removed, and, as far as the drainage of this part is concerned, the above considerations hold good. Drainage of the track, however, is also probably necessary, and the observations made below on the third type of wound will then apply.

3. A Potential Tubular Space.

The track formed by the passage of a missile will contain blood clots and debris; the collapse of its walls will in most cases obliterate the cavity. The injury will have opened up a series of connective tissue planes, and the aim of drainage is to prevent the spread of infection along them. As the exact position of the openings of these planes cannot be determined, the ideal drain should evacuate discharges from the entire inner surface of the wound track. Thus a simple tube lying in the track will permit discharge in the capillary space between its outer surface and that of the wound track; but when, as rapidly occurs, this space becomes clogged by clots or the viscosity of the discharge, the movement will cease. In this instance the action of gravity is acting at a disadvantage in the small capillary surface.

If a rubber tube with side holes be used, its action will not be very different. The perforations are rapidly filled in with granulations and intruded tissue. The discharge which there may be in the direction of gravity from the lumen of the tube will come from these buds of half-strangulated tissue, and satisfactory drainage from the connective tissue planes is impossible. The same observation holds in relation to a perforated metal or glass tube.

A gauze wick acts ideally for a time, but it becomes so rapidly saturated and put out of action that it is of no value in practice.

In general it will be admitted that drainage is rapidly inhibited in all wound tracks, whether a drain is inserted or not, either by the clotting of the discharges or by the obstructive action of the surrounding tissues.

The aim must therefore be to overcome this tendency to stagnation. The hypertonic saline advocated by Sir A. Wright induces a fluid discharge which does not clot. Its use, therefore, facilitates as well as increases wound discharge. But to obtain the best results this solution must be brought into contact with the entire surface of the wound, either by continuous irrigation or by frequently repeated lavage.

The above-mentioned types of drainage tube do not allow this purpose to be fully effected, but I think the form I describe below fulfils this requirement, and also increases the capillary drainage surface in action.

THE GUTTER DRAIN.

The tube should be made of rubber. In section it is star or pinion shaped (Fig. 1). The outside diameter should be the same as that of full-sized ordinary drainage tube.

For certain cases the drain should be provided with a central lumen (Fig. 2). The tube is passed through the entire length of the wound track; the upper projecting extremity is capped by a piece of thin rubber tubing (shown in Fig. 2)—for example, a cut rubber glove finger—which extends just into the entry of the wound.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1.—Section of gutter drain. Natural size.

Fig. 2.—Section of gutter drain with a central lumen. The section also shows the cap. Natural size.

Fig. 3.—Gutter drain extemporized from sections of ordinary rubber tubing sewn together centrally. The cap is not shown. Natural size.

It will be seen that, as a result, a series of gutters lying against the wound surface extend the length of the track. When fluid is syringed into the cap, it passes down each gutter, so as to bring the solution into contact with practically the whole wound surface, at the same time clearing away from the same area all debris. After lavage, the maximum capillary surface in proportion to the size of the drain is in action. When this type of tube is employed

for blind wounds (Type 2), the provision of a central lumen (Fig. 2) allows the fluid to be syringed to the bottom of the track, whence it will return along the various gutters.

Theoretically, it might be expected that this drain would give good results with continuous irrigation, but in practice relatively forceful periodical washing out of the gutters has proved more satisfactory.

It has not been possible to obtain drains quite in the form depicted, but I have for some months used a substitute made from ordinary rubber tubing. The tube is halved longitudinally; three lengths are then lightly sewn together to form the drain. It is capped as described above.

The appearance of a section is shown in Fig. 3.

As stated above, whatever drain is put in the tissues the reactionary tissue formation round it soon leaves only a capillary space between wound surface and drain; for this reason, if it is necessary to leave the drain in place for more than a few days, and, in addition to lavage, periodical movement of the drain of the gutter type is desirable.

Conclusion.

In conclusion, it should be repeated that the above drain has only been used in its extemporized form. It is not suggested that it affords an ideal method of wound treatment, but in two respects it appears to be an improvement on the patterns in common use—namely:

1. The drain forms with the surface of the wound track, in proportion to its diameter, the maximum capillary space, along which the evacuation of fluids can occur.
2. It admits of lotions being brought into general contact with the surface of the wound track while the drain is in place.

REFERENCE.

- ¹ Magnus, *Hydrostatics and Pneumatics*, p. 89, 1909.

THE RECRUIT'S HEART.

A MEMORANDUM FOR MEDICAL EXAMINERS.

BY

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SINCE the outbreak of the war I have seen a large number of healthy young men rejected as recruits because of some manifestation of the heart which the examiner took to be abnormal and a sign of weakness. I have also seen a number who have been invalided out of the army because of these manifestations.

At the request of the War Office I drew up recently a memorandum upon this subject to serve as a guide to medical examiners of recruits, and as this memorandum may not come before all the examiners, Sir Alfred Keogh has asked me to call attention to it. It is as follows:

THE SIGNIFICANCE OF ABNORMAL SIGNS IN THE RECRUIT'S HEART.

It should be understood that the healthy heart in the young can exhibit murmurs, and variations in rate and rhythm, which are perfectly physiological in origin and indicative neither of disease nor of impairment.

The Functional Efficiency of the Heart.

Before examining the heart, find out the functional efficiency by ascertaining how it responds to effort. This is shown by finding out the amount of exertion the candidate has been accustomed to take in the past in his work or play, and if he can undergo severe bodily exertion without distress.

Murmurs.

The physiological murmurs are always systolic in time, and the situation of the greatest intensity may be at the apex, mid-sternum, or base of the heart. If the candidate's response to effort be normal, and the heart normal in size, the murmur is negligible, for it is manifest that, if the cause which produces the murmur hampers or embarrasses the heart in its work, the size of the embarrassed chamber will increase, and its functional efficiency be impaired.

Irregularities of the Heart.

There are only two forms of irregularity that need be considered. Irregularities indicating serious mischief will be associated with such diminution of the functional efficiency that the candidate would not seek to recruit—such as the irregularity of auricular fibrillation or of heart-block.

Youthful Type of Irregularity.

The most common irregularity is that which occurs in the healthy heart of the young. It is characterized by a lengthening and shortening of the pauses between the beats; it will often be found to vary with the respiration, the beat increasing in rate during inspiration and decreasing during expiration. When it does not have the characteristic respiratory character it can be made to take on the character by getting the candidate to breathe slowly and deeply for a few minutes. It is frequent in perfectly healthy hearts, and is therefore of no importance, and candidates should not be rejected on account of its presence.

Extra-systoles.

In rare cases the pulse may be found intermitting more or less frequently. If the heart be auscultated, two short sharp sounds rapidly following one on the other may be heard during the pause. If this is the only sign present—that is, if the functional efficiency of the heart be good and the size normal—then these extra-systoles are of no significance and the candidate should not be rejected.

The Effects of Excitement.

Many candidates whose hearts are perfectly healthy suffer from palpitation or excited action of the heart during examination. The beat becomes forcible and rapid and a systolic murmur may be present. If such a candidate be told to lie down and breathe slowly and deeply for a few minutes the heart's action becomes less violent and the rate slows during expiration. With a history of good functional efficiency the candidate may be considered suitable for enlistment.

Memorandum

ON

THE EMPLOYMENT OF BANDAGES FOR THE IRRIGATION OF WOUND-SURFACES WITH THERAPEUTIC SOLUTIONS, AND THE DRAINING OF WOUNDS.

BY COLONEL SIR ALMROTH E. WRIGHT, M.D.,
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THE irrigation of wounds has over the application of wet dressings the following advantages.

We can bring our therapeutic solution continuously into application, maintaining its concentration unaltered. I have elsewhere, in my lecture, emphasized that this is, in treatment with saline solutions, of fundamental importance.

We can, given proper arrangements, apply our therapeutic agent to all the internal and external surfaces of the wound, and at the same time obtain ideally effective drainage.

I propose in this Memorandum to describe a series of simple arrangements which, I think, satisfy all requirements.

In the ordinary arrangement in which the irrigating fluid is supplied in the form of a "drip" falling into the wound—and it is the funnel-shaped wound I have in view—the fluid makes its way down along the side of the wound in a runnel, and we thus treat only one small sector of the wound. We have, in fact, the conditions of a rock valley or cave, where a thread of water flows to the bottom in a single channel, leaving all the rest dry.

Let me show you that by an arrangement of bandages the water can be led into the wound where we require it, that it can be distributed so as to wash down all the walls,

and that it can then be carried away without any leakage into the bed.

It will be convenient to begin by considering the properties of bandages and strips of gauze as conduits for carrying water. They may be regarded as conduit pipes

Fig. 1.

Fig. 2.

with porous walls—pipes which will convey water uphill by capillary attraction, downhill by gravity, and first up and then down hill when arranged as siphons.

We may, as a matter of fact, confine our consideration to bandages, for the ordinary bandage is, as comparative experiments bring out, a more effective water carrier than a strip of gauze cut to the same width.

The first point which comes up in connexion with the employment of bandages in suppurating wounds is their liability to be obstructed by the lodgment of particles in the meshes. The method which is employed when the dependent opening of a wound is plugged with a strip of gauze would seem specially designed for the purpose of compassing such obstruction. Here gravity carries the undiluted pus directly down into the wick, and we obtain instead of a drain an impermeable bung which effectually confines the discharges.

The arrangements shown in the models (Figs. 1 and 2) show how these difficulties can be circumvented and the wick be kept free from obstruction. We have in these—we may call them "mud-funnel" experiments—funnels filled in with a glutinous mixture of flour and water and in each case a bandage arranged as a siphon. In the first model (Fig. 1) the siphon is a simple loop of bandage carried over the rim of the funnel. We have in addition in this model a wick carried up into the stalk of the funnel. In the second model (Fig. 2) we have a rubber tube introduced through the stalk of the funnel and standing out above the surface of the fluid. This rubber tube is threaded with a bandage, and its end has been cut into two strips which hang down into the muddy fluid. The siphons are here, as you will appreciate, working in what would correspond to wounds standing full of pus, and they have, as you see, in each case carried over a very considerable volume of muddy fluid. And if they were continually refilled they would—for only the distal ends of the ascending limbs of the siphon bandages can here be obstructed and put out of functioning—continue to siphon over indefinitely through the upper segment of each ascending limb. You will also note that the wick in Model

Fig. 3.