TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, December 5, 1898.

The President, J. EWING MEARS, M.D., in the Chair.

EXSTROPHY OF THE BLADDER, PUBIC BONES ABSENT.

DR. DE FOREST WILLARD presented a child, five years of age, who had come under his care on account of complete absence of abdominal and anterior vesical wall, with protrusion of the posterior wall of the bladder. (Fig. 1.) This protruding membrane was deep crimson red, and bled easily upon slight traumatism. The upper margin of the area was a thin bluish-white cicatricial tissue, which cicatrix probably included the umbilicus, as no distinguishable navel was present. The urine appeared to trickle intermittently through three ureteral orifices instead of two; the third point being about one-fourth of an inch above the ordinary right orifice. A distorted, flattened, clubbed epispadic penis was attached below the lower margin of the opening. The scrotum was normal but small; both testicles had descended through the external abdominal rings, but had not reached the bottom of the scrotum.

There was a readily palpated cleft or division of the pubes, but no movement of the pelvic bones. The skiagraph (Fig. 3) shows a deficiency of the pubis fully two inches wide.

The child was otherwise perfect; of good size, well nourished, but was, of course, constantly saturated with urine.

An operation for the relief of this condition was done as follows:

An inverted U-shaped flap was cut from the abdominal wall, beginning from a little outside of the upper right angle of the opening, passing upward as high as the epigastric region,

at which point its flattened apex was cut one-fourth greater than the lateral diameter of the opening, to allow for shrinkage, thence downward, and ending at the outside of the left upper angle. This flap was made very large, so that after it was folded upon itself at its base, with skin surface inward, it might lie over the entire exposed bladder area easily, and require no tension upon the stitches to retain it in place.

A deep undercutting incision was now made around the entire lateral and lower aspects of the opening, except only the central lower portion opposite the median portion of the penis, which area was left as a urethral orifice. This incision extended through healthy skin and fat, and was one-quarter of an inch outside the red margin of the abdominal opening. Into this crevice was tucked the reverted abdominal flap with its raw surface outward.

Fine chromicized catgut stitches were inserted at numerous points, so as to bring the flap in close apposition with the marginal cut. These stitches included the fat and connective tissue of the flap, and caught the under layer of the derm, but did not extend through the epidermis, either in the reverted flap or in the skin surfaces of the abdomen in the marginal incision.

By this process both skin edges were slightly inverted, and the raw surfaces were brought absolutely into apposition, while the fat and connective tissue of the reverted flap lay in apposition, with the fat and connective tissue and skin upon the outer margin of the gaping cleft made by the circumferential incision. As a reinforcement to these sutures, a continued suture was applied secondarily, completely encircling the flap, and turning in more raw tissue in the same manner as a reinforcement stitch in intestinal work. The base of the flap being left as broad as possible, made cornua at the upper angles, which were strongly stitched.

The wide gaping wound made by turning down the flap from the upper abdomen was easily drawn together, even without much undercutting.

The raw face of the reverted flap was next covered by two lateral flaps cut from the skin and subcutaneous connective tissue in the abdominal portion of the pubis and groins, care being taken to avoid the testicles which lay outside of the external rings. These two flaps were placed with their raw surfaces inward, in apposition with the already existing raw flap surface,

FIG. 1. – Case of exstrophy of the bladder, with absence of pubic bones; condition previous to operation.

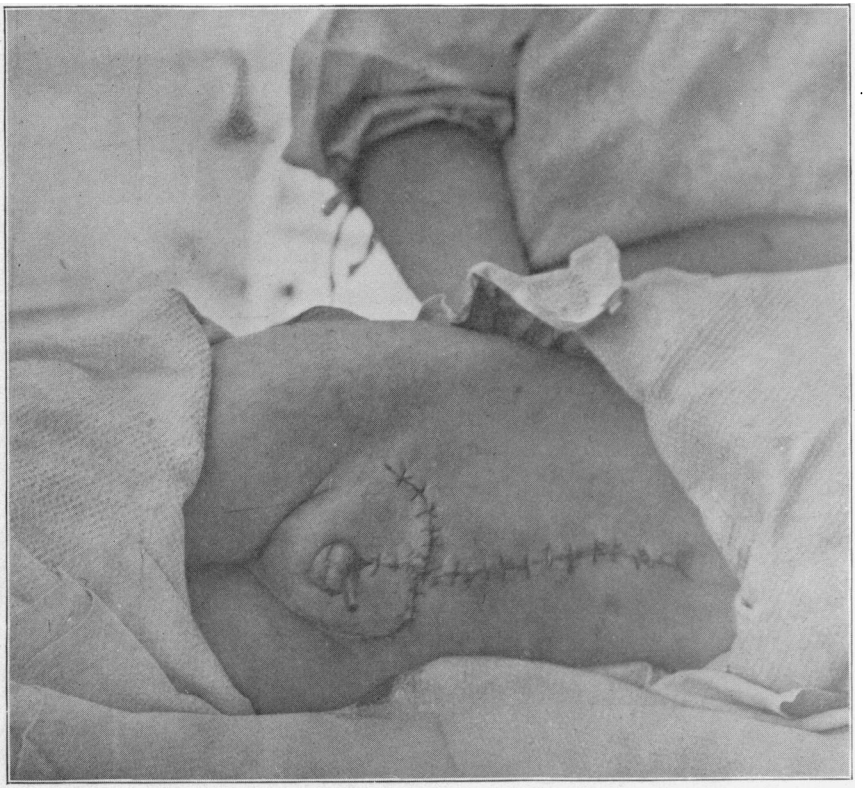

FIG. 2.—Case of exstrophy of the bladder; after plastic operation for its relief.

FIG. 3.—Skiagraph showing separation of the pubic bones in case of exstrophy of the bladder.

and were sutured together at the median line. At their upper and outer aspects they were stitched to the abdominal skin, giving the appearance as shown in the cut. (Fig. 2.) There remained only a small opening for the escape of urine just above the distorted penis at the bottom of the original opening. Into this opening was inserted a soft drainage-tube, which lay along the groove in the upper surface of the epispadic penis.

Sterilized gauze, wet with one-eighth of 1-per-cent. solution of formalin, was kept over the wound, and renewed as often as soiled with urine.

The wounds, constantly soaked with urine, healed slowly, but at no time was there any leakage through the stitch-holes. The drainage-tube was removed after a few days. Union occurred throughout the entire area, even at points where, for the first week, gray patches threatened its safety.

At the present time the opening for exit of the urine, at the base of the penis, is narrowed to one-fourth of an inch in diameter. Further attempts will be made to construct an urethral tube along the upper surface of the penis; should this be secured, a third operation, having for its object the closure of the small aperture at the base of the penis, and the connection of the new bladder to the new urethra will be undertaken. If successful, it will bring the outlet of this reservoir at the tip of the penis.

Two attempts have already been made, but have failed. In the first one, the gutter along the dorsum was deepened by an incision, into which gutter was turned a long, slender flap of preputial skin in order to prevent readhesion. Large flaps were then raised from either side of the penis, and their raw surfaces brought together at the median line by shotted quill suture. Union failed to take place, but the preputial flap, turned in to prevent the reunion of the sides of the deepened gutter, lived.

Two months later another plan was adopted: two longitudinal surfaces, each one-fourth of an inch in width, were denuded along the dorsum of the penis, leaving a central strip of skin tissue in the centre as an urethral floor. Across these raw surfaces was then turned a large flap, cut from the prepuce and lateral skin of the penis, and stitched with its raw face inward along the edges of the bared area. As this distance was less than one-half inch in length, the stitches could be inserted on

both sides. This also failed, but a third attempt will be made as soon as the condition of the tissues will permit.

It is wise never to sacrifice the prepuce until the completion of all operative procedures for this difficulty, since it is often most useful in supplying needed tissue. After final success is attained, the prepuce may be pruned as desirable for cosmetic purposes. The natural tendency of the flattened clubbed penis to assume its original condition makes too much tension upon the flaps if any attempt is made to draw its sides together.

A few words in relation to the question of the formation of a urinary receptacle, or an artificial bladder. Necessarily such a constructed bladder does not yield the results of a muscular contractile organ, and it seems hardly possible that a contractile cavity can be secured. The object of the procedure is rather to secure a receptacle in which the urine may be temporarily stored, from which it can be drained through a narrow orifice into a rubber vessel to be worn constantly upon the person. The special variety of urinal is a question of mechanical adaptation. The skin in such a constructed bladder retains its hair-bulbs, and in cases where capillary growth occurs, it becomes the centre of deposit for urinary salts. Many attempts have been made to secure another route for the ureters, principally transplantation into the rectum or perineum. The latter point, however, does not offer a much more favorable area for the adaptation of a urinal than does the abdomen, save as gravity assists.

The operative closure of the bony pubic cleft, either by the separation of the sacro-iliac articulation, as advised by Trendelenburg, with direct suturing and closure of the soft parts, does not fulfil the indications, and the wounds are specially liable to infection from constant saturation of urine. A new bladder constructed only from the posterior wall surface would be an exceedingly small one. The risks of infection would not seem much greater if the existing posterior wall mucous membrane were dissected free from its circumference, and its freed edges united to form a pouch, without disturbance of the bony structures. Should the peritoneal cavity be opened by this procedure at the thin margin, it could be sutured. The strength of the anterior wall could be fortified by turning in lateral flaps, raw surfaces inward.

The operation of König—osteotomy of the pubic rami—is

open to the same objection of wound infection as is that of sacro-iliac section. The sides of the pelvis, after either of these operations, must necessarily be brought together with considerable force, and the resultant injury to the pelvis in a female would be unjustifiable.

Transplantation of the ureters has for many years been a favorite procedure, the rectum being naturally the receptacle adopted, as the vagina offers but little power of retention. Many experimenters have proved that the rectum resents the urine, but the chief ultimate danger is the infection of the kidneys through the ureters. Recently attempts have been made to improve the technique of the operation, in order to prevent this most serious result. Maydl, Fowler, and others have succeeded to a moderate degree, but many years must elapse before the success of the procedure can be determined. Maydl's plan, which endeavors to retain nature's method of vesical valve-opening of the ureters, consists in transplanting the whole bas fond, together with its ureters, into the rectum bodily.

Other operations, as that of Bignoni, aim to provide a V-shaped valve cut from the anterior wall of the bowel, so that the orifices may be covered by little folds. Fowler very properly criticises Maydl's operation by calling attention to the fact that the conditions in the rectum, even after union is secured, are entirely different from the water-pressure valve as exerted in the bladder upon the lower ends of the ureters. Pisani's operation, of carrying the ureters across the calibre of the rectum and inserting them into the posterior wall, seems to offer no advantage, but, on the contrary, many defects.

Fowler (*American Journal of the Medical Sciences*, March, 1898) has proposed an ingenious method, but whether it will be practicable remains to be determined by experience. With the patient in the Trendelenburg position, he opened the abdomen, secured the ureters at their entrance into the bladder wall, and cut them off obliquely. A longitudinal incision was then made into the anterior wall of the rectum, through serous and muscular coats only; these layers being dissected aside, and retracted by stitches, a diamond-shaped area of submucous tissue was exposed. A tongue-shaped flap, base upward, was then cut through the mucous membrane, opening the calibre of the rectum, which had been previously cleansed. This tongue-flap was then

doubled upon itself so that one-half of its mucous surface presented anteriorly, in which position it was secured by catgut sutures, thus securing a flap-valve covered on both sides with mucous membrane. The ureters were then stitched in the incision with the obliquely cut ends lying upon the presenting mucous membrane surface of the flap, care being taken not to invade the lumen of the ureters with the catgut stitches. The flap-valve, together with the attached ureters, was then pushed into the cavity of the rectum, the wound being closed in such manner as to maintain this flap free within the bowel. The ureters in this closure were made to pass obliquely for a considerable distance in the wall of the bowel, so that the subsequent muscular constriction of the tube would assist in the prevention of infection.

This operation was done more than two years ago, with the result that the rectum would retain the urine for three hours or longer, and that urination and defecation took place independently, the latter occurring only once daily, a fact that would seem to indicate that the sigmoid flexure, or the upper portion of the rectum, as has been otherwise observed, is the ordinary receptacle of fæces. The child, at the time of the report, had not shown evidences of renal disturbance, but the period is too short to determine definite results.

The boy presented for examination by Dr. Willard showed a firm abdominal cicatrix, with a bladder capable of containing several ounces of urine, but there was no control of the flow from the basal opening, save as the stunted penis acted as a sort of valve. Should further attempts at construction of a urethra fail, the application of a truss or pad to this distorted penis might possibly be effectual in converting it into a pad or cork that would close the small existing opening, and permit the boy to empty his bladder at stated intervals, and thus be saved from the misery of constant dribbling.

As he will be entirely incapable of procreation, the question of castration will be considered later, as an element in the prevention of the moral degradation which so often characterizes this class of cases.

CLOSURE OF PERFORATING TYPHOID ULCER.

DR. DE FOREST WILLARD reported the following case:

A Massachusetts soldier was admitted to the Presbyterian Hospital October 30, 1898, under the care of Dr. Musser, with a history of sickness of five days' duration, accompanied by nose-bleed, etc. Temperature 104° F. Frequent baths were given, reducing the temperature to 99°, with variations, the highest point attained being $104\frac{2}{5}$°. Marked distention of abdomen by tympany developed. On the thirteenth day a small hæmorrhage from the bowels occurred, followed by depression of temperature to 99°. On the fifteenth day, at 11 A.M., sharp pain to the right of umbilicus was complained of, followed by rapid weakening of heart-power, dyspnœa, cold sweat, etc. Two hours later the pain in the abdomen was of moderate degree, but persistent. Muscles resistive rather than rigid; this resistance slightly in excess on the right half of abdomen; had vomited once, and was retching occasionally; had just passed a small amount of thin yellow fæces, *without blood.* The abdomen was moderately distended and tympanitic; line of resonance between liver and diaphragm. Temperature 98°, pulse 150, small, feeble, and thready. Voice also feeble.

The question of diagnosis between fresh hæmorrhage and perforation seemed to favor the latter hypothesis. Pain, depression, etc., might follow either accident, but the absence of any blood in the stool, two and one-half hours after the onset, together with the presence of resonance above the liver, were in favor of perforation.

Immediate operation was advised, but during the removal of the man to the operating-room, and the preparation incident thereto, most marked failure in heart volume and in respiration were apparent, and when the operation was commenced the patient was almost *in extremis.* An attempt to save his life, however, seemed justifiable. A rapid incision was made along the right semilunar line. A large amount of greenish-yellow, ill-smelling serum and fæces flowed through the wound. The deeply congested ileum was drawn out, and followed downward towards the right iliac fossa, the most probable point of perforation. Several thin ulcerated portions were passed, but in a few seconds a point four inches above the ileo-cæcal valve was reached from

an opening in which, of size just sufficient to admit a grooved director, oozed yellowish fæcal contents. About this area already were indications of lymph exudation.

Interrupted Lembert silk sutures were introduced, inverting longitudinally the perforation. The extreme thinness of the intestinal walls, with the irregular induration, showed a large ulceration.

A secondary, fortifying, continuous suture was inserted. No other perforations existing above the ileo-cæcal valve, the abdomen was thoroughly flushed with large amounts of hot sterilized water, which, together with the use of oxygen, assisted in partially reviving the patient.

His condition had been throughout the operation most desperate, necessitating rapid work, and absolutely prohibiting the question of evisceration and dry sponging of lymph. A large glass drainage-tube was inserted, and the wound closed. Patient was kept alive by the administration of oxygen, but he died almost immediately after the completion of the dressings. The attempt to save him and the prompt securing of the perforation, within a few minutes after making the incision, rendered the proceeding, however, thoroughly justifiable, although the rapid collapse previous to the operation indicated a positive and speedy death.

The subsequent examination showed that the point had been firmly closed, and had the patient's condition been more favorable, might readily have resulted in saving his life. The intestine showed numerous points of deep ulceration; at the point of perforation a large, ragged, deeply excavated ulceration existed, of irregular shape, at least an inch in diameter. The appendix was normal.

Dr. J. Ewing Mears said that, ten years since, he read a paper at a meeting of the American Surgical Association in Washington, in which, so far as he was able, he collated the number of cases in which cœliotomy had been performed for perforating typhoid ulcer. The cases were four in number, and, in chronological order, were those of Professor Kussmaul, of Strasburg, Mr. T. H. Bartleet, of Birmingham, England, Dr. R. B. Bontecou, of Troy, N. Y., and Dr. T. G. Morton, of Philadelphia. All of these cases were fatal. The conclusions presented in the paper were as follows: First, surgical interference should not be instituted in cases of typhoid fever, in which perforation occurs

when the infective process is at its height. Second, in mild cases of the disease, in which the pyrexia has not been of high grade, and in which perforation occurs at the end of three weeks or later, when the stage of convalescence is fully pronounced, cœliotomy may be performed. Surgical interference, in cases of this character, is advocated with the hope that, if the method suggested by Lucke—cœliotomy with the formation of an artificial anus—be adhered to, success may be accomplished. Third, rapidity in operation would be an essential factor in the achievement of success, through which prolonged exposure of the cavity will be avoided and shock greatly lessened. The perforations having been closed or an artificial anus having been formed, hot antiseptic solutions should be poured in sufficient quantity into the cavity, a glass drainage-tube carried to the floor of the pelvic cavity, and the wound closed. Prolonged "toilet" of the peritoneal cavity, as is generally understood, should not be made while the cavity is opened. Irrigation through the drainage-tube should be made as soon as the cavity is closed, and should be repeated at such intervals as the surgeon may deem proper. Should the patient survive, relief from the artificial anus can be obtained by operation.

DR. WILLIAM J. TAYLOR remarked that in Dr. W. W. Keen's book, on the "Surgical Complications and Sequelæ of Typhoid Fever," there are a number of cases recorded of recoveries after operations. All of these were operated upon within twenty-six hours after the perforation was supposed to have occurred, and nearly all were operated upon within a few hours. No cases recovered that were operated on later than twenty-six hours.

DR. WILLARD said that, of course, the number of recoveries in operative cases following perforation must necessarily be small, because the condition before the operation is generally a desperate one, and most cases are seen when *in extremis*. If the operation is performed within twenty-four hours the percentage of cures will be increased; after twenty-four hours interference seems almost hopeless. This man was operated on between five and six hours after the perforation, and he was dying at the time, —it was only a desperate attempt to save him.

As to the length of time required to find the perforation he made the right lateral incision purposely, so that he could reach

the point of perforation in the quickest possible time. He did not think it was more than two or three minutes after the abdomen was opened before the perforation was found. He struck the ileum about twelve inches above the ileo-cæcal valve, and the perforation was four inches above. He only had eight inches of the ileum to run over, stopping to investigate two or three points of ulceration before this perforation was found. The sutures were inserted and the perforation closed as quickly as possible.

In regard to flushing or the toilet of the abdomen, the time consumed would be just about the same in suturing, or excision, or the formation of an artificial anus, so that the question of time would not enter very seriously as regards to the method.

As to the question of excision of the ulcer. The man was in a desperate condition, as are nearly all these cases. In this case the intestinal wall was exceedingly thin, and in placing the stitches he felt that he was going as closely to the ulcerated mucous membrane as it was possible, and yet only one stitch out of seven or eight interrupted sutures tore out or had to be reinserted. He whipped a continuous suture outside of the first row to roll in more of the bowel and invert this ulcer still farther into the lumen. After the operation all of them were found to be firmly placed, as is shown in the specimens, the ulceration itself dipped there far into the lumen of the bowel.

PENETRATING WOUNDS OF THE THORAX.

Dr. Robert N. Downs, Jr., presented a man, thirty-nine years of age, who, on the evening of October 18, 1898, was brought to the Pennsylvania Hospital, suffering with three stab-wounds of the chest, all on the left side. The upper one was situated in the posterior axillary line, in the eighth interspace, on a level with the nipple. The direction of the thrust was apparently directly inward, as the finger carried in revealed wounded pleura and lung tissue at the same level. The lower wound, from which a piece of omentum was protruding, was located in the ninth interspace and midaxillary line, two inches to the right and six inches below the upper wound.

In addition, there was present a non-penetrating wound, one inch below and behind the upper.

The man was quite shocked on admission. Temperature, 96° F.; pulse, soft and rapid; countenance pale and surface

sweaty. There was, however, but slight external oozing from the wounds, although each respiratory effort was accompanied by rushing of air in and out through the openings.

The abdomen was distended, tense, and dull, especially in the flanks. Dr. R. G. Le Conte saw the case almost immediately, and decided upon operation. The patient was etherized, and an incision made in the median line of the abdomen, above the umbilicus. Upon opening the peritoneum a large quantity of blood, liquid and clotted, escaped. A small portion of bleeding omentum was ligated and excised, and the abdominal cavity flushed out, rapidly filling, however, with blood.

Search for the source of hæmorrhage now revealed a rent of considerable extent in the left segment of the diaphragm, through which the blood was escaping from the thoracic into the abdominal cavity. At this point the patient's condition became so alarming that three quarts of salt solution were quickly transfused into the median basilic vein, and the abdominal incision was closed. An attempt was now made to insert gauze packing into the lower chest wound with hope of controlling bleeding. This was followed by free hæmorrhage through packing and at the same time expectoration of frothy blood, the pack was withdrawn and a fenestrated rubber drainage-tube was then inserted at the upper and brought out at the lower wound where it was secured. Atmospheric air was now rushing into the pleural cavity with each inspiration, and at the same time a large quantity of blood was escaping through the tube. A large antiseptic dressing was now applied and the patient was put to bed. His condition after operation, though precarious, was even better than on admission. Eight hours after operation, though the primary dressing was saturated with blood and some oozing still persisted, his condition was fair. Pulse rapid but of good volume and temperature 100° F. No further hæmoptysis occurred, but some dyspnœa was experienced.

The drainage-tube was removed on the third day after operation, the hæmorrhagic oozing having almost ceased. In the mean time he had steadily improved. Free bowel movement had been secured, and no symptoms of peritonitis had developed.

From this time on, with the exception of a mild purulent pleurisy, developed ten days after operation, accompanied by rise

of temperature and free discharge from chest wounds, his convalescence was unnoteworthy.

Examination of the chest, at the time of presentation, revealed a dulness on percussion over base of left chest behind, less marked when patient turned on his side, accompanied by diminished tactile fremitus and distant breath-sounds.

Dr. Downs also presented a second patient, a colored man, thirty-five years of age, who, on the same day that the first case was admitted, was brought into the receiving ward, suffering with a penetrating stab-wound of the chest, inflicted with a pocket-knife. The blade had severed the costal cartilage of the fourth rib, on the right side, about three-fourths of an inch to the right of its sternal attachment, passing thence into the pleural cavity. The section made by the weapon in passing through the cartilage was complete, and transverse in direction, quite similar in appearance to the wound caused by the costotome when removing a sternum during post-mortem examination.

There existed in addition a punctured wound in the deltoid region of the left arm.

When seen, shortly after admission, the patient was in a condition of collapse. Countenance pale and voice husky. Pulse weak and rapid, extremities pinched and cold, with sub-normal temperature; and in addition, considerable nausea and vomiting. There was, however, no hæmoptysis, and but slight external oozing from the chest wound. On physical examination, as in the first case, atmospheric air could be heard passing into chest with each respiratory effort, and blood also could be seen welling up. The right side, especially on the posterior aspect, was very dull on percussion, with absent breath-sounds. When seen by the chief of the service, Dr. T. G. Morton, his condition was such that any operative procedure was deemed unadvisable. The patient was accordingly placed in the ward, having made his ante-mortem statement before a magistrate, and treated with free stimulation and opium in moderation. His external wounds were closed with catgut and dressed with sterilized gauze.

Twenty-four hours after admission his voice had become more natural, his pulse was comparatively faint but of good volume, temperature slightly elevated, extremities warm and not shrivelled at tips. No further nausea and no external oozing. He complained of soreness in his chest and difficulty in breathing.

In the succeeding forty-eight hours the dyspnœa disappeared, and the patient's general condition was much improved.

He was permitted to be out of bed thirteen days after admission, at which time, though feeling fairly well, the percussion dulness still persisted on the right side, less marked, however, on the anterior aspect. He was discharged from the hospital on the 21st of November.

Physical examination at the present time reveals a dull percussion-note over right posterior chest, amounting to flatness at the base, accompanied by greatly diminished tactile fremitus and weak breath-sounds, which at the base are inaudible.

DR. ROBERT LE CONTE remarked that when a knife or any other sharp instrument penetrates the pleura and wounds the lung, the hæmorrhage is generally profuse, and frequently alarming. The bleeding may take place from the lung, from an intercostal or internal mammary artery, or from both. He had never been able to demonstrate that the intercostal artery was cut. He had never seen it spurt, and he should infer from its protection by the lower border of the rib that it is not often injured, unless the rib also shows marks of violence. The small branch that runs along the upper border of the rib is too insignificant to be of much consequence. That great and alarming hæmorrhage can take place from the lung is well illustrated in a case reported by Dr. J. Chalmers Da Costa a year ago before this society. To be sure, in that case the hæmorrhage was a secondary one; but if it can occur as a secondary result, why not also as a primary one. Hæmorrhage from the lung, as seen by him, is characterized by very dark, almost black, blood. This must be due to a wounding of the branches of the pulmonary artery, the darkest blood in the body, and the escape of the blood before it has a chance to be acted upon by the air. If, however, the blood has collected in the pleura, and been exposed to the air for a short time on account of a pneumothorax, it will be considerably lighter in color. Also, as seen on the dressings, it will present a normal hue, but as it comes from the lung it is darker than ordinary venous blood. Hæmoptysis may or may not be present. In the few cases he had seen it had been absent certainly half the time. When present, the blood is bright in color, as it has had a chance to be well aërated on its passage through the bronchi.

If there is profuse bleeding from a penetrating stab-wound of the chest, and no indications that an intercostal artery has been severed, and the locality of the wound eliminates injury of the internal mammary, one must infer that the hæmorrhage is from the lung itself. In dealing with it some advise the immediate closure of the external wound by suture or a plug of gauze, others the insertion of a drainage-tube with free drainage, and some text-books give both procedures, but do not state why you should use one in preference to the other.

When plugging or immediate suture of the external wound is resorted to, strapping of the chest is also recommended, with the application of cold and the administration of drugs, like ergot, sulphuric acid, etc. The object of closing the wound is to dam up the blood in the pleural cavity, and so, by its mechanical pressure on the lung, stop the hæmorrhage. That many cases have recovered under this line of procedure is well known; but does the hæmorrhage cease on account of this intrapleural pressure? He would answer no. In the first place, the pressure in a lung on forced inspiration is equivalent to about thirty millimetres of mercury, and at expiration its pressure is a negative one of from six to ten millimetres of mercury,—in other words, the tendency for the elastic tissue of the lung to still further contract at expiration is equivalent to from six to ten millimetres of mercury. By strapping the chest one endeavors to prevent the respiratory muscles from acting and to keep the lung in a position of expiration, one in which the intrapleural pressure is negative instead of positive. To be sure, the capacity of the chest is diminished, but it will still be large enough to hold a quart or two of blood before any very considerable pressure will be exerted on the lung. Secondly, when blood is poured into the pleura and the air is excluded, there is little or no tendency for it to clot, and it frequently remains fluid for days or even weeks. Therefore the chances of the cut vessels closing by clot are materially decreased. Thirdly, as the mechanical pressure from the effused blood increases and forces the lung back against its root, it must materially affect the circulation of blood through the lung, and so engorge the right side of the heart and raise the blood-pressure. Therefore, as the mechanical pressure increases the blood-pressure rises also, and, the severed vessels remaining patulous, the gain from the outside pressure is in a measure over-

come by the increased pressure within the vessels. He said in a measure, for the loss of blood would tend to decrease the blood-pressure. By the application of ice to the chest only a very slight effect can be exerted on the lung, and the exhibition of drugs he believed to be useless, and of ergot to be rather harmful. Now when such a case recovers, he does so with a pleura filled with blood. If the blood remains fluid it may be easily aspirated and no harm result. But if clotting takes place before aspiration is tried, a rather formidable operation would be required to remove the clots, and if they are allowed to remain, organization will take place, the pleural cavity will be obliterated, and the lung tightly glued to the chest wall: a condition which certainly impairs the usefulness of the organ and renders it more vulnerable to disease.

In a case in which a bronchus has been opened in addition to a severing of the vessels of the lung, and in which the external wound has been sealed, the hæmorrhage will be much more rapidly controlled, owing to the mechanical pressure of the pneumothorax on the lung, and the blood will readily clot in the presence of the air; an ideal condition for the rapid control of hæmorrhage. But the patient is subjected to the risk of having this mass of blood-clot infected through the opened bronchus, and changing a hæmothorax into a pyothorax. This risk is a very serious one, and one not to be incurred with the hope and a prayer that infection will not take place. Also by closing the external wound the chances of a general emphysema taking place are vastly increased, a complication which is annoying and may be serious.

In cases where a drainage-tube is inserted into the pleural cavity and free drainage established, the pleura is immediately filled with air, and the muscles of respiration are prevented from acting on the lung, allowing the lung to contract by its own elastic tissue as well as by the pressure exerted by the pneumothorax, and at the same time the presence of the air favors clotting in the severed vessels. In his limited experience this simple procedure had been quite sufficient to stop the hæmorrhage. In addition, the drainage has cleared the pleura of blood, and if any infecting material has been carried in, it has reduced its dangers to the minimum. It has been objected that the drainage-tube is itself a menace to the sterility of the wound, but in these

days of asepsis the dangers of infection from this source are very slight. However, if it does occur, it will be limited to the immediate neighborhood of the wound, and cannot be a complication of much seriousness. Another objection, and one of more weight, is the danger from a large and rapidly formed pneumothorax. Quénu, of Paris, experimented on a dozen dogs to find out just what the dangers are in a quickly formed pneumothorax. He states that when a healthy pleura (one without adhesions) is freely opened, the symptoms of heart-failure will be rapid, labored breathings were always present and very alarming, and in one or two instances were sufficient to cause the death of the dog. If the animal did not die, the dangerous symptoms slowly disappeared. Death was undoubtedly due to the sudden engorgement of the right side of the heart, and the dog lost his life because he was strong and full-blooded, and the sudden rise in blood-pressure was sufficient to overcome the heart. Would this objection seriously apply in a man who has lost much blood? He thought not, but if it did, it could readily be controlled by venesection. Further, he could conceive of its being of positive benefit, where the hæmorrhage has been very great and the blood-pressure reduced to its lowest ebb, as a quick and ready means of raising the pressure and tiding the case over until salt solution can be injected into a vein.

If drainage and the admission of air to the pleural sac does not control the hæmorrhage as a last resort, the wound in the lung must be packed or sutured, or the bleeding vessels ligated. This will require the resection of one or more ribs, as a lung cannot be packed unless grasped and held.

Referring to the first case reported by Dr. Downs, his condition was very serious, and he showed the effects of having had great hæmorrhage, yet but little blood was coming from the chest wounds. The lower wound was plugged with omentum, and the blood from the lung was pouring into the abdominal cavity through the cut diaphragm. While searching the abdominal organs for an injury, his pulse rapidly failed, and not finding anything to account for the hæmorrhage, the abdomen was quickly closed and the lung wounds investigated. The hæmorrhage now was very profuse from the pleural cavity, and he was strongly tempted to resect one or two ribs and pack or suture the lung to control it, but he felt death must follow any pro-

longing of the operation, and that the man's best chances of recovery lay in drainage.

DR. DE FOREST WILLARD said that the objections that Dr. Le Conte had urged in regard to closure of the external wound in these cases were certainly valid. Simple closure of the external wound in order to arrest a hæmorrhage, which is separated a considerable distance from this wound, across the pleural cavity which will contain a quart of fluid, certainly does seem a very uncertain procedure. He had, however, been largely influenced against the method of free opening of the chest by a series of experiments which he undertook some years ago on dogs for pneumotomy and pneumectomy, and opening the bronchus for foreign bodies, etc., by the alarming and tremendous collapse of the dog that took place, whenever a free opening was made in the chest. The dyspnœa and the signs of impending death were regulated almost in exact proportion to the size of the opening. If the wound was closed absolutely, the dog began to breathe much easier, would recover again, and the operation could be proceeded with. If partially closed, and the opening was small, the dog improved; if it was left large, he was very apt to die and die speedily. It seemed that the size of the opening increased the amount of pressure upon the lung, interfered with the circulation through the pulmonary arteries and veins, and produced collapse. From these experiments he was led to the conviction that the safest plan was that of closure of the external wound, so far as the immediate results were concerned. In many of these cases, if the hæmorrhage is large, it is the immediate death that is to be averted. The secondary results, hæmothorax and pyothorax, must be met later by surgical measures; opening the chest, then, can be done with safety, as in a case of empyema. As noted in the late war, even perforating wounds of the lung—a very considerable number of them—recovered when no operative interference was instituted and when the wounds were simply closed. The thorax seems to be a cavity which bears blood fairly well. The hæmorrhage frequently does cease under this method of closure, and while the objections are valid, yet in practice the weight of testimony is in favor of the method of closure of the external wound.

DR. J. CHALMERS DA COSTA said that he had been very much struck with the argument that Dr. Le Conte had made

in favor of incision with the introduction of the drainage-tube. The views which he has reached as to the effect of intrapleural pressure are also the views which have been maintained with considerable force by Pagenstecher. A number of cases of wound of the lung have been scientifically studied of late, but there have not been enough cases to emphasize very clearly which treatment we should follow, closure or incision and drainage. It is certain that a number of cases have recovered under both plans of treatment. Surgeons will not be able to determine these points until the records of a large number of cases can be brought together, records in which the general condition has been accurately outlined, and in which the subsequent treatment has been carefully pointed. out We need something in the nature of a collective investigation.

The problem, when should one attempt to suture a lung, is involved in still more obscurity. In the French Congress of Surgeons there was recently a debate upon this question, and great differences of opinion were noted. When one sees a man who seems certain to die without interference, a man in whom the line of hæmorrhage is rapidly rising, and in whom the symptoms of shock are rapidly increasing, he believed that, in spite of the peril which there may be in opening the chest, the common rule of surgery should be applied, an incision should be made, one or two ribs should be resected, and the hæmorrhage should be arrested. He could imagine no more serious harm that could come to a patient than to simply leave this hæmorrhage in the charge of nature.

In some cases bleeding may be arrested by ligature, in others by suture, in others by packing with gauze, in others by fixing the lung with gauze packing, as applying a gauze compress against the bleeding point.

DR. LE CONTE remarked that in his remarks he had in mind only severe hæmorrhage. He did not refer to small punctured wounds of the lung or wounds where the bleeding was not excessive, but to those cases where the hæmorrhage was large, where it was an immediate threat to the patient's life if not stopped. Unless resection of some ribs with packing or suturing of the wounded lung is resorted to, it seemed to him that the first object should be to get pressure on that lung. Air will do this as well as blood in the pleura: it will do it instantly in-

stead of waiting until a sufficient amount of blood has been poured out: it will permit the vessels to close by clots, while the other prevents it: and it will save to the patient the amount of blood necessary to exert mechanical pressure. These are the immediate benefits, and the remote ones are that there are eliminated the dangers of a pyothorax or of universal adhesions of the pleura. The danger of engorgement of the right side of the heart must be slight where the patient has lost much blood. Because it is great in a full-blooded dog is no reason why it should be so in an exsanguine man. The conditions are different, and the cases are not parallel.