

We have had ocular demonstration of this in the case of a double wound with openings on opposite aspects of the limb, and not communicating with one another, so far as could be judged by previous attempts to force fluid through by means of a syringe, though at an earlier stage in the progress of the case these wounds had intercommunicated. After applying the device to one of these no change in the uncovered opening was observed for several hours, during which ebb and flow was continued in the primary wound. It was then noticed that the purulent discharge from the untreated wound was becoming thinner, and this continued until it became perfectly obvious that the irrigating fluid was "worming" its way through. The effluent from the secondary wound finally became quite clear. This was regarded as an illustration of how seepage occurs, and an indication, presumably, of what happens in blind off-shoots from the main channels of a wound during ebb and flow. It is a natural corollary to this that whatever virtue an antiseptic possesses will likewise be exerted to the maximum. The same applies to hypertonic solutions, as well as to the therapeutic use of heat, a fomentation being virtually applied to the *interior* of the wound.

(2) As opposed to this gross cleansing action on the wound, let us now consider the action, which for the sake of a better term may be called micro-mechanical, upon the tissues. As to what exactly does occur in granulation or other tissue lining the walls of a wound when subjected to alternating pressures, we do not pretend to determine. It is known, however, that the pressure of the blood in the capillaries is something under 40 mm. of mercury, or roughly that of an 18 in. column of a watery fluid. A pressure, therefore, beneath this should not blanch granulations, and the amount of negative pressure that would just be sufficient to create the correct degree of vascular dilatation might be worked out.

Harm, however, will not result if such fine degrees of pressure, based upon these physiological considerations, be not rigidly adhered to. Though there must be an optimum for these, clinically we have found that any pressure, positive or negative, which causes no discomfort to the patient is salutary only in its effects. Just what degrees of pressure, and what lengths of alternations will be found the best, is matter for future inquiry. The following rough experiments bear out our experience in cases undergoing actual treatment:—

With a view to observing the effect of positive and negative pressure upon granulation tissue we improvised a manometer by modifying the device as follows: A disc 2 in. in diameter was cut out of the centre of the rubber cover, and a collar of stout rubber cemented around the opening so formed. A circular glass window, 3 in. in diameter, was then placed within the collar, which latter, being put upon the stretch, gripped it tightly. The inflow and outflow of the fluid were served by a single-branched tube inserted near the margin of the window. The apparatus was then bandaged over the wound to be investigated—necessarily a superficial one covered with clean granulations.

With the granulations in full view beneath the covering glass we were enabled to draw some broad inference with regard to what takes place during this form of irrigation. We found that the positive pressure required to blanch the capillaries increased with the chronicity of the case. In acute cases with young granulations, a pressure from 16 to 20 in. was usually sufficient, whereas in old indolent wounds the vessels remained pervious under the pressure of a 3-ft. column of water.

Similarly, the effects of negative pressure varied with the acuteness or otherwise of the cases. In old cases a pressure as represented by a 2½-ft. pendant column of fluid produced no obvious rupture of the capillary walls, but after this steady pull had persisted for twenty or thirty minutes the fluid beneath the cover was moderately tinged with blood. Less chronic cases showed minute ecchymoses after the action of this amount of negative pressure had been exerted for the same period of time. A negative pressure of 2½ ft. produced in acute cases a marked engorgement of the vessels and definite extravasation of blood. In the most recent wounds there was oozing of blood with a negative pressure as represented by a few inches only. In all a marked outflow of lymph was produced which collected in considerable quantities beneath the glass.

One may fairly assume that the alternate compression and

dilatation of these minute vascular structures profoundly affects the wound. Yet how far beneath the surface of the walls of a sinus these influences extend we do not know. That capillary loops and lymphatic spaces, however, do not lie inert under such variations of pressure is certain. It is common knowledge that an outflow of lymph is produced by negative pressure, and our own observations have assured us that the degree we use is sufficient to effect this to a marked degree. Is it unreasonable to infer that this lymph carries its quota of bacteria? Whether the emigration of leucocytes is encouraged by these activities has not been determined.

ITS USE IN DRESSING STATIONS AND AMBULANCE TRAINS.

For the purpose of this argument let us ignore whatever special therapeutic values we have attached to this plan of treatment, and consider its adaptability to the work of a dressing station when the fight is on. Let it be regarded merely as a portable wound-bath which becomes part and parcel of the patient during transportation, and to this end a convenience, but in a place and at a time when such a convenience means much.

Now that the technique of its application has been reduced to elemental simplicity and the bugbear of leakage overcome, the query becomes more insistent than ever: Why should not this device be used in dressing stations and on hospital trains? It is suggested that this question be closely examined.

It is now within the reach of practical surgery to bind a pint or more of antiseptic fluid to the part, so that the remotest recesses of a wound may be bathed by it, and this not laboriously or precariously, but with confidence and dispatch. Both tubes leading from the main chamber might then be tied off and the patient evacuated, the fluid to be drained away and replaced by fresh at the next stop without so much as undoing the bandage. Agitation of the limb, incident to transportation, assisted by convection currents and diffusion, would ensure an interchange of fluid, so that at no time would that in the wound be more vitiated than the total content employed. And this treatment, when instituted before bacterial growth had advanced, would allow of an antiseptic acting in the approved Listerian fashion, as a result of which we would expect to have many deep wounds close without the accompaniment of the otherwise almost inevitable infection. It was with this end in view that we have laboured to simplify its technique so as to render it serviceable as near the firing line as possible.

There will be those, of course, who will ask: "What about sealing a wound in the presence of the anaerobic bacilli of gas and tetanus?" But why a large body of oxygen containing antiseptic for a limited period of time should imply the exclusion of oxygen, or why a deep wound swathed about with more or less impermeable dressings and filled with a mass of reducing organic material should be in any better posture as regards oxygen, are questions that may be left to find their answers.

Two chief points are to be considered before deciding whether the employment of this method in field ambulance work should be given a trial. The first is, whether casualties coming through during a "push" could be handled in this way without congestion. The second is the matter of expense.

Let us visualize the two sets of operations. Nothing could be superior as regards simplicity and speed to the application and bandaging on of a moist dressing. Basins of eusol, pads of gauze, absorbent cotton and bandages, safety-pins and ampoules of iodine are ready at hand. The wounded are hurried in, dressed, and gone again, and still they come. This technique is as speedy as it well could be. Anything much less so would not do.

How, then, would the method here suggested compare in point of speed? Let us visualize again. We should have as before our gauze pads, bandages, &c., and in addition a large tub of solution containing a plentiful supply of these rubber devices. There would be depending from the ceiling a large reservoir provided with a rubber tube and pinch-cock and filled with antiseptic solution.

In all wounds likely to become seriously infected we should use this device, which, when it is clapped upon the skin and momentary pressure exerted to exhaust the air, clings to the surface while the bandage is being applied. It remains but to insert the irrigating nozzle into one of the short tubes