PRACTICAL OBSERVATIONS
ON
THE HEALTHY AND MORBID CONDITIONS
OF
STUMPS.

By GEORGE LANGSTAFF, Esq.

Read May 4, 1830.

FROM the frequency of disease in stumps of amputated limbs, and the consequent prevention of the application of artificial aid, I am induced to offer, to this Society, the following facts and practical observations, on the healthy and morbid changes, arising from such operations, both on the upper and lower extremities; and also to describe the method I have adopted, most successfully, in making what is termed ‘a good stump,’ and rendering the parts capable of receiving any mechanical assistance.

I cannot effect my object better than by describing the appearances of various preparations contained in my museum, illustrative of my opinions, and by detailing the history of the cases of the individuals from whom they have been taken ; and I may here remark, that as what I am about to submit, has been the result of my inquiries for nearly twenty years, I trust it will meet with the sanction and concurrence of operative surgeons.

In the first place, I shall, from various dissected stumps, describe the different changes which have taken place in the soft, and osseous parts ; as well as in the arteries, veins, and nerves.

The first attempt of nature, to effect the reparation of parts divided in amputation, after the consequent inflammatory action of the minute arteries, which supply the cellular connecting media belonging to the muscles, vessels, and nerves has been subdued, is, the effusion of lymph, which becomes organized ; the absorbents then remove such superfluous parts of the muscles as are likely to retard the progress of cicatrization of the integuments.

After this period the nutrient arteries of the periosteal covering of the divided bone or bones and the medullary parts, deposit lymph ; a medium of cellular tissue is produced, which unites to the organized integumental surface, and these together

form a cushion, or defence, as a protection to the end of the stump.

These salutary changes effected, the absorbents begin to execute their functions by the removal of the asperities, occasioned by the division of the bone, at the time of the operation; a deposition of osseous matter takes place round the edges of the divided bone, which forms an union with the osseous matter deposited by the vessels belonging to the cancelli of the medullary, or internal part; and the absorbents, if not interrupted by nervous irritation, consequent on the disease of the stump, produce a regular rounded appearance of the extremity of the bone, only leaving apertures for the communication of the nutrient arteries, veins, and nerves of the shaft of the bone, with its coverings.

Should the surfaces of the amputated part not regularly unite by the first intention, or by the second, and there be inflammation affecting the divided nerves, then a morbid action is established, which occasions the face of the stump to ulcerate, or mortify; frequently causing a portion of the extremity of the bone to project, which occasionally becomes carious, and should be taken off; this I have had occasion to do, and I prefer Mr. Liston's forceps to any other instrument for this purpose.

Sometimes osseous deposition takes place,

round the edges of the sawn bones, and exostosis is produced; sometimes a spiculum of bone projects horizontally, generally taking the direction of the artery, vein, and nerves of the limb, which thus become implicated with the bony deposit; and, sometimes, I have found a large spiculum of bone with a very sharp point taking an oblique direction, and connected with a muscle occasioning morbid changes in its fibres, and being a source of great suffering to the patient.

In all such stumps I have invariably found the nerves greatly enlarged at their extremities, giving them a ganglionic appearance, and generally firmly adherent to the surface of the stump, and frequently in union with spicula of bone, in the manner I have just described.

I think it right to mention, that, on cutting through these bulbous extremities of the nerves, there are no signs of enlargement of their natural structure, the thickening appearing to have been occasioned wholly by the deposition of lymph, the effect of inflammation in the cellular tissue covering the neurilema. /

I shall now describe, as briefly as possible, the different appearances of the surfaces of stumps, when operations have been performed above or below the knee-joint, also below or above the elbow-joint. The numbers of each are given as

they were arranged at the time they were completed, to facilitate the examination of the parts they represent.

No. 3128. Stump of the limb of a man, which had been amputated too near the tubercle of the head of the tibia, close to where the ligamentum patellæ is attached, prohibiting the use of an artificial leg.

This preparation exhibits the integuments and cicatrix of the stump, and the medium of the newly formed cellular tissue connecting them to the extremities of the divided bones and muscles; also the rounding off of the edges of the sawn bone, (as I have described before,) and the new covering to it, which has been reflected.

Some of the muscles are injected with size and vermilion, and minutely dissected, as well as the nerves and blood-vessels.

The popliteal nerve, as well as the external cutaneous, and anterior tibial, have their extremities greatly enlarged.

The patient suffered severe pain in the stump for several years.

No. 1739. The inferior portion of a thigh-bone, where amputation had been performed by the circular incision.

In this preparation, it will be seen that there is great enlargement at the extremity of the bone, but well defended by a dense covering of newly formed cellular tissue.

There is also an extensive accumulation of bone, in a horizontal direction, having its origin from the linea aspera, nearly in a line, where the thigh-bone had been sawn off. There is also a spiculum of bone with a sharp point, taking a perpendicular direction, which occasioned great irritation to the muscle with which it was in contact.

In this case, the two branches of the ischiatic nerve were united, forming one large ganglionic knob connected to the popliteal artery and vein, and to the horizontal portion of newly formed bone before described.

No. 800. Is another specimen of the end of a thigh-bone, shewing nearly the same morbid changes described in the last case.

This preparation shews, beautifully, nature's powers in the production of a cushion of cellular membrane, intervening between the bone and the integumental parts, and in rounding off the asperities of the divided bone and depositing ossific matter to cover and protect the medullary cavity.

This patient was in Cripplegate Workhouse. He informed me that he had been afflicted with scrofula in the joint, which was the cause of its being removed, about twenty years since, by Sir Astley Cooper; that the stump was an immense time in healing; and that the end of the bone projected, which was the principal cause of the want of union. The sufferings of the patient were very great, for many years; he could not bear the least pressure on the thigh, consequently was prevented wearing a wooden leg, and was often affected with increased pain by atmospherical change, which impaired his health, and rendered him incapable of attending to his business. He died of phthisis pulmonalis.

No. 801. The stump of a thigh-bone, shewing the projection of the end of the bone in a state of caries, also ulceration of the soft parts which surround it. The two branches of the ischiatic nerve are shewn, their cellular coat dissected off, exhibiting the immense enlargement of their structure in the form of a ganglion.

One of the nerves is cut open, which presents an appearance not unlike a new growth between the cellular septa, connecting the fibres of the nerves.

The extremities of these nerves are united firmly together, and with a portion of the pro-

jecting bone, close to the ulcerated extremities of the stump.

The femoral artery is injected with wax. Its course is shewn, in the preparation, passing between the tendons of the two portions of the triceps to form the popliteal, and terminating at the extremity of the stump, where it is obliterated to about the extent of an inch.

The patient was a man about seventy years of age; he died of sanguineous apoplexy, in Cripple-gate Workhouse.

Previous to his death, he informed me he had suffered severe pain at the end of the stump, extending upwards, as far as the hip; in describing the seat of the pain, he traced with his finger the course of the ischiatic nerve, informing me that the end of the stump had never united completely, and that the bone projected through the ulcerated integuments. He had suffered from frequent attacks of hæmorrhage from the extremity of the stump. The limb was amputated by a surgeon in Nottingham, about thirty years ago.

No. 2835. The stump of a thigh-bone. The patient died a month after the operation.

The end of the bone projected; a fungus grew

from the medullary canal. This growth was very vascular, and bled frequently; great pain was complained of; matter formed in the cellular tissue connecting the muscles, a considerable distance from the face of the stump; the discharge was profuse, and of a very unhealthy quality; the ligatures came away, on the fourteenth day after the operation; the integuments, divided in the operation, united, except where the bone projected; but fresh collections of pus formed, and the patient died, with all the signs of irritative fever.

I examined only the stump; the gentleman who gave me the preparation, and inspected the body, said there were no signs of disease in any of the viscera.

The muscles of the thigh had nearly lost all their natural structure; they were extremely soft, and of a blackish colour; as if affected with melanosis. The femoral artery was completely obliterated at its extremity, where the ligature had been applied. There was a plug of blood and lymph in the artery, about an inch in length, which adhered partially to the internal surface of the tube.

The extremities of the ischiatic nerve, which was formed of two portions in this instance, as it occasionally is, seemed to have been placed too

near the surface of the stump. They had begun to exhibit that bulbous appearance before noticed, where they had been divided, and during the healing of the integuments had been in a state of irritation.

The periosteal covering was thickened by lymph, and greatly inflamed, from the end of the bone to a considerable distance beyond. The internal periosteum was also inflamed.

There was a deposition of ossific matter beneath the periosteum and around the extremity of the bone.

It is very probable, that the want of success, in this case, was occasioned by the inflammation of the internal part of the bone, and its periosteum, and that the exostosis was in consequence induced, as well as all the other effects, from a sufficient quantity of integuments not having been preserved when the operation was performed, and the extremities of the nerves having thereby become irritated.

No. 2773. Knee-joint of a man fifty-nine years of age, whose leg had been amputated twenty years before death, by Sir Charles Blicke, in St. Bartholomew's Hospital. The arteries were injected, and the muscles, vessels, and nerves, afterwards dissected.

The operation had not been very well performed, the tibia and fibula having been sawn off too high up to allow of proper support being given by a wooden leg. The stump did not heal well, and the cicatrix afterwards frequently ulcerated near the ends of the bones. The man said he had occasionally suffered severe pain in the stump since the operation.

On dissection, it was found that the muscles on its posterior surface, such as the heads of the gastrocnemius, and the poplitæus, also those on the outer side of the leg, viz. the upper portions of the tibialis anticus, and extensor longus digitorum pedis, from not having been for so long a time in action, had become of a whitish colour, very soft in texture, and only retained a faint resemblance of muscular fibre.

These appearances, I have no doubt, were occasioned by a sufficient quantity of integuments not having been preserved to cover the stump, which prevented its healing, and caused the diseased state of the extremities of the nerves.

On cutting open the capsule of the joint, the synovial membrane was seen greatly thickened by organized coagulable lymph, and the reflected parts of that membrane on the condyles of the femur, and that belonging to the patella, had been absorbed, and the principal part of the cartilagi-

nous coverings of the condyles, as well as that belonging to the patella, had undergone the same morbid change.

The thigh-bones and the tibiæ, in this man, had been affected with rachitis, at an early part of his life; they were gibbous, as may be seen by the lower part of the femur, which has its two sides flattened, which gives an oval figure to the cavity of the bone.

No. 1788. The healthy stump of a thigh-bone, shewing the complete reparatory process by which the bone is defended by the deposition of osseous matter, where there had not been irritating causes preventing this effect.

A portion of the femoral artery is also preserved in the preparation, exhibiting the extent of its obliteration by coagulated lymph.

No. 3646. Two portions of a thigh-bone dried, where amputation had been performed, and where the extremity of the stump had projected, in consequence of the want of integumental covering.

In this case there had been excessive inflammation of the external and internal periosteal covering, with osteitis; the latter appearance being

very apparent, not only at the edges of the sawn bone, but throughout the whole remaining part of its shaft.

The patient died from the constitutional effects of these morbid changes.

I have another specimen of the bones in a similar state in the tibia and fibula, where the result proved equally unfavourable.

No. 3647. Stump of an arm, which had been removed above the elbow-joint.

This preparation illustrates the morbid changes which had taken place, from want of union of the divided parts.

The stump is injected with size and vermilion; the ulcerated and sloughy state of its surface are well exhibited, also the inflamed condition of the periosteal covering of the projecting portion of bone, which had become affected with necrosis.

The nerves, arteries, and veins, also the obliterated portion of the brachial artery which had been secured by a ligature, are exhibited.

No. 3648. Elbow-joint, shewing the morbid

changes the extremities of the nerves had undergone, on the surface of the stump where the forearm had been amputated, and where complete union had not taken place.

To give a more clear view of the nerves and arteries, all the muscles were removed, and the parts forming the articulation were exposed, which appeared perfectly natural in structure.

In this preparation, the median, radial, and ulnar nerves are shewn, which are remarkably large ; the extremities of the two latter greatly increased by deposition and organized lymph.

Portions of the brachial, radial, ulnar, and interosseal arteries are shewn. The patient was a female, about 20 years of age. In consequence of a fall, and in endeavouring to save herself by stretching out her left arm, the articulation of the carpus was greatly injured, also the muscles and tendons, and she was immediately rendered incapable of straightening her fingers. Great effusion took place, which was succeeded by inflammation, and swelling of the whole of the hand and arm, which symptoms were not easily subdued. Every endeavour was employed to recover the power of the fingers and movement of the carpal articulation without effect. The flexor muscles and tendons were in rigid action, and the

finger ends drawn closely to the palm of the hand.

The patient continued to experience great pain, and the limb was quite useless.

She was seen by several surgeons, without receiving any benefit, and was a sufferer, nearly two years. She then obtained admission into a hospital, where every plan was employed to endeavour to restore the natural function and action of the hand, but without success. Her health became affected, and she suffered not only great misery from the painful sensations in the arm, but also from the local means employed in the recovery of the use of her fingers.

All endeavours proving fruitless, amputation was proposed and agreed to.

The stump, I understand, did not unite favourably; and she suffered distressing agony, which affected her health, so that she became extremely nervous. She was discharged from the hospital, and afterwards admitted into Cripplegate Workhouse, where she had my advice, and was strictly attended to by my son.

When I saw her, the surface of the stump presented an unfavourable appearance; the skin co-

vering the ends of the radius and ulna, was very thin, excessively vascular, and the ends of these bones seemed likely to cause its absorption. There was also a constant state of convulsive action of the muscles of the stump, accompanied with agonizing pain. Every thing that could be done to improve her health, and to relieve the pain she experienced, was fairly tried for several months without the least good effect.

Poulticing, opiate lotions, belladonna, and gentle pressure by bandage, were employed, which did not lessen her sufferings.

She was hysterical, and the paroxysms were frequent; the spasmodic affection of the muscles of the arm became more evident, and a pulsation almost aneurismal, could be seen and felt at the extremity of the stump, in the situation of the ulnar and radial arteries. It now became a serious consideration to know what could be done to prevent the exciting causes of the morbid actions. Having seen, in several cases, symptoms similar to these, caused by the extremities of the nerves becoming ganglionic, and a second operation rendered requisite for the alleviation of the patient's sufferings, I concluded this could be the only mode of treatment adopted in the present case. But I did not wish to propose amputation, without having the opinion of gentlemen capable of de-

ciding on what was to be done in such a case; she was for that purpose sent to Bartholomew's Hospital, where the opinions of two of the surgeons were obtained; the conclusion was, that they thought it would be advisable to make further attempts to improve her health, and thereby prevent the necessity of a second operation.

This advice was strictly attended to, for a considerable time, but without effect. She had frequent convulsive fits, the irritability of the muscles and the aneurismal pulsation became more violent, and her health so much more affected, that I thought it my duty to propose the removal of the arm above the elbow-joint, which she willingly agreed to. I performed it by the flap operation, and previous to securing the arteries, I drew out each nerve to the extent of half an inch from the surface of the stump with a tenaculum, and cut through them, to prevent their interrupting the progress of cicatrization of the integumental parts, which I have done in other instances with success, and I was astonished that the division did not occasion greater pain than was complained of by the patient.

She was relieved of all the painful sensations she had so long been distressed with, had no recurrence of hysteria or convulsion, her health im-

proved, a good stump was effected, and she is now able to obtain her livelihood.

No. 3644. A section of the superior extremity of the tibia, where amputation had been performed by the flap operation.

All the soft parts and periosteal covering were removed, and the bone afterwards boiled in a solution of subcarbonate of potash, to expel the fatty matter from the bone ; it was then dried, and preserved in spirits of wine, and shews beautifully the cancellous structure ; it likewise displays admirably how the end of the bone had been defended by the secretion of osseous matter from the minute arteries ; the absorbents having afterwards removed all the asperities of the bone, thereby preventing any irritation of the newly formed cushion of cellular membrane.

No. 3645. The stump of the fore-arm of a young man, where the flap operation had been employed.

Portions of the muscles, tendons, nerves, and arteries, are shewn by dissection. In this case every thing went on favourably, after the amputation, and a perfect stump was effected.

The ends of the ulna and radius did not project, and the extremities of the nerves were

placed at such a distance from the surface of the stump that they did not become enlarged, as I have described after the unfortunate operations.

The following is a case which lately came under my care, and illustrates more remarkably the facts just stated, and renders the subject more complete.

A man fifty-one years of age, an engineer, while superintending a steam-engine, unfortunately received an injury in the left foot and leg. I was sent for, but having gone to visit a patient at Exeter, he was taken to St. Bartholomew's Hospital, and amputation was immediately performed below the knee-joint. The stump did not go on so favourably as could be desired ; great swelling about the knee-joint and thigh took place, accompanied with very active inflammation, sloughing of the stump, and projection of the bones.

Great constitutional disorder was the consequence ; every endeavour was made to check the threatening symptoms ; erysipelatous inflammation took place at the end of the stump, extending as far up as the groin. Enlargement of the knee-joint commenced, which was suspected to depend on the formation of pus in the synovial membrane, and distinct fluctuation could be felt.

It was thought right to make an opening to let

out the fluid, which was done about six weeks after the amputation, and an immense quantity of pus, mixed with a fluid supposed to be synovial effusion, was discharged. The symptoms became less alarming; a second accumulation took place, and was again cut down to, when an immense quantity of the same kind of fluid was evacuated.

He remained in the hospital ten weeks; the stump did not heal; he was greatly enervated and emaciated. He was removed from the hospital, and, as I had for many years attended him, he wished to place himself under my care.

I visited him, on the day following the one he left the hospital, when the poor fellow was so much changed in features, that I could scarcely recognize him. The surface of the stump was in a sphacelated state, the ends of the tibia and fibula were exposed; the latter projecting considerably more than the former.

He complained of excessive pain in the knee and thigh, as high up as the groin; there was an immense enlargement of the knee-joint, and distinct fluctuation, from the presence of matter which seemed to be seated beneath the fascia of the thigh; yet the external figure greatly resembled knee-joints I have seen, where there had been great synovial effusion, and considerable

thickening of the capsular ligament, from chronic disease, or where the distension was caused by pus, the effects of active inflammation of the synovial membrane, specimens of which are in my museum *.

Upon examining the knee I could distinctly feel that the patella was not projected from the surface of the condyles as it was in the two cases I have alluded to; this induced me to imagine, the fluid was not within the capsular ligament, but only beneath the fascia of the thigh; whether this was the case or not, it was very immaterial as to the mode of treatment that was to be pursued. I therefore cut boldly down through the integuments and fascia on one side of the thigh, when, to my surprise, nearly two pints of pure pus were evacuated; showing no signs of synovia after standing. After this, I carefully examined the knee-joint, which seemed to have contained no part of the fluid that had been evacuated.

I placed a plug of lint in the opening I had made, to prevent its uniting, requesting his wife occasionally to remove it, and to endeavour with slight pressure with a sponge, to get out more matter, and then to replace the lint, and apply linseed meal poultices, mixed with opiate lotions. His health, which was greatly reduced by the ex-

* Numbered 1744, and 2029, the former exhibiting chronic, and the latter, acute inflammation.

cessive pain he had experienced, was principally to be attended to. I at first entertained little hopes of his recovery ; and to amputate with such extensive destructive action going on in a constitution nearly broken down, would have been highly imprudent. His pulse was very weak, 120 in a minute ; his tongue covered with a brownish fur ; he had hectic flushes, and morning perspirations ; his digestive organs, as might have been expected, were, to use Mr. Abernethy's phrase, greatly disordered.

He took sulphate of quinine and infusion of roses, and suitable diet was ordered. He improved in health by this treatment ; but he was greatly distressed by the pain he experienced, at the end of the stump, in the joint of the knee, and along the whole course of his thigh, which disturbed his rest, and required the aid of *Liquor opii sedativus* to palliate his sufferings. •

Fresh accumulations of matter frequently formed beneath the fascia requiring the use of the knife ; sometimes the pus was excessively offensive, and gas often escaped with it.

From the patient being obliged to remain on his back in bed, the matter gravitated to both sides of the thigh, requiring frequent openings to let it out.

He was now allowed wine and porter, as he became greatly reduced by the immense quantity of matter secreted. The end of the stump began to slough again, although strict attention was paid to it by poulticing, and the application of leeches, where the integuments were inflamed.

The fibula projected considerably, and, as it appeared to be a source of great misery, I removed it with Mr. Liston's nippers, as high up as I could, taking care to remove it beyond the mortified part, that I might place it out of the reach of the surface of the stump.

After this period granulations formed, and cicatrization commenced. As there were free openings for the escape of matter under the fascia of the thigh, and as its quantity was greatly lessened, a bandage was employed, which assisted considerably in lessening the secretion.

Hope was now entertained, that things would go on favourably; but, unfortunately, the end of the stump became again painful, the joint inflamed, and required frequent applications of leeches, poultices, &c., and his health was seriously affected. Matter again formed beneath the fascia at the inferior part of the thigh, which I was obliged to cut down to, and the discharge was equally as great as that which before took place at the upper part.

The opening being very extensive, gave free outlet to the matter, and afforded the patient great relief; the discharge was very profuse, offensive, and often mixed with blood; I had frequent occasion to remove large portions of sloughy cellular membrane, and fascia. When I lifted up his thigh to examine the opening, there appeared an immense chasm, and the muscles and tendons looked like the inferior part of a thigh, where the cellular tissue had been removed by dissection.

With all these changes, by attending strictly to his health, and ordering plenty of nourishment, granulations formed; the thigh was now well supported throughout its whole length, with a belt properly regulated by buckles and straps; his health is now, April 25th, 1830, nearly as good as ever, and I believe he will soon be able to wear a wooden leg.

Observations.—Most of the specimens of the stumps I have described, were obtained from patients who died in Cripplegate Workhouse, of which institution I have held the appointment nearly twenty years, and where I have had the advantage of seeing nearly all the diseases the human frame is liable to be affected with, also extensive opportunities in operative surgery, and the permission of inspecting the bodies of those who have died there.

With these advantages, I have been led to the

study of morbid anatomy, and have formed a museum exhibiting nearly all the morbid changes of structure that we, at the present period of our pathological knowledge, are acquainted with ; and which I hope, at some future period, to make public.

My object in publishing this paper is to give my reasons for recommending the flap operation in preference to the circular, in amputating the arm or leg ; having witnessed the mischievous results from the latter mode, and having succeeded in every instance where I have employed the former.

In operating I make the flap by cutting obliquely through the integuments, muscles, vessels, and nerves ; taking especial care to preserve a sufficient quantity of the skin to cover the end of the bone, as I believe this is all that is necessary to effect a complete union of the incised parts.

When the circular incision has been employed, I have seen the woeful effects that have ensued, from the union having been prevented, by leaving too much muscle ; and it is injurious by impeding the adhesive process, the absorbents having to remove the unnecessary parts of the muscles, before this process can be established.

If, in performing the flap operation, a sufficient

quantity of skin be not preserved to cover the stump, and the ends of the nerves are likely to be included, whilst cicatrization is going on, I should have no hesitation in shortening them, by cutting off a portion of each. Not being in the habit of referring to authors who have written on pathology, my time being so much occupied with my own pursuits, I am unacquainted with the discoveries that have been made respecting the morbid changes I have been noticing. From Dr. Monro's third volume of anatomy, p. 407, and chap. 2nd., I shall copy his remarks on the organic derangement of the nerves.

“ A nerve when punctured, sometimes swells considerably, and for some extent, as when the cutaneous nerve of the arm has been injured in venesection ; but, in other cases, the swelling is circumscribed, and limited to a small part of a nerve ; thus, a very evident tumor may be observed, connected with the extremity of the sciatic nerve, after amputation of the thigh.”

In page 409, he also says, “ The nerves have also been said to inflame violently ; which inflammation is succeeded by suppuration.”

Sommering has made mention of what he calls *Corruptio Nervi*. “ *Corruptus nervus gracilior fit, brevior, firmior, simul atque durior, semiper-*

lucidus, cartilaginis in modum, coloremque cinereum induit.

“Corrupto nervo pars, quam adit, usui publico, non amplius inservit.” Vid. vol. iv. of his Book, *De Corporis Humani Fabrica*.

Sir Astley Cooper, Bart. in his Lectures, has given two very interesting cases, denoting the symptoms and morbid changes which the nerves undergo, where there had been retraction of the skin of a stump after amputation; the cases are related in the *Lancet*, Vol. I. page 77. From this work I shall quote the following sentence:—

“How the nerves become longer than the bones in these cases, does not admit of easy explanation.”

Having for so many years had the advantage of examining so great a number of limbs after amputation, I am led to believe, that the appearance of elongation of the nerves is a deceptive one. I do not think, from the structure of nerves, that they can be elongated.

If morbid appearances can enable one to make clear deductions, I should account for the supposed elongation in the nerves as follows:—During the first stage of nature's attempts to

unite the surfaces of the stump, the cellular tissue connecting the neurilema, forms more firm adhesion, than that supplying the muscles and tendons. If the nerves become inflamed by being placed too near the surface of the divided parts, they excite inflammation, which terminates in suppuration, and sometimes in gangrene. The nerves which supply the muscles are excited into spasmodic action, which causes them, and the integuments to be drawn upwards ; thus occasioning the bone, or bones to project ; whilst the nerves, and blood-vessels remain nearly in the place, where they were divided, having previously obtained more firm adhesion than the other parts.

I shall conclude by abstracting that portion of Mr. Lawrence's Lectures, alluding particularly to the state of the nerves after amputation. He says :—" When nerves have been divided, as in the operation of amputation, the extremity which is left swells into a kind of bulb ; a sort of oval tumour forms, or rather the end of the nerves swells into a bulb of oval shape, of perhaps about the size (in the case of a large nerve) of a nut or a filbert ; this is found to possess very considerable firmness, sometimes approaching almost to a cartilaginous structure, so that it is cut with difficulty, and makes a noise under the knife as it is divided. There are instances in which the extremities of nerves thus enlarged seem to produce

very painful symptoms after amputation. Whether it is from the extremities of the nerves being involved in the cicatrix which follows the operation, or, in certain cases, that the ends of the nerves are by the contraction of the cicatrix pressed against the sawn end of the bone, I do not know ; but in many instances very painful sensations are experienced after a certain time, at the end of the stump, confined in some cases to a particular spot, and appearing to indicate that the affection depends upon the condition of the divided nerves at a certain part of the cicatrix.” *

* Lancet, Vol. II. p. 564. 1829-30.