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LECTURES
ON
AMPUTATION,
AND ON THE
Nature, Progress, and Terminations of the Injuries for which it is required.

(Delivered at Sydenham Coll. Med. School.)

BY RUTHERFORD ALCOCK, K.C.T.,&c.

LECTURE XIV.

On Amputation, &c.

Observations on "Irritative Fever," and its connection with diseased stumps, phlebitis and secondary abscesses, or purulent depôts in distant parts of the body; with cases illustrative of the cause and progress of these diseased actions.

WE have traced the various diseased actions supervening on fractures and complicated injuries of the extremities when amputation is not resorted to; as also, those fatal actions which follow the operation performed in the Primary, Intermediary, and Secondary periods. Having also endeavoured to determine the proportions and relative frequency of each form of disease, under a variety of modifying influences and circumstances, it will be expedient now to inquire into the real nature of these actions; their resemblances and differences, and the true causes of their development after injuries and capital operations.

In order to present the many facts and views into which such an inquiry naturally branches, in a clear and systematic manner, I shall limit myself to certain classes or groups of diseased actions; arranging these in reference to their causes, and the frequency with which they are found combined.

It has been shown that there are two general actions of most fatal character supervening on primary amputation: the one, *bilio-remittent fever*, chiefly occurring when the patients are placed under unfavourable circumstances; the other, which I have defined under the term "*irritative fever*," occurring, independent of circumstances, in a great measure, and despite of the most favourable means of treatment, &c. To this latter, therefore, as clearly referrible to the injury and operation (but little influenced by external or collateral circumstances), I shall first refer.

Irritative Fever.—This occurs in all classes of amputation, and under all circumstances, but in its fullest development only in primary and intermediary amputations: in the former, more generally in a pure or simple form, without organic lesion; in the latter, more frequently attended with complicating diseases of different organs, leaving it more or less doubtful how far the irritative febrile action is a cause or an effect. In its most simple form this action destroys the patient, without any complicating organic lesion, or unfavourable local action.

In a second and less favourable form, there is highly inflammatory local and unhealthy action developed in the stump, and extending generally as high as the next joint, without, however, any complicating affection of the viscera, or other organic change or disease. The morbid action in the system falling chiefly on the stump.

In a third form of irritative fever, there is secondary abscess or purulent depôt at some distant part: often disease of chest, or of the contents of the abdomen, frequently suppurative in character; and, finally, phlebitis, superadded to various forms of local disease in the stump. Any one or all of these affections may be developed during the progress of this subtile and destructive febrile action.

Here are short abstracts of five cases illustrative of the first form, which may be defined as "irritative fever, induced by the double shock upon the nervous system of the original injury and the operation, and capable of destroying life in a few days, without perceptible change of structure, or any other marked form of disease."

CASE I. —— *Almy, ætat. 37, an unfavourable case of compound fracture of tibia and fibula, three inches below patella; amputated by circular incision on 2nd day, within 48 hours; died 23rd day, with a small irri-*

tative fever; external circumstances unfavourable; viscera healthy; stump soundly healed, end of bone rounded by callus; fever supervened 13th day after the operation.

Operation borne well; 3 ligatures; little blood lost. Up to 12th day, case went on most favourably; slept well, and felt refreshed by his sleep after the first night of operation. On 4th day of operation stump dressed; seemed inclined to unite by first intention.

Fifteenth day after the injury, and 13th after the operation, sickness of stomach, and slight pain of head; skin hot, moist; pulse full and frequent. The succeeding morning the remaining ligature came away, "stump looking well, and discharge trifling and healthy;" sickness abated; complained of weakness and great perspiration. The two following days, 15th and 16th, after operation, also better; slept well, free from pain; stump healing soundly, discharge trifling; bowels regular; tongue clearing, and moist; pulse 90, soft.

17th. Vomiting and purging, which he attributed to some fancied mistake in the medicine he had previously taken, without such effect. Carbonate of ammonia and spiritus ammonia aromat. ordered in small doses.

18th. Bowels relaxed, free from pain, face flushed, skin hot and moist, pulse feeble and frequent; complains of difficulty of voiding urine. Half an ounce of thick high-coloured urine drawn. Next day, no change. Last three days, soporose, countenance and breathing anxious, slight blush over stump, incoherent.

Post-mortem. — Body not emaciated; stump had healed soundly; callus rounding end of bone; a small collection of healthy pus found on outer side of thigh, but unconnected with any other part; viscera healthy.

CASE II.—*Thomas Crowther, ætat.* 20, *gunshot fracture of femur in action of August* 1, 1837; *amputated by flap operation from four to six hours after receipt of injury; died 17th day, from irritative fever; bone a little denuded, but stump almost united; no lesion of any important organ; external circumstances favourable.*

First day after amputation passed a quiet night, sleeping greater part of time; in good spirits; pulse soft, moderately full, and regular; tongue rather loaded, and white; no heat of skin. One dose of aperient medicine administered, has not operated; stump not swelled; very slight bleeding; some increased action about noon, but slept a good deal, and felt no pain of any consequence. *Evening*—stump swelled; pulse rapid, and rather full, with occasional intermissions; thirst considerable. 2nd. Slept well, upon the whole better; towards evening, exacerbation; stump cool; no blush of redness; bled to syncope. 3rd. Much relieved by bleeding; quiet, and slept well; secretions good; stump commenced discharging freely; dressed; apparent adhesion all round incision; pulse less frequent, soft, and not full; less thirst. 4th. Satisfactory. 5th. Not slept so well as usual, but no particular complaint; eruption about the mouth. 9th. Stump looking well, and united by first intention through its greater portion; general health good. 11th. *Stump discharging copiously; bowels rather relaxed.* 12th. *Discharge has diminished exceedingly*; pulse rapid. 13th. Heat of skin; pulse rapid, and a tremulous motion in the hands and countenance. 14th. Singultus tendinum; stump looking well: again relieved by a free bleeding; blood put on a bluish tint, and looked thin. 15th. A more comfortable night; face and neck bathed with perspiration. 16th. Died at night.

Post-mortem.—No recent or organic disease of any important organ. Although bone denuded near extremity, stump healthily united. Whence the sudden diminution of discharge, and the irritative fever that killed?

CASE III.—*Sergeant Cunningham, ætat.* 40, *amputation under unfavourable circumstances by circular incision forty-eight hours after receipt of injury; a fractured femur through the knee-joint; shock from the injury great, supervening irritative fever; death in fourteen days.*

Stated to have lost much blood in the two hours' transit from the field. He was anxious to have the operation done, but about the fourth hour, on being taken to the operating-room, he was so weak and exhausted, as to forbid any attempt before reaction. Stimulants were administered during the night, but he did not much improve, and was restless, though inclined to sleep; pulse fluttering, and limb easy.

Second morning after wound—Passed a tolerably good night, and slept at intervals during the day; in the evening he was feverish; pulse, early, was full, but immediately before the operation at mid-day it became accelerated, and less full; countenance cheerful; tongue clean. Operation borne tolerably well: a large limb. In the evening, composed and tranquil, pulse quick, but wishing for sleep. Opiate ordered.

First day after operation—Slept pretty well; tongue clean; pulse quick and full; free from pain, and countenance cheerful. 2nd. Little change. 3rd. Slept well; tongue clean; pulse quick; drinks much; bowels open. 4th. Stump dressed; partial union; fœtid discharge; tongue clean; pulse regular; free from pain; slept tolerably well; bowels regular. 5th and 6th. No obvious difference. 7th. Bowels act; pulse full and quick; tongue white and flabby; skin cool; countenance natural; stump suppurating and looking healthy. 8th and 9th. Discharge dimi-

nishing. 10th. Stump rather sluggish; little or no discharge; some cough; pulse full and quick; tongue clean; sleeps badly. 11th. Stump more sluggish and unhealthy; tongue foul and clammy; pulse small and quick; skin hot and dry. 12th. He died.

Post-mortem examination not made.

CASE IV.—*Lieut. B., ætat. 20, gunshot fracture of femur in action, Sept. 13, 1837; amputated by circular incision five hours after receipt of wound; stump healed second month; supervention of irritative fever, and a depôt of purulent matter above the stump; external circumstances favourable.*

Limb already swelled, and very muscular; no arterial blood; but a fair quantity of venous blood allowed to be lost. He was not faint with the operation. Some little hæmorrhage, brought on by a clumsy visitor brushing across it, two hours after operation. *Evening*—Pulse hard, but not much accelerated; tongue pale, clean, and moist.

First day after. Febrile action; venesection; swelling of limb not increased since amputation. *3rd day after.* Healthy adhesive action going on in stump. *4th day.* Still feverish. *6th day.* Slight sloughing of cellular tissue; no suppuration; long round worm expelled from the bowels previous day. *8th day.* No fully-formed suppuration; tongue cleaner; feels some appetite; been freely purged by medicine. 10th. Decided improvement; *suppurative stage established; irritative fever has subsided, and pulse, for the first time, again* 80, *and soft;* skin slightly peeled off the amputated side, probably the result of sharp inflammation which set in.

During second month stump closed, but a baggy feeling was communicated on pressure above, apparently from the presence of matter which had not easily found vent from the external corner; this became subsequently considerably increased. About 40th day it seemed diffused through the limb, with some redness, and a slight tendency to point on the outside. Forty-third day an opening, deep through the integuments on the outside of thigh, was made, and nearly half a pint of thick, well-formed purulent matter let out: a good deal still left diffused in limb.

In a short period the incision healed, and a good healthy stump remained.

CASE V. —— *Toledano, ætat. 22, shattered humerus from gunshot; amputated by circular incision 3rd morning after the action; formation of purulent depôts within the stump, and accompanying attacks of irritative fever; recovered 3rd month; external circumstances unfavourable.*

Swarthy, middle-sized Castilian; anxious temperament; amputation near head of bone.

Within the first twenty days nothing remarkable, beyond a slight attack of fever: tongue continued more or less loaded. On the 24th, pain in the axilla; uneasiness in the epigastric region; and about 30th day some fever. An emetic produced the ejection of a considerable quantity of greenish fluid, and an incision in the axilla gave exit to about two ounces of well-formed pus. During the succeeding ten days he complained, at intervals, of pain and uneasiness in the epigastrium, and passed a worm by the mouth; after which the tongue gradually cleaned. From 40th to 60th day a second collection of matter formed nearly in the same place, and a small piece of partially-detached bone was felt by the probe, near the surface of the stump, which he would not allow to be removed. This was never observed to exfoliate. Third month he was discharged well in health, and stump healed.

Nos. I. and II. are both of the thigh, and they present one remarkable feature in common, viz., that the stumps in both showed no kind of sympathy in regard to the adhesive process. In one there was sound union, without any disease, and merely a small collection of pus on outer side of thigh, showing the disposition to form those secondary deposits. In No. II. some slight disease of bone, yet the stump healthily united. The diseased action causing death, not only, therefore, *did not commence* with the stump, but the latter scarcely seemed to have sympathised, except by a sudden and remarkable diminution of discharge.

Another point worthy of notice is illustrated by No. I. of these cases, viz., that the development of this irritative action does not always take place at first, but the deleterious action seems to lie dormant; or, rather, the shock acts as a narcotic, keeping the patient in a deceitful calm: these effects were only disturbed, and the narcotic influence worn out from the 12th to the 15th day, when the reaction fully showed itself, and in a few days carried off the patient. A somewhat similar result may be observed to follow a shock, or commotion to the brain, in injuries of the head.

In No. II. this narcotic action disappeared as early as the second day. The patient was a fine, healthy young man, watched by myself with the greatest care, and treated under favourable circumstances. The febrile and nervous reaction was checked by bleeding and other measures. Union seemed to be going on most favourably; and to one who had not studied this peculiar impression on the nervous system, and its effects, there was no appearance of immediate danger from the small irritative fever hanging about him. My prognosis from the first supervention of these symptoms was unfavourable. On the 16th he died, and no trace of organic disease could be discovered after death.

No. III. furnishes an example of a modification of this action. In this patient there was obvious sign of the injury itself having inflicted a most perilous shock and impres-

sion upon the nervous system and the powers of life, so much so as to induce me to defer operation unto the second day. On being carried into the operating-room two or three hours after having been wounded, such was his state of depression and prostration, that death must rapidly have followed amputation. On the succeeding day his powers had rallied, but from the time of operation I traced the development of what might best be described "*une fievre sourde.*" I augured ill of the result, notwithstanding he bore the removal of a large limb remarkably well. Although there was partial union, yet the stump had an unhealthy aspect, and he sank on the 12th day after amputation.

No. IV. is a case of cure, but well adapted for comparison with No. II.: both fine, healthy young men. Operations performed within six hours, and, for similar injuries, within thirteen days of each other. The same action commenced in this as in the case No. II. He was most carefully watched, and by the 10th day it was happily subdued; but although the stump closed from the beginning, and united, a large secondary abscess formed in the outside of the thigh. On this being evacuated, no other untoward occurrence presented.

No. V. is a second case of somewhat similar character, where, twice after this irritative fever, there were collections of matter forming secondary abscesses, although the febrile action partook somewhat of the bilio-remittent type as well as the irritative. He was a Spaniard, whose arm I removed in a Spanish hospital, and the only one out of a large series performed in the same locality that was saved. To these cases of purulent depôts in or above the stump I shall refer hereafter, in some observations on the value of union by first intention.

We pass on to the second series, showing with this irritative action the development of severe local disease, but still no other organic or visceral disease to account for death. Sometimes this is accompanied by phlebitis, and then has been esteemed as the simple effect; at others, however, no trace of venous inflammation can be discovered, and therefore it cannot be considered otherwise than as a febrile and irritative action of the system, independent of such cause: the more so, that with it we find occasionally a metastatic or secondary abscess, in some distant and otherwise unimportant part.

Let me draw your attention to the three following cases.

SECOND SERIES OF IRRITATIVE FEVER,

"*Accompanied by severe local disease, sometimes by phlebitis, but presenting no organic lesion to account for death.*"

CASE VI.—*James Smith, ætat.* 21, *compound fracture of femur; amputated on the field by circular incision, from four to six hours after infliction of wound; secondary hæmorrhage; unhealthy action of stump; great irritative febrile disturbance; extensive necrosis; cured* 206*th day; external circumstances favourable.*

Great splintering of middle of bone; *limb swollen;* amputation a little below trochanter minor. 1st day after. Slept about eight hours; severe pain in the stump; dysuria, and some oozing of blood from stump, checked by cold water; pulse 95; tongue furred; some thirst; bowels have not acted. 2nd. Restless night; some pain. 3rd. Slept none; tongue white; bowels costive; pulse regular; pain of stump "going down to ankle." 4th. Sleepless still, but free from pain during the night; bowels opened; stump looking tolerably healthy; not much discharge. 5th. Slept at intervals; trifling pain; freely purged; stump opened out, considerable discharge, with a small slough; little constitutional disturbance; tongue covered with white fur. 6th. Pain since previous day's dressing; stump discharging profusely; pulse 90; tongue furred. Six, P.M. Hæmorrhage to 4 oz.; soon checked, but recurring at nine o'clock again. 7th. On removing dressings, surface covered with large coagulum, say 12 oz.; stump decidedly unhealthy; muscles pale, and covered with a cheesy-like matter; bleeding proceeded from a branch of profunda; pulse 95, weak; countenance pale and anxious; tongue furred; vessel secured by taking up part of surrounding substance, with two curved needles, and passing a ligature round. 8th. Rallied; tolerable night; profuse discharge. 9th. Some appetite for the first time. 10th. No sleep; surface of stump bad; constitution sympathises greatly; tongue covered with whitish-brown fur; pulse 90, weak; skin natural; bowels free; no appetite. 11th. Local and general improvement. 12th. Not so evident. 13th. Stump somewhat improving; great debility and constitutional irritation; bad night. 14th. Cavity on inner side, where needle and strangled muscle imbedded; constitutional irritation increased; tongue covered with dark-brown fur; pulse 95, weak; difficulty of breathing on right side. 15th. Bad night, but pains of chest and abdomen relieved; much fever; skin hot and dry; tongue covered with a dark-greyish fur; pulse 90, hard; bowels relaxed; stump still presents a healthier action; much sloughing of muscles on inner side. 16th. Febrile action abated; stump improved; weight of poultice has produced slight ulceration of integument. 18th. Healthy; good discharge; granulations are springing up rapidly of good florid hue; sloughing of skin from pressure of poultice trifling. There is a plentiful covering of skin, and the loss of substance from sloughing is making up by granulation. Unequivocal signs of irritation on the system; tongue moist, with a dark-brown streak on each side; appetite failing; pulse small, accelerated, and irritable; bowels open, tend-

ing to diarrhœa; now improving. 45th. Towards this period symptoms anything but favourable; state of mind desponding; delirious one night; granulations pale and unhealthy; had diarrhœa; tenesmus and want of sleep; bone becoming slightly discoloured; rest of stump nearly healed up; patient exceedingly irritable; prognosis unfavourable.

75th. Stump healed much; rounded, and become in all respects, save one, more healthy and satisfactory in its appearance; exfoliation threatens to be a long process; pain from time to time near bone; health and appetite good.

95th. Projecting bone getting loose. 120th. Fungus projects from centre of bone, which is exceedingly painful. 130th. Great pain in the bone at night, preventing sleep. 135th. A large portion of inner table of shaft removed four inches in length by gentle traction. 140th. A little erysipelas of stump; disappeared 143rd. 160th. Fungus gradually lessening under the daily application of the nitrate of silver, dry lint, and pressure. End of 7th month invalided, with sound and fleshy stump; surrounding parts healthy; no pain or inconvenience of any kind.

Patient a shoemaker, from Pimlico; habitually healthy; has had the fever slightly, which was prevalent at Vittoria.

CASE VII. — *William Cooper, ætat.* 23, *a parallel case to No. VI., but ending fatally; shattered tibia into knee-joint, amputated by circular incision six hours after receipt of wound; died* 122*nd day; treated under favourable external circumstances.*

Stump dressed 4th day. Limb considerably swollen; great retraction of integuments; surface of stump bare for three inches, and unhealthy; no complaint of pain or uneasiness in the limb; a little febrile action, which did not last long. 19th. Doing well. 11th. Stump deteriorates; discharge of flaky matter. 18th. Constitution giving no evidence of irritation or disturbance; pulse full and regular; tongue clean; bowels acting; bone protruding considerably. A month later, surface of stump not very florid, still not unhealthy; bone and granulations presenting a very projecting cone; health and appetite long continued excellent. In thirty days more the stump had deteriorated considerably; glazed and unhealthy kind of fungus; pale and flabby at most projecting surface, and surrounding the bone, which is more exposed than at last report, and discoloured; still general health does not seem to suffer, although subject to an occasional attack of diarrhœa. He had no pain; and, although he coughed, no clear indication of disease of chest; appetite good, and tongue clean. From this, the 83rd day, to the last, there was a slow diseased action of stump; cough; occasional diarrhœa, and once vomiting. On the 123rd day, appetite good; felt quite comfortable; discharge not very great; much emaciated; face extremely pallid and sharp; globules of pus were remarked in the expectoration for the first time on the day of his death; but that very day, "appetite good; sleeps at night; perspires profusely!" was the report.

Post-mortem. — Hepatisation, adhesions and vomicæ of lungs; liver greatly enlarged; mesenteric glands ditto; necrosis involving the whole of femur.

CASE VIII.—*Serg.-Major Simpkin, ætat.* 35, *gunshot fracture of head of tibia through the knee-joint; amputation of thigh by flap operation performed three hours after wound received; died* 32*nd day; late supervention of irritative fever and phlebitis; no trace of visceral disease or lesion of important organs; treated under unfavourable external circumstances.*

Third day. Stump seemed united; patient easy, not much swelling; bowels confined; pulse full, but soft; tongue clean, &c.

Fifth day. Stump discharging. 7th. Discharge becoming more thick and healthy; adhesions firm, and edges well approximated; scarcely any constitutional disturbance. On the 23rd day he is noted, "without an unfavourable symptom."

25th. A sinus extending down to the bone, the aperture being at inner side of incision, from which about four ounces of thin curdish and slightly fœtid matter escaped; slight febrile symptoms. 29th. Rigor succeeded by perspiration, morning and evening. 31st. Two last days repeated rigors, but attended with no very urgent symptoms, either of constitution or stump. 82nd. Vital powers sinking; sensorium affected; died.

Post-mortem. — Thoracic and abdominal viscera healthy; internal part of stump in a state of gangrene; the front and inner muscles emphysematous; adhesion of stump in the line of incision perfect, with the exception of two fistulous openings, one inferior and the other superior, communicating with the bone which was denuded at its extremity, and in patches to the extent of four or five inches; femoral vein showed marks of inflammation.

Finally, in the third form in which we find this irritative fever developed, we have the whole series of complicating actions accompanying; viz., phlebitis, purulent depôts, affections of viscera, and diseased stumps. I will only draw your attention at present to two examples of this most fatal form.

THIRD SERIES OF IRRITATIVE FEVER.

CASE IX.—*John Frederick, ætat.* 36, *elbow-joint shattered by grape-shot; arm amputated by circular incision six hours after receipt of wound; died* 30*th, with purulent depôt in shoulder joint, lungs, and liver; treated under unfavourable external circumstances.*

Stump was found open and irritable on 2nd day; constitutional disturbance slight; stump

soon improved; and to the last presented a good and healthy appearance. About 16th day he had some derangement of bowels, was very restless, and in the succeeding two or three days he complained of some shiverings previous to the formation of an abscess in the inside of arm. 20th. A shivering fit; again on 21st. 22nd. Checked after commenced by a dose of morphine; tenderness over right hypochondrium; thirst; tongue moist; stump at this date healing rapidly. 23rd, 24th, 25th. He seemed generally worse; but on the 26th his pulse was 100, soft, then natural; tongue clean and moist. 28th. Pronounced moribund. 29th. Wonderfully rallied; pulse 85, distinct and regular; some diarrhœa; tolerably coherent; stump discharging considerably; no tenderness. 30th. *Died.*

Post-mortem.—Superior lobe of right lung contained a large quantity of pus; middle sound; inferior full of well-formed tubercles. There were several tubercles in the inferior lobe of left lung, and on this side a large effusion of bloody serum; liver enormously enlarged, but appeared tolerably sound, with the exception of one abscess in the inferior portion of left lobe; humerus denuded of periosteum for one inch and a half of extremity; abscess in shoulder-joint; three ounces of pus not communicating with the stump.

CASE X. —— *Burrard, ætat.* 20.—5. *Fractured humerus into elbow-joint; arm amputated by circular incision within six hours; threatened tetanus; febrile action supervening 15th day; patient died 28th day; disease of all the viscera; of the stump and of the axillary vein; treated under unfavourable circumstances.*

Third day. Some pain of stomach; tongue clean; pulse 104. 5th. Stump and general state good. 6th day. Difficulty in opening mouth wide, referring pain to articulation of jaw; slight twitching pains in stump, otherwise free from pain. 7th day. Stump united two lower thirds, but large discharge from upper part of wound; still difficulty in opening mouth. To 12th day going on well, general health and stump.

15th. "Some febrile symptoms." 17th. Stump opened, and a slough is being detached; discharge of a flabby character, and mixed with blood; a sinus in axilla has been opened and is healing; fever somewhat abated.

19th. Stump swollen, painful; exacerbation of febrile symptoms; skin hot; dry and loaded tongue; so to 22nd. Delirium during night; pulse 112, hurried; skin moist; tongue somewhat cleaner.

23rd. Great delirium at night; eyes suffused; vacant stare; pulse 112, quick and jerking; skin hot. 24th. Same. 25th. Same; skin and tongue dry; pulse small, quick and flattering; bone protruding.

27th. Appears in a much more natural state, and free from pain. In the evening died.

Post-mortem.—Body emaciated. *Head.* Effusion under dura mater; pia mater turgid; substance of brain studded. *Chest.* Lower lobe of left lung cavities filled with pus; rest more or less diseased; purulent matter in both cavities of chest. *Liver* mottled. *Stump*—Bone protruding; pus surrounding course of bone; veins surrounding shoulder-joint contains pus as far as axillary vein.

The connection in this last case between the shock and subsequently morbid state of the nervous system, and the extensive diseased actions of all the viscera, is clear, and strongly confirms the deduction that the latter are the effects of that disorganising shock.

The three series of cases I think sufficiently demonstrate,

Firstly. That there is a febrile action of a small irritative character, depending, apparently, on some deleterious impression made upon the nervous system by severe injuries and great operations, and rousing it into morbid action.

Secondly. That sometimes this action alone destroys, leaving no trace of organic lesion or local disease; at other times in company with it, is developed a diseased and disorganising action of stump, from which the patient may recover; or the local disease continuing, he may die worn out by its violence, and the continued irritation of the system.

Thirdly. That with this irritative febrile action, phlebitis, secondary abscesses, diseases of liver and lungs, may also be developed, and that their connection or dependence on each other is apparently but slight and difficult to trace, but all are referrible to the nervous shock. The fever in some of these instances vacillates in type between a continued inflammatory, an irritative, and a bilio-remittent fever. These, then, are the facts of greatest importance at present, as proving—

That not only do patients die by the direct action of a shock—clearly by the impression on the nervous system, and generally so immediately as to allow no time for the development of organic disease—but that this same impression, acting with less intensity and less promptly, induces a small irritative fever—presenting no very alarming appearance, but frequently destroying the patient in the same manner as by shock without organic disease—the same influence is in operation, but in a less concentrated form, affecting vital *functions* rather than important *structures*.

That various complications by some attributed to arrested suppurations in secondary amputations, and to those referred only—by others referred to phlebitis only (the type of febrile action marking it, being described as always bilio-remittent)—may be more justly referred to the deleterious impression on the nervous system made by a severe double shock, and that the fever attending may either

be continued, hectic, irritative, or remittent; but the two latter are the most frequent, neither being absolutely distinctive of phlebitis, and phlebitis, on the other hand, being by no means necessary to the production of the secondary abscesses, bilio-remittent fever, &c., attributed to it. If these premises be correct whenever a severe shock has been received, these effects may follow; and as some patients by their temperaments and constitutions must be more liable than others, no very correct scale of relative proportions under different circumstances can be fixed. It may, however, be fairly assumed, that these cases, in which there is a double and quickly-succeeding shock inflicted upon a system full of vigour, and the elements of excited action, will be most liable, and these form the class of primary and intermediary amputations. The injuries not amputated, and cases of secondary amputation the least liable, for, although in the latter there are two shocks, they are yet widely separated, and the second falls upon a system often less sensitive. These conclusions are fully verified by the results of my own experience.

The cases hitherto related show this effect resulting from the double shock of primary amputation. The single shock of the injury, as I have shown was to be anticipated, will occasionally produce the same results, but, like the cases of secondary amputation, much more rarely than when two shocks are experienced with an interval more or less short between each. If the shock be, in its concussion or commotion, very perceptible, it destroys the patient at once instead of by the slower process of developing a small insidious, but fatal febrile action of irritative character. By this singular correspondence between the two classes, where there is but one shock, and where the shock of an operation supervenes at short intervals upon that of injury, the view I have taken of this cause of danger, and often of death, seems still farther borne out.

Thus, although death by shock, or by tetanus, occurs in cases of injuries unamputated in a considerable proportion, it is difficult to affix this particular type of irritative fever upon more than 1 or 2 in 38 fatal cases. So in secondary amputations, this peculiar irritative fever is rare, while the shock of the operation more immediately destroys a large proportion. Tetanus also more rarely occurs in cases of secondary amputation; the long-continued wasting discharge, seems to reduce the susceptibility of the nervous system to any deleterious impression, unless it be overwhelming, and then the patient sinks, not by tetanus, not by irritative fever—but at once and completely, without a struggle or an effort, under the violence of the commotion.

If we turn to the intermediary amputations, we find this irritative fever, and its frequent complications, predominating over all other causes of mortality, and tetanus in considerable proportion also. There is some difficulty often in determining the really predominant character of the febrile action leading to death, sometimes unaccompanied by organic disease, but more frequently with some of the complications I have enumerated; but of this I can feel no doubt, that in the primary and intermediary amputations there is always large predominance of three forms—the irritative, bilio-remittent, and inflammatory continued form, sometimes merging into each other in such a manner, as to make it doubtful to which type the action might most be strictly referred; but one of the two first largely predominate.

These forms of fever exist also in the cases of injuries for which amputation is not performed, but they by no means predominate. On the contrary, in this class, as in that of secondary amputations, when the shock does not at once carry the patient off, hectic plays the principal part, with its usual accompaniment, diarrhœa; the remainder die by a host of irregular and accidental actions, as I have defined them in a previous paper, consisting of secondary hæmorrhage, from ulcerated arteries, gangrene, tetanus, complicating wounds, &c.

To the primary and intermediary amputation, then, is this irritative and subtile action chiefly confined; and to nearly the same extent the bilio-remittent, the cases of secondary abscess, phlebitis, &c. They certainly, as far as my experience extends, do not exist in anything like similar proportions in either of the other classes, although such cases occasionally occur in all.

These facts lead to the strong conviction, that they are peculiarly the results of that shock or commotion, moral and physical, the chief force of which must fall upon the whole nervous system, and that of organic life more particularly—vitiating the secretions, causing, in many instances, a merely functional though fatal derangement; in others, with those vitiated secretions and functions developing a bilio-remittent and malignant fever of typhoid character, and such as we would the most naturally attribute to, as we would expect it to arise from, any influence falling upon the nervous system of organic life—vitiating the functions of the most important organs, depraving all the secretions and poisoning the circulation. At the same time, there is probably irregular distribution of nervous power to different organs, the blood itself, is sent in morbid quantity, and irregularly, to one or more points, leading to congestion, inflammation, and suppuration.

In illustration of these remarks, I will conclude by calling your attention to a brief outline of three cases of injury where amputation was not performed. Observe how close the analogy between the diseased actions and those I have pointed out as supervening on the shock to the nervous system by amputa-

tion, and how the tendency to tetanus tends to confirm these views, which refers the first cause of such fatal actions to the nervous system.

CASE XI.—*J. Waite, partial fracture of tibia into knee-joint; shock affecting nervous system and threatening tetanus, followed by the development of fatal febrile action, and no organic disease.*

Second day after injury. Pain and tension considerable; pulse quick and sharp; straight position rendered impossible by the agony it occasions; free bleeding; leeches; opiate. 4th day. All symptoms aggravated; heat, tension, redness, and pain considerable; febrile action high; bowels costive; pulse 110, hard and full; tongue dry and brown; skin hot and dry. 5th. Two incisions made inside of joint, followed by discharge of matter. 7th and 12th days. Considerable improvement, local and general. Intervening days. Return of symptoms. 17th day. Evidence of great exhaustion; restless; little pain; discharge profuse; tongue dry and foul; rigidity about the jaw. 18th. Fluid in joint; calf baggy with matter; stiffness of jaw continued, and previous night extended for a time to the throat; great irritability. After this the stiffness of jaw gradually diminished, while all the symptoms of fatal exhaustion gradually increased up to the 27th day, when he died.

Sectio cadaveris.—Leg much diseased with infiltrated matter; deep ulceration near external malleolus; knee-joint filled with pus; cartilages extensively absorbed; interarticular cartilages in a state of slough, and connections destroyed; larynx presenting no source of irritation.

CASE XII.—*Peter Carey, shattered knee-joint, not amputated; shock to nervous system determining violent and gangrenous local action, as the chief result and cause of death.*

Musket-shot passed through head of tibia, and made its exit in poplitcal space. Patient retained perfect command over the limb, and would not submit to amputation. 2nd day. Pulse 180, rather sharp; little swelling or pain set in; skin hot and dry. A sharp purgative and febrifuge mixture ordered. 3rd. No sleep; tongue foul; venesection to 16 oz. 4th. Tenseness of leg; swelling of knee; pain moderate; febrile action continued. 5th, 6th, and 7th days. Remarkably free from pain; pulse 112; tongue slightly furred and brown. 8th. Delirium; vesications and gangrenous appearance of limb; thigh tense; little discharge from the wounds; pulse 112, small and intermittent; free incisions to let out matter and relieve tension, with a good deal of relief, after which he slept. 9th. No delirium; less tension; large sloughs separating; pulse 112, more regular, and of better strength; in the evening, worse; feeling exhausted and pulse intermitting. 10th. Limb gangrenous to the knee, and extending on the inside; delirium; pulse small, thready, 112, regular. Died at night.

Sectio cadaveris.—All the tissues of the leg disorganised; no injury to vessels or nerves, but the former filled with coagula to the popliteal space; no further disease ascertained; the synovial membrane of uniform pink colour.

CASE XIII.—*Sergeant West, ætat. 37, partial fracture of tibia into knee; irritative fever, in its development threatening tetanus, leaving congestion of lung and disease of liver.*

Great swelling and tension, with a sharp pulse at 100, came on by the second day. On the 6th, swelling relieved, and an abscess opened on outer side of leg. Improved to 12th day, when some spasmodic action of muscles of leg set in; a piece of bone removed next day. 14th. Spasms continuing; discharge thick and healthy. 16th. Stiffness about the jaw; spasms diminished in frequency, but increased in intensity; tongue clean and moist; appetite good; spasm of leg and rigidity of jaw continued more or less severe up to the 28th day, with some soreness of mouth, and an attack of diarrhœa; these symptoms gradually disappeared, and on the 39th profuse discharge existed, but general health seemed improving. 40th. Great irritability. 42nd. Spasms quite gone; slept well, and was free from pain; next day swelling of leg increased, and on the 44th day the spasms returned; restlessness; unhealthy discharge, and after rallying for a few hours he speedily sunk.

Sectio cadaveris.—Knee distended with pus, without much disease of articulating surface; thickening of synovial capsule only. Abscesses of unhealthy pus extending upwards and downwards; posterior tibial nerve adhering firmly to the surrounding parts; left pleura vascular; lower lobe same side congested. Several small cavities of pus in liver.

In No. XI. you have an example of fracture producing some symptoms of tetanus, and killing the patient by the development of a purely febrile action. In No. XII. the same action results from a similar injury, but attended with disorganising local action of limb, but still no visceral disease or lesion of important organs. Finally, in No. XIII., we see an example of the third form, or series, viz., irritative fever, determining congestion of lung and purulent depôts in the liver.

What have these cases of injury, and of amputations in common, to which may reasonably be attributed this parity of progress and results? I would answer without hesitation, a shock to the nervous system; to this, I believe, may be very distinctly traced the various lesions to which I have in this lecture directed your attention.