Democritus and Empedocles saw her that the physicist deals, while the physiologist and physician deal, or ought to deal, with that truer and deeper vision of her as she appeared to Hippocrates. On the practical side the physicist aims at guiding and controlling Nature, whereas the physician aims at helping her. The object of this lecture will have been attained if I have succeeded in indicating how we may help in one of her tight places that ever more marvellous "Nature" which the keen intellectual vision of Hippocrates first began to reveal definitely to the world.

WAR LESSONS AS APPLIED TO CIVIL PRACTICE.*

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IN the limited time at our disposal I propose to select a few subjects only which seem to me to have some bearing upon practice in civil life, and which suggest some modification of previous principles and methods of treatment.

Wound Treatment.

With regard to wounds, it will suffice to describe all gunshot wounds as potentially septic wounds. Potentially septic wounds are by no means uncommon in civil life also—for instance, abrased, contused, lacerated, incised, or punctured wounds received by workers on the soil, especially made soil containing manure, bicycle and motor accidents, and street accidents generally, where any of the above types of wounds may be contaminated by mud, dust, or dung, and are often complicated by fracture of bone; bites of animals, hunting accidents, and the like—all such wounds are potentially septic, and, in so far as they are potentially septic, they resemble the wounds of war, and should be treated on the same lines. If we do so treat them, our results should be better than under war conditions, because we can get at them soon, whereas during heavy fighting forty-eight hours, or even more, often elapsed before the casualty clearing station was reached by the wounded soldier.

During the four and a quarter years of actual fighting the treatment of wounds was revolutionized, and the results showed a marvellous improvement as time went on. The researches of the pathologists laid the foundation, upon which the surgeons built new methods, and we must briefly trace the more important of these in order that we may apply the lessons to be learnt from them.

In the early part of the war tetanus was alarmingly frequent. A large and constant supply of antitetanic serum was then organized, and for the last three years every wounded man received 750 units of serum at the dressing station and another 750 in seven days' time. As a result tetanus became rare, and such cases as were seen were of the modified or so-called local type. Now and again by some oversight a man did not get his injection—I saw such a case in France. He arrived late at night, three days after being wounded, at the base hospital, and there was no record on his field card of his having had an injection. He was given 1,500 units early the next morning; but acute tetanus began that evening, and ended fatally on the seventh day.

It is perfectly true that tetanus is a rare disease in this country, but when it does occur, it is so dangerous and so often fatal that we should, I think, as a routine practice always give an injection of serum as soon as possible after the infliction of wounds such as I have described above. And it is the duty of the sanitary authority or of the Government to provide us with this serum. This, however, is only a preliminary to the actual treatment of a potentially septic wound.

The facts in connexion with such a wound are these: On the one hand, the tissues have been laid open by some contaminating agent, the wound surfaces have not only been contused, injured, or in part devitalized by that agent, but they have had implanted on them a bacterial infection, whether *Bacillus tetani*, staphylococci, streptococci, gas-forming anaërobes, *Bacillus coli*, or what not. On the other hand, there is an exudate from the wound surface, consisting primarily of blood and blood serum.

The bacteria thus implanted require for their growth disorganized albumin, such as is afforded by devitalized tissues, and also the presence of trypsin, which trypsin is formed by the fermentative action of bacteria. If there has been much devitalized tissue, or if there has been much loss of blood, or shock, or there is general debility and malnutrition, the bacteria multiply rapidly and the wound quickly becomes septic. If, on the other hand, there is no devitalized tissue and the vascular supply is uninjured, it comes to be a direct conflict or trial of strength between the invading bacteria and the natural defences of the body fluids.

The weapons of the invading bacteria are three: (1) Their proteolytic action or power of disorganizing the body albumin; (2) their power of producing trypsin by their fermentative action; (3) their power of producing toxins.

The natural defences of the body are in the main two: (1) The antitryptic power of the blood serum; (2) the phagocytic action of the living cells.

So that if the antitryptic action of the blood serum is able to keep pace with and to neutralize the trypsin formed by the bacteria, and the phagocytic action of the body cells is able to destroy them, repair sets in without suppuration—and this, indeed, is what usually takes place in wounds of the face, owing to the free vascularity of the tissues. The defence therefore has the advantage in wounds of the face. If, on the other hand, the trypsin and broken-down albumins increase and leucocytes are killed by the toxins the defence is beaten. There is suppuration and all the local signs of acute sepsis, with unknown dangers ahead in the shape of toxaemia, septicaemia, secondary haemorrhage, and the like. The vital reaction has failed and the invader has conquered.

To put the case briefly, except in the case of wounds in the face, it may be said to be "a toss up" in potentially septic wounds as to which will win, the invaders or the defence. I submit that the war has taught us how to help the defence so that in the majority of cases it wins, and I further suggest that in civil practice we should adopt the methods which have been so successful in war. To acquiesce in it being "a toss up" is no longer either prudent or justifiable.

The problem, therefore, is how best to aid the defence in the case of a wound which is contaminated, the walls of which are possibly in part devitalized, and which forms, therefore, a very favourable soil for the growth of bacteria.

Since Colonel Sir H. M. W. Gray published his paper on excision of gunshot wounds, in the *Journal of the R.A.M.C.*, vol. xxvi, in 1916, it has been universally acknowledged that excision is the best prophylactic method of avoiding suppuration; it has been recognized, further, that the sooner a wound is excised after the receipt of the injury the more certainly is infection avoided. By excision we remove entirely, or aim at removing entirely, the wound surfaces which are sown with bacteria, as well as all devitalized tissue and shreds which are cut off from their blood supply, leaving a clean wound relatively free from contamination and capable of healthy reaction.

The procedure, in superficial wounds which do not extend beyond the deep fascia, is comparatively simple.

The skin is shaved and swabbed with iodine, or a 5 per cent. solution of picric acid in spirit, and the tissues infiltrated with novocain and adrenalin. The wound itself is then wiped out with a swab soaked in either iodine or the picric acid solution, and dried; the ends of it are clipped up with Lane's or other forceps so as to put the tissues on the stretch, and with a sharp scalpel the wound is excised completely at a distance of one-third to half an inch from the wound surface. Care is taken to prevent the clean new surface from being touched or contaminated by the original wound surface.

In deep wounds total excision may be anatomically impossible, but the skin and more superficial parts can be excised, and injured muscle removed, loose bone fragments picked out, and a careful toilet of the wound made under a general anaesthetic.

If immediate primary suture is not employed—and in the majority of cases this is too risky—the wound is packed with gauze well soaked in flavine; then in forty-eight hours, if the bacteriological findings are favourable, the wound is sutured carefully so as to bring all surfaces into contact and leave no cavities. This is called delayed primary suture.

There are two classes of wounds where primary or immediate suture has been found to be advisable—namely, in wounds of the scalp, and wounds of the knee-joint. In scalp wounds primary suture after excision is employed in order to attain immediate aseptic union, so as to give an aseptic field for any subsequent operation if such should

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be necessary owing to fracture or symptoms of compression. In wounds of the knee-joint the wound is excised down to the capsule and sutured, with or without previous flushing of the joint cavity with normal hot saline. In all other wounds, except those of the face, excision and delayed primary suture has been found to be the safest and best course. I submit statistics of 150 consecutive cases of delayed primary suture which were performed in May, June, and July, 1918, at a base hospital in France, which will give you some idea of the proportion of successes to failures, and the bearing of bacteriological findings on results. You will note that suture was employed in eleven cases of compound fracture, and that with one exception they all healed *per primam*. As to the other 139 cases you will see that failure was rare, that the minor bacteriological risks were a few colonies of skin cocci, and that the major risks were streptococci, or massive infections by *Staphylococcus aureus*.

I may say that these cases were the work of several different surgeons, being all the cases of suture from the different surgical wards; and I suggest to you that they afford evidence of the desirability of treating all potentially septic wounds in civil practice, except wounds of the face, by excision and primary or delayed primary suture.

Delayed Primary Suture.

No. of cases, 150.

Superficial, 35. All healed p.p. Sterile, 19; cultures, 7; no report, 9. Cultures, *Staphylococcus aureus* or *albus*.

Deep, 115—

(*a*) Healed p.p., 97 (complete suture 82; partial suture 15).

(*b*) Failures, 18 (complete failure 13; partial 5).

Of 82 complete sutures—successes:

3 Major risks (2 profuse *Staph. aureus*; 1 *B. coli*).
15 Minor risks (*Staph. aureus* or *albus*).
39 Sterile.
25 No report.

Of 15 partial sutures—successes:

3 Major risks (2 streptococci; 1 profuse *Staph. aureus*).
0 Minor risk.
8 Sterile.
4 No report.

Of 13 complete failures:

4 Major risks (1 streptococcus—amputation of arm; 2 massive *Staph. aureus*; 1 multiple mixed infection).
2 Minor risks.
3 Sterile.
4 No report.

Of 5 partial failures:

3 Major risks (all abundant *Staph. aureus*).
1 Minor risk.
0 Sterile.
1 No report.

Compound fractures sutured, 11:

Humerus (sterile; p.p.)	2
Clavicle (sterile; p.p.)	1
Radius (sterile; p.p.)	3
Ulna (sterile; p.p.)	1
Ulna and radius (few *Staph. aureus*; p.p.) ...	1
Tibia and fibula (sterile; p.p.)	1
Os calcis (sterile; p.p.)	1
Metacarpal (*Staph. aureus*; healed with superficial suppuration)...	1
	11

I well remember some years ago a case of a young lady whose right shoulder-joint was dislocated by a motor accident, and there was a contused laceration just below the insertion of the deltoid muscle where the arm which she had stretched out as the landaulette fell sideways against the bank became squeezed between the frame of the door and the ground. The wound extended through the deep fascia although its entrance was small, and when I first saw her three days afterwards the wound was very septic. High fever, abscess, tracking pus involving the shoulder-joint, profuse secondary haemorrhage, amputation, septicaemia, and death, all followed with tragic and uncontrolled rapidity.

I am convinced that with the knowledge we now possess this life would have been saved by immediate excision of the wound, and delayed primary suture.

Antiseptics.

The war has also revolutionized our ideas about antiseptics. When a wound is really septic, and the colonies of bacteria have penetrated deeply into the tissues of the wound, no antiseptic quâ antiseptic is of any avail. But when a wound is fresh, and has been excised wholly or in part, and is awaiting early suture, a suitable antiseptic is of value. For in this case we may imagine that there are a few bacteria scattered superficially over the wound surface. The question is what is a suitable antiseptic?

The ideal antiseptic should have certain qualities.

1. It should be a powerful germicide in the presence of blood serum.
2. It should be non-poisonous.
3. It should not hinder or destroy the antitryptic power of the blood serum.
4. It should not injure the phagocytes or hinder phagocytosis.

The antiseptics upon which we relied in pre-war times have been found to fail notably in one or other of these qualities—for example, carbolic acid inhibits leucocytosis in a lower concentration than that required to kill organisms. Again, mercuric chloride is a very powerful germicide *in vitro*, but it loses much of its power in the presence of serum, and it not only inhibits leucocytosis but is poisonous.

Browning and his fellow workers investigated the relative values of various antiseptics, old and new, and deduced what they called a therapeutic coefficient for each, which they arrived at by a certain ratio. The ratio being—

$$\frac{\text{Concentration which reduces phagocytosis by 50 per cent.}}{\text{Lethal concentration in serum.}}$$

Take, for instance, carbolic acid against the coccal and *Bacillus coli* groups respectively.

	Cocci.		B. coli.
Carbolic acid ...	$\frac{1:500}{1:250} = 0.5$	...	$\frac{1:500}{1:500} = 1$

So that the therapeutic coefficient of carbolic acid is said to be 0.5 and 1 respectively in regard to these two groups. Similarly the coefficients of mercury perchloride and the hypochlorites are also a little under or a little over unity. Brilliant green has a coefficient of 15 against the coccal group but drops to 1.7 against the *Bacillus coli*. Flavine, on the other hand, has a large therapeutic coefficient of 400 against the coccal group and 200 against the *Bacillus coli* group.

We see, therefore, that flavine is by far the most efficient antiseptic which we possess—its peculiar quality being that it is very powerful in high dilution against both the coccal and *B. coli* group, and that its power is greatly enhanced in the presence of serum. The hypochlorites, eusol, Dakin's solution, and the like, have a low therapeutic coefficient, but they possess the useful quality of destroying trypsin. They are, however, soon decomposed by contact with the wound secretions and continuous renewal by some irrigation method is necessary for their efficient action. This, therefore, rather limits their usefulness, except in hospitals. A solution of flavine in normal or hypertonic saline 1 in 1,000 or 1 in 2,000 is by far the safest and best antiseptic with which to dress our freshly excised wound preparatory to suturing it. Gauze saturated in this solution is lightly packed into the wound and kept moist by adding flavine to it from time to time. In the case of a hopelessly septic wound antiseptics are of little or no avail. Besides the well known boracic fomentation, which encourages vascularity, I would draw attention to two dressings of value—namely, the salt pack, and the bismuth, iodoform and paraffin paste. The former has been shown by Sir Almroth Wright to produce a copious flow of lymph, and so facilitates the reaction of the tissues against the invading bacteria. The latter, Professor Rutherford Morison's device, acts we know not how, but it stimulates the tissues to form granulations rapidly. The wound should be dried out with methylated spirit before the paste is rubbed in. This dressing does not need daily renewal; it is merely necessary to add more gauze soaked in spirit if the discharges come through the dressing.

Transfusion.

Transfusion for haemorrhage and shock is another subject for our consideration. There can be no doubt that the transfusion of human blood is the ideal method—but this necessitates the presence of a suitable donor or at any rate a store of citrated blood; it is therefore not suitable for ordinary practice.

The effect of the usual transfusion of normal saline has been found to be transitory in cases of haemorrhage and shock, owing to the rapidity with which the fluid transudes through the capillary walls by diffusion into the perivascular tissues. But if the saline is thickened by adding gum arabic in the proportion of 0.9 per cent., the tendency to transude is greatly diminished, and the beneficial effects of the transfusion are much more lasting. So far as my experience goes, the addition of the gum is a

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great advance in the treatment of all cases of haemorrhage combined with shock. The solution can be easily made and sterilized and stored in suitable glass bottles.

The Value of Team Work.

The last lesson from the war to which I should like to draw attention is the extreme value of what I can only call team work in research, diagnosis, and treatment; and I think that perhaps this is the most important of all the lessons which the war has to teach us, and not only us as a profession but the Government, or rather the Ministry of Health, also. Consider for a moment the disadvantages under which we at present labour. We are the victims of a half-fledged, inadequate piece of legislation which is founded apparently upon the supposition that disease can be dealt with effectually by giving bottles of medicine or liniment to the sick, or that if this fails and the sick get worse they can be sent to one of the overcrowded voluntary hospitals with which the Legislature has nothing whatever to do. Anything more unsatisfactory to the sick, or demoralizing to us as a profession, it is hard to imagine.

I should like to bring to your notice an able and altogether admirable letter in the *Lancet* of June 14th last, by Dr. Flemming of Bradford-on-Avon, entitled "The general practitioner's hospital," in which he puts his finger on the crying need of the present day, namely, the establishment of an adequate number of what might be called auxiliary hospitals throughout the country, staffed by teams of general practitioners, to which all practitioners can have access, and to which they can send cases requiring clinical observation of any kind, rest, or treatment which cannot be carried out in the sick person's home. The present general and special hospitals would still be amply filled by cases of severity or difficulty, but they are essentially and always will be the hospitals of the specialist and consultant, and should be reserved as such. He demonstrates that no medical service insurance scheme can be efficient without such provision—provision to enable the general practitioner to diagnose, observe, and treat his cases adequately and to the satisfaction of himself as well as of the sick.

War has shown the extreme advantage of men in this way working together, not in rivalry but for a common end, helping to solve knotty problems, picking each other's brains, and not only gaining valuable knowledge, but conferring untold benefits upon those under their care.

That which is new and up to date to-day is old and obsolete to-morrow, and it is only by some such means as Dr. Flemming has described that we can keep our heads above water, maintain our interest in our work and our cordial co-operation with each other. Let us insist, then, that this is our due, that we should be given opportunity to meet and work together for the common good more often than is ever now possible, so that it may be less hard to maintain our self-respect and our pride in a profession which at the best is most arduous, which, speaking generally, is inadequately paid, and which makes a very great demand on the qualities of unselfishness and self-sacrifice.

The outlook for our future is surely encouraging. The nation and the Government know full well that they owe a great debt to the medical practitioners of this country and of the empire; without them war on a large scale would have been impossible, and the record of their work and its results will for all time be a reminder of how large a part is played by our profession in the welfare, prosperity, and happiness of all. Moreover, there is, and will be in the future, a department of State and a responsible Minister with whom we can deal.

No doubt the aftermath of war will bring us anxieties—these are universal; we must, however, possess our souls in patience, and remember Bacon's dictum that the greatest innovator is time. Do not let us be in a hurry, but study to preserve that unity which is the only sure measure of success.

PROFESSOR A. HOPEWELL-SMITH has received the honorary degree of D.Sc. from the University of Pennsylvania.

AT the recent elections in Germany only one member of the medical profession, Dr. Hartmann, was returned to the National Assembly. Three physicians, Drs. Abderhalden of Halle, Schlossmann of Düsseldorf, and Struve of Keil, were elected to the Prussian Assembly.

NOTE ON RE-AMPUTATION.

BY

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UNFORTUNATELY a primary amputation frequently fails to yield a satisfactory result. One main cause is, no doubt, that the circumstances under which the first amputations were done did not tend towards good healing. Patients brought to the casualty clearing stations were often in a low condition, and infection was always present. In many cases the amputation was performed above the zone of infection, but this was not always a reasonably correct procedure. Very often the wound was wisely left open and packed. The resulting delayed union tended towards cicatrization and contraction, and the scar was apt to become adherent to the end of the bone. Should sepsis develop, the result must often be imperfect healing with possibly sequestrum formation and sinuses.

Some Reasons for Re-amputation.

1. Adherent scar with weak or partial healing. If the scar is terminal, and especially if adherent to bone, it is apt to become irritated by pressure of the artificial limb. If lateral and adherent to the bone near its end, there is apt to be trouble from dragging. Such scars may break down. "A large or a small adherent scar is not necessarily an indication for re-amputation. Many cases with an adherent thin scar do well—in fact, far better than they would do with a better scar and a shorter stump. It is when the stump is conical and has a large terminal scar or ulcer that a re-amputation may become necessary" (Huggins).

2. A chronic granulating surface, especially if terminal and near the end of the bone, is very likely to lead to weak and unsatisfactory healing with adhesion to the end of the bone, or healing may fail altogether.

3. The presence of sinuses. Huggins says: "No aseptic operation should be performed on a stump until all sinuses have been healed for two or three months." I hesitate to express an opinion contrary to one with so large an experience, but I think that at least in cases with very mild sepsis in the sinuses, much time may be saved and a good result obtained by re-amputation, provided certain precautions are observed.

4. Sequestra. It is usually wiser to re-amputate than to be content with removal of the terminal sequestrum; time will thus be saved as the separation of the sequestrum need not be waited for, and if removal of the sequestrum alone be performed, the resulting end of the bone is likely to be irregular and ill adapted for weight bearing. Further, the sinus leading to the site from which the sequestrum has been removed will be somewhat septic, in many cases terminal or nearly so, and will tend to heal rather slowly with an inclination to form a cicatrix firmly fixed to the bone.

Although sequestrectomy, in the lower limb at least, should rarely be considered a final operation, it is a very sound procedure when active sepsis is present, and when it would be unjustifiable to re-amputate. The sequestrum may be removed and the track cleaned and the wound left open. When the sepsis has abated the radical operation may be performed. In the upper limb, where end bearing is not required, sequestrectomy may be found sufficient.

Prevention of Haemorrhage.

It is rarely, if ever, necessary to employ a tourniquet in re-amputating. If the main vessel be properly controlled by digital pressure, very little blood should be lost. There is good evidence that there is not only an immediate reactionary hyperaemia when the tourniquet is removed, but that there is a greater liability for reactionary bleeding to take place several hours later if a tourniquet has been used than if digital pressure has been employed alone. The main vessels should be cut through late and clamped early. It is well to superimpose the fingers of the two hands in controlling the femoral artery, so that alternate relief may be given without changing position.

In amputating through the thigh without a tourniquet some slight haemorrhage may take place from the uncontrolled terminals of the obturator and sciatic arteries, but these can be quickly clamped.

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