AN ADDRESS

ON THE

ANTISEPTIC SYSTEM OF TREATMENT IN SURGERY.*

Delivered before the Medico-Chirurgical Society of Glasgow.

By JOSEPH LISTER, F.R.S.,

Professor of Surgery in the University of Glasgow, etc.

I will now proceed to speak of the mode of dressing. Carbolic acid, as I have already remarked, is soluble in liquids of very different kinds, so different for example as water and one of the fixed oils; and each solution has its own special value. Water, having little affinity for the acid, dissolves but a small quantity, only one-twentieth part of the pure crystals,† and holds that small quantity very loosely, so as to permit it to act with energy on any substance for which it has stronger attractions, and also to become soon dissipated on exposure. Hence, the watery solution is a pretty potent but transient application. Now this is exactly what we want when we apply carbolic acid to the interior of a wound for the purpose of destroying any germs which may have been introduced into it. We require something that will act with energy for the moment; but which, as soon as it has extinguished the vitality of the septic particles, may disappear from the wound, in order that the tissues may be left free from all unnecessary irritation. The fixed oils, on the other hand, have so strong an affinity for the acid that they will mix in any proportions with it, and hold it so firmly as not to permit it to act with much energy on the tissues, or to become soon dissipated into the atmosphere. Hence an oily solution is comparatively bland but permanent in its operation. These are just the properties which are desirable for an external application. We wish it to serve as a reservoir of the acid, retaining it for twenty-four hours at least, so that it may remain constantly exerting its antiseptic influence upon the discharges that flow out beneath it. At the same time it is most important that it should be mild in its action on the surface to which it is applied, in order to avoid irritation and excoriation. It appears clear, therefore, that a watery solution is best adapted for the treatment of the interior of a wound in the first instance, while an oily preparation is suited for an external dressing.

We have next to consider the best form for the oily application. I have used various forms; of which some have proved trustworthy, and others not so. One that has shewn itself thoroughly reliable is a paste composed, like glazier's putty, of boiled linseed oil and whitening, but with the addition of about one part of carbolic acid to four of the oil. Even in the case of large abscesses, where there has been in the first instance a profuse discharge, the putty, if properly applied and retained securely in position, prevents with perfect certainty the spread of putrefaction into the interior. But the putty is a somewhat clumsy and inconvenient preparation, and I have been desirous, if possible, to get rid of it. Within the last few months I have given a full trial to cloths dipped in a solution of carbolic acid in olive oil, but I am sorry to say that this method, though attractive from its simplicity, is not reliable. It is true, indeed, that we have had some beautiful cases under this mode of management; as for example the following.

Case of Compound Fracture of the Right Leg and Severe Contused Wound in the Left Foot, in a Person of Advanced Age.—On the 31st of January last, a woman, aged 74 years, was admitted into the Infirmary, having been run over by a heavily laden omnibus. The wheels had passed over both lower limbs, producing in the right leg compound fracture of both bones a little above the ankle, with a considerable wound

on the outer side of the limb communicating with the broken fibula, and another on the opposite aspect, not directly connected with the seat of fracture. In the left limb the violence had been sustained by the foot, which presented at its inner aspect a large gaping contused wound, four inches long and two inches broad, while the skin was extensively detached, so that when a watery solution of carbolic acid had been introduced at the wound, pressure over the skin at the outer or opposite side caused some of the fluid to escape, shewing that it had passed freely over the upper surface of the foot, beneath the undermined integument. She had also a wound on the forehead, two inches long, exposing the os frontis. From these various injuries she had lost a great deal of blood, and she was also suffering from contusions in other parts of the body. All the wounds were dressed with layers of lint soaked with a solution of carbolic acid in olive oil; the superficial layer, larger than the rest, being changed daily while the deeper layers were left undisturbed. Under this treatment the wound on the forehead healed without the formation of a drop of pus, and those in connection with the compound fracture were converted into superficial granulating sores, without any more disturbance, local or constitutional, than if the fracture had been a simple one; and the bones united in the usual period under the use of pasteboard splints. But the most remarkable circumstance in the case was the progress of the injury of the foot. Three days after the accident, my house-surgeon, Mr. Appleton, observed that a considerable portion of the undermined skin on the dorsum of the foot had lost its vitality; and instead of adopting the usual course of applying wet lint or a poultice till the slough should separate, he extended the antiseptic dressings so that they overlapped the dead portion of tissue for a considerable extent in every direction; after which, the daily changing of the superficial layer was continued as before. The result, though in strict accordance with the principles which I am endeavouring to enforce, was strikingly opposed to ordinary experience. After the subsidence of the copious sanious effusion which took place immediately after the injury, the discharge became reduced to about one minim in twenty-four hours, without any distinct appearance of pus, while the foot remained free from the slightest uneasiness, so that she moved it as usual in the bed, and imagined it perfectly recovered. Such being the case, knowing, as I did, that to remove the deep dressings would be to induce, at the best, two large granulating sores which must, from that time forward, furnish a considerable amount of pus that would act as a drain upon the old lady's feeble system, I left the crust of lint and dried exudations untouched for seven weeks, at the end of which time it became spontaneously detached. On raising it, we found a narrow line of cicatrix along the inner side of the foot, complete healing by scabbing having occurred in, I suppose, the largest wound ever known to heal in that manner in the human subject. And on the dorsum of the foot, in place of the large slough, was a broad scar, a portion in the centre about as large as a fourpenny piece alone remaining unhealed; the dead tissue having, apparently, been absorbed, as none of it was found on the dressing. The superficial layer of antiseptic lint daily renewed, had answered the purpose of preventing putrefaction from spreading inwards, while the thickness of the permanent crust had kept the carbolic acid constantly supplied externally from penetrating to its deepest parts. Hence, the portion of the dressing in contact with the skin, having lost its original acid by diffusion into the circulation, before sufficient time had elapsed for granulation and suppuration to take place under the stimulating influence of the antiseptic, became a perfectly unirritating or neutral body, and the dead portion of tissue beneath it, being in like manner destitute of any stimulating properties, became amenable to absorption, like the bit of the external coat in the noose of the antiseptic ligature, or the dead bone in the case of necrosis, above related.

But, while I have mentioned this case as a good example of the behaviour of severe injuries under antiseptic management, I wish it to be distinctly understood that I do not recommend the mode of dressing adopted. For, as I have already stated, and as bitter experience in some other cases has but too clearly convinced me, it cannot be implicitly relied on. The reason why it is less trustworthy than the putty is sufficiently plain. The lint, being porous, absorbs the discharge, which, as it enters, displaces the antiseptic oil, and may thus, if profuse, establish a channel of putrescible materials from the external atmosphere to the wound. Again, when the discharge has passed through the dressing, even though it have been imbued with carbolic acid in its passage, it gives it off into the atmosphere on exposure, when it becomes again liable to putrefaction, and, having putrefied, may soak back into the porous dressing, and deprive it entirely of antiseptic virtue. For carbolic acid and the products of putrefaction exert a powerful chemical action upon each other; and, on this account, the former is a deodorant as well as an antiseptic, and, conversely, the latter, if in sufficient quantity, neutralise the acid and render it inert. In this way, I have known a dressing, con-

* Continued from page 102.

† The impurities often met with in carbolic acid interfere with its solubility in water. The first specimen with which I happened to experiment was an impure liquid kind, sold as "German creasote", and this was absolutely insoluble in water; the associated organic compounds having, apparently, too strong an affinity for the acid to permit water to appropriate any of it. I was thus led into the mistake of stating that carbolic acid is insoluble in water. (*Lancet*, March 16th, 1867.) I may remark that the public are much indebted to Mr. Crace Calvert, of Manchester, for his successful efforts to prepare carbolic acid in a pure form at a moderate price. Mr. Calvert's second quality of the crystallised product, sold wholesale at 1s. 6d. per pound, is sufficiently pure for surgical purposes.

sisting of several layers of the oiled lint, lose all odour of carbolic acid and acquire that of decomposition within twenty-four hours of its application.* The putty, on the other hand, being impermeable to the discharge, retains the carbolic acid securely stored up, except in so far as it is exhaled from the surface, to maintain a constant antiseptic action upon the blood, serum, or pus, that flows out beneath.

Impermeability to a watery fluid being thus evidently the essential cause of the superior efficacy of the putty, the chalk, which is its chief constituent, being of no other use than to give consistency to the mass, it naturally occurred to me that, if the oily vehicle of the carbolic acid were in a solid form, the chalk might be dispensed with, and the advantages of the putty might be obtained in a less bulky and more convenient form. I tried, in the first place, various kinds of *emplastra*; but these appeared objectionable on account of their adhesiveness, which is greatly increased by the admixture of carbolic acid, and which seemed likely to be mischievous by retaining the discharge. I next employed paraffine, mixed with a little wax to give it tenacity, and a little olive oil to confer the requisite softness. This certainly made, under ordinary circumstances, an effective as well as elegant substitute for the putty, being perfectly devoid of adhesiveness, while a comparatively thin layer proved secure by antiseptic. But the paraffine cerate had this great disadvantage, that, in situations where it was subjected to much movement, such as the groin, it was apt to crumble down and become useless. Meanwhile I learned that Dr. Watson of Edinburgh was employing soap-plaster mixed with carbolic acid, and that, though adhesive, it appeared to work well; the discharge finding its way out beneath it. Thus I was again induced to try *emplastra*; and of late we have been using what seems to answer admirably; viz., *emplastrum plumbi* mixed with one-fourth part of bees-wax to give it sufficient consistence, the carbolic acid being in the proportion of about one-tenth of the whole.† This is used as a plaster spread on calico in a layer of about one-twentieth of an inch thick, and I can recommend it as thoroughly reliable. There is a case which I am dressing with it at the present time, which I may mention on account of its interest otherwise.

Case of Old Fracture of the Ankle with Fixed Displacement of the Foot, Rectified by Aid of the Antiseptic System.—A young man, aged 29, was engaged in mooring a vessel on the 11th December, 1867, when one of the massive ropes, used for the purpose, slipped and struck him with violence at the outer and posterior aspect of the ankle, fracturing the fibula about two inches above the joint, and breaking off the internal malleolus at its base, driving the bones of the leg forwards and inwards with respect to the foot, or, in other words, producing displacement of the foot backwards and outwards. Four months after the receipt of this injury he came under my care in the Infirmary, with the heel very prominent and the foot greatly everted, and firmly fixed in its abnormal position by osseous union of the fragments. In this condition the limb was absolutely useless, and the question arose whether anything could be done to restore it. It was clear that the foot could not be replaced without

* If fresh oil is assiduously supplied at short intervals by night as well as by day, this objection to oily cloths as a dressing is removed. But this would in many cases be impracticable; and, as a general rule, it is obviously undesirable, from the trouble and uncleanness involved in it. There are situations, however,—such as the perineum,—in which this is probably the best mode of management. And it may be added that, in any case where the discharge is very trifling, oiled lint, changed once in twenty-four hours, will prove sufficiently reliable.

† In making the plaster with the ingredients mentioned in the text, the *emplastrum plumbi* and the bees-wax are melted and mixed together, and allowed to cool, till the liquid begins to thicken; the carbolic acid is then added and stirred in, which has the effect of bringing back the mass into the state of a thin liquid, which is assiduously stirred till it thickens, to prevent the wax from separating in granules. This plaster is, however, inconveniently soft, and cannot be kept spread in stock. I have since found that by increasing the proportion of litharge, the lead-soap may be made of any degree of firmness that may be desired, provided that water be not used in the manufacture. When the litharge and olive oil are in the proportions directed by the *Pharmacopœia*, a certain quantity of water must be added to promote the combination of the fatty acids with the oxide of lead, and even then the process is a very tedious one. But it is an interesting fact chemically, that if the litharge is used in about four times the pharmacopœial proportions, although no water be employed, the combination proceeds under a brisk heat with great rapidity. It is upon this fact that the following method of manufacture is based.

Take of olive oil, 12 parts by measure; litharge (finely ground), 12 parts by weight; bees-wax, 3 parts by weight; crystallised carbolic acid, 2½ parts by weight. Heat half the oil over a slow fire; then add the litharge gradually, stirring constantly till the mass becomes thick or a little stiff. Then add the other half of the oil, stirring as before till it becomes again thick. Then add the wax gradually till the liquid again thickens. Remove from the fire and add the acid, stirring briskly till thoroughly mixed. Cover up close and set aside, to allow all the residual litharge to settle; then pour off the fluid, and spread upon calico to the proper thickness. The plaster made in this way can be spread by machine, and kept rolled up in stock; and, if in a well fitting tin canister, will retain its virtues for any length of time. This I believe to be the most perfect form in which an antiseptic lead-plaster can be obtained. It is supplied at a very moderate price by the New Apothecaries' Company, Glassford Street, Glasgow. For almost all purposes, however, it is superseded by the lac-plaster, which will be found described in the succeeding part of this address. These improvements in the materials for dressing have occupied a much longer time than I had anticipated; and have been the cause of the delay in publication.—J. L.

breaking through the "callus" which could be plainly felt in both bones, and there seemed no prospect of being able to do this without cutting down and adopting means which, in the case of the tibia, would necessarily involve opening into the articulation, or producing artificially a compound fracture into the ankle joint. This I certainly should not have dreamed of doing without the aid of the antiseptic system, being well aware of the disastrous course such injuries commonly run under ordinary management. If I had operated at all, I should have made a point of removing the end of the tibia, and even then I should have felt that I was subjecting the patient to some risk. But feeling confident that I had the means of converting a compound fracture into a simple one, I did not hesitate to adopt the following procedure. On the 11th inst. (April 1868), the man being under the influence of chloroform, I made a curved incision behind and below the prominent end of the tibia; and, a solution of carbolic acid in about four parts of olive oil being dropped into the wound during the progress of the operation, I detached the soft parts from the bone sufficiently to enable me to insinuate behind the callus one blade of a pair of cutting pliers, smeared with the same oil, and then having placed pieces of lint, soaked with the oil, around the blades of the pliers, so as to prevent the chance of septic air entering the joint when the bone should give way, divided the callus, and at once covered the wound with the antiseptic lint. I then made a longitudinal incision over the seat of fracture in the fibula, and divided it with similar precautions. Having thus overcome the obstacle presented by the bones, I proceeded to draw the foot towards its proper position by pulleys acting upon its outer and posterior part through the medium of a skein of worsted passed round it, while a padded belt supported the opposite aspect of the leg above the ankle: the wounds being kept carefully covered with the oiled lint. When a considerable amount of force had been used there was a sudden sensation of something giving way; and now, on removing the apparatus, the foot was found to have resumed its natural place. The wounds were then dressed with layers of lint soaked with a weak oily solution of carbolic acid, and covered with the antiseptic plaster; after which, a Dupuytren's splint was applied at the inner side of the limb to prevent eversion, and Mr. Syme's horse-shoe splint anteriorly to obviate the tendency to displacement backwards. Fresh plaster has since been applied daily; and the result has been that, while the foot has retained its position satisfactorily, the patient has not suffered at all either locally or constitutionally, during the six days that have elapsed since the operation. His pulse has remained 68 or 70, he has not lost his sleep a single night, his tongue has been quite clean, and his appetite good. In fact, he has taken his food with better relish than before, because he has been freed from his previous gloomy prospect of hopeless lameness, while the operation has caused him no anxiety; as the assurance which I felt justified in giving him, that it was entirely free from danger, has been confirmed by the absence of pain or other annoyance. The discharge which was sanious and copious in the first instance, has of late been only about three minims of clear serum in twenty-four hours; and judging from our previous experience with compound fractures, there is every reason to expect that in a few days more it will cease entirely.

[The subsequent progress of the case has been, on the whole, very satisfactory. But, for reasons to be soon referred to, healing by scabbing did not take place as was anticipated. The discharge, instead of drying up, showed rather a disposition to increase, and assumed a somewhat puriform character; and, although the renewal of the superficial plaster once in two or three days did not involve much disturbance of the limb, I thought it best to expose the wounds when sufficient time had passed to ensure the secure coalescence of their deeper parts. Accordingly, on the 1st of May I removed the lower portions of the dressings, disclosing two superficial granulating sores, with very prominent granulations which explained the want of disposition to cicatrise. These, though treated with astringents, proved rather indolent, so that they were not completely healed till the 4th of June, though the bones were firmly united a fortnight before.]

When he was allowed to walk, though he placed the sole fairly on the ground, he experienced inconvenience from a contracted state of the sural muscles, produced by the long continued displacement of the foot backwards and consequent downward pointing of the toes, so that he could not bend the ankle beyond the right angle at which it had been maintained since the operation. I hoped that this inconvenience would be overcome by exercise; but in this I was disappointed; for though his power of walking improved, it was by no means satisfactory. It also appeared that the abnormal position of the foot had led to an exaggeration of the curve of its arch, to such an extent as to make the foot half an inch shorter than the other, while the plantar fascia was felt as a rigid band. I therefore divided that fascia and the tendo Achillis subcutaneously on the 26th of July, and this had the immediate effect of restoring the foot to its natural length, and permitting the ankle to be bent

at an acute angle. Had I the case to treat over again I should perform the tenotomy at the same time as the main operation. But except the loss of time that has occurred, the result is nearly all that could be wished. Under the use of a Scarpa's shoe he has continued to improve steadily, and when I last saw him, in the early part of September, he could walk firmly and well, and complained only of some remaining stiffness of the ankle.]

[To be continued.]

PERIOSTEAL PRESERVATION IN OPERATIVE SURGERY.*

By WILLIAM STOKES, JUN., M.D.,

Surgeon to the Richmond Surgical Hospital, and Lecturer on Surgery in the Carmichael School of Medicine, Dublin.

As the value of periosteal preservation in operative surgery is a topic in which I have been much interested during the past five years, I am desirous of drawing the attention of this Section of the Association to it; not because I can boast of having to add much to the knowledge which we already possess on the subject, and for which we are so largely indebted to Professors Syme and Langenbeck, and M. Ollier; but because this modification in operative surgery is one which I cannot but think is of considerable practical value in the technical department of our art. This opinion, however, is far from being generally accepted. Operating surgeons—some of them of the highest eminence—question the possibility of performing subperiosteal resections; others absolutely deny the utility of this modification; while, again, others either contemptuously ignore it in their writings as if it were altogether unworthy of discussion, or, at most, consider its value very questionable indeed. This being the case, I was specially anxious to bring the subject under your notice in a brief communication; inasmuch as, although, as I previously mentioned, I have nothing that is very novel to relate on the subject, yet some operations in which I have practised both preservation as well as transplantation of periosteum, have been attended with results which, in truth, I may say have been signally illustrative of the importance of this modification in joint resections, as well as in other operative measures.

Did time permit, I would wish much to draw your attention to many points connected with this subject, which have led to the practical application of periosteal preservation in operative surgery. First, for example, to discuss the results of subperiosteal resections made on the lower animals; secondly, the proofs of osseous regeneration by the periosteum in man; thirdly, the result of transplantation of the membrane in the lower animals; and, lastly, to discuss generally the results of the experimental researches proving the osteogenetic properties of periosteum, which have been made, in the first instance, by Du Hamel, his pupil Fougereux, Vigarous and Wiedmann, as well as those of Syme, Ollier, and others; all of which have, in truth, proved incontestably that the function of the membrane is not limited, as was formerly held by Haller, Bordenare, Bichat, and others, to simply limiting the form and size of osseous structure, its vessels supplying nutrition to the bones it enveloped, and, lastly, acting as a barrier against the extension of disease. The discussion of these topics would, of necessity, be replete with interest; but, on consideration, I have determined to refrain from entering on this part of the subject on the present occasion, as it would require, to do it justice, much more time than is at my disposal, and is also, perhaps, more adapted for purely physiological investigation, than for that which is the prime object of our present meeting; namely, to discuss subjects which may, directly or indirectly, tend to modify or improve the science or art of practical surgery.

My attention was specially directed to this subject, in consequence of my having witnessed on several occasions, during the years 1863 and 1864, the application of the subperiosteal method, applied not alone to articular resections, but also, in some instances, to those of bones in their continuity. These were performed respectively in the surgical clinics of Professor Langenbeck and M. Ollier; and it was from the remarkable results which I had an opportunity of witnessing, that induced me to investigate the subject myself—first experimentally, and subsequently practically.

I shall not detain you by attempting to demonstrate the possibility, as well as facility, of this operative method, both of which have been denied—or, at all events, strongly questioned—by various surgeons, many of whom, I cannot but think, have condemned this novel procedure without first taking the necessary trouble of investigating its merits for them-

selves; but, without reference to any experimental research on the lower animals, having given you the leading facts connected with some of the cases on which I have operated in this way, I shall then indicate the difference between the results obtained in the one instance by the subperiosteal method, and in the other by the ordinary mode of excision.

The first of these operations was performed on a girl, aged 12, of delicate habit, who was under my care in the autumn of 1864, and who suffered from strumous disease in her left elbow-joint. The patient stated that, four months previous to her admission into hospital, she received a fall in which the elbow was struck against the ground with great violence. After falling, the patient suffered severe pain in the joint; it swelled greatly; and she found it impossible to extend or "stretch" it, to use the patient's own expression. The inability of extension of the arm remained a permanent condition. Three months after the accident, the patient was admitted into my wards in the hospital. I found the arm forcibly flexed; extension was impossible. The soft parts about the joint were swollen and puffy, so that it was quite impossible to determine whether the original injury was an epiphysary disjunction, which the age of the patient rendered probable, or a simple luxation. There were three or four sinuses, situated over and in the immediate vicinity of the internal condyle; and, on introducing a probe into any one of these, the existence of soft diseased bone could be readily determined. I accordingly performed the operation, adopting the long vertical incision, carrying it over the ulnar side of the olecranon, and, taking especial care not to divide the triceps tendon, proceeded to raise the periosteal envelope by means of the various formed raspatories devised for the purpose. The elevation of the periosteum was not attended with any great difficulty, and the remaining steps of the operation were then completed in the ordinary manner. The limb was afterwards put up in a gypsum bandage, and kept in a continual bath for four weeks. After this, the wound being all but healed, gradual flexion and extension were commenced. Three months and a half after the operation, the power of flexion and extension of the joint was almost perfect; and now, at a period of little more than three years after the operation, during which period there has not been the slightest evidence of a re-appearance of the disease, the patient enjoys every motion that the healthy joint possesses, perfect power of flexion, extension, pronation, and supination; and, what bears more directly on the immediate subject of this communication, there is a most obvious osseous re-formation, not only of the condyles, but also of the olecranon. This re-formation of the olecranon has also been frequently observed by Langenbeck, and also by Hueter, one of his former assistants.

The next case was also one in which I excised the elbow-joint. The patient was a girl, aged 8. The right elbow-joint, which was the seat of very extensive strumous disease, had been affected for upwards of nine months; the disease had commenced, according to the account which her parents gave, without any local exciting cause. There were several sinuses over the posterior portion of the joint. Through these, on introducing a probe, softened diseased bone could be felt. Excision was performed precisely in the same manner as in the previous case; and the subsequent treatment by the gypsum-bandage and the continual bath in every respect identical. It is now six months since I saw the case; but then the sinuses had healed, the motions of the arm were excellent, and the re-formation of the portions of bone removed was perfectly obvious.

In a third case, in which I excised the elbow subperiosteally, the case progressed most favourably until the ninth week after the operation, the wound being at that time quite healed; but symptoms of pneumonia supervened, which unfortunately proved fatal. I regret extremely that I was not permitted by the friends of the patient to make any examination of the joint.

Another case affords a striking illustration of the osteogenetic properties of periosteum, and, consequently, of the great practical importance of carefully preserving it in resections. The patient, a young woman, about 19 years of age, suffered from suppurative osteitis of the right ulna, the result of a severe blow. A free incision was made down to the bones; and over this, which I found extensively diseased, the periosteum was much thickened. Having divided the membrane by one of Nélaton's so-called periosteal knives, I then detached it by means of raspatories from off each side of the bone. The diseased portion of bone, about two and half inches in length, was then removed by small resection-saws. Three months after the operation, the wound was completely healed. New bone had formed throughout, and the patient was enabled to return to her employment, which was that of a house-servant. The result of this case, though of the last importance, does not afford so signal an example of the importance of periosteal preservation, after resections of portions of bones in their continuity, as the classical case of Louise Gaillard, recorded by M. Ollier—a case which I was fortunate enough to have an opportunity of seeing—where the upper half of the humerus was excised for a similar affection, and with

* Presented to the Surgical Section at the Annual Meeting of the British Medical Association in Oxford, August 1868.