

In case, however, a displacement exists, it ought to be remedied, if possible, since, if only very slight, it may become the source of a serious annoyance. If the fragments project upwards, they interfere with the wearing of a boot, and if they sink toward the sole, the skin beneath is liable to remain constantly tender, and the patient may thus be seriously maimed for life.

In case the displacement is not due to the action of the muscles, but only to the nature and direction of the force producing the fracture, or to entanglement of the broken ends, and it is likely to cause any of the inconveniences which I have mentioned if permitted to remain, it will be advisable at once to employ considerable force in the way of pressure, or to elevate the fragments through an opening previously made upon the dorsum of the foot, calling to our aid even the saw or the bone-cutters, if necessary. After which the fragments may be retained in place by carefully applied pasteboard splints and compresses.

## CHAPTER XXXVI.

### FRACTURES OF THE PHALANGES OF THE TOES.

IF fractures of the other bones of the feet are generally of such a character as to require immediate amputation, these fractures demand this extreme resort still more often. Our experience, therefore, in the treatment of fractures of the phalanges of the toes is extremely limited.

Lonsdale observes that it is not uncommon to find great irritation arise after fracture of the great toe; an inflammation extending along the absorbents on the inside of the leg to the groin, causing abscesses to form in different parts of the limb, and producing sometimes great constitutional disturbance. An illustrative case has come under my own observation at the Buffalo Hospital of the Sisters of Charity. The patient, Morgan McMann, æt. 18, was admitted Dec. 23, 1853, having several days before received an injury upon the great toe, which contused the flesh severely and broke the first phalanx. He was then suffering from severe pain in the foot and leg, and the absorbents were inflamed quite to the groin. Poultices being applied to the foot and cool lotions to the limb, the inflammation soon subsided, but not until a portion of the toe had sloughed away. Eventually also it became necessary to remove some portion of the phalanx, which had died; after which the wounds healed kindly.

When any of the smaller toes are broken, it will be found easier to support the fragments by a broad and long splint which shall cover the whole sole of the foot and all the toes at the same time, than to attempt to apply a splint to the broken toe alone. If, however, we prefer this latter mode, a thin piece of gutta percha will be found altogether the most convenient material for the purpose.

If the great toe is broken, its great breadth may prevent any displacement, and a well-moulded gutta-percha splint will generally secure a perfect and rapid union.

## CHAPTER XXXVII.

### GUNSHOT FRACTURES.

GUNSHOT fractures have already been considered, more or less in detail, in the several portions of this work, wherever it seemed to be necessary to call especial attention to them. This chapter will be devoted, therefore, to a brief *résumé* of my own observations and conclusions in this department; to which will be added a few general statistical statements, drawn chiefly from the published records of the late war.

*Causes.*—Gunshot fractures are caused by a great variety of missiles, such as musket and rifle balls, solid shot and shell, grape, canister, Shrapnel, chain and bar shot, fragments of iron, stone, splinters of wood, etc., etc. The only qualities which these missiles possess in common is, that they are all projected by the elastic power of gunpowder, and generally strike the body with great force; and that they cause fractures by direct violence—seldom, if ever, by counter-stroke.

Round, smooth balls frequently impinge upon bones without causing a fracture, for the reason that they are easily deflected; and this happens especially when they are not moving with great velocity.

Conical rifle-balls seldom fail to fracture the bones which lie in their direct course; never, perhaps, when, at the moment of contact, the ball is moving with its average velocity. The peculiar destructiveness of this missile is due to its weight, momentum, and form.

Canister, grape, Shrapnel, solid shot, shells, chain and bar shot, are still more destructive; generally tearing the limbs from the body in such a manner as to render readjustment and restoration impossible.

*Pathology.*—These fractures may be simple, compound, comminuted, or complicated; and in addition to these common varieties of fractures there is occasionally presented an example of simple "perforation," or mere penetration of the bone without fissure or other fracture; and still more frequently are seen examples of perforation with fissures.

Probably ninety-nine per cent. of all gunshot fractures are both compound and comminuted; the comminution being, in general, excessive.

As in gunshot wounds of the soft parts it has been generally observed that the point of entrance is more round, more smooth, and somewhat smaller than the point of exit, and that the tissues are a little depressed at the entrance, while they are slightly protruded at the exit; so also in gunshot fractures it will often be found that the side of the bone on which the ball has entered, or upon which it first impinged, is less comminuted than the opposite side; and, if it is a "perforation," that the opening is smaller upon the one side than upon the other; that the edges are

slightly depressed upon one side, and elevated or protruded upon the other; and, finally, that numerous small, as well as some large, fragments of bone have been carried into that portion of the track of the wound which lies between the bone and the point of exit of the missile.

When a ball fractures the shaft of a long bone, although the blow may have been received three, four, or even six inches from an articulation, the comminution or a single longitudinal fissure may sometimes be found extending into the joint. These fissures or splittings of the shaft often extend also a long distance up or down, without terminating in the joint.

Perforations without fissure occur most often in the broad bones of the pelvis, in the scapula, or in the spongy extremities of the long bones. In the latter, however, it is exceedingly rare to find perforation without fissure.

Perforations with fissure are pretty common in the head of the humerus and in the head of the tibia; they occur also, but less often, in the lower ends of the femur and tibia, in the trochanteric portion of the femur, and in the head of the femur. I wish to be understood to say that fissures occur less often at the points last mentioned, simply because perforations are there less common. It should be known that if perforations do occur at these points, a splitting or fissure communicating with the joints is almost inevitable. A misunderstanding here would lead to a very fatal error in many cases.

*Prognosis.*—In general it may be stated that gunshot fractures of the upper extremities do not demand amputation, and that similar injuries in the lower extremities do demand amputation.

This statement is very broad, and cannot be understood except by a consideration of these accidents somewhat in detail. Thus:

Gunshot fractures of the clavicle, scapula, of the shaft of the humerus, of the shafts of the radius and ulna, and of the carpal, metacarpal, and phalangeal bones, notwithstanding these bones have suffered extensive comminution, do not usually demand amputation; they will in most cases eventually unite, and give to the patients tolerably useful limbs. If, however, at the same time that the shaft of the humerus, or of the radius and ulna, is thus broken, the large nervous trunks are torn asunder, so that the extremity is cold and insensible, the limb cannot probably be saved, nor, if it could be, would it be of any value. Destruction of the main artery supplying the limb diminishes the chance of its being saved, but does not, in the case of the upper extremities, necessarily demand amputation.

Penetration of the shoulder-joint by a musket or rifle ball, producing a fracture of the head of the humerus or of the glenoid cavity of the scapula, demands amputation when either the axillary artery or axillary nerves are injured; but resection can generally be practised with a reasonable chance of success when the arteries and nerves are untouched. Resection is also made successfully at the shoulder-joint in some cases where larger missiles have traversed the joint, such as canister, fragments of shell, etc.

Penetration of the elbow-joint by a large shot, or by a Minié rifle-ball, the missile fairly entering or traversing the joint, demands amputation when the main arterial and nervous supplies are cut off, and resection,

generally, when both remain uninjured. Resection may be attempted at the elbow-joint, also, in some cases where, the nervous supply remaining good, only one of the principal arterial trunks is cut off.

Frequently a ball strikes the outer or inner condyle of the humerus, making but a small opening into the joint, and producing only slight comminution, and in such cases we often save the limb with more or less ankylosis, and without resection.

The remarks which have been made in reference to gunshot fractures of the elbow-joint apply, almost without qualification, to the same accidents at the wrist-joint.

For gunshot wounds with fracture of the carpal, metacarpal, and phalangeal bones neither resection nor amputation is often required, unless the soft parts are almost completely torn away.

The prognosis which, as we have now seen, is so favorable in the upper extremities, will be found very different in the lower extremities; indeed, it is almost reversed. Thus:

Gunshot fractures of the shaft of the thigh, of the shafts of the tibia and fibula, and of the tarsal bones, generally demand amputation; or, to be more precise, gunshot fractures of the head and neck of the femur almost always terminate fatally under amputation or excision, and equally under treatment as fractures, that is, where an attempt is made to save the limb without interference with the knife. The same accidents in the upper third of the shaft of the femur are generally fatal; but if the main artery and the principal nerves are uninjured, the life is, in general, less hazarded by an attempt to save the limb than by amputation. In the middle third, under the same circumstances, the chances may be considered equal, as between amputation and the attempt to save the limb by apparatus; in the lower third the chances are in favor of amputation.

The above statements in relation to fractures of the femur are based mainly upon my own experience, and have been carefully considered.

I have seen no resections of the knee-joint, and but few of the shaft of the femur, after gunshot fractures, which have not terminated fatally; and I am convinced that they should never be attempted in fractures of the thigh, unless it be that case which presents so little hope in any direction, viz., gunshot fracture of the head or neck of the femur.

Gunshot fractures of the shafts of both tibia and fibula demand amputation where the comminution is extensive, or the pulsation of the posterior tibial artery is lost, or the foot is cold and insensible. It is not intended to say that some limbs thus situated have not been saved, but only that the attempt to save such limbs greatly endangers the life of the patient, while amputation at or below the knee is relatively safe.

Amputation is the only safe expedient in deep penetrating wounds of the tarsal bones produced by missiles of the size of musket-balls or larger. The only exceptions, which can safely be made, are in cases where balls have opened partially and superficially these articulations.

Resections at the ankle-joint are much more hazardous than amputations, and scarcely to be preferred, in army practice, to attempts to save the foot without surgical interference.

*Treatment.*—While considering the prognosis in these accidents, I have necessarily spoken of the treatment in certain cases; especially with a

view to the propriety of amputation or resection. It remains only to speak briefly of the treatment of those cases in which we may attempt to save the limb without resection, properly so called; for we must not forget that pretty often we find it necessary to remove small, loose fragments of bone by the finger, or by the aid of the knife, or to resect sharp points with the saw or the bone-cutters, when we do not practise "resection," in the sense in which this term is usually employed by surgical writers.

I shall take the liberty, in this connection, of reproducing what I have written elsewhere in relation to gunshot fractures, since it comprises nearly all that seems necessary to be added upon this subject.<sup>1</sup>

"If an attempt is made to save a limb badly lacerated and broken, certain conditions in the treatment are necessary to success.

"All projecting pieces of bone which cannot be easily replaced and are not firmly attached to the soft parts, must be at once cut or sawn away.

"All foreign substances, such as fragments of balls or other missiles, pieces of cloth, wadding, dirt, etc., must be removed.

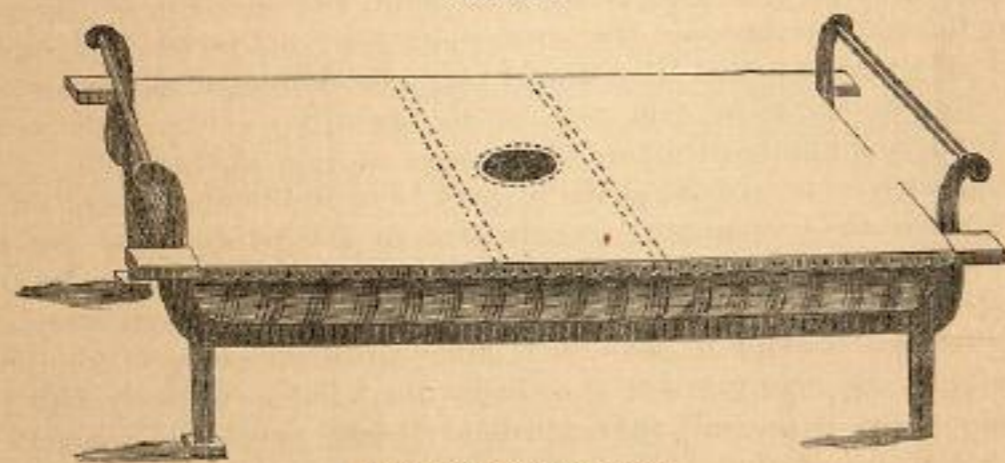
"Any portions of integument, fascia, or muscles, which are entangled in the wound, and prevent a thorough exploration, or may obstruct the free escape of blood or of matter, must be freely divided.

"Counter-openings must be made at once, or at an early period after the formation of matter, to insure its easy escape (and in certain cases a drainage-tube must be carried through both wounds).

"The limb must be placed in an easy position, and not confined by tight bandages or forcibly extended by apparatus.

"The inflammation must be controlled by constitutional and local means, and especially by the use of water lotions whenever their employment is practicable."

FIG. 253.



Author's movable canvas.

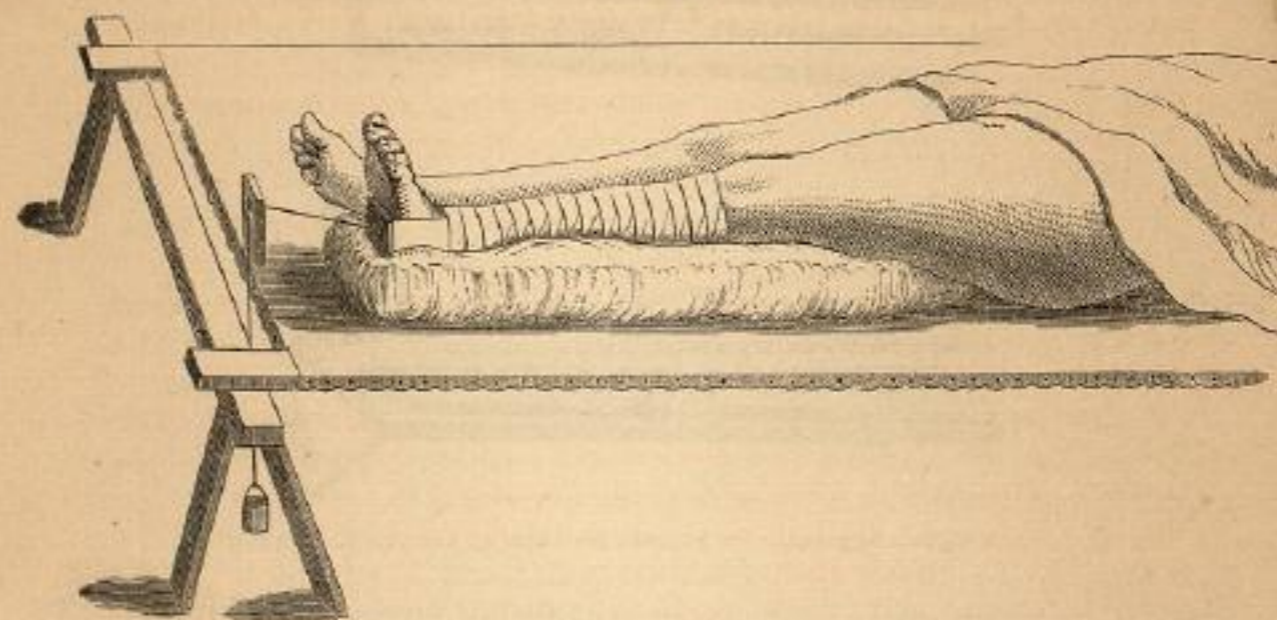
If joints are implicated seriously, and an attempt is still made to save the limb, the joint surfaces must be laid freely open, so as to prevent all possibility of the confinement of blood, serum, or pus; and the joint

<sup>1</sup> Treatise on Military Surgery, by Frank Hastings Hamilton. 1 vol., 8vo. Published by Baillière Brothers. New York, 1861; also enlarged ed. of same work in 1865.

must be placed perfectly at rest, without adhesive strips, bandages, or any apparatus which shall compress the limb or embarrass its circulation.

I do not know that it is necessary to speak more particularly of the treatment of gunshot fractures, unless it be to say that I still give the preference, in fractures of the femur, to the straight position. In most cases I have preferred my own apparatus, already described when speaking of fractures of the thigh in general, with moderate extension; and by moderate extension is to be understood such as may be effected with from five to ten pounds.

FIG. 254.



Movable canvas, with extension, on "horses."

A movable canvas, such as is shown in the accompanying woodcuts with a hole in the centre, and reinforced by an additional piece of canvas where the weight of the hips rests, will enable the surgeon to move his patient and clean the bed when necessary. The standard which supports the pulley can be received in a slot in the frame.

An apparatus similar to this was used, during our late war, in the Lincoln General Hospital at Washington.

I have also used, with the movable canvas, and upon an ordinary bed, Hodgen's apparatus, or "cradle," as he terms it, and have found it exceedingly useful, and much preferable to any form of double-inclined plane, whether suspended or not. The cradle is simply a skeleton-box, of the length of the thigh and leg, made of light strips of wood. Across the two upper bars are laid, transversely, cloth bands, upon which the limb is laid at full length.<sup>1</sup>

Of gunshot fractures of the femur many hundreds, probably many thousands, during and since the close of our civil war, have come under my observation; but of these, only 92 have been made the subject of especial record. Of this number, 75 were fractures of the shaft of the femur; 9 being fractures of the upper third; 36 of the middle third; and

<sup>1</sup> Hodgen, Treatise on Military Surgery, by the author, p. 408.

30 of the lower third. Nearly all of these fractures were caused by the conical rifle-ball. They were treated in various Federal and Confederate hospitals by a great variety of methods, and under a variety of circumstances, which latter were sometimes favorable and sometimes unfavor-

FIG. 255.

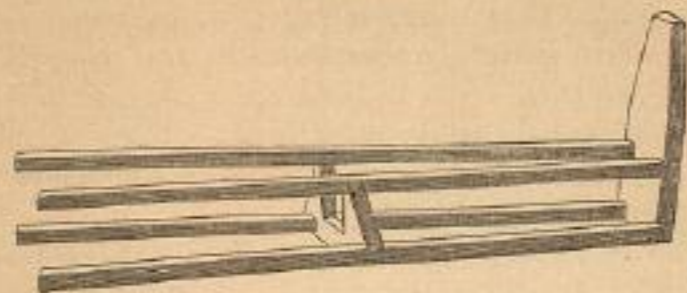
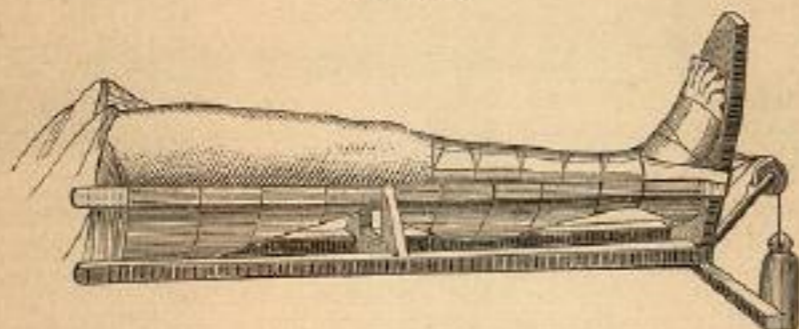


FIG. 256.



Hodgen's apparatus for gunshot fractures of the thigh.

able. The results may, therefore, be regarded as furnishing a fair basis for conclusions as to what may reasonably be expected in army surgery, or during the progress of a great war. I have a strong conviction, however, that if in an equal number of cases the straight position, with moderate extension, were to be employed, and the circumstances were as favorable as are usually found in civil hospitals, the results would be considerably better than are here shown. Indeed, my own recorded cases show, in a marked degree, the advantages of the straight position, with slight extension, over the double-inclined planes. In a number of these cases, while the limb was flexed, the shortening and bending were excessive, and the substitution of Buck's apparatus, Hodgen's, or my own, has made at once a great improvement in both regards, besides contributing manifestly to the comfort of the patients.

The average shortening, in those fractures of the shaft of the femur which were measured by myself after union was effected, was, in the upper third, two inches and one-eighth; in the middle third, two inches and one-quarter; and in the lower third, a little more than one inch and a half. In the upper third three were shortened two inches or more; the greatest shortening being three inches and one-quarter. In the middle third, twenty were shortened two inches or more, six three inches or more, two four and a half, and one five inches. In the lower third, two were shortened two inches or more; the greatest shortening being two inches and three-quarters.

In a large proportion of the cases the thigh was bent at the point of

fracture, the bend being in most cases outwards, or to the fibular side of the limb. Where N. R. Smith's suspension apparatus was used, the bend was usually backwards, while in most of the cases treated in the straight position, with moderate extension, the limb was nearly or quite straight.

It is somewhat remarkable that in this table of ninety-two cases there are only three examples of union delayed beyond four months, and one of these patients was evidently about to die. In a pretty large proportion of cases the union was not delayed much beyond the usual period of union for a simple fracture, although the limb might be much shortened and crooked, and still discharging pus, with fragments of bone occasionally.

Among the cases which have come under my especial notice are a few of peculiar interest, and which deserve to be particularly mentioned.

*Limb Lengthened.*—Melchior Bri tel, private 12th N. Y. Volunteers, was wounded in June, 1862, at the battle of White Oak Swamp, Va., by the fragment of a shell, which struck the left leg three inches above the condyles. He was taken to Richmond as a prisoner, and about a month later he was exchanged and sent within our lines. January 1, 1864, I found him in the United States General Hospital at Newark, under the charge of Surgeon Taylor. The wound was still discharging matter occasionally, and several fragments of bone had been removed. Splints were not applied until after his exchange. No extension was ever employed. At the end of four months he began to walk about with crutches.

On measuring I found this limb lengthened half an inch, and this measurement was confirmed by Surgeon Taylor and others. There was no ankylosis at the knee-joint.

It is doubtful whether, in this case, the shaft was broken across entirely; if it was, probably no displacement ever occurred. The most reasonable supposition is that the fragment of shell entered the bone, and that it was in the bone at the time of my last examination, and that, in consequence of its presence, the bony structure had become hyper emic, and had undergone hypertrophy in the direction of the axis of the limb.

*Perforating and Penetrating Wounds of the Femur.*—James S. Mussey, of 16th N. Y. Volunteers, was wounded at Gaines's Mill, June 27, 1862, probably by a round ball. The ball entered the right nates from behind, passing entirely through the right trochanter; a finger could be thrust through the round, smooth hole in the bone. When I saw him, three months after the accident, at Baltimore, under the care of Surgeon Hasson, the wound was still discharging pus, but in no other way was the injury causing either local or general disturbance.

At the same time, also, my attention was called to the case of Henry Voger, 20th Mass. Volunteers, who was wounded, June 30, 1862, at the battle of White Oak Swamp, Va. A ball had entered the lower end of the femur, near the joint, in front, but did not pass through, and had not, up to this time, been found. Three months had passed since the injury was received, and the wound was now entirely closed, the knee-joint being ankylosed; but in other respects the condition of the limb

was almost normal. At no time was there much inflammation of the soft parts in the neighborhood of the injured structures.

Sergeant Lewis Monell, of the 119th N. Y. Volunteers, was wounded July 1, 1863, by a ball, which entered on the outside of the left thigh, within one inch of the lower end of the femur, passing forwards, and emerging in front above the patella. Four months after the accident I found him at the Fifty-first Street United States General Hospital, New York City. Several fragments of bone had escaped; the limb was bent to an acute angle, and pus was still discharging from the wound. There was no effusion into the joint, and his ultimate recovery seemed to be assured.

H. O. C. was a private in the French army in the Crimea, when he was wounded in his left leg by a ball which passed through the bone from before backwards just above the patella. Synovia with pus discharged for several months, and three small fragments of bone escaped. In seven months the wound became permanently closed. When I examined the limb in 1864 the joint was a little deformed, and slightly ankylosed, but in other respects sound.

These examples of recovery after gunshot injuries of the femur in the vicinity of the knee-joint must be understood to constitute rare exceptions to the rule. In most cases such perforations have been accompanied with longitudinal fissures involving the joint, as is illustrated in Fig. 1 of this volume; and attempts to save the limbs have resulted in the loss of the lives of the sufferers.

*Fracture from Duelling Pistol; Recovery without Lameness.*—In the somewhat famous duel fought between J. C. Breckenridge and Frank Leavenworth, on Navy Island, June 7, 1855, with duelling pistols, at ten paces, Breckenridge was shot in the calf of the leg, and Leavenworth through both thighs. After Leavenworth fell he was carried in a small boat to a point known as Fort Schlosser, on the American side of the Niagara River, and placed in a wooden cabin, the only tenement in the place. I was at once summoned, but did not reach there until the following day. Drs. Grimes, Church, and Ware were already present. We found that the bullet had entered his right thigh about eight inches above the knee, and passed through the limb in front of the bone. The ball then entered the left thigh a little farther back and a little lower down, striking the femur and breaking it about five or six inches above its lower end. Here the ball was arrested, probably being deflected and becoming lodged in the flesh, and it was never found; nor did it ever afterwards cause any trouble.

I visited Leavenworth, in consultation with Drs. Ware and Church, once or twice each week until his recovery was complete. During the first few days no apparatus was applied, but the broken limb was supported by junks, and both limbs were kept cool and moist with evaporating lotions. On the eighth day a long side-splint was applied (Boyer's), with a perineal band for counter-extension, and a screw for extension. The amount of extension was varied from day to day, but it was never more than could be comfortably borne. Still later, short side or coaptation splints were applied. At the end of eight weeks the long splint or extending apparatus was removed, and a few days after

the coaptation splints. Eleven weeks after the accident he was on crutches. The femur was then found shortened half an inch, and perfectly straight.

Mr. Leavenworth survived this injury many years, and, although he led a very active life, he never suffered any inconvenience from the wounds in either limb, and his gait was perfect.

It is probable that in this case there was no comminution of the bone; and I think the same thing has happened under my observation several times, where the femur has been broken by a round ball, or by a conical ball whose force was nearly expended. A conical ball at short range, when it strikes the shaft of the femur fairly, can never fail to cause extensive comminution.

*Missiles remaining in the Bone.*—Lieutenant Champlain (subsequently Commodore) was wounded by a bullet, in 1813, during a sortie from Fort Erie, on the Niagara frontier. The ball entered about the middle of his thigh and buried itself in the bone. Subsequently Dr. William Gibson, of Philadelphia, and, still later, Dr. Nathan Smith, of New Haven, attempted the removal of the ball, but without success.

During all of his long and active life his limb continued to give him serious trouble at intervals, and I was several times called to open abscesses which had suddenly formed, but I was never able to find the ball. The limb was firm, somewhat shortened, and strongly rotated outwards at the point of fracture.

Lieutenant Charles Payson, aide-de-camp to General Devins, was wounded by the fragment of a shell while leading a charge upon a portion of the enemy's lines at the battle of Cold Harbor, Va., June 1, 1864.

The missile entered about the middle of the left thigh, breaking and comminuting the bone. Surgeon Rice, of the 25th Mass. Volunteers, removed on the same day one fragment of bone about two inches in length by half an inch in breadth, but the piece of shell could not be found. On the third day he was taken to Chesapeake Hospital, near Fortress Monroe. Subsequently the surgeon in charge removed with a saw portions of both fragments.

October 24th, nearly five months after the receipt of the injury, I was summoned to the hospital to see Lieutenant Payson in consultation. I found the limb suspended in Smith's anterior splint, the two separated ends of the broken femur pointing backwards at an angle of 45°, and nearly projecting from the wound. This is the position which I have seen the fragments take in very many, probably in a majority, of the gunshot fractures of the shaft of the femur treated by this apparatus; and which vicious position the surgeon had in vain sought to prevent in the case of Lieutenant Payson.

Having removed three or four detached fragments of dead bone, we laid the limb in a straight position upon a Hodgen's splint or cradle, while permanent extension was made with a weight and pulley secured to the leg by adhesive strips. The amount of extension employed was eight pounds. The fragments were now in line, and the patient declared that he was much more comfortable.

March 31, 1865, five months after this change in the mode of dressing

has been adopted, he was brought to New York greatly improved in health, the bone firmly united, with a slight outward bend at the seat of fracture, and shortened six and a half inches, and with almost complete ankylosis of the knee-joint.

From this time Lieutenant Payson remained constantly under my charge for two or three years, when at length the wound became permanently closed, and his health was completely reestablished. In the meanwhile, however, after his return, to New York, the original wound discharged more or less constantly, and occasionally abscesses of considerable size were formed which had to be opened. On the 8th of November, 1865, seventeen months after the wound was received, it was my good fortune to detect the position of the fragment of shell which had caused all this trouble. I had searched for it many times before, but on this occasion a Nélaton's probe disclosed an iron-rust mark by which I was guided to its bed in the centre of the bone, and from which it was at once removed.

As supplementary to this chapter, it seems proper to add a brief *résumé* of the statistics of the late civil war, drawn from the reports of the Surgeon-General, made in 1865 and in 1867.<sup>1</sup>

Of 4167 gunshot wounds of the face, 1579 were accompanied with fractures of the facial bones. Of these latter, 107 died, and 891 recovered. The remainder are undetermined. Secondary hæmorrhage is said to have been the most frequent cause of death.

Of 187 examples of gunshot injuries of the spine (not including those in which the chest or abdomen was penetrated), 180 died. Six of those reported as having recovered were examples of fracture of the transverse or spinous processes. The seventh is that of a soldier wounded at Chickamauga, September 20, 1863, by a musket-ball, which fractured the spinous process of the fourth lumbar vertebra, and penetrated the vertebral canal. The ball and fragments of bone were extracted, and one year after he was reported as "likely to recover."

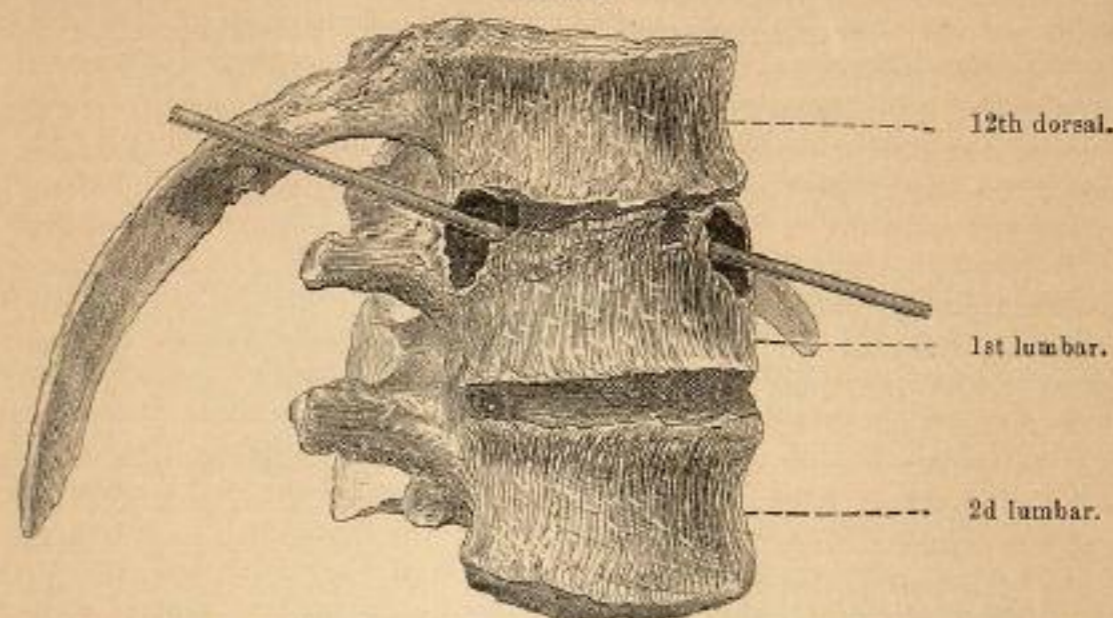
(President James A. Garfield was shot by the assassin Guiteau, July 2, 1881. The weapon employed being a "bulldog" pistol of large size, which was fired at short range, the ball entering his body on the right side, about three and one-half inches from the spine. Its direction, after penetrating the muscular parietes, could not be determined. Immediately upon receipt of the injury he complained of sharp pains in his right foot and ankle, and later he felt similar pains in the left ankle, with slight pains in the right scrotum. These pains gradually subsided, and after a few days disappeared altogether. Beyond this there was never at any time a symptom pointing to an injury of the spine. No degree of paralysis ever ensued. President Garfield died September 19, 1881, eleven weeks after the receipt of his injury. The autopsy disclosed the following facts:

The ball, after penetrating the thoracic wall at the tenth intercostal space, and fracturing the adjacent ribs, passed through the connective tissue and fat behind the upper edge of the right kidney, without wounding the liver, perforated the psoas fascia, and the psoas magnus muscle near its attachment to the first lumbar vertebra, and penetrated

<sup>1</sup> Circular No. 6 Surgeon-General's Office; also Circular No. 7.

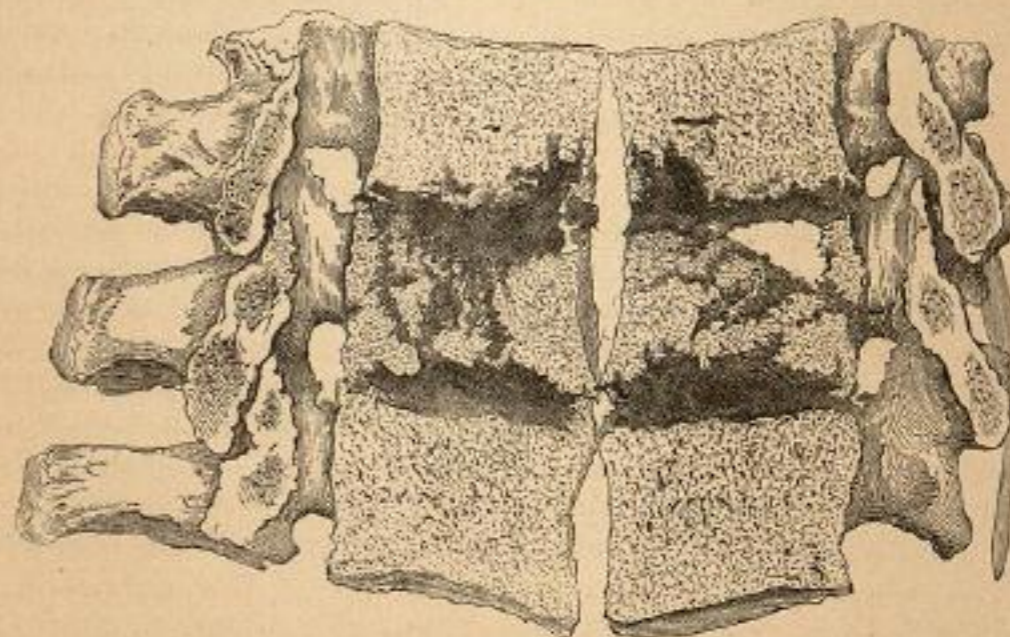
the first lumbar vertebra in the upper part of the right side of its body. The aperture by which it entered the vertebra involved the intervertebral cartilage next above, and was situated just below and anterior to the intervertebral foramen, from which its upper margin was about one-quarter of an inch distant. Passing obliquely to the left and forwards through the upper part of the body of the first lumbar vertebra, the bullet

FIG. 257.



Course of the ball through the first lumbar vertebra, its direction being indicated by the probe.

FIG. 258.



Same specimen sawn open.

emerged by an aperture, the centre of which was about half an inch to the left of the median line, and which also involved the intervertebral cartilage next above. The cancellated tissue of the body of the first lumbar vertebra was very much comminuted and the fragments some-

what displaced. Several deep fissures extended from the track of the bullet into the lower part of the body of the twelfth dorsal vertebra. Others extended through the first lumbar vertebra into the intervertebral cartilage between it and the second lumbar vertebra. Both this cartilage and that next above were partly destroyed by ulceration. A number of minute fragments from the fractured lumbar vertebra had been driven into the adjacent soft parts.

It was further found that the right twelfth rib also was fractured at a point one inch and a quarter to the right of the transverse process of the twelfth dorsal vertebra; this injury had not been recognized during life.

On sawing through the vertebra, a little to the right of the median line, it was found that the spinal canal was not involved by the track of the ball. The spinal cord and other contents of this portion of the spinal canal presented no abnormal appearances. The rest of the spinal cord was not examined.

Beyond the first lumbar vertebra the bullet continued to go to the left, passing behind the pancreas to the point where it was found. Here it was enveloped in a firm cyst of connective tissue, which contained besides the ball a minute quantity of inspissated, somewhat cheesy pus, which formed a thin layer over a portion of the surface of the lead. There was also a black shred adherent to a part of the cyst-wall, which proved on microscopical examination to be the remains of a blood-clot. For about an inch from this cyst the track of the ball behind the pancreas was completely obliterated by the healing process. Thence, as far backward as the body of the first lumbar vertebra, the track was filled with coagulated blood, which extended on the left into an irregular space rent in the adjoining adipose tissue behind the peritoneum and above the pancreas. The blood had worked its way to the left, bursting finally through the peritoneum behind the spleen into the abdominal cavity. The rending of the tissues by the extravasation of this blood was undoubtedly the cause of the paroxysms of pain which occurred a short time before death.

The fatal hæmorrhage proceeded from a rent nearly four-tenths of an inch long in the main trunk of the splenic artery, two inches and a half to the left of the coeliac axis. This rent must have occurred at least several days before death, since the everted edges in the slit in the vessel were united by firm adhesions to the surrounding connective tissue, thus forming an almost continuous wall bounding the adjoining portion of the blood-clot. Moreover, the peripheral portion of the clot in this vicinity was disposed in pretty firm concentric layers. It was further found that the cyst below the lower margin of the pancreas, in which the bullet was found, was situated three inches and a half to the left of the coeliac axis.<sup>1</sup>)

<sup>1</sup> See official report of the autopsy; made at Elberon, Long Branch, N. J., September 20, 1881, eighteen hours after death, by D. S. Lamb, of the Army Medical Museum, Acting Asst. Surgeon U. S. Army, in the presence of the attending physicians and surgeons—Joseph K. Barnes, Surgeon-General U. S. Army; J. J. Woodward, Surgeon U. S. Army; D. W. Bliss, M.D.; Robert Reyburn, M.D.; and of the consulting surgeons—D. Hayes Agnew, M.D., and Frank H. Hamilton, M.D.

The report was signed also by Andrew H. Smith, M.D., who was present as a representative of the coroner of the State of New Jersey.

See, also, the author's summary of the President's case, *Med. Gaz.*, Oct. 1881.

Of 359 gunshot wounds of the pelvis (not including those in which the abdominal cavity was penetrated), 77 died and 97 recovered. In the remainder the result is not ascertained. In 256 cases the ilium alone was injured; in 19, the ischium alone; in 12, the pubes; in 32, the sacrum; and in 40 cases the lesions extended to two or more portions of the innominata. Pyæmia was a frequent cause of death.

Of 1689 gunshot fractures of the humerus, 436 died, and 1253 recovered. Nine hundred and ninety-six of these 1689 cases were treated by amputation or resection, with a mortality of 21 per cent. In 693 cases the conservative treatment was adopted, with a mortality of 30 per cent.

Of 68 cases in which attempts were made to save the limb after gunshot injury of the hip-joint, without resection, all died. (I have seen two cases of successful treatment of these accidents by the conservative plan, and others have been reported.)

Fifty-three amputations at the hip-joint, made by surgeons in the Federal and Confederate armies, including also reamputations, gave seven successful results. The fate of two is uncertain.

Sixty-three excisions at the same joint, made by Federal and Confederate surgeons, furnished five successful cases.

Three hundred and thirty cases of gunshot fracture of the upper third of the femur, in which neither amputation nor resection was practised, gave a mortality of 71.81. Thirty-two cases in which amputation was made gave a mortality of 75 per cent. Twenty-two in which resection was made, gave a mortality of 81.18. (I have rejected three cases given in the report as cured. Two of these were resections of the head, and one was merely a "rounding off of sharp edges.")

Two hundred and thirty-two cases of gunshot fractures of the middle third, treated without amputation or resection, gave a mortality of 55.46. Ninety-three treated by amputation gave a mortality of 54.83. Fifteen treated by resection gave a mortality of 86.66.

One hundred and seventy-three gunshot fractures of the lower third, treated without amputation or resection, gave a mortality of 57.79. Two hundred and forty-three amputated—mortality 46.09. Two resected—both died.

Of 308 gunshot wounds of the knee-joint, with or without fracture, treated without amputation or resection, 258 died—mortality 83.76. Of the 50 which recovered there were, however, only six or eight in which the testimony is unequivocal that the joint was opened. Of 452 amputated, 331 died—mortality 73.23. Of 10 resected, 9 died—mortality 90 per cent.

Of 696 gunshot fractures of the leg, 169, or 24 per cent., were fatal. No analyses have been made of fractures of the smaller bones.

It is much to be regretted that in these comparative analyses of the treatment of gunshot fractures, except in the case of the hip-joint, by the three methods, it is not stated whether the amputations or resections were primary or secondary. In all secondary amputations and resections, which, for aught that appears, may have constituted a majority of the whole number, the conservative treatment had been tried and had failed, and the deaths which followed ought in justice to be charged to conservatism, and not to the operation. As the reports now stand, they

are of little or of no importance in determining the relative value of conservative and operative treatment.

From the reports of the Confederate army, as published in the *Confederate States Medical Journal*, we learn that of 221 cases of gunshot fractures of the thigh, treated without amputation or resection, 105 died and 116 recovered. The shortest period of recovery was 41 days; the longest, 255 days; the average, 104 days. The shortest period of fatal

FIG. 259.



Gunshot fracture of thigh. (Author's collection.)  
Side view.

FIG. 260.



Front view.

termination was one day; the longest, 185 days; average, 52 days. Greatest shortening, five inches; least, half an inch; average, one inch and nine-tenths.<sup>1</sup>

Of 507 amputations for gunshot fractures of the thigh, 250 recovered.<sup>2</sup>

<sup>1</sup> Richmond Med. Journ., Feb. 1866, from Confederate States Med. Journ.

<sup>2</sup> Ibid., January, 1866, p. 52.

## PART II.

## DISLOCATIONS.