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William Pepper.**

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A FURTHER CONTRIBUTION

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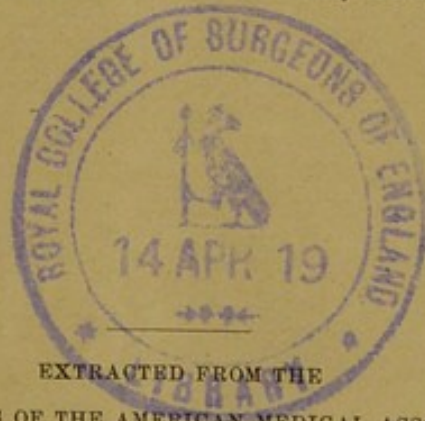
TO THE

LOCAL TREATMENT OF PULMONARY CAVITIES

BY

WILLIAM PEPPER, A.M., M.D.,

Professor of Clinical Medicine in the University of Pennsylvania.



EXTRACTED FROM THE
TRANSACTIONS OF THE AMERICAN MEDICAL ASSOCIATION.

PHILADELPHIA:
COLLINS, PRINTER, 705 JAYNE STREET.
1880.

THE UNIVERSITY OF CHICAGO

PHYSICS DEPARTMENT

PHYSICS 311

LECTURE 10

PROBLEMS

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I HAVE two objects in offering this brief summary of my recent experience in the local treatment of pulmonary cavities. It is, in the first place, desirable that each observer engaged in such an important work as the attempt to effect a radical improvement in any part of our treatment of pulmonary phthisis, should publish fully and promptly the favorable or unfavorable results obtained. Moreover, I promised my highly-esteemed friend Dr. H. H. Smith, Chairman of the Section of Surgery and Anatomy of this Association in 1878, that I would, at that meeting, present this summary of results, in connection with a brief allusion to the local treatment of pulmonary cavities contained in his able address¹ before his Section. Circumstances prevented this, but I have felt as though it were my duty to offer these results to the appropriate Section of the Association at the earliest convenient opportunity.

I may say in advance that, after pursuing the use of intrapulmonary injections assiduously, until their entire harmlessness was demonstrated, and until it seemed to me that the range of their applicability was fairly determined, the attempt has been made to medicate the interior of pulmonary cavities by other means. It is of course well known that frequent efforts have been made to do this successfully. Indeed, considering that it is an established clinical fact that pulmonary cavities do, in a small proportion of cases, result in recovery by contraction and cicatrization; while, on the other hand, the dangers and inconveniences resulting from their presence are so very serious; it is but natural that continuous efforts should be made to learn the most efficient mode of treating them. The chief indications

¹ Trans. Amer. Med. Association, vol. xxix., 1878, p. 205.

that are presented for such treatment are: the disinfection of the contents of the cavity; the modification of the lining surface of the cavity so as to lessen the amount of expectoration, and of irritating and exhausting cough; and the modification of the morbid action in the layer of tissues immediately surrounding the cavity. In attempting to secure these results, medicated liquids have been injected down the larynx and bronchi; brushes or probangs containing some medicated liquid have been passed through the glottis and carried down into the bronchus of the affected side; all forms of inhalation have been used; and, finally, direct operative treatment by incision or puncture has been tried.

The first two of these methods—the introduction of liquids through the larynx and bronchi into the cavity, either by injection or by probang—have apparently been entirely abandoned. Ordinary inhalations, either by an atomizer or by the more simple inhaling tubes or bottles, do not seem capable of producing any positive or lasting effect. There is, however, one form of inhalation, more recently brought into use, that would appear to promise more favorably. I refer to methods of continuous inhalation, by which the patient is enabled to respire continually, by day and by night, an atmosphere charged quite strongly with alterative or disinfectant vapors. Two or three years ago, Dr. W. Roberts, of Manchester, England, described a simple portable “respirator inhaler,” in the form of a metal box perforated in front and behind, and filled loosely with layers of tow on which the inhalation liquid was poured. This inhaler fits over the mouth, and is fixed over the ears like an ordinary respirator. A much more convenient form of apparatus for continuous inhalation has been devised and extensively employed by Dr. H. Curschmann, now of Hamburg. He has used it with great success in cases of putrid expectoration due to chronic bronchitis, and also where there has been destructive disease of the lung accompanied with offensive sputa. In at least one of his two most remarkable cases, I think, however, the physical signs are open to an interpretation different from that which he assigns, and one which renders the recovery of the patient less extraordinary.

I quote the following report of one of these cases: A man aged 53, who had been ill some months with symptoms of phthisis, was admitted under Dr. Curschmann’s care in Nov. 1878, with

dulness, bronchial breathing, and medium-sized moist râles over the lower half of the right lung posteriorly. At one point percussion was tympanitic, and auscultation revealed signs of a cavity, which was proved to be such by tapping and drawing off some of its fetid contents. The patient expectorated about a litre of most intolerably putrid secretion in twenty-four hours. His evening temperature was 39° C., his pulse 112, and he suffered from night-sweats. He was treated throughout with almost continuous inhalations, first of oil of turpentine, and then of pure carbolic acid. In three weeks the sputa were quite free from smell, fever and night-sweats had left him, and he only spat up about one-third of the amount he had done on admission. As in the other case referred to above, there was ultimately extraordinary disappearance of the abnormal physical signs, and the patient gained twenty pounds in weight during his scarcely six months' stay in the hospital. Except a little morphia for the cough at the first, he took no medicine internally—no hypophosphites, no iron, no cod-liver oil. In both cases the successful result can be attributed to nothing except to antiseptic treatment—for such it is—by inhalation.

Since obtaining a supply of Curschmann's respirators from Berlin,¹ I have used continuous inhalation in a certain number of cases. There can be no doubt of its efficacy in destroying the putrid odor of the sputa in some cases of dilated bronchi or pulmonary cavity. It certainly exerts a modifying effect on the bronchial mucous membrane, and may be of material service in the treatment of obstinate bronchitis. I have seen unmistakable benefit from its use in cases of empyema discharging putrid pus through a pulmonary fistula. In cases of extensively diffused chronic catarrhal pneumonia, I have some interesting evidence pointing to the benefit that may possibly be derived from the continuous inhalation of suitable vapors. In cases of true pulmonary cavities, however, apart from the disinfection of their contents, it seems to be unsettled yet how far the condition of the walls can be modified even by this method of inhalation. It appears to be a subject deserving of thorough and prolonged investigation, and I am now engaged in carrying out observations on a number of suitable cases. The mode of using these respirators is very simple. The space between the wire disks

¹ This respirator is figured in the Berliner Klinische Wochenschr. No. 27, 1879, fig. 430; and can be obtained from H. Dunzelt, 22 Schaaren-Strasse, Berlin.

through which the air is respired, is filled with fragments of sponge on which the substances used for inhalation are poured. Those which have so far yielded the most satisfactory results are carbolic acid, creasote, oil of turpentine, a mixture of tincture of iodine and compound tincture of benzoin, and thymol. If care be taken to apply a little cosmoline to the skin where the rim of the inhaler touches the face, and to wipe the rim frequently, no local soreness will be produced. The vapors of these substances, even when dropped on the sponge undiluted, are tolerated with remarkable ease. Some patients become impatient of the constraint of wearing such a mask continuously, but as a rule, a clear explanation of the object in view, and the permission to leave off the respirator for a few hours each day, will overcome all such difficulties.

Admitting, therefore, that as yet, I know of no satisfactory evidence that the healing of pulmonary cavities can be positively favored by any method of inhalation, I will ask your attention to the results of treating such cavities by the direct injection of medicated liquids by means of a small syringe and delicate canulated needle.

In an article that appeared in the *American Journal of the Medical Sciences* for October, 1874, all of the questions connected with this subject were discussed by me at such length that it is now unnecessary to do more than refer briefly to a few points of interest.

In the *first* place, although the idea of opening lung cavities by an incision through the chest-walls is almost as old as Baglivi (possibly much older); still, owing to the very imperfect character of the early clinical records of thoracic diseases, it is difficult to show that such an operation was actually performed before the last century (Barry), or more probably the present one (Hastings and Storks).

Secondly. The idea of conducting continuous treatment of such cavities by local applications made directly through the chest-walls, has been seriously entertained only within the past few years.

Thirdly. That the possibility of penetrating the lung in a state of health with delicate needles without injury, was demonstrated in a few instances by the advocates of acupuncture; and more recently, in the lower animals, by Koch and others. I have myself repeated the experiment a number of times; and before

I ventured to inject iodine into the lung-tissue of the human subject, I made numerous injections of this substance into the lungs of healthy rabbits, which were killed at varying intervals afterwards, so that I was able to satisfy myself that not the least trace of irritation remained.

Fourthly. The operations of Storks and Mosler have shown that lung cavities are very tolerant of external interference, and that they may be cut down upon and opened, canulæ introduced and retained, and various medicinal agents injected in solution or spray (Mosler).

Fifthly. That the observations reported in full in my paper above referred to, have shown that the continuous treatment of lung cavities by repeated injections by means of delicate canulæ (a mode of treatment that had never been suggested until I practised it in February, 1874), may be conducted without severe pain, hemorrhage, traumatic irritation, or interference with internal medication and hygienic measures.

I proceed now to report in brief all of the cases in which this mode of treatment has been employed, in order to establish certain conclusions that would appear to follow.

CASE I. (No. II. in former communication.) John Wilson. Chronic phthisis; cavity at left apex, with disease of the lower lobe; seven injections of iodine into the cavity; temporary improvement in cough and expectoration; pneumonia of right lung from exposure, followed by caseation and softening; death. At the autopsy the *left* lung was much contracted, with dense pleural adhesions. On careful examination of the area through which the punctures had been made, it was impossible to detect any trace of the passage of the needle. A large anfractuous cavity existed in the upper lobe, divided into sacs by several imperfect septa. The various injections had entered the largest and most anterior of these sacs, the lining membrane of which was smooth, shining, and whitish.

CASE II. (No. III. in former communication.) Thomas Peyton. Chronic phthisis, with large circumscribed cavity at the right apex; two injections of iodine, without any unpleasant result, but treatment discontinued on account of nervousness of patient.

CASE III. (No. IV. in former communication.) Chronic phthisis, with large circumscribed cavity at the right apex; incipient disease at the left apex; forty-eight injections of iodine or of carbolic acid in the course of fourteen months.

William Sabin, *æt.* 29. Lame from coxalgia, and with strong hereditary disposition to phthisis, was attacked with cough in August, 1872, and in October had hæmoptysis; he lost flesh and strength, had marked hectic and dyspnœa, with troublesome cough and abundant purulent expectoration.

On physical examination, some roughness of breathing and a few crackling râles at left apex. On the right side tympanitic resonance from the clavicle down to the fifth rib. Cracked-pot sound existed from the second to the fifth rib; over the whole area, tubular or in places cavernous respiration, perfect pectoriloquy and gurgling râles. Unquestionably a large superficial cavity existed in right upper lobe. His treatment had been varied, but the course of the case had been downwards. He was in the Philadelphia Hospital, and during the continuance of the new treatment he remained under the same hygienic conditions. Injections into the lung cavity were begun February 24, 1874, and continued at intervals of about a week (with a break during my summer vacation) until April 11, 1875, a period of fourteen months. Forty-eight injections were given in all. The amount injected varied from $\text{m} \text{iv}$ to $\text{m} \text{l}$; and the composition from three to twenty-five per cent. of Lugol's solution in water, or from two to three per cent. solution of carbolic acid. An aspirating pump was attached to the canula when the first few punctures were made, and on one occasion, a few drachms of blood flowed into the vacuum; but this never recurred, and the operation never caused any unfavorable symptoms. There were fluctuations in his symptoms, but on the whole his condition improved very decidedly. He gained in weight; the hectic fever ceased; cough and expectoration became comparatively trifling; dyspnœa diminished notably, and he became able to take much more exercise, walking over a mile at a time, and spending the greater part of every fine day out of doors, instead of being confined exclusively to the ward as he had previously been. During this period of fourteen months, marked changes occurred in the physical signs. There was little or no extension of the disease in the left lung. The right side underwent progressive contraction; the heart was

drawn over towards the right; and the signs of cavity grew more and more circumscribed, and less distinct.

Additional proof of the progressive contraction of the right lung and of the closure of the cavity was given by the fact that whereas at first it was perfectly easy to introduce the needle to a depth of two inches, to move its point about freely, and to inject f3j of liquid, it became more and more difficult to make the injections, as the point of the needle became imbedded in dense tissue and the introduction of even a few drops of liquid met with very great resistance. The point of injection was repeatedly varied, so as to make sure that the above change was not the result of mere local thickening. By May, 1875, his cough and expectoration had almost entirely ceased, and he was discharged in an improved state of health to go to a Home for Consumptives in Boston. A few months after arriving there, signs of renal and hepatic disease appeared, and death occurred early in 1876 from ascites. Through the kindness of his physicians I secured the lungs. The left one was emphysematous and enlarged, with a limited amount of inactive disease at the apex. The upper and middle lobes of the right lung were reduced to less than one-third their normal size, and were for the most part converted into tough, non-crepitant, fibro-cellular tissue. On section, a small irregularly-shaped cavity, not more than two-thirds of an inch in its greatest diameter, was found in the anterior part of the lung, involving both the upper and middle lobes. Its surface was trabeculated, and covered with a smooth organized membrane. It was surrounded by a dense, fibrous, darkly-pigmented wall, which presented only a few indistinctly-marked streaks to indicate the lines along which the needle had been so frequently passed. Unquestionably all of the injections had entered the cavity; and it was impossible to avoid the conclusion that they had been instrumental in aiding the remarkable contraction and cicatrization of the large cavity that had occurred. Microscopic examination, conducted by Prof. James Tyson, showed that the condition of the wall surrounding the contracted cavity was one of interstitial inflammation, the alveoli being compressed and for the most part empty. The liver was displaced upwards, encroaching on the right thorax, so as to take the place of the retracted lung; and it, as well as the kidneys, was considerably enlarged. No special examination was made, but probably there was albuminous degeneration.

In this very unfavorable case there can, I think, be no doubt that the pulmonary injections were not only harmless, but positively beneficial.

CASE IV. (No. V. in former communication.) Chronic phthisis of right lung, with large cavity at the apex; smaller cavity in lower lobe behind. Twenty-five injections of iodine. Relief of symptoms, and temporary improvement. Death from acute tuberculosis of left lung. Autopsy.

James Hill, æt. 27, with hereditary tendency to phthisis, began to cough in April, 1872, and first spat blood in following July. Subsequently he lost flesh and strength, had several hemorrhages, and was admitted to the Philadelphia Hospital in November, 1873. Physical examination showed contraction and impaired mobility of the right side of the thorax, with large cavity with thick walls at the right apex. Evidently marked pleural thickening over remainder of the lung, with some induration of its tissue. The heart was displaced towards the right. The left lung was hypertrophous and apparently healthy. No improvement showed itself between November and the March following, when the first injection was made. Twenty-five injections of dilute Lugol's solution (7 to 30 minims, 14 to 20 per cent. strength) were made between March 8 and Oct. 26, without the occurrence of even the least unfavorable symptom. Marked improvement in cough and amount of expectoration showed itself; and the physical signs indicated progressive contraction of the cavity at the apex. His general symptoms also improved, and he became able to take more out-door exercise. During the summer he continued in the hospital, and was attacked during my absence on vacation with severe purpura and diarrhœa. This was followed by signs of breaking down of lung tissue at the posterior part of right lower lobe, and about the close of October a rapid development of acute tuberculosis with pneumonia of the left lung occurred, and proved quickly fatal. Post-mortem examination showed that the body was still fairly nourished, with a good deal of subcutaneous fat. The right lung was small and contracted, being reduced to about one-half its size. Its tissue was thickened throughout. Over the anterior face of the upper lobe, opposite the second interspace where all the injections had been made, the pleura was greatly thickened, and on cutting into the lung a small cavity was found, with smooth lining membrane, com-

municating with a bronchus. The tissue around this cavity was very dense and tough, and undoubtedly marked contraction with diminution in the size of the cavity had occurred since he came under observation. No trace of the punctures remained. The lower lobe presented a small cavity in the posterior part. The left lung contained disseminated tubercles in upper lobe, with recent pleuro-pneumonia of the lower lobe.

In this case, as in the previous one, the prognosis was rendered unfavorable by the large size of the cavity and the implication of the rest of the lung, as well as by the hereditary predisposition of the patient, the frequent recurrence of hemorrhage, and the marked emaciation, dyspnoea, and prostration. On the other hand, the tendency of the disease to assume a fibroid form indicated a slow course. Until the severe failure of general health, with purpura and diarrhoea, occurring during the intense heat of midsummer, the course of the case had been for a number of months exceptionally favorable. Subsequently, the dyscrasia of the system showed itself by the breaking down of a new spot of lung tissue, and by the development of acute tubercular formation in the opposite lung. So far as the condition of the original cavity was concerned, it may be confidently stated that the injections not only were harmless while they seemed to afford some relief to the symptoms of irritation, but that they were instrumental in favoring cicatrization and contraction of the cavity.

CASE V. (No. VI. in former communication.) Chronic phthisis: frequent hemorrhage; large cavity at right apex; injections of iodine; marked improvement. The full history of this case is given in my former article,¹ and as the patient passed from under observation soon after the date at which that was published, it is not necessary to reproduce it here.

The patient was 43 years old, with hereditary tendency to phthisis, and had presented symptoms of serious lung trouble for over three years. There was a large superficial cavity at the right apex, with a healthy state of the lower part of that lung: at left apex, there were signs of slight catarrhal trouble. Sixteen injections of iodine (℥xv to xxx; 10 to 20 per cent. Lugol's sol.) were made between April 9th and August 17th; during which time he took also cod-liver oil, and two ounces of whiskey

¹ Amer. Journ. Med. Sciences, Oct. 1874.

daily. He gained steadily in flesh and strength, and by the latter date was able to walk five miles a day without fatigue. The cough decreased rapidly and finally ceased, as did also the expectoration. At the time he left the hospital, August 19th, his general appearance was excellent; his appetite and digestion were good; he had gained from twelve to fifteen pounds. The physical signs indicated positive improvement in the condition of the right apex.

CASE VI. *Chronic phthisis: large cavity at right apex; disease of the lower portion of the lung; steady decline under general treatment; thirty injections of iodine; marked relief and temporary improvement. Subsequently, change of climate, dysentery, rapid decline, and death. Autopsy.*

Mr. L. had presented symptoms of phthisis for eighteen months, and under judicious general treatment had steadily failed, came under my care April 3, 1874. Cough very troublesome; sputa abundant. Physical examination showed a large superficial cavity in upper lobe of right lung. There were also patches of consolidation with beginning softening through the lower portion of the same lung. Dyspnœa marked and weakness extreme. He continued to take cod-liver oil and syr. ferri iodidi alternately. Thirty injections of iodine (℥x to 1 of a solution of ten to twenty per cent. Lugol's solution of iodine) were made into the cavity between Sept. 23, 1874, and April 19, 1875. No unpleasant symptoms followed in any single instance. The entrance of the injection was frequently proved by a strong taste of iodine in the mouth. During this time he improved slowly. On March 23, 1875, the following note was taken: much less cough and expectoration; appetite and digestion good; walks three or four miles every fine day; better than he was one year ago; no hectic; progressive contraction of the right chest, with drawing of the heart to the right, and evident contraction of the cavity in upper and middle lobes. No further injections were used. He went to the country about May 1st, but returned in August, feeling less well, with marked impairment of digestion from improper food. This was corrected with difficulty, and Nov. 1st he started for San Antonio, Texas, in good condition; the physical signs about the same. He was seized with dysentery, however, and never regained what he lost, but returned home in a greatly exhausted condition with chronic

dysentery and died Sept. 1, 1876. During the last two months of his life signs of scattered centres of disease in the left lung were noticed. Post-mortem showed some tuberculous nodules in the left lung. The heart was displaced towards the right, so that the right auricle was above and outside of the right nipple. The apex must have pulsated just at the right edge of the sternum. The right lung was bound down by dense fibrous pleural adhesions, which required to be cut. No trace of the punctures remained. The lung was very greatly contracted in all its dimensions. There were the remains of a huge cavity which had occupied the centre of the upper and middle lobes, but which was evidently much reduced in size by the contraction of the lung tissue; it had a smooth polished lining, with many trabeculæ and sacculations. The pulmonary structure surrounding it formed a wall half an inch or more in thickness; it was everywhere dense and fibrous, but especially so in the region of the injections where it had undergone advanced fibrous change. No evidence of fresh action in the right lung. I think it would be safe to say that in this case the relief afforded to distressing symptoms, and the improvement in the general condition during the continuance of the injections were marked; while the progressive change in the physical signs, confirmed later by the post-mortem examination, made it appear that the injections aided in causing contraction of the cavity.

CASE VII. Barney McDade, æt. 46, had been under observation for a number of years with fibroid phthisis of the right lung. This was deeply seated in the upper lobe, with extreme contraction of the side, displacement of the heart, and deviation of the trachea. In 1875, he began to have frequent hemorrhages, marked hectic, etc., and, after failure of usual remedies, two injections of dilute Monsell's solution were made into the right upper lobe. The tissues were found to be so dense, however, that it was difficult to effect the injections, and they were not repeated. At the post-mortem examination, the extremest lesions of fibroid phthisis were found.

CASE VIII. Mary Wiley, æt. 31, a frail, delicate woman, with hereditary tendency to phthisis, and broken down herself by repeated childbirths, came under observation in September, 1877, at the Philadelphia Hospital. Symptoms of phthisis for fourteen

months, several hemorrhages; very troublesome cough, often causing vomiting; fœtid purulent sputa daily; pulse 120; respirations 45; weight 85 pounds, having lost 25 pounds of flesh; appetite so poor that little food and no drugs could be borne. Physical examination showed a very large cavity occupying the upper part of the right lung, with scattered moist râles through the lower part of the lung; left lung apparently healthy. In the hope of relieving paroxysms of cough, injections of dilute Lugol's solution (gtt x to xx; sixteen to twenty-five per cent.) were begun September 30, 1877, and twelve were used before the end of the year. The needle was introduced about one and a half inch; no difficulty whatever was experienced, and no unpleasant symptoms followed in any instance. On the contrary, very positive and decided relief was given. The expectoration diminished, the paroxysms of cough were much relieved, and the pains in the right chest became less severe. About January 1, 1878, she left the hospital to nurse one of her children who had been taken seriously ill. Although too weak to bear any exertion, she devoted herself to the care of her child for almost a month until its death; and then returned to the hospital to resume treatment. She was, however, so utterly exhausted that it was clearly unwise to attempt any such measure, and she sank in the course of a few days. Post-mortem examination showed a very large superficial cavity in the upper part of the right lung, into which the injections had all entered.

CASE IX. Peter Dowley, æt. 37, admitted to the Philadelphia Hospital June 17, 1874. For nine years has had some cough, dyspnœa on exertion, and occasional hæmoptysis, but has worked steadily at his trade as a shoemaker. For the past three years, however, he has been failing, although the symptoms have presented many fluctuations. On admission he looked fairly well, and complained chiefly of the dyspnœa on exertion, and the paroxysms of cough: expectoration was quite copious. Cavity from left clavicle down to the third rib, with consolidation of the lung below that as far down as the sixth rib, anteriorly and posteriorly, over which area fine mucous râles were heard. There were also moist crackling râles over the upper lobe of the right lung, with broncho-vesicular breathing. Injections into the cavity were begun August 17th, and eighteen in all were used, between that date and January 4, 1875. He left the hospital very much

improved, and February 2, 1875, he returned to work. The first eight injections were, dilute Lugol's solution (℥ xx to xxx, twenty to twenty-five per cent.), the others were two per cent. solution of carbolic acid (℥ xx to xxx). No unpleasant symptoms attended any of the injections; and unquestionably they were serviceable in relieving the cough and in lessening the expectoration.

CASE X. A. B., a German, æt. 45, in the Philadelphia Hospital. Had suffered from an injury which had caused marked double lateral curvature of the spine, with contraction of the upper part of the right chest. He had presented the symptoms of chronic phthisis for about two years, and on examination a large superficial cavity was found situated in the upper part of the right lung. There was very little consolidation of the surrounding lung tissue, and no demonstrable disease of the left lung. He had lost about fifteen pounds of flesh, but still had a good appetite. The expectoration was very copious (Oss q. d.) purulent, and quite offensive; the cough was very frequent, and severe paroxysms frequently occurred. Twelve injections into the cavity were used, at first of dilute solution of carbolic acid; later, when the offensive character of the sputa passed away, of dilute solution of iodine. No unpleasant symptoms followed in any instance. Very positive relief was afforded to the cough; the sputa became inoffensive and reduced in amount to one-third or one-quarter of the former quantity; he gained flesh and strength, and was discharged to return to work.

CASE XI. Mr. M., seen in consultation with Dr. T. V. Crandall, æt. 47, with hereditary tendency to phthisis, and always of delicate health. He had catarrhal pneumonia in 1872 and 1874, followed by chronic phthisis of the upper part of right lung. Fistula in ano formed in 1875. His former weight was 160; in 1877 it was only 118. There had been four hemorrhages between April and October, 1877. A circumscribed superficial cavity existed in the right apex; and a few small centres of disease in the lower part of the left lung. His extreme debility, anæmia and emaciation, and the long-standing malnutrition rendered the prognosis eminently unfavorable; but the most careful and judicious treatment, including various forms of inhalation, having failed to relieve the terrible paroxysms of cough,

which very frequently caused vomiting, it was decided to attempt to modify the condition of the surface of the cavity by intra-pulmonary injections. Twenty-five injections in all were given in a period of seven months, from Oct. 1877, to May, 1878. Dilute solution of iodine (twenty to thirty per cent. Lugol's solution) m xx to xxx , was used in each instance. The entrance of the iodine into the cavity was often demonstrated by taste, odor of breath, etc. The injections frequently brought on immediately a paroxysm of cough, which could be allayed by fragments of ice and deodorated tincture of opium. All agreed that the treatment was successful in securing the desired result. The expectoration lessened, and the paroxysms of cough diminished greatly in frequency and severity. Progressive contraction of the right apex occurred, with condensation of the wall of the cavity and decrease in the size of the cavity itself. This was shown by the changes in the physical signs, and by the increasing difficulty in effecting the injections. Different spots of puncture had to be chosen, and finally they became so difficult, that it was decided to abandon them, as they appeared to have accomplished all that could be expected. In consequence of the greatly lessened frequency of vomiting his nutrition improved, and there was some gain in flesh and strength. Unfortunately other centres of disease became active, an attack of catarrhal pneumonia occurred in the lower lobe of the left lung, and he declined quite rapidly subsequently, and died towards the close of 1878. Undoubtedly the use of intra-pulmonary injections both prolonged life and greatly increased comfort in this case; while they exerted a beneficial effect on the lesions at the spot to which they were directed. An autopsy could not be secured.

CASE XII. Mrs. J. D., *æt.* 52, had been a very hard working woman, and had borne many children. Soon after the menopause her health failed, and cough began, and when I first saw her symptoms of chronic phthisis had existed for more than a year. Her general symptoms were very unfavorable, although physical examination showed no disease save at the left apex, where there was a small superficial cavity, with consolidation surrounding and extending as low as the third interspace. Cough was very troublesome, and often induced vomiting, and the expectoration was viscid and muco-purulent. There were marked anæmia, debility, loss of flesh, hectic fever, sweatings, anorexia, and

mental despondency. Careful treatment, including change of climate, having been faithfully tried for many months, without affording relief to the symptoms or checking the progress of the disease, it was decided to use injections into the diseased area. The general symptoms justified a grave prognosis, and especially the fear of constitutional infection and outbreak of the disease in other localities. The result confirmed this apprehension. Fifteen injections were made into the left apex; and the notes of the case record marked relief to the cough, lessening of the expectoration, with evidences of arrested activity of the local disease, and tendency to contraction of the left apex. But ere long tuberculous formation made itself manifest at right apex, and extended rapidly through the lung. Intense cachexia was developed and death occurred. Here, as in Case XI., the local action of the injections was undoubtedly beneficial, but was exerted at too late a stage to secure as much good as might otherwise have been derived.

This comprises all the cases in which I have used injections into pulmonary cavities. Before attempting to sum up the result of the twelve cases, in which a total of 210 injections were made, I will report a few cases where injections were made into areas of partial or complete consolidation, in order to test the applicability of such local treatment to such cases.

CASE I. (No. 1 in former communication.) John Dortt: pneumonic phthisis, with caseous infiltration of entire left lung and secondary tuberculous formations in right upper lobe. The symptoms had lasted only nine months, but patient was sinking very rapidly. Five injections of dilute iodine solution were made in the course of sixteen days into the upper lobe of the consolidated left lung to the depth of one and a half inch. The punctures caused no symptoms whatever. Death occurred five days after last injection. Post-mortem examination showed no trace whatever of passage of needle through the intercostal tissues, nor of the punctures of the lung substance.

CASE II. Charles Johnson, a Swede, æt. 40, was admitted to Philadelphia Hospital Sept. 10, 1874. Symptoms of phthisis had existed for a year; cough, purulent sputa, numerous small hemorrhages: for six months there had been marked dyspnoea, and

rapid loss of flesh and strength. Examination showed a cavity in upper lobe of right lung, with infiltration of the entire lung, and with signs of breaking down of lower lobe in numerous points; also signs of scattered small centres of disease of left lung. Five injections of dilute Lugol's solution, or of two per cent. sol. carbolic acid were made to depth of one inch into right upper lobe between Oct. 1 and Nov. 1, 1874. After two injections pain was complained of, and on one occasion some sense of oppression. There was some apparent trifling relief to cough, but rapid decline continued, and death occurred Jan. 12, 1875. Post-mortem examination verified the diagnosis of the disease, and showed no trace of the injections.

CASE III. *Incipient Catarrhal Phthisis of Left Apex. Three Injections of Iodine.*

Charlotte Cummings, æt. 36, with hereditary tendency to phthisis, came under observation Oct. 10, 1877, with history of cough for five months, hæmoptysis, purulent expectoration, hectic fever, loss of flesh and strength. Physical examination showed marked impairment of resonance at left apex from clavicle down to third rib, with prolonged expiration and numerous fine crackling râles. Atropia, quinia, and paregoric were given. Three injections of dilute Lugol's solution of iodine (25 per cent. ℥x) were made into the first interspace at intervals of about eight days. She complained of some pain, but there was unquestionably relief to the cough, and when she passed from under observation soon after last injection, the râles were not nearly so numerous as previously, and her general condition was greatly improved.

CASE IV. Ellen Morrow, æt. 27, with hereditary tendency to phthisis, has had syphilis, and is of very intemperate habits. She came under observation Sept. 18, 1874, having had cough for two years, and one slight hæmoptysis. She was weak and anæmic, with dyspnœa on exertion. At left apex there were slight depression, lessened mobility, impaired resonance, prolonged expiratory murmur, and numerous crackling râles as far down as third rib. No disease of right lung. During the whole course of her treatment she was in hospital wards, under unfavorable hygienic conditions, and the only medicines administered were cod-liver oil, with occasionally pills of quinia, opium, and

digitalis. Intra-pulmonary injections were begun Oct. 17, 1874, and were continued at intervals of about a week or ten days, for nearly eighteen months. The needle was introduced to a depth of one to one and a half inch at various points in first and second left interspaces. At first ten injections of two per cent. sol. carbolic acid (m̄x to xxxv) were used; for the remainder of the time dilute Lugol's solution of iodine was used. Fully forty-five or fifty injections were used in all. The case was in every respect an unfavorable one, and presented many fluctuations in its course. There was, however, a steady improvement in the physical signs, and by the end of the period named all evidences of active disease in the left lung had subsided. The retraction of the apex had increased, resonance was still impaired, and respiratory murmur was feeble, with prolonged expiration, but no râles could be heard, even on forced inspiration after coughing. She gained flesh and strength; cough and expectoration almost ceased, and she was able to leave the hospital and return to work. During 1876, 1877, 1878, and 1879, she remained fairly well, although she committed occasional excesses. In the latter year, after a severe exposure, she contracted renewed disease of left apex. Owing to unavoidable circumstances no injections have yet been used, although she has been very anxious to resume the treatment, being convinced of its great value to her formerly. When last seen in May, 1880, her general health was good, and the physical signs showed that the lung-tissue, at the left apex, possesses greater power of action than formerly.

CASE V. Mr. Furrows, æt. 48, had suffered some years from chronic catarrhal phthisis, affecting both lungs, and associated with marked atrophous emphysema. The areas of disease were not large, and were much masked. All kinds of treatment proved unavailing to arrest the disease or to relieve the severe coughing and extreme dyspnœa. At his urgent request, eight intra-pulmonary injections of dilute solution of iodine were made, without any unfavorable or unpleasant effect, but with entirely negative results. Post-mortem examination about two months after last injection showed no trace whatever of them.

Having thus given a brief record of all the cases in which I have used intra-pulmonary injections, it remains only to state as succinctly as possible the practical conclusions that seem fairly

deducible. It is unnecessary to describe the mode of making the injections, further than to state that the syringe used is like an ordinary hypodermic one, only with a larger barrel, and a longer and even more delicate needle; that the skin at the point of puncture should be chilled by ice, so as to deaden the sensibility; that the amount of liquid to be injected must be determined by the tolerance of the individual case, the first injection being small in amount, say $\text{m}v$ to x , and subsequent ones larger, $\text{m}xx$ to xxx ; and that the depth to which the needle is to be introduced must be governed by the thickness of the chest-walls and the deep or superficial position of the lesion, varying in different cases from three-fourths of an inch to two inches. The only liquids I have used to any extent have been dilute solutions of iodine and of carbolic acid. The strength of the latter was uniformly two per cent.; while for the iodine, Lugol's solution (the *liq. iodinii comp.*) was used in proportions of one part to from three to twenty parts of water. In a previous communication already referred to, other liquids were suggested as possibly available. Only one of them, dilute Monsell's solution, has been tried, and that but imperfectly in two instances.

It may probably be assumed that the effects of such intrapulmonary injections may be learned from the record of 291 distinct injections, in 17 distinct cases of very varied character.

The dangers that might be feared from their use are: from the effects on the layer of tissue traversed by the needle before reaching the seat of lesion; from the escape of liquid from the lung through the opening made by the needle in the pulmonary pleura; and from hemorrhage from the pulmonary tissue, or from the surface of the cavity. In regard to the first point, it may be stated that, in cases where the cavity is not superficial, no injurious effects whatever have been noticed, whether the intervening layer has been of vesicular structure, of cheesy exudation, or of organized fibro-cellular tissue. In regard to the danger of liquid (blood, pus, softened cheesy exudation) escaping through the minute puncture into the pleural cavity, and exciting inflammation, it may be stated that, while in nearly every case of pulmonary cavity there are adhesions at the point of puncture, all the evidence goes to show that even without such adhesions, not even the most trifling escape of any such liquid actually occurs; or if it does, that it excites only local adhesive inflammation of a rather beneficial and protective character. In regard to the danger of

hemorrhage, I may confidently repeat the opinion formerly expressed after sixty-five injections had been made, that with ordinary care there is no danger of any serious bleeding. In fact, in only a single instance, where the puncture was made with a vacuum (Dieulafoy's aspirating syringe) connected with the canulated needle, has any hemorrhage whatever occurred. Rarely only have the first few sputa expectorated after the puncture been slightly blood-stained. The only unpleasant results that may follow such injections are, paroxysms of cough, and a certain amount of pain, though either of these very rarely occurred to such a degree as to constitute an objection to the mode of treatment. When severe spells of coughing did occur, they yielded to the action of ice held in the mouth, or to a small dose of chlorodyne or deodorized laudanum. The pain caused was, as already stated, rarely bad enough to call for relief; in a few instances where it did, a small dose of morphia hypodermically promptly allayed it.

If it can be shown, then, that such injections are practically free from all danger or serious inconvenience, it remains to be asked what indications present themselves for their use, and to what extent they are capable of meeting these indications.

These questions have, however, been so fully discussed in my previous article on this subject (q. v.), that I shall limit myself here to a bare mention of the different points.

The chief indications that present themselves for treatment in connection with pulmonary cavities, are:—

1. The disinfection of their contents.
2. The relief of cough.
3. The diminution of secretion.
4. The modification of the morbid action of the lining surface of the cavity, so as to favor cicatrization and contraction, and the prevention of infection of the constitution.

In addition to these, it would be desirable to secure free and easy escape of the contents, and to afford rest to the cavity by avoiding the necessity of coughing to discharge the secretions; and by relieving tension of the walls, so as to allow partial collapse of the cavity under atmospheric pressure. When a large canula is introduced and allowed to remain permanently in the cavity—as was done by Storks and more recently by Mosler—the latter objects may be secured to some extent; but

it seems that the very serious traumatic effects of such an operation more than cancel this advantage.

In regard to those first mentioned, however, it appears to me, both from general considerations and from the clinical records I have here submitted, that intra-pulmonary injections are capable of affording material aid in suitable cases.

In but a few of the instances where I have used them were the sputa of such an offensive character as to require the special use of disinfectants. But the injection of a dilute solution of carbolic acid was found to exert a prompt influence in removing fetor where it did exist.

As already stated, the entrance of the liquid into the cavity will occasionally excite a paroxysm of cough, rarely of long duration; but in every instance where this mode of treatment has been pursued, very considerable relief has been afforded to the cough, and the amount of expectoration has become notably diminished. In several cases these results followed in a really surprising degree.

I shall not repeat the lengthy consideration into which I have already entered,¹ as to the possibility of such injections modifying the morbid action on the surface of and in the tissue immediately surrounding a pulmonary cavity; since my object now is merely to call attention to the results of experience in this direction. It seems, then, that in no instance did the passage of the delicate needle excite any injurious or destructive action in the tissue traversed; that the lining membrane of the cavities into which numerous injections had been thrown, presented a highly favorable appearance, indicative of an arrest of ulceration and a marked tendency to reparative action (see particularly Cases Nos. I., III., IV., VI.); and that in a certain number of cases the conditions of the surrounding lung tissue showed clearly not only an arrest of progressive disease, but a marked tendency to the development of fibro-cellular tissue so as to circumscribe the cavity and tend towards its contraction and cicatrization. (See particularly Cases III., IV., VI.)

Finally, it remains only to consider in what cases such injections are applicable and most likely to be of service.

It will of course be understood that it is not assumed that the positive value of this mode of treatment has been definitely determined by the experiences here narrated. But as they are

¹ American Journal of Medical Sciences, October, 1874, p. 324.

sufficiently numerous to serve as the basis of some general deductions, and as their generally favorable character indicates that it is important that further observations shall be conducted, the following suggestions may be briefly stated:—

Cases of single, superficial, and circumscribed cavity with comparatively little surrounding disease, and without implication of the other lung, are best adapted for local treatment by injections.

Cases of cavity, with extensive disease of the surrounding lung or of the other lung, hold out no prospect of permanent benefit from local treatment; but, nevertheless, much relief may be afforded to certain symptoms, as frequent paroxysmal cough connected with efforts to empty the cavity, or fetid expectoration.

In cases of extensive consolidation of lung tissue, there is no good to be expected from injections into the diseased area.

In cases where there is circumscribed partial consolidation—as in the first stage of catarrhal phthisis—which persists obstinately and tends to spread despite the use of other measures (hygienic care, change of climate, suitable internal medication, etc.), or, where the most important of these favorable influences cannot be secured, injections of medicated liquids into the diseased tissue may be tried with propriety.

It will thus be seen that more extended experience has amply confirmed the conclusions reached in 1874.¹

¹ *Loc. cit.*, p. 341.

