LECTURE IV.

ON MORTIFICATION.

A PART of the animal body may lose its vitality, while the rest continues to live. We say then that it is mortified; and the process by which this change is brought about we call mortification, or sphacelus. The term gangrene properly signifies the commencement of mortification, or that condition of the affected part which immediately precedes mortification. But it is somewhat loosely employed, and not unfrequently is used as synonymous with mortification and sphacelus. This change, by which a living organ returns to the state of dead matter, viewed in connection with the changes by which it is preceded, and those which follow it, is one of the most interesting subjects in the whole science of pathology, and the treatment to be employed under these circumstances forms one of the most important inquiries belonging to practical surgery; and I am sure that you will not think your time ill bestowed if I call your attention to these matters in this and the following lectures.

The causes of mortification, as I shall explain to you hereafter, are various. If the part affected be one immediately concerned in the vital functions, the death of the entire animal is a speedy, if not an immediate consequence. If the part affected be one not directly necessary to life, still if mortification exist to a very considerable extent, so great an impression will be made on the whole system that the same result will probably ensue. Otherwise, after a certain period of time, another process becomes established, by which the dead part is separated or thrown off from the living. We distinguish this process, when it occurs in soft parts, by the appellation of sloughing, and the part separated is called a slough. When, however, it occurs in the hard parts, as in the bones or cartilages, we call it the process of exfoliation, and we give the name of exfoliation to the dead bone which has become detached.

Sloughing and exfoliation are accomplished by ulceration of the living parts in contact with the dead. A thin layer of the living parts is absorbed, and the dead part is left lying loose on the ulcerated surface.

The period of time required for the completion of the process of mortification differs according to the circumstances under which the mortification takes place: it may be very slow; it may be rapid; it may be almost instantaneous; as I shall explain to you more fully hereafter. The period required for the completion of the after-process of sloughing varies also; *first*, according to the state of the system, and the activity of the vital powers generally; *secondly*, according to the organization of the part in which the disease occurs: thus, other circumstances being the same, the sloughing of the skin

is much sooner accomplished than that of tendon, or than the exfoliation of bone; *thirdly*, according to the state of the neighbouring living parts, without reference to the state of the general system; thus, if there be much inflammation in them, the ulcerative process proceeds much more rapidly than when the inflammation is very slight; and *lastly*, as long as the mortification continues to spread there can be not even the commencement of the process of separation. The reason of this is so obvious that it can require no explanation.

I have seen mortification begin in an old man's toe, and be gradually spreading even for months, up the foot and leg, without the least appearance of a line of demarcation, or the least attempt at sloughing. In the same manner a piece of dead bone may continue adherent to the living even for some years. If the disease, on which the death of the bone depends, can be arrested, as it sometimes can, (by mercury for example, or by sarsaparilla,) the exfoliating process begins immediately, and when begun it is completed as soon as under ordinary circumstances.

The separation of the dead part is followed by another series of changes, which terminate in healing—or cicatrization. But these changes are not at all different from those which occur when there is a loss of substance in other ways, and it is not my intention, therefore, to enter into the consideration of them at present.

Having offered these general observations on the subject, I shall proceed to consider the various circumstances under which mortification may take place, and the treatment which it requires, accordingly as it arises from one cause or from another.

MORTIFICATION FROM INFLAMMATION.

Mortification is described as one mode in which inflammation terminates. A very intense degree of inflammation may lead to this result in any structure, or in any constitution; but a moderate degree of inflammation may lead to it also in particular cases. Inflammation of cellular membrane terminates in mortification more readily than inflammation of the skin; and in persons of bad constitution, the cellular membrane is more likely to mortify than in others. You see examples of this over and over again in the cases of the diffuse cellular inflammation which occurs in dram-drinkers. A small puncture of the leg, or a compound fracture in which the injury is apparently trifling, may, as you know, cause inflammation extending gradually from the foot to the buttock, and the whole cellular membrane may, in the course of a few days, become a putrid slough. I have seen a case in which a patient became affected in this manner from a leech-bite; and another in which a similar mischief followed the sting of a bee, and both these patients died. From what has since fallen under my observation, I have little doubt that they were both dram-drinkers, though I was not sufficiently acquainted with the subject to have my attention directed to it at the time. In the case of the man stung by the bee, however, something may, perhaps,

be attributable to the operation of the animal poison; and I shall revert to this point hereafter. I once lost a patient with diffuse cellular inflammation ending in mortification after the simple operation of castration; and I was disposed to attribute this unfortunate result, in a great degree, at least, to the operation having been performed after a long course of the tincture of iodine.

If inflammation of the skin terminates in mortification, independently of any antecedent inflammation and mortification of the cellular membrane beneath, the inflammation is usually intense; the surface of the skin is of a dark red colour, and there are severe pain and tenderness. As the inflammation advances, the skin assumes a livid appearance; a serous fluid is thrown out under the cuticle, which is thus elevated in the form of blisters; and then the skin itself perishes. If the mortification takes place to any great extent, the general system suffers. The pulse is feeble, irregular, intermitting; the countenance is anxious; the skin becomes cold; there is an utter incapability of exertion; and after a few days, and sometimes sooner, the patient dies. If the constitution does not suffer in this manner, or if the patient survives the shock, after a few days the separation of the slough begins to take place, and this is the first step towards a complete recovery.

In cases of diffuse cellular inflammation, the occurrence of mortification is preceded by an abundant infiltration of serum. In some instances the serum is of a peculiar yellow colour, and the skin over the whole body, and the *tunicæ conjunctivæ* of the eyes, may assume the same appearance. I do not know to what cause this yellow tinge is to be attributed. The patient looks as if he were jaundiced; but he is not so in reality, for there is no bile in the urine. When mortification of the cellular membrane has begun to take place, the constitution suffers in the manner which I have already described. If the patient survives the shock, or lives for some time under it, the mortification of the cellular membrane is invariably followed by mortification of the skin over it to a greater or less extent.

Allowing for the difference of function in the affected organs, the foregoing description will apply pretty nearly to all cases in which inflammation of the soft parts terminates in mortification. If there be mortification of the intestine, there is an effusion of dark-coloured serum into the abdominal cavity. Whenever the part which mortifies is situated internally, so that the putrid serum formed round the slough cannot escape, the constitution suffers much more than where it is situated externally, and especially an intermitting pulse and hiccough are often added to the other symptoms. Probably these more aggravated symptoms are to be attributed to the pent-up putrid matter being in part reabsorbed into the circulation. I shall mention some circumstances hereafter which seem to favour this opinion.

It proves an interesting subject of inquiry, how it is that inflammation terminates in mortification; or what is the pathological explanation of this phenomenon? and this leads us to the question as to the nature of inflammation itself. Mr. Hunter describes it as

consisting in an increased action of the small blood-vessels. If increased action be indicated only by a greater degree of contractility in the coats of the vessels, the theory is evidently wrong; for microscopic examination proves that there is no such thing. But, in fact, this is not what Mr. Hunter meant: and in another sense of the words he is clearly right; for the vessels of an inflamed part secrete serum, lymph and pus, and build up new structures; in short, they do many things which they do not do under ordinary circumstances; and all this affords an abundant evidence of increased action. Another theory of inflammation which has been of late promulgated in opposition to that of Mr. Hunter is that the essential part of it is a debility, a weakened state of the capillaries; and the propounders of this theory refer to the dilatation of these vessels in proof of it. But I own that I can discover no reason to believe that the dilated state of the capillaries proves any thing, except that there is something in the condition of an inflamed part which makes a greater supply of arterial blood necessary, and that they have the power of adapting themselves to those new circumstances. Nor is this power limited to the capillaries. It exists in the arterial trunks, in which the capillaries have their origin. Thus, in an animal killed by arsenic, in whom the poison produces extensive inflammation of the mucous membrane of the stomach and intestines, the branches of the mesenteric are seen dilated to double their natural diameter. In like manner, when muscles are in exercise, or when a gland is pouring forth an abundant secretion, the capillaries become dilated so as to admit the increased quantity of blood which under those circumstances of greater activity of the organ is required; but no one dreams of their being therefore in a state of debility, and I see no difference, in this respect, between those cases and that of inflammation. But microscopic examination proves something more than the mere dilatation of the capillaries. "The blood itself is affected. It loses its globular structure, and previously to this the globules themselves are observed to have lost their repulsive properties, and either to agglomerate together, or to adhere to the sides of the vessel in which they are contained," and not unfrequently they seem to stagnate, so as to choke up the vessel altogether, and destroy the circulation in it. Now if this happens in many vessels, the vitality of the part cannot be maintained, and thus the occurrence of mortification is easily explained. There is, however, something more than this in some instances. For example, let us suppose a case of inflammation of the cellular tissue of the scrotum. The cells are filled with serum. They are fully distended and the skin is on the stretch. If nothing be done to the part, the cellular membrane first, and the skin afterwards, will mortify to a great extent. But make some incisions with the point of a lancet, and the serum escapes in sufficient quantity to relieve the tension, and the mortification is in great measure, or perhaps, wholly, prevented. It is reasonable to suppose, that, in consequence of the extreme distension, the fluid in the cellular membrane causes so much pressure on the vessels which supply the skin as to impede the passage of the blood through them, and that the punctures of the scrotum and

the escape of the serum prevent the mischief which would otherwise have ensued, merely by removing the pressure. When a common abscess opens, as it sometimes does, by mortification and sloughing of a portion of the skin over it, we are not to regard the mortification as the mere result of inflammation, any more than in the case which I have just stated. The ulcerative process going on under the skin destroys a portion of the vessels by which the skin is supplied, and the pressure of the matter probably prevents the free passage of the blood through those which remain; and thus a due suppy of blood being prevented, the skin perishes.

Treatment of cases in which inflammation terminates in mortification.—Whatever tends to lessen the violence of the inflammation, ought to prevent, or check the progress of, the mortification; and, on these grounds, the patient ought to derive benefit from the abstraction of blood.

But, on the other hand, the abstraction of the blood by which the life of a part is supported, if carried beyond a certain point, is of itself an adequate cause of mortification; and the abstraction of even a small quantity of blood may lead to this result under certain circumstances.

It is not by a reference to principles alone that you can learn how you should act in this dilemma. Experience is our safest guidance, and on this as on many other occasions, the mere practical surgeon will have a great advantage over the mere scientific pathologist.

If the inflammation be intense, if the pulse be strong and full, the countenance flushed, and the skin hot,—that is, if there be marks of great general excitement of the system, it is probable that the patient will derive benefit from blood-letting; and if you have reason to believe that he is of what may be called a sound constitution, blood may be drawn to a considerable extent, and the blood-letting may be repeated. I have often adopted this practice under these circumstances with the greatest success, not only where the purple colour of the skin and the existence of vesications showed that mortification was impending, but where it had actually begun; and have had the satisfaction of seeing the progress of the mortification immediately suspended. You will have no better opportunity of watching the beneficial results of such a mode of treatment than in some cases of sloughing sores or chancres on the *glans penis*. While you administer opium and stimulants, the marginal inflammation increases, and the sloughing continues to spread. Take some blood from the arm, and the inflammation becomes abated, and the progress of the sloughing is suspended. Repeat the blood-letting, and the sore assumes in a short time a healthy aspect. In such cases I have known nature accomplish what was wanted, while a timid surgeon was doubting how to act. There has been a spontaneous hæmorrhage; the patient has lost half a pint or even a pint of blood. Immediately the pain, the tension of the surrounding part, the redness, and the general excitement, have been relieved; and in the course of a week the sloughs have separated, and the sore has become covered with healthy granulations.

But there are other cases in which blood-letting would be as mischievous as it is useful under the circumstances which I have just described.

Let us suppose a patient who has been a dram-drinker, or who, belonging to the more affluent classes of society, has indulged in too copious libations of wine, or whose constitution has been otherwise impaired, and that he has received some injury of the leg, followed by diffuse inflammation, which threatens to terminate in sloughing of the cellular membrane, and afterwards of the skin; or in whom the mortification of these textures has already begun: let us suppose also that although inflammation is spreading rapidly, it is not marked by any very urgent symptoms: that the pulse is small and feeble; and the countenance expressive of anxiety. Now, if, under these circumstances, you abstract even a moderate quantity of blood, it is probable that you will hasten the progress of the local mischief; and if blood-letting be employed to a considerable extent, it will certainly destroy what little chance there might otherwise have been of the patient's recovery. Let us suppose another case. There is a chancre or other sore on the penis. It is surrounded by a languid inflammation; the neighbouring parts are gradually assuming a dark livid appearance; the pulse is small and quick, or no excitement of the general system. Under these circumstances also, the abstraction of blood, instead of checking, will cause a more rapid progress of the disease.

Now it is highly important that you should learn to distinguish these two classes of cases from each other: and in a great number of them you will have no difficulty in doing so. You cannot, however, draw any exact line between them: and cases will occur in practice, in which you cannot exactly determine in the first instance, which is the proper course for you to pursue. Here you must proceed cautiously, watching daily the operation of the remedies which you employ, and persevering in one mode of treatment, or adopting another, according to the effect produced; and frequently it may be right to take away a moderate quantity of blood in the first instance, and to have recourse to an opposite mode of treatment almost directly afterwards.

In order that I might bring the subject before you in its simplest form, I have hitherto referred merely to the question of blood-letting. But of course this involves much other treatment. Where blood-letting is proper active purgatives will be proper also, as well as saline and diaphoretic medicines; and every thing in the shape of stimulating liquors and food should be avoided. Where blood-letting, on the other hand, is improper, though aperient medicine may be required, very active purgatives should be avoided. The patient should be allowed such diet as his stomach is capable of digesting; and he should have wine, or ale, or even brandy or gin—the quality, as well as the quantity, of the stimulus varying according to the character of the symptoms, and his previous habits. I say his previous habits; for it is essential that you should always inquire what these have been, and act accordingly. It is rarely safe to deprive a dram-

drinker, for any considerable time, altogether of his usual stimulus; and the effect of a judicious exhibition of it is very remarkable, not only in arresting the progress of mortification, but in abating the violence of the inflammation which leads to it. Decoction of bark, quinine, and other tonics, may be useful under certain circumstances; but I must say that the longer I live, and the more I see of these cases, the less is my faith in such remedies, while inflammation and mortification are going on: and I am satisfied that they often do great harm, by loading the stomach, and interfering with the digestion of food. At a later period, however, when the progress of the mortification is stopped, and the sloughs are beginning to separate, I have no doubt that they are eminently useful. The repeated trials which I have made, and seen made, of ammonia, have not left on my mind any more favourable impressions of this remedy than those which I entertain of bark and quinine. It is a temporary stimulus; but alcohol, prudently administered, is much better: and my observation leads me to suspect that large doses of ammonia, if persevered in for a considerable time, tend to depress the vital powers, and lessen the chances of recovery. Opium is useful under certain circumstances; as where there is severe pain; or where the inflammation or mortification depends on the operation of a specific poison.

I have already had occasion (with a view to explain the pathological phenomena of mortification) to advert to the effects of incisions made through the skin into the cellular membrane, when the cells of the latter are exceedingly distended with serum. Whether the explanation which I then ventured to offer of the mode in which this serous infiltration operates in producing mortification be or be not correct, there can be no doubt that the evacuation of the serum, and the consequent relief of tension, will go far towards preventing an extensive mortification in all cases, and will prevent it altogether in a great many. It is not, however, always necessary for this purpose that we should make scarifications or incisions. Mere acupunctures are not unfrequently sufficient. I have on many occasions requested the house-surgeon of this hospital to make punctures where this serous infiltration of the cellular membrane was going on, every morning and evening, or whenever he had the opportunity of doing so; and it often has happened that nothing more was required. But of course this simple practice is useful only in an early stage of the disease — where there is that state of things which may lead to mortification, but where mortification has not actually taken place. Where sloughs of the cellular membrane have begun to form, or where an infiltration of pus has begun to follow the infiltration of serum, mere punctures of course will be insufficient. Incisions or scarifications will then be required; and they should be of sufficient extent to allow the serum and pus to escape freely, and to relieve the tension of the skin. But they should not be more than this: first, because such painful operations are a great shock to the nervous system of a person in vigorous health, and a very great one indeed to one who is weakened by previous disease: secondly, because this shock is not given to the system once for all, as, if the inflammation

spreads, it may be necessary that the incisions should be repeated: thirdly, because in proportion to the extent and depth of the incisions, is the danger of hæmorrhage; the occurrence of which, to any considerable extent, is sufficient to prevent the patient's recovery. In making the incisions, you should always bear in mind that it is of vital importance that there should be as little hæmorrhage as possible; and here you will find the advantage of having some active and intelligent assistants, who will carefully watch your lancet or scalpel, and whenever they see a vessel beginning to bleed make pressure with the finger on it. Ligatures may be sometimes required; but not in general. The divided vessels under these circumstances bleed profusely in the first instance, but they soon contract, and the pressure of the finger for a few minutes is usually sufficient to stop the hæmorrhage altogether.

The foregoing observations apply to all cases in which inflammation of cellular membrane has alreay begun to terminate in gangrene, or threatens to do so, whether the inflammation be phlegmonous or erysipelatous, or that peculiar variety of inflammation which produces carbuncle. The effect of scarifications in preventing the further progress of mortifications of the skin in all these cases is very remarkable; but under certain circumstances, they produce a still greater benefit to the patient. Whenever putrid matter is pent up round a slough of the cellular membrane, the system is, as it were, poisoned. The sulphuretted and carburetted hydrogen gas evolved during the decomposition of dead animal matter, seems to pass, in part at least, into the circulation, and produces the most dangerous symptoms. The incisions, which relieve the tension of the skin, allow these noxious gases to escape, and the relief which this affords to the patient is most remarkable. I might, if it were necessary, enumerate a great number of cases in illustration of what I have just observed. One, however, will be sufficient: and this I am tempted to relate, because the subject is one of great importance, and because a particular instance may serve to impress it more on your minds than a mere general observation. I was called some few years since to see a gentleman, who appeared to be actually on the point of death. His extremities were cold; his pulse barely perceptible. It was doubtful whether he was sensible or not. He made, on being roused, several imperfect attempts to speak, but could say nothing intelligible. Below the right hypochondrium there was a considerable tumour; the skin being of a dark red colour on the verge of mortification. I said to myself this gentleman ought not to be allowed to die without it being ascertained what this tumour is. On examination with the fingers I perceived a sort of emphysematous crackling, and only an imperfect fluctuation. On making a free incision, I discovered underneath the discoloured skin what might be called a quagmire of slough. A small quantity of putrid matter escaped. But there escaped also such a quantity of noisome and offensive gas, apparently sulphuretted hydrogen, that I could scarcely bear to remain in the room. The stench pervaded the whole house, and even could be perceived in the garden round it. Within two minutes after the performance of

this operation, so trifling in appearance, but so important in reality, the patient looked up, and said quite distinctly, "What is that you have done which has made so great a difference in my feelings?" At the same time the pulse returned at the wrist, and from this moment he recovered without any further unfavourable symptoms. After a few days sloughs came away, probably of muscle, cellular membrane and peritoneum, in a confused mass; and with them a gall-stone of moderate size—explaining, to a certain extent, at least, the origin of the disease.

The cases in which you will most frequently have occasion to resort to the employment of scarifications are those of diffuse cellular inflammation of the extremities, whether it be phlegmonous or erysipelatous, and those of carbuncle. But there is another class of cases, which occur after injuries, and often after slight injuries of the scalp, in which the same treatment will be required; to which, before I conclude this present lecture, I am tempted to draw your attention. *First*, because they will serve to illustrate the observations which I have already made; and *secondly*, because the disease is one with which you ought to be made acquainted, but which, as far as I know, has not been distinctly described by surgical writers. Here, as in cases of erysipelas of the skin, there is a rigor followed by an attack of fever preceding the local symptoms. The latter show themselves in the form of pain in the neighbourhood of the wound or contusion, and an œdematous swelling of the scalp, without any redness of the skin. The swelling pits on pressure. It spreads over the whole scalp to the forehead, and sometimes over the whole face, the skin still retaining its natural colour, or even appearing paler than natural. The progress of the swelling is accompanied by pain in the head, and a continuance of febrile symptoms. In some cases, the disease, after having continued for ten or twelve, or perhaps fourteen days, begins to subside; the serum which caused the œdematous swelling being gradually absorbed without any further mischief. In other cases suppuration takes place underneath the scalp, with extensive sloughing of the cellular membrane, and this is followed by sloughing not only of the scalp above, but of the pericranium underneath. I have known the latter destroyed to such an extent as to lay bare a large portion of the bone of the cranium. If you would prevent all this great mischief, you must by one method or another relieve the tension caused by the œdematous effusion into the cellular membrane. Simple acupunctures are often sufficient for this purpose, provided that they are repeated once or twice daily for several successive days. Where a sufficient quantity of the serum does not escape by the punctures, large openings are required, and incisions must be made through the scalp, and the subjacent textures, quite down to the cranium. These must be repeated from time to time, as the disease extends from one part of the scalp to another. The appearances observed when these incisions are made explain in some degree the seat and nature of the disease. There is a slight effusion of serum immediately underneath the scalp; but the great effusion, and that on which the tumefaction chiefly depends, is

underneath the tendon of the occipito-frontalis muscle; and here the effusion is in some instances so extensive, that I have known the tendon to be separated as much as half an inch, or even more, from the pericranium. A large quantity of serum immediately escapes on the incision being made, the tension is of course relieved, and the destruction of the parts is prevented. I suspect this disease to be a form of erysipelas, although the skin is not usually inflamed, as every now and then it assumes the character of true erysipelas as soon as it reaches the face.

Let us now suppose that mortification has taken place to a certain extent; that the progress of it is arrested; that the system survives the shock; what further local treatment is required?

Indeed, I have little faith in any. The separation of the slough is a natural process. It is usual to apply stimulating, or as they are called, digestive ointments; solution of chloride of soda; stale beer poultice, and other things of the same kind. But my own experience would lead me to believe that the process of separation will go on just as fast with the simplest treatment, such as that of a bread and water poultice, or a linseed poultice, or wet lint with a piece of oiled silk over it. The constitutional treatment at any rate is of much more importance than any topical applications. Bark may generally be given with advantage; but the discreet administration of wine and a nourishing diet is of more importance still. Of course no general rule can be laid down. You must study the existing symptoms and act accordingly.

LECTURE V.

ON MORTIFICATION. (*Continued.*)

MORTIFICATION FROM STRANGULATION OR LIGATURE.

I now call your attention to some other varieties of mortification.

A ligature drawn round any part of the body, so as to intercept the communication of the great vessels and the heart, may cause that part to perish. But the effect of the ligature is not the same in all cases; and it does not always produce mortification in the same way. You apply a bandage round the arm before you bleed a patient, to make the veins of the forearm become distended, the object being merely to stop the circulation in the superficial veins. If you take it off at the end of a few minutes, the hand is at once just as it was before the ligature was applied. If you were to leave it on for twelve hours, the whole hand and forearm would become swollen, and would remain swollen for some time after the bandage was removed. The swelling in such a case arises from the congested state of the veins, and from the consequent effusion of some of the