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ON THE

CAUSES OF MORTALITY

AFTER

AMPUTATION OF THE LIMBS.

PART II—DISEASES.

BY J. H. JAMES, F.R.C.S.,

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A Paper communicated to the Provincial Medical and Surgical Association, and published in the Seventeenth Volume of the "Transactions."

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Surgeon to the Devon and Exeter Hospital, and Consulting Surgeon to the Exeter Dispensary.

A WISH having been kindly expressed by the Council of the Association, that I should complete the inquiry into the "Causes of Mortality after Amputations;" and it being, perhaps, even of more consequence that these should be investigated when performed for disease than for injuries,—1st, because they are more numerous; 2nd, because hitherto fewer facts and tables have been offered on this head; and, 3rdly, because a just comparison of these with the cases performed for injury will throw a very strong light on the pathology of both; and, if I mistake not, will tend powerfully to correct some erroneous impressions which have been produced by the statistical tables hitherto published, in consequence, as I believe, of their not having been strictly analyzed, I now submit the following observations. They are deduced from the results of my own tables, which will, I think, show that the mortality after amputation for *disease*, if regarded as arising from *the operation itself*, contrary to the ideas recently entertained on the subject, is very small; and will tend to confirm the opinion advanced in my first

Fewer facts and less extensive information have been collected on the subject of amputation for disease than for injury. Comparison will strongly illustrate the pathology of both.

A strict analysis of the results of amputation for disease, will show that the mortality is much less than

has been supposed, and will further show that the operation in itself is seldom fatal.

paper (vol. xvii.), that the great mortality after amputations for *injury* (which has been the means of involving the whole subject in error, from its not having been altogether separated) is also not truly referable to the *operation itself* in cases of *that* class.

By reference to my first paper it will be seen that I took 300 cases in succession as the basis of my observations and calculations: of these, 94 were for injury, 206 for disease. On a more strict examination of the records, I find, that although as to eleven of the latter the dates, the operators, &c., were specified, yet that there was an omission of the cause for which the amputation was performed, and I have therefore taken the *next* eleven on my list, in order to complete my number.

The views sustained in my former paper were founded on the results of 94 amputations for injury; in the present on 206 for disease,—making altogether 300. A supplementary list has been necessary to complete the latter with accuracy, for reasons now stated.

It has already been stated (vol. xvii., p. 87), that my notes of all operations have been made chiefly with reference to circumstances connected with their mode of performance, and in no respect with a view to their publication. Although from these reasons they are in many instances incomplete, yet I think that from other sources I can make it appear extremely probable, although not certain, that the mortality subsequently stated is substantially correct; for on comparing it with a document, undeniable and very accurately kept, viz., the recent Hospital Register, and excluding the amputations for injury, it appears that the table for *disease*, from April 12th, 1847, to April 12th, 1851, gives the following results:—

TABLE I.

Small amount of mortality after amputations for disease, as shown by the Hospital Register.

	No.	*Recovered.*	*Died.*
Thigh*.	11	11	0
Leg	10	9	1
Arm	0	0	0
Fore-arm	2	2	0
	23	22	1
	Proportion, say 5 per cent.		

* Another case, that of Ann Brewer; a thigh amputation, for scrofulous knee, August 19th, is not included in the deaths. She was discharged, but died the following winter of phthisis.

I may also add the results of *my own* proportion of the 206 operations for disease, which, although not possessing the accuracy of a Register, yet may be considered as a very near approach to correctness, as I hardly think I should have omitted the notice of any deaths which might have occurred, but of course this can only be taken *pro quanto valeat*. Of the 206 amputations for disease, there were performed by myself 62; of these, 5 died; 2 after amputation of the thigh, within a month; 1 after three months (from tubercular disease); and 2 after amputation of the leg. The latter were cases of old and unhealthy persons, with old ulcers of the leg. If we exclude the latter as belonging to a class which, as hereafter shown, has a *peculiar* mortality, the numbers will stand thus: deduct 8 amputations for old ulcers (the number I performed), there will remain 54 amputations and three deaths; the case which died after three months, from tubercular disease, might well be excluded also. Having thus established the probability that the number of deaths which will be stated for the whole 206, if not absolutely correct, is at least sufficiently near to afford a fair basis for reasoning; and in such an inquiry absolute certitude (if it could be obtained) is not necessary, a close approximation being sufficient for the purpose; I may add, that it cannot be doubted that the errors of imperfect statistics, not only as to numbers, but the *nature* of the facts, may well counterbalance the benefits. Tables will be found valuable in proportion as they are strictly analyzed; those on amputation would induce the impression that from 20 to 25 per cent. of amputations perish; but let the examination be strictly carried out, and then it will be found that this formidable statement disappears, as regards amputations for disease; and it will be a matter of some surprise, I believe, when the subject is fully investigated, to see how seldom the operation proves fatal in situations compatible with health, excepting for diseases of a particular class; and this is the point on which I shall next enter.

Although my record of my own proportion of the 206 cases of amputation for disease is not absolutely correct, it probably is sufficiently so to sustain the arguments and views advanced in this memoir

Importance of a strict and accurate analysis of the statistics of amputations, not only as to numbers, but distinctive facts.

To reduce the matter to some accurate test, I have classed the amputations for disease under the following

Analysis according to the nature

of the *disease*, as well as the limbs.

heads, still, however, observing carefully the classification as to limbs:—

Diseases which require amputation may be divided into certain heads; nine here presented for consideration.

Diseased joints.
Necrosis and Caries.
Old ulcers.
Malignant diseases,
1. Tumours;—2. Carcinomatous ulcers.
Chronic sphacelus.
Sphacelus senilis.
Acute sphacelus.
Acute suppurative inflammation.
Useless limbs and conical stumps.
Varia.

And I shall now proceed, taking the whole 206 cases, to state the number of deaths recorded under each head, and, as far as may be, the probable *causes* of death; but it must be borne in mind that, with the exception of my own fatal cases, I have not always had the means in my power of obtaining the full information requisite for this purpose.

Amputation for Diseases of Joints.

With the exception of youth, the conditions in cases of amputation for diseases of joints appear very unfavourable, yet the results are far from being so.

By far the larger number are for diseases of the joints; these have occurred chiefly to the young,—at all events, to persons not past the prime of life. As the subjects of these diseases do not present a favourable aspect, being for the most part scrofulous, and as amputation is rarely resorted to until every fair chance of recovery has passed away, and, in many instances, extensive suppuration has occurred, it might, *à priori*, be expected that such cases would fare ill; it will, however be found that this is not the case, as the following table will show:—

TABLE II.—*Amputations for Joint Diseases.*

	Cases.	*Deaths.*
Thigh . .	62 .	2
Leg . .	32 .	2
Arm . .	11 .	0
Fore-arm .	7 .	1
Total . .	112 .	5

The four last are fairly attributable to the operation. Two other deaths are recorded after it, but cannot be ascribed to it; they will, however, be shortly stated.*

The deaths which occurred often attributable to the diseased condition at the time.

If we investigate the *causes* of death, it will be found that they were greatly dependent upon the previous condition of the patient. Two stated in the note (167 and 280) are known to have died of tubercular disease when all immediate effects of the operation had passed away. These are not included in the table. In the earlier period of this record, we did not explore the chest prior to such operations, but for many years past, the discoveries of Laennec having been better appreciated, they were seldom undertaken without regard to this important point; at the same time, it is not, in my opinion, clear that the operation should be declined when tubercular disease is ascertained to exist, but is not far advanced; for, in the first place, I think the facts now stated, will show that the operation is *in itself*

Tubercular disease in *other parts* frequently the cause.

The operation, however, justifiable where this diathesis is known to exist.

* The following is a short summary of these fatal cases:—

Thigh.—No. 14, vol. ii., p. 518. Woman, 30. Scrofulous knee. March 14th, 1849. At the time of the operation she was much sunk. The limb œdematous throughout. Sloughs on the nates and shoulders occurred within a week. The stump also became sloughy; and she died, worn down, a month after the operation, hardly owing to it.

No. 136, vol. v., p. 390. Girl. Diseased knee. Operation Sept. 3rd, 1833. Inflammation of the brain came on three weeks after the operation, and she sunk rapidly.

Leg.—No. 120, vol. v., p. 369. Old man. Operation September 8th, 1832. Had secondary hæmorrhage, which of course required the reopening of the stump. Irritative fever followed, and proved fatal. Ankle.

No. 288, vol. ix., p. 340. Man, 45. Strumous habit. Diseased knee. Operation January 19th, 1848. February 5th, doing well; 18th, died of hæmatemesis.

Fore-arm.—No. 171, vol. vi., p. 428. Elderly man. Diseased wrist. Operation 1837. Stump nearly healed, but he got irritative fever; was jaundiced, and died in three weeks. Abscesses were found in his liver.

No. 167, vol. vi., p. 424. Young woman. Scrofulous knee. Operation Nov. 7th, 1835. Died February 1st, 1836, *i.e.*, three months afterwards. Extreme tubercular disease was found in pleura, peritoneum, lungs, and liver.

No. 280, vol. ix., p. 321. Young woman. Scrofulous knee. Operation April 12th, 1847; was *discharged* the following May, never having had a bad symptom consequent on the operation. The following October was reported sinking from phthisis, *i.e.*, six months afterwards.

Diseased Joints.]

little dangerous; secondly, that since the introduction of chloroform, the pain may commonly be avoided; and, thirdly, that as tubercular disease in an *early* stage may often be averted, the chances of such a result are greatly increased when the incidents belonging to a painful and diseased joint are removed, inasmuch as they involve a denial of almost all those circumstances which are known to be advantageous in the tubercular diathesis, especially exercise and fresh air.

On what grounds.

To these considerations I will add another. From the observations of many cases, I am disposed to think that the removal of a part, especially if large, becomes a source of increased nutrition and strength to the remaining body. It may be presumed, that under ordinary circumstances the amount of nourishment demanded, and food digested, is governed by the wants of the system, which are, by sympathy, conveyed to the digestive apparatus of the body; but, for this to be duly regulated and *effected*, it pre-supposes a healthy condition of that system; when it is otherwise, it arises from the impairment either of the organs of primary assimilation, in which case enough is not taken and digested, or of the organs of secondary assimilation, in which case enough is not converted into nutriment. The presence of such a cause as a diseased joint, with all its concomitants, will sufficiently account for these deviations, and its removal for the restoration of a normal state; but I conceive the matter goes further than this. I believe that in many persons the organs of assimilation are themselves, from hereditary defect or other causes, inadequate to the full and sufficient nourishment of the body to which they belong; and this very inadequacy becomes a frequent cause of joint and other disease, by giving a weaker blood than ought to be supplied. Now, it is very clear that if we subtract from the whole mass, which is to be nourished, a considerable portion, *e.g.*, a large part of an extremity, the digestive apparatus remaining the same, its power may henceforth suffice, and amply, for the due nourishment of the remainder. This, which I only advance as an hypothesis, I think is much borne out by the facts, and I believe that I am entitled to state, from considerable experience, that many puny and feeble persons have become remarkably strong and healthy after losing a limb, and that others, not previously so, have become plethoric, even to a dangerous degree.

Removal of a portion of a limb gives a larger proportionate nutriment to the rest of the body.

The results of amputation for joint disease in an especial manner confirm the opinion that the operation in itself is little fatal, and is borne out by others.

But to return to our more immediate subject. A review of the mortality which has ensued on amputation for joint disease will very much confirm the opinion, that the operation is in itself little fatal, when abstracted from the previous condition of the patient, or any ill management of the operation; and, by contrasting these joint cases with those for injuries, I shall probably succeed in showing the difference between them in the strongest light; still, I should not be warranted in pursuing this course, unless the remainder of the series bore me out, but a reference to the tables at the end will prove that they do so. We may repeat, that in every joint case the operation has been avoided until no hope of cure offered itself; that, in a great proportion, the subjects originally feeble and unhealthy, were reduced by an exhausting disease; that, in many of the cases hectic existed; that, in many also, there were complications with other diseases; that, in fact, the greater part of these cases were in such plight that they would have died, unless the limb had been severed. When these things are well considered, they will afford a fair ground for the conclusion before stated, that little mortality, considering the number of deaths, has arisen from the amputation abstractedly considered.

The causes of the mortality divisible into three heads, —that from previous disease; that from faults in the operation or treatment; and that from the operation itself.

If I possessed perfect histories of the deaths (the remark applies to every class of disease requiring amputation), my inquiry would be; first, as to those cases which died from the effects of the previous disease; secondly, as to the probable effects of bad stumps, or bad treatment, in producing the result; and, thirdly, as to the cases which may have clearly perished from the operation itself. The first branch of the inquiry may even now, to a certain extent, be carried out. The second is impossible; but there is no doubt that, as respects operations attended with fatal results, a share of the mortality does arise either from ill performance or from subsequent ill-treatment,—much more frequently from the latter, it being too often delegated by the principals. The third inquiry will have its advantages, for it will bring into strong contrast the difference between the processes which occur on the one hand, when the operation has been rendered necessary by injuries, and, on the other, by disease.

Diseased Joints.]

The mortality from the operation itself is in these cases so small as to show how little probable it is that the great amount after amputation for *injuries* arises from the operation, but rather from certain effects of the injury, hitherto little recognized, and erroneously imputed to inflammation of the veins of the part, especially in its bony structure.

When speaking of the amputations for injuries, the causes of mortality were considered, first, as arising from the effects of immediate shock; and, secondly, from secondary processes; the latter also being explained in chief measure from the *more remote* influence of shock (*vide* "Transactions" of Provincial Medical and Surgical Association, vol. xvii., p. 64 et seq.) This opinion was then supported by the phenomena of that series only, and it is founded on views widely different from those of men of the highest rank in the profession, many of whom have lately imputed them to venous inflammation originating in the part, especially *in the bone,* and the subsequent admission of pus into the circulation. A review of the present series enable me to examine the question more closely. Looking at the cases from injury, of 13 primary amputations of the thigh, 8 died (vol. xvii., p. 52; table also, p. 59); of these, four proceeded from phlebitis and secondary inflammation. After 62 thigh amputations for diseased joints, two; one from secondary inflammation of the brain; one from exhaustion and gangrene. Again, of 18 amputations of the leg for injury, seven died; five from phlebitis and secondary consequences. After 32 leg amputations for diseased joints, two only (No. 120, from irritative fever; No. 288, from hæmatemesis.) Placing them in a tabular form, they will stand thus:—

Comparative statement of mortality after amputation for injuries with that for diseased joints

TABLE III.

Amputations for Injury.				For Joint Diseases.		
	Cases.	*Died.*	From secondary processes.		*Cases.*	*Died.*
Thigh (primary)	13	8	4	Thigh	62	2
Leg „	18	7	5	Leg	32	2
	31	15	9		94	4

Subtracting the deaths from immediate shock in the list for injury, the proportion is as 31.9, from phlebitis and secondary processes; allowing all the cases after amputation for diseased

joint to have died from secondary processes, &c., the proportion would be 94.4. The tables at the end will confirm this view.

Argument. That, *à priori*, no greater mortality could be expected in the healthy subjects of amputation for injuries than in these unhealthy subjects; but the reverse.

As regards the operation (the matter at present under consideration), if taken abstractedly, it can hardly be affirmed (as elsewhere shown, vol. xvii., p. 65), that, *à priori*, it should involve a greater probability of ill consequences to the healthy, who are the more frequent subjects of injury, than to the unhealthy, in whom disease has rendered it necessary; if, therefore, phlebitis, secondary inflammation, &c., occur much more frequently in the former than in the latter cases, a cause for the difference must exist, and may, I think, be found. The question has been partly considered in my former paper; the evidence offered by the present series will tend further to elucidate it. It has, as stated, been greatly attributed to the veins inflaming, causing the secretion of pus, and that pus, being mixed with the blood, corrupting the mass, and also mechanically or otherwise, producing inflammation and suppuration in various parts of the body. Very high authorities attribute this in a great degree to a cause which, at first sight, appears to offer a ready solution, namely, that in amputations, the veins within the bones are mechanically prevented from closing, as in the soft parts, and are therefore prone to inflammation. The facts now stated will show that, however this may be, it cannot be the real cause, *for precisely the same conditions as to the bony structure obtain in amputations for disease, when such consequences rarely ensue, as in those for injury in which secondary inflammation is so common,* and in those for injury, I may observe that they occur in a very small proportion when the amputation is of an *upper* extremity, the conditions remaining the same. That inflammation of veins often takes place after amputation for injury, and that secondary inflammations in other tissues also occur, is a fact, and that these, whenever they take place, are capable of exciting an additional and often fatal effect, is quite certain; but it may be demanded, if veins inflame in the one case, why should they not equally in the other? If the amputation is performed

The hypothesis stated as regards inflammation of the veins, to which the mortality after amputation for injuries has lately been so largely ascribed.

Independently of the failure of proof as regards the opinion grounded on the condition of the veins in bony struc-

Diseased Joints.]

ture, other strong grounds for doubting the hypothesis.

through sound and healthy parts in a healthy person, why should the veins inflame when the cause is an injury so much more frequently than in the unhealthy, when it is disease?

This inflammation of veins rather to be regarded as an effect than as a cause; for taking the different cases alleged in proof by various authorities, the inflammation of veins in parturient females, for example.

On a careful review of all the phenomena, it appears to me that venous inflammation is rather to be regarded as an effect than the cause. Let us take the case of parturient females, so often advanced in proof of the origin of uterine phlebitis as connected with peculiarity of venous structure. Thousands are delivered every day. The uterine veins are exposed to the local, the mechanical causes of phlebitis, equally whether women are confined in healthy dwellings or in Lying-in Hospitals. Why, in the latter case, do they so often inflame? because, with every care taken, the air of the house *taints their blood.* This is liable to happen if they are visited by persons carrying the emanations from other puerperal cases, or indeed from any kind of erysipelatous inflammation, and we *must* believe that such emanations operate through the medium of the breath on the circulating fluid generally, and not directly on the *uterine veins.* Now, put the case of operations, amputation (or any other operation), placed in a similar atmosphere. Venous inflammation, hospital gangrene, &c., are very frequently the results. The claim, then, to explain these various diseased states from an original venous inflammation (excepting where peculiar violence has occurred to the veins,) is hardly well grounded. And if it be allowed to be probable that the shock of a great injury induces a state of the system not precisely the same, yet similar to that which is transmitted from the air, it will follow as a reasonable conclusion, not only that the essential cause of the phlebitis, &c., in the cases first alluded to, is a change in the general system, probably in the blood, from miasmata, introduced through the blood, but that, as regards those which occur after amputations for injuries, disorganization of the blood from shock is an equivalent cause.

Or after operations.

They are hardly the result of the veins being open, for this is the case in an immense multitude of instances where no such consequences follow, but seems to be produced by tainted air (unless where veins have been violently treated,) thus acting through the medium of the blood Venous inflammation being the effect, not the cause, and in cases of amputation for severe injury, an analogous change of the blood the pre-existing condition and cause.

In pursuing the subject, I may revert to other points (advanced

in my former paper) connected with the phenomena of injury, which, in my opinion, have hardly yet been sufficiently investigated; and, first, let us consider the difference which is occasioned by the superaddition of an external wound. A man shall fall from a height; shall be battered from head to foot; shall break some of his bones; and shall be all but dead. From this he rallies, and in the subsequent processes which occur everything tends to recovery; whereas, if an external wound be superadded, and that external wound be connected with a fractured bone or a joint,—although the extent of injury be much less,—the system is disposed to excessive and bad inflammation, and those other consequences we have been considering. It is very difficult to ascertain precisely the cause of this, nevertheless I venture to offer an explanation, which may in some degree account for it. In the former case, death not immediately occurring, the system is, and feels, capable of repairing the injury; in the latter this becomes a matter of difficulty, it may be of impossibility, from the difference in the local processes required, where the suppurative is substituted for the adhesive, and if, as I conceive, the system possesses a *consciousness* (vol. xvii., p. 62) of all that befals it, whether for good or for evil, when an external wound is superadded, from the consciousness of the difficulty, the impression will be proportionately more grave. Again, referring to the argument advanced in my former paper, that the peculiar results of amputation for injuries might be explained by reference to the supposition that the blood is suddenly altered, the next point is to show the probality that changes of the blood can take place in a very short space of time,—for it may be argued adversely, that if a limb is amputated shortly after the receipt of an injury, sufficient time has not elapsed to allow the blood to be so affected. As a proof of the possibility of its being so, let us examine a similar case: the effects which arise from the bite of a poisonous animal. If the animal bitten has received the poison from one possessing it in great intensity, as regards

Such states are not equally induced by severe injuries without a wound.

When a wound is superadded, from the impression made on the system, it becomes conscious of the material difference in the reparative processes rendered necessary thereby.

To support my own explanation of the phenomena, it is necessary to show the great rapidity with which the condition of the blood may be altered in the case of any grave injury

An example from the influences of poisons.

Diseased Joints.]

their comparative powers, say in the case of a rabbit bitten by a rattlesnake, the effect on the whole mass of blood is almost immediate,—possibly chemical, but I think not; and, by parity of reasoning, if the nature of any other injury inflicted on the body is capable of making a violent impression on the circulating fluid, it may be produced with similar rapidity.*

In the case of a poisonous bite (the communication with the nervous and vascular centres being open), the effect increases for a given time, and then, unless death ensues, it ceases by degrees; animals having the power of resisting, overcoming, and eliminating poisons of all kinds, and so, when disorganized by injury, it is capable of being retrieved. It is well worthy of remark, that if in either case the recipients do not at once succumb, a very similar train of consequences accrues, gangrene of distant parts being in both an especial consequence.

The present leaning of pathological inquirers is adverse to *reasoning from results;* and little inclined to favour a pathology founded on the leading doctrines of Hunter.

I am aware that the tide of professional opinion, of late years, sets so strongly in a direction opposed to *reasoning from results,* if I may so express myself, and that there is such a confident expectation of our being able to trace with perfect accuracy the causation of the phenomena in animals and vegetables to the independent action of their minute structure, and the mechanical and chemical action of the atoms, of animal bodies, as to make me fear that such arguments as these I adduce will find but little favour with many of the most talented inquirers of the present day; and when I profess my adherence to the existence and *predominant influence* of such causes as sympathy, and consciousness of necessity for action, and of sufficiency of power, or the reverse,—doctrines which were entertained by Hunter, and which the close observation of many years has only confirmed in my mind,—I well know that these opinions will now be regarded by many with disfavour rather

* There is another well-established phenomenon, which will show very strongly how completely the condition of the mass of blood may be perverted in a very short time, so as to go through stages in some respects very similar to those consequent on grave injuries. A number of persons have been shut up in a small space—soldiers, sailors; healthy people. For want of air, many of them have died outright; but what has occurred to the survivors? many of them have passed into fevers of a very malignant character. No infection,—no marsh miasmata,—no chill operating here. It is the rapid conversion of a pure into an impure blood.

than otherwise; I may, however, state for the consideration of those who are now pursuing their inquiries in the ardour of early or middle life, that the present generation has seen the re-establishment of doctrines which had become equally unpopular as these now are. I may, perhaps, be permitted to mention, as regards the humeral pathology, that in 1822, it was necessary to explain the grounds on which I supported a then exploded theory.* It has ever been the failing of medicine to pursue or to abandon in too bold, too reckless a spirit. It is not the first time that eminent men have believed that the mysteries of the animal economy might be explained upon mechanical and chemical principles; but while it is most certain that all the changes which occur in matter are phenomena of this nature, we must not only observe these, and the laws which govern them, but recognise the fact that inasmuch as these are in some respects manifestly different in living bodies, there must be a *cause* for this difference. An animal, when dead, will corrupt, and this corruption arises from the reciprocal action of the molecules of which it consists; but, after all, this could not be but from a principle ceasing to act which modified their former condition,—that principle which Hunter and many other great physiologists called the "vital." It is also true that, when alive, these molecules act on each other, and by their action the nutrition, the warmth, the existence of the animal, are provided for; still, we cannot resolve the matter into any mere system of chemical and mechanical actions; we must go much higher for a governing principle to induce and regulate these actions, though we cannot now, perhaps never shall, be able to ascertain its real nature. These opinions I should be prepared to support from arguments drawn from the same source as those cited by the advocates of a different system, I mean the epigenesis of the animal body; but such a discussion would be wholly foreign to the objects of a paper in these Transactions. I shall proceed, therefore, to the examination of the results of amputation, when adopted for the

Experience shows the alternate prevalence and decline of many medical hypotheses, but it equally shows the constantly prevailing tendency in medical inquirers to pursue or to abandon in too eager a spirit.

No hypothesis is likely to be true which does not recognise the great principles of vital pathology; principles which Hunter advocated, and which the strictest inquiry seems to corroborate.

* "Observations on Inflammation."

other classes of disease; these, however, offer under each head a much smaller number, but in the conclusion I shall give a connected view of the mortality of the whole, as contrasted with amputations for injury.

Caries and Necrosis.

Although often combined, they indicate essentially different states of constitution in most cases.

There can be no doubt that these modes of disease, although often blended, are essentially different, not only in their specific forms, but in their nature. Caries, perhaps, never occurs as an original affection without some constitutional vice; necrosis, on the other hand, is often the result of an accidental cause. A sudden chill, for instance, a fever of any kind, or blow, may induce inflammation of bone and necrosis, if proper care is not early taken, and, when once induced, the diseased limb may become a burden for the best years of a person's life; albeit, means timely applied might have prevented the inflammation from proceeding to a destructive point. When necrosis has once been fairly established, it often is combined with caries; and I only regret that I cannot separate the cases which were originally or altogether necrosis from those of caries. As it is, to avoid a too great and not always true division, they will be considered under the same general head.

The state of constitution in caries analogous to the scrofulous, and, as regards the question of amputation, similar results may be expected as in cases for disease of joints.

It will, then, at once be understood that caries presupposes an original vice in the constitution, and this is very generally allied to the scrofulous diathesis, so that if no very material difference should be found between the results of the amputations for these cases and diseased joints, we should not much wonder. The subjects are commonly young, and, although diseased, no type of constitution attends which necessarily involves a tendency to a fatal result after amputation or any other operation, considered *per se*, and if the patient dies, it is more remotely from other, generally tubercular, disease, the effect of the pre-existing diathesis.

In cases of necrosis it is otherwise, and the patients much more frequently defer the operation, even for many years, and in the meantime become much worse subjects for it.

In cases of necrosis it is otherwise. In the first place, many patients go on year after year hoping for better times, and it is only after a long period of fruitless expectation and suffering that they resolve rather to lose

the limb than wait still longer; and not unfrequently, especially when the leg is affected, a large ill-conditioned and sometimes cancerous ulcer is combined, an additional and important cause of mischief, as will be hereafter explained under the head of old ulcers. In the second place, when these amputations occur in the thigh, it is not only necessary to perform them high (an objection, I may observe, more doubtful than has been supposed), but it not unfrequently happens that the whole length of the shaft short of the epiphyses is compromised, and although there may be no sequestrum in the part left, the bone and its periosteum are in a state of inflammation or undue vascular excitement, circumstances unfavourable to the operation. Nevertheless, our own fatal cases have arisen from other causes.

The frequent necessity of a high operation in the thigh, and the inflammatory condition of the bone and its appendages above the point of section, in some cases constitute an additional objection.

TABLE IV.—*Amputations for Caries and Necrosis.*

	Cases.	*Deaths.*
Thigh . .	25 .	2
Leg . .	5 .	0
Total .	30 .	2

It will thus be seen that there were 30 cases of amputation for necrosis and caries, all of the lower extremity; and of these, two for necrosis were fatal; one complicated with hæmorrhage (No. 223); one from tetanus (No. 233*); not one from phlebitis or secondary inflammation.

Nevertheless the mortality under my own observation has been very small, and rather accidental than otherwise.

* No. 223, vol. vii., p. 435. Young man. Amputation of thigh for necrosis, Aug. 29th, 1841. Much hæmorrhage, continuing during the afternoon, especially from the bone, and of course disturbance of the stump. Constant vomiting, which opium and other means did not control; and death the following morning, from sinking, at 5 a.m. On examination, there was no particular disease found, except an enlarged spleen, and the body was not anæmious. The spleen weighed 3 lbs. 10 oz.

No. 233, vol. viii., p. 404. Boy, 12. Amputation for thigh for necrosis. Operation Nov. 4th, 1842. Stump a good one. Tetanus came on the 14th, and on the 15th he died, in the evening. He was of a very irritable constitution.

Old Ulcers.

Amputation in cases of old ulcers is resorted to, either to save life or to rescue the patient from a miserable one.

Cases sometimes occur when ulcers of the limbs are not only incurable, but render the patient's life helpless and miserable, and even assume at last a cancerous character. In addition to this, the profuse discharge of pus is equivalent to a hæmorrhage, and the subjects become more or less anæmious. These are cases in which amputation may become necesssary to give a chance of saving life, more frequently to rescue the patient from a miserable one. They are never undertaken by the surgeon unless compelled; they are never submitted to by the patient unless driven to despair.

The mortality much greater than in cases of diseased joints, necrosis, or caries, and may perhaps be imputable to the removal of a long established suppuration

Caries, necrosis, diseased joints, are all chronic maladies as well as these, and the effects of such will materially deteriorate the constitution, yet experience would indicate that death much more frequently results from the removal of limbs when the subjects of old ulcers, than from the former causes. If this be true, the reason must be sought for, and it will probably be found to depend, either upon the *age and constitution,* or on the removal of a *long-established suppuration,* or both.

There can be no doubt that *age* is an adverse circumstance, yet if we regard the results of other great operations, *i.e.*, for hernia, lithotomy, tumours, &c., we do not find that it alone proves a frequent source of mortality. I am more disposed to attribute it in these cases to the peculiar condition of the system under a state of long-continued profuse and unhealthy suppuration. In the first place, discharges of pus often relieve the system remarkably; this is a fact too well known to require comment; but the most remarkable proof of ulcers affording such relief from noxious matters, is probably to be found in the singular exemption from infection of persons labouring under them during the influence of a pestilential epidemic. It can hardly be that their state of health is superior to their neighbours; it is more likely that the noxious material is discharged by these outlets. The removal of such ulcers involves the risk consequent on the cessation of such discharges, not only in epidemic

The remarkable effects of old ulcers in giving vent to the materials of epidemic poisons, and probably of matters in other cases vitiating the blood.

seasons, but at all times. Again, in persons so circumstanced, it is not improbable that the ordinary state of the blood differs from the normal. It is not necessary to suppose what is indeed not likely, the actual existence of pus-globules in the circulating fluid, but the condition of that fluid may be so changed as to fall readily into an inflammatory and puogenic character. There can be no dispute that such changes do in many cases take place in the blood, disposing in a remarkable manner to local inflammation, and although neither the microscope nor chemical tests completely and accurately distinguish them, yet no reasonable person can regard the peculiar alterations of the blood in many instances (as, for example, in pregnant women) without acknowledging that such do occur, and that they are governed by some fixed and certain laws. In this last cited example, the condition is consistent with health, still it will be allowed that pregnant women are especially liable to inflammatory attacks, and it will also be allowed, that in them many diseases invariably take an unfavourable or mortal course,—I may especially mention scarlatina. Is it too much to suppose that the state of their blood disposes them to such tendencies? Is it not a fact that bleeding, in them, strongly controls or arrests them? Now, there are many persons who, I firmly believe, have a similar state of the blood, differing, however, in some important particulars, especially as being connected with no such natural cause as pregnancy, nor, like it, having a fixed period of cessation. Such a state, I believe, exists in many females on the cessation of the menses; in many, after parturition, where no natural relief is afforded by the secretion of milk; but I also believe that there are many persons of both sexes who are constantly labouring under such a condition; who are often ailing, and even, when apparently well, are ever disposed to inflammatory diseases,—persons who are liable to spontaneous attacks of erysipelas, or boils, or eruptions,—persons who suffer severely from any accidental injury, or who get serious inflammatory attacks from chill or other occasional causes. The common saying of the supposed ignorant vulgar is, that such persons have an *inflammation of*

Probability that in such persons the blood is disposed to inflammation and puogenic action.

Analogous states are to be found in pregnancy.

In females about the cessation of the menses.

In many persons of both sexes, who labour under a condition popularly denominated "inflammation of the blood."

Old Ulcers.]

the blood. The phrase is remarkable, and I believe that, like many other popular sayings, it is not wholy without foundation. If it be conceded, then, that these persons possess a circulating fluid changed from its normal state, and affording an apt pabulum for inflammatory processes; it will not be denied that the condition may also be puogenic; neither that the disposition will be to form bad rather than good pus, consequently, if such is the case in the subjects of old ulcers, if the natural vent is suddenly cut off by amputation, it may well be expected that they will be prone to inflammatory attacks, and these be of a bad character. Be this as it may, it is a fact, that death very frequently occurs after amputation for old ulcers, and that the immediate cause is often erysipelas, a bad pneumonia, or bronchitis, with rapid effusion, and, less frequently, secondary inflammations or phlebitis.

The subjects of old ulcers are not only prone to inflammation and suppuration, but these are of a bad kind, and if the constitutional vent is suddenly stopped unhealthy and often fatal inflammations will occur in the form of erysipelas, or analogous affections in distant parts.

Sympathetic fever is the natural result of severe injuries or operations, and consequently of amputation, and it is more especially during this effort of the constitution that the phenomena alluded to occur. In the healthy man the febrile action would run through its ordinary phases, and contribute only to such processes as the mutilated part might require; but in the unhealthy, during this species of erethysm, other organs are disposed to inflame, and that inflammation may or may not prove fatal.

These results more particularly apt to occur during the sympathetic fever consequent on amputation.

Mr. Phillips, to whom we are indebted for calling the attention of the civil branches of the profession to the mortality resulting from amputation, has also applied himself to this point, not, however, as regards this particular class, and has proposed as a means of averting the mischief, the substitution of some artificial drain. In such cases as these the plan may be peculiarly proper, but if effected *after* the operation, it will probably come too late, for it is, as I have now stated, during the sympathetic fever that the phenomena alluded to commonly arise, before a newly-made drain could take effect. Whether it might answer if established prior to an operation is a question

The substitution of an artificial drain promises to be service in cases of this class, if established prior to the sympathetic fever.

[*Old Ulcers.*

well worthy of consideration, but I must make this remark, *en passànt*, that the secreting surface of an old ulcer is disposed to separate a very different *kind* of discharge from one artificially and recently made.

Still there is an essential difference between the secretions from a natural and artificial drain.

It is a circumstance, as already stated, deserving of remark, that the mortality after amputations for old ulcers appears to be much greater than from caries or necrosis, or diseased joint, although the latter are also often attended with profuse suppuration. It may be, that in these cases the subjects are of a younger age; it may be, that the secreting surface differs. In them the suppuration is chiefly produced from the cellular membrane lining divers *sinuses*, in the former from a *large exposed surface of integument*.

The difference in the mortality after amputation in these cases and for those of diseased joints, caries, and necrosis, where copious suppuration has long existed, is remarkable. This may perhaps be explained partly from the difference of age, more from the secretion taking place from an open sore.

TABLE V.

	Cases.	*Deaths.*
Thigh . .	4 .	2
Leg . .	10 .	3
Arm . .	0 .	0
Fore-arm .	1 .	0
Total .	15 .	5

A short statement of the five fatal cases is annexed.* It will be seen that they were all of an advanced age.

* *Thigh.*—No. 21, vol. iii., p. 467. Woman, aged 60. Thigh. She had large old ulcers on the leg, of many years' standing, originally produced by a compound fracture. She wished to go to America, and have her limb previously removed. At the time of the operation her health was not good, and her constitution bilious. The leg was amputated October 23rd, 1819, and irritative fever, followed by an irregular but bad erysipelas, set in immediately. On the 2nd November she died.

No. 158, vol. vi., p. 410. An old man. Thigh. The ulcer was in the leg, of many years' standing, and had a carcinomatous appearance. He died nine days after the operation, from general giving way of the system and imperfect union of the stump. No phlebitis.

Leg.—No. 189, vol. vii., p. 404. A man who had suffered a great many years from an immense ulcer in his leg. December 3rd, 1838. The stump went on most favourably. A cough, to which he was subject, increased, but no symptoms existed of a threatening nature, till on the night of the 26th he rose up suddenly in bed, and

Old Ulcers.]

Ethical considerations as regards the operation in cases of old ulcers.

As regards the ethics of such operations, so to say, they have hitherto stood upon the same footing as many others; but if a larger number of results should confirm my own, it may appear right rather to dissuade the patient from the operation more strongly than in apparently similar cases, although two elements ought to enter into our consideration, namely, whether, for example, the ten who recovered might not have been worn down by the disease had the operation been refused to their entreaties; and also, whether, if so refused, the five who died might not have perished after no long period, and more miserably. The conclusion is, that each case should be well considered, and the chances carefully submitted to the patient.

Malignant Diseases.

Sub-division into,—1st, medullary sarcoma, &, 2nd, carcinomatous disease of the limbs. In the former rarely fatal, & tends to defer death, if it does not prevent it.

It has been my endeavour to distribute these into natural species, as thus,—medullary sarcoma and malignant osteo sarcoma, diseases so nearly allied in point of fact, that they may well be considered together, as far as regards amputation. The material point in both is to determine,—first, whether the operation itself often proves fatal in these cases; secondly, whether, if successful, it retards the progress of the malady or otherwise.

It will be seen, that out of thirteen one death only

almost immediately expired. On examination, the lungs were found highly emphysematous; a fibrinous concretion in the right ventricle, half filling it, and extending into the pulmonary artery, and firmly adhering. A similar one in the right auricle; the left cavities healthy. No evidence of inflammation in the popliteal veins of the amputated limb, nor in the great vessels.

No. 202, vol. vii., p. 418. Man, 78. Ill forty years. Leg. Operation November 23rd, 1839. He had cough prior to the operation; it increased rapidly after it, and he died on the evening of the second day, of peripneumonia notha. There was large effusion into the bronchiæ, and two pints of serum on the left side of the thorax. The operation was performed at the urgent desire of the patient.

No. 214, vol. vii., p. 423. Man, 61. Ill thirty years. Leg. Operation May 9th, 1840, died May 24th, of erysipelatous inflammation.

occurred (No. 48*), and that, under circumstances in which it might well be expected. It was a desperate and last attempt to save life, and it failed. The amputation, moreover, was of the thigh, very high.

The second point is less satisfactory. In two I know the disease returned soon afterwards, and it very probably did so in more. Yet I am inclined to believe, from what I have been able to collect from subsequent inquiries, that the removal of the part tends to defer the fatal event, if it does not prevent a recurrence of the disease.

The second species comes under the head of carcinomatous ulcers, but I find two descriptions of cases; one resulting, in all probability, from cancer of the skin, or, as it is now called, epithelial cancer; the other arising from the degeneration of ulcers connected with long-established caries. It will hardly be possible to draw the line strictly between the ulcers originating in soft parts, and *eventually* becoming carcinomatous (which have already been classed under amputations for old ulcers), and those which, originating in *bone*, have produced ulcers of the soft parts, ultimately becoming carcinomatous also, and entered under the present head. Of eight cases, two died after amputation (*i.e.*, No. 93 and No. 272.) The principal circumstances of these are briefly stated in the note;† and it will at once be perceived that they bear a strong affinity to those which

The second species is more apt to terminate fatally after amputation, and, indeed, in this and other respects has a strong analogy with the class of old ulcers, but, as regards the ultimate results is more favourable than in cases of medullary or osteo sarcoma.

* *Thigh.*—No. 48, vol. iv., p. 479. Woman, 66. *Medullary sarcoma* in the upper part of the *thigh*. April, 1824. Much hæmorrhage from numerous vessels; nineteen requiring ligature. She was of a very unpromising aspect at the time, and bad symptoms immediately followed. She died in about two days, vomiting, and with the appearance of black jaundice.

† *Thigh.*—No. 93, vol. v., p. 339. Man, 62. Epithelial cancer of twenty years' duration, involving nearly the whole leg. *Thigh.* Nov. 16th, 1829. The man's previous state was decidedly bad, with great derangement of the liver, which could not be corrected. The operation was performed at the urgent solicitation of the patient. Little adhesion took place. He had gastric irritative fever, and in the middle of December sunk and died.

No. 272, vol. ix., p. 306. Woman. *Thigh.* For carcinomatous ulcer of the leg. October 24th, 1846. Irritative fever, with bilious complication, immediately set in, and she died within the week.

Malignant Diseases.]

so largely proved fatal under the head of old ulcers. But it must further be observed, that of the whole number, including the cases of medullary and osteo sarcoma, those only fatal, were the amputations of the thigh. The ultimate results, as far as I can judge, are much more satisfactory in the cases of carcinoma than in medullary sarcoma. I have known few instances of a recurrence.

TABLE VI.—*Malignant Diseases.*

	Cases.	*Deaths.*
A.—Medullary Sarcoma and Osteo Sarcoma.		
Thigh . .	10 .	1
Arm . .	3 .	0
B.—Carcinomatous Disease.		
Thigh . .	3 .	2
Leg . .	2 .	0
Fore-arm .	3 .	0
Total .	21 .	3

Amputations for sphacelus, either chronic or acute.

The remaining cases which were subjected to amputation were of a different character. One class will comprise sphacelus, either acute or chronic, not proceeding from external injury; also, spreading suppurative inflammations. The other an entirely distinct set, *i.e.*, cases of amputation for useless limbs.

Chronic, taken first. Are essentially different in their nature from acute.

With respect to the first class, it might perhaps be expected that the acute species would be taken first, according to ancient custom, but it will be at once perceived that the chronic, if I have justly applied the term, are essentially different from the others (albeit they have their periods of activity); but there is a more important ground of distinction, namely, that they may continue for an indefinite time without involving the general system in any consentaneous state, whereas the cases of acute and spreading gangrene, although local in their origin, very soon compromise it.

Chronic Sphacelus.

Gangrena Senilis.]

Before entering upon this section, a few remarks may be permitted as to the term. I am by no means disposed to think a

change of name desirable, when the old one does not involve a positive error, on the contrary, it is liable to create confusion, at all events trouble, to those who have already learnt another; and, after all, it too often happens that a new title is also founded on some false assumption not perceived at the time it is bestowed. The triumphs of nomenclature are often very short, and I have lived long enough to see two or three generations of names succeed one another; when, however, a title, whether old or new, involves an error, it is better to get rid of it, taking care that we do not perpetuate mistakes. In this respect, designations perfectly arbitrary, and not assuming a principle, create no risk of erroneous impressions; are often the best; and if, in the present instance, the disease had been called Pott's gangrene to this day, it would have led to no mistaken opinions as to its nature, and have served to perpetuate the name of a justly celebrated surgeon.

The term objectionable, but great caution necessary in adopting new ones.

Although most commonly affecting old or elderly persons, it does not invariably do so, and I have known a few instances in which it has occurred early in life. The name, I need not repeat, is a misnomer.

It is not my intention to enter at length into a discussion as to the intimate nature of this malady, which, however, has been a subject of a good deal of controversy of late, but rather to speak to the facts which have come within my knowledge as regards the results of amputation; and I may venture to affirm that there can be found nowhere a greater proof of the soundness of that ancient maxim, "*Nullins in verba jurare magistri.*" It is unnecessary for me to say how often the removal of such limbs has been denounced in the strongest terms by the greatest masters of our art, especially in modern times. Notwithstanding these interdicts, however, I was bold enough to amputate the thigh of an old man, 30 years ago, grounding my proceedings upon principles I am still ready to support. The result proved that the principles were well founded.

Amputation in these cases condemned by high authority.

Five amputations for this disease have been since performed at the Devon and Exeter Hospital, by my colleagues, and not one of these patients has died from the operation; some have survived quite long enough and happily enough to fully justify its performance,

Six successful cases in this Hospital justify its performance under certain conditions.

Sphacelus Senilis.]

and, as they have been rare, I shall venture to offer a brief notice of the whole six.

First case; Webber (given at full length in my work on inflammation.*) He survived more than a year, and then died under the severities of a very cold winter.

No. 116, Case Book, vl. 5, p. 367.

Second; Man, aged 68, of firm constitution. The great toe had sloughed. Sphacelus was extending on the dorsum of the foot; the lower part of the leg œdematous. The man wished the operation. The leg was amputated July, 1832. The arteries exceedingly diseased, and in tying them "cylinders of bony matter were forced out." The stump became sloughy, but the constitution stood it well. August 21st, recovering. November, this man was discharged.

No. 119, Case Book, vl. 5, p. 369.

Third; A man, whose appearance "marks great age." Case of "*Ulcus senilis*," with ossified arteries.† He had lost the other leg some years before. The amputation (leg) was performed September 8th, 1832; in November, the report is, "this man is getting well." I saw him walking on his wooden legs some years afterwards; he lived near Exeter, at Heavitree.

No. 201, Case Book, vl. 7, p. 413.

Fourth; A very stout old man, of 70, whose mother was then living, at nearly 100. The operation performed April 27th, 1839, and he was alive some years afterwards. I often saw him, and believe he continued his occupation as a gardener.

No. 203, Case Book, vl. 7, p. 413.

Fifth; A man, about 60. Sphacelus had reached nearly to the knee, but a line of separation had been formed before the operation. The thigh was amputated June 20th, and on the 14th of August he was reported "going on well." In this case it is stated that the vessels did not appear much diseased.

No. 217, Case Book, vl. 7, p. 427.

Sixth; A man, 76. The right limb had been amputated about two years before, and I believe for the same disease. The left foot becoming affected, it was

* "Observations on Inflammation," p. 552.

† This case is entered as "Ulcus senilis, with ossified arteries." I consider it to be identically the same in nature as gangrena senilis, but it commonly commences on the heel or leg, instead of the toes; disposed to ulcerate deeply, with scanty granulations, or none, but with sanious discharge and much irritability of surface, having a callous margin, which from time to time sloughs away, increasing the extent of the sore.

determined to amputate that leg also, October 18th, 1840. The arteries did not retract, but when tied their two inner coats were forced out. Nov. 4th, much improved in appearance. January, 1841, "got quite well."

These cases (all that were operated upon) will sufficiently establish the fact that amputation *may* be performed with success for gangrena senilis, that great suffering may thereby be avoided, and life prolonged; at the same time, it must be understood, that when the constitution is decidedly bad, especially if the heart or lungs are gravely affected, it would be injudicious to attempt it, even at the earnest wish of the patient, excepting on a full explanation of the chances.

An attempt to establish the pathology on which the practice of amputation may be supported in these cases.

From these, as well as from other cases, it may be concluded that an ossified state of the arteries is not of itself a sufficient cause to deter us from operating. The true pathology of this form of disease, with reference to amputation, appears to be this, that at the extremities of the animal body (as often happens in vegetable life also), the organization or vital power becomes inadequate to maintain life. The part which perishes must be separated by an effort of the surrounding ones, which are still alive. *In this effort they, being feeble and inadequate to the task, also perish, after a weak and unhealthy inflammatory action.* But, although the parts in the vicinity of the disease may be unable to accomplish successfully the long process of separating, not only soft parts, but tendons and bones, they continually show, by the repeated formation of lines of demarcation, that they are capable of the adhesive process, and hence an amputation which involves *no further effort than the establishment of adhesion,* may, and does, prove often successful, especially since it is performed through parts much nearer the centre, where the nervous energy is greater, the circulation more perfect, and the disposition to diseased action has not yet been strongly communicated from the part already involved. To this it may be added, as explained under the head of amputation for diseased joints, that the subtraction of a part from a body whose assimilating organs are little capable of supporting the whole, will leave a larger proportion of nutriment for the remainder, if the patient survives,—a consideration of no small moment. I may, perhaps, further add, that, independently of the evidence

Acute Sphacelus.]

produced by these cases, the collateral evidence, as regards the small amount of mortality from mere amputations, will tend to support the propriety of the operation in many instances.

Amputations for Sphacelus, ensuing on the interruption of the circulation through the great vessels, or in aneurismal cases.

The propriety of amputation in any case of sphacelus determined by its causes and nature.

In determining the propriety of amputation in any case of sphacelus, its causes and nature must be duly considered. The main question to be determined is, whether the general system, being originally affected, has produced it, or whether, if arising from a local cause, that has imparted such an influence to the system as to render the mere removal of the part ineffectual. This question may be examined with reference to the part actually dead; the secretions and actions around it; and the condition of the system generally.

The part actually dead has little influence.

It is little probable that the dead part, unless shut up, acts in any other way than as unoffending foreign matter, at least in those cases of chronic sphacelus just described this does not appear to be the case, for they may exist for weeks or years without the least reason to suppose that they have been the means of introducing septic matter into the constitution; and even if shut up, as in carbuncle and carbuncular abscesses (where the inflammation is of the *limited* class), it does not seem probable that they necessarily occasion a taint of the blood; for, formidable as the symptoms are, if we make the *useful experiment* of a free crucial incision, the symptoms subside with great rapidity, which could hardly be the case if the blood had been largely impregnated with septic matter. It is not the dead substance in these cases which produces the symptoms, but the poisonous secretions thrown out, and the sympathetic effect on the system, which those secretions in their turn produce (speaking still of the *limited class* of gangrenous inflammation.) In the *spreading class*, we have superadded to this sympathetic effect, the contamination of the blood. I may be permitted to observe, that in both classes the

As appears from the phenomena of sphacelus senilis and carbuncular abscesses.

The symptoms rather depend upon sympathetic affection, from the poisonous secretions thrown out, and (whether they are absorbed or not) the actions they give rise to. In the limited

symptoms much resemble each other, and if not properly met, the results are the same, and the man who dies from carbuncles dies in a similar way to him who has traumatic gangrene; but there is this material difference in the essence of the diseases, that in the former case local means will give effectual relief, for ample incisions, timely made, will terminate the unsuccessful efforts of the part to control the mischief (a result, I may repeat, which could hardly have been obtained if the symptoms depended upon contamination of the blood), while in the other class the entire removal of the part by amputation too often fails, because the system has been largely affected.

class they appear to taint the blood but little; in the spreading, quite the reverse.

previously

The symptoms in both classes remarkably similar, but in the one removable by local means; not so in the other, and hence the frequent failure of amputations.

While considering the question of the introduction of septic matter into the system, I may be permitted to mention other phenomena, which are calculated to show that very similar symptoms may arise from *sympathy*, as well where there is little probability of the introduction of septic matter as where there is much; thus, sloughing ulcers of the cornea, and more especially of the throat, although producing a very small amount of secretions, and although in both cases the morbid secretions *are speedily washed away*, will produce an intense degree of constitutional disturbance, and, in the latter instance, of a similar kind to those which arise from an extensive gangrene in a limb; still, further, if we observe the effects which are often produced by the application of caustics in the two cases above stated, we shall see that the immediate change in the general symptoms, as in the case of carbuncle treated by incision, negatives the belief that they *can* arise from contamination of the blood. In the various cases of gangrenous inflammation spreading in a limb, however, these two causes co-exist and co-operate, and it is from a due consideration of the original nature of spreading gangrenes in a limb, that we shall be best enabled to appreciate the chances afforded by its removal.

The symptoms which arise where septic matter is introduced are also closely resembled by another class of gangrenous inflammation where the secretions are not confined, but the surface is so small, and they are so immediately washed away as to render contamination little probable.

In spreading gangrenes of a limb there is both the sympathetic disturbance and the actual contamination.

For practical purposes, as regards the question of amputation, acute cases of gangrene may be divided into two heads, easily intelligible; one, where the cause

For practical purposes, as regards the question of amputation, acute

Acute Sphacelus.]

gangrene, where it does not arise from the state of the system, may be considered under the following heads—*i.e.*, 1st, when the cause and malady are quite local, albeit the system may become contaminated, such are the cases now spoken of; 2dly, where the cause is a sudden and violent injury, at once affecting both the part and general system.

and the malady are originally quite local, however much the system may be ultimately contaminated; the other, where the local cause has, *ab origine*, inflicted a disorganizing effect on the whole system. The cases from injury which were spoken of in the first memoir, and which, if subjected to what are called intermediate amputations, so seldom succeed. Those cases which arise from a vice of the constitution, of the blood I may say, and which derive their cause from a general cachochymy, as O'Halloran and the ancients termed it, are no subjects for amputation.

When the cause is strictly local and the blood has not become contaminated, amputation commonly successful.

When the cause is local, and when the blood is not originally disorganized or subsequently contaminated, if amputation be performed before it becomes so, we may well expect success, and such are the cases which come under the present division, arising from the sudden and accidental interruption of the circulation in an extremity, whether from a mere wound, or rupture of a large vessel, or its ligature; but it must be understood that *concurrent circumstances* may make a material difference, by disabling the powers of the part, and in disposing it to limit the gangrene. Thus, in a case of simple wound of a great vessel, when gangrene ensues, at the very extremity of a limb, amputation, if early resorted to, will generally succeed; but where a great vessel has given way, from injury or otherwise, and the blood has been largely and forcibly driven into the tissues of the limb, or when an aneurism has occasioned that formidable and painful œdematous condition which precedes gangrene, the moment that occurs, the inflammatory effort fails to limit its progress in very many cases, and spreading gangrene not only extends to the point where the circulation is interrupted, but too often invades the parts above, and such is its character that it contaminates the blood. When, therefore, amputation is performed in these cases as at a late period the result too often is similar to that where it is instituted for gangrene, ensuing on severe injuries, and from a similar cause,—that it fails

But if concurrent circumstances have influenced the part, such as large or active extravasation, or an active or painful œdema from aneurism,

in which the parts are unable to resist the disposition to spread, and the system becomes contaminated.

in preventing the taint of the system, and will rarely succeed until that is conquered.*

I have thus attempted an explanation of the principles on which we should act in this particular matter of amputation, when gangrene affects a limb, and to show cause for a division into those arising from a grave *injury*, where the whole system is affected, and it is little likely to succeed, unless the constitution can be so far redeemed as to limit the mischief, as stated in my last paper; those, where the cause is originally quite local, as in a simple wound of a great vessel, and where, if not too long delayed, it is pretty sure of success; and, again, the intermediate cases of gangrene ensuing on a local interruption of the circulation

Thus we have the cases of severe injury affecting the whole. Local interruptions from lesions of the great vessels affecting the the supply of the parts only; and local interruptions accompanied

* I may be pardoned for offering a general view of what appears to me to be the most natural division of mortification, and noting those which may require amputation, and on what principles.

First division.—Acute in character, originating in the system, whether from a peculiar vice or introduced from without. (*a*) Carbuncular abscesses; pustule maligne; (*b*) erysipelas; diffuse cellular inflammation; thecal inflammation, and gangrene consequent on phlebitis; (*c*) bites of venomous animals, &c.; (*d*) various kinds of phagedœna; noma; gangrene of mucous surfaces.

Of these it may be said that none can require amputation in the acute stage, but a limb ruined by them may subsequently.

Second division.—Chronic in character, originating also from the system, and it can hardly be questioned chiefly from the state of the blood. (*a*) Scurvy; bad food; low fever; (*b*) ergot of rye.

In these gangrene of the extremities often occur, and may require amputation when the condition of the system is mended.

Third division.—From impaired nervous energy (also chronic in character.) (*a*) Fever; paralysis; (*b*) in debilitated persons or parts.

Fourth division.—Destruction of vitality from heat, cold, or chemical agents.

When occurring in the extremities, amputation may be necessary to remove a worse than useless part.

Fifth division.—1st, From impaired circulation. (*a*) Wounds of arteries or veins; (*b*) simple obstruction in them; (*c*) complicated with effusion; (*d*) aneurismal tumours; 2nd, chronic. The capillaries impaired; the larger tubes often ossified.

The four first, if the objects of amputation, require it before the system is gravely affected; the last, during an interval of extension.

Sixth division.—From mechanical injuries.

Amputation may be required in anticipation of gangrene, or after it stops.

Acute Sphacelus.]

with the disabling addition of extensive extravasation.

through a great vessel, *accompanied with collateral mischief,* as extravasation of blood; in aneurism with acute œdema, &c.

Four cases occur of the last kind, and as they all possess interest, a brief history is subjoined.* In the first, gangrene had not commenced, but was imminent: one (No. 124) proved fatal, and is a very interesting case; indeed all were sufficiently so to deserve mention.

Amputations for cases of Acute Suppuration of Thecal and Intermuscular Structure.

We know too well that when paronychia sets in severely, or when the fibrous apparatus of the hand is punctured, or suppurative

* *Spurious Aneurism of the Ulnar Artery.*—No. 32, vol. iii., p, 415. Man, 56. March 17th, 1821. *Arm* amputated. The history previous to his admission was, that he strained his arm, and an abscess ensued. It was opened by a very good surgeon in the country, but he did not get well. Soon after his admission, a strong aneurismal pulsation was felt, and a tumour of that character was ascertained in the course of the ulnar artery. This having given way, blood was forcibly diffused in the tissues of the fore-arm, so as violently to stretch the fascia; and I may here be permitted to mention, that the explanation of this phenomenon which then offered itself to me was, *that the principle of the hydrostatic pressure could alone account for it,*—an explanation which I subsequently offered to the Association, as accounting for the powerful dilatation of aneurismal sacs, in a communication on the subject of Inguinal Aneurism, vol. xii., p. 581. In this case gangrene was imminent. Amputation succeeded. The aneurism was of the spurious kind. The ulna beneath it carious. He recovered.

No. 54, vol. iv., p. 490. Man, 30. June 27th, 1825. *Thigh.* A popliteal aneurism had suddenly burst, and blood was largely extravasated in the thigh. Gangrene of the leg had commenced. The result is not expressly stated, but the case is related in such detail that I have no doubt if death had occurred it would have been so.

Phlebitis and Secondary Inflammation.—Fatal.—No. 124, vol. v., p. 384. Young man. February 7th, 1833. *Thigh.* The femoral artery had ulcerated at the groin, from a bubo. The external iliac was tied, October 14th, 1822. Suppuration and finally gangrene of the limb ensued. Amputation was resorted to as a last recourse, February 7th, 1833, and on the 17th he died with well marked secondary inflammation. On examination, the external iliac vein also was found obliterated, and in various places the veins of the extremity inflamed. Half a pint of pus was contained in the left side of the thorax, thick and dark, with extensive inflammation of the pleura. Liver tuberculated.

No. 270, vol. ix., p. 302. Man, 60. September 30th, 1846. *Thigh.* Bellingham's plan of compression had been tried in a case of popliteal aneurism, but did not succeed. The femoral artery was then tied in the usual place, July 15th, 1846. By degrees the limb got into a bad state. Superficial sloughs formed on the outside of the foot and leg, and began to spread rapidly. Amputation of the thigh, September 30th. He was in a doubtful state for a few days, with tympanitic abdomen, but recovered, and was discharged November 19th.

The use of limbs may not only be destroyed, but life endangered by active suppuration in thecal or intermuscular structure.

inflammation is communicated to it in any way, from causes which it would be superfluous to dwell upon now, the hand and arm are not unfrequently ruined, or even life threatened. It often happens that a wreck is saved, and although it may be less useful than an artificial apparatus, patients do not choose to part with it, nor surgeons to recommend amputation. Sometimes, before this consummation is obtained, the progress of the disease bids defiance to all attempts to limit it, and amputation, as stated, is necessary to endeavour to save life. It will be observed that of the cases of this kind included in the report, one died, and another had a narrow escape.* In addition to these were two cases of severe, acute, and extensive intermuscular suppuration, consequent on *simple* fracture of the patella. The joint becoming involved, would make it doubtful whether these should be classed with diseases of the joints, but independent of their cause being a distant and severe injury, there are other circumstances which establish a difference. I may observe that all these cases of acute and spreading intermuscular suppuration have in their nature a considerable analogy with those cases of injury which become the subjects of secondary or intermediate amputations from injury.

* *Cases of Amputation in the suppurative stage of Thecal Inflammation and Erysipelas.*

Arm.—Thecal Inflammation.—No. 26, vol. iii., p. 500. Man, 60. April 16th, 1820. Arm. The hand and fore-arm had been altogether ruined, and the arm invaded. He was so reduced by fever and discharges that I was obliged to amputate on the bed, as he lay. He was in a state of great jeopardy, but eventually recovered.

Leg.—Erysipelas Phlegmonodes.—No. 34, vol. iii., p. 524. Man. May 22nd, 1824. Leg. The limb had been ruined by erysipelas phlegmonodes, and the continued drain was fast running him down. He made a good recovery.

Arm.—Thecal Inflammation. Fatal.—No. 115, vol. v., p. 355. Old man. June 14th, 1831. Arm. For thecal inflammation. He died, but the particular circumstances are not detailed.

Thigh.—Fractured Patella.—No. 215, vol. vii., p. 425. Healthy man. June 17th, 1840. Thigh. A case of fractured, or rather ruptured patella, which had occurred and been treated in the country. The upper portion of the bone had retracted four inches, and when he came in extensive suppuration had occurred, and extended high up the limb. An entry is as follows: "Case, I think, did well."

Thigh.—Fractured Patella.—No. 219, vol. vii., p. 428. Man. December 8th, 1840. Thigh. A similar cause. The accident had occurred three years before. The divided portions at a similar distance. Union by ligament, but the knee was in a flexed position, from the original inflammation. A fresh injury excited suppurative inflammation, extending up the thigh, and it was necessary to amputate. He made a good recovery.

Amputation for Useless Limbs.

There yet remains one class of amputations of a sufficiently vague character, no doubt, where the operation has been performed from no imperative necessity, but to relieve the patient from an incumbrance which militated greatly against his comfort. Such are cases of limbs, useless, distorted, injurious to his pursuits, but not affected with any present active disease. Such also are conical stumps, giving constant uneasiness, and preventing the use of an artificial apparatus. These are the "*operations par complaisance*" of the French.

Attended with little mortality as far as my own record goes.

My own record contains but few cases of this kind, none of which appear to have proved fatal; and I am much inclined to think, from the present examination and a careful consideration of the subject, that little risk is incurred. The limbs are wasted; there is no active disease. The time, the season, and the place may be selected, and in all these respects such operations stand apart from many others.* If, some years since, I had arrived at these conclusions, I should not have refused the operation to a gentleman whose future prospects would have been much advanced by the substitution of a good artificial leg for a nearly useless limb. At that time I was led to believe an amputation of the thigh a highly dangerous operation; closer discrimination of the whole matter has perhaps enabled me to assign a juster idea of the degree of risk.

* Although no particular interest may attach to the history of these cases, a short abstract of them may not be amiss:—

No. 8. A leg and foot rendered useless by sphacelus, from frost-bite (an old case) ..... Leg.
No. 29. An old compound luxation of the ancle ..... Leg.
No. 84. Anchylosis of knee..... Thigh.
No. 86. Ditto ..... Thigh.
No. 96. Ditto ..... Thigh.
No. 108. A foot torn off by the run of a rope, leaving a bad stump at the instep. (This was the only case followed by any threatening symptoms. The weather, however, was hot, and the man's habits intemperate) Leg.
No. 129. A leg useless from an old compound fracture ..... Thigh.
No. 185. A previous amputation of the fore-arm had left a useless and painful stump ..... Arm.
No. 253. Leg and foot burnt some time previously, from sleeping close to a lime-kiln ..... Thigh.
No. 294. For a very conical and unhealed stump. (The previous amputation was not in the Hospital)..... Thigh.

Total..... Thigh, 6...Leg, 3...Arm, 1—10.

No. 279. To these may be added, although perhaps it might have been better classed with old ulcers, a case of elephantiasis of the leg in a young woman. She perfectly recovered..... Thigh.

TABLE A.

Amputations arranged under separate heads, in the order pursued in the preceding Memoir, setting forth also the limbs operated on. Total, 206; which, with the 94 for injury, make up the 300.

	No.	Deaths.	Total.	Deaths.
Diseased Joints,—				
Thigh	62	2		
Leg	32	2		
Arm	11	0		
Fore-arm	7	1		
	112	5	112	5
Necrosis and Caries,—				
Thigh	25	2		
Leg	5	0		
	30	2	30	2
Old Ulcers,—				
Thigh	4	2		
Leg	10	3		
Fore-arm	1	0		
	15	5	15	5
Sphacelus Senilis,—				
Thigh	3	0		
Leg	3	0		
	6	0	6	0
Malignant Diseases,—				
A. Thigh	10	1		
Arm	3	0		
	13	1	13	1
B. Thigh	3	2		
Leg	2	0		
Fore-arm	3	0		
	8	2	8	2
Varia.—Acute Sphacelus,—				
Thigh	3	1		
Leg	0	0		
Arm	1	0		
	4	1	4	1
Acute Suppuration,—				
Thigh	2	0		
Leg	1	1		
Arm	2	0		
	5	1	5	1
Useless Limbs, &c.,—				
Thigh	7	0		
Leg	4	0		
Arm	1	0		
	12	0	12	0
Elephantiasis,—				
Thigh	1	0	1	0
	1	0	206	17

Table B.

Amputations for Disease, divided into two Groups, according to their nature, and the Mortality connected therewith.

First Group—*Consisting of diseases often dangerous to life, and disabling the limbs; but, as regards the consequences of amputation, rather local than general in their influence, and not often fatal:—*

	THIGH.		LEG.		ARM.		FOREARM.	
	No.	Deaths.	No.	Deaths.	No.	Deaths.	No.	Deaths.
Diseased Joints:—	62	2	32	2	11	0	7	1
Necrosis and Caries:—	25	2	5	0	0	0	0	0
Chronic Sphacelus: *Sphacelus Senilis*:—	3	0	3	0	0	0	0	0
Malignant Diseases: A. *Tumours*:—	10	1	0	0	3	0	0	0
Useless Limbs:—*	7	0	4	0	1	0	0	0
Elephantiasis:—	1	0	0	0	0	0	0	0
	108	5	44	2	15	0	7	1

Total, 174; Deaths, 8.

Second Group—*Consisting of old-established ulcers, or spreading suppurative or gangrenous inflammation, frequently fatal:—*

	THIGH.		LEG.		ARM.		FOREARM.	
	No.	Deaths.	No.	Deaths.	No.	Deaths.	No.	Deaths.
Old Ulcers:—	4	2	10	3	0	0	1	0
Malignant Diseases: B. *Cancerous Ulcers*:—	3	2	2	0	0	0	3	0
Acute Sphacelus:—	3	1	0	0	1	0	0	0
Acute Suppurative Inflammation:—	2	0	1	0	2	1	0	0
	12	5	13	3	3	1	4	0

Total, 32; Deaths, 9.

Thigh, 1st Group, 108.5; 2nd Group, 12.5; say as 5 to 40 per cent.†

* I must here note an error which I became aware of too late to rectify it. My tables were,—thigh, 7; leg, 4; arm, 1. It ought to have been,—thigh, 6; leg, 3; arm, 1; and it will reduce the total number to 298, instead of 300. By adding two additional cases, this might have fulfilled my original intention, but the tables were in type.

† There is an element which must not be overlooked in considering the very small ratio of mortality after amputation for disease of the 1st Group. By the operation a long-continued and hourly source of irritation and disturbance is removed. It is performed on a system accustomed to struggle against disease; and the consciousness of relief from the one, and of power to accomplish the cure of a natural instead of a diseased surface, has a large share of influence in aiding the recovery.

These tables, then, (especially C), will show at one view the relative mortality under each head. The first follows the order in which the diseases have been taken in this memoir, and which, before they were closely analysed, I believed to be the most natural. It is evident that the series is readily transposed to the second, where they are separated into two groups, in which the difference of mortality is remarkable. That it depends upon the circumstances I have adverted to seems probable; at all events, in a practical point of view, the fact appears to be of great importance. It tends strongly to remove our apprehensions of the supposed fatality of amputations, *per se*, in cases of diseased joints, necrosis and caries, of tumours, although malignant, of useless (or rather worse than useless) limbs, and perhaps I may add to the list certain cases of gangrena senilis. On the other hand, it will lead us to apprehend a much larger share of mortality in cases of old and extensive ulcers, whether carcinomatous or not; and in cases of gangrene arising from interrupted circulation, if actively spreading; also, when the progress of acute suppurative inflammation in a limb involves danger to life. If these tables clear the question, they may greatly assist our future appreciation of the dangers and advantages of amputation in the various classes of disease for which it is proposed. They have been very carefully prepared, and I will undertake, after repeated revisions, to say that no important error, with the exception noted p. 332, has been committed which due care could avoid; at the same time, it must be remembered that I do not pledge myself for complete accuracy as to results; but, even supposing that a small number of deaths may have occurred without my cognizance, and have not been entered, still this would not account for a difference of ratio relative to primary amputations as compared with the first group for disease, of 40 per cent. in the former to 5 in the latter (*vide* Table C); and, as regards the two groups for disease, of 28 to 5 per cent.

It remains to examine more particularly the causes of death in those cases where a fatal termination occurred, as far as I have the means of doing so, and I believe they will in most instances suffice. The following, then, is a short but collected view of all those deaths already recorded under the appropriate heads, and now divided into two lists; one of cases proving fatal from

Analysis of Fatal Cases.]

irritative fever, from phlebitis, or other secondary processes; the other from various causes, of a different nature. The latter will be given first, to clear the statement.

On analysing the deaths, I find them as follows:—

From exhaustion. No. 14. A young woman, whose thigh was amputated for disease of the knee, in a state of extreme exhaustion, with anæmia. She got sloughs on her nates, shoulders, and stump, and died within a month. She probably would have died equally without the operation.

Tubercular disease. No. 167. A young woman. Thigh. For diseased knee. Died three months after the operation, from tubercular disease of the lungs, liver, and peritoneum.

Hæmatemesis. No. 288. A man, aged 40. Leg. Amputated for disease of ancle. Of a strumous habit. Went on well for a fortnight; a few days afterwards had hæmatemesis, and died.

From sinking. No. 223. Young man. Thigh amputated for necrosis. *Much hæmorrhage* continuing during the afternoon, he sunk and died on the following day. The hæmorrhage caused much disturbance of his stump. On examination, his spleen was found much enlarged; it weighed 3½lbs.

Tetanus. No. 238. Boy, aged 12. Thigh. For necrosis. Died of tetanus.

From sinking. No. 158. Old man. Thigh. For old ulcers. Died from sinking, seven days after the operation, stump not uniting.

Peripneumonia notha. No. 202. Old man, 78. Leg. For old ulcers. Cough prior to the operation. Died of peripneumonia notha two days after it.

From shock No. 48. Woman, aged 66. Thigh. For malignant sarcoma. *Much hæmorrhage* during the operation. Nineteen vessels required ligature. Continued vomiting came on; she became jaundiced, and died on the second day.

Of these eight cases, none can be fairly traced to phlebitis or irritative fever, and four would in all probability have died if amputation had not been performed, namely, Nos. 14, 167, 223, and 48. The others might not improbably have done so.

I may remark, that in two of these cases, *i.e.*, 223 and 48, much hæmorrhage followed the operation, and thus not only exhausted

the patient, but rendered it necessary to disturb the stump afterwards very much; a circumstance always involving the risk of unfavourable condition of the stump, and increased fever.

In the remaining nine cases there is very little evidence of phlebitis, but irritative fever and secondary inflammation ensued, and in great measure may be deemed the cause of death.

No. 120. An old man. Thigh. For diseased knee. Had troublesome *secondary hæmorrhage*, irritative fever, and died. — Irritative fever.

No. 171. An old man. Fore-arm. For diseased wrist. He got irritative fever; was jaundiced; a large abscess was found in his liver. — Irritative fever.

No. 21. Woman, 60. Thigh. For old ulcers of the leg. Got erysipelas and irritative fever, and died ten days after the operation. — Erysipelas and irritative fever.

No. 186. Old man. Leg. For old ulcer. Subject to cough; had no alarming symptom; but died *suddenly*, three weeks after operation. Lungs found very emphysematous, and large fibrinous concretions on right side of the heart. No appearance of inflammation in the veins of stump. — Suddenly, from fibrinous concretion in the heart.

No. 214. Man, 61. Leg. For old ulcers. Died fifteen days afterwards, of erysipelatous inflammation. — Erysipelas.

No. 93. Man, 62. Thigh. For epithelial cancer. Little adhesion of the stump. Gastric irritative fever; sunk and died, a month after the operation. — Irritative fever.

No. 272. Woman. Thigh. For carcinomatous ulcer of the leg. Irritative fever, with bilious symptoms, immediately set in, and she died within a week. — Irritative fever.

No. 124. Young man. Thigh. For gangrene of the limb, consequent on ligature of the external iliac artery, but occurring long after it. Phlebitis of the limb had followed that operation, but had not produced decided general secondary symptoms until the occurrence of gangrene. Amputation was followed by irritative fever, and he died ten days after the operation. It may be observed, that the liver was found tuberculated. — Irritative fever.

No. 105. Old man. Arm. For thecal inflammation of fore-arm. He died, but the particulars are not stated.

The first remark to be made is, that of these nine cases which

appear to have died of irritative fever or erysipelas, seven were old persons, and most of unsound constitutions, added to the unfavourable predispositions already spoken of, as arising from extensive and old ulcers, from spreading gangrene or suppurative inflammation, which existed in seven of them.

There is little evidence of phlebitis in any as produced by the amputation; but supposing it had existed in the whole number, the proportion would be very small as regards 204 cases; and it will be observed, *that the bones were equally sawn in all of them, as well as in the cases for injury, which proved so fatal,* and the only difference in the two classes is, that these were old and diseased persons, whereas the others were people in health and the prime of life, and, *a fortiori,* much less subject to deficient adhesive process, —facts which militate against the hypothesis which ascribes the fatal consequences so frequently ensuing in the latter cases to phlebitis, and that phlebitis to lesion of the bony structure.

It would be quite premature now to offer any extended remarks on the views which ought to be entertained with reference to operations generally; but among the various systems of classifications which have been adopted by the masters of our profession at different times, it strikes me that there is one which has not sufficiently attracted attention, namely, the direct influence they may exert on vital organs or otherwise. Trephining, lithotomy, hernia, evidently come within the former category. The removal of many parts, such as tumours, diseased jaws, diseased limbs, &c., follow another. I may state this in ignorance of the distinction having been sufficiently noted; but, at all events, with reference to our present subject, it is important. The removal of a diseased limb may prove fatal, but not in the same way as a lesion of a vital organ during an operation. It may prove fatal from hæmorrhage, but this is rare; from shock, but this is rare also, except for injuries. These tables show that out of 204 cases, three at most died from this cause when the operation was performed for disease; and there is very good reason to believe that the numerous cases which prove fatal when performed for injuries owe their fatality to the injury itself, and not to the operation, at least such appears a fair conclusion from the comparison of the tables I have submitted.

Whether we regard the deaths after amputation for injuries, or

those for disease, the greatest amount has arisen from irritative fever and its concomitants. It does not appear, from the cases here stated, that phlebitis has been extensively or strongly marked. In some hospitals this has been the case, but it has been, as I believe, where vitiated air would account for it. Our own cases which have died from irritative fever, and what may be called secondary processes, may by some be attributed to phlebitis, but the characteristics of that form of disease are so very peculiar that I hardly think they would have escaped notice, if distinctly marked; but, even supposing it otherwise, it would by no means follow that it should not be regarded as an effect rather than a cause, according to the proofs before offered in support of this opinion.

No reference has been made in this memoir to other tables or reports of the results of amputation for *disease;* and I feel it my duty to say here, that it has arisen from no wish to undervalue the labours of others, but having adopted a mode of examining the various questions connected with it, based on a method of analysis not hitherto pursued, I found it the best plan to rely upon my own materials only. It may also be observed, that as regards any extensive returns which have been hitherto presented from large hospitals, they relate to institutions which, possessing every other advantage, do not, as far as I can judge, possess in an equal degree with ours those which regard *the distribution of patients prior and subsequent to the performance of the operation.**

In conclusion, I may be allowed to say, that cases numerous, taken in succession without selection, carefully examined as far as my records enable me, and analysed so as to form series which may be deemed sufficiently natural, will afford fair evidence of the truth of many of the facts submitted as such in the present and the preceding memoir. I am bound, however, to allow, in contradistinction, as regards the *opinions* which have been advanced, that they

* There would be more reason to question the validity of this opinion, if our mortality after amputation for injuries did not so much accord with the experience of others; and the explanation of this fact depends, as I conceive, upon the overwhelming influence of *this* cause (as in great epidemics) overbearing all other conditions in a very great degree.

Concluding Remarks.]

may be partly or altogether erroneous. Granted that those which relate to the influence of the blood in these cases,—that those which seek to maintain or even to augment the doctrines of Hunter,—may be fallacious; even if this be so, there still remain a large body of facts which may have their value. The subsequent experience of abler men will ascertain its degree; and the only point on which I am solicitous as regards this matter is, that the experience by which they are tested should be of the same nature, and that when derived from sources where the *agency of vitiated air prevails,* it should not be too readily allowed to invalidate these statements.

I shall make no extended summary, but simply offer, as fair conclusions, the following remarks.

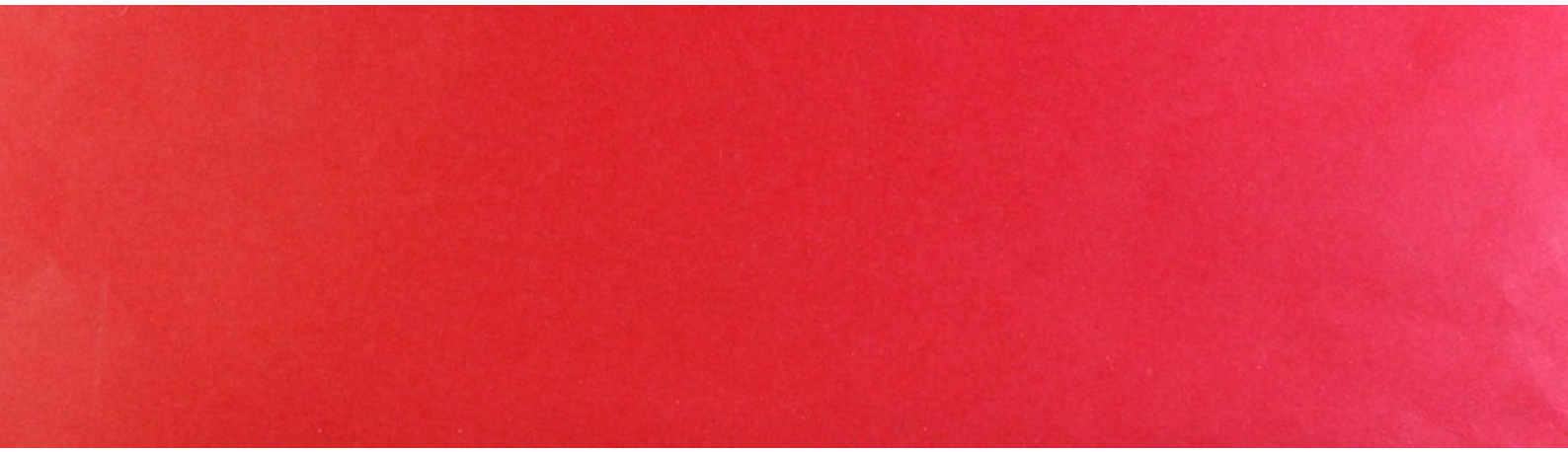
That amputation (especially of the upper extremities) is an operation, *per se,* little fatal when well performed, when the case is carefully attended to, when no after hæmorrhage or other important contingency affects the result; but that injury or disease will cause a material difference, if they have affected the general system prior to the operation, and in proportion to the degree and mode in which they have done so.

That grave injuries do this at the time of their infliction, and independent of any subsequent inflammatory action; although, when this arises, it increases it in a greater or less degree, according to the character of that inflammation and the treatment adopted. They rank first in order in regard to the mortality.

That diseases of a particular class,—for example, those which may have recently contaminated the constitution, as acute gangrene (not arising from external injury) or acute suppuration, and long existing ulcers,—will also be the cause of a large share of mortality.

In other cases of disease, although very severe in themselves, and complicated with such affections of other organs as may eventually cause the death of the patient, yet, the system not being similarly contaminated,* amputation is much less fatal.

* The term contamination, although applied with strict propriety to the blood only, is here used to express a change in the system for which I can find no better; and it must not be held as necessarily assuming a change in the blood, although my own opinion is in favour of that view.



This Table, retaining the principle of grouping, gives the total numb
the lower extremities as compared with the upper. It further
especially, in these different cases.

AMPUTATIONS FO

First Group.	*Diseased Joints.*			*Necrosis, &c.*			*Sphacelus Senil*	
	No.	Deaths.		No.	Deaths.		No.	Death
Thigh	62	2	...	25	2	...	3	0
Leg	32	2	...	5	0	...	3	0
	94	4	...	30	2	...	6	0
Arm	11	0	...	0	0	...	0	0
Fore-arm	7	1	...	0	0	...	0	0
	18	1	...	0	0	...	0	0
Total	112	5	...	30	2	...	6	0

Second Group.	*Old Ulcers.*			*Cancerous Ulcers.*	
	No.	Deaths.		No.	Deaths
Thigh	4	2	.....	3	2
Leg	10	3	.....	2	0
	14	5	.....	5	2
Arm	0	0	.....	0	0
Fore-arm	1	0	.....	3	0
	1	0	.....	3	0
Total	15	5	.....	8	2

To

Without reducing the proportions to decimals, which the nature of the
the lower extremities,—for injuries, 40 per cent.; for diseases, Group 1st,

Note.—The two next amputations on the list are the following:—Martha Gillard, aged 39. Disea
nd not at all affect the calculations.

I will now only repeat, that the record of these cases of amputation, as well as of other operations, was originally undertaken with no view to such an endeavour as the present. The object I proposed to myself was, to collect materials which might enable me to judge of the advantages of particular methods, both in conducting operations and their subsequent treatment, as well as the prudence of undertaking them under given circumstances. When the opinions we had previously entertained of the little comparative danger of amputation were powerfully shaken by the extensive statistics recently offered, I was induced to see how far my own experience confirmed them or otherwise; and although many years passed before I undertook the task of strictly scrutinizing the materials I possessed, I found, when I did commence, so many facts which to me appeared to be of interest, and to justify large limitations to the views entertained,* that I was induced to offer them to the public, and the favour of the Council of the Association has given them a place in their valuable Transactions. It is obvious that the purpose for which I originally commenced my record has found no place in these memoirs. On any subject connected with the mode of operating or treatment I have been silent, nor do I think they would be well adapted to a publication of this class. Such further observations as I have had an opportunity of making on these points, I may perhaps, at a future time and in a different manner, submit also for consideration.

* These will appear most plainly in Table C.