by nitrous oxide and oxygen,

and the intrapharyngeal method was used. Doctor Aschner assisted at the wound.

Operation.—An incision almost to the top of the shoulder was made from the posterior angle of the old wound. The next three upper ribs were divided posteriorly and most of the seventh rib was removed with its periosteum. There was a little annoying bleeding from one intercostal vessel which could only be properly secured after the rib-spreader had been put in. It was now seen that the upper and middle lobes were nicely adherent to the chest wall and were of good normal color. The space in which the rubber dam had been placed was filled with opalescent serum and the adjacent lung surface looked almost like the walls of a pyogenic cavity. The lower lobe had become firmly adherent to the diaphragm, some adhesions having to be cut between ligatures. Where the lower lobe was adherent to the chest wall behind, it had to be peeled away, but the resulting hemorrhage was slight. Orientation up to this time had been difficult.

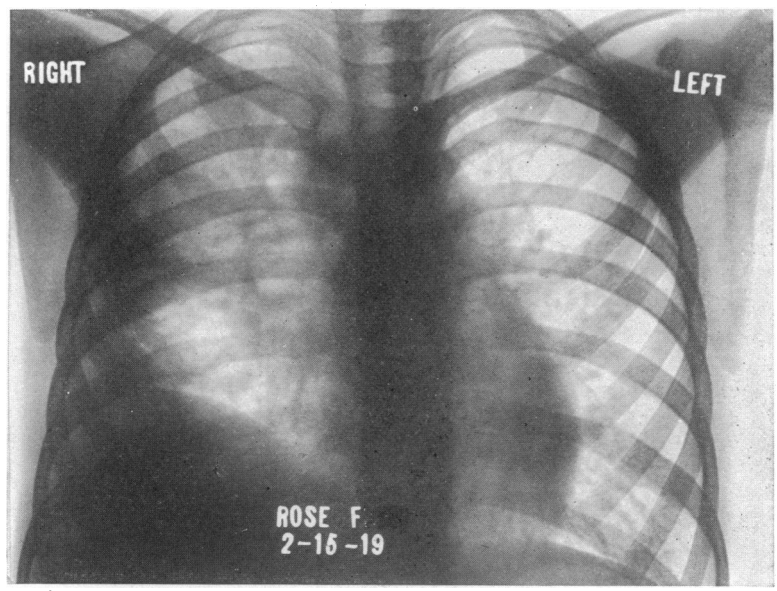

FIG. 11.—See legend on Fig. 7.

A few adhesions between the upper and lower lobes were divided between ligatures. The pedicle was now transfixed by numerous silk ligatures carried on hæmostatic needles, none of which took too large a bite. All ligatures were of No. 3 twisted silk, except one which was not finally counted upon but which encircled the greater part of the pedicle. This silk was of the heavy braided variety, about No. 12. As each ligature was tied the lung beyond it was cut away. At one point a large vessel bled for a second or two, but was quickly secured with a heavy clamp. Ligatures were placed behind this clamp and also distal to it before it was removed. The lobe was at last cut away, the stump carbolized and all ligatures were carried out of the posterior wound, which had been enlarged by the removal of about an inch of the anterior portion of two of the divided ribs. The stump was covered by iodoformized gauze which was led out of the chest in one bunch. An intercostal incision was made low down in the axillary line through which a drainage tube was drawn for drainage at a low level. The muscular parts were sutured, closing the chest, and one pericostal suture of chromicized catgut was also put in, although it could not draw the ribs

together because of the long resection of the seventh rib. The skin was left open, a dry dressing put on and held in place by adhesive plaster, not encircling the chest. The immediate shock was severe on the table; the pulse disappeared, but the transfusion of 1000 c.c. of citrated blood by Doctor Ottenberg, who was present for the occasion, brought back the pulse and reduced the shock.

Post-operative Course.—At the first dressing two days post-operative, the wound was found to be clean. The skin packings were removed, and after iodization the skin edges were drawn together with adhesive plaster. The deep packings were not disturbed. The pulse was still almost 150 but of good quality. At the time of the transfusion some citrated blood got into the tissues of the right arm and there was a rather sharp reaction with considerable painful swelling as far as the shoulder, but under pure alcohol dressings this subsided.

FIG. 12.—Case 10. Miss M. V. Taken three weeks before operation. Shows right lower lobe post-tonsillectomy bronchiectasis.

All the ligatures except the large transfixion suture came away between the eighth and tenth day following operation, leaving the bronchi open. There was the usual foul gangrenous exudate in a large part of the wound and also in the pleura. Oxygen in a continuous fine stream directly from the tank was passed through the chest for twenty-four hours in order to combat anaërobic infection and then the whole cavity was lightly packed with iodoformized gauze. In a few days all odor had disappeared. The heavy silk ligature became very annoying, for it refused to come away, and eventually I had to cut it off in the depths of the wound, illuminating the parts with a flashlight. About April 5th I attempted to use Dakin's solution very cautiously, trying to avoid the bronchial openings. For about three days it was possible to do this. Then, however, there was a severe attack of coughing during the injection, and, although no more Dakin's solution was used, the cough and even a little expectoration were annoying for a few days.

Two months after the operation the patient was up and about, going out for drives and nearly well, although a minute opening still persisted. She showed

the usual great sensitiveness to exertion, even slight exercise being followed by a temperature as high as 101°, when without exercise the temperature remained normal. She left the hospital on May 1, 1920, and has remained perfectly well, exercising, and, in fact, doing fancy dancing.

CASE XI.—*Suppurative Pneumonitis Following Tonsillectomy—Pneumectomy—Death.* Gertrude K., Hospital No. 201,642, eight years old, entered Mount Sinai Hospital on May 27, 1920, with a temperature of 103.8°, pulse of 142 and respirations thirty-eight. Eight months before she had had measles and three weeks before her tonsils were removed in ether anæsthesia because of frequent attacks of sore throat.

Physical examination showed a very ill, poorly nourished, rapidly breathing child, the tongue coated, the left chest expansion limited, fremitus and resonance

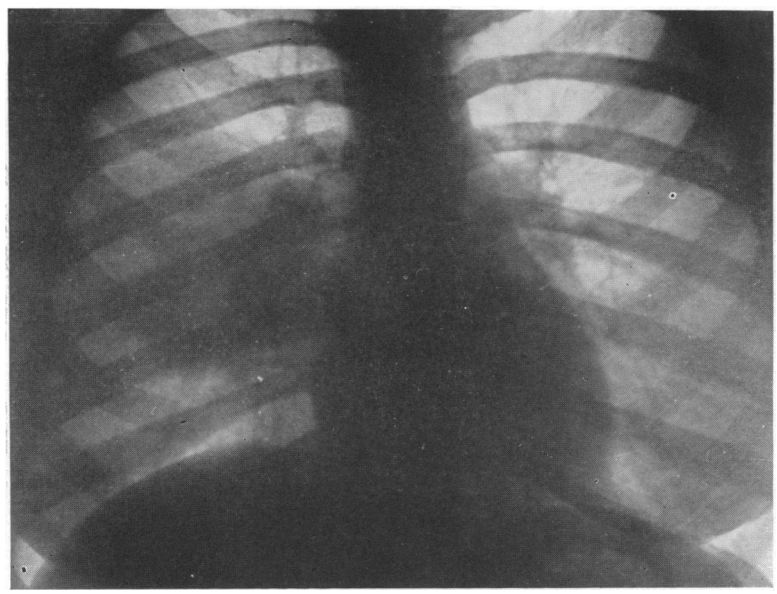

FIG. 13.—Case 10. Two weeks later. Great extension.

diminished over left chest, and a few râles, which were cleared by coughing. The pulse was regular but rapid. Urine negative.

The X-ray picture showed an infiltration of the left lower lobe from the seventh interspace to the base, indicating apparently a pneumonic process. No cavities were shown. The child was kept under observation with occasional days of improvement until on June 5th she complained of pain over the region of the apex of the heart, and another X-ray picture now taken showed a dense shadow as of fluid but without displacement of the heart. It was thought that this fluid might be somewhere encapsulated, and it was for this reason that the heart was not displaced. Believing that a lung abscess had perforated, causing some form of empyema, a major intercostal thoracotomy in ether anæsthesia was done on June 7, 1920, the seventh interspace being the location selected. Just previous to entering the chest, and after the skin and muscles had been incised, aspiration was done with a fine needle and hypodermic syringe and pus was withdrawn. After opening the chest, however, no pus was found, but a bluish-red infiltrated left lower lobe. The needle had entered the lung, and even from this tiny

puncture pus exuded, illustrating how easy it is to cause empyema even by the most careful aspiration. An opening was made in the lower part of the chest for drainage and a tube inserted, using the hand within thorax as a guide. A gauze sponge dipped in iodine was roughly wiped over the upper lobe and upper parietal pleura so as to make adhesions here previous to the second-stage lobectomy.

Post-operative Course.—No empyema developed, although there was a little purulent discharge from the drainage wound itself. There was some relief judging by the diminished cough and the general comfort of the patient, but her pulse and temperature remained about the same, the pulse running to about 130 and the temperature to 103½°. The thoracotomy wound, the skin of which had been left open, began to granulate. This case was obviously a bad risk, but recovery without radical operation was considered practically impossible. Therefore, on June 17th, Dr. Harry Goldman anæsthetizing and Dr. Harold Neuhof

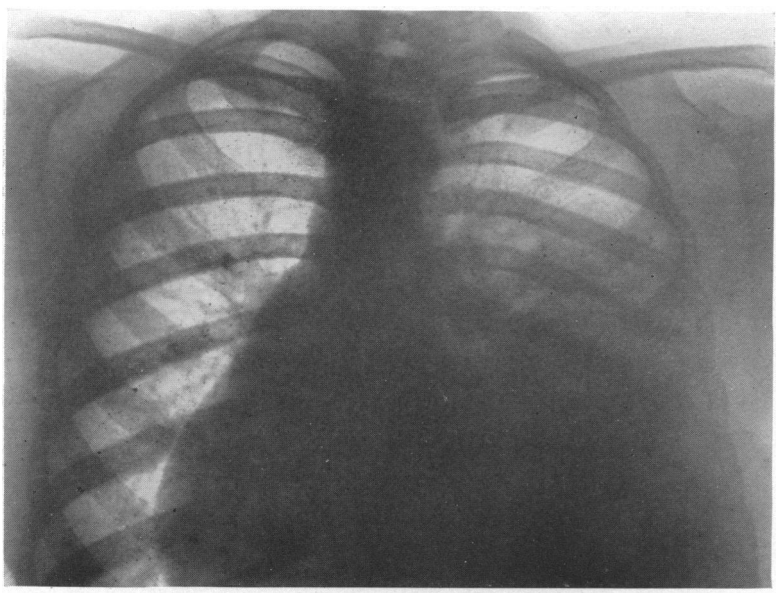

FIG. 14.—Case 10. Day before operation. See history.

assisting at the wound, the entire left lung was extirpated. In separating the lobes pus exuded from the upper as well as the lower lobe. The recent adhesions were quickly broken down and the pedicle ligated with six or seven transfixion sutures of strong twisted silk. Generous stumps were left. Loss of blood slight. Considerable pus appeared at the mouth during the operation and the passages were kept as clear as possible by the use of intermittent suction. The wound was closed with three pericostal sutures and a number of muscle sutures of chromicized catgut. Skin left open. Time of operation twenty-seven minutes. Two hundred c.c. of citrated blood were transfused during the operation by Dr. Ira Cohen. Condition at the end of operation excellent and the patient perfectly conscious before leaving the operating room. The respirations were about forty but without dyspnœa and the pulse of good quality, rate 140. The lack of respiratory embarrassment was explained by the fact that the solidified lung was not functioning before operation. Although the patient reacted well, 90 c.c. of citrated blood were put in the following day.

First dressing forty hours after operation. There was a considerable quantity of serum which escaped when the tube which had been previously clamped was freed.

The expected anaërobic infection appeared but in an unusually malignant form, septic absorption causing diarrhœa with rapid emaciation. A week after operation I was distinctly hopeful, the odor became less offensive and the pulse remained strong. Four days after, however, on account of her diarrhœa and the necessary limitation of food, another sodium citrate transfusion had to be done, this time by Doctor Kaliski, who put in 300 c.c. The hæmoglobin, in spite of the diarrhœa, had dropped to thirty-five per cent. A chill and temperature to 106° followed this procedure, but the reaction subsided, and again there was general improvement. Dr. Herman Schwarz, Associate Pediatrist to the hospital, superintended the diet, but in spite of everything the looseness of the

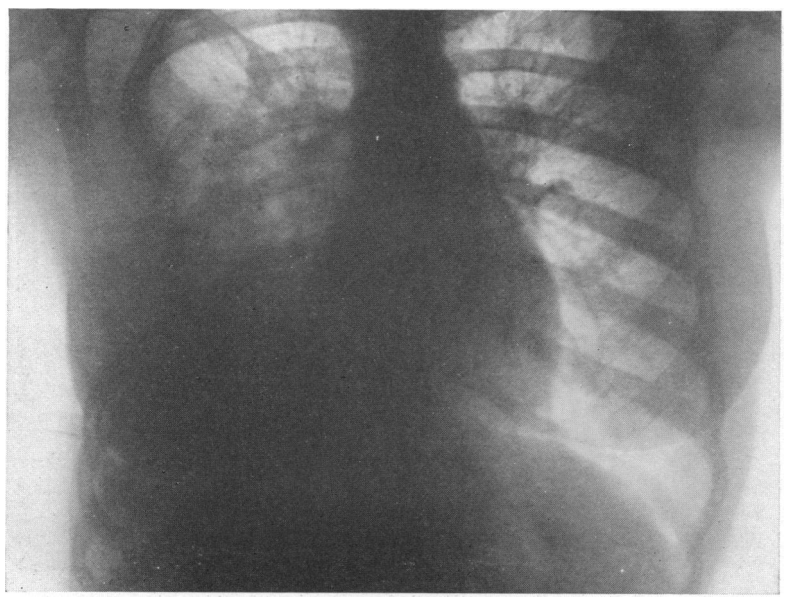

FIG. 15.—Case 10. About four months after operation. Dense shadow means recent scar tissue and thick pleura. Compare with Fig. 16.

bowels continued with as many as thirteen movements a day. The first bronchial fistula appeared about this time. Thirteen days after operation a severe hemorrhage occurred which ceased, however, spontaneously. Careful examination of the chest did not show the source of bleeding. Again Doctor Kaliski transfused with 300 c.c. of blood. About midnight, at the end of the thirteenth day, after another hemorrhage, which had also ceased spontaneously, I examined the wound and found traces of old clotting around the pedicle. While I was examining this a hemorrhage occurred from which she died in a few seconds.

This is the first and only time that I have seen hemorrhage from the pedicle. It undoubtedly occurred from destructive infection of the wall of an important vessel, probably the pulmonary artery, not from slipping of a ligature, for the ligatures were off by this time.

CASE XII.—*Post-tonsillectomy Lung Abscess—Empyema—Thoracotomy and*

Drainage. Abraham G., eight years old, entered Mount Sinai on May 18, 1920, with high fever—103 degrees—and all the signs of acute suppurative lung infection which had followed tonsillectomy three weeks before. Fever, cough, foul sputum and pain in left chest had appeared a week after the operation. Physical signs of left upper lobe pneumonia. Double cardiac murmur at apex. White blood-cells 4000, polymorphonuclears eighty-nine per cent. X-ray examination showed left lung dense from apex to base. May 22nd, bronchoscopy, by Doctor Yankauer, showed acute localized bronchitis, possibly causing obstruction of the left upper lobe bronchus.

May 27, 1920, Doctor Aschner performed a seventh interspace thoracotomy, evacuating foul, thick pus. Some days later I performed major exploratory thoracotomy, encountered a bronchial fistula with such dense lung and with such firm adhesions to the mediastinum that nothing further could be done. However, there was a gradual improvement, and all wounds healed. He had several bad

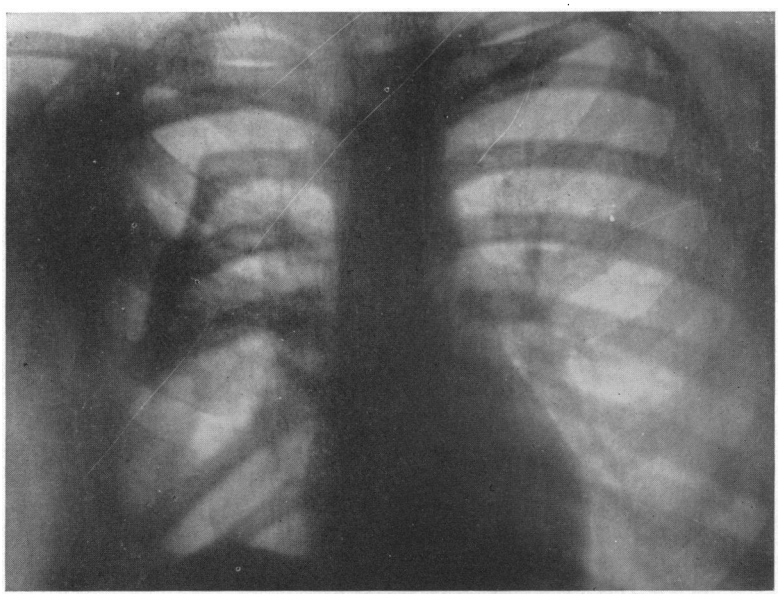

FIG. 16.—Case 10. One and one-half years after operation. Patient remains entirely well. Perfect function. Note bony bridge between three divided ribs. No pneumothorax.

relapses later and at this writing is just recovering with a bronchial fistula from a severe exacerbation.

CASE XIII.—*Bronchiectatic Lung Abscess—Attempted Extirpation—Death.* (Abstract of history reported in the ANNALS OF SURGERY, July, 1916.) Jacob S., 36 years old, Hospital No. 146,288, was admitted to Mount Sinai Hospital on June 2, 1914. Twenty-eight years before he had had pneumonia from which he completely recovered. Two years before he had been operated upon for abscess of the right lung. The present illness began with pain in the right chest, copious expectoration of foul sputum, severe night sweats and vomiting. These symptoms had existed for more than six years and had not been relieved by his operation of two years before when sections of the sixth, seventh and eighth ribs had been removed, evidently with the idea of collapsing the diseased part of the lung.

Pre-operative Condition.—Physical examination showed signs of cavity in the chest, clubbed fingers, cyanosis and rapid pulse. Urine contained a trace of albumin and a few white blood-cells. On admission his temperature was 101.2°, his pulse ninety-six and the respirations twenty-four. The temperature depended largely upon the patient's ability to empty the abscess by coughing. At times he ejected as much as twenty ounces of sputum in a single day.

X-ray examination showed an extensive involvement of the right lower lobe and a portion of the upper lobe.

Bronchoscopy was performed on June 8, 1914, by Doctor Yankauer, and the abscess pretty well emptied, with reduction of temperature and some improvement subjectively. No foreign body was found, but the bronchi were seen to be enormously dilated.

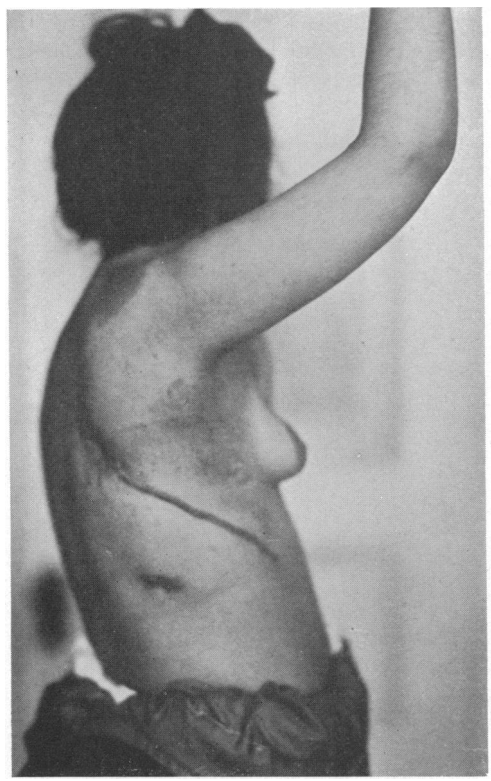

FIG. 17.—Case 10. Wounds healed after right lower lobectomy. Function of arm perfect. Patient perfectly well.

Operation.—On June 11, 1914, in intratracheal anæsthesia with ether an attempt was made to extirpate the diseased part of the lung. A long incision in the sixth interspace was made and the rib-spreader put in. Dense adhesions were encountered everywhere, so it was with great difficulty that I finally succeeded in entering the free pleural cavity, even at this high level. An attempt was made to isolate the diseased part by peeling it away from the parietes. This proved to be impossible, and then an attempt was made to isolate the diseased portion by means of ligation through the apparently healthy lung. During this process, however, although he had not lost much blood and although the lung was well fixed by adhesions which prevented flapping of the diaphragm, the patient suddenly collapsed and the operation had to be stopped. We had taken the precaution to practice blood segregation and the ligatures of the thighs were now cut away. The patient also received twenty ounces of saline solution intravenously with a few drops of adrenalin. He revived, the pulse improved and he was able to respond to questions. About an hour and a half after the operation, however, he died. No autopsy was permitted.

I think it quite possible that oozing from the abscess cavity which had been entered during the operation was instrumental in his final taking off. I was at work over another patient when word came that this patient was bleeding. My house surgeon had at once reopened the wound and packed the abscess cavity from which he stated the bleeding came. This case exemplifies the importance of recognizing an inoperable case after the chest is opened. Had we then satisfied

ourselves with rib resection directly over the abscess, as found on thoracotomy and exploration, with evacuation and packing of the cavity, the operative death might perhaps have been avoided though the patient would not have been cured.

CASE XIV.—*Bronchiectatic Lung Abscess—Resection of Middle Lobe and Part of Two Adjoining Lobes.* This case has been reported in the ANNALS OF SURGERY for July, 1916. The following is a brief abstract:

David J., Hospital No. 150,495, sixteen years old, was admitted to Mount Sinai Hospital on December 2, 1914. His temperature was 99°, the pulse was 90 and respirations 22. Cause of disease unknown. Cough and expectoration had begun six months before and had steadily increased until large quantities of greenish, offensive mucopus were expelled. There was pain in the right chest and a loss of fifteen pounds in weight. The urine was negative. Leucocytosis present; no tubercle bacilli found. The Wassermann blood examination was negative.

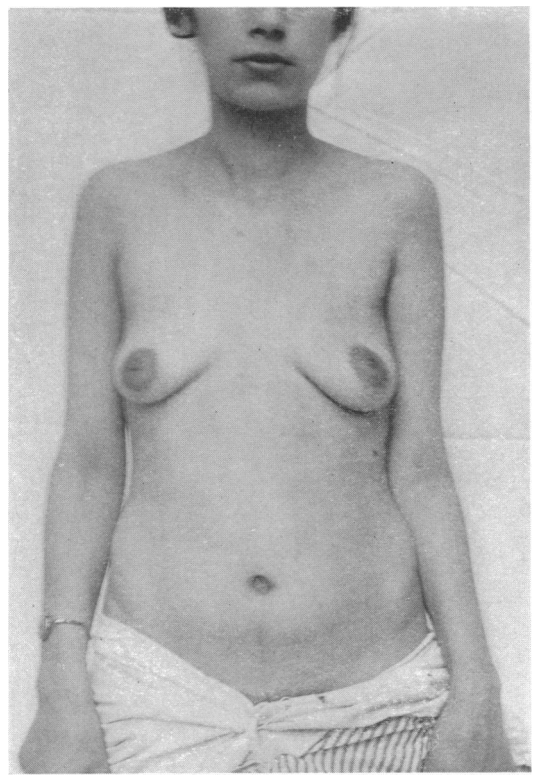

FIG. 18.—Case 18. Fannie B. Patient well after extirpation of left lower and part of upper lobes. Note symmetry of body.

Bronchoscopy by Doctor Yankauer showed a dilated secondary bronchus on the right side from the middle lobe, but a lower branch was also discharging pus.

X-ray Examination.—The X-ray showed a dense shadow the size of an adult palm in longitudinal position roughly in the line of the fissure. The diagnosis before operation was bronchiectatic abscess.

Patient transferred to me by Doctor Manges.

Operation.—On December 28, 1914, in intratracheal anæsthesia by Doctor Branower, a nine-inch incision was made in the sixth interspace. There were general adhesions in the entire chest, so that although anatomically within the pleura, there was no free cavity. The middle lobe—the principal site of the disease—was resected beyond chromicized catgut ligatures and removed. The remaining part of the indurated tissues in the contiguous parts of the upper and lower lobes was surrounded by transfixing ligatures of chromicized catgut through healthy lung. The part of the lung strangulated by these ligatures was not removed but was left to slough off. A piece of the seventh rib was now resected for drainage and the entire cavity packed with gauze which emerged at the drainage opening. The remainder of the wound was closed in two layers without pericostal suture. Loss of blood was slight.

Post-operative Course.—The pulse-rate rose to 140 and two days later the temperature was 103°. Expectoration about two ounces in twenty-four hours

and no longer foul. Cough and expectoration rapidly diminished until on June 22nd they were almost absent. There then developed an encapsulated empyema on the mediastinal side which was opened in local anæsthesia on February 1st. The subsequent progress of the case was satisfactory, although far from steady, with little relapsing attacks of empyema of small size. He was not discharged until May 3, 1915. The wound was then soundly healed, and after a few weeks in the convalescent home he was apparently perfectly well. He remained well until April 29, 1916, when after undue exertion in playing baseball an abscess in the scar developed which communicated with the chest. It was incised under local anæsthesia and quickly healed. I kept track of this boy for two years afterward and he remained well, although subject to colds with slight cough and expectoration. I then lost track of him.

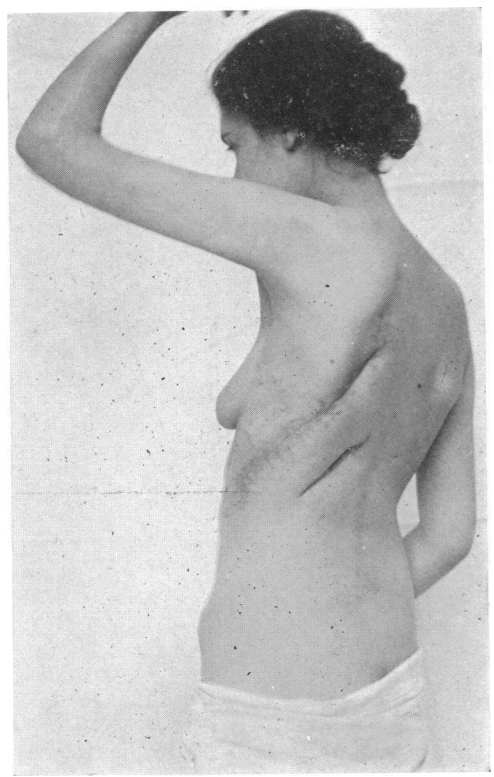

FIG. 19.—Case 18. Illustrating function of arm

CASE XV.—*Chronic Lung Abscess—Extirpation of Right Lower Lobe—Death.* This case has been reported in the ANNALS OF SURGERY for July, 1916. A brief extract follows:

Jacob K., Hospital No. 155,433, patient of Dr. Geo. Mannheimer, fifty-three years old, was admitted on June 16, 1915. The patient had been operated upon for cholecystitis about a year before and had been operated upon again on account of a jaundice in February, 1915. Soon after this he began to cough and the usual symptoms of lung abscess developed with loss of twelve pounds in three months. The patient was pale and emaciated. The lung was emphysematous anteriorly. On the right from the angle of the scapula to the base extending to the axilla râles and flatness. Clubbing of fingers. Urine acid; trace of albumin.

X-ray examination showed a dense shadow which was interpreted as infiltration of the upper part of the right lower lobe.

Operation.—On June 17, 1915, in intrapharyngeal anæsthesia by Doctor Branower, I made a long seventh interspace incision. Posterior part of lower lobe densely infiltrated and dark in color. Infiltration extended also a little way into the middle lobe. The right lower lobe was freed to the hilum and the pedicle being small it was cut off beyond two heavy silk mass suture ligatures. Four bronchi were ligated separately beyond the ligatures after the specimen had been removed. The operation was easy and quick. The stump of the lung was not fixed to the chest wall. The wound was closed in layer sutures and three drainage tubes were left just within the thorax posteriorly.

Post-operative Course.—The patient left the table in good condition with pulse of about 100. In less than an hour, however, his respiration became gasping, his pulse feeble, and he died in a few moments. Probably his death was due to mediastinal flapping.

CASE XVI.—*Suppurative Bronchiectasis (Post-pneumonic)—Lobectomy Right Lower Lobe—Death.* (Abstract from report in ANNALS OF SURGERY, July, 1916.) Joseph S., Hospital No. 160,179, twenty-five years old, was admitted to Mount Sinai Hospital, December 22, 1915. Temperature, pulse and respirations normal. He had had the usual diseases of childhood and six years before admission had had pneumonia and pleurisy for six weeks. The following year he remained well, but then there began cough with profuse greenish expectoration.

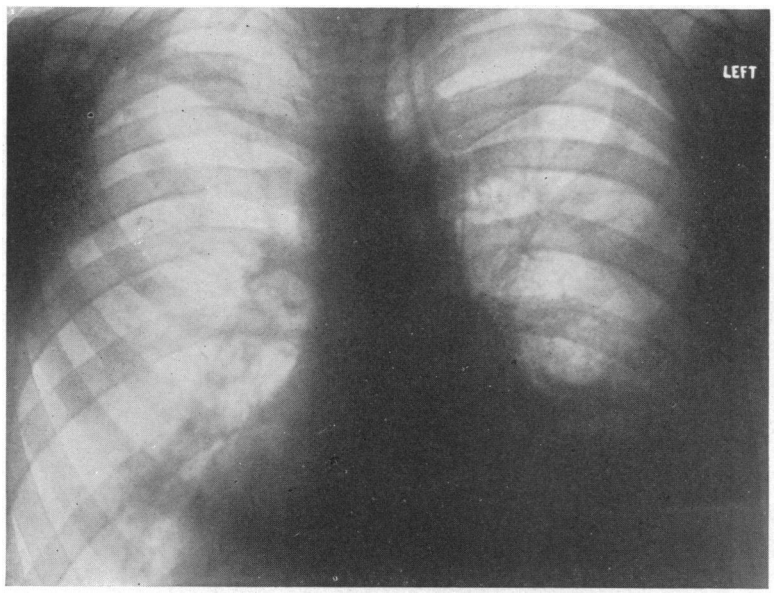

FIG. 20.—Case 21. J. M. W. Preoperative. This is a case of transposition of the viscera. Left lower lobe bronchiectasis. The diagonal right shadow from midchest to base parallel with heart shadow was not considered pathological by the röntgenologists. It suggests to the writer peribronchial congestion.

The symptoms subsided in summer and became aggravated in winter. This went on for about four years, but two years before admission to the hospital the cough and expectoration became continuous, and it was thought that he had tuberculosis until he became the patient of Dr. George Mannheimer, who made the diagnosis of bronchiectasis. There was no fever and no other constitutional sign of sepsis. On admission his condition was good. The right chest posteriorly showed dullness from the spine of the scapula to the base with increased voice and breathing, with sibilant and sonorous râles. On the left side there were similar signs. No tubercle bacilli in the sputum, the total amount of which was about eight ounces in twenty-four hours, foul and purulent in character. The urine was normal. For several years the man had been unable to work and became so miserable and depressed that he begged for relief at any risk. The X-ray showed a shadow occupying the position of the right lower lobe with adhesions between the lung and chest wall and between the lung and diaphragm. The left lower lobe also was not above suspicion.

December 27, 1915, I operated. Narcosis induced by ether was continued with nitrous oxide and oxygen administered by the intrapharyngeal method (Branower).

Operation.—A long eighth interspace incision was made, but it was also necessary to remove the greater part of the eighth rib, to divide the seventh also, just in front of the angle and again near the cartilage, and with the rib-spreader plenty of room was obtained. At the first inspection the case looked inoperable on account of the presence of dense, tough, fibrous adhesions to the chest wall, to the diaphragm and between the lobes. Indeed, in the light of subsequent events this case should probably have been regarded as inoperable. The lobe, however, was finally mobilized, but at the expenditure of much time.

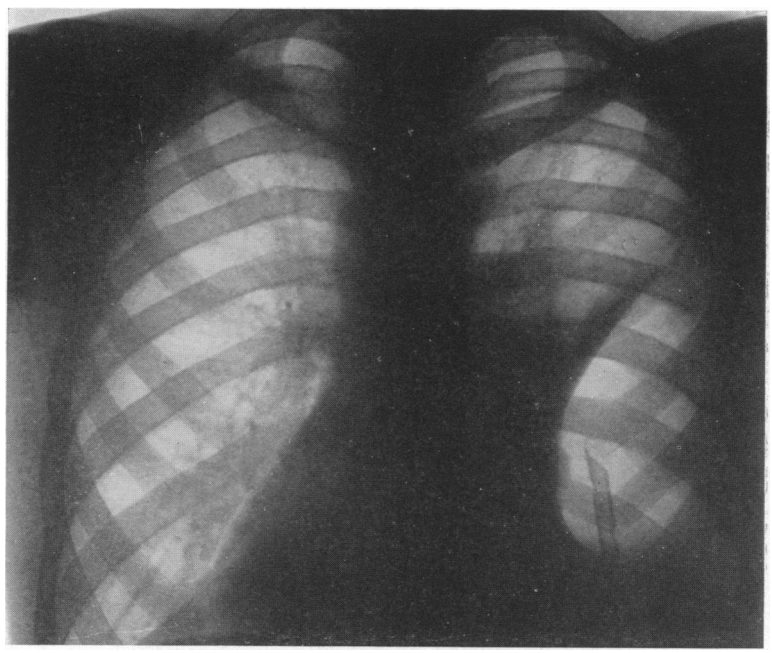

FIG. 21.—Case 21, during healing. Note pneumothorax and drainage tube. The pneumothorax was later replaced by lung tissue. (See Fig. 23.)

It was removed after crushing the pedicle with a special clamp devised by Doctor Yankauer at my suggestion. The pedicle was crushed to a ribbon and was then ligated with fine ligatures of chromicized catgut and the lobe was cut away. Immediate section of the specimen showed great infiltration and numerous greatly dilated bronchi. During the operation possibly eight ounces of blood were lost. The entire right diaphragmatic surface was left raw. All bleeding had apparently ceased at the end of the operation which had lasted nearly one and one-half hours. The ribs were approximated with pericostal chromicized catgut sutures and the mediastinum was steadied with the help of a large suture through the pedicle fastened to the chest wall. At the end of the operation the pulse was 140 but of good quality and the respirations twenty. There was, however, great shock and he was given twenty ounces of saline solution subcutaneously.

Post-operative Course.—Two hours later the pulse rose to 168 and there was cough with slight blood-tinged sputum. It was necessary to give him an intravenous saline infusion three and one-half hours after the operation and the next day he received 300 c.c. of citrated blood. His condition apparently im-

proved and I had great hopes of his recovery, but thirty-six hours after the operation he became unconscious, the right pupil dilated and the left apparently contracted. A lumbar puncture yielded clear fluid under increased pressure. The temperature rose to 107½°, the pulse which had remained good suddenly became weak and he died forty hours post-operative.

CASE XVII.—*Suppurative Bronchiectasis (Chronic)—First-stage Contemplated Lobectomy—Death.* Charles G., Hospital No. 168,304, age thirty-seven, had been operated upon for gastric ulcer in November, 1916, and appeared to make a complete recovery. He entered Mount Sinai Hospital on November 22, 1916, with a history of having cough and expectoration for six months. The discharge was thick, yellowish and foul. It was worse in the morning and frequently

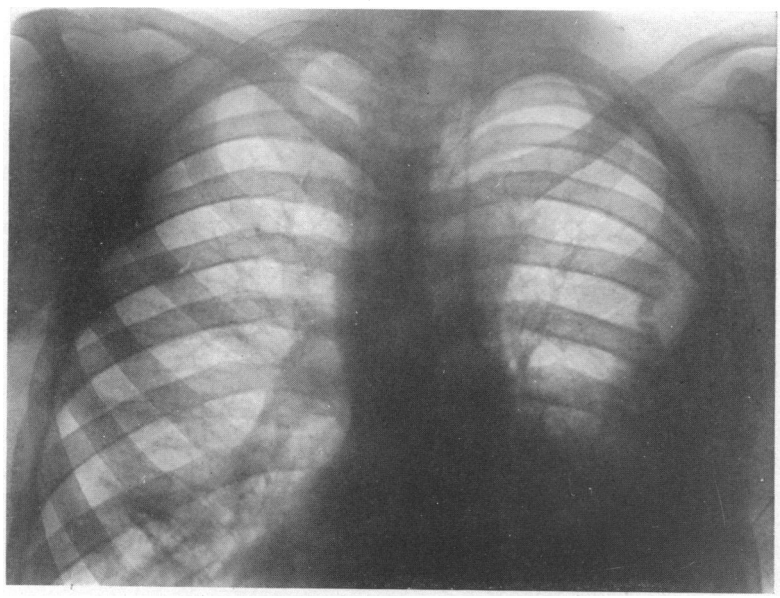

FIG. 22.—Case 21, about 3 months after left lower lobe resection.

accompanied by vomiting. No hæmoptyses. He finally became bedridden and the sputum became blood-stained.

On admission to Mount Sinai the lungs showed crepitating râles all over the right side with dullness toward the base on the right, dullness posteriorly from the angle of the scapula and flatness at the extreme base. There were no elastic fibres and no tubercle bacilli in the sputum. Pulse sixty-four; respirations twenty, and while the temperature was ninety-nine and one-half degrees on admission, there was a history during a sojourn at Bellevue of exacerbation with fever running to 104.

Bronchoscopy.—On November 27, 1916, bronchoscopy by Doctor Yankauer. No pus was seen in the left bronchus but the right was dilated and contained pus from the lower lobe. No pus from the middle lobe. Entrance to upper lobe bronchus swollen and a small quantity of pus seen coming from it.

X-ray.—The X-ray picture showed disease of the right lower and possibly middle lobes toward the hilum, the interpretation being suppurative bronchiectasis.

On December 7, 1916, in general anæsthesia I operated.

Procedure.—I made a long eighth interspace incision and divided the seventh and eighth ribs posteriorly to permit good exposure. Most of the disease was

found near the hilum in the lower and middle lobes; the upper lobe was adherent to the chest wall by a few tender strands. It was rubbed briskly with gauze, the costal pleura was also rubbed with gauze and then painted with tincture of iodine. The chest was then completely closed and the lungs during closure were kept inflated by Doctor Branower with the aid of the intrapharyngeal insufflation.

Post-operative Note.—This patient never came to his second stage because he died apparently of septic pneumonia four days after operation. Unfortunately there was no autopsy.

CASE XVIII.—*Suppurative Bronchiectasis—Left Lower Lobectomy and Partial Resection of Upper Lobe.* Fannie B., Hospital No. 196,598, sixteen years old, was admitted to the Medical Service at Mount Sinai on November 17, 1919, in the care of Doctor Celler. At five and one-half years of age her tonsils had been removed and she had remained well until one year before admission when there began pain in the left chest and expectoration of mucoid, greenish material, increasing in quantity; then there was a gradual recession until on admission the daily expectoration amounted to about two ounces of slightly fetid sputum. Her temperature was 102.2°, the pulse was 124 and the respirations were 24. Her general condition was excellent and there was no clubbing of the fingers. There was dulness from the scapula to the base of the left lung with diminished breathing and crackling râles.

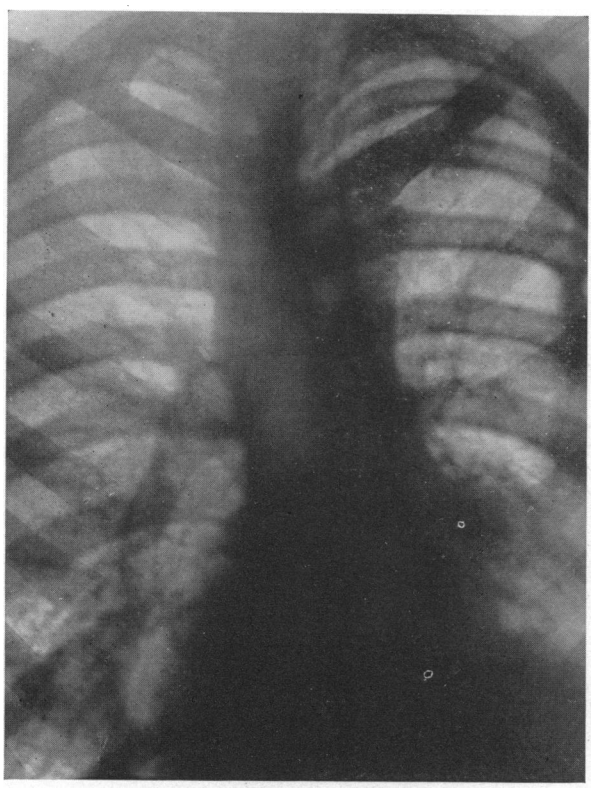

FIG. 23.—Case 21. One year after lobe resection. Patient still has some expectoration and still has nasal sinusitis. Otherwise well.

Pathological examination of the blood showed 11,000 white blood-cells, seventy-five per cent. polymorphonuclears and twenty-four per cent. lymphocytes.

The X-ray showed the heart drawn to the left and a shadow occupying the lower part of the chest from the base of the heart exteriorly to the ninth rib exteriorly.

Bronchoscopy by Doctor Yankauer demonstrated pus from the left lower bronchus.

I operated on December 4, 1919, in intrapharyngeal ether administered by

Dr. J. Lawrence Jones of the House Staff, assisted by Doctor Aschner. Doctor Neuhof acted as first assistant at the wound.

Operation.—A long eighth interspace incision was made and the rib-spreader inserted. The entire lower lobe was dark in color and greatly contracted. A few adhesions held it firmly to the diaphragm and to the upper lobe. The lower anterior edge of the upper lobe was also dark and sharply defined from the normal lung. The diseased lung was soft, contained air, and a number of nodules were felt. After enlarging the wound posteriorly, the eighth, seventh, sixth and fifth ribs were divided and part of the eighth rib was resected. Extirpation of the lower lobe was now performed after division of the adhesions, and a resection of the diseased part of the upper lobe about two and one-half inches long and one inch wide was made. The stump of the lower lobe was carbolized. An incision was made in the lower part of the chest for drainage, and after drawing the ribs

FIG. 24.—Case 29. Gussie P. Congenital bronchiectasis, right lower lobe, later infected. Before operation.

together the wound was sutured by pericostal chromicized catgut sutures. The ligatures from the stump were drawn out of the posterior wound and fastened there at slight tension to steady the mediastinum. All ligatures and also the end of a piece of gauze which had been carried to the stump were buried beneath the skin suture so as to make the chest airtight. The distal end of the tube from the drainage wound was now submerged beneath water and the lung was distended until all bubbles ceased to appear; then the tube was clamped. The wound was dressed and after the patient was put to bed the end of the drainage tube was carried under weak lysol solution and the clamp removed according to Kenyon's method for drainage.

Post-operative Course.—The operation was well borne, the pulse was steady throughout, no blood appeared at the mouth and the patient's color was good. The reaction temperature never exceeded 101 degrees. Thirty-six hours post-operative the first dressing was done; there was comparatively little discharge. The sutures over the buried gauze and ligatures were removed. The patient, however, was coughing as much as six ounces of thick, tenacious mucus. This diminished under guaiacol carbonate medication.

On the eighth day after operation the ligatures came away spontaneously. The same day suddenly the respirations rose to forty and became shallow. The patient's color became ashen (not cyanotic) and the appearance anxious. I was out of town for the day and Doctor Wessler discovered a pneumothorax pushing the heart and mediastinum far to the right. The pulse remained good, however, not rising higher than 120. The following morning I aspirated about 600 c.c. of air through an anterior puncture in the third interspace. The X-ray showed fluid, but the level could not be determined since the patient was not examined in the erect position. (In this case it is my theory that the pneumothorax was due to the rapid absorption of the ligatures around the stump of the resected upper lobe which was on the mesial side and that the patient's violent coughing had resulted in air leakage from this stump through the smaller air passages. Either unchromicized gut was given me, although it was stained the red color of the Mount Sinai chromicized catgut, or the gut had been insufficiently chromicized, for this gut ordinarily remains unabsorbed six weeks.)

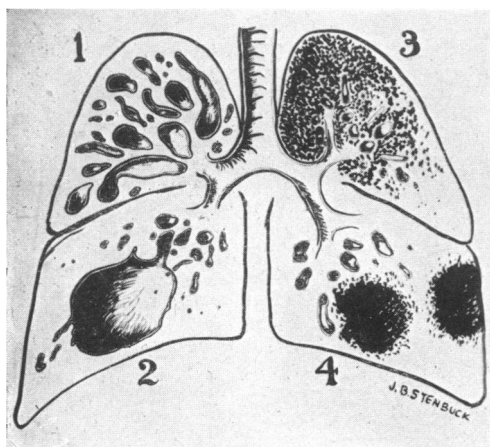

FIG. 25.—Diagram showing four types of pulmonary suppuration. 1. Bronchiectasis. 2. Bronchiectatic abscess. 3. Suppurative pneumonitis. 4. Extrabronchial abscess.

On December 14th, after fluoroscopy by Doctor Wessler and myself, in which a fluid level was clearly demonstrated crossing the median line, the patient was taken to the operating room and without anæsthesia a block-tin catheter bent to the curve of the chest was passed through the anterior adhesions into the pneumothorax. The dilated opening evacuated air and about a pint of perfectly clear yellow fluid. After this, except for occasional setbacks due to retention, there was continued improvement. The upper wound closed, but a long tube was kept in the lower opening because of sacculation in the chest. She was discharged a few weeks later, apparently well.

About April 24, 1920, the patient was readmitted to Mount Sinai with fever, cough and muco-purulent expectoration. In the upper wound behind the scapula was found a small area of softening where it was believed an empyema might break through. The X-ray showed a small fluid level in the region of the upper wound. A day or two later a sliver of rib was extruded from this point. There was no connection with the thoracic cavity.

On April 28th, with the patient sitting up in bed, I put an aspirating needle through the cicatrix behind the scapula into the chest with the idea of finding the pus. Instantly there was a sharp hæmoptysis and on withdrawing the needle a stream of blood, two or three drams in all, ran down the patient's back. She strangled, became cyanotic, gasped for breath, the pulse became extremely rapid, there was perspiration and for a moment it looked as if a fatal accident had occurred. About three or four ounces of blood were expectorated. The bleeding stopped at once after the inhalation of amyl nitrite and ligation of the thighs. Next day, with the exception of the expectoration of brownish muco-purulent sputum, the patient had returned to the normal state. Two days after

the hæmoptysis the X-ray showed the left chest almost filled by lung, only a pneumothorax at the apex remaining. The temperature had dropped and while there was still slight streaking of the sputum the patient was in excellent condition. Finally, all symptoms disappeared and the patient was discharged apparently well after a residence in the hospital of about three weeks. She probably had a pneumonia which may not have been connected with her old trouble. The last report in October, 1920, was that "she is well and has gained many pounds." (Figs. 18 and 19.)

Bronchiectasis: Left lower lobe one stage lobectomy.

CASE XIX.—Mrs. A. M., twenty-six years old, was referred to me by Doctor Bertram Waters. First signs of the disease appeared four years before I saw her. No actual assignable cause for her condition excepting a history of

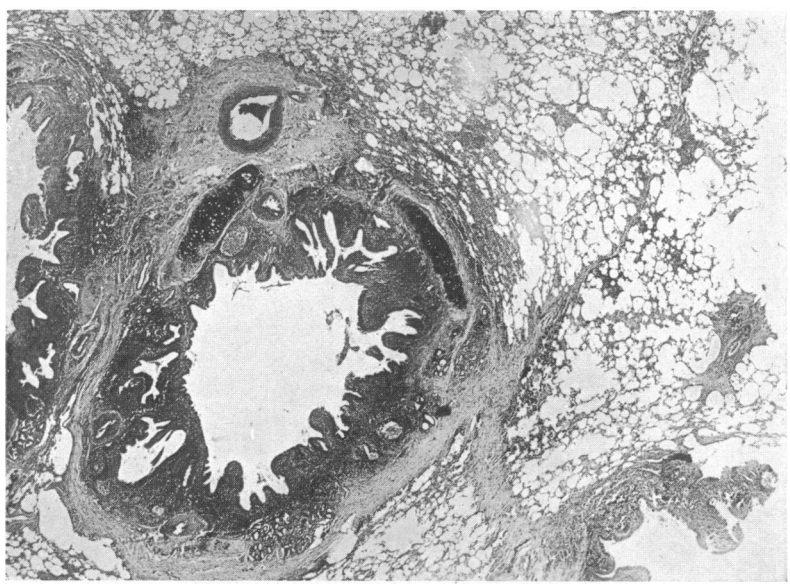

FIG. 26.—Bronchiectasis, cross section of bronchus, showing thick infiltrated papillary mucous lining.

frequent colds with bronchitis. Influenza in December, 1918, from which she never entirely recovered. Tuberculosis was suspected but tubercle bacilli were never found.

Pre-operative Course.—Left lower lobe showed definite signs of cavitation, diagnosed as bronchiectatic. Daily evacuation of large quantities of foul, purulent sputum occasionally blood streaked. The disease progressing gradually, artificial compression pneumothorax was made at the Loomis Sanatorium. This resulted in collapse of the upper normal part of the lung with little effect on the diseased portion. There was, however, some improvement in the general condition with slight gain in weight and with less sputum.

Bronchoscopy by Doctor Yankauer demonstrated the disease confined to the left lower lobe.

Life was intolerable to the patient and she asked for operative relief.

Operation, December 16, 1920, Private Pavilion, Mount Sinai Hospital. Anæsthetic administered by Doctor Branower. First assistant, Doctor Neuhof. Procedure: Long seventh interspace incision with removal of seven inches of the eighth rib with its periosteum. Incision then carried up behind the border of

the scapula dividing the seventh and sixth ribs. Lower lobe was contracted and solid. Upper lobe showed a few small patches of discoloration, suggesting possible areas of bronchiectasis. Adhesions few and easily divided. Lobectomy at once performed because it was believed that the conditions were safer now than they ever would be again. Operation easy and bleeding slight. No transfusion. Counter-opening in lower part of the back with resection of a short piece of the tenth rib and through this opening airtight tube drainage was secured. The principal wound was then closed with pericostal and muscle sutures, skin being left open and packed with a strip of gauze. Condition at the end of operation excellent.

Post-operative Course.—A sharp reaction with temperature to 104° and pulse 130 twelve hours after operation. In twenty-four hours after operation, abdominal

FIG. 27.—Bronchiectasis, longitudinal section of bronchial branches, showing peribronchial infiltration and fibrosis.

distention with cyanosis and dyspnœa and the continuous belching of enormous quantities of gas accompanied by brownish-black, foul-smelling fluid from the stomach. Abdominal distention at first relieved by rectal irrigation, but the patient quickly failed and died fifty-nine hours after operation. No post-mortem examination.

A few days after the death of this patient Doctor Neuhof happened to meet a physician who resided in the tropics and who stated in regard to a fatal abdominal case of Doctor Neuhof's in which curious whitish bodies were present on the viscera that he believed that the disease from which Doctor Neuhof's patient died was sprue, which is endemic as a visceral disease in the West Indies; where my patient resided. A fatal outcome of the condition, peritonitic in character, frequently occurs after any capital operation, no matter what its character may have been, and so well known is this condition that in the presence of sprue one does not operate except in emergencies. Doctor Neuhof suggested that this might have been the case with my patient, and I then recalled that she had had an indolent ulcer of the posterior right part of the tongue. This was called to my attention by the nurse

during the post-operative period. I did not think that the condition at that time would influence the result. Unfortunately no culture was made. As soon as I knew of the possible complication of sprue I requested Doctor Aschner who had the lung specimen to try to isolate the monilia. This, however, was impossible, as the specimen had already been put into antiseptic preserving solution. It is interesting to know that the above facts in regard to this disease are being studied by Colonel Ashford for the United States Army at San Juan, Porto Rico, and that a number of articles on this subject have been written.

CASE XX.—*Bronchiectatic Lung Abscess—Exploratory Thoracotomy.* Morris U., forty-two years old, was admitted to Mount Sinai Hospital April 10, 1920. Epilepsy for past five years. Eleven months before admission hæmoptysis of about a drachm. A month later began characteristic signs and symptoms of

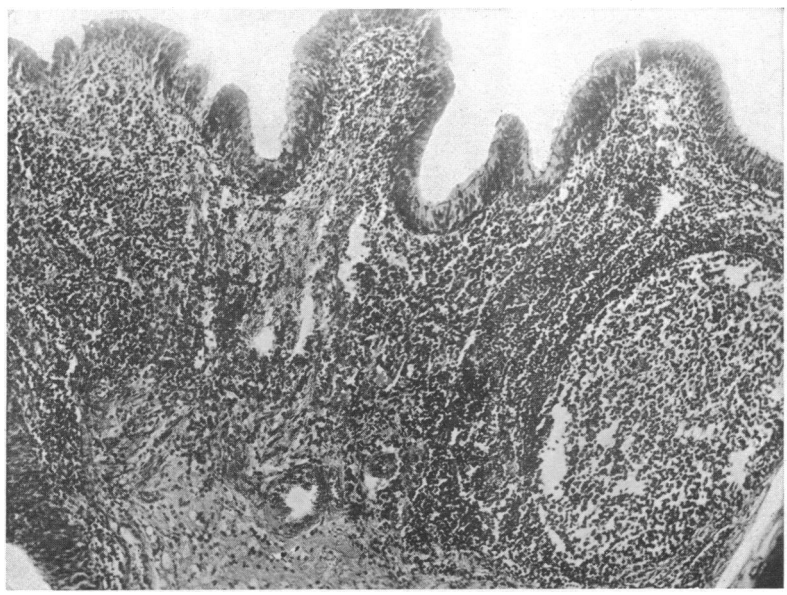

FIG. 28.—Bronchiectasis, mucosa more highly magnified.

pulmonary suppuration on the right side. Since February, 1920, cough, fever, loss of weight.

Physical examination showed signs of infiltration of right lower lobe and this was confirmed by X-ray examination. White blood-cells 8200; polymorphonuclears, forty-two. I refused to operate, but patient threatened suicide because he could not even find a place in a sanitarium on account of the fetor of his expectoration. Wassermann examination negative.

On April 12, 1920, I operated, making wide exploration of the right chest. Most of the upper lobe free but remainder of lung solid and adherent. Adhesions were broken down and chest closed to await second stage. April 19th, patient was doing badly, with signs in opposite chest. Still, in nitrous oxide and oxygen by Doctor Branower, I reopened the wound and opened and packed the abscess, not attempting lobectomy. No pleural infection was found at second stage, but he died half an hour later.

A wound examination showed the opposite lung diseased much as was the right side, though this had not been diagnosed by X-ray. Doctor Yankauer and I feared preoperative bronchoscopy because of epilepsy.

CASE XXI.—*Suppurative Bronchiectasis; Lobectomy, Left Lower Lobe.* J. M. W., twenty-three years old, was referred to me by Dr. James A. Miller on September 22, 1920. From the age of three this patient had suffered from nasal sinusitis, and there was an operation on the frontal sinus at that early age. Since then there were numerous other operations and the sinuses are still infected. The patient had influenza pneumonia twice. Cough had been present for six and a half years with purulent expectoration, usually foul but without blood. The amount varied from 250 to 400 c.c. per day. No tubercle bacilli were found. There were numerous exacerbations with fever. Clubbing of the fingers was present.

The X-ray pictures showed opacity of the left lower lobe but the right lung did not appear to be perfectly clear. The viscera of the patient were completely transposed.

Doctor Miller had treated the case with nitrogen pneumothorax and the X-ray then showed adhesions of the region of what might be the middle lobe

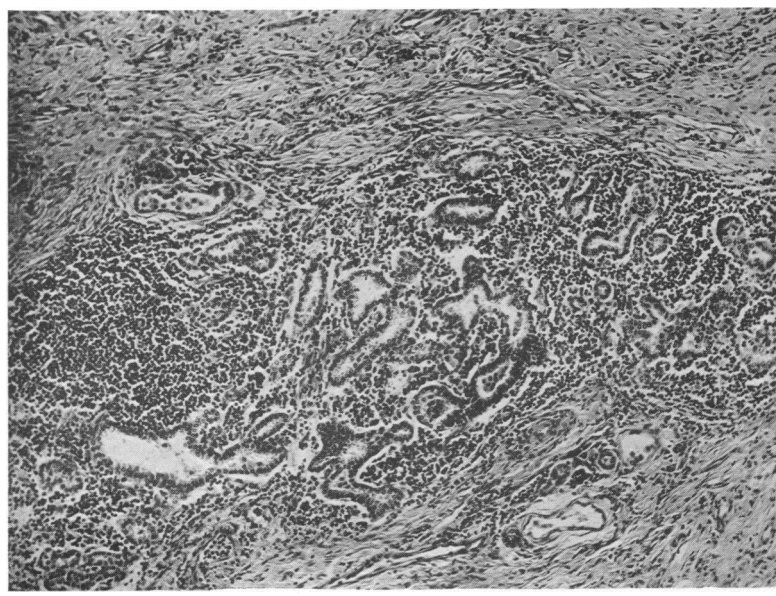

FIG. 29.—Proliferation of air passages in an area of fibrosis.

to the chest wall and of the lower lobe to the diaphragm and chest wall and so the collapse of the lower lobe was only partial. Bronchoscopy by Dr. Chevalier Jackson had been done in the hope of finding a possible foreign body, but none was found. On my advice another bronchoscopy was performed by Doctor Yankauer. who reported that the principal seat of disease with dilatation of the bronchi was in the left lower lobe, though the upper lobe did not appear to be perfectly clear. The right lung, however, was not diseased. No middle lobe bronchus was found. In the presence of the nasal infection, which was probably the prime cause of the entire pulmonary trouble, I hesitated to advise operation and suggested pulmonary lavage, but the patient refused this, preferring an operative attempt at cure. Operation was performed on October 27, 1920, at Mount Sinai Hospital. Anæsthesia in ether, then gas and oxygen by the intrapharyngeal method, with occasional suction (Doctor Branower).

Operation.—First stage. A long seventh interspace incision was made with resection of about eight inches of the eighth rib, including the periosteum. About

seven ounces of sanguinolent fluid was found in the chest. To our surprise the greater part of the lung was normal in appearance and density, the diseased area being rather dark and sharply defined, occupying the lower half of the left lower lobe, where on handling coarse crackling was made out and pus appeared at the patient's mouth. The two adhesions shown by the X-ray were broken down without the slightest difficulty and at these two points there was what appeared to be recent lymph coagulum. As preparation for a possible second-stage resection, gauze was placed between the upper lobe and the chest wall so as to cause adhesions and another piece of gauze was then placed between the lower lobe and the diaphragm. The chest was then closed without drainage by suturing the muscles, the skin left open and packed with iodoformized gauze. The patient stood the operation well.

Two days later, in nitrous oxide anæsthesia in bed, a few of the muscle sutures were removed from each angle so that the gauze could be withdrawn.

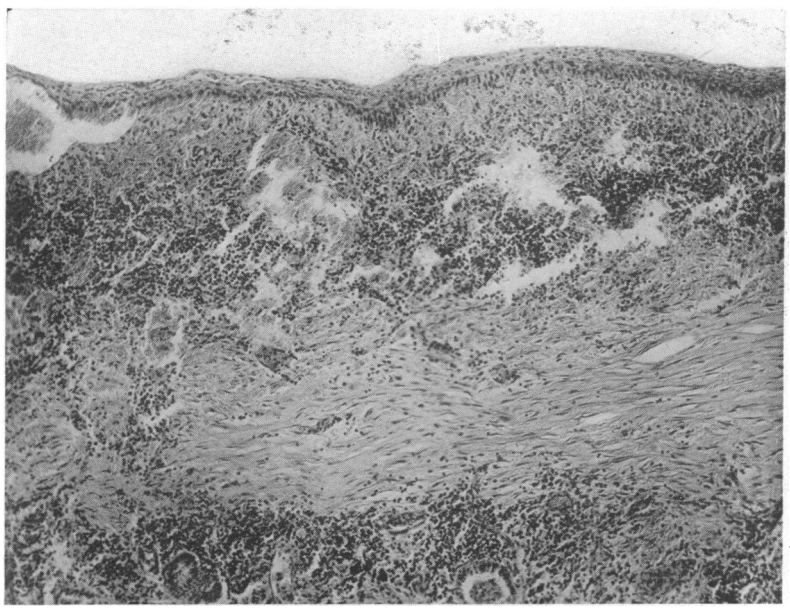

FIG. 30.—Bronchiectatic abscess wall, section near entering bronchus showing epithelial lining of cavity and muscular coat still present.

About a pint of non-odorous, sanguinolent fluid escaped. The wound was then strapped to prevent sucking.

Operation.—Second stage. On November 3, 1920, the patient having been prepared for forty-eight hours with digitan the lung resection was done. The anæsthesia was administered by Doctor Branower. First assistant at the wound, Dr. Harold Neuhof. Wound reopened by cutting sutures and rib-spreader inserted. No fluid found. The diseased part of the lower lobe was adherent to the diaphragm, upper and middle (?) lobes adherent to the chest wall. During the operation it was necessary to loosen some of the adhesions of the upper lobe to the chest wall, but a number remained firm posteriorly. The middle lobe was not fully developed, although a sulcus of demarcation was present. The infected part of the lower lobe was cut away beyond numerous ligatures of chromicized catgut and silk passed through the healthy pulmonary tissue. This made an unusually broad base or pedicle. The seventh rib was cut through posteriorly

and a short section, about an inch and a half, was removed for drainage. Another drainage opening was made into the back, through which a large-calibre tube was passed between the ribs into the chest low down. The stump area was carbolized and the ligatures tied together with a fillet of silk. This mass of ligatures was passed through a hole in a large piece of rubber dam which embraced the neck of the pedicle, broad though it was, and then this sack of rubber dam was filled with gauze, the entire mass of rubber dam, gauze and ligatures being led out through the upper posterior part of the wound. The mediastinum was steadied by traction made by fastening the bunch of ligatures to the chest wall. Three pericostal sutures approximated the ribs to within about three-quarters of an inch of each other and the remainder of the thorax was closed with chromicized catgut sutures through the muscles in two layers; skin wound left open. After the operation the patient was considerably shocked, although the blood-pressure which before the operation

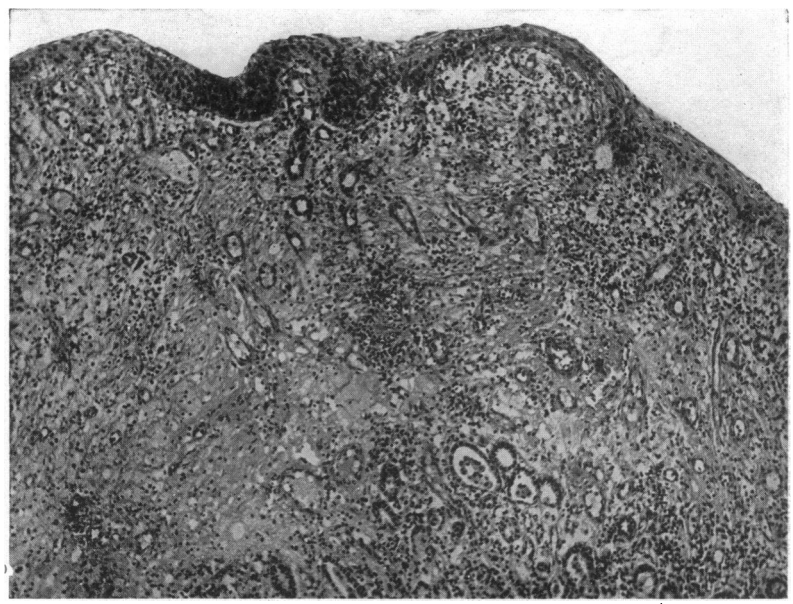

FIG. 31.—Bronchiectatic abscess wall, a more peripheral area, showing epithelial layer covering vascular granulation tissue.

had been 115-100 had been reduced to but 100 systolic. Doctor Ottenberg then transfused by the citrate method 700 c.c. of blood.

Post-operative Course.—The convalescence was far from simple. A section of the stump came away fifteen days after operation and two days later the other section, but a transfixion ligature which had been put in for security was very slow to be dislodged, finally coming away twenty-eight days after the lobectomy. For a time the sputum almost disappeared and the cough improved greatly. By December 6th, however, some sputum had reappeared (about 90 c.c. per twenty-four hours) and this has continued up to the present time. About four weeks after the lobectomy when everything seemed favorable a pneumonia developed in the right lung which caused me great concern. It cleared up, however, without leaving any trace. A small bronchial fistula persisted at the time of his discharge from the hospital on January 17, 1921, but it finally closed completely. A note on April 4, 1921, stated that the "wound is healed; patient in fine general condition, but there are still about two and one-half ounces of expectoration." A tube

through the lower drainage opening was not removed until a mere narrow track was all that was left of the cavity.

This patient cannot be considered cured because he still has some cough and expectoration. He has submitted to other nasal operations since the lobectomy but the sinuses are still infected. Judging by the most recent X-ray pictures it appears possible that there is a small patch suppurative in character near the site of the resection. Whether this is an extension or not it is impossible to know. At the time of the operation all visible and palpable pathological lung tissue was extirpated.

CASE XXII.—*Suppurative Bronchiectasis—Lobectomy Left Lower Lobe—One Stage.* Miss Josephine E., eighteen years old, entered Mount Sinai Hospital June 17, 1921. For nine years she had cough with purulent sputum. Her tonsils

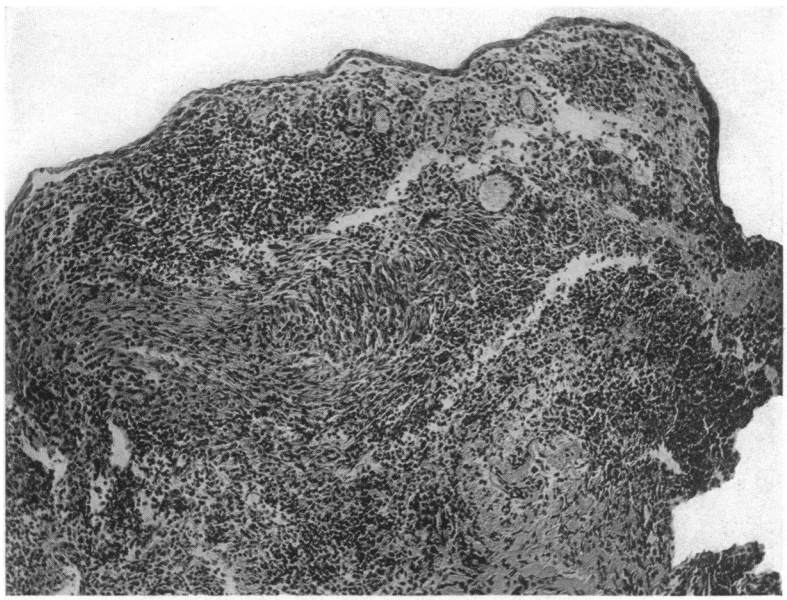

FIG. 32.—Bronchiectatic abscess wall, a remote area showing thin squamous epithelial lining.

had been removed a year before her admission, this of course having no relation to her disease. The amount of sputum was great and the odor indescribably foul. There were periods of emptying with comparatively little sputum in the intervals. For a year she had been treated bronchoscopically nearly every week by Doctor Yankauer, who kept her condition tolerable by lavage of the dilated bronchi, which were clearly observed through the instrument. During the three months preceding her admission, however, there had been a loss of twenty-two pounds in weight. There was no fever and no tubercle bacilli had been found on repeated examination. The breath had a gangrenous odor. There was slight dulness and few râles at left base posteriorly. There was clubbing of the fingers. The general nutrition was fair in spite of the great loss in weight. Urine examination negative. Blood Wassermann negative.

The X-ray showed opacity occupying the lower part of the left lower lobe. The right chest was apparently free. Doctor Yankauer stated that the disease was limited to the left lower lobe.

Her parents had been opposed to operation, but when she became eighteen years

of age she took matters into her own hands and insisted upon a chance with surgery, although well aware of the great dangers.

On June 20, 1921, I performed a left lower lobectomy, Dr. Harry Goldman beginning the administration of the anæsthetic, which was continued by Dr. L. Mason Lyons, House Surgeon. Sodium citrate given intramuscularly. Doctor Neuhof and Dr. Ira Cohen assisted. Although the patient had apparently emptied her pus focus before operation, a considerable quantity escaped during narcosis.

Procedure.—A long seventh interspace incision extending upward behind the scapula with section of the eighth, seventh and sixth ribs. The upper lobe was adherent to the pericardium in its lower anterior part, the upper portion of the lobe being free. This lobe showed a small atelectatic area not larger than a silver quarter and not infiltrated. The lower lobe was adherent to the diaphragm by a few

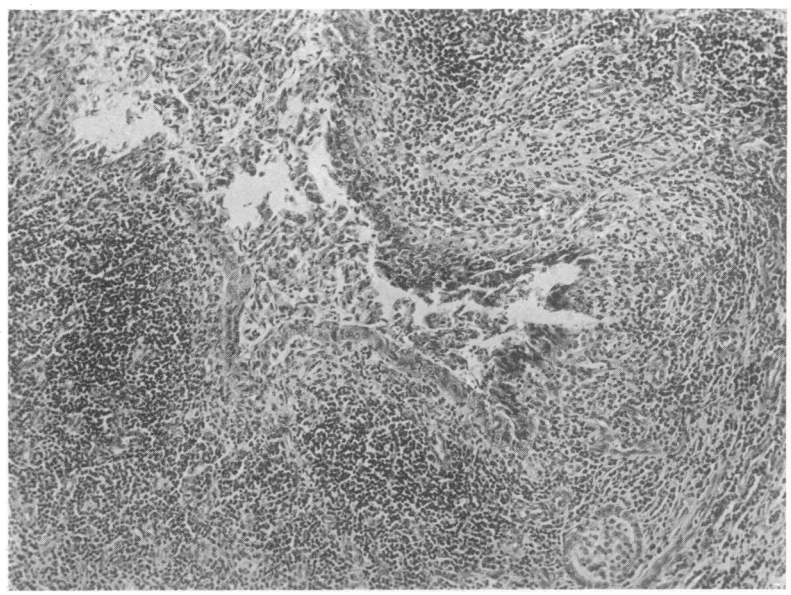

FIG. 33.—Bronchial branch with beginning epithelial metaplasia.

tough but fine adhesions which were easily divided. The lobe was not discolored, but it felt more fleshy than normal and there were dense nodules within the lung tissue with numerous large nodes in the hilum. Although there were no adhesions of the upper lobe and the case therefore should have gone into the two-stage group, the conditions were so tempting for an immediate lobectomy that I carried out this plan according to my present technic. Twenty-four hours after operation there had been free drainage of bloody serum and the patient received 300 c.c. of citrated blood. Three days post-operative the upper part of the wound was opened and the gauze changed. Soon afterward there were signs of tense pneumothorax with the heart pushed to the right. The cause of this proved to be the accidental slipping out of the tube, although it had been fastened to the fascia with a catgut stitch. A separate chamber had established itself in the wound on the mediastinal side and it was in this chamber that the pneumothorax had occurred. The tube was at once replaced and suction established. The patient was immediately relieved and in a few hours the heart was in its normal position. Nine days after operation there occurred a pneumonia on the opposite side with rapid respirations and much prostration. On July 5th there was a large bronchial fistula,

but the stump had not yet come away. Respirations had been so rapid for the past two days that I closed the entire thoracic wound with adhesive plaster and an occlusive wet dressing which gave the patient much relief. Three weeks after the operation the main slough came away through the upper wound and the patient's condition became good. On July 18th—twenty-eight days after the operation, when she was nearly well with only a small tube in the lower cavity, there was a sudden and dangerous hemorrhage. Fortunately Dr. Ira Cohen happened to be present. The removal of the tube was followed by a gush of blood and some blood was also coughed up, the patient going into a condition of shock. Doctor Cohen at once reopened the small granulating upper wound and packed the chest as well as he could and the patient was taken to the operating room, where I examined her in nitrous oxide and oxygen. I recognized that there

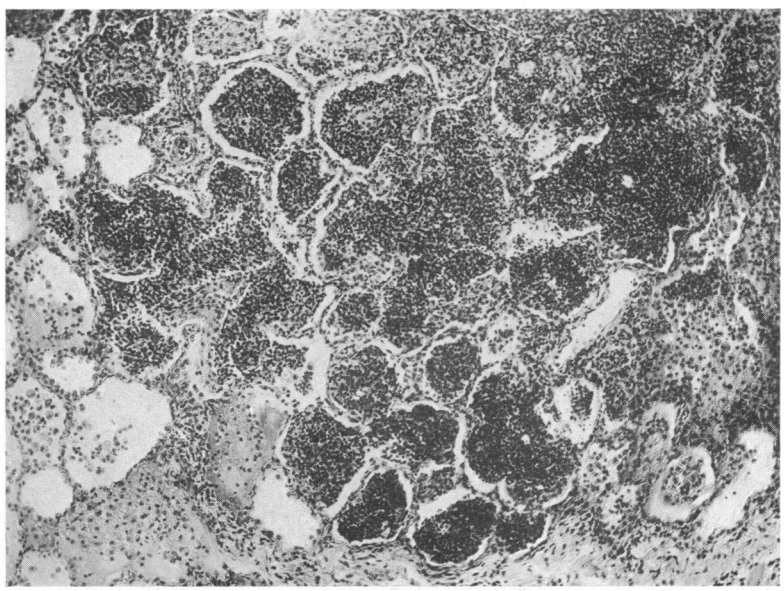

FIG. 34.—Suppurative pneumonitis, purulent exudate in alveoli, septa breaking down.

were two places where the hemorrhage might have originated. The most probable was erosion of an intercostal artery by the drainage tube. The other was from the region of the stump which would have been much more serious. On removing the packings there was an alarming hemorrhage, and because I wished to inspect the most dangerous region first I crashed through the soft parts and new bone with a large rib cutter and opened about four inches of the wound, putting in a rib-spreader. The stump was perfectly clean and there was no sign of bleeding there. The lower wound was then immediately enlarged and a rib resected. A spurting intercostal, evidently the source of bleeding, was caught in a hæmostatic suture. A few hours later Dr. N. Rosenthal gave a transfusion of 240 c.c. of whole blood by the Unger method. From this time on recovery was uninterrupted and she was discharged late in July with the wounds not quite healed. November 14, 1921, the patient having reëntered the hospital because the upper wound was still discharging moderately, I removed a rib sequestrum in light anæsthesia. There were slight hæmoptyses for two days after operation but the patient's general condition is excellent. She is up and about and will leave the hospital tomorrow with a clean granulating wound, this time, it is hoped, "for good." Careful

measuring of the sputum, no longer foul, showed only from one-half to three-quarters ounce in twenty-four hours and the amount is rapidly diminishing. Prognosis for permanent cure excellent.

CASE XXIII.—*Bronchiectatic Lung Abscess—Right Lower Lobe; First-stage Lobectomy.* Max L., sixteen years old, was transferred from the Medical Service of Doctor Libman at Mount Sinai Hospital to my service on May 11, 1921. A nasal operation of some sort had been performed four years previous; three years before there had been pneumonia which the patient believed was right-sided; about two years before, tonsillectomy had been performed and about one and one-half years previous, without immediate apparent cause, there began productive cough with foul expectoration, and he entered the hospital for the relief of this condition. On admission he was in good general condition, although he was

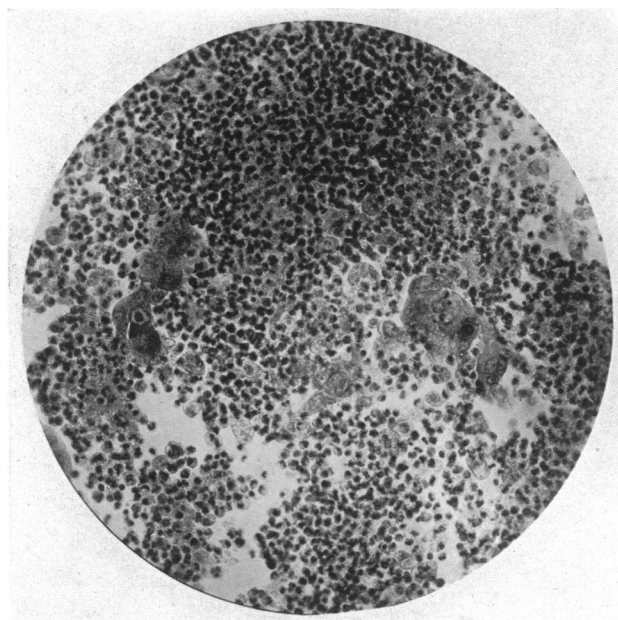

FIG. 35.—Suppurative Pneumonitis, higher magnification.

slightly cyanotic and there was infiltration of the right lower lobe. Examination of the blood showed the hæmoglobin to be 110 per cent., red blood count 5,200,000, and blood-pressure 106 over fifty-six. The sputum was negative for tubercle bacilli. The X-ray showed a shadow in the right lower lobe which suggested suppurative bronchiectasis. Bronchoscopy by Doctor Kempfer revealed pus coming from the bronchi, but the patient was unmanageable and the examination was unsatisfactory. A thoracotomy for exploration was advised and performed on May 12, 1921, in general anæsthesia with nitrous oxide and ether, administered by Doctor Branower. Doctor Neuhof assisted at the wound. Sodium citrate was injected intramuscularly.

Operation.—A long seventh interspace incision was made, the eighth rib was divided posteriorly and the rib-spreader inserted. Adhesions of the upper lobe made intrapharyngeal pressure unnecessary. Thin, tough adhesions to the chest wall and diaphragm were encountered in the middle and lower lobes and these were divided with knife and scissors. There was very little hemorrhage. In the anterior lower edge of the lower lobe there were spots of atelectasis, bluish

in color. When the lobe had been almost completely freed it was found to be dense and hard—almost tumorlike in consistency—the greater part of the disease being in the posterior part. A hole was cut in a large piece of rubber dam and through the opening the diseased, isolated lobe was drawn in order to prevent reformation of adhesions. A small posterior resection of the eighth rib was made and the wound was closed in layer sutures, three pericostal chromicized catgut sutures approximating the ribs. No drainage.

Post-operative Course.—There was a reaction temperature of 102 plus. The patient's condition was apparently good. His pulse was about 115 but of good quality. The sutures were removed three days post-operative and a number of pus foci were found beneath the muscle sutures. A wet dressing was applied. Fluoroscopy on the fourth day post-operative showed a perfectly clear upper lobe with a shadow in the lower half of the chest but no displacement of the heart. This was interesting as the physical examination showed the apex far to the left of normal. The left chest was clear. On the fifth day the pulse became rapid and thready. There was no cyanosis. The wound was dressed and an opening made between the ribs into the chest, evacuating some very bloody serum but no clots. He suddenly collapsed and died.

A wound examination revealed no infection in the pleural cavity, no large quantity of bloody serum. The upper lobe of the right lung was normal; the lower lobe showed multiple abscesses with bronchiectatic areas and very large lymph-nodes in the hilum.

CASE XXIV.—*Bronchiectatic Lung Abscess from Foreign Body—Right Lower Lobe Extirpation.* This case has been reported in full in the ANNALS OF SURGERY for July, 1916. This is merely a very brief abstract.

Francis W., age three and three-quarters years, had a chronic gangrenous, diffuse bronchiectasis limited to the right lower lobe following the aspiration of some partly masticated nuts. Doctor Yankauer had succeeded in removing most of the fragments through the bronchoscope but without curing the condition. The patient's general condition was very poor. There was much spasmodic cough and foul expectoration.

On February 27, 1914, Doctor Branower gave ether by the intrapharyngeal method and I performed complete lobectomy through a seventh intercostal incision without dividing a rib. There was complete recovery and the patient has remained well and has developed symmetrically.

CASE XXV.—*Chronic Suppurative Pneumonia of Right Lower Lobe—Lobectomy.* This case has been reported in the ANNALS OF SURGERY for July, 1916. Following is a brief abstract of his history. Lawrence F., Hospital Accession No. 31,838, age eight years, was admitted to the service of Doctor Koplik of Mount Sinai Hospital on February 27, 1915. Seven months before admission pneumonia, followed in two or three weeks by a second attack. Cough persisted. Four days before admission fever, cough, and occasional vomiting. The child had gained weight continually during the seven months before admission. In this respect he was abnormal, probably suffering from some form of dyspituitrism. The respirations were thirty-two to sixty-four; the pulse 100 to 144; the temperature 100° to 104.8°.

X-ray examination showed the right lower lobe almost solid and sharply marked from the remainder of the lung which appeared healthy.

On March 1st he was aspirated in the right posterior axillary line and one-half a drachm of pus was said to have been obtained. I first saw him the following day. A diagnosis of pulmonary suppuration was made and on March 4, 1915, I operated in intratracheal anæsthesia, administered by Doctor Branower. Three minims of Magendie's solution had been ordered for this patient, to be given three-quarters of an hour before operation.

Operation.—Through a long seventh interspace incision without cutting ribs the lobe was extirpated. Small resection of eighth rib for drainage.

Post-operative Course.—The operation was well borne with very little loss of blood. The pulse at its conclusion was 140 and the color pink and good. Soon after the patient went to the ward the respirations dropped to about ten and were extremely irregular, although the heart was beating 120 and strong. There was cyanosis and the patient looked dangerously ill. Doctor Branower made artificial respiration by intrapharyngeal insufflation and with the aid of this and one-three hundredth grain of atropine, he revived. It was later found that one-fifth of a grain instead of one-tenth of morphine had been given. The day after the operation the respirations were sixty, the pulse was 145, but the condition did not appear dangerous. Convalescence was in this case unimpeded, although on March 14th the temperature rose to 105.2° without explanation. He was discharged well on May 18th with some contraction of the right side. This deformity rapidly disappeared and four and one-half years later he was perfectly symmetrical, well and strong.

CASE XXVI.—*Suppurative Bronchiectasis—Two Lobe, One Stage Lobectomy—Death.* Sarah G., Hospital No. 168,034, six and one-half years old, was referred to my service at Mount Sinai Hospital by Doctor Koplik on November 27, 1916. She had had measles at one year of age and whooping-cough followed by pneumonia two and one-half years before admission. Chicken-pox and pneumonia seven months before admission. The illness for which she was brought to the hospital was supposed to have begun two and one-half years before at the time of her whooping-cough pneumonia. The outstanding feature of this case was cough, with expectoration, and fever. Frequently the coughing, which was paroxysmal, was followed by vomiting. The expectoration was extremely foul. The fingers were clubbed. On examination the right lung showed dulness beginning just below the angle of the scapula with amphoric breathing at the right base. The urine was negative. The blood showed 3,400,000 red cells; 7200 white cells; polymorphonuclears fifty-two per cent.; lymphocytes thirty-eight per cent.; basophiles two per cent.; eosinophiles three per cent.; myelocytes one per cent.; mononuclear lymphocytes four per cent.; hæmoglobin seventy-two per cent. On admission the temperature was 99.8°; pulse 100 and respirations twenty-four.

X-ray examination showed dense shadow at the right apex. Peculiar formation of dense shadow in lower lobe.

Bronchoscopy by Doctor Yankauer revealed the right bronchus pressed upon by something from without and pus exuding from it. There was also pus from the left main bronchus but Doctor Yankauer thought this might have run in from the right. It was not possible to enter the right bronchus.

This was considered a case for exploratory thoracotomy and on November 27th I operated, Doctor Branower administering nitrous oxide and ether by the intrapharyngeal method. Doctor Ware was first assistant.

Operation.—Through a long right seventh interspace incision the exploration showed the middle lobe to be normal and larger than usual. The right upper lobe was grayish and firm in consistency. The seventh, sixth and fifth ribs were now divided posteriorly and ample space was obtained A few adhesions were divided and the right lower lobe was crushed with a clamp a little beyond the hilum. The clamp was then removed, a series of catgut suture ligatures were put in and the lobe cut away. It was then found that the lower lobe was in quite as bad a condition as the upper and it was removed by the same method. The ligatures of the upper lobe were cut short; those of the lower lobe were left long and were fastened to the chest wall to steady the mediastinum. There was little hemorrhage, only one vessel in the hilum of the lower lobe requiring separate

ligation. A low posterior stab wound was made for drainage. The time of the operation was fifty-five minutes.

Post-operative Course.—The operation was followed by considerable shock, but the patient recovered quickly and in less than an hour was wide awake, perfectly conscious, and asking for Seltzer water. For four days there was steady improvement. The usual foul discharge from the sloughing stump appeared and most of this was drained through the lower opening by the use of a suction apparatus. At the end of the fourth day following the operation I had great hope for a recovery, but at six o'clock on the morning of the fifth day, having been left alone by her special nurse with the side of the crib down, the child fell out of bed. At once there was shock, cyanosis, irregularity of the pulse, and for the next eight hours sinking until she died twelve hours after the accident.

It is by no means certain that recovery would have taken place in any event, but the immediate change in condition after the accident causes me to believe that this shock had much to do with the fatal termination.

CASE XXVII.—*Pneumonic Lower Lobe Lung Abscess (Suppurative Pneumonitis)—Extirpation of Left Lower Lobe—Death.* Joe S, twenty-eight years old, was transferred from the Medical Service of Mount Sinai Hospital on July 15, 1919, and on the same day I operated. Eight weeks before he had had a sharp pneumonia and six weeks before he had begun to expectorate large quantities of fetid sputum. His temperature had varied from subnormal to 104°, but was running more nearly normal when I saw him. His general condition remained good and there was no clubbing of the fingers. Bronchoscopy by Doctor Yankauer showed secretion from the upper and lower lobes. X-ray examination showed a large abscess with infiltration occupying about the middle of the chest, so that it was difficult to make sure whether both lobes were diseased or not. He had been prepared with digitalis for two days previous to his transfer.

Operation.—In local anæsthesia, a long seventh interspace incision was made, the pleura opened and a large part of the eighth rib was resected. Because of distress due to mediastinal motion, the operation was then continued in general anæsthesia by the intrapharyngeal method (Doctor Branower). Both lobes were found to be involved and the abscess firmly adherent to the posterior chest wall. Adhesions to the diaphragm were found everywhere on the lower surface of the lower lobe and after releasing them the pedicle was easily loosened and cut off behind chain ligatures of chromicized catgut. This was not difficult because of the absence of the dense infiltration ordinarily encountered here. The stump and raw posterior chest wall were carbolized. Two other openings were made with small resections of rib for drainage by tube, one in the lower part of the chest and the other in the upper end of the wound where the long ligatures also protruded. The main wound was closed, burying the sutures and upper tube. Lower drainage wound closed airtight around the tube, the end of which was carried beneath the surface of lysol solution under the bed.

Post-operative.—No shock followed the operation, but a large amount of bloody discharge came away through the tube. The pulse gradually rose to 108, but was of good quality. There was some abdominal distention, but no vomiting. Two days afterward I was obliged to leave town, and on the third day post-operative death occurred from sudden heart failure with œdema of the lungs.

CASE XXVIII.—*Suppurative Bronchiectasis—Two-stage Lobectomy—Death.* The following is the first case in which I performed lobectomy in two stages. This was after I had been convinced by Dr. Samuel Robinson of the advantage of securing adhesion between the healthy lobe and the chest wall before removing the diseased lobe. This principle appears surgically sound and from the standpoint of the anæsthesia should add much to the ease and safety of the operation.

K. G., Hospital No. 168,297, a man thirty-two years old, was admitted to

Mount Sinai Hospital on November 22, 1916. From the age of twelve he had been in the habit of drinking from eight to ten glasses of beer a day; otherwise his history was unimportant. The pulmonary condition for which he sought relief began about a year before, following an attack of influenza. The principal symptom had been cough, with thick, yellowish expectoration, often colored with blood. Five months before admission there began a series of severe pulmonary hemorrhages, the last one seven weeks before. In spite of climatic treatment and good care in an institution his condition became steadily worse. There appeared pain in the right upper thorax, especially on coughing, and there were attacks of vomiting. There were signs of consolidation in the right upper thorax running down to the middle of the chest. The urine showed nothing abnormal. The blood-pressure was 105 over 65. Numerous examinations of the sputum failed to reveal tubercle bacilli. Fever was moderate, pulse on admission ninety-six, respirations twenty-four. Wassermann blood examination was negative. Complement fixation test for tuberculosis was negative.

X-ray Examination.—The X-ray showed dark infiltration from the right apex to the interlobar fissure, where it was sharply limited. The appearances were those of pneumonic infiltration which is often associated with bronchiectasis.

Bronchoscopy.—On November 28, 1916, Doctor Yankauer found by the bronchoscope that secretion was coming from the upper lobe branch of the right bronchus, but this branch could be entered only a short distance because of swelling of the mucous membrane. The middle and lower lobe branches were dilated to twice their normal size but contained no secretion. The left bronchus was normal.

Operation.—I operated on December 7, 1916. Doctor Branower administered the anæsthetic (ether, nitrous oxide and oxygen) by the intratracheal method. An incision was made in the seventh interspace over healthy lung and the rib-retractor put in. The X-ray findings were corroborated and there were dense adhesions of the upper lobe of the lung to the chest wall, the lower lobe being free. The lower lobes were now brushed briskly with gauze, the parietal pleura was wiped with gauze and then brushed with tincture of iodine and the chest was closed by suture without drainage, while the lung was expanded by the intratracheal pressure.

It was hoped that this treatment would cause adhesions to form where they were desired. The wound healed by primary union without reaction and on December 18, 1916, I performed the second stage of the lobectomy, Doctor Branower again administering the anæsthetic by inhalation.

The seventh, sixth and fifth ribs were divided close to their angles through a vertical incision connecting with the former operative wound. The rib-spreader was put in and at once it was seen that sufficient adhesion had formed to hold the lower lobe to the chest wall, simplifying the anæsthesia. The middle lobe was firmly adherent anteriorly and its appearance and texture on palpation appeared normal. The upper lobe was densely adherent to the anterior chest wall and was not all diseased, but it was soon found that the entire lobe would have to be sacrificed because of disease near the hilum. The pedicle was cartilaginously hard and could not be crushed even by a powerful clamp, which had been made by Doctor Yankauer and which worked on the letter-press principle. The operation was continued with great rapidity, quickly peeling the lobe from the chest wall, ligating the pedicle with silk and ablating it in the usual manner. The stump was carbolized. A drainage opening was made posteriorly by a small seventh rib resection. The chest was entirely closed so that there should be as little immediate respiratory embarrassment as possible. Doctor Branower inflated the lower and middle lobes of the lung just as the last sutures were tied.

Post-operative Course.—The pulse was of excellent quality and about 120 in rate; respirations thirty. The temperature was normal until December 20th, when it rose in the evening to 103°, and on the fourth day the wound was dressed without anæsthetic, the patient sitting up. There was fetid discharge which had oozed out of the wound between the sutures. The wound in the chest wall was at once widely opened and packed with iodoformized gauze. For the first post-operative thirty-six hours the cough, which had been constantly present before, disappeared completely. Then it recurred with slight expectoration. We found it impossible to sterilize the wound and impossible even to check the sloughing which had begun under the cutaneous stitches. The case resembled one of those which were seen so often during the War of gas gangrene of the chest wall and after a noble fight the patient died of sepsis on December 27, 1916, nine days after the second stage of his operation.

Remark.—The two-stage method can not be blamed for the death in this case, but probably the closure of the skin by suture made the propagation of the anaërobes more rapid. It is from this case that I came to the conclusion not to suture the skin after even the simplest lobectomy. The discussion of the relative value of the one- and two-stage methods is taken up elsewhere in this paper.

CASE XXIX.—*Suppurative Bronchiectasis of Right Lower and Middle Lobes —Two-stage Lobectomy—Death.* Gussie P., twelve years old, was admitted to Mount Sinai Hospital on January 31, 1921, with a temperature of 99.8°, pulse of 104 and respirations twenty-six. She had coughed since she was three days old. There was considerable thick, green sputum, especially in the morning, and there was pain in the lower right chest. Physical examination showed dulness and broncho-vesicular breathing with moist râles over the lower right lobe. There was no clubbing of the fingers and the expectoration was not fetid. An operation for nasal polypi had been performed. Bronchoscopy by Doctor Yankauer revealed purulent secretion from all the branches of the right bronchus and what was considered overflow coming from the left. X-ray examination showed infiltration with consolidation in the right lower lobe.

An operation preparatory to lobectomy was performed on February 24, 1921, Dr. Ira Cohen, first assistant. Intrapharyngeal anæsthesia by Doctor Eliasberg. of mucopus and during he anæsthesia about twenty ounces were discharged.

At request just before the anæsthetic the patient coughed up about ten ounces of mucopus and during the anæsthesia about twenty ounces were discharged.

Procedure.—A long seventh interspace incision entered the chest and retraction was made with the rib-spreader. The lower lobe, while not dusky in color, was of a peculiar appearance, showing numerous minute nodules over its surface which were easily detected by sight as well as by touch, so that the viscus looked as if infiltrated with many metastases. The middle lobe was less visibly involved and the upper lobe appeared normal to touch and sight. A long section of the eighth rib was now removed for the sake of gaining space at the next operation. A strip of iodoformized gauze, single thickness, was placed between the upper lobe and the chest wall so as to make adhesions, and the wound was closed in layers with suture of muscle but not of skin.

Before tying the last suture an attempt was made to distend the lung but with doubtful success.

An X-ray picture taken March 9th showed a clear lung at the left side and with the general condition of the patient apparently good the lobectomy was undertaken. Nitrous oxide and oxygen, with a little ether, administered by Doctor Branower. Dr. Ira Cohen assisted at the wound.

Procedure.—The wound was quickly reopened and two more ribs were cut upward at the posterior angle. The rib-spreader was inserted. Adhesions had formed between the upper lobe and chest wall posteriorly. The lower and middle

lobes were covered with lymph and densely adherent to the surrounding parts. The lower lobe was separated bluntly from the diaphragm and from the upper and middle lobes and was extirpated beyond numerous transfixion ligatures of strong twisted silk. The child's condition was not good enough to warrant extirpation of the middle lobe also. The ligatures were left long and were tied together. The ligatures and stump which had been carbolized were brought through a perforated rubber dam which was loosely packed with iodoformized gauze. The ligatures, packings and rubber dam were brought out from the posterior part of the wound, the ligatures being fixed with a safety pin so as to steady the mediastinum. Considerable blood was lost and during the remainder of the operation the child received a saline infusion intravenously. The wound was now closed by three pericostal chromicized catgut sutures and muscle sutures. A few tubes were placed in the costophrenic sinus anteriorly for further drainage. The second wound was packed with iodoformized gauze.

Post-operative Course.—Immediately after the operation 250 c.c. of citrated blood were transfused. An hour after the operation the temperature had risen to 106 degrees, and in spite of the steadying of the mediastinum there was practically a sucking wound. This was overcome by firm strapping and the respirations became much easier. The child never reacted, however, and there was great rattling in the throat on respiration. Death occurred seven hours after the completion of the operation with hyperpyrexia of 108 degrees.

Post-mortem.—A wound inspection showed surgically perfect conditions in the right chest. The middle lobe, however, was bronchiectatic. The upper lobe was erected normally. The left lung was pneumonic and showed small areas of disease, probably bronchiectatic in character.

Pathological diagnosis by Dr. F. S. Mandlebaum.

CASE XXX.—*Infected Mediastinal Dermoid Cyst—Carcinoma of Cyst Wall—Secondary Bronchiectasis—Resection of Right Lower Lobe—Drainage of Cyst—Death.* Miss E. R., thirty years old, a patient of Dr. A. Peskind, of Cleveland, had for many years expectorated foul pus and for about seven years the quantity was fully twelve ounces a day. There were occasional hæmoptyses. A drainage operation a year before I saw her had not benefited her and the wound had closed, but even while it was open and draining the cough continued uninfluenced. She consulted me on September 22, 1921, a well-nourished but slightly cyanotic girl, a scar just behind the right mamma, fingers clubbed, dullness and râles in the right lower chest. The X-ray showed a peculiar shadow in the right lower thorax which we interpreted as a bronchiectasis. The possibility of suppurating dermoid had been also considered, especially by Doctor Neuhof. Bronchoscopy by Doctor Yankauer revealed much pus coming from the dilated right lower bronchus. The patient was prepared for operation. Blood-pressure 115–84. Operation September 26, 1921, Doctor Branower anæsthetizing (intrapharyngeal) with gas, oxygen and ether and Doctor Neuhof assisting at the wound. The patient was given sodium citrate intramuscularly.

Procedure.—A long sixth interspace incision with resection of the seventh rib was made. The entire lower half of the chest was filled with adhesions, obliterating the pleural cavity. Orientation was effected with difficulty and the right lower diseased and shrunken lobe, the size of a small orange, was resected beyond numerous transfixing ligatures. On section the pedicle showed greatly dilated bronchi. The patient's condition being excellent and only a moderate loss of blood having occurred, a further exploration was made, when a cavity containing pus and sebaceous material with hair was opened. It was fully the size of a lemon and contained a large nipple-like mass of embryonal skin attached to the mediastinal region. This was cut away beyond ligatures, the cavity packed with

iodoformized gauze and the usual drainage of the stump accomplished. There was no danger of mediastinal flapping because of numerous adhesions.

Post-operative Course.—The operation lasted fifty minutes and the patient's condition at its termination was encouraging. Pulse-rate 120; fair quality. I felt that I had every reason to hope for a recovery. As soon as the patient was transferred to the stretcher, however, there was sudden collapse with weakness of the pulse, and, although she regained consciousness, had no pain and was able to drink water, she died of shock ten hours after the conclusion of the operation.

CASE XXXI.—*Bronchiectatic Lung Abscess; Middle and Lower Lobes—Major Thoracotomy and Exploration.* Charles J., Hospital No. 197,461, thirty-seven years old, was admitted to Mount Sinai Hospital December 21, 1919. About a month before had been operated upon for gastric ulcer and appendicitis and there supervened pneumonia with hiccough. Then came cough, bloody sputum and pain in right chest. Loss of sixteen pounds. Night sweats, etc. Physical examination showed dulness in right chest posteriorly with diminished voice and breathing. Blood showed 10,000 white cells and ninety-two per cent. polymorphonuclears. Fluoroscopy showed limitation of movements of the right diaphragm and the plate was interpreted as pneumonia of right lower lobe. Bronchoscopy by Doctor Yankauer showed mucopus from the middle lobe bronchus and from second branch lower lobe bronchus. Lavage was done once, but patient refused further bronchoscopical treatment. In spite of treatment under Doctor Manges, disease progressed and exploration with probable lobectomy was decided upon.

February 16, 1920, at first-stage operation, upper lobe found free but dense indurated mediastinal portions of middle and lower lobes were seen. Diseased lobes partly mobilized and upper lobe prepared by gauze packings for second stage.

Second stage never performed because of poor reaction following first stage. Procedure was difficult and one and one-quarter hours were consumed. After operation there was severe shock. Thirty hours later citrate transfusion of 400 c.c. of blood. Three days after operation the wound was reopened. Convalescence was slow. There was much foul discharge but patient gradually recovered, the large wound filling by granulation. About two months after operation patient was discharged still unhealed, but there was final recovery, and he is apparently well at this writing.

HISTORICAL SUMMARY

Gluck, Schmid, Block, Biondi successfully extirpated lung experimentally about 1884.

Stretton, Tuffier, Doyen, Lowson, Sonnenburg and McEwen resected lung for tuberculosis. (Recovery.)

Lowson removed successfully a tuberculous lung apex the size of "half a fist."

Tuffier delivered a lung apex through an intercostal incision and removed a portion of it experimentally.

Doyen resected the remains of a right lower lobe in which a large hydatid cyst had previously been drained.

Garré excised a lower lobe for bronchiectasis by first resecting a sufficient number of ribs to cause a caving in of chest wall sufficient to permit the delivering of the lobe and extrathoracic treatment of the stump at a subsequent operation.

TABLE OF CASES*

(Pathology by Dr. Aschner)

No.	Name	Age	Sex	Cause	Location of lesion	Type of operation	Pathological anatomy	Complicating pathology	Result	Remarks
1	Mrs. E. M. B. ..	33	F	Post-tonsillectomy infection	Middle lobe	One stage lobectomy	Bronchiectatic abscess	Pneumonitis	Well	1000 c.c. of mucopus per day
2	Mrs. C. M.....	28	F	Post-tonsillectomy infection	Upper left lobe	One stage resection of lobe	Bronchiectatic abscess	Pneumonitis	Well	Has gone through severe typhoid fever without lung complications
3	W. A. B.	26	M	Post-tonsillectomy infection	Right lung	One stage sub-total pneumectomy	Bronchiectatic abscess	Pneumonitis interstitial	Well	Patient has apparently permanent incomplete pneumothorax and wears a small tube to prevent recurrent empyema. No symptoms
4	Miss S. K.....	16	F	Post-tonsillectomy infection	Right lower lobe	Two stage lobectomy	Bronchiectatic abscess	Pneumonitis interstitial	Death	Shock
5	Miss E. B.	33	F	Post-tonsillectomy infection	Middle & upper lobes	One stage single lobectomy	Bronchiectatic abscess	Pneumonitis	Death	Shock
6	Miss J. K.....	32	F	Post-tonsillectomy infection	Right upper and lower lobes	One stage resection of lower lobe	Bronchiectatic abscess	Pneumonitis	Death	Shock
7	Sylvia M.	8½	F	Post-tonsillectomy infection	Right upper lobe	One stage lobectomy	Bronchiectatic abscess	Pneumonitis interstitial	Well	Is studying fancy dancing
8	Rose F.	12	F	Post-tonsillectomy infection	Right lung	One stage pneumectomy	Bronchiectatic abscess	Pneumonitis interstitial	Death	Œdema of opposite lung. See series of radiographic pictures illustrating progress of disease
9	Mrs. J. P.	30	F	Post-tonsillectomy infection	Both left lobes	One stage partial lobe resection	Bronchiectatic abscess	———	Death	Shock. Case actually inoperable because of dense adhesions from previous attempted drainage
10	Miss M. V.	14	F	Post-tonsillectomy infection	Right lower lobe	Two stage lobectomy	Bronchiectatic abscess	Pneumonitis interstitial	Well	Studies fancy dancing
11	Gertrude K.....	8	F	Post-tonsillectomy infection	Left lung	Two stage total pneumectomy	Suppurative pneumonitis	———	Death	Septic infection diorrhea. Death 13 days postoperative from hemorrhage from stump
12	Abraham G.	8	M	Post-tonsillectomy infection	Left upper lobe	Major thoracotomy and exploration	———	———	Improvement	Relapse and bronchial fistula; again in hospital
13	Jacob S.	36	M	Unknown	Right lower lobe and part of upper lobe	Attempted extirpation	———	———	Death	———
14	David J.	16	M	Unknown	Middle lobe and part of adjoining lobes	One stage resection of middle lobe and part of adjoining lobes	Suppurative pneumonitis	———	Well	Followed for two years
15	Jacob K.	5	M	Unknown	Right lower lobe	One stage lobectomy	Suppurative pneumonitis	Abscesses	Death	Death probably due to mediastinal flapping
16	Joseph S.	25	M	Unknown	Right lower lobe	One stage lobectomy	Bronchiectasis	Pneumonitis	Death	Death probably from cerebral metastasis
17	Charles G.....	37	M	Unknown	Right lower and middle lobes	First stage of lobectomy	———	———	Death	Septic pneumonia
18	Fannie B.	16	F	Unknown	Left lower and part of upper lobe	One stage lobectomy left lower and part of upper lobes	Bronchiectasis	———	Well	———

19	Mrs. A. M.	26	F	Unknown	Left lower lobe	One stage lobectomy	Bronchiectasis	————	Death	Death probably due to visceral sprue
20	Morris U.	42	M	Aspiration (?) epilepsy	Right lower and middle lobes	Two stage attempted lobectomy	————	————	Death	X-ray failed to show disease in other lung; revealed by post-mortem. No bronchoscopy because of epilepsy
21	J. M. W.	23	M	Congenital (?) later infected	Left lower lobe	Two stage lobectomy	Bronchiectasis	————	Still some cough and expectoration	Case of transposition of viscera
22	Miss Josephine E.	18	F	Unknown	Left lower lobe	One stage lobectomy	Bronchiectasis	————	Convalescent	Nearly well
23	Max L.	16	M	Unknown	Right lower lobe	First stage of lobectomy	————	————	Death	Cardiac failure
24	Francis W.	3¾	M	Foreign body	Right lower lobe	One stage lobectomy	Bronchiectasis	Pneumonitis	Well	————
25	Lawrence F. ...	8	M	Chronic suppurative pneumonia	Right lower lobe	One stage lobectomy	Suppurative pneumonitis	Miliary abscesses, large bronchi slightly dilated	Well	————
26	Sarah G.	6½	F	Whooping-cough pneumonia	Right upper and lower lobes	One stage lobectomy (2 lobes)	Bronchiectasis	Pneumonitis	Death	Immediate cause of death fall from bed with tearing loose of traction ligature between lung and chest wall
27	Joe S.	28	M	Pneumonia	Lower left lobe	One stage lobectomy	Suppurative pneumonitis	Abscesses	Death	Death probably from pneumonia of opposite side
28	K. G.	32	M	Post-influenza infection	Right upper lobe	Two stage lobectomy	Bronchiectasis	Pneumonitis and bronchial abscesses	Death	Anaërobic infection of wound; death from sepsis
29	Gussie P.	12	F	Probably congenital, later infected	Right middle and lower lobes	Extirpation of lower and middle lobes —two stages	Bronchiectasis	Suppurative broncho-pneumonia	Death	Death with temperature to 108 soon after citrate transfusion
30	Miss E. R.	30	F	Infected mediastinal dermoid cyst	Right lower lobe	One stage lobectomy	Bronchiectasis	Suppurative broncho-pneumonia	Death	Shock. Had diagnosis been made drainage of cyst should have preceded lobectomy
31	Charles J.	37	M	Post-operative aspiration pneumonia	Right middle and lower lobes	First stage of lobectomy	————	————	Apparently well	Second stage not performed because of dangerous reaction following first stage

* For conscience's sake I will mention here one case which is not included in the table because it was a mere exploration, not even an intended lobectomy. It is given here to round out every bit of personal operative experience with this disease which I have had in the period covered by this paper. The patient was a soldier in France who following a mouth operation developed an acute gangrene of the right upper lobe. I exposed the lobe by thoracotomy and the patient expired on the table. It was not a true bronchiectatic case because only a few days had elapsed since his infection.

Heidenhain reported a successful removal of left lower lobe for bronchiectasis. Two previous operations had been performed with drainage of several large bronchiectatic cavities. Rib resections had been performed at each of the preliminary operations. Patient remained with bronchial fistula.

Rehn, Bardenheuer, König, Garré, Trendelenburg and others, tumors of chest wall with removal of greater or lesser portions of lung.

Helferich removed two complete lobes. Patient died seventeen hours post-operative.

Murphy: Unsuccessful attempt to resect lung.

Veerhoogen: Partial resection of lower lobe of left lung for a tuberculous cavity in a man of thirty-five. Patient shown six weeks post-operative. No further data.

Gerulanos: Reports Helferich's case in which middle and lower lobe of right lung resected for breast sarcoma.

Stretton resected upper lobe right lung for tuberculosis successfully.

Friederich: In two cases resected left lower lobe for bronchiectasis in a pneumatic chamber. Both patients died five days post-operatively when bronchial stump gave way and they developed a tension pneumothorax.

Müller resected right lower lobe for tuberculosis in a child. Patient died three weeks post-operative.

Körte resected right lower lobe for bronchiectasis successfully in a boy. Boy still alive four years after operation. No further report.

Kümmel resected an entire lung in forty-eight-year-old man for carcinoma. Patient died six days after operation of œdema of the remaining lung.

W. Meyer, in 1914, made the statement that sixteen cases of pneumectomy for bronchiectasis had been reported in the literature, of which eight were cured or improved and eight died.

Robinson: Five cases of pneumectomy for bronchiectasis with one death. All done in several stages.

First stage consists of subperiosteal resection of ribs.

Second stage opens pleura and if conditions are favorable operation may be completed; if not, resection is done in third stage after packing chest at end of second stage.

In a later paper he reports seven cases with three deaths.

Hitzrot extirpated in stages a right lower lobe for suppurative bronchiectasis with lung abscess. Patient was presented at a meeting of the New York Surgical Society, February 11, 1920.