Original Articles.

THERAPEUTIC ARTIFICIAL PNEUMOTHORAX AS ASSOCIATE TREATMENT IN PULMONARY TUBERCULOSIS. A PRELIMINARY REPORT OF SIXTY-TWO CASES.*

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THERAPEUTIC artificial pneumothorax consists of the introduction of a sterile gas under pressure, into the pleural cavity, for the purpose of establishing and maintaining for an indefinite period a complete or partial collapse of an infected lung.

The principal results following the immobilization of a tuberculous joint, and the sudden reversal of the prognosis in certain advanced cases of pulmonary tuberculosis following the accumulation of a pleural exudate, are well known. Coincident with the accumulation of pleural effusion the cough and expectoration decrease, the temperature slowly returns to normal, and the patient's strength and weight also increase. It has been our practice, until recently, to refrain from removing the fluid unless there were well grounded reasons for so doing. Recently, however, we have been replacing the fluid with sterile nitrogen gas.

Carson, in 1821, proposed inducing pneumothorax as a therapeutic measure in pulmonary tuberculosis. Adams, in 1887, reported a case of advanced pulmonary tuberculosis in which the occurrence of an extensive hemoptysis was controlled by the sudden onset of a spontaneous pneumothorax. He, like Carson, recognized the possibility of establishing a pneumothorax as a therapeutic measure, but did not put it into effect. Forlanini, between 1882 and 1894, experimented on the immobilization of the lung, both on animals and also on human beings. At first he introduced various solutions, but, on account of unfavorable results, he discontinued their use, substituting oxygen and atmospheric air. These, too, however, on account of their rapid absorption, he found to be impracticable. Later, on account of its slow absorbing powers, he substituted nitrogen gas. In 1895, he reported the cure of an advanced unilateral case of pulmonary tuberculosis. This condition, which was at first a spontaneous pneumothorax, was maintained by frequent and prolonged introductions of nitrogen gas.

Murphy, in 1898, reported five instances of unilateral pulmonary tuberculosis treated by

compression of the lung. At the time of the report all had shown improvement, but had been under treatment for only a few weeks. Schell, in 1898, reported a case of profuse hemotysis controlled by inducing pneumothorax. Lemke, in 1899, an associate of Murphy, made a preliminary report of 53 persons treated, but owing to his early death, a subsequent report was not made. In the years intervening between 1901 and 1911, therapeutic artificial pneumothorax was apparently discontinued in this country. Brauer, in 1906, published for the first time his observations on therapeutic artificial pneumothorax. Lapham, Robinson and Floyd, Rothchild, Balboni, King and Mills, Barnes, Hammon and Sloan and others have recently reported a number of patients treated by this method.

The selection of cases for pneumothorax therapy is difficult, and, in our present state of knowledge, it would seem best to limit its application to that class of cases which fail to respond to the usual sanatorium régime; to those of extensive or recurrent hemoptysis and to those which give a bad prognosis irrespective of the stage of the disease. Cases with an active process existing in both lungs are not suited to this treatment. If the treatment is resorted to with patients who are rapidly approaching their termination, the failures will be many and the unpleasant complications which persistently follow will be embarrassing. That unilateral cases, free from adhesions, will afford the best results is attested by all authorities on the subject of artificial pneumothorax therapy; but that its application should be limited to this class is by no means true, because if it were, its usefulness would be extremely limited.

With a few exceptions all our cases are bilateral, and it has been, and is our rule to refrain from establishing at once a complete collapse of one lung where the disease extends beyond the apex in the opposite one. We have felt that its greatest usefulness in these cases lies in relieving the cough, the amount of expectoration, and the toxemia, by restricting the mobility of the more extensively diseased lung, and later, if conditions are favorable, to establish a complete pneumothorax. In other words, it is our experience that if the disease in the untreated side has extended beyond the apex and is moderately active, the compensatory changes following the collapse of the opposite lung increases the activity of the other. In several instances we have witnessed the disappearance of all physical signs of active disease where the disease has been confined to the apex of the untreated side. We credit this change to the diminished cough, and the expectoration and toxemia following the collapse of the more extensively diseased lung.

Our failures are recorded under three headings:—unilateral cases with extensive pleural adhesions, instances where an active process in

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both lungs extended beyond the apices, and cases which are rapidly reaching the terminal stage.

With the majority of patients, percussion, auscultation or the x-ray will determine the area best suited for the introduction of the nitrogen gas. In not a few cases, however, one will be surprised at the simplicity with which the pleural cavity is reached, although the percussion note and respiratory murmur suggest extensive pleural adhesions. On account of the simplicity of the method, we adopted the operation advocated by Forlanini in preference to the more complicated one outlined by Brauer, which is as follows:—Shortly before the operation the patient is given an opiate. The areas to be operated upon having been determined, the arm is extended over the head, and several pads or pillows are placed under the patient's side to separate the intercostal spaces. Then the area is sterilized, cocaineized, and an incision from five to seven centimeters in length is made through the skin, fascia and superficial muscles. The fibres of the intercostal muscles are then separated, exposing the parietal pleura. A dull cannula, with a small opening located upon the side near the point, is then forced through the pleura. A rubber urethral catheter can then be passed through the cannula to palpate the pleural cavity. In this way, one is enabled to determine more accurately the extent of the pleural adhesion if present. When it is determined that the pleural cavity has been reached, and there are no contraindications, nitrogen gas at body temperature is slowly introduced. Brauer advocates introducing from 500 to 1000 c. c. of nitrogen gas at the outset, claiming that it minimizes the danger of perforating the lung tissue during a secondary filling.

Forlanini, without local anesthesia, penetrates the tissues lying in the intercostal space with a small aspirating needle which is attached to an apparatus equipped with a manometer. If the needle is in the pleural cavity, a characteristic manometer reading will follow. The gas is then allowed to flow in. Forlanini introduces from 200 c. c. to 300 c. c. of nitrogen gas at the first sitting and advocates giving small doses at frequent intervals until the lung is completely collapsed. Brauer's operation has many disadvantages, in comparison with the simpler method of Forlanini. It is more complicated and more painful, and cannot be persistently performed several times at the same sitting. It is much easier to obtain the consent of the patient if he is told that the operation is painless and that there will be no unpleasant after effects.

Pleural shock, cardiac dilation, infection, spontaneous pneumothorax, air embolism, pulmonary hemorrhage and recrudescence in the untreated lung are the chief dangers accompanying induced pneumothorax. Floyd cites a fatality in his series caused by pleural shock and cardiac dilation.

Pleural shock comes on suddenly as a rule. We have seen it occur while injecting a solution of novocaine into the pleural cavity, and have witnessed it following the introduction of a small amount of nitrogen gas. The patient complains of a sensation of pressure in the chest near the heart, the pupils dilate, the heart beat becomes rapid and weak, the respiration shallow, cyanosis develops and the patient may become unconscious.

V. Muralt reports a case of pyopneumothorax following Brauer's method, while Hammon and Sloan cite an instance following Forlanini's method. Hemoptysis may occur if the needle is introduced into the lung tissue during manipulation. This happened in one of our cases. We have, in several other instances, punctured the lung but have not caused blood spitting, nor have we had an infection of the pleura follow. Keller and V. Muralt report cases in which a spontaneous pneumothorax followed the secondary filling. This occurred in one instance in our series (Case 9021), and, following a recent secondary filling, it ended fatally.

The possibility of sudden death being caused by air embolism can best be described by relating the experiences of Brauer. While he was giving a second filling the patient suddenly moved. At first there was a feeling of severe pain, following which the patient became unconscious. Later hemiplegia developed, and in a few hours he was dead. In another instance in a patient who had received but one treatment, Brauer was unable to get the characteristic manometer reading and, thinking the needle might be occluded, he introduced a small amount of gas. The patient at once became unconscious, and died in a few minutes.

The one infection which occurred in our series came about in this way. We were unable to get the characteristic manometer fluctuation, and slightly withdrew the needle. The manometer still refused to work satisfactorily and, thinking it occluded with a blood clot, we allowed the nitrogen gas to flow in. When a small amount of gas had been introduced, the manometer recorded a decided positive pressure, after which we withdrew the needle. Within a few hours the patient complained of severe pain extending over the anterior chest. Later, extensive redness and swelling of the tissue developed, and in a few days several dermal incisions were made and large amounts of pus were found to be present. There can be but little doubt that the infection was carried from within, and that the needle was in the extra-pleural space when the gas was allowed to flow, spreading the infection throughout the soft tissues.

If the failure of the manometer to work satisfactorily had been regarded, or gas had not been introduced, it is reasonable to suppose that this infection would not have followed, because in all the other instances when we have punc-

tured the lung, with the exception of the slight hemoptysis cited above, no unfavorable complications developed.

If, during the first few injections, the intrathoracic pressure is raised to too high a degree, the gas will escape through the opening made in the parietal pleura by the needle and invade the surrounding tissues, causing surgical emphysema. While this has occurred in several of our cases, we have witnessed it in but one where it caused any marked discomfiture to the patient. In this instance the patient was an emaciated subject, suffering from a complication of ulcerative laryngeal tuberculosis. During the first treatment following the introduction of 800 c. c. of gas, the manometer registered 1+ positive pressure. After the patient had returned to the ward she had a paroxysm of coughing and, within a few hours, the gas had infiltrated the subcutaneous tissue of the chest, neck, face and scalp. The patient suffered from dyspnea, dysphasia and hysteria for several hours. But within a few days the emphysema had entirely disappeared, and the treatment was resumed.

The apparatus used is the one devised by Robinson; the needle the one perfected by Floyd.

Before beginning the operation, the tubing *H* and the instruments are sterilized by being put into a hot 2% lysol solution for twenty minutes, and then passed through 95% alcohol, and finally rinsed in sterile water. The Robinson apparatus is then connected with bottle *L*, which contains a 1-500 bichloride solution, by tubing *N*, at point *M*. Cock *B* is closed, and cocks *C*, *D* and *F* are opened. The gas from tank *K* is

then allowed to wash slowly through the 1-500 bichloride solution in bottle *L*, which in turn displaces the bichloride solution in bottle *E*, forcing it into bottle *G*. At this juncture the valve on tank *K* and cocks marked *C* and *D* are closed. The tubing *N* is then detached, and replaced by tubing *H*, to which is attached needle *J*.

As before mentioned, the site of the puncture is determined by the percussion note, the respiratory murmur, or the x-ray. Unless contraindicated, we have usually chosen the anterior chest in the nipple line on the right, or the anterior axillary line on the left. The site, however, will be governed by conditions present. One must be careful to avoid the proximity of the heart, the root of the lung and cavities. The patient reclines in bed, or on the operating table with several pillows under the chest to separate the intercostal spaces. The skin is then cleansed with benzine, and painted with tincture of iodine by the nurse. The operator, whose hands have been sterilized, places one or more sterile towels about the field of operation, and a sterile solution of 1% novocaine with 1 to 10,000 adrenalin chloride is then injected, first into the derma, then gradually into the underlying tissues until the pleural cavity has been reached.

This can usually be recognized by the lessened resistance of the plunger. After waiting from two to three minutes a small incision is made through the derma, and the needle *J*, which has been attached to the apparatus by the sterile rubber tubing *H*, is then cautiously forced through the tissues until its point has

established itself into the pleural cavity. This can frequently be determined by the consciousness of the lessened resistance afforded, and the ease with which the point of the needle can be moved about. The trocar is then withdrawn, and the cocks *C* and *B*, governing the manometer *A*, which contains 95% alcohol, are opened.

If the needle is free within the pleural cavity, there will be a negative pressure, depending upon the degree of adhesions present. If the opening of the needle is pressing against the visceral pleura, slightly withdrawing it will frequently give the manometer reading. This characteristic negative pressure will not follow if the needle has penetrated the lung, a cavity, entered a bronchus, or has merely encountered the tissues of the chest wall. If there are extensive adhesions present the manometer variations will be extremely limited, and the negative pressure will be slight, or entirely absent. In case the needle has penetrated the lung tissue, entered a bronchus, the variations will be marked, but irregular, and will give a mean pressure of about zero.

If it has been determined that the needle is in the pleural cavity, cock *B* is closed, and cock *D* is opened, allowing the gas to flow in slowly. The rapidity and force of its introduction may be regulated by elevating the bottle *G*, which contains 2000 c.c. of a warm 1-500 bichloride solution, and the amount given computed by reading the scale *I* on bottle *E*, which contains approximately 2000 c.c. of sterile nitrogen gas.

After each 100 or 200 cubic centimeters have been introduced the manometer reading should be taken, and the amount administered regulated accordingly. It has been our practice to regulate the amount given by conditions present, but we have usually limited the amount introduced at the first sitting to 400 c.c. At the outset, introductions are made twice a week until a complete pneumothorax is established, and then the time is extended to one week, two weeks, three weeks, and four weeks respectively. The frequency of injection must depend upon the conditions present, as shown by physical examinations. It is our experience that the interval between injections should at first be every three or four days, and that after the lung has been collapsed the injections should be given at least every four weeks.

In the absence of pleural adhesions the operation is comparatively simple. We have on quite a number of occasions attempted to break up dense adhesions by injecting gas cautiously under moderate water pressure, but, with few exceptions, we have met with failure. In some few instances we have been able to introduce from 50 to 100 c.c. of nitrogen, but the results have been unsatisfactory, and we have discontinued the practice because of the possible serious consequences. As the operation has not caused any discomfort to the patient in the majority of cases, we have frequently made several punctures in search of a free pleural

space. Under constant moderate pressure pleural adhesions occasionally break or stretch sufficiently to permit the formation of a complete pneumothorax. In four instances where pleural effusion has developed, we have removed the fluid and replaced it with sterile nitrogen gas. In the above mentioned cases the results have been satisfactory.

The technique of this operation is the same as that described above for introducing nitrogen gas. The level of the fluid is ascertained by auscultation, percussion, and an exploratory puncture with a glass aspirating syringe. The needle attached to the nitrogen apparatus is then introduced anteriorly through the intercostal space into the pleural cavity, just above the level of the fluid. Then a large needle attached to a vacuum bottle is introduced posteriorly in the sixth interspace, into the pleural cavity. As the fluid is withdrawn the nitrogen gas is introduced slowly, replacing the pleural exudate. The amount of gas administered should be sufficient to give a neutral pressure, as indicated by the manometer. Gas should not be introduced until the manometer gives a negative pressure, and if this does not occur on account of the fluid present, a sufficient amount should be withdrawn to produce it. Rigid technique should be practiced, lest a hydrothorax should be converted into a pyopneumothorax.

We have had but one instance in our series which developed hydrothorax (Case 9381) to any great extent. Two others developed it in a small amount, but not sufficiently for its removal. In both instances it was readily absorbed.

Graetz, Kistler, Langman and Forlanini have made pathological studies of the lung after it had been in a collapsed condition for months. When a complete pneumothorax has been established, the lung is in a firm mass lying close to the spinal column. The increased connective tissue, which is marked, is greatest in the regions where the compression has not been restricted by adhesions. The bronchi and alveoli are sometimes found imbedded in connective tissue. The epithelium of the alveoli is changed and becomes cuboidal or columnar in type. There are capsular formations surrounding old tuberculous foci, and there is a tendency to callous formation in the region of the blood vessels and bronchi.

Of the sixty-two patients treated in our series two were incipient ones, and treatment was given to relieve frequent hemoptysis. The lungs in both instances have been collapsed since April, 1913, and February, 1913, respectively. There has been no recurrence of the hemoptysis, and for the past several months the sputum has been negative to tubercle bacilli. It is our intention to discharge both these patients at an early date. There were thirty-one cases in the moderately advanced stage of the disease, two in which the prognosis was questionable, seventeen unfavorable, and twelve bad. In three

instances the lung was collapsed to relieve hemorrhage and the experiment was successful. The treatment had to be discontinued with two of the patients on account of a recrudescence of the disease in the opposite lung. One developed a severe hemoptysis in the uncollapsed side (Case 8833) and the treatment had to be abandoned. Four had to be discontinued on account of a recrudescence in the opposite lung, in one on account of neurosis, in three because we were unable to introduce a sufficient amount of gas to expect any results. In two instances the treatment was abandoned on account of the occurrence of pleural shock, on both occasions when we attempted to introduce gas the patient became unconscious. The treatment was discontinued in still another case which developed appendicitis. One died following a spontaneous pneumothorax (Case 9021), and the treatment was discontinued in another case on account of adhesions at the base of the opposite lung, causing marked dyspnea.

Of the fifteen remaining patients, five have been discharged and are doing well, three of this number are at present employed about the institution and are working eight hours per day. The treatment is being continued satisfactorily in the remaining ten cases, many of whom are soon to be discharged.

The greatest number of injections made in a given case was 28, the maximum amount given was 1700 c.c., and the minimum amount was 50 c.c., with the exception of the patients suffering from pleural shock. Here, none was given. In the twenty-nine far advanced cases the prognosis was unfavorable in ten, and bad in nineteen. The treatment was discontinued in eight instances on account of recrudescence in the untreated side, four on account of neurosis, ten on account of dense unyielding pleural adhesions. One died of acute cardiac dilation and pulmonary edema. Of the six remaining patients, one has been discharged as arrested and is working in the institution eight hours per day, three are progressing satisfactorily, the treatment was discontinued in another instance on account of pregnancy, and the one remaining is a spontaneous pneumothorax (Case 9529), and the collapsed lung has been maintained by occasional introductions of gas. The greatest number of injections with any one person was 20, the maximum amount introduced was 1600 c.c., and the minimum amount was 50 c.c.

When the results of the treatment are analyzed, it must be understood that in almost every instance the prognosis was not encouraging and was, in most instances, exceedingly bad. Of the sixty-two cases treated, fifty-eight were bilateral and four were unilateral. The treatment was discontinued in thirteen cases on account of dense unyielding pleural adhesions, and in twelve on account of recrudescence of the disease in the untreated side.

The following cases on account of their special interest are summarized:—

CASE 8833. Female, age 22, waitress. Family history negative. Admitted April 29, 1912, classified as incipient. The presumable duration of the disease was six months. Physical examination on admission: general development good, patient well nourished; the intrapulmonary disease is moderately active and confined to the upper portion of the right lung, extending down to the third rib anteriorly, and to the third vertebra posteriorly. Prognosis favorable. During the third week of residence she had several small hemorrhages amounting to six or eight ounces. From this time on, the disease extended rapidly in the right lung and in a few weeks it had infiltrated its upper two-thirds anteriorly and posteriorly. She lost twelve pounds during the next two months, and on August 2, 1912, 1000 c. c. of gas was introduced into the right pleural cavity. Subsequent fillings were made every few days until the lung was collapsed, and then every few weeks. From August until January, 1913, she gained 11 pounds and the cough, expectoration and tubercle bacilli had been absent several months. The last introduction of nitrogen gas was made on January 10. On January 19 she had a pulmonary hemorrhage of about nine ounces, and for several days following had numerous ones, ranging from three to 11 ounces. A physical examination showed the right lung to be completely collapsed but numerous râles were heard at the base of the left. By April the gas in the right chest had, in part, absorbed, a few fine râles could be heard in the apex. The process in the left lung had extended from the base upward, involving the whole lower lobe anteriorly and posteriorly, and the lower portion of the upper lobe anteriorly. The patient was discharged July 1, 1913, as unimproved.

CASE 9021. Male, age 20, clerk. Family history negative. Admitted August 19, 1912, classified as moderately advanced. The presumable duration of the disease was about seven months. Physical examination on admission: general development poor, slightly emaciated; there are a few interstitial changes in the right apex, and scattered infiltrated areas with moderate activity in the upper one-half of the left lung in front and behind. Prognosis unfavorable. During the first two months he failed to gain in weight and his temperature fluctuated from 97.8° F. in the morning to 102.4° F. (rectal) in the evening. The process in the lungs remained about the same. On October 21, 500 c. c. of nitrogen gas was introduced into the left pleural cavity under slight pressure. The day following the temperature dropped to 99.8° F., slowly to rise again to 100.8° F. on the third day. On October 24, 750 c. c. of gas was introduced after which the temperature returned to normal and remained so. On October 30, 650 c.c. of gas was introduced and a pneumothorax was established, with the exception of a small area anteriorly about the second and third interspace, where the lung appeared to be held down by adhesions. The patient began to gain in weight, the cough and expectoration had almost entirely disappeared, and on November 9 the patient was sitting up an hour a day in a reclining chair. In a few weeks he was up and dressed for the day. The treatments were maintained sufficiently often to maintain a complete collapse of the lung. In January, 1913, the physical signs of active disease had entirely disappeared in the right apex, the temperature continued to remain normal, and the patient

was able to go to the dining room to his meals. During the intervening months until July 18, he continued to make satisfactory progress and was on unlimited exercise. On July 14, after a period of one month had elapsed and a treatment had been given, the manometer reading was very limited, tending to be slightly negative. After 150 c. c. of nitrogen had been introduced, a pressure of 4+ was produced. A physical examination showed the lung to be collapsed against the point of adhesions in the second and third interspace near the sternum. Three days following, on the 17th, the patient had a severe coughing spell, and complained of dyspnoea. On the following day the temperature rose suddenly to 104.5° F. (rectal) and the pulse was rapid, 140, and weak. A metallic tinkling was heard all over the left chest extending to the bottom of the right pleural cavity, about four inches from the median line. He grew worse, and died on the night of the 20th. We were unable to obtain a post mortem examination, but the assumption is that the visceral pleura was torn during a paroxysm of coughing, and this resulted in the formation of a valvular pneumothorax. Death was due to shock, cardiac dilation, and pulmonary oedema of the untreated lung.

CASE 8783. Female, age 17, student. Family history negative. Admitted March 25, 1912, classified as moderately advanced. The presumable duration of the disease eight months. Physical examination: general development good, well nourished, color of lips and mucous membrane pale. There is a general infiltration scattered throughout the left lung with moderate activity, the right lung shows an incipient lesion in the extreme apex. Prognosis unfavorable. Sputum positive 6 Gaffky. During the first six months of residence she slowly declined, the cough was marked and troublesome, the expectoration increased, and there was persistent loss in weight. On September 30, 1912, 550 c. c. of nitrogen gas was introduced, under slight pressure, into the left pleural cavity. The lung movement became restricted, the râles fewer, and the breath sounds faint. October 4, the manometer gave a decided negative pressure and 600 c. c. of gas was introduced. The patient's condition afterward was good and the manometer showed that the negative pressure had been greatly reduced. Following the treatment the physical signs were the same as on September 30. Subsequent fillings ranging from 300 to 600 c. c. were given twice weekly for the next three weeks, at the end of which time the lung had completely collapsed. The period between treatments was then extended to one week, two weeks, three weeks, and four weeks respectively. With the exception of the treatment given on the morning of January 10, 1913, at which time 825 c. c. was introduced, the patient stood the operations very well. The physical examination before the introduction of gas on this occasion showed a complete pneumothorax. The manometer reading was negative, and a sufficient amount of gas was introduced to obtain a positive pressure of 4 cm. of alcohol. The patient's condition immediately following was satisfactory. About 2 p. m., she experienced a slight pain in the chest, and in attempting to find relief got out of bed and walked the floor, following which she became short of breath. The respiration ran up to 40 per minute, and she became cyanotic. The heart action was rapid and weak, with a pulse of about 140. The

patient was extremely excited. A subcutaneous injection of morphine sulphate, grs. $\frac{1}{4}$, and atropine sulphate, grs. 1-100, was given, following which the heart quieted down and the respiration became less labored, and less frequent. The temperature, which was at first subnormal, rose to 101° F. Bromides in small doses were given every two or three hours during the night, and on the following morning the respiration had dropped to 24 per minute, the pulse was full and strong, and rated about 120 to the minute. We kept her in bed until the 14th, at which time she got up and went, in a day or two, to the dining room for her meals. This was a distinct evidence of cardiac dilatation brought on by too great an intrathoracic pressure, aggravated by the patient's exercising. On January 20, the pressure was negative and 450 c. c. was introduced, giving a slight positive pressure of about 1 cm. of alcohol. There were no unfavorable symptoms following this and subsequent treatments. The patient from the beginning of the pneumothorax treatment began to gain in weight; the expectoration and cough increased at first, then decreased, and in a short time disappeared altogether. The last injection, 500 c. c., was made on August 13, 1913, and the patient was discharged as an arrested case on the 15th of the following month. On repeated examinations during the last eight months of residence, the sputum was free from tubercle bacilli.

CASE 9094. Male, age 17, student, youngest of nine children. Family history negative. Admitted October 4, 1912, classified as moderately advanced. Physical examination: general development poor, fairly well nourished, net weight on admission 120 pounds. There is an infiltrated area in the upper lobe of the right lung with slight activity, and a general infiltration throughout the upper two-thirds of the left lung with moderate activity. Prognosis unfavorable. Sputum positive 6 Gaffky. During the first month of residence the patient's condition was unchanged, his temperature and pulse irregular. At times the temperature would suddenly rise to 102° F. (rectal), then in a few days slowly drop to normal. The daily maximum pulse rate was 130 beats per minute. His cough was moderate in extent, and the 24-hour amount of sputum was approximately 75 c. c. He had gained but two pounds in weight. On November 8, 1912, 800 c. c. of nitrogen gas was without difficulty introduced, under slight pressure, into the left pleural cavity, in the anterior axillary line. The manometer, which registered a marked negative pressure, was greatly reduced, but did not become neutral. Following the introduction of the gas the râles could be heard faintly, and breath sounds and respiratory excursion was diminished. The patient was transferred to the recovery room. Shortly afterward he complained of severe pain in the left chest, following which he became pale, his pulse fell to 40 and became slow and weak, after which he lost consciousness. Within a few minutes he regained consciousness and one drachm of aromatic spirits of ammonia was given. The pulse returned to normal within the next half hour. The patient was comfortable the following day, the maximum temperature being 101° F. (rectal) and the pulse 124. Within three days the temperature and pulse returned to normal and remained so until his discharge. Another treatment was given on November 20 in which 500 c. c. of gas was introduced without any ill effect. A com-

plete collapse of the lung was brought about on Nov. 22, at which time 600 c. c. were introduced. This complete collapse continued at the time of his leaving the institution, on December 24, with his disease arrested. In all, 26 injections varying from 1250 c. c. to 250 c. c. in amount were administered at different intervals. The last treatment was given on November 31. He had gained 17 pounds in weight and his cough and expectoration had completely disappeared. His sputum, during the last six months of residence, was negative to tubercle bacilli.

CASE 9517. Male, age 27, laborer. One brother died of pulmonary tuberculosis two years ago. Admitted September 6, 1913, classified as moderately advanced. General development poor, poorly nourished and anemic. The disease was confined to the upper two-thirds of the right lung. On October 10, the right chest was found to be larger than the left, and was bulging. Percussion showed that the flatness extended up to the fourth interspace. Over this area the voice and breath sounds were absent, and over all of the left chest there was an exaggerated breathing. A small aspirating needle was introduced into the right chest and 1 c. c. of clear serum was removed. This was found to contain tubercle bacilli. On October 15 the needle attached to the nitrogen apparatus was introduced into the pleural cavity in the mammary line and above the line of flatness. The manometer recorded a positive pressure. A large needle attached to an aspirating bottle was then introduced into the pleural cavity, posteriorly, in the sixth interspace in the mid-scapular line. After a small amount of fluid had been removed the manometer gave a slight negative pressure. Then, slowly 1250 c. c. of gas was introduced and, at the same time, we removed 1200 c. c. of pleuritic fluid. The manometer at this juncture gave a pressure of 10+ and, thinking it too great, we reduced it to 4+. The patient suffered no discomfort or ill effects. There was no alteration of the pulse during the operation, nor was there at any time a tendency to cough. The pneumothorax has been maintained by frequent introductions of gas, and to date, there has been no reaccumulation of the fluid.

CASE 9529. Male, colored, age 30, physician. Family history negative. Presumable duration of disease 15 months. Patient was admitted on September 15, 1913, classified as far advanced. General development good, poorly nourished. Pulse 120, irregular and thready; temperature 103° F. There was a marked bulging of the right side, and on percussion, flatness up to the fourth interspace. By oscultation over the area above, there could be heard a distinct metallic tinkling, the breath sounds were absent and there was a decided hyper-resonant note on percussion. The left lung appeared normal. Diagnosis, hydro-pneumothorax. Seven hundred cubic centimeters of fluid were at once removed, but this did not relieve the patient. His condition remained critical and on October 15, 2400 c. c. of fluid was withdrawn, and 1450 c. c. of nitrogen gas introduced. After this, his temperature dropped one or two degrees, and he was more comfortable. On October 22, 710 c. c. of fluid was withdrawn and 750 c. c. of nitrogen gas was introduced. On November 6, 1200 c. c. of fluid was removed and 1200 c. c. of gas was introduced. On November 24,

we removed 310 c. c. of fluid, but did not introduce nitrogen gas, as it was not considered necessary. Again on December 31, 1150 c. c. of fluid was removed and 600 c. c. of nitrogen gas was introduced, following which the manometer recorded a neutral pressure. The patient's condition is somewhat improved and a complete collapse of the impaired lung is present, but the outlook is unfavorable.

Therapeutic artificial pneumothorax will give the best results when administered to those suffering from unilateral pulmonary tuberculosis free from adhesions. That its application should be confined to this class of patients is by no means true, and if it were, its usefulness would be extremely limited. Bilateral cases in which the active disease in the untreated side is limited to the apex, will, in many instances, show satisfactory improvement after being subjected to this treatment. When the treatment is resorted to where the active disease has extended beyond this point in the untreated side, the results will frequently be unsatisfactory.

The replacing of tuberculous pleural effusion with sterile nitrogen gas will prevent the formation of pleural adhesions and will prevent the reaccumulation of the fluid.

It is our belief that artificial pneumothorax therapy is applicable to a very limited number of advanced cases of pulmonary tuberculosis, and that the best results will follow its careful administration in that class of incipient and moderately advanced patients who fail, after a reasonable length of time, to respond to the older and better known forms of treatment.

THE FUNCTIONS OF A DISPENSARY OR OUT-PATIENT DEPARTMENT.

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IN 1687 the medical profession of London, stirred by the evident amount of unrelieved illness in the growing metropolis, voted, through their official organization, the College of Physicians, that all members should give, without charge, their services to the poor. They transmitted this resolution in due form to the Lord Mayor and Aldermen. At the end of the seventeenth century the drug-shop was more in the foreground of medical treatment than it is today, and, unfortunately for the charitable intentions of the medical brethren of London, the pharmacists of the city were organized as "Apothecaries' Hall," the guild of the trade; and the prices of prescriptions established by the guild were beyond the means of the poor. Although the physicians were prepared to donate their services, Apothecaries' Hall would not reduce its prices. Fifty leading members of the