partly explains the good results—the wound being aseptic, at least for a time. Then Hack's results have a strong bearing on these cases, for absorption does not take place readily. Mr. Hutchinson is also very particular to have free drainage, which powerfully helps to maintain the aseptic condition; and lastly, he carefully selects the cases for operation, only operating, unless in cases of necessity, where the patient is in good health. This selection of cases is a thing not necessary and not done where complete aseptic treatment is employed.

The method which I should think was the best, acting on this principle, is the following; it is practically what Mr. Lister employs with excellent results, only I would reject the carbolic acid. After the wound has been made, and before any stitches are inserted, the raw surface ought to be thoroughly sponged over with chloride of zinc solution (40 grs. to the oz. of water). In the case of operations on the extremities, this is best done before the tourniquet is relaxed, so as to ensure its thorough application, for otherwise the blood would wash away the solution or dilute it before it has had time to act. Silver wire stitches are then inserted—special care being taken to ensure free drainage, by the use of large drainage tubes. As a dressing in the first instance, till the bleeding has stopped, several layers of wet boracic lint (wet in boracic lotion) are applied.

On the day following the operation, the lint is removed, the surface of the wound is thoroughly cleaned with sulphurous acid or chlorinated soda lotions, or with Hutchinson's lotion, and the drainage tubes are washed out with the same, though not removed. The dressing is now a narrow strip of the salicylic, eucalyptus or full strength boracic ointments, thinly but evenly spread on calico, and outside this, overlapping it in all directions, one or more broad layers of boracic lint.

On the second or third day, the drainage tube is removed, and is washed in 1–20 carbolic lotion, the wound being then syringed out with the sulphurous acid or other lotion. After a day or two the ointment over the line of incision is changed to the half-strength boracic, or if salicylic or eucalyptus ointment was used, they are retained. These dressings are changed daily

at first, but when the discharge diminishes, they may be left for two days.

Terebene and *sanitas* are remarkably good applications where the smell is bad.

The results of this treatment are of course not so perfect as those of the aseptic method, for, however carefully one washes out the wound, there are pouches in it into which the fluid does not enter, and pieces of slough cannot of course be disinfected. Thus, prolonged suppurations may occur, caries may continue without tendency to cure, and even accidental wound diseases (pyæmia, &c.) attack the patient.

With regard to the use of chloride of zinc, I ought to say that it is well not to apply it to wounds which must, if possible, heal by first intention, as, for instance, in incisions about the lips or face.

It was on this principle, as we shall see, that Lemaire employed carbolic acid and coal tar; and his results, though very good, by no means correspond to those obtained by strict aseptic treatment.

It was also on this principle that good results followed the use of balsams of various kinds in olden times. The most remarkable example of the success of such attempts at rendering the wound secretions incapable of putrefaction by the use of balsams, was that of Bilguer in the last century. No doubt where the wound is shallow, and possesses few recesses, and where the balsam or other antiseptic employed fills up these recesses, we have really an aseptic treatment and an aseptic result.

By sprinkling powdered salicylic acid on wounds till no more fluid passes out, Neudörfer manufactures a paste under which he says that healing may occur without suppuration.

II. *On Free Drainage as an Antiseptic Method.*

I have already discussed the main principles of drainage under the head of aseptic surgery. It is quite clear that, if discharge flows away as fast as it is formed, there can be no marked development of bacteria or of their products. The free drainage

of a wound from which organisms are not from the first excluded is therefore of the utmost importance. I have already described the use of india-rubber tubes, and I have referred to catgut and horse-hair. Since, in a wound not treated aseptically, fermentation, most probably followed by suppuration, generally occurs in the track of the drain, we must provide such a drain as shall permit the free escape of pus. Now, neither horse-hair nor catgut can drain pus, and, therefore, a tube of some kind or other must be used. This may be an india-rubber one, or it may be made of various kinds of metal, perforated at its sides, and cut flush with the surface. The tube, of whatever material, must be removed from the wound at each dressing and washed with a strong antiseptic lotion, say 1–20 carbolic lotion. If this be not done, portions of decomposing tissue, &c., remain inside the wound, and become more and more putrid till very soon they become caustic.

Where the wound is not treated aseptically, the principle of having the most dependent opening possible must be carried out to the full.

III. *Irrigation and Immersion.*

The principle of free drainage is never of course used alone, other principles act along with it. Of these, one of the most satisfactory is that in which the discharge is not merely allowed to flow away, but is washed away, and the further addition to this principle of adding an antiseptic to the water used for the irrigation and of thus keeping the wound constantly bathed in an antiseptic fluid. The latter is the form in which irrigation and the water bath are now always employed, viz., by the use of an antiseptic solution.

Irrigation is, as a rule, only practicable on the extremities, though it may be carried out on the trunk. For the latter, however, the continuous water bath is the most convenient.

The wounded part having been arranged at perfect rest, a sheet of mackintosh is fastened to the limb, and so arranged that the fluid flowing from the wound shall be conducted to a tub; the vessel containing the fluid is fixed at a considerably higher level than the patient. The form of irrigator most

generally used at the present time is Esmarch's. This consists of a cylindrical leaden or zinc vessel, which has a ring at its upper part to enable it to be affixed to the wall. From the side of this vessel, close to its bottom, a tube passes, and to the end of this tube is fastened a long piece of india-rubber tubing with a nozzle at its end. This nozzle is arranged so as to direct the fluid into the deeper parts of the wound. The fluid used is generally some weak antiseptic solution, such as chlorinated soda or sulphurous acid, or boracic acid.

A very good apparatus can be made in an emergency (according to Thiersch) by knocking the bottom out of a champagne bottle, and having the tube for conveying away the fluid passed through the cork. The bottle is inverted, filled with the solution, and fastened to the wall. The fluid used may be tepid or cold, as we shall see later. There is no advantage in using it very cold, as recommended by some.

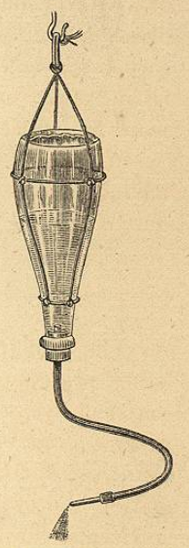

FIG. 73.—THIERSCH'S CHAMPAGNE BOTTLE IRRIGATOR.

Where the fluid is dropped on to the wound, it is well to place a piece of lint over the part where the drop falls, to prevent the constant irritation caused by the concussion. The skin in the neighbourhood of the wound ought to be coated with palm oil, in order to prevent maceration.

The continuous bath is either a bath in which the whole patient can be immersed, or one in which the wounded part alone is placed. There are numerous methods of doing this, and the references to these will be given in the history of the subject.

The advantages of the treatment by constant irrigation are, that the discharges are removed as fast as they form, and at the same time, where an antiseptic is employed, the part is kept constantly sweet. Thus, where the cavity is small and uncomplicated, there may be a truly aseptic state of affairs.

At the same time, where tepid water is used granulation is favoured, while pain and nervous irritation are very much