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LECTURES

ON

AMPUTATION,

AND ON THE

Nature, Progress, and Terminations of the Injuries for which it is required.

(Delivered at Sydenham Coll. Med. School.)

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LECTURE XVI.

Observations on the effects of a shock to the system from severe injuries and operations, continued. 1. Death without the development of febrile action. 2. Tetanus. Observations on Secondary Hæmorrhage, Hospital Gangrene, Mortification, spontaneous and traumatic, and on Exfoliation.

ALL impressions made upon the nervous system, whether the agent take effect on the mind or the body first, are capable of acting as stimulants; and the same impressions, in an increased degree, will as certainly act as sedatives: in other words, they impair the nervous power without previous excitement. All sudden and violent impressions have a strong tendency to produce a sedative effect; yet, if even a violent impression be very gradually induced, it is more likely to act as a stimulant: the sedative effect will be in proportion, therefore, to the suddenness of the shock, and the deficiency of vigour in the system. Thus the pain and shock of an operation on robust frames will often act as a powerful stimulant; while on a debilitated subject it acts as a fatal sedative, without any previous excitement.

In reference to the shock of an injury or operation, however, there seems to be, two states of the system but ill-adapted to resist its deleterious effects, when that shock is violent; these states are most diametrically opposed—the two extremes, in fine; for in the physical world as in the moral, they often meet. 1st. In persons of nervo-sanguineous habit, plethoric and in rude health. 2nd. In patients exhausted by the effects of a previous shock, followed by the hectic state, accompanying a wasting discharge and con-

tinued irritation. These are the two conditions in which patients are most liable to the fatal sedative action resulting from shock.

Thus it is that after every severe injury to the human frame (therefore necessarily after every amputation or capital operation), there is a disposition in the system to develop febrile action, unless the shock be so severe as to annihilate all power, and induce a state of total prostration and collapse, from which the patient never rallies.

This febrile action varies much in character, and is modified by the severity of the injury, the state of the system, the temperament of the patient, and the favourable nature, or the reverse, of the external circumstances by which he is surrounded. In the preceding lectures, two of the principal forms of fever supervening in cases of severe injury and in amputations have been described, together with certain peculiar complications, such as purulent depôts in vital organs, or distant parts of the extremities, affections of the viscera, &c.

The two forms of fever to which I allude, the Irritative and the Bilio-remittent, together with the complications enumerated, I have traced, I think unequivocally, to the impression made upon the nervous centres in the first instance, and the vitiated quality of the circulating fluid which often results. In these cases death may result, but it is always preceded by febrile action.

Death, however, not unfrequently, in extreme cases, results from the shock, in a different mode. 1st. By the immediate sedative effect upon the nervous centres generally, destroying their power, and life itself, so rapidly as to preclude the possibility of any febrile action supervening. 2nd. By making a morbid and stimulant impression upon the true spinal centre, and developing tetanus in its most frightful forms.

Upon what these very different modes of action depend, by which the patient's life is lost, all arising from an apparently similar injury, I will not at present detain you by attempting to determine. Why the chief effect should appear in one instance to fall upon the sanguiferous system and its nervous power, occasionally involving, in a distinctive inflammatory or suppurative action, the structure

and tissues of vital organs; at other times falling upon the whole of the nervous centres, or again upon only one division or system; the true spinal, for instance, inducing tetanus; is more, probably, than can be satisfactorily explained in the present state of our physiological knowledge. My present object is merely to show the connection between the four chief modes of development, and their common relation to the one pervading cause, shock or commotion to the nervous centres, inflicted by a sudden injury, or the operation of amputation.

In the two effects of the shock more particularly under consideration, patients are liable to be carried off in a few hours; occasionally they fall at once into a state of stupor and collapse, from which they never rally: while in other cases a kind of sickly struggle is kept up for two or three or more days, at the end of which period the patient sinks irretrievably.

Of this latter kind, I have before me in the abstract of cases in my own practice more than one example. In one, a case of secondary amputation, the patient died on the second day; and it is remarkable that, notwithstanding such a prompt and fatal result, the patient bore the operation well, and its exhausting and sedative effects did not become apparent for some hours.

A second, on the contrary, bore the operation ill, yet did not die until the fifth day. Shortly after amputation his state improved, and he seemed to rally. On the fifth day, however, the cerebral system became involved, and he sank very rapidly.

It is impossible, in the first instance, to predict with any certainty, under similar circumstances, whether patients will perish by the shock, or which among a certain number will be those who survive. It is not always the patients apparently the most exhausted, or who have laboured under the most diseased local actions, that are swept away.

Two cases are present to my memory strongly illustrating the truth of this assertion. Both were fractures of the femur: one died within twenty-four hours by the direct and sedative action of the shock of the operation; the other was a case of amputation for fractured femur also, but performed for the rupture of the femoral artery by a projecting sharp end of the broken shaft during treatment; and although he sank at first to an alarming degree, he rallied promptly, and was cured on the sixty-third day. Here the parts divided by the knife were much diseased, the patient suffered the additional shock of a considerable loss of blood, and the terror to which such an accident invariably gives rise.

In reference to this cause of death there is little further to remark. Of the second class of effects of shock upon the nervous centres—tetanus, I am unwilling to add

a mass of details, the application or utility of which I cannot myself see. I have observed tetanus occur from slight and apparently simple flesh-wounds, yet the most complicated cases are in a very large proportion exempt. We are warranted, therefore, in the conclusion, that the supervention of this morbid action has no direct relation to *the severity of the injury*. Tetanus does not supervene so frequently on amputations as on cases of injury treated with a view to save the limb: yet I believe that the nature of the wound has little influence compared with the temperament of the patient, and probably some peculiar state of the system at the time the injury is received: possibly the state of the atmosphere and its temperature may also be taken into account, sultry weather, apparently, favouring the development of this affection.

In reference to treatment, neither bleeding nor amputation, I have assured myself, will arrest its action when once fairly established, although a slight and temporary relief is occasionally the result. The system is rendered in a great manner insensible to the influence of ordinary narcotics. I have given three-grain doses of morphine every two hours with very slight effect. It is true I have seen patients recover; and it has been the custom on such occasions to attribute the fortunate result to whatever treatment might have happened to be adopted. Thus one of the patients recovered under full doses of carbonate of iron; but in others it has seemed to possess no virtue whatever. I have been unable to trace any lesion or physical change in the structure of the spinal marrow or brain to account for the effects, and only in one instance any signal disease in connection, and that was purulent and suppurative disease in the viscera: not however depending upon each other, I conceive, but upon a first cause—the shock to the system. The periods of attack in injuries leading to *amputation*, in four instances in which I tried its effect, were the seventh, eighth, tenth, and fifteenth days; and in the only instance, in more than fifty cases, where it supervened on primary amputation, it appeared on the twelfth day.

These are all the supervening actions which I think may be tolerably directly traced to one and the same source—the shock or commotion received by the nervous system, and the consequent altered properties and vitiation of the circulating fluid due to its deleterious action.

Hectic fever, Secondary Hæmorrhage, Hospital Gangrene, and Mortification, are the only actions of importance which now remain for consideration.

Hectic is rarely a cause of death in primary or intermediary amputations; it is common in fractures treated, and in secondary amputations. It is remarkable, however, that of all the supervening actions on injuries it seems the most easily arrested by amputa-

tion; and unless the exhaustion of the patient is so great as to offer no hope of his surviving the shock of an operation, it is never in itself a sufficient ground for resigning a patient to its slow and certain progress without such an effort at rescue. Diarrhoea is its most frequent complication, depending, I am inclined to believe, upon the relaxed state of the capillaries, found by experiment to be induced by deficient or exhausted nervous power: rarely, therefore, is there any change of structure in the mucous membrane of the intestines. Of the other diseases found grouped with hectic, Gangrene and Sloughing, from a want of vitality in parts subjected to pressure, is the most common, as in the bed sores of the back; gangrene from inflammation and suppurative disease, as in the wounded limb, occurs less frequently. The occasional development of phthisis in those predisposed, and (though much more rarely) phlebitis, of which I have seen but one example, form the whole of the complication or attending diseases usually noticed with hectic.

Gangrene simply, hospital gangrene, erysipelas, hæmorrhage, complicated wounds, may all be included in a chapter of accidents. On hospital gangrene, so much has already been written, that unless I felt I had something new and valuable to offer, there can be little excuse for dwelling upon it in these lectures. Of hospital gangrene, and of spontaneous mortification and gangrene arising in the foot and leg, and subsequently affecting the stump, I had in Oporto and in Vittoria, unfortunately ample experience. But as there is no specific treatment for either the one or the other, and circumstances must so much modify the application of any principles laid down, I do not think it necessary to enter into any detail.

With respect to the question of amputation, however, there are some points of interest on which new facts are of importance.

Baron Larrey has already, I think, sufficiently demonstrated the propriety in *traumatic gangrene* of amputation above the injury *without waiting for the line of separation being formed*, if the state of the patient in other respects does not forbid operation. When mortification has once declared (in the case of a severe injury), it arises in all probability *not from any want of vital power in the system*, but from the congested state and impeded circulation of the parts below, probably promoted, if not in many instances induced, by deficient nervous influence in those parts, deeply impairing the vitality of the whole of the tissues;—or from an inflammation so violent in the parts immediately surrounding the injury, as to destroy the vitality of all the tissues by excessive action. This, then, as the result of a specific local and circumscribed action, destroys the parts involved, beyond the possibility of repair. Nature immediately proceeds, by a process of absorption upon the living portion of the limb, to detach the dead parts; but

this is a work of time, exhausting the system and injuring its healthy and vital powers. To save this idle waste is the true object of the surgeon, who removes, in a few seconds, with the knife and saw; that which otherwise, it would require weeks or months to separate, leaving a bad stump after all, even if the patient survived all the waste and irritation of the long-protracted process. It is quite true that a severe shock is inflicted by the operation, and that the patient, with previously impaired strength, may sink from it; but without this summary measure, how many more would die? We must bear in mind, also, that which I trust has been amply demonstrated in these lectures, viz., that a man *is by no means necessarily* in a worse state for amputation, who may have already undergone some previous sickness. Here are abstracts of two fatal cases, which show that we shall not, indeed, always succeed in saving life by prompt amputation; yet, notwithstanding these occasional adverse results, there can be no doubt that the chances of recovery are much improved by surgically cutting short a doubtful and wasting struggle on the part of nature to throw off the dead mass.

The first case was one of peculiar interest to me; it occurred at the commencement of my career in the Peninsula, after a desperately-fought action, which crowded every public building in the city of Oporto with wounded. I found many of the British scattered in various Portuguese hospitals, and the patient in question was one of these; a musket-shot had entered over the forearm, and, coursing upwards, bruised and destroyed the vessels of the arm, emerging near the armpit. I say it was of peculiar interest, for had I erred in judgment, comparatively young and untried as I then was, I should have lost the confidence of those who gave me such responsible duties. I did not find this man until the second day after the action; his arm was in process of mortification below the wound: the diagnosis to me was so obvious, that I at once decided on amputation; and, as a matter of courtesy, communicated with the Portuguese surgeon-in-chief of the hospital, who, pointing to the ecchymosed and discoloured state of the integument of the thorax opposite to the exit of the ball, shook his head, and assured me that it indicated a want of vitality in the whole system, and commencing mortification beyond the wound. I felt authorised in strongly insisting on a different view of the case, and I found, at the hour I had fixed for operation, a considerable number of the Portuguese medical staff assembled to test my accuracy, or bear witness to my error. The operation satisfactorily proved that there was no mortification at the shoulder; and on the first dressing, three days after the operation, there was almost entire union of the stump; the healthy adhesive process left nothing to desire: a few days later an irritative fever de-

veloped itself; the stump opened out, and he died. The unfavourable progress of this case I attribute almost exclusively to the unfavourable circumstances in which the patient was placed; intense summer heat prevailed while in the crowded Portuguese hospital, there was bad ventilation, and worse attendance.

In the second case there did exist, apparently, some deficiency of vital power generally, both at the time of operation and subsequently in the action of the stump, to which may be attributed the fatal result. It must be remarked, however, that no gangrenous or sloughing action supervened in either of the stumps, and as both proved fatal cases, this fact may be taken as a fair proof that there is little danger of such a result.

Case of amputation at intermediate period (10th day) for traumatic gangrene of foot, in a case of compound fracture of tibia and fibula; patient died two days after operation; performed by circular incision; external circumstances unfavourable; middle age.

H. Bull, October 23, 1832. First day after injury. Leg much swelled. 4th day. Leg, foot, and ankle continues much swelled, and several large, dusky-coloured blisters appear; temperature of limb a little more than natural. 5th. Whole of the foot and ankle and lower third of leg is of a dusky livid hue; toes cold; lower part of foot retains its increased temperature; there is also a *bluish, unhealthy* tint in face; pulse regular, full, and slightly accelerated; tongue clean; bowels confined. 6th. Whole of the foot cold and livid; he was delirious at night. 8th. Mortification still not extended as high as the wound; he is free from pain, and action above the wound seems to promise a line of separation; pulse thrills, but is regular; bowels open; says he has appetite; tongue clean; sensorium; less affected. 9th. Strength keeps up; little change in foot. 10th. Amputated. 11th. Passed a good night; pulse quick. 12th. Full accelerated pulse, after restless night; complains of no pain; suppuration copious; Venesection. Evening. Pulse still full; restless. 13th. Pulse more soft and natural; discharge from stump not healthy; no adhesive action; died.

In the successful cases which have occurred in my own practice, or under my observation, there is little worthy of remark, save that almost immediately after the removal of the mortified limb an abatement of febrile action and irritability may be noticed, and the certain and rapid amelioration of all the patients' symptoms is the result.

It is a different question how far it may be sound surgery to remove a limb in cases of spontaneous gangrene, before nature has herself fixed the limits to which that action shall extend. Where an obvious cause, such as a contused and fractured limb, exists, we may

safely take it for granted that the action has for its object to separate the limb below its incurable wound, and no more, the cause and the effect are equally obvious. But when an action arises spontaneously, apparently from constitutional rather than local influences, the cause and the object are alike uncertain and undefined. When a foot begins to mortify under such circumstances, or both feet, as happens in a very large proportion of such cases, the patient either knows not how it came, or traces it to some night when exposed to the cold; or some time when, being cold, he held them to the fire: here would seem a local cause, but evidently a very insufficient one, if there were not something vitally wrong in the system. In such cases a local and a general cause, neither of them very certain or defined, are in presence; moreover, a mechanical cause, the result of a general morbid action, may exist, such as the thickening or narrowing and obliteration of the arteries, commencing either in the trunks or the capillaries: and if in the former, to what point does it extend—what means have we of determining? If from some general cause of adynamic character, will the mechanical removal of the foot prevent its action on the leg above? The impossibility of answering these queries, important in every sense, has led to the principle of practice, that under such circumstances amputation is inadmissible until nature has commenced detaching the dead from the living, by forming a line of demarcation and separation.

The principle is a sound one, as a general rule; and in the large number of cases presented to my notice in Estremadura and Lisbon, and later at Vittoria, it was acted upon. Nevertheless, there are circumstances in which it may be departed from, to the great advantage of the patient, and where death would in all probability ensue, if an apparently more safe, but in reality only a more timid and less judicious practice were followed. When the extremity of a limb is involved in mortification, without sufficient or apparent local cause, it is our duty to wait for a line of demarcation, while it gradually rises to the joint *next to the one uniting it to the trunk*. But having passed that, particularly after having remained for a longer or shorter period *stationary*, and if it still proceed, threatening speedily to involve the last articulation, and ultimately the trunk itself, what hope is left of life?

The experiments of Le Gallois and Dr. Wilson Philip have sufficiently demonstrated that when the action of the heart and blood-vessels is impaired by an impression made upon the nervous centres, so as to be unequal to the effort of continuing the circulation through the body, we may, by ligatures cutting off the supply of blood to the extremities, enable the sanguiferous system to carry on the circulation in the more limited circle of the head and trunk with sufficient vigour.

The heart, under such circumstances, recovered its power, contracting and dilating with renewed force.

By removing a limb in which mortification has already begun at the more remote extremity, and to which nature is in vain making an exhausting effort to send more blood, and to permeate parts no longer capable of receiving it, we not only gain the result obtained in the experiments by cutting off the supply to the extremities, but we relieve the system of the gangrenous action, and its sedative influence upon all the vital functions. It is easy to perceive, therefore, how the power of the nervous system generally, and of the heart and blood-vessels, may be improved by the amputation of a gangrened limb, and thus become fully adequate to the healing of the stump, although before unequal to the action necessary to separate the dead parts from the living.

In a case which came under my care at Lisbon, in the year 1834, I operated upon this principle;—once more, in direct opposition to some of my Portuguese colleagues. The facts were briefly these:—A drummer-boy, aged seventeen, arrived at the hospital, from the outposts at Cartaxo, near Santarem, with a gangrened foot. He stated himself to be healthy, but was not a very robust-looking boy. He had neither received any injury, been the subject of fever, nor exposed to cold in any way. The gangrene for some days was stationary, with a very distinct line of demarcation (by altered colour) half way up the leg. In three days gangrene again commenced, by a dark circumscribed spot on the knee. I had purposed amputating a day or two before, in the belief that nature was unequal to the process of separation, but had deferred in compliance with the strong dissident opinion of all my colleagues, and the Portuguese director of the chief military hospital at Lisbon. In accordance with the principle already laid down, that when the gangrene extends beyond the joint leading to the trunk, amputation offers the best chance of life, if the system still retain considerable power; I hesitated no longer, but removed the limb midway in the thigh. Scarcely any arterial blood escaped, and the femoral artery was deeply retracted, and showed no disposition to bleed. On examining the artery in the leg at the amputated surface, I found its coats considerably thickened, and greatly diminished in calibre. One of the smaller vessels was secured; no ligature was placed upon the femoral; a tourniquet of precaution was applied, and he was carefully watched. As I had predicted, no tendency to secondary hæmorrhage was shown. Dressings were not even stained with blood: the case went on most favourably. There seemed at first a slight deficiency of action; for although the edges remained exactly in contact, the corners only had united. His health and appetite,

however, both continued good, and his pulse soon indicated the increased vigour of the circulation. The cause of gangrene thus seemed to have been a thickening of the coats of the popliteal artery, and final obliteration of the canal; thus cutting off the chief supply of blood to the foot: the deficiency of power to throw off the dead portion is attributable, therefore, in a great degree, to the insufficient supply of blood to the living parts immediately above the dead parts, added to the sedative effect of the gangrenous action upon the system; and the longer the state was allowed to exist, the less capable of any efficient action must the system have become. On what general morbid action this thickening of the coats and diminution of the calibre of the chief trunk was dependent, and why it should exist in one lower extremity and not in the other, are questions difficult of solution, and somewhat foreign to the more immediate object of this lecture. Whatever may have been the first cause, it certainly did not proceed further, or recommence and lead to the gangrene of the stump.

Secondary hæmorrhage is a more frequent cause of amputation than of death. It occurs less frequently during the treatment of complicated injuries than after amputation has been performed; and in amputations it occurs most rarely after the primary.

In 38 deaths which occurred during the treatment of 153 cases recorded in Tables I. and II.,* secondary hæmorrhage contributed to the result in two only.

In 27 intermediary amputations,† secondary hæmorrhage was the cause of amputation in four cases: and in 25 secondary amputations, three were performed for the same cause. Thus, in 205 cases, nine occurred either causing death, or leading to amputation, and its chances of fatal result, the proportion being 1 in 22.7.

In reference to the occurrence of secondary hæmorrhage after amputation, when it takes place to any extent after the first twenty-four hours, the case generally proves fatal; not so much by the loss of blood frequently, as by the irritation of opening out a tender and partially-united stump; and the mental shock induced by the terror of the patient, generally increased by the alarm of the attendants.

This is an important fact; since it should impress upon your minds the necessity of taking every precaution, when putting up the stump, to guard against such a dangerous occurrence. To this subject I shall recur in the next lecture, when speaking of the first dressing after treatment of amputations.

* See LANCET, page 397, 398, vol. i., 1840-41.

† Ibid., page 433, 434, vol. i., 1840-41.

In 57 cases of primary amputation, secondary hæmorrhage supervened in .. 9 cases, 1 in 6.3.

In 27 intermediary, it occurred in 5 1 in 5.4.

In 25 secondary..... 6 1 in 4.1.

— 109 amputations.. 20 1 in 5.4.

Yet in 55 fatal cases, in 5 only, or 1 in 11, was the secondary hæmorrhage a prominent cause of fatal result; 1 primary, 2 intermediate, and 2 secondary: and in 4 other cases, 3 secondary and 1 intermediary, its influence was not of so decided a character, although the hæmorrhage probably materially contributed to the unfavourable issue. We see, therefore, that the serious cases of secondary hæmorrhage are in proportional frequency of occurrence, in reference to the primary, intermediary, and secondary amputations, as 1 in 57, 9—5; the cases in intermediary being more than six times the number of those in primary; and in secondary, more than double those of the intermediary.

There are many points of interest connected with the study of these cases in detail, which I cannot, however, attempt to develop at any length here. The average period of supervention in these cases of secondary hæmorrhage, is from four to five days. Three occurred in the first day, a few hours after operation; all for branches of the brachial, and one for both trunk and branch. Three took place from the femoral artery, and in two the artery was unavailingly secured above. One from a branch of the profunda, secured on the face of a sloughing stump, by means of two needles and a twisted suture. Hæmorrhage from branches is in some degree more frequent than from the trunks. Sloughing stump, generally, or the same action limited to the artery, proves to be a very general cause. In three of the cases occurring in my own practice, the total absence of all adhesive inflammation in secondary and intermediary amputations was the more obvious cause. In one there was only a partial plug of fibrin. From these, and other facts which have been presented to my notice, I conclude—

First. That hæmorrhages, within twenty-four hours of amputation, are almost invariably from the branches, and not generally from any diseased action in the vessels, but from their not having been secured before the stump was put up.

Secondly. After this period to the tenth or twelfth day, within which the worst cases almost invariably occur after amputation, secondary hæmorrhage generally supervenes, from one of two causes: either a general sloughing action on the tissues of the stump, involving the arteries (occasionally almost exclusively confined to the coats and sheath of the arteries), or a less obvious diseased action, the chief effect of which is to prevent

the formation of a plug of fibrin and the obliteration of the artery by adhesive inflammation. In these latter cases, both trunk and branches are generally open-mouthed; and there is little ground for hope that the ligature of the artery above the stump will be of permanent service.

Thirdly. Whenever secondary hæmorrhage becomes a cause of amputation, the chances of a fatal result to the patient from the operation are greatly increased. There is always loss of blood, more or less, before amputation. There is always in addition to the shock of the operation a moral shock from alarm, and the unavoidably sudden announcement of the necessity of removing a limb, which the patient had hoped to preserve, and of inflicting a degree of bodily pain from which his nature instinctively shrinks. These impressions, physical and moral, are, in the highest degree, prejudicial and deleterious in their action.

In stumps, then, secondary hæmorrhage usually occurs, as you have seen, either from small vessels having escaped ligature, and subsequently throwing out blood, by a sloughing or ulcerative action in the arteries; or, finally, from the total absence of all adhesive inflammation in the trunk of a divided artery, when we find the ligature lying loose, and the open mouth of the artery exposed. But in complicated injuries under treatment, secondary hæmorrhage frequently occurs by the mere separation of eschars and sloughs, caused by the bruising or injury to the artery in the first instance; the separation of such dead parts, so far from being the result of disease, is effected by a healthy process; or at other times by the separation of sloughs, which, previous to the suppurative stage, had assisted in closing a partially-ruptured vessel; or, finally, by spicula of fractured bone forcing their way through the coats of an artery, or by pressure exciting an ulcerative action.

In complicated injuries, for some time under treatment, such is the state of disease in all surrounding parts, that many difficulties oppose, and sometimes successfully, the best line of practice; viz., the ligature of the artery at the point injured; but two resources then remain, to tie the artery above the wound, which in the arm is perfectly useless, although it occasionally succeeds in the lower extremity when the artery injured is the peroneal, posterior, or anterior tibial, or that which is most generally the one we are compelled to adopt—amputation. Here, as I have pointed out, besides the loss of blood, the anxiety, and moral shock, there is the shock of the amputation, and rarely a healthy action of stump ensues, while not unfrequently in consequence of this there is again secondary hæmorrhage.

In bleeding from a stump, if it occur soon after amputation, the wound must be opened and cleansed, and the bleeding point secured.

If, however, the bleeding happens at a later period, the face of the stump much diseased and sloughy, the attempt to take up the artery, particularly if a branch, rarely succeeds. I have found it effectual, and occasionally when all other methods have failed, to include between two curved needles a portion of the surrounding parts, and wind a ligature under them, subsequently, with the bone-nippers or cutting-plyers, removing the points, and any superfluous length. The case I related, in illustration of the second class of irritative fevers in a former lecture, is one where this method succeeded, and the patient's life was saved.*

Among the causes of amputation in complicated injuries, as well as one of the supervening actions after operation, extensive periosteal disease ought not to be omitted: although it does not figure very frequently as the obvious cause of amputation, yet from some well-marked cases which have come under my notice, I am inclined to think that the extensive suppurative and disorganising disease which ultimately renders any attempt to save a limb hopeless, may take its origin from periosteal disease in the first instance.

More importance is to be attached to the action the periosteum may take on, both in cases of injury under treatment and subsequent to amputation, than is usual. My attention was first directed to this subject by the frequent and often very tedious exfoliations which took place in amputations,—many of these operations performed by myself, and with great and especial care in reference to this point. I was convinced at last that no care or precaution in amputation sufficed to prevent this troublesome result, and it ultimately became evident that the violence inflicted on the bone and its two membranes by the saw was one principal cause. Some inflammatory action of both the membranes and a disposition in the immediate extremity of the bone to slough off, if I may so define it, where it had been in contact with the saw, was very constant; the vessels at their divided extremities not affording nutrition, and active only a short distance above. I very carefully examined and preserved the sawn extremities of the bones in a great number of fatal cases of amputation, and I fully satisfied myself on some points of importance in reference to the nature and causes of exfoliation. To these I can only at present glance in general terms. The separation of a rim of the sawn extremity either in a piece or by minute particles, and consequently unobserved, I believe to take place in *all* amputated limbs. Whether it be a large or a small piece, whether it involve only the extremity or the whole shaft, will, I believe, be found to depend upon many causes, the state of local disease existing or supervening in the stump or extremity, the

general health and susceptibility to morbid action of the medullary or periosteal membrane, &c., contributing to the result.

In some there is great exfoliation carried forward by a long and tedious process; in others, again, contrary to all anticipation, no palpable exfoliation takes place, although disease may have already denuded the bone in some degree previous to amputation. One such case came under my observation, proving this fact in a most remarkable manner. This action, therefore, would seem to depend more upon the state of the system, and a general susceptibility to morbid action, than upon the state of parts in the vicinity of the amputation.

In a case of shattered carpus an extraordinary want of sympathy was manifest in the system, and comparatively little pain suffered either before or after amputation. Exfoliation took place not the less.

I am led to believe, therefore, that under any circumstances some exfoliation may be expected, depending, in a great measure, upon the injury inflicted upon the sawn surface of the bone, depriving the vessels at their divided extremity of vitality.

This is a subject essentially connected with the pathology of bone of great interest, and well deserving careful study. I must limit myself, however, to a very few observations on the stages and progress of these actions.

In all sawn bones there is at the extremity an absorbent process set up, the object of which is to round the sharp edges, and remove the flat and injured surface. Under the most favourable circumstances the absorbent process removes but particles at a time, while the deposit of callus is proceeding; but at other times, and without any very obvious reason, nature immediately sets to work to cast a line of demarcation round the edge, so as to cast off a complete rim, extending higher or lower, and then very frequently we find coexistent an irregular and morbid deposit of callus, not round the end merely, but extending upwards where it is not required. The periosteum takes on a morbid action, with which not seldom the medullary membrane sympathises, absorbing the inner shell. If this state proceeds far, then we have extensive necrosis: the case which I have already given,* is one of the best examples I have met with.

I only find any distinct reference to exfoliation in about one-fifth of the cases amputated, including several in which the process was found after death to have been going on, although not completed. It is probable, however, that this action existed in many more, particularly fatal cases, although no special notice was taken of the circumstance. From a careful study of all the facts which have come under my observation, in reference to the pathology of the osseous tissue,

* See Case VI., vol. ii., p. 500.

* See Case VI., vol. ii., p. 500.

and more especially the actions on which exfoliation depends after amputation, I have drawn the following conclusions.

1. The proneness to diseased action in the lining and investing membranes of the bone may fairly be considered as one of the causes of danger in amputation. This action commences at the sawn extremity; and if it extend far beyond, involving any considerable portion of the bone, it produces an irritative or hectic fever, wearing out the powers of life, and ultimately destroying the patient. One of the most remarkable circumstances attending the development of the exfoliating process is that it will occasionally take place, while the stump in the greater part of its extent is soundly uniting. An example of this I have already brought before you.*

2. It is evident that whatever influence a local disease of the soft parts of the stump may in some cases exercise upon the bone, the process of exfoliation is neither dependent upon nor essentially connected with it. In some cases, where the stump has been firmly and healthily united, I have found exfoliation had been going on. In other cases similarly situated, the bone, on the contrary, has been rounded with callus.† In a third series of cases, although the stump has been three months in healing—long continued disease marking the case—no exfoliation was perceived; nay, even when the parts divided by the knife have been exceedingly diseased, including the periosteum, I have often been unable to detect any process of exfoliation. All these facts tend to prove that exfoliation arising from the necessity of nature's efforts to remove the sharp edges of bone, which would otherwise remain sources of irritation to the soft parts, and to throw off the parts which, by immediate bruising and contact of the saw, lose their vitality, may be effected in two ways. 1. By gradual absorption of minute particles which are conveyed into the circulation and out of the system, with other effete particles separated by the various secretory organs; and, 2ndly, by an absorbent ulcerative process effecting a line of separation, and throwing off larger or smaller portions of the extremity of the bone, as sloughs are separated and thrown off in soft parts. The mode which may be adopted by nature is determined by causes and influences extremely difficult to appreciate, and not clearly referrible either to the state of the surrounding parts, or to any obvious changes in the general health of the patient.

* See Case II., vol. ii., p. 498.

† See Case I., vol. ii., p. 497. †

RESEARCHES
INTO
VALVULAR DISEASES OF THE
HEART,
IN CONNECTION WITH THE
SOUNDS OF THAT ORGAN;
ILLUSTRATED BY CASES.

By THOMAS MOORE, Esq., M.R.C.S., late
Secretary to the Dublin Medico-Chirurgical
Society.

[Read before the Dublin Medico-Chirurgical
Society.]

GENTLEMEN:—Since the publications on diseases of the heart, which, within the last twenty years, have emanated from the press, not only in Great Britain, but also on the continent, little remains for the junior practitioner to do, excepting to compile what has been already written; to translate the works of those whose experience and talented treatises on this branch of the profession have deservedly attained a very high rank in the medical world; or to remain silent, and admire or condemn; praise or dispraise, "in thought's deepest reverie," the labours of those who have had the priority of him; the innumerable theories which have of late distracted his medical brethren; and the host of refutations daily adduced by others opposed to them; each succeeding theory, grounded on some recently-discovered experiment, a repetition of those already performed, viewed in a different light; the adaptation of some newly-invented instruments, or the modification of those already in use; whether established on all these linked together, or any one taken by itself, tends, nay, is always sure, either to differ in some respect from, or upset altogether, the theory or theories which have preceded; and yet the deductions drawn by each and all of those individuals, from the observations they have severally made, seem to them perfectly clear, satisfactory, and such as will set at rest immediately the errors of those who are now mouldering in their graves; the researches of those distinguished alike for their acuteness of observation, as for their unremitting zeal in the investigation of the truths of medicine; the disputes which have arisen; the discussions which have taken place; the labours and opinions, too, not merely of individuals, but even of committees, selected and appointed especially for the purpose; and despite all these exertions, would fain impress on the minds of their readers the necessity of adopting theirs, as the only true and sensible mode of accounting for the occurrence of certain phenomena, to the utter exclusion of all others.

Amidst those perplexities, and the contending opinions of the day, it is with no small degree of reluctance that an essay on