Hunterian Oration, 1917,

ON
THE INFLUENCE EXERTED BY
THE MILITARY EXPERIENCE OF JOHN HUNTER
ON HIMSELF AND ON THE MILITARY
SURGEON OF TO-DAY.

BY

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THIS day one hundred and eighty-nine years ago witnessed the birth of John Hunter. Since the year 1814 it has been customary for a member of the Council of this College to deliver at stated intervals an address recalling the memory of that illustrious man.

The speakers on these occasions have in turns devoted the short space of time at their disposal to either a philosophical disquisition, an attempt to form an estimate of the influence exerted by Hunter on the surgical thought of his time, or to dwell upon some portion of the writings he has left us.

My own powers are unequal to the first task, while my knowledge of the state of surgery as Hunter found it is too limited to allow me to essay the second. I therefore propose to deal briefly with his work as a military surgeon, and to try and show what influence this may have had on his successors and upon himself, and how far the views which he held and taught deviate from those which guide the military surgeon of to-day. I think the divergence is not a very wide one, for although some of the most modern surgical practice has been spoken of as a *Revolution*, yet the general tendency has rather been in the direction of a *Reaction*. I believe that this reactionary character has been as striking in the surgery practised during the present war as it has been in the military methods employed. I may instance the return to the direct transfusion of blood, the performance of excision of joints in the early stage of acute arthritis, the extensive operations for head injuries, and the character of the methods of wound treatment advocated by some. Even in the case of the chief triumph of recent military surgery—operations for injury of the hollow abdominal viscera—the advance has depended rather on the favourable conditions furnished by the nature of the warfare than on any change in surgical principles.

Of John Hunter's actual life and doings in the field we know little. In the year 1760 he went as surgeon on the staff to Belleisle and Portugal, his term of active service amounting to two years, while in 1790 he was appointed inspector-general of hospitals and surgeon-general of the army.

It is perhaps not astonishing to find that not a small share of the meagre correspondence at our disposal is devoted to matters regarding promotion, pay, the character of his seniors, and the social qualities of his colleagues. The world and military life have no doubt altered but little in these respects.

With the exception of his own writings nothing remains of the surgical history of the wars in which he took part. This is to be explained by the fact that the wounded men were transferred on board ship as quickly as possible and sent to England. Hence Hunter, as is the case with his successors of to-day, was afforded but small opportunity of following out the complete history of the majority of the patients who may have come under his care. His own brief mention of his work is characteristic enough; he says in one of his letters:¹

Thank God I have succeeded in everything I have attempted, but my practice in gunshot wounds has been in a great measure different from all other, so that I have had the eyes of all the surgeons upon me, both on account of my supposed knowledge and method of treatment.

How far Hunter's immediate colleagues agreed with his opinions and practice it is impossible to tell, but that his influence at a later date was great is evident from the comments of the next great military authority belonging to our own College. Mr. Guthrie says:²

Hunter served for a few weeks in 1761 at the siege of Belleisle, and it is much to be regretted that his opportunities were not sufficiently numerous to enable him to draw such inferences

from them as would have left but little to desire. The greater part of what he did leave was from this cause found not to accord with the observations made by his successors, while the prestige attached to his name was so great, as much to impede their progress on many essential points.

An examination of Guthrie's writings does not, however, appear to afford much support to this statement, except in so far as Hunter's disinclination to perform either primary or intermediate amputations is concerned. We shall perhaps do better, therefore, to shortly examine for ourselves the material which Hunter left behind him, and judge how far his opinions and teaching differ from those of to-day. While, however, confining ourselves for the most part to the two lectures especially devoted to the treatment of gunshot wounds, we must bear in mind that Hunter states that his "extensive opportunities of attending to gunshot wounds" drew his attention to the subject of "inflammation in general" and enabled him to make observations which formed the basis for his *Treatise on the Blood and Inflammation*.

The two lectures on the treatment of gunshot wounds differ considerably in character from the series devoted to general surgery. They are more simple and direct, less overlaid by theory, and consist for the most part of clinical observations and practical instructions. Perusal of them furnishes some support to Guthrie's criticism, in that the illustration of some of the statements made is found in descriptions of cases met with at a later date in civil practice. An equally satisfactory explanation of this occurrence is, however, offered by the fact that for these lectures, as in all Hunter's writings, the material on which they are based was collected many years before the time at which it was utilized for publication.

In the second lecture, devoted to gunshot injuries of the special regions of the body, little is included which is not equally applicable to the subject to-day. In dealing with the subject of injuries to the head Hunter belonged to the active school—any injury appeared sufficient excuse for trepanning the skull. He dwells on the necessity of raising a sufficiently extensive flap to allow of proper exploration of the injury to the skull, and speaks of the propriety of incising the dura mater in some instances. With regard to the latter procedure, however, he says: "Whenever I have seen the dura mater opened, the brain has worked through the opening, and the patients have died";³ hence he recommends caution.

The favourable prognosis attendant upon wounds of the chest is recognized, also the importance of collapse of the wounded lung in restraining primary haemorrhage, and the tendency of the blood effused into the pleural cavity to clot. Hunter⁴ made a number of experiments on the production of pneumothorax, etc., on dogs, and recommends "the operation for the empyaema" in cases of haemothorax. It does not appear, however, whether he ever performed this operation.

In the section on injuries to the abdomen the expectant method of treatment is imposed, and this perhaps especially because Hunter was familiar with the favourable course which followed the formation of a secondary faecal abscess and fistula when the colon had been injured. In the matter of diagnosis no great advance has been made since his time, except that dependent on the use of the x rays in localizing the seat of foreign bodies. The value of localized pain and tenderness as a diagnostic aid is dwelt upon, also the various haemorrhages as signs indicative of injury to special viscera. Again, it is interesting to notice that he dwells upon the absence of any certain sign denoting injury to the spleen, also the fact that either the spleen or spleen and liver may be wounded without any obvious adverse result. The often rediscovered fact that there is little tendency for the contents to escape from a wound of the small intestine was also impressed by Hunter. In view of the modern treatment of septic peritonitis it is instructive to note that the suggestion is made of placing the patient in a tepid bath in order to supply fluid to the general constitution. Directions for treatment consist, however, mainly of instructions how to deal with the secondary consequences of injuries to the abdominal viscera; as to primary lesions he says, "I should suppose the very best practice would be to be quiet and do nothing, except bleeding, which in cases of wounded intestine is seldom necessary."

Conservatism is impressed in the matter of primary removal of bone fragments in gunshot fractures, and the

too early interference with the sequestra. Hunter, in fact, takes the same line in dealing with these as he lays down in the case of retained missiles. "In general there can be no better way of coming to a part or extraneous body than by waiting for the formation of an abscess there."

The one point on which Hunter's immediate successors appear to differ most freely from him is as to the line to be followed when an amputation has to be considered; he says, "I have already observed that few can support the consequences of the loss of a lower extremity when in full health and vigour"; hence he avoided primary amputation whenever possible, condemned operations of an intermediate nature, and preferred those of the secondary class.

We may now pass on to the question of the treatment of gunshot wounds in general, dealt with in the first lecture and throughout the whole *Treatise on the Blood and Inflammation*.

WOUND TREATMENT.

Hunter's methods of treatment were guided by the views held by him on the pathology of the healing of wounds, and these methods were limited in consequence of his ignorance of the part played by infection as a cause of inflammation. Hence he is not concerned to differentiate between the process of repair and that of inflammation.

He says: "The injury done has in all cases a tendency to produce both the disposition and the means of cure. The stimulus of imperfection taking place immediately calls forth the action of restoration"; yet "injuries often excite more action than is required." Then inflammation is excessive, and this "may arise from a vast variety of causes with which we are at present unacquainted; nay, which we do not perhaps even suspect."

While he regarded suppuration as an unavoidable consequence of many wounds, yet he says, "suppuration may be considered a resolution, but it is the mode of resolution we commonly wish to avoid." Hence his attempts to diminish the degree of general reaction by blood-letting, and locally to effect an immediate closure of the wound. "In parts which have been divided and exposed the inflammation is in great measure prevented by bringing them together," and when this cannot be done, "Nature attempts to prevent inflammation by covering the wound with blood and forming an eschar." Thus a power of resolution is shown "even in cases where the parts have been exposed."

It is of interest in this relation to recall that he combats the opinion promulgated by Ambroise Paré and held long after, that exposure to the air was in itself a cause of suppuration. "Exposure to air certainly has not the least effect on parts exposed, for a stimulus would arise from a wound even were the part contained in a vacuum." Air takes no part in the formation of an abscess, cellular emphysema is not attended by suppuration, the air itself in a pneumothorax is not a source of danger, nor is air necessary for the development of a gonorrhoea.

In describing the special characteristics of gunshot wounds, contusion is the feature upon which he lays most stress.¹⁰ He observes that the degree and extent of the contusion varies inversely with the velocity retained by the missile. Thus, the greater the velocity retained by the ball the cleaner it wounds the parts, yet they slough; if the velocity is low the mischief is less and the ball more easily deflected. If the velocity be high, blood vessels are divided instead of being contused, if it be very low they are torn.

The contusion of the tissues and the resulting slough prevent healing by the "first intention" "from which circumstance most of them must be allowed to suppurate."¹¹ Hunter observed that the tissue devitalized by contusion temporarily protected that lying beneath, and hence the advent of inflammation (infection) was retarded, an observation which still retains its force in the case of more modern projectiles. Hunter deprecates the practice handed down from Ambroise Paré and Wiseman of routine enlargement of gunshot wounds, and ascribes its origin to anxiety on the part of the surgeon to remove a foreign body. He then points out the difficulty often accompanying the attempt to extract foreign bodies, the fact that experience had shown that these might be left without evil consequences, and concludes that the custom of opening up wounds had been continued in ignorance of its primary object. He

does not appear to have realized that the practice afforded an advantage, not then properly appreciated, of supplying drainage to an infected area.

Still the rule "that it should not be opened up because it is a gunshot wound, but because there is something necessary to be done which cannot be executed unless the wound is enlarged"¹² is sound enough, as also the statement, "this is common surgery and should be military surgery respecting gunshot wounds," and is certainly to be preferred to that of Baron Percy, enunciated so late as 1792, "The first indication is to change the nature of the wound as nearly as possible into an incised one."¹³

Hunter, however, improperly undervalues the argument that enlargement of the wound takes off the tension arising from the inflammation, because he considered inflammation a necessary consequence of gunshot wounds, and "any increase in the size of the wound was to be considered as an extension of the first mischief, and must be supposed to produce an increase of the effects arising from that mischief."¹⁴

He then proceeds to enumerate a number of conditions which call for enlargement of the wound which obviously hold good to-day; but "if none of these circumstances has happened I think we should be very quiet."

Nevertheless he recognized the danger of a contour wound, and recommended an incision over the centre, or the laying open of the entire track, to avoid the danger of abscess formation and the occurrence of extensive suppuration—a danger not always appreciated as it should be in dealing with contour wounds of the head, chest, and abdomen even to-day.

LOCAL TREATMENT OF THE WOUND.

The injury done has in all cases a tendency to produce both the disposition and the means of cure. The stimulus of imperfection taking place immediately calls forth the action of restoration.¹⁵

The first and great requisite for the restoration of wounded parts is rest, as it allows that action which is necessary for repair to go on without interruption.¹⁶

In these two axioms we find the theory upon which Hunter's treatment of wounds was based. The dominating factor in the healing of the wound he held to be the vital process or action of the body, a principle dwelt upon in equal measure by his great successor Lister, and one to which perhaps too little attention is given even to-day by the originators and advocates of various local methods of wound treatment.

He drew little distinction between the process of repair and that of inflammation, regarding both as the consequences of an "operation" in which the blood vessels took the major share, since in the state of knowledge then existing he was ignorant of the important part taken by increased activity of the fixed tissue elements in addition. Again, his ignorance of the common dependence of inflammation on infection hampered him in devising any local form of application to the wound. Hence we find him mainly occupied with discussing the relative merits of a cold or hot water dressing, and the advantages to be obtained by the use of the poultice which required to be less frequently reapplied and could be removed more easily and with less pain to the patient.

Regarding the healing of a wound as a natural "vital operation," Hunter saw no greater mystery in this process than in the growth and development of the infant to the man. So to-day in apportioning its relative value to any special form of wound treatment, we must bear in mind that it is difficult—aye, impossible—to prevent the healing of a wound, much as the process may be interrupted or distorted by extraneous causes.

During the past two years the local treatment of gunshot wounds has given rise to as lively and ardent discussion as that accompanying the introduction of the antiseptic principle by Lister during the earlier part of the last half-century. It appears as if the steady development of the "aseptic principle" and its obvious success in civil practice had lulled the modern surgeon into a happy dream, from which he was suddenly awakened to the terrible spectacle of wounds infected in a proportion and to a degree to him almost incredible.

As a ship which passeth over the waves of the water, which when it is gone the trace thereof cannot be found, neither the pathway of the keel in the waves.

So, indeed, the experience of the pre antiseptic surgeon seemed to have vanished and left no trace in the minds of men. This is perhaps the less remarkable in that the simple wounds inflicted by the bullet of small calibre in recent wars, had proved themselves of little consequence in affording either a ready pathway for the entrance of infection or a fertile ground for its extension.

The antiseptic measures suited to meet the limited demands attendant on the practice of aseptic surgery, and in which trust was at first reposed, proved impotent when applied to the treatment of the severe and grossly infected wounds produced by the altered forms of missile employed in the present warfare.

This disappointing experience was followed by a brief acute reaction in the direction of attempting an immediate and complete primary sterilization of the wound by the application of powerful antiseptic media such as liquefied carbolic acid and strong solutions of mercurial salts.

It appears strange that attempts at complete primary sterilization of the wounds should have found so much advocacy. No surgeon has ever succeeded in procuring immediate sterilization of extensive infected areas of tissue, and the striking statement made by Lister¹⁷ on this subject seemed to have been completely forgotten:

If, for example, a pair of forceps is handed to the operator with the intervals between the teeth occupied by dry septic pus, and a portion of this dirt becomes detached and left in the wound, the evil cannot be corrected by any antiseptic wash that is now at our disposal or that the world is ever likely to see.

This being Lister's view regarding the ill effects liable to follow the detachment of particles of infective matter from the teeth of a forceps, we may readily assume what his opinion would have been as to the feasibility of complete primary sterilization of gross infections dependent on the passage or impaction of fragments of shell and dirty clothing.

The complete failure of attempts at effective primary chemical sterilization led to increased resort to mechanical cleaning of the wound by removal of devitalized and infected tissue by the knife and scissors, and to the employment of counter incisions for drainage, both to prevent extension of the infection and to effect a cure. These procedures remain measures of primary importance whatever subsequent method of treatment may be adopted.

Bacteriological investigation of gunshot wounds during the process of healing has shown that, whatever method of treatment may be adopted, a certain primary sequence of bacterial growth and development is maintained.

Examination of "smear" preparations taken during the first twelve hours reveals the presence of no organisms although cultures prove positive. This incubation stage is followed by the appearance first of micrococci and a highly varied flora of other organisms. These latter, in a properly drained wound, tend to die out rapidly, and in the course of five or six days micrococci alone may persist. This is the crucial period for the completion of sterilization, and success depends on two factors: (a) The vitality of the natural process; and (b) the efficiency of the method of treatment adopted.

As to the first factor, in a certain proportion of instances the vital powers will suffice, but in a considerable number either the primary reaction is deficient, the infection too gross to be efficiently dealt with, or the infection regains ascendancy when the initial reaction commences to fail in power.

Determination of the degree of activity and efficiency of the vital powers in any given case is impracticable, hence some general plan of treatment must be adopted for all. Opinion has been to some extent divided as to the most desirable method, and the chief differences have arisen in connexion with the antiseptic system as laid down by Lister and the physiological or phylacagogic system of Wright.

The question obviously resolves itself into that of the secondary sterilization of wounds; in the one method an attempt is made to supplement the natural vital powers from without by the employment of chemical media to inhibit or destroy bacterial growth in the wound; in the second an attempt is made to modify and strengthen the vital powers by the local application of a simple physical process.

In proceeding to a consideration of the comparative value of these two methods from the point of view of the

surgeon it is well to first inquire what is to be hoped for by the use of chemical antiseptic media. Lister proved beyond any possibility of doubt the absolute efficiency of such media as prophylactic or preventive agents, yet both his teaching and writings indicate that he viewed the question of dealing with an established infection from an entirely different standpoint. Of this no better illustration can be found than in the sharp distinction which he drew between "bactericidal" and "inhibitory" media and the way in which he employed them respectively.

We may first ask, Is it possible by chemical means to effect the sterilization of tissue lying beneath the surface of the wound?

It has not been proved that any chemical antiseptic can penetrate the tissues in sufficient quantity or to a sufficient depth to exercise bactericidal powers, unless it is at the same time sufficiently powerful to destroy the tissues themselves. As in other methods, the deeper tissues must depend upon the vital process for sterilization, or, as Lister terms it, the co-operation of the "natural antiseptic"—that is, the constituent parts of the blood.

Before leaving this part of the question, we may also ask whether a complete clearance of organisms from the tissues deep to the surface of the wound is a necessary preliminary to closure of the cavity. This question may be answered in the negative. Evidence is offered by the common observation that many wounds, the surfaces of which are free of organisms, may be safely and definitely closed if the surface be not disturbed or injured in the course of the operation, while others in which disturbance of the surface is necessary for the completion of the operation often flare up with a fresh infection. Moreover, experience of the safety with which a serous cavity such as the peritoneal may be closed in the evident presence of a definite degree of infection also supports this view; again, a less satisfactory observation, the long period during which the organisms which have given rise to an attack of osteomyelitis or enteric fever may remain latent is familiar enough. A certain number of organisms may no doubt be safely left to their fate and for the tissues to deal with.

The virtues of chemical antiseptics are restricted to the power to render sterile the wound surfaces and the cavity included by them. If this sterilization be effected the patient is protected from the dangers of a renewed direct extension of the infection and from the risk of absorption of toxins formed by the bacteria which may collect under pressure in the recesses of the wound cavity. Further, the dangers and ill effects of prolonged suppuration may be avoided.

To effect this purpose Lister's essentials of a thoroughly trustworthy unirritating antiseptic, so stored up that it cannot be dissipated to a dangerous degree before the dressing is changed, must be fulfilled.¹⁸ It is of interest to recall that Lister in 1870¹⁹ made a suggestion for the primary treatment of gunshot wounds, consisting in the provision of an abundant supply of external dressing soaked in an oily solution of carbolic acid, and again, during the Boer war, suggested²⁰ the use of a powder of the double cyanide of mercury and zinc as an antiseptic reservoir; but neither of these methods were largely employed or successful in application.

The phylacagogic or physiological method of Wright seeks to attain the same objects as the antiseptic method by the local application of a physical process to regulate, modify, and alternately augment the strength of the various factors involved in the normal vital reaction. It seeks:

I. To maintain the patency of the opened up lymphatic vessels and spaces which normally undergo closure in the same manner as the wounded blood vessels, and to encourage an increased flow of lymph from the wound surface with the following objects:

- (a) To effect a natural lavage of the tissues.
- (b) To maintain an outward current in the flow, and thus oppose the entrance of microbes into the tissues.
- (c) To utilize the bactericidal properties of the fluid.
- (d) To remove exhausted lymph from the tissues in place of leaving it to return by the normal route of the lymphatic circulation.
- (e) To maintain a moist surface to the wound, and wash away debris of devitalized tissue and bacteria. In this

last particular simple irrigation on the part of the hypertonic or isotonic solutions plays an important part.

II. At a later date to encourage and increase the number of migrating leucocytes, both with the view of increasing phagocytosis and providing a sufficient supply of active trypsin to aid the separation of sloughs.

The normal outflow of lymph is increased by the physical ("drawing") process induced by continuous irrigation of the wound with a hypertonic solution of sodium chloride, and the augmented migration of leucocytes by similar alternate irrigation with "isotonic" solution (normal saline).

Before attempting to gauge the relative value to be assigned to the antiseptic or to the phylacagoc methods respectively, it may be at once allowed that in some instances the unaided normal vital reaction may attain parallel results when treatment with simple dressings or mere exposure to air and sunlight is adopted; but, unfortunately, such results form rather the exception than the rule. Hunter, in referring to the good results which may follow primary closure of the wound, or closure by scab formation, deals with them as an exception, and tells us "thus a power of resolution is shown, even in cases where the parts have been exposed."

It may be proper here to offer some preliminary criticism as to the validity of the theory upon which the phylacagoc method is based. Hunter²¹ says, "yet injuries often excite more action than is required." It is indeed indubitable that in a large proportion of all wounds the activity of the reaction exceeds that necessary for the process of repair, or for sterilization of the tissues, proceeding in some even to the undesirable degree of acute inflammation and tissue destruction. In fact, in the process of repair, as in the normal physiological processes of the body generally, a large margin of excess is allowed to meet possible accidents in the course of the closure of the wound.

I think we may, therefore, assume that the normal vital reaction is not, as a rule, deficient in activity, and that even in a wound that heals normally by granulation both the outflow of lymph and the migration of leucocytes tends to be wasteful of the vital powers of the patient. Again, it must not be forgotten that an excessive lymph flow is in itself a serious drain upon the powers of the patient, a fact illustrated in a remarkable degree by the rapid emaciation seen to occur in the subjects of the multiple superficial wounds which have formed so strong a feature of the surgery of the present campaign. Lastly, any interference with the coagulation which limits the primary flow of lymph following the wound tends to remove one of the most important barriers afforded by Nature for the protection of the system from the dangers of the entrance of organisms and their toxins from the infected area.

The most useful practical test of the efficiency of any method of wound treatment is furnished by observation of the date at which microorganisms disappear from the surface of the exposed tissues, and at which the wound may be safely and permanently closed by suture or other means. When subjected to this test, the antiseptic method has proved itself more rapid and more trustworthy than the phylacagoc.

As an example of the antiseptic method, that known as the Carrel-Dakin is chosen because it appears to fulfil the conditions already laid down, and because in the hands of its originator it has afforded admirable results, which have, moreover, been repeated by other surgeons and in our own camps.

It may be at once allowed that the method demands special care and exactitude in application, but such objections as may be raised as to its suitability for military surgery are of a practical and not of a theoretical nature. Such are the necessity of strict supervision of the standard composition of the solution of the hypochlorites employed, the need for care and judgement in locating the instillation tubes, the necessity of regularity in the instillations of the fluid, and the difficulty in some cases of ensuring that the patient's clothing and bedding do not get soaked. All these problems are more difficult of solution in military than in civil practice, but they are not insuperable, while the last trouble attends equally the irrigation forming a part of the phylacagoc method.

Allowing these practical difficulties we find in compensation that the wound cleans more rapidly, firmer and

healthier granulations form, the organisms die out more promptly, the occurrence of suppuration is reduced to a minimum, or actually avoided, secondary wound complications are rarer, and the wounds are fit for closure at a much earlier period. The treatment, moreover, attains success even when applied to suppurating wounds of some standing.

The special success which has attended the use of this method depends mainly on the highly ingenious plan of maintaining the constant supply of the antiseptic medium by specially devised tubes and on the character of the antiseptic employed. Other antiseptic methods, however, have attained results which, while less striking, yet are superior to those observed with the phylacagoc. Of these latter, the most satisfactory have been the dressing with solution of hypochlorous acid (eusol) and the iodoform bismuth compound of Rutherford Morison. The latter, which combines a maximum amount of rest to the wound, a "persistent storage" of an efficient inhibitory antiseptic, and a minimum of attention on the part of the surgeon, has much to recommend its employment in military surgery, where economy of time and labour are so important. Its employment as a primary method of treatment of all gunshot wounds is, however, not free from serious risks, and therefore, in the absence of further experience, not advisable.

In application the phylacagoc method fails to realize the merits which have been claimed for it. The increased flow of serum from the tissues has proved of small value from the bactericidal aspect; the "fluid" "drawn" has been shown by other observers (Parry Morgan,²² and others) to be deficient in organic constituents and hence incomparable to the normal lymph furnished in response to the stimulus of the original injury and resulting infection; and, either in the "fluid" itself or admixtures of it with hypertonic salt solution, organisms such as the streptococci grow freely. This deficiency in the quality of the "fluid" drawn is intelligible if it be regarded as the product of a local physical process exerted on the wound itself. Such a process can hardly be relied upon to induce great additional activity either in the fluid or cellular elements which are normally provided as a response to the combined stimulus of injury and subsequent infection on the organism as a whole, in which case we have to deal with a general vital reaction of the entire system the whole intensity of which is directed towards the infected region. The phylacagoc method, in fact, while attempting to increase the normal vital reaction within the tissues, an object not always to be desired, deals inefficiently with the extraneous elements in the wound cavity which form the main obstacle to normal healing.

In practice it is found that with the phylacagoc method the initial changes in the wound are slow, the tissues tend to become sodden, the separation of sloughs is delayed, and a longer period is required before the wound surface can be regarded as having reached the stage at which secondary closure can be effected. Hence the period in which secondary wound complications may arise is prolonged; moreover, in cases treated by the phylacagoc method which fail to reach the "closure" standard, a few days' treatment with an antiseptic often suffices to attain the result desired.

In passing from the subject of the local treatment of wounds, we may conclude with Hunter that "the stimulus of imperfection taking place, immediately calls forth the action of restoration"; further, that the vital operation may be most effectively aided, not by attempting to regulate and modify the process, but by striving to nullify the extraneous influences which tend to distort and interrupt it.

I can scarcely leave the subject of wound treatment in the present war without a word of mention of the most serious wound complication that has had to be dealt with—gaseous cellulitis or gas gangrene.

I can find no evidence that Hunter was familiar with this scourge. In the lectures on gunshot wounds a case is quoted in which "air came out of the wound" during the process of removal of a ball from the abdominal wall, but no mention is made of any special condition of the tissues, and it may well have been a *Bacterium coli* infection secondary to a minor injury of the colon.

Hunter was certainly conversant with the rapid decomposition with development of cellular emphysema which sometimes follows death as a result of a general anaerobic infection of the body, hence we must conclude that he

would have been quick to detect a similar form of cellulitis during life.

It seems more than doubtful whether gas gangrene has ever before assumed such a serious aspect during war. The writings of Ambroise Paré make no mention of emphysema as a sign in the gangrenous wounds observed by him, neither do the more modern writings of Guthrie suggest that the hospital gangrene seen in the wars in the early part of the last century in any way resembled the "gas gangrene" of to-day.

It is clear that Lister, when speaking of hospital gangrene, referred to a process similar to that described by Guthrie, and surgical textbooks generally have based their descriptions of hospital gangrene on a complex of identical signs.

On the other hand, anaërobic gangrene under the title of acute traumatic gangrene has for many years been individualized as a definite disease, and its pathology to some extent elucidated.

It is clear that the form of hospital gangrene observed during the American War of the Rebellion coincided in character with that described by Guthrie, and in the reports special stress is laid on the observation that the process did not involve the muscles. Lastly, no mention of "gas gangrene" has been made in any of the more recent campaigns.

Hence I think it must be allowed that the frequency of gas gangrene is to be regarded as a peculiarity of this war, referable perhaps to the nature of the soil, and perhaps to the abundant diet of the men and irregularity in defaecation. In the latter relation it is a striking fact that of a small series of patients who died as a result of wounds of the colon, in every case a rapid general *post-mortem* anaërobic infection of the blood took place. On the other hand, hospital gangrene of the classical types has been conspicuous only by its absence; during a period of two and a half years I have only seen one or two cases which seemed to resemble the spongy form, although the membranous type has been occasionally seen.

HUNTERIAN LIGATURE.

No individual procedure originated by John Hunter has preserved the freshness of his name to a greater degree than the operation for the cure of popliteal aneurysm. Every student of medicine at an early date of his career makes acquaintance with Hunter's canal, and later with the principle of proximal ligature.

In one respect the influence exerted on military surgery by the knowledge of the ease and safety with which proximal ligature can be performed has not been for the good. It has encouraged the employment of proximal ligature at the seat of election for secondary haemorrhage and even for primary bleeding from a wounded artery. Both these practices are to be condemned, except in rare instances of absolute necessity.

It is to be regretted that Hunter himself did not write the paper describing his operation and the grounds upon which he was led to undertake it, but the paper by Sir Everard Home included amongst Hunter's writings opens up one question of considerable interest to-day.

In at least one of the cases there described,²³ possibly in the first three, both the femoral artery and vein were included in the ligature; in the fourth we are definitely told that the artery only was included. From that period onwards surgical opinion has been definitely to the effect that the greatest care should be taken when occluding a main artery to avoid all injury to the vein. In fact, every operation for the ligature of an artery has been so devised that the aneurysm needle is passed in a direction away from the vein in order to minimize the risk of injury to that vessel. This, not alone to avoid the technical inconvenience of immediate haemorrhage, but also with the definite object of preserving the venous circulation intact.

Observation of a large number of coincident wounds of large arteries and veins has in no way endorsed the view that simultaneous occlusion of both artery and vein exercises any deleterious influence on the subsequent collateral arterial circulation and the vitality of the limb.

In support of this statement a few examples illustrating the innocuous nature of operations for the occlusion of veins in general may be first given. Operations for the cure of varicose veins have demonstrated the ease with

which a compensatory balance is attained when the blood is diverted from the larger channels. Occlusion of the internal jugular and other large venous trunks effected in order to prevent the diffusion of septic emboli (the process of septic thrombosis was, I believe, first observed and described by John Hunter himself²⁴) has not given rise to obvious permanent trouble.

In a very considerable proportion of gunshot injuries to large arterial trunks the neighbouring vein is contused and becomes thrombosed, and this has not been shown to give rise to increased risk of gangrene of the limbs. Ligature of the common carotid artery, together with the internal jugular vein *en masse*, has been performed in cases of emergency without increased risk of the development of the cerebral anaemia and softening so often a consequence of ligature of the artery alone. Further, where simultaneous ligature of both artery and vein in other parts of the body has been obligatory on account of wounds of both vessels untoward events have not been observed.

Evidence, moreover, exists that under certain conditions simultaneous occlusion of both artery and vein is a preferable procedure. The first example, not an unmixed or simple one, may be sought in the results observed to follow the application of a single proximal ligature to the artery in cases of arterio-venous aneurysm or aneurysmal varices of the femoral or popliteal vessels. In patients so treated during the South African campaign, gangrene of the limb followed in more than 50 per cent. of the cases.²⁵ The frequency of this accident finds a simple explanation if we consider what actually results from the operation. The main vessel being occluded and the direct arterial pressure from behind being practically abolished, blood which has been carried by the arterial collaterals to the distal portion of the injured trunk, instead of passing to the peripheral circulation, takes the course of least resistance backwards into the vein through the arterio-venous communication, and thus the limb practically bleeds to death much in the same way as if the distal end of the wounded artery opened on to the surface of the limb. Hence, the comparative safety of removal of the communication *en masse* and occlusion of all four openings by ligature.

A more striking example is offered by the result of ligaturing the popliteal vein alone for the treatment of senile gangrene of the foot.²⁶ W. A. Oppel,²⁷ ascribing the good results occasionally observed to follow arterio-venous anastomosis for the cure of this condition to obstruction of the venous circulation and consequent rise in the blood pressure of the limb, was led to substitute simple occlusion of the popliteal vein to produce the same effects. In six cases thus treated the extremities were seen to recover not only their warmth and colour without the development of oedema, but also a certain degree of hyperaemia of the feet and toes.

On these and other grounds it must be admitted that the balance of the collateral circulation is likely to be more efficiently maintained if the vessels which carry it on more nearly correspond in size and consequent equality in the blood pressure and rate of flow. The elimination, in fact, of the capacious main vein is a real advantage, since this for the time affords a too ready channel of exit for the diminished arterial supply as well as an undesirable reservoir for stagnation.

These considerations lead me not only to regard obligatory simultaneous occlusion of a main artery and vein as a negligible factor in the risk of gangrene of a limb, but to hold, further, that the procedure is preferable whether the vein be wounded or not. The result of the combined procedure being to maintain within the limb for a longer period the smaller amount of blood supplied by the collateral arterial circulation, and hence to improve the conditions necessary for the preservation of the vitality of the limb.

EFFECTS OF MILITARY SERVICE ON HUNTER HIMSELF.

We may now turn from the question of how far the work of John Hunter has influenced that of the military surgeon of to-day, to that of how his experience gained in the field may have influenced his own life's work.

Hunter was emphatically a student of nature; his early years were, as we know, spent mainly in the fields around his home, where he sought out such secrets as he could from his surroundings. This fallow period, while responsible

for depriving him of a facile pen and literary style, yet, no doubt, opened his mind, developed habits of thought and observation, and affords some explanation of the superhuman task to which he set himself with such devotion in the later periods of his life.

The whole world was his book, and it is of some interest, in passing, to contrast the character of his upgrowth and surroundings with those of his greatest successor, Joseph Lister. Hunter gained his earliest inspiration from the limitless field of nature with naked eye and unbridled freedom. Lister, born into a home the cradle of the modern microscope, passed through a blameless career at school and college in a continuous atmosphere of scientific thought and investigation. Both great men devoted their whole energies to the cultivation of science throughout a busy and industrious life—Hunter throughout with a yearning for the pedestal, Lister concerned only with the success of his labours.

Hunter died in the midst of an incomplete and impossible task, while Lister had the incomparable satisfaction of witnessing the success of his own efforts, the goal reached, and the benefit to mankind immeasurable.

Each illustrious man, however, perhaps found his proper field. Hunter in a life of continuous stress, immoderate labour, a struggle for his daily bread and the means to pursue his researches, and a tragic death not unsuited to the fiery nature of the man. Lister, in a more equable existence, spent in steady and industrious pursuit of the one great object he had in view, and, after attaining a success duly appreciated by the whole world, passing quietly away in the zenith of his fame.

The abrupt change from a boyhood of untrammelled freedom to the life of a hard-worked demonstrator in a school of anatomy, than which no greater contrast can be conceived, laid heavy hands on Hunter; his health began to fail, and hence his transit to the field of war.

To join an army in the field is to enter the most intimate school of human nature. The most admirable features of man's character and the meanest are alike displayed. Unsuspected strength is revealed, long concealed weakness exposed, and in a year's campaign the events of a whole lifetime of ordinary existence may be passed through. Hunter entered this school at a turning point in his career after two periods—the one of comparative idleness, the second of drudgery; and little doubt can exist as to both the sobering and inspiring effect it had upon his nature. As a result of his experiences he emerged a stronger and a better man, with a vastly wider outlook on the world, and doubtless capable of forming a juster estimate of his own powers and capacity to undertake the line of life for which he felt himself to be fitted.

The life of a military surgeon on active service, however, offers advantages beyond the mere acquisition of worldly wisdom and a knowledge of men. An army is not always fighting, and the surgeon between periods of active and unceasing work has intervals of quietude which are rare in any other path of professional life. Freedom from the cares of ordinary business and the manifold duties of practice allow uninterrupted opportunities for following out lines of thought and the prosecution of research. There can be no doubt Hunter utilized these opportunities to the utmost, for throughout his writings references are made to observations and investigations made during his period of service. He tells us, in fact, that his most comprehensive and complete contribution to scientific literature—the *Treatise on the Blood Inflammation and Gunshot Wounds*—was the direct produce of the experience gathered at that time. The long period which elapsed between the conception of the work and its publication is characteristic of Hunter's method—a method founded on the desire to complete his knowledge on any subject before submitting himself to public criticism; a method desirable in itself, but when adopted by a man whose aims are of the scope of Hunter's, too often, as in his own case, robs the world of receiving the benefits of a wealth of critical observation and knowledge, which passes together with its owner to the grave.

While considering the opportunities of research his military life afforded to Hunter, one cannot help comparing them with those enjoyed by the present generation.

During this campaign laboratories, both of the clinical type and those fitted for more extensive research, have been provided not only for the base hospitals but also in connexion with the casualty clearing stations, which have

performed so much of the duties of stationary hospitals near the front. A number of active young observers have been engaged in a research on every problem which the wounds and diseases of the soldiers have raised, and it may be confidently expected that a weighty harvest of new facts will have been garnered when opportunity arises for their collation and digestion.

The pathological anatomy of the lesions produced by gunshot injury to the brain, the spinal cord, the lungs, heart, and the abdominal viscera has been worked out to an extent that will leave little to desire.

New facts regarding cerebral localization and the functions of the spinal cord have been noted, while others founded on animal experiment alone have been confirmed by injuries comparable to the knife of the physiologist. Observations regarding the fevers of the field have been accumulated, an enormous practical experience of the value of the protective inoculation for enteric fevers has been acquired, while the prophylactic value of tetanus antitoxin and its influence in modifying the character of a subsequent attack has been placed beyond the region of doubt. It is not perhaps too much to expect that not only the acquisition of this extended knowledge, but also the manner of its acquisition, will exert an enduring influence upon the workers to whom we are indebted for it, and a resulting benefit will be conferred upon the community as a slight return for the misery and suffering which has been imposed upon the present generation.

May we not hope that many of the workers may be influenced as John Hunter was, and remain to the end of their careers active searchers after and exponents of the secrets of Nature, as well as better practitioners of medicine?

Many of my predecessors have striven with a varying measure of success to portray Hunter as a man and member of society; yet, the strange paucity of material at command appears to render any estimate of his personality from this point of view incomplete and uncertain.

I prefer to ask my audience to study his presentment as it hangs upon the wall before us, and from its inspiration to try and form a true conception of the man and the soul that was within him.

The concrete labour of his hands is still exhibited within these walls, while the germs contained in his writings have served to incite and direct the minds of the many searchers in the wide field of biology who have followed in his footsteps. If but one lesson could be learnt, the secret of his untiring industry, and this pressed home on those whose privilege it is to follow in his path, great indeed might be the result to mankind. The problems that to-day await solution are no less numerous or less vital than those John Hunter sought to unravel, while the constantly increasing means of investigation at command lay a growing responsibility upon the student.

The memory of John Hunter is fresh within these walls, and it is still green without, and I cannot, perhaps, better close this unworthy effort to sustain that memory than by quoting the words of one of his bitterest foes regarding the period of Hunter's life immediately following his return from the wars:

"During this time he found himself at leisure for meditating plans of life that plainly denote an intrepidity of mind and a vigour of application which, natural obstacles unsurmountable by most, could not suppress in him; (plans) which few have attempted although supplied by the completest aid of academic learning."²⁵

Mr. President, posterity has judged how far Hunter succeeded in his aims, and has within the walls of this College awarded him a standing memorial which would, I think, have satisfied the man himself.

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ROTATION OF THE LIVER ON ITS VERTICAL AXIS.

BY

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ON June 23rd last I was asked by my colleague, Dr. Hobbblethwaite, to perform cholecystotomy for the removal of gall stones on a female patient of his, aged 33, in the hospital. The history and symptoms were the usual ones in a case of this kind, and the physical signs gave no clue either by their presence or absence of the difficulty that was shortly to be encountered. There was tenderness and rigidity of the right upper rectus and pain on pressing the twelfth rib about an inch from the spine.

On opening the abdomen in the right upper semilunar line by the usual gall bladder incision, which discloses the liver in its upper third, on this occasion the liver could not be seen until a fold of peritoneum which covered it and separated it from the diaphragm and upper abdominal wall had been lifted up. The hand was then introduced to explore the gall bladder, but no gall bladder was to be felt or seen, the only thing that bore the remotest resemblance to it was soon found to be the lower pole of the right kidney, which therefore must have been projecting forwards unduly. I then passed my hand up to the transverse fissure, but I could not find the foramen of Winslow, and though I could identify the anterior pillar and its contained structures, the common bile duct, the hepatic artery and portal vein, yet the "feel" of it seemed in some indefinable way to be not quite normal. There was nothing left to do but to trace the edge of the liver both ways; towards the left nothing could be identified the whole way round; towards the right I came upon the liver notch in a position corresponding to the anterior axillary line. Here was something definite at last. The fold of peritoneum which covered the edge and upper surface of the liver was found to be tied down at this notch and so was identified as the suspensory ligament, and this was confirmed by tracing its free edge to the umbilicus; its attachments to the diaphragm occupied the normal position. On tracing the edge of the liver further round still I came upon a small flaccid sac containing calculi suspended hammock-like by a mesentery from the under surface of the liver in a position corresponding to the posterior axillary line and in front and to the outer side of the upper part of the right kidney.

The riddle was now almost solved: the liver had rotated on its vertical axis through an angle of approximately 90 degrees; the lobe opposite the incision and covered by the suspensory ligament was the left with the characteristic omental tuberosity on its under surface, and the quadrate lobe, instead of being opposed to the abdominal wall between the mid and right semilunar lines, was related to the right hypochondrium between the anterior and posterior axillary lines. It was impossible to see the gall bladder through my present incision, though it extended from the margin of the ribs to opposite the umbilicus. I tried to rotate the liver back again to its normal position, grasping it with both hands to make the attempt, but I found that it was immovably fixed in this position, nor could the gall bladder be made to present in the incision. I therefore made a transverse incision at right angles to my first incision back as far as the mid axillary line. The gall bladder could now be opened in the corner of this incision, and I evacuated eighty-one small calculi. A tube was put in and brought out at the same place.

The patient made an uninterrupted recovery.

I regret that the condition of the patient after the transverse incision was made permitted us to do very little more than complete the operation we set out to do—namely, to relieve her of her gall stones—otherwise more time would have been spent in examining the relation of the liver to the neighbouring organs and viscera. I did make another attempt to pass my finger through the foramen of Winslow, but was no more successful. The stomach, pylorus, duodenum, and hepatic flexure of the colon

seemed to occupy their normal positions, and the liver seemed to be of the size to be expected in a female patient. The gastro-hepatic omentum seemed to be more superficial than is ordinarily the case, but I made no examination of the cardiac orifice of the stomach.

It is, I think, significant that the rotation of the liver is from left to right, and through the same angle, namely, 90 degrees, that the stomach and duodenum rotate early in fetal life, and at first it was a tempting theory to suppose that it took place at the same time.

In the meantime, however, I have had the benefit of a note from Professor Arthur Keith, who has set me right on this matter. It appears that this rotation is an extreme degree of prolapse of the liver, occurs only in women, and in women over 30 years of age. It is usually accompanied by evidence of visceroptosis. My patient was certainly on the spare side, and was such a patient as one would not be surprised to find a movable kidney in, but the right kidney, at any rate, was fixed with its lower pole projecting forwards under the liver. The only other evidence of visceroptosis was the gall bladder mesentery, which was about an inch long.

THE EFFECTS OF CINEMATOGRAPH DISPLAYS UPON THE EYES OF CHILDREN.

BY

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THE following observations refer only to the direct effects of the cinematograph display upon the eyes, and ignore indirect effects that may be held to arise from undue excitement, confinement within a place the atmosphere of which may be injurious, and the fatigue caused by the late hours at which children attend exhibitions.

In general, it may be said that the effects on the eyes of children do not differ from those experienced by adults. There are few, if any, adults who do not experience some annoyance, very many of the more sensitive or impressionable feel considerable strain; children may be taken to be in the same class as the more impressionable of adults, owing to their lesser power of resistance and readier experience of fatigue.

The unpleasant effects associated with the cinematograph exhibition, so far as they affect the eyes, are due to the following conditions: (1) Glare; (2) flicker; (3) rapidity of motion; (4) concentration of attention; (5) duration of exhibition.

Some of these conditions are peculiar to the cinematograph, others are found in the same or some degree in other optical exhibitions. But none of them are natural, and the more they depart from the conditions of natural phenomena the greater is the adverse influence on the eyes.

1. Glare.

Though the human eye has a wonderful power of adapting itself to varying conditions of illumination, it is well-nigh incapable of adapting itself to a single light in a dark place. The light may be feeble, but if the space in which it is exhibited be dark, it will be relatively intense, and therefore irritating to the eyes.

These conditions are found exemplified in the highest degree in all optical lantern exhibitions. To enhance the effect of the show the room is made as dark as possible, the light of the lantern as bright as possible, and the transparency as strong as possible. The light from the lantern is projected on to the whitest possible screen, and therefrom it is reflected directly into the eyes of the observer. All these necessary conditions of the show are bad conditions for the eyes; they all tend to produce the maximum of fatigue. The effects of glare are further intensified in the cinematograph show by the programme screens shown between the films. These slides are often far too brilliant in the contrast between the white print and the dark background; particularly bad are the impromptu slides made by scratching the writing on a screen of coloured gelatine. These slides should be prepared so that the contrast between the print and the background is the smallest necessary for visibility. In a