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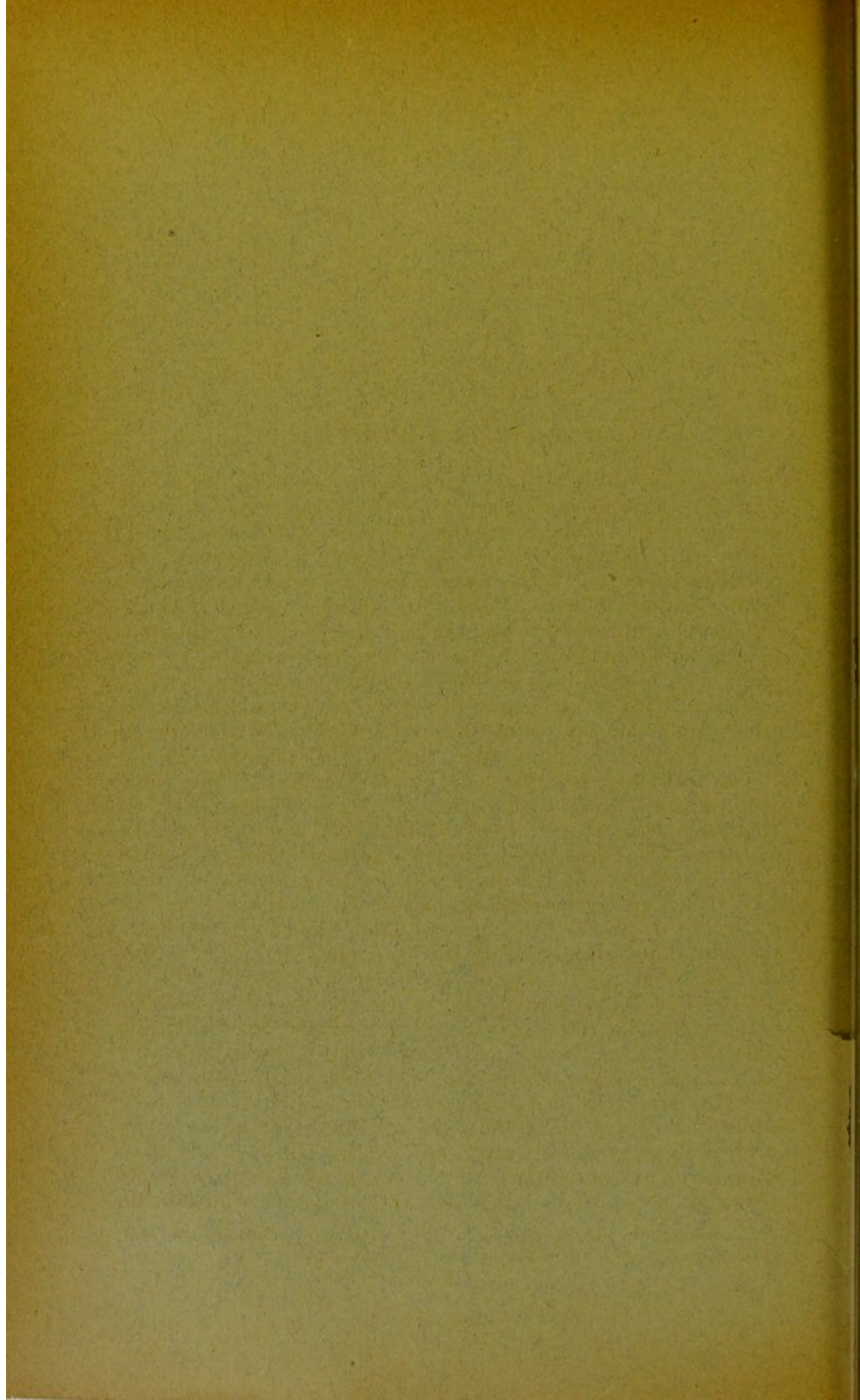


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AMPUTATIONS.

By WILLIAM JAMES FLEMING, M.D.

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AMPUTATIONS.¹

BY WILLIAM JAMES FLEMING, M.D.

AMPUTATIONS have always been looked upon as affording probably the best example on which to found comparisons of surgical work. This is because of their uniformity, when taken in large numbers, and because they involve, under all circumstances, nearly the same operative procedure and a similar extent of open wound. In addition to this the conditions which necessitate amputation are practically the same in any sufficient series of cases. For these reasons, I have selected them as a basis on which to bring before you to-night some statistics of the Royal Infirmary, and some conclusions which my recent ten years' surgical work there have led me to form. We have available the records of amputations in the Royal Infirmary for over one hundred years. These have been collected by Dr. Laurie from the years 1794 to 1838; by Dr. Steele, from 1838 to 1848; and by Dr. Thomas, from 1849 to 1873. The great uniformity in results which now obtains, and the immensely increased number of amputations performed, has made it unnecessary for me to attempt to complete the record from 1873 to the present date; but I have extracted the total amputations during the ten years 1885 to 1895, and also my own results during the same period. It will be noticed that those various sets of records group themselves naturally under three great surgical eras. The statistics collected by Drs. Laurie and Steele from 1794 to 1848 are part of the pre-anæsthetic era; Dr. Thomas' statistics, 1848 to 1873, cover the period of anæsthesia without antisepsis, while during the ten years 1885 to 1895, both those great surgical discoveries were uniformly employed. It is true that antisepsis had been initiated in our wards several years before 1873, but those of you who, like myself, were familiar with

¹ Presidential address delivered to the Glasgow Pathological and Clinical Society on 15th February, 1899.

the practice of the day will remember that, although already largely influencing our results, it was then by no means universally practised by the surgeons, indeed, by some was bitterly opposed, and therefore can have had only a small

AMPUTATIONS—ABOVE WRIST AND ANKLE.

	LAURIE. 1794—1838.	STEELE. 1838—1848.	THOMAS. 1849—1873.	G. R. I. 1885—1895.	FLEMING. 1885—1895.
Numbers, .	271	284	970	774	160
Deaths, .	98	122	344	132	25
Per cent, .	36·16	42·95	35·74	17·0	15·62

influence upon Dr. Thomas' statistics, extending as they do over twenty-five years. The most striking thing in these tables is the comparison of the recent statistics with those of the past—coming, as they all do, from one hospital, and from what I may describe as the same school of surgery, they can be fairly compared. It will be noted that the percentage mortality for all amputations above the wrist and ankle was greater in the second period, 1838 to 1848, than from 1794 to 1838. It is a little difficult to understand the causes of this, but it is probably due in great part to the increasing boldness of surgeons, justified by considerably improved methods of performing the actual amputations, and especially of arresting bleeding, leading them to operate upon cases which, in the hands of their predecessors, would have been considered hopeless, and therefore unsuitable for interference. At anyrate, both the statistics give what we would now consider a terrible mortality. The third period, which can be most fairly compared with the second, is characterised by a marked decrease of the mortality, and a great increase in the number of amputations. It is interesting to notice that during the years embraced in the first period, only 6·7 amputations per annum were performed; while there were during the second period, 28·4; during the third period, 38·8; and during the fourth period, 77·4 annually.

It is obvious that the rise in the third period was due to the use of anæsthetics, and the increased number of surgical beds. The greater number in the fourth period is explained by the greater security given to all operative procedures by antiseptic surgery, and by further increase in the surgical accommodation.

Antiseptic surgery also accounts, I believe, entirely for the brilliant reduction in the mortality. So far as I can judge, these statistics include all amputations, even those primary cases in which the patient did not survive for forty-eight hours, which are so often excluded from hospital mortality statistics. Certainly, in the later period, no such exception has been made.

The revolution achieved by Lord Lister is strikingly shown; when calculating from these statistics, it appears that in cases of amputation alone, one hundred and fifty-six lives were saved during ten years in the Glasgow Royal Infirmary. It must also be borne in mind that the same cause which reduced the mortality, probably in even a greater proportion saved limbs which would previously have been amputated.

The next table gives the ten years' amputations, including the wrist and ankle, performed from 1885 to 1895—first, by all the surgeons of the infirmary, and, secondly, by myself. This

TEN YEARS' (1885—1895) AMPUTATIONS, INCLUDING
WRIST AND ANKLE.

	ROYAL INFIRMARY.	AUTHOR.
Numbers,	1,031	206
Deaths,	147	29
Per cent,	14·16	14·07

table is principally of interest because it seems to me in a remarkable manner to confirm the accuracy of the figures, and to show how little the personal element affects the results. During these years I had charge of almost exactly one-fifth of the surgical beds, and you will observe that within a decimal point I performed one-fifth of the amputations with practically the same mortality.

Considering next the relative mortalities of amputations, classed as primary, secondary, and for disease, and comparing Dr. Thomas' statistics with the total hospital numbers for the selected ten years, we find that in the primary amputations there was a diminution of mortality of 17·4 per cent; in the secondary, of 31·5 per cent; and of those from disease, of 12·1 per cent. These differences quite coincide with what we would expect to be the effect produced by antiseptics. The most marked difference is in the secondary

amputations, because it is in this class of case that septic mischief is so generally fatal.

PERCENTAGE MORTALITY.

	PRIMARY.	SECONDARY.	DISEASE.
	Per cent.	Per cent.	Per cent.
Dr. Thomas,	36·5	51·7	21·9
G. R. I. (ten years), . .	19·1	20·2	9·2
Differences,	17·4	31·5	12·7

To turn now to my personal views and conclusions, I have a few remarks to make upon methods of amputation—after treatment—and circumstances necessitating this operation.

In regard to methods of amputation, I have little to say. I attach importance to making the incisions at right angles to the skin, so as to avoid bevelling. I know this is an elementary rule of operative surgery, but especially in amputation it is more difficult than one would think to carry out, and a point in which many surgeons fail. The ease with which the skin of the flaps can be adjusted, when this has been attended to, is in marked contrast to the difficulty when the skin has been divided obliquely. I avoid any redundancy of the flaps. The more I am in doubt as to their viability, the shorter am I inclined to make them. The base is the same in either case. Through it is derived the nutrition—a definite and limited blood supply—and the less tissue this has to provide for, the better will what there is be nourished. I have heard surgeons say they made large flaps, in case of part of them dying. I consider this is the best way to ensure it. I advise every surgeon to acquire sufficient dexterity with his left hand to at least make incisions in amputating with it. Standing in front of a limb, especially the thigh, it is much easier and better, after making the incision as far as possible with the right hand, to transfer the knife to the left and complete the cuts, than to pass behind the assistant holding the limb, so as to reach the other side. In cases where the condition of the patient, either from shock or exhaustion, calls for the utmost possible rapidity of operation, I secure the main vessels only, and pack the stump with sponges or masses of gauze, enveloped in perforated green protective. A few silkworm-gut stitches

are put in and tied in a reef bow with the ends left long, so as to keep the packing in place and the flaps approximately in position. I then bandage with a damp gauze roller next the skin; then apply a resilient dressing, such as absorbent medicated cotton, and over all, a light elastic bandage. About forty-eight hours afterwards the plugs can be removed with ease and without pain to the patient, thanks to the smooth protective and the facility with which the bow stitches can be released. No bleeding takes place. The flaps are adjusted with the aid of the sutures already in position, and if necessary a few more, aided by carefully adjusted pressure. Union is generally rapid. In all cases where shock exists or may be expected, very great advantage is derived from the use of a large tin, completely covering the operating table, filled with hot water. I made an arrangement by which a constant current of water at the desired temperature was conveyed by a hose from the water-taps in the theatre, caused to circulate through the tin, and run off by the waste pipe. By this means a constant temperature can be maintained during the most prolonged operations. An intelligent nurse must be told off to watch it, as from changes in the pressure in the water main, extremes of heat and cold may otherwise arise unnoticed. I dislike all mechanical operating tables. Two plain strong deal tables of different height are all that the most exacting surgeon can require, if he knows how to use them.

All surgeons now save a large number of limbs, which not very long ago they would have amputated. As a rule, I never amputate primarily, except when the main vessels are destroyed. I do not mean that I reserve these cases for secondary operation in the true sense of the word, or that I save them all, but I take great care to make them aseptic—as I often express it, I “pickle” them—and after a few days can see exactly how much can be saved, how much must be removed. By “pickling” I mean rendering and keeping aseptic. It is often very difficult to accomplish, especially the rendering. However, it is fortunate that “dirt” is not always surgically unclean. This holds especially good with the very black material compounded chiefly of oil and finely powdered metal with which the recipients of machinery accidents and their wounds are usually liberally begrimed. Perhaps the almost universal use which is now made of the antiseptic mineral oils for lubricating purposes, helps to explain the frequency with which the presence of this form of

dirt in a wound is compatible with asepticity, but in addition we must remember the affinity of carbolic acid for oil, in consequence of which greasy dirt is easily disinfected by that agent. Carbolic acid, 1 to 20 in water, or in some cases 1 to 10 spirit, is the best thing to use in such cases, although I have had very successful results with mercury. I cannot help thinking that the volatility of carbolic at the body temperature largely increases our chance of reaching every possible corner and cranny of the wound, and even to some extent of penetrating blood clot, in which mischief may lurk. In its application, and in that of the soap and water which, of course, precedes its use, I have great faith in the virtues of a firmly handled nailbrush. Turpentine, ether, and spirit are also useful auxiliaries, and the free dusting and rubbing in of iodoform is essential. While avoiding undue tension and retention of discharge, I always adjust the tissues with silk-worm-gut stitches, however much they may seem injured.

Where possible, bleeding should always be absolutely controlled during the dressing by an elastic tourniquet, and this should be an ordinary broad elastic bandage. I cannot deprecate too strongly the use of the elastic cord or even tube, which I am sorry to say is still supplied and recommended in many quarters for ambulance work. I have had several cases of sloughing of flaps due to its use, and in others have required to amputate higher up than would otherwise have been necessary had the flat bandage been used. The cumulative force of numerous turns of even feeble elastic bandage is very great, sufficient to control all the vessels of the extremities. It should be applied and removed rapidly, so as to arrest and relieve both the venous and arterial flow as nearly simultaneously as possible. The advantage of dealing with a dry wound, both in facility of manipulation and thoroughness in the application of the disinfecting agents, more than counterbalances the increase in subsequent capillary oozing which its use entails. As to the bleeding in the wound itself, every day I trust more and more to pressure carefully adjusted and less to ligature; even in an amputation I generally only ligate the vessels which can be found from their anatomical position or easily seen, and this before the removal of the tourniquet. I stitch, and except in very large wounds use no drain, but apply pads, and bandage so as firmly to press the raw surfaces against each other as far as possible. In the great majority of cases there is no oozing nor rise of temperature, and when the dressing is removed at the end of ten days or a fortnight, sometimes longer, the

wound is found firmly united, at least the skin is. Not infrequently blood serum in considerable quantity is collected in the deeper part of the wound, but this is generally indicated either by a slight rise of temperature about the second or third day or by staining of the dressing. It is easily got rid of by the introduction of a director or pair of sinus forceps through the soft skin cicatrix, and seldom recurs or gives any trouble. If left alone it is absorbed, but this takes time and delays firm union. Most surgeons, I believe, endeavour by much ligation to get a dry wound before closing it. Theoretically this is most desirable, but I consider impossible in practice. Some blood is always effused and also serum. In fact generally, even after the greatest care in arresting hæmorrhage, the wound during the first few hours becomes filled with blood, and this effusion is only arrested when the pressure within the wound becomes sufficient to control it. I aim at arresting as much of the bleeding as possible by pressing the greatest extent of the surfaces of the wound against each other. Any spaces which are left must be filled with blood-clot and should be. If the skin is healed and all below it is aseptic, we have the same conditions as a simple fracture. A simple fracture behaves as the ideal wound. It should be our standard of comparison. Few lessons are more instructive and, curiously, few are less often demonstrated than the dissection of a recent simple fracture. In a large hospital many cases appear on the *post-mortem* table in which, besides the lethal injury, one or more simple fractures have been sustained. How seldom does the pathologist cut down upon the fracture and point out the great effusion of blood, the tearing of muscles, and, in short, how terrible a wound of the soft parts it would appear if on the surface. Few things are more instructive to the student and to ourselves. It is a great lesson in the value of the skin as an obstacle to sepsis. Close your skin, and the deep parts if aseptic will take care of themselves. Without phagocytosis the surgeon would be in a much worse position than he is. But we do not yet, perhaps never will, know how far we can trust to it. I feel that at present at anyrate we can only hope that it may correct our errors. We dare not rely upon it. What, then, is the way in which we can best obtain immediate union of two freshly cut surfaces? Syme exposed his flaps till they "glazed," brought them together, and often got primary union. The exposure was the risk. Can we dispense with it? I believe we can. If we wash the surfaces of a clean cut with a strong alkaline solution of mercury bichloride we get the serum covering

these surfaces coagulated, converted into a serum-sublimate. This is practically insoluble and closely corresponds to Syme's "glazing." It is, moreover, a perfectly sterile soil. From its insolubility it is very slowly absorbed, so that no constitutional poisoning takes place. Two raw surfaces thus prepared and brought in contact are rapidly glued, and the organisation of the fine intervening septum of serum-sublimate proceeds with marvellous speed. In reducing this theory to practice I wash my wounds with a strong solution, sometimes even 1 to 500, of sal alembroth, and then wash off any superfluity with a much weaker lotion, say 1 to 2,000. I dust well with iodoform, carefully close the wound, generally without drainage, and apply firm pressure so regulated as to bring the greatest possible area of the raw surfaces in contact. I have had no cases of either mercury or iodoform poisoning. In the matter of the mercury, I attribute this to the use of strong lotion producing an almost insoluble compound with the serum albumen. Iodoform used pure is also very slowly dissolved in the tissues. I once had the opportunity of examining the elbow in a case in which there was rupture of the kidney, from which the patient died in four or five days, where there had also been a compound dislocation of the elbow, with fracture of the olecranon. I had wired the olecranon and dusted freely with iodoform, and at the *post-mortem* much of the iodoform was found in the joint unaltered. We know that certain lower forms of life are killed by comparatively innocuous substances, which are harmless not only to higher forms but to other low forms, *e.g.*, sulphur and the itch insect. I can only, then, as a working hypothesis suppose that iodoform, although by no means experimentally shown to be a powerful or universal antiseptic, has a specific influence on some microbes which are common in wounds, and is deleterious to them.

I now comparatively rarely employ drainage in clean wounds, and, when from their great extent much serous exudation cannot be avoided, only for a short time. Absorbable drains have not been successful in my hands. If made of chicken-bone they either become at once filled with blood-clot or collapse into ribbons. Hanks of catgut are better, as they to a certain extent act as capillary drains, but as I like to remove whatever drain has been used in forty-eight hours, a strip of absorbent mercuric or iodoform gauze answers the purpose best in dealing with serum. For pus the rubber tube is by far the best.

For deep sutures, of course catgut, but for the skin silk worm-

gut and horse-hair give me the most satisfactory results. With either silk or catgut you have more liability to stitch abscess, the stitch marks are worse, and the catgut never can be relied upon, especially if subjected to the slightest strain. If there is no strain upon them, continuous sutures of fine catgut often give good results. Wire I only use when buttons are necessary. If at all possible I avoid their use, as despite every precaution they almost always leave a stitch track which gives trouble.

After trying many dressings I have for some time used exclusively (1) absorbent gauze impregnated with sal alembroth, and outside this, if much discharge is expected, wood-wool bags; (2) boracic lint.

I have tried the various forms of zinc and mercury gauze, the preparation of which has been worked out so beautifully by Lord Lister, and have found them answer admirably, but not any better than the sal alembroth. They are dearer and more difficult of manipulation, and cannot so well be prepared by practically unskilled labour as can the sal alembroth.

Whether the Scottish skin is more resistant than that of the natives of other countries I do not know, but in only an infinitesimally small number of instances has irritation of the skin of any moment arisen in my experience from the use of the alembroth gauze. Very often pressure can best be applied by bandaging with the mercurial gauze in actual contact with the wound, thus applying the dressing in the form of a bandage.

One or more thicknesses—*but not a mass*—of this blue gauze, as it is generally called, are wrung out of mercuric solution and laid upon the wound, to make sure that no unsterilised dust is brought in contact with it. Above this a quantity of the dry dressing is placed, and, if necessary, a wood-wool pad.

Skin irritation, if it occurs, is almost always due to the use of such a large mass of wet gauze over the wound that it is a long time before it dries. Wet mercuric gauze is irritating, dry is not, to the average skin.

There is a point in connection with these dry mercurial dressings to which I desire to direct attention—viz., the amount of material required to ensure the asepticity of a wound. When we used carbolic gauze it was necessary to employ a large mass, so as to obtain a sufficient quantity of the disinfecting agent, and also to include under the dressing a large area around the wound. The discharges were kept moist, and only prevented from putrefaction by a highly volatile agent, so that, whenever they escaped from the edge

of the dressing, decomposition soon set in, and was apt to spread even under the dressing. With a dry mercurialised material not covered with waterproof, an entirely different set of conditions exist. The discharge which soaks into it is at once saturated with a powerful and soluble but non-volatile antiseptic and soon dries up, so that it is doubly protected from putrefactive changes. Hence it follows that any part of the dressing which is not saturated with discharge is of no use and is wasted. In consequence, a much smaller quantity is required, and it should be applied, not in such a way as to guard a large area surrounding the wound, but in the manner best calculated to rapidly absorb the discharge and permit it to dry, and in quantity just sufficient to deal with the amount of fluid likely to be poured out, with, of course, an ample margin for safety. Working on this principle a great reduction in the quantity of dressing used can be effected with safety and economy. The latter, especially in hospital practice, I consider deserves our most serious attention.

For all ulcers and superficial sores, and for others where a moist but unirritating dressing is desired, boracic lint is employed.

During the later part of the period under review, asepsis as opposed to antiseptics was strenuously advocated, and still is, by many surgeons. I gave it a fair trial, both in my own hands and those of my assistants, but never acquired confidence in it, and on theoretical grounds consider it a dangerous line of treatment. It is only applicable to a limited class of cases, those in which the wound is made by the surgeon. It can only be carried out successfully in hospitals and nursing homes with the aid of elaborate and expensive appliances and specially trained assistants and nurses. Where it is used, students see only surgical practice which they cannot possibly carry out afterwards in private, and they are not taught the methods which they can use. I have already seen the dire results of this in practitioners who, finding themselves unable to provide hospital appliances, and never having seen the simple *antiseptic* treatment, are compelled to leave their patients without the benefit of either. Those who practice the aseptic methods necessarily dread even the most remote connection with septic cases, make difficulties about receiving or treating them at all, and so lose the advantage which was originally the greatest claim of antiseptic surgery—the ability to treat cases successfully despite their surroundings.

And what do they gain? A supposed escape from the irritation of the germicides and that mental satisfaction

afforded by the successful issue of a practice, theoretically possible, but so beset with difficulty that to carry it out requires a dexterity of which one is naturally proud.

Personally, as I have said above, I never found any of the evil effects for which germicides are blamed. With their aid I was able, as I consider my statistics show, to obtain as large a measure of freedom from septic mischief as I think any reasonable man can expect, and this without adopting the idea under the thrall of which the aseptic surgeon now lies—that septic cases are surgically anathema, and must not be allowed “to come betwixt the wind and his nobility,” no matter what happens to the patients.

I maintain, and I was so taught by Lister, that one of the great beauties of antiseptic surgery lies in its capacity, intelligently and carefully employed, to exclude from our wounds the influence of surrounding sepsis. Even granting, which I do not, that successful asepsis, by avoiding chemical irritation permits slightly earlier healing, this is its only advantage that I know of, and is, I maintain, dearly bought at the price of the disadvantages I have enumerated. The only merit which I consider the system deserves, is that attempts to carry it out have taught us that septic mischief is more frequently introduced into a wound by solid than by aërial conduction, and that the disinfection of the human skin is one of the most difficult of tasks. These very lessons seem to me to point to the advantage of the greater security obtained by the application of germicides to our wounds. From the point of view of hospital management, in which I am now particularly interested, the question is very serious. On the one hand, no hospital manager, medical or lay, has any right to interfere with the method of treatment employed by any of the medical or surgical staff; but, on the other hand, the demands both for appliances, space, and nursing put forward by some of the extreme advocates of asepsis are beyond either the means or the accommodation at the disposal of hospital managers. I feel sure in a few years the difficulty will right itself, and, as in all previous cases in the history of medicine, the extremists will fall into line and a *via media* become the universal usage.

There is only one other point, with a few remarks upon which I will still detain you—that is the question of primary amputation during severe shock.

Experience has increased my inclination to hold my hand. No doubt each case must be judged on its merits. So far as I have been able to come to any guiding conclusion, it is that

in cases where the injury is in itself probably fatal no operation should be performed. It is often said that "operation gives the only chance." I am, on the contrary, more and more convinced that it often destroys any faint prospect of survival the patient has. It used to be taught, and perhaps still is, that during profound shock amputation has no further depressing influence, but this I cannot bring myself to believe. At anyrate, the anæsthetic, even if ether be used, is followed by depression. Amputation is rarely necessary for the arrest of bleeding, and if a patient survives even a few hours the operation can be performed with greater chance of success, while if he dies almost immediately, the surgeon is saved an operation which he cannot help feeling was of no benefit to the patient, and the performance of which under these circumstances must always be a cause of regret. The old advocacy of primary amputation was based upon the terrible mortality of secondary, which was explained in a wrong way because sepsis was not recognised. I fear that some surgeons are still guided by the old rule, forgetting that it was based on conditions no longer existing. Nevertheless, few surgical decisions require more calm and experienced as well as rapid judgment, and give more anxiety, than in many cases the election between primary amputation and delay.

