

CHAPTER III.

ASEPTIC SURGERY—MATERIALS EMPLOYED.

Problems to be solved in order to keep a wound aseptic: Carbolic acid—*Carbolic lotions—Pure carbolic acid—Solution in methylated spirit—carbolic oil—Carbolic acid and glycerine*: Spray producers: Catgut—*Carbolised catgut—Mr. Lister's carbolised chromic catgut—Dr. MacEwen's chromic catgut—Catgut trough and pocket case*: Carbolised silk: Protective: Carbolic gauze—*Composition—Method of preparation—Von Bruns' gauze*: Macintosh: Sponges: Boracic acid—*Boracic lotion—Boracic lint—Boracic ointment*: Salicylic acid—*Salicylic acid cream—Salicylic ointment*: Chloride of zinc: Iodoform: Carbolised cotton wool.

ASEPTIC surgery is based on the principle first enunciated by Mr. Lister, and indicated in the preceding pages; viz. the *exclusion* of active ferments from the discharges of wounds.

Theoretically, this is the ideal form of antiseptic surgery, for here, supposing that the attempt is successful, the causes of putrefaction do not enter the wound in a state capable of producing fermentation, and therefore decomposition of the discharges, or of dead portions of tissue, &c., cannot possibly occur.

The problem which Mr. Lister sought to solve may be shortly stated as follows:—

On all objects in the external world septic dust is present—on the skin of the patient, on the hands of the surgeon and his assistants, on all instruments, in water, in the air, &c.; and when a wound is made any introduction of this dust must be carefully avoided. Then after the wound has been made, care must be taken to prevent its entrance during the after-treatment. Some sort of dressing must be provided which shall prevent its passage in an active state, and at each change of this dressing the problem is the same as at the time of infliction of the wound. Such being the question

at issue, I must now proceed to the modes in which it has been answered.

I shall first enumerate the substances employed in aseptic surgery.

CARBOLIC ACID is the antiseptic employed to destroy the particles in the air and on surrounding objects which give rise to putrefaction. It is obtained in the solid state and of extreme purity from Bowdler and Bickerdike, Church, Lancashire, who give it the name of Absolute Phenol. It is used in various forms.

The *Carbolic Lotions* used are of two strengths—1 in 20 and 1 in 40; one part of crystallised carbolic acid dissolved in 20 or 40 parts of water respectively. The solution is kept in a stoppered bottle in order to avoid evaporation of the acid. It ought to be quite clear; when it is not so, and more especially when globules of oily matter are present, it is impure, the oily particles consisting of cresylic acid. It is a mistake to add alcohol or glycerine to aid the solubility of the acid, because these substances hold the acid more tenaciously than water, and it is thus not so potent for producing an instantaneous effect.

Undiluted Liquid Carbolic Acid may in some cases be required. This is obtained by liquefying the crystals by the addition of a few drops of water. This is chiefly used for injecting nævi, varicose veins, &c.

A solution of carbolic acid in *methylated spirit* or in rectified spirit, in the proportion of 1-5, is used for the purpose of purifying wounds inflicted some twenty-four or thirty-six hours before coming under treatment.

Carbolic Oil is employed in various proportions, generally 1 in 5, 1 in 10, and 1 in 20, consisting of carbolic acid mixed with olive oil in the foregoing proportions.

Carbolic oil 1-5 is but rarely used, though it is occasionally applied as a dressing to foul wounds, for the purpose of purifying them. It is chiefly known as the solution in which catgut is permanently preserved.

Carbolic oil 1-10 is used as a dressing for wounds in the neighbourhood of the anus, penis, &c.

Carbolic oil 1-20 is used for oiling catheters or other in-

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struments before introducing them into the bladder. Carbolic acid of this strength does not seem to be too irritating for the

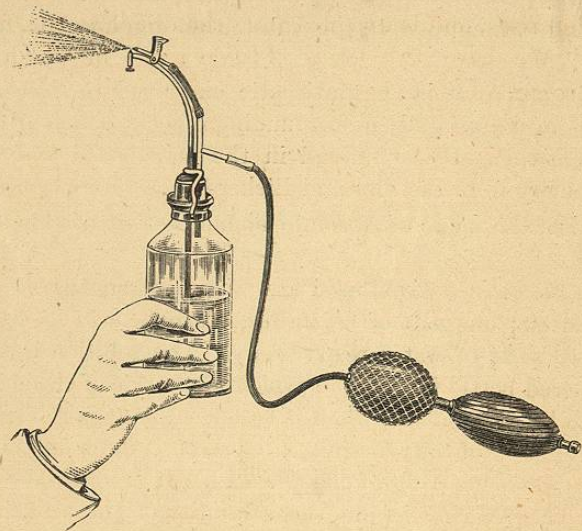


FIG. 15.—HAND SPRAY PRODUCER.

mucous membrane of the urethra, while it apparently secures against the introduction into the bladder of matters which are capable of causing putrefaction.

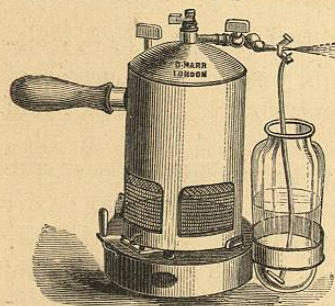


FIG. 16.—THE ORDINARY STEAM SPRAY PRODUCER.

There are various objections to these oily dressings. The chief are, that the carbolic acid is very rapidly washed out by the discharge, and that they are very dirty, and soon spoil india-rubber tissues.

The latter disadvantage is got rid of by the use of *carbolic acid and glycerine* in the proportions of 1-5 and 1-10. This is now employed as a dressing in the circumstances in which the oil has been generally used.

A *spray* of carbolic acid is generally employed in order to purify the atmosphere. This is obtained by driving a rapid

current of air or steam through a horizontal tube so as to pass over the orifice of a more or less vertical one. In this way a vacuum is produced in the vertical tube, and the fluid at its lower end rises, and is expelled from the orifice in the form of spray. We have two forms of spray: one in which air is

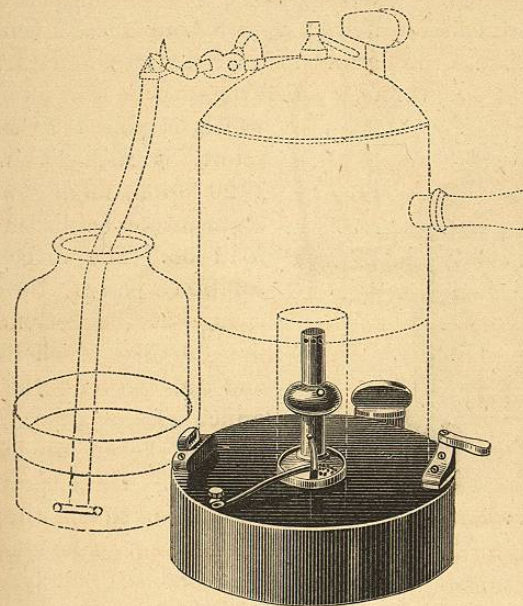


FIG. 17.—STEAM SPRAY PRODUCER, SHOWING THE LAMP AT PRESENT IN USE.

It consists of a small flame, which plays on a plate of metal attached to a hollow central tube containing a wick, and perforated by holes at the top. The heat is communicated to the wick—the spirit volatilises, and burns as it escapes from the top of the tube. The hole in the plate allows the flame of the small wick to pass up and light the spirit vapour, which passes out through the holes at the top of the central tube. The cap, which is placed over the lamp when not in use, and the boiler and vessel for the carbolic acid, are indicated by dotted lines.

driven over the vertical tube—hand or foot sprays; and the other in which steam is employed—steam sprays. The hand or foot sprays produce a somewhat coarse spray, and the force required is such as soon to exhaust the individual employed. They are therefore very uncertain implements, and have now entirely given place to the steam sprays, where there is a steady current as long as the water in the boiler lasts. When the hand sprays are employed 1-40 solution is placed in the bottle.

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In the steam spray the 1-20 solution is used because the steam, mixing with the solution, reduces its strength to 1-30 or 1-35.

I need not describe here the steam spray apparatus, more especially as it can be easily obtained, of Mr. Lister's pattern, from David Marr, 27 Little Queen Street, Holborn. These sprays consist of the following parts:—A boiler which contains water, and which is heated by a spirit lamp placed beneath it. The steam issues through a tube placed at an angle to another more upright one, through which the carbolic acid lotion 1-20,

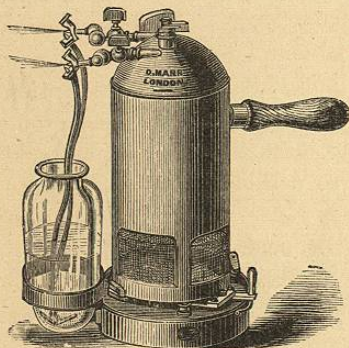


FIG. 18.—LARGE STEAM SPRAY PRODUCER WITH DOUBLE NOZZLE FOR OVARIOTOMY, ETC.

which is placed in the glass retort, is sucked up. This 1-20 lotion, mixing with the steam, makes a solution of 1-30 to 1-35. The carbolic acid solution passes through a sponge at the bottom of the upright tube, which filters it, and thus prevents the minute orifice of the tube from becoming choked up by coarse particles. These sprays are of various sizes, and the largest ones have two nozzles, which may be used singly, or to-

gether where the field of operation is large as in ovariectomy.

The *catgut* used for tying the vessels is prepared in the following manner:—Ordinary *catgut* as obtained from the shops, when introduced into blood-serum, soon swells up and becomes weak. At the same time it is very slippery, and a knot will not hold; and when placed in the tissues it very rapidly becomes absorbed. With the view of obviating these defects it is prepared by placing it in a solution of carbolic acid in oil (1-5) with a very small quantity of water (10 per cent.) diffused through the oil. As the water ultimately falls to the bottom, a few pebbles are placed on the bottom of the vessel, on which the *catgut* rests. It does not then come in contact with the water. As a result of keeping it in this solution, the *catgut* first becomes supple and soft, but afterwards harder and firmer, and is then able to resist the action of the fluids and

tissues for a considerable time. It is kept in this fluid for six or eight months, and is then transferred to the ordinary 1-5 oily solution. The longer it is kept in this solution the better it becomes. The rationale of this method will be found in Mr. Lister's paper in the 'Lancet' of Feb. 5, 1881.

Quite recently¹ Mr. Lister has published a new method of preparing *catgut*, by means of which a stronger article is obtained, and one not absorbed nearly so soon as the old kind. It also possesses an advantage over the old kind, in that it disappears by erosion of the surface, and does not become infiltrated with cells, as is the case with the ordinary forms. It thus remains as a firm constricting band, till it is completely replaced by new tissue. I cannot do better than quote Mr. Lister's description of the method by which this gut is prepared: 'I dissolve one part of chromic acid in 4,000 parts of distilled water, and add to the solution 200 parts of pure carbolic acid, or absolute phenol. In other words, I use a 1-20 watery solution of carbolic acid—only that the carbolic acid is dissolved, not in pure water, but in an exceedingly dilute solution of chromic acid. But, minute as is the quantity of the chromic acid, it exerts, when in conjunction with carbolic acid, a most powerful effect upon the gut. The first effect of the addition of the carbolic acid to the chromic solution is to change its pale yellow to a rich golden tint. But if the liquid is allowed to stand without the introduction of the *catgut*, it changes in the course of a few hours to a dingy reddish-brown, in consequence of some mutual reaction of the two acids; and a considerable amount of reddish grey precipitate is formed. If, however, *catgut* about equal in weight to the carbolic acid is added as soon as the ingredients are mixed, the liquid retains its brightness, and the only change observed is the gradual diminution of the depth of the yellow colour; the precipitate, which I presume still occurs, taking place into the substance of the *catgut*. As soon, therefore, as the preparing liquid has been made, *catgut* equal in weight to the phenol is introduced into it. If you have too large a proportion of *catgut*, it will not be sufficiently prepared; if you have too small a quantity, it may run the risk of being over-prepared. At the end of forty-eight

¹ *Lancet*, Feb. 5, 1881.

hours the chromic element of the liquid has nearly spent itself, and precipitation is complete. The catgut is then taken out of the solution and dried, and when dry placed in 1-5 carbolic oil: it is then fit for use. . . . The preparing liquid causes a certain amount of softening of the catgut, and if it is introduced in loose hanks, this will tend to produce a little uncoiling of the twisted cord, and a still greater degree of uncoiling will take place during drying. It is of very great importance that this should not occur, because it involves weakening of the thread, and that in different degrees in different parts; and this may lead to the gut giving way when you subject it to a strain. The catgut then should be prepared on the stretch, both when it is put to soak and when it is put to dry.

‘I need not enter into the mode in which this can be done by the manufacturer. I may only say this, that the surgeon who wishes to prepare it himself may do it in different ways. For instance, he may take two large test-tubes, one a little larger than the other, and he may wind the catgut on the smaller tube, fixing one end by sealing-wax, winding it round, and then bringing it up again, and fixing the other end with sealing-wax at a higher level than the liquid will reach, putting sufficient liquid into the larger test-tube, and introducing the smaller test-tube with the catgut wound round it, with a little shot to keep it down in the liquid. After forty-eight hours, he takes out the smaller test-tube, and leaves it till the catgut is completely dry. I merely mention this as an illustration, and also as furnishing a hint to some surgeons in private practice who may desire to prepare the catgut themselves; or a couple of gallipots, one larger than the other, will do just as well. But, as I have said, the principal uncoiling takes place during drying; and for all ordinary purposes a sufficiently good article is got by putting the catgut loose into the liquid, and making it dry on the stretch by tying the ends of each hank to two fixed points in a room.’ Erosion of this catgut does not begin till about a fortnight after its introduction into the tissues.

Dr. MacEwen has lately brought forward a somewhat different method of preparing catgut.¹ ‘These ligatures are prepared by making, first, a watery solution of chromic acid, one

¹ *British Medical Journal*, Jan. 29, 1881.

to five; then one part of this solution is added to twenty of glycerine. This forms a dark greenish compound, in which the hanks of catgut are inserted and retained for seven or eight months, the bottle containing them being occasionally shaken. At the end of this time the catgut acquires a semi-translucency, and has a dark colour like preserved ginger. It is then ready

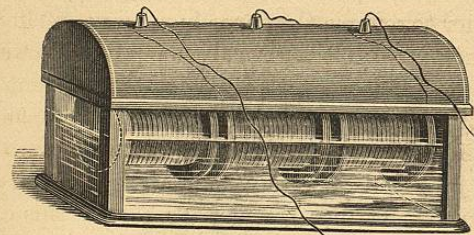


FIG. 19.—TROUGH FOR CATGUT.

for use, and is stored in a solution of carbolic acid and glycerine (one to ten).’ Ligatures so prepared begin to soften on an average about the fourteenth day, and are more or less completely absorbed the twentieth day.

A very convenient method of keeping catgut for use in hospital is to wind it round reels, say three, each holding a different thickness of gut, which are suspended in a vessel

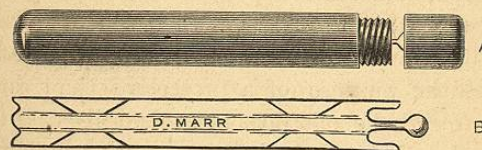


FIG. 20.—LISTER'S POCKET CATGUT HOLDER.

A, Holder complete. B, The reel on which the catgut is wound.

containing carbolic oil 1-5 (see Fig. 19). The lid of the box is perforated with holes through which the ends of the catgut pass. In this way the gut may be taken directly from the oily solution without any trouble.

In order to have a supply of gut always at hand, Mr. Lister has devised the catgut holder shown in the accompanying figure (Fig. 20). The gut is wound on a reel which is carried in a German silver case. There is no necessity to fill this case with

carbolic oil, as is done by some surgeons. Sometimes the case is combined with a caustic holder at the other end.

Carbolised Silk is often used for sutures, and is prepared as follows:—Nine parts of beeswax and one part of carbolic acid are melted together. Silk thread of various sizes is steeped for some minutes in this mixture, till it is thoroughly impregnated with it. As the thread is taken out, it is drawn through a cloth in order to remove the superfluous wax. The wax holds the carbolic acid, makes the thread more useful, and fills up to some extent its interstices, thus preventing it from becoming soaked with fluids. The carbolised silk thus prepared is kept permanently in stoppered bottles, or wrapped in carbolic gauze. It must not be steeped for any length of time in the lotion before being used, because the threads become opened out. If the thread be properly kept, the interior is aseptic or even antiseptic, and passing the thread through the fingers moistened with carbolic lotion, or a momentary immersion in 1–20 carbolic solution, is sufficient to destroy any septic dust adhering to its exterior.

In order to protect healing wounds from the irritation of carbolic acid a special material is employed termed the *Protective*. This consists of oiled silk coated with copal varnish. When this is dry a mixture of one part of dextrine, two parts of powdered starch, and sixteen parts of cold watery solution of carbolic acid (1–20) is brushed over the surface. The rationale of this method of preparation is the following:—Oiled silk alone is better for the purpose of a protective than gutta-percha tissue, because carbolic acid does not so readily pass through it. It does, however, do so, and therefore copal varnish, which is almost absolutely impermeable to carbolic acid, is added. As, however, the fluid collects on this as on a duck's back, leaving intervals between each drop on which dust may fall and escape the action of the acid, the dextrine solution is added, and the result is, that when moistened the whole surface of the protective remains uniformly wet. The use of the carbolic acid in the dextrine solution is not to add any carbolic acid to the protective, but because it is better than water for enabling the dextrine to adhere to the varnished oiled silk. For the same reason the powdered starch is added. The original carbolic

acid flies off very quickly from the protective, leaving a material containing no antiseptic in its substance.

Carbolic Gauze is the material generally employed as a dressing to guard against the entrance of causes of fermentation into a wound after an operation. The gauze used is ordinary fine unbleached tarlatan washed and dried. There are various methods of impregnating this gauze with carbolic acid. I will give Mr. Lister's description of a simple method, which can be used in any hospital, and which was recently employed during the Russo-Turkish war for making fresh gauze in camps.¹ The mixture employed for charging the gauze was originally one part of carbolic acid, five parts of resin, and seven parts of paraffin. Lately the formula has been changed to one part of crystallised carbolic acid, four parts of common resin, and four parts of paraffin. These materials, mixed together, are added to an equal weight of unprepared gauze. 'In order to charge the gauze, the paraffin and resin are first melted together in a water bath, after which the acid is added, and blended by stirring. The object now is to diffuse this melted mixture equally through the cotton cloth, and for this purpose two things are requisite, viz. that the cotton be at a higher temperature than the melting point of the mixture, and that it be subjected to moderate pressure after receiving it. The cotton cloth, a yard wide, is cut into six-yard lengths, and these having been folded so as to be half a yard square, are placed in a dry hot chamber, formed of two tin boxes placed one within the other, with an interval to receive water, which is kept boiling by fire or gas beneath, the upper edges of the boxes being connected and provided with an exit pipe for the steam. There is also a glass tube arranged as a gauge of the amount of the water, and the chamber has a properly fitting lid. The bottom of the chamber is strengthened with an iron plate, to enable it to bear the weight used for compressing the gauze when charged. There is a piece of wood about two inches thick nearly fitting the chamber, covered with sheet lead, so as to make it about as heavy as a man can lift by means of two handles in the upper surface. The weight is heated along with the cotton, and is put first into the chamber so as to leave

¹ See *Lancet*, March 13, 1875.