In the present case the narrowing of the pylorus appeared to be, to a great extent, due to the contraction of peritoneal adhesions. The trouble may have originated in an injury to the stomach due to the kick from a horse, or may have followed upon a perforating ulcer at the pyloric extremity of the viscus.

TREATMENT OF EMPYEMA BY A VALVULAR TUBE HERMETICALLY SEALED TO THE CHEST.

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IN proceeding to give an account of the principle and mechanism involved in this plan of dealing with empyema, it will simplify my task considerably, as well as shorten the communication which I have to offer on the subject, if I commence by dealing with the consideration of the pathology of a typical case of the disease, and especially with the conditions which determine or have most influence on the ultimate fate of the patient when treated by any of the means hitherto adopted.

Taking an ordinary case, then, the facts are as follows: Chest full of pus, lung collapsed and more or less covered on its surface with effused inflammatory products, which have the usual tendency of such products to become organised into connective tissue and to subsequent contraction; these changes only requiring time, and, when once attained, permanently disabling the lung, as, being bound down in a collapsed state, the function of this organ will remain ever after in more or less complete abeyance. But to return: An opening, we will suppose, is now made in the side; the pus is allowed to drain away through a tube long or short, air enters to displace the pus, and with each act of respiration is plainly heard to rush in and out; a washing, say twice a day, with some antiseptic solution is performed, but the rest of the progress towards recovery, or towards an opposite termination, as the case may be, is left entirely to time, except that sometimes the doubtful expedient of cutting through some of the ribs, with a view of helping the side to collapse, is resorted to. Then comes the question: How does time cure the case? Almost entirely by means of the chest-wall. This, under some influence not very apparent, is gradually forced down on to the immovable lung beneath, until ultimately it is sufficiently collapsed to obliterate the pleural cavity completely, that is, sufficiently to come into touch with the whole of the external surface of the lung; the secretion of pus now ceases, and consequently the opening made to drain it will close. Now, but not until now, with the closure of the opening, and so exclusion of atmospheric pressure, the chest-wall, in its endeavour to regain its former size and shape, gives the lung a helping hand, by attempting to carry it outwards with it. Of course this attempt, or this journey outwards, will be completely successful only where the lung is capable of full expansion, and where the chest itself has not been lamed by having had the ribs cut across in the previous treatment. In other words, then, the success of this endeavour will be almost entirely under the control of the very process which has been allowed to go on all this time undisturbed, namely, the organisation of the inflammatory products which were poured out on the surface of the lung during the initial attack of pleurisy, and, if this process has had time to develop firm adhesions, permanent contraction is the result, and the rule is to have deformed sides in prolonged cases.

Children easily and quickly recover, because their chest-walls, being more pliable than those of adults, more readily fall in; a child's side is soon seen to be greatly contracted; the opening then closes, and afterwards the normal size and shape of the thorax is quickly regained, simply because the lung is not given time to establish firm adhesions; the accommodating chest-wall comes down upon it, or into touch with it, too quickly, and so has afterwards no difficulty in carrying it out with it under atmospheric influence. In adults, however, and especially in the case of elderly people, the process is anything but so simple and favourable, and it is for their benefit especially that the valvular tube which I have devised, and commenced using towards the end of 1887, is recommended. The period taken by their unyielding chests to fall in is so lengthy, that a great proportion of such patients die of the exhaustive drain, or of its effects on other

organs, long before the stages these cases have to pass through are compassed.

The principle of the treatment by my valvular tube is the taking away of the atmospheric pressure from the external surface of the lung while the opening in the chest-wall still remains, and so enabling the organ to fulfil its functions and to fill up its side of the chest from the first, without waiting for any falling in of the side to take place; in other words, to cause the lung to expand at the commencement instead of at the end of the treatment.

The method of carrying out this principle is the following: A rubber tube a yard and a half in length, and of a thickness that will admit of its being introduced through a cannula of the ordinary size used to open empyemas, is taken, and one end is introduced into the chest by this means; over the tube, starting from the free end, is next run up an oval, slightly-curved—concave towards the chest—metal plate or shield, three inches by two inches, having a metal tube half an inch long soldered in a hole in its centre, and projecting on the convex side only; through this the drainage tube passes as the shield is run up to the chest, and they should, of course, fit each other air-tight. Now, between the plate and the chest stiff ointment on dressing, or a layer of soft rubber sheeting, or what not, is placed so as to form an air-tight joint, when the whole is finally firmly strapped down and bandaged. Turning again to the free end of the drainage-tube, we fix on to it by means of a piece of glass tubing a valve that opens outwards, and the contrivance is complete.

Many varieties of valves that answer extremely well are to be found in the rubber trade, and one that does as well as any other, and from which I first got the idea of a suitable valve—though not the first idea of the principle, which I had often thought of before—may be obtained from the air-bag of an ordinary spray-producer; others, again, are made by flattening chisel-shape one end of a short bit of thin rubber tubing.

The valve end of the tube when in use is placed in a bottle containing some antiseptic solution, as the valve acts best in a liquid, and the bottle forms a convenient and cleanly method of dealing with the discharge of pus. Lastly, once or twice each day the valve is removed and the chest washed out by simply elevating and lowering the bottle and changing its contents. It is essential that this should be done often at first, to thin the pus, which is then frequently very thick, presenting while in that state greater difficulties to its expulsion through the valve than when more fluid, and no obstacle should on any account be allowed to cause a postponement of the application of the valve for a single day.

By means of this mechanism the side of the chest acted upon is converted into the cylinder of a pump, of which the diaphragm forms the piston, having two exit openings, trachea and rubber tube, but only one inlet opening, trachea alone; therefore, each time the diaphragm ascends, the contents of the lung and also that of the pleural cavity are expelled; but each time the diaphragm descends only air into the lung can enter the chest; so each quantity of pus that is driven out through the tube during expiration is replaced at the next inspiration by so much re-expanded lung. By a repetition of this action the pleural cavity is ultimately pumped dry, and so the lung is made to reoccupy it; the action is, in fact, that of a continuous aspirator, and that it actually does take place is, I think, without doubt. It can readily be shown to occur under similar conditions by an experiment made with a contrivance consisting of a bottle with an open bottom, to which is attached a diaphragm of india-rubber, and which is closed at the mouth by a cork perforated by two tubes, to one of which is attached a bladder and to the other the valvular tube. Now, when the diaphragm is worked up and down with the hand, it will be seen that the expansion of the imprisoned bladder only takes place when the valve is *in situ*.

But, in addition to this experimental evidence, the following facts are, I think, proofs: At first the tube, if thin, will be seen to collapse during inspiration; again, the patients complain of a drawing sensation, and will often, if not watched, remove the valve, when they obtain immediate relief; lastly, the discharge of pus during the first twenty-four hours is infinitely greater than it is during any subsequent similar period, and with the fall of the discharge to an insignificant quantity the complaints of the drawing action of the valve will also cease to be made.

Of course, during the daily washings, as also during the renewal of the pad or dressings under the shield, the lung collapses somewhat for the time being; this is, however, of no importance.

as the instant the tube and valve are replaced expansion again takes place at once. A difficulty, and of rather a formidable character, did however present itself in my first case. It was found to be impossible to do without the tube; if when the discharge had virtually ceased it was taken out, some collapse at once took place, pus reappeared and increased rapidly in quantity; in fact the case altogether changed its aspect, and it became evident that unless some mode of finally doing without the tube was discovered, there would be no possibility of recovery taking place without some amount of falling in of the side first. When the tube was replaced the previous condition was immediately regained. I was a good deal puzzled by this circumstance, which remained as a real difficulty for some time; the patient, apparently quite well, up and about, carrying the bottle with him in one of his pockets while wearing the instrument, but a very decided invalid without it. Mr. Jackson, who then acted as my house-physician, and to whom great credit is due for the care with which he carried out the details of the treatment, hit upon a plan by which this difficulty was at once overcome. He found that by gradually shortening the end of the tube extending from the shield into the chest, the opening was made to heal out after it, the pleural surface healing first, and the two cases that subsequently underwent this treatment gave little or no trouble in this direction.

Mr. Jackson has contrived a shield which he considers to be an improvement on the one I have described, and also a special trocar and cannula for its application.

The method of introducing the drainage tube through a cannula I first learnt from my colleague, Mr. Paul, who introduced the long rubber tube for empyema into our hospital some years ago, and to which Mr. Jackson had already adapted a metal tube to keep it in position when my plan of making it valvular and hermetically sealing it to the chest was started.

The following three cases, treated as above described, I showed at the Medical Institution on January 31st, 1889:

CASE I.—H. R., aged 29, admitted October 29th, 1887. Right empyema. Valvular tube hermetically sealed to the chest, applied some time after the forty-first day of the disease; the chest was opened on the forty-first day, and drained for some time into antiseptic gauze. Weekly quantity of pus discharged uncertain; the tube remained nearly three months, owing mainly to the difficulty experienced in doing without it. Chest measurements on the day of discharge: right side, 17½ inches; left, 18¼ inches. On his return for examination at the end of a fortnight from the convalescent home, the two sides were found to be equal.

CASE II.—R. B., aged 23, admitted December 9th, 1887. Left empyema. Chest opened and the tube introduced on the fifty-third day of the disease. Discharge: first day, 29 oz.; second day, 18 oz.; third day, 8 oz.; fourth day, 4 oz.; first week, 62 oz.; second week, 23 oz.; third week, 19 oz.; fourth week, 16 oz.; fifth week, 14 oz.; sixth week, 8 oz.; seventh week, 4 oz. It now remained at from 3 to 4 oz. a week for three weeks, then at about 1½ oz. for another four weeks, when scarcely enough to colour the water escaped for two weeks more. Evidently pretty firm adhesions had occurred in this case. Chest measurements on the day of discharge: right side, 16½ in.; left side, 15½ in. On his return at the end of a fortnight for examination, no difference in the sides could be detected.

CASE III.—W. H., aged 54, admitted July 26th, 1888. Left empyema. Chest opened and the tube introduced on the twenty-eighth day of the disease, and remained for eight weeks. Discharge, first day, 94 oz.; first week, 112 oz.; second week, 14 oz.; third week, 6 oz.; fourth week, 5 oz.; fifth week, 1½ oz. Rapidly got well. Evidently no adhesions of any stability had formed in this case. Chest measurements on the day of discharge: 17 in. each side. Weight a week previous to discharge (October 15th), 8 st. 7½ lbs.; at the end of the week, 8 st. 12 lbs.; a month later still, 9 st. 7½ lbs; total gain for five weeks, 14 lbs.

It will be seen that in two of the above cases the tube was worn for a long time, but it must be borne in mind that for at least two-thirds of the time the patients suffered extremely little inconvenience; they gained flesh rapidly, and there was no fever so long as nothing went wrong with the instrument.

A SOCIETY of Neurology and Psychiatry is in course of formation in connection with the University of Moscow, on the initiative of Professor Koshewnikow.

It is now stated that Lord Herschell will be the chairman of the new Vaccination Commission. It is not yet definitively settled who the members of the Commission are to be.

REPORTS TO THE SCIENTIFIC GRANTS COMMITTEE OF THE BRITISH MEDICAL ASSOCIATION.

REPORT ON THE COCA ALKALOIDS.

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(From the Pharmacological Laboratory of Edinburgh University.)

(Continued from p. 1047.)

III. *Cocaine: Action on Frogs: Summary and Criticism of Previous Investigations.*—The results of my experiments with cocaine on frogs have led me to conclusions differing in some respects from those of previous observers, and hence it is necessary to give a very short *résumé* of what has been already done. In the various descriptions we find so many discrepancies, that a suspicion is at once aroused that the investigations have been carried out with widely different substances. As we shall see, there is serious disagreement regarding both the exact symptoms and the dose required to produce them. The statements as to the lethal dose are also much at variance. The earliest experiments with cocaine were made by Schroff²⁶ who used a preparation obtained from Merck; but, from the description given of its physical characters, it does not seem to have been quite pure. Doses of 0.005 to 0.02 gramme were given. The former caused lessening of activity of voluntary movement and respiration; medium doses caused deeper torpor, while after large doses the animal lay as if dead; the heart was much depressed, and death ensued. Stimulation of the central nervous system, muscles, or motor nerves gave no reaction. Schroff regarded cocaine as a narcotic, but he has failed to describe some of the most prominent symptoms in frogs. It may now be concluded with certainty that the substance which he used in his experiments was a mixture of the coca alkaloids, as the lethal dose given (0.02 gramme) is much too small for pure cocaine. The passage in which he describes the action of medium doses on frogs is, perhaps, worth quoting at length:—"One bridge after another which connects the organism with the outer world is broken. The nictitating membrane falls over the eye, the brain shuts itself out from sound, the skin no longer conveys external impressions; all movements, even slight respiration, stop, and only the heart works on quietly and strongly caring for the inner organism. Thus the frog lies, sunk in the deepest ego of a brute soul, left to the calm contemplation of itself." He regards its action as similar to that of Indian hemp, and diametrically opposed to that of caffeine.

F. Jolyet²⁷ obtained a more correct idea of the cocaine action on frogs, and summarises his results in four paragraphs. He found that (1) very small doses of a soluble salt excite sensibility and decrease motility; (2) larger doses cause loss of power over co-ordination of movement, loss of power of movement from one place to another, while sensibility is entirely retained; (3) still larger doses induce diminution and ultimate disappearance of sensibility, the excito-motor power being never lost; and (4) in fractional doses characteristic tetanus is caused.

The most complete account is given by von Anrep.²⁸ He found that what he calls very small doses (1 to 2 milligrammes hydrochlorate of cocaine subcutaneously) had no effect, or sometimes caused a stage of excitement marked by restlessness and increased reflex, lasting altogether about ten minutes. Medium doses were 0.005 to 0.01 gramme, and were followed by active movements succeeded soon by quietude. On slight stimulation of the skin there were marked contractions amounting almost to tetanus, and abortive attempts to jump. The frog soon lay quite helpless, and only on violent stimulation gave a slight reflex twitch. This also soon disappeared, and it then lay as if dead, but recovered in a few hours. Larger doses had the same but more marked effects, and anything above 0.04 gramme was fatal.

The spinal reflexes were first slightly increased, and then de-

²⁶ Schroff, *Wochenbl. d. Gesellsch. Wiener Aerzte*, 1882; *Schmidt's Jahrbücher*, cxvi, 297, 1862.

²⁷ F. Jolyet, *Comptes Rend. de la Soc. de Biol.* (4) iv, 162, 1867.

²⁸ Von Anrep, *Pflüger's Archiv*, xxi, 38, 1880.