

employed compresses soaked in wine or in balsams, such as the balsam of Arcæus, or covered with an ointment consisting of equal parts of wax, turpentine, and oil of hypericum. In order to avoid the contact of the air the dressing was changed as quickly as possible.

HEISTER¹ (1753) used balsams very extensively, not because he held that they conduced to form new flesh, but chiefly because they removed everything that might hinder that process, more especially putrefaction. In order to prevent the access of air, which he considered hurtful, the surgeon was instructed not to remove the old dressings till the new were ready for application. Heister attended to the drainage of his wounds, and, if necessary, he made a counter-opening into which he introduced a piece of lint covered with some sort of balsam. The edges of the wound were brought together either by stitches or by plasters composed of various balsams.

The most important work, however, in which the action of antiseptics is especially recommended, was BILGUER'S² (1764). His method of treatment in all kinds of wounds consisted essentially in filling all the recesses of the wound with antiseptics, and laying over the wound a piece of lint dipped in an antiseptic solution. His method is specially described in connection with cases of mortification. He makes incisions through the dead parts, which incisions should be large and numerous, but should not touch the living part. He then squeezes out the corrupted humours, and pours in the following mixture: 'Of frankincense, mastick, sarcocolla, and myrrh finely powdered, true balsam of Peru, and genuine essential oil of cloves—equal parts; of balsam of Fioraventi, as much as may, after mixing all the ingredients over a very gentle fire, form a thin liniment.' Over this is laid some dry lint, thoroughly sprinkled with a powder composed of 'an ounce of myrrh finely powdered, half an ounce of sal-ammoniac, camphor and nitre—of each a drachm.' If necessary, fomentations may be applied outside this. These fomentations should be composed of 'a pint of lime-water, 3 ounces of camphorated spirits of wine, and 1½ ounce

¹ *General System of Surgery*, translated 1753.

² *A Dissertation on the Inutility of the Amputation of the Limbs*, with notes by M. Tissot, 1764.

of sal-ammoniac.' A variety of other mixtures and methods of treatment are mentioned, but the quotations will show the essential points.

In this method the thorough application of these substances would no doubt result in complete asepticism; and the results which he obtained are very remarkable. From his experience, he sets his face strongly against amputation. He says: 'The cutting off a limb being the severest means employed in surgery for the relief of mankind—an operation which every one beholds with horror—I cannot, I imagine, better accomplish my design, or do a greater service than by demonstrating that the cases wherein amputation is necessary are much less frequent than has been hitherto supposed, and that it may even be almost totally dispensed with.'

With regard to his results he says: 'I have had under my care, during the course of the late bloody war, a great number of wounded limbs, torn and shattered by cannon and musket-balls, by the bursting of bomb-shells and grenades, by grape-shot, &c. I cured them without ever performing amputation . . . although there were bones broken and shattered, large blood-vessels divided, the flesh miserably lacerated, and limbs carried off; others in which the bones were split up as high as the articulation; all which circumstances might make us reasonably apprehend a tedious and difficult cure, too plentiful a suppuration, hæmorrhages, violent inflammation, excessive corruption, mortification, and death.' . . .

'I had at one time, during the war, in a military hospital, 6618 wounded persons, who were all treated according to my direction, and part of whom I attended myself. Of these, 5557 persons were perfectly cured, and in a condition to support all the fatigues of the service; 195 were able to do duty in garrison—what they call "half-invalids"—or to work at any trade; 213 remained incapable of any labour, civil or military, what they call "grand invalids," and 653 died.'

The 195 and 213 invalids belonged to the class of cases who had their bones bruised, broken, or shattered. After a calculation which I need not go into, he very reasonably concludes that 'much the greater part of these 408 men cured and sent to the Invalides would have died if amputation had

been performed.' He compares this with the 'prodigious number of wounded men who at the beginning of the war had their limbs taken off on account of dangerous wounds, of whom scarce one or two escaped with their lives.' He concludes thus: 'Further, if it be considered that many of those who died might have recovered, had they been taken care of anywhere else than in an hospital, where the air is very bad, and if it be called to mind at the same time, what some very eminent surgeons have observed, that two-thirds of those die who have their limbs cut off, I hope it will be readily acknowledged that my method of treating wounded limbs by saving them, is highly preferable to that of amputation.'

As a contrast to this method I may refer to that used by PERCIVAL POTT¹ (1768) in compound fractures. Where the limb is treated conservatively, he recommends immediate reduction, and then he mentions two requisites: 1. The maintenance of a proper opening for the free escape of discharges—a counter-opening being made if necessary; and 2. The prevention of inflammations in order that the wound may heal, as far as possible, by first intention. His dressing was a piece of dry lint next the wound, and outside this a 'pledget spread with a soft easy digestive.' As the result of this treatment in compound fractures, wounds of joints, &c., he thinks that the patient has the best chance by immediate amputation. Thus Bilguer, by his piles of dressings, but these acting more or less completely on aseptic principles, regards compound fracture as a much more favourable accident than does Percival Pott with his simple non-antiseptic dressings.

Towards the end of this century, the evil influences of air on wounds was brought very prominently forwards, more especially in England. About this time PRINGLE² published a work on the diseases of the army, in which he speaks of diseases arising in consequence of foul air, and narrates a series of experiments made with various antiseptic substances.

In 1784 BENJAMIN BELL³ published his treatise on the theory and management of ulcers, in which he speaks very strongly

¹ *Chirurgical Works*, edited by Sir James Earle, 1808.

² *Observations on the Diseases of the Army*, third edition, 1761.

³ *Treatise on the Theory and Management of Ulcers*, 1784.

of the bad effects of air: 'The bad effects of air,' says he, 'on every species of sore are well known to every practitioner, but its pernicious influence on a newly opened abscess is often really astonishing. It first occasions a total change in the nature of the matter, from perhaps a very laudable pus to a thin ill-digested sanies, and afterwards brings on a quickness of pulse, debilitating sweats, and other symptoms of hectic fever, which for the most part, when the collection has been considerable, either carries the patient off in a short time, or terminates in a confirmed phthisis, which sooner or later proves fatal.' How air acts he does not know, but he thinks that it may stimulate the absorbents to greater absorption of pus, 'and it may likewise, by rendering the matter more putrid than before, give even to the same quantity greater activity in producing the different symptoms of hectic.' On this principle (of preventing putridity) he would account for the operation of many of the remedies commonly employed at that time in the treatment of sores. As a means of avoiding all these dangers, he recommends the introduction of a seton into an abscess, and he thinks that the progress of cases so treated is better than that of those in which the abscess is laid freely open. In hydrocele, however, he found that the use of the seton was followed by great pain and constitutional disturbance. From what has gone before it will be readily understood why such disturbance resulted, and also that, in the case of the abscess, no real benefit was derived.

Benjamin Bell also used leaden drainage tubes. In incised wounds, after bringing the edges together, he applies 'no dressings' except a thin covering of soft lint to protect the parts beneath from cold, and to keep out the air.'

He is always reiterating the statement that 'nothing proves more hurtful to sores than exposure to the air;' and he directs his efforts to excluding the air by closely applied ointments, &c. He also details the disastrous results of wounds of joints, and he says that many authors advise immediate amputation in such cases. In small wounds, however, he draws down the skin and stitches it in such a position as to make a valvular opening.

He proposes a valvular incision for the removal of cartilages

from joints where the cartilages are quite loose, but where they are attached to any part of the synovial membrane, and the pain is insupportable, he would advise amputation as 'less painful as well as less hazardous.'

Similar views as to the bad effects of air on wounds were expressed by HUGH MUNRO¹ (1792); and he agrees with Bell in attributing the disastrous consequences following wounds of joints and incisions into psoas abscesses to the entrance of air and the putrefaction of the discharge.

ALEXANDER MUNRO² (1788) had previously written on the bad effects of air on serous sacs, but he thinks the *coldness* of the air is their chief cause.

JAMES LATTA³ (1795) gives the teaching of the Edinburgh school, which is essentially that of Benjamin Bell. He says that the admission of air into abscesses 'is immediately attended with symptoms of putridity; the pus, which at first was white, thick and free from any fœtor, becomes instantly thin, fœtid, and corrosive; a quick pulse and hectic sweats come on, from which the patient scarcely recovers, if the collection of matter has been very large.'

In the *ENCYCLOPÉDIE MÉTHODIQUE* (1790) Alexander Munro's idea as to the coldness of the air being the injurious factor is upheld, but, at the same time, the impurity of the air is also brought forward, and an attempt is made to prove its influence by citing the different results of amputations in town and country.

The advocate of the bad effects of air who succeeded in turning his views to the best account was, however, ABERNETHY⁴ (1793). He first points out in his 'Essay on Lumbar Abscesses' that 'whilst the condensed cellular substance which forms the cyst of an abscess remains entire, it continues free from inflammation, and the contained pus suffers no putrefaction, nor evident alteration of quality; . . . whenever the abscess is opened, either by ulceration or by the hand of the surgeon, a sudden and generally considerable inflammation extends over the whole cyst. This is followed by a copious

¹ *A Compendious System of the Theory and Practice of Modern Surgery*, 1792.

² *Bursæ Mucosæ*, 1788. ³ *Practical System of Surgery*, 1795.

⁴ *Surgical and Physiological Essays*, 1793.

discharge of frequently fetid pus.' Abernethy's writings are so well known, and so well worthy of perusal, that it is unnecessary for me to discuss them in detail. His principle of treatment was to reduce the size of the cavity to as small dimensions as possible by successive tapplings of the abscess, and when this was done, the remaining sac was opened. This method was first carried out by drawing off the pus by means of a trocar and canula, but that was soon abandoned for a valvular incision. Several cases are recorded which clearly show the advantages of the method.

In investigating the reason why air does harm, Abernethy discusses the views as to whether it is on account of some irritating property which it possesses, or by causing putrefaction. He concludes, from observation of the phenomena seen in emphysema, and also from Astley Cooper's experiments, in which he inflated the abdomen with air without causing any harm, that the first supposition cannot be correct. Nor does he think that it is the putrid matter which does the harm, for 'if the matter had only an incomplete discharge, if it was confined in a state of putrefaction, and thus applied to the surface of the abscess, it surely would be in some degree injurious, but as the outlet in general is sufficient, and as the former matter is washed away by that which is newly secreted, this is not likely to be a common occurrence.' His belief is that it is partly the primary injury to the cyst when it is opened, but chiefly the *constant* action of the air. 'The circumstances, however,' he says, 'are different' (from those in Astley Cooper's experiments). 'When the opening is permanent, a constant renewal of air is permitted; and the application of a matter so unusual to these surfaces, I am inclined to believe, does harm.'

In his 'Lectures on the Theory and Practice of Surgery' (1830), he speaks of the objects to be aimed at in the treatment of wounds, viz. position, accurate union, avoidance of movement or tension, and prevention and mitigation of inflammation. Stitches are bad, and he uses plasters instead. He approves of leaving wounds open till they become glazed, and then, when the edges are brought together, he covers them very lightly or leaves them quite exposed.

The dangers of air, and the advantages of the valvular

method, were accepted by the leading German writers of this period.

JOHANN CHRISTIAN ANTON THEDEN¹ (1795) used a lotion for wounds, consisting essentially of sorrel water and alcohol. He speaks of washing out wounds with warm wine, then bringing the edges together, and applying compresses soaked and kept moistened in this lotion. He does not regard wounds of joints as so dangerous as other writers have made them out to be; and he mentions a case of compound fracture of the olecranon from a sword cut, in which there was but little fever and discharge, and the joint was ultimately only somewhat stiff. Three cases of removal of loose cartilages from the knee-joint are narrated. Pressure was made during the operation so as to prevent the entrance of air, and then his lotion was applied. Two cases did well, the third patient got a 'malignioses Fieber' after the operation, and died. Theden does not think that this bad result was a consequence of the operation.

AUGUST GOTTLIEB RICHTER (1799)² advocates the free removal of pus by counter-openings if necessary. He used various digestive ointments, and rather tended to the old style of stuffing an open wound without employing any special antiseptic means. It is interesting to note that with him the question of amputation in gunshot injuries and compound fractures is brought prominently to the front. He fears an absorption of pus, if attempts are made to save the limb, and this absorption is, according to him, always followed by death. He advocates Abernethy's method of opening lumbar and psoas abscesses.

These views as to the bad effects of air on wounds and in abscess cavities were not allowed to pass unchallenged, and were especially objected to by John Hunter and John Bell.

JOHN HUNTER (1792)³ ascribes the bad consequences following a wound to the injury itself, and not to the action of the air. A disposition in the part to inflammatory action may also be superadded. In speaking of the view that air is a cause of suppuration, he says: 'Various have been the opinions on this

¹ *Neue Bemerkungen und Erfahrungen zur Bereicherung der Wundarzneikunst*, 1795.

² *Anfangs-gründe der Wundarzneikunst*, 1799.

³ *John Hunter's Works*, Vol. III., edited by F. Palmer, 1835.

subject' (the question of inflammation in wounds); 'and as every violence committed from without, under the circumstances before mentioned, is exposed more or less to the surrounding air, the application of this matter to internal surfaces has generally been assigned as a cause of this inflammation; but air certainly has not the least effect upon those parts, for a stimulus would arise from a wound were it even contained in a vacuum. Nor does the air get to the parts that form circumscribed abscesses, so as to be a cause of their formation; and yet they as readily suppurate in consequence of inflammation as exposed surfaces.

'Further, in many cases of emphysema, where the air is diffused over the whole body, we have no such effect—and this air not the purest—excepting there is produced an exposure or imperfection of some internal surface for this air to make its escape by, and then this part inflames. Nay, as a stronger proof, and of the same kind with the former, that it is not the admission of air which makes parts fall into inflammation, we find that the cells in the soft parts of birds, and many of the cells and canals of the bones of the same tribe of animals, which communicate with the lung, and at all times have more or less air in them, never inflame; but if these cells are exposed in an unnatural way, by being wounded, &c., then the stimulus of imperfection is given, and the cells inflame, and unite, if allowed; but if prevented they then suppurate, granulate, &c.

'The same observation is applicable to a wound made into the cavity of the abdomen of a fowl, for there the wound inflames and unites to the intestines to make it a perfect cavity again; but if this union is not allowed to take place, then more or less of the abdomen will inflame and suppurate.

'If it was necessary that air should be admitted in order for suppuration to take place, we should not readily account for suppuration taking place in the nose from a cold, as that part is not more under the influence of air at one time than at another; nor is the urethra in a gonorrhœa affected by the air more at that time than at any other; these parts being at all times under the same circumstances with respect to air. Therefore, there must be another cause.' Truly there is another cause, as has been

already demonstrated, but not the one John Hunter supposed, as we shall see when we consider the results of subcutaneous injuries and subcutaneous operations.

John Hunter's treatment of wounds is very simple. He wished to allow nature to perform her work herself, simply applying poultices or ointments to allow the protecting dressing to come off easily.

It is in his views on healing by scabbing that we are mainly interested. He observed that when blood dried on a wound, that wound often healed without suppuration; and hence he concluded that a scab was an obstacle to suppuration, chiefly because it precludes the necessity for the formation of discharge to act as a covering for the exposed surfaces. He considered that it was the best practice to let superficial wounds scab over. Many deep-seated wounds also, where the deep parts are in contact, may be allowed to scab. This ought likewise to be done in cases of compound fracture with a small external wound. In large wounds this formation of a scab did not always succeed, but he did not think that there was any danger in trying to get it. In such cases the crust formation could be aided by the sprinkling of powders over the surface, such as chalk or lapis calaminaris. Where suppuration occurred under the crust, he did not even then remove it in the first instance, but pressed out the pus in the hope that the remainder might dry up. When, however, it was evident that harm was being done, he applied poultices and removed the crusts.

JOHN BELL¹ likewise denied that the bad results of wounds were due to the admission of air. In the edition of his 'Principles of Surgery,' edited in 1826 by Charles Bell, he opposes strongly the idea that air can in any way cause inflammation, and he criticises severely Munro's book on the 'Bursæ Mucosæ.' He points out that in the case of abdominal wounds or of psoas abscesses air cannot enter the cavity. He further adds: 'That the air which we breathe, and which we feel upon the surface so bland and delightful, should have so opposite a relation to the internal parts, that it should there be a stimulus more acrid and more dangerous than the urine or bile, is not to be believed upon slight grounds: this misfortune of inflammation

¹ *Principles of Surgery*, edited by Sir Charles Bell, 1826.

running so quickly round all the surfaces of shut sacs, wherever they happen to be wounded, proceeds altogether from another source, simple and plain to the last degree. For, in the wound of any shut cavity, where the parts do not adhere, the inflammation spreads and runs its course by a law of the animal economy, which we explain very ill when we call adhesion, the adhesive stage of inflammation, representing, as the first stage of a most dangerous disease, that adhesion which is a natural and healthy action, the most natural in all the system, and the farthest from disease. Thus, in a wound of the breast or belly, in a joint, or in any shut sac, if the parts, being neatly laid together, should once adhere, then there is no swelling, no pain, no formation of matter, the parts are well and sound in the very moment in which they adhere; thus it is sometimes in narrow or slanting wounds. But if the wound be broad and open, or if the least thing keeps the lips apart from each other, or if they run into inflammation, then the lips turn away from each other, matter forms, the wound inflames, and not the wound only, but also the wounded cavity inflames, so that if it be in a vital part, the man dies.'

In speaking of compound fractures and dislocations, after citing the opinion of French surgeons, chiefly Palfin and Duverney, that amputation should always be performed, he says: 'We do not comply with any such barbarous rule; . . . we know that nature will do wonders, but they are wonders, and we never enter upon the attempt of preserving a limb thus desperately fractured without awful hesitation, and when we do venture to dilate the wound, and push back the bones, or saw them off, we feel all the responsibility of what we have just done.'

Of wounds of joints he similarly says:¹ 'We here pronounce the opinion which we have too often to deliver in common practice, that openings into inflamed joints are fatal; and though there are in every book cases of ankylosed joints, we cannot forget that for one that has escaped by ankylosis, thousands have died.' Such are the results of his treatment, founded on the views we have quoted.

He says, with regard to the methods of treatment: 'When a modern surgeon allows himself to talk about the mundifying,

¹ *Discourses on the Nature and Cure of Wounds*, 1812.