to one, which is quite pertinent, as having been reported in the *Gazette des Hôpitaux*. A woman, æt. 64, was treated for an intracapsular fracture of the neck of the femur at one of the hospitals in Paris, and "at the end of four weeks she was discharged perfectly cured, and without shortening." We fully partake of Mr. Smith's surprise at the impudence of this claim, yet we do not see in it much greater improbability than in Mr. Swan's case, received by both Mr. Smith and Sir Astley himself, where the neck was found almost wholly united by bone in five weeks, although the woman was eighty years old, and actually dying while the process was going on! Says Dupuytren, "I would lay it down as a general principle that all fractures of the neck of a cylindrical bone should be kept at rest twice as long as ordinary fractures of the same bone; and even after that period I have seen displacement take place. The term may, therefore, be lengthened to a hundred days, or even longer in aged and feeble persons, whose powers of reparation are much deteriorated."

It is not the purpose of the writer to describe particularly all of the accidents or pathological conditions with which these fractures may be confounded. It is sufficient to allude to them, and leave to others the labor of a complete historical record; but I am tempted to devote a paragraph to what has been variously termed "morbus coxæ senilis" (Robert Smith); "chronic rheumatic arthritis" (Adams); "interstitial absorption of the neck of the thigh-bone" (B. Bell); "rheumatic gout" (Fuller); and by others "*dry arthritis*," "interstitial and progressive absorption;" but the exact nature and cause of which morbid changes are not yet fully understood. Mr. Colles does not think this partakes of the nature of rheumatism. I have myself a specimen of what has been more generally called chronic rheumatic arthritis, occurring in the knee-joint, accompanied with a flattening and eburnation of the articular surfaces, and Gulliver has shown that similar changes of form in the neck of the bone may occur in tolerably young persons.

Fig. 135.

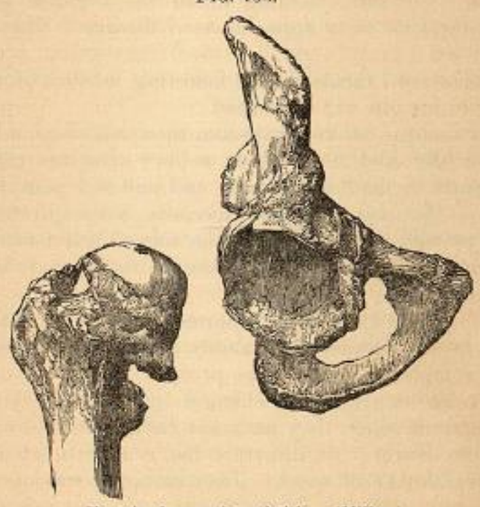
Section of a sound adult femur.

I suspect also that it will be found to occur under a great variety of circumstances, and to present a greater variety of forms than have yet been described; and we shall, perhaps, find a partial explanation of this diversity and frequency in one single circumstance, namely, the peculiar anatomical structure of the neck. The neck of the femur stands nearly at a right angle with the shaft, or at an angle so great as that the weight of the body, even in health, has the effect to depress gradually the head below the top of the trochanter major, and to diminish its length. This is seen constantly in the striking change of form which occurs between childhood and old age. Now, if from any cause whatever, such as a blow upon the trochanter or upon the foot, the

neck or head is made to suffer; and inflammation, or, perhaps, only a slight degree of increased action in the absorbents, ensues, resulting in an equally slight softening of the bony tissue, these pathological circumstances may end, sooner or later, in a striking change of form in the neck or head. But it is not necessary to suppose an external injury to explain the occurrence of this inflammation, and consequent softening of the bone; a scrofulous, or rickety, or tuberculous constitution may occasion it, and we see no reason why these conditions are not as likely to lead to a change of form here as in the bones of the leg or of the spine. A change of form in the head may be the result of an ulceration of the cartilage; and a change of form in the neck, of ulceration of the neck. Among other causes, also, "chronic rheumatic arthritis" may operate in a large proportion of those examples which belong to advanced life. One case, reported Gulliver, would seem to show that a deformity may occur here as a result of disease, and independently of pressure,[1] yet it is plain, from the direction which the deviation of the head and neck usually takes, that pressure performs an important part in the causation.

From these various causes, operating in these diverse ways, we shall have the different deformities enumerated and described by surgical writers. The head flattened, irregularly spread out, depressed, and

Fig. 136.



Chronic rheumatic arthritis. (Miller.)

polished; the neck shortened and irregularly thickened and expanded; the trachanter major rotated outwards and drawn upwards; sinuous chasms traversing the neck, produced by ulceration; and finally, shortening of the neck, by a true interstitial absorption, and with little or no increase in its breadth, the trochanter major also being rotated outwards. It would be strange, moreover, if the interior of these bones did not

[1] Gulliver, Lond. Med.-Chir. Rev., vol. xxxix. p. 544.

present some changes in structure, such as have been frequently observed, namely, an irregular expansion or condensation of the cellular tissue, and which latter might easily be supposed, by one who was inattentive to all of these circumstances, to indicate the line of an imaginary fracture.

The following example will illustrate the incipient stage of one class of these cases, namely, that in which the neck is not only shortened, but its surface is irregularly seamed, as if it had been broken and imperfectly united:

William Clarkson, æt. 43, was admitted into the Toronto Hospital, C. W., May 5, 1858, with tubercular consumption, of which he died on the 25th of the same month.

He had been under the care of Dr. Scott, and it having been noticed that he complained of his right hip at the time of admission, an autopsy was made on the 25th, at which I was, through the courtesy of the house surgeon, permitted to be present.

We examined both hip-joints, and found the neck of the right femur shortened, especially in its posterior aspect. At the junction of the head with the neck, posteriorly, and extending about half-way around, the bone was carious, and so far absorbed as to leave a sulcus of a line or two in depth, and of about the same width. Adjacent to this, also, the bone was quite soft, yielding under the slightest pressure of the knife. There was no other appearance of disease. The opposite femur was sound.

The hospital record furnished the following account of his case, so far as the injury to his hip was concerned:

About nine months before admission, then laboring under the malady of which he finally died, he received a blow upon his right trochanter, ever since which he had been lame, and suffered pain in the region of the hip-joint. The pain was felt especially in the groin, when the trochanter was pressed upon, or when the sole of his foot was percussed. The thigh was slightly flexed; the toes a little everted; and he walked with some halt.

The case of the soldier, Fox, reported by Gulliver, and who died of tuberculosis, presents a case also exactly in point, but illustrating a later stage, or the completion of the same process.

Of the precise nature of the changes in the two following examples I cannot be certain, since they have not been determined by dissection. They will serve, however, to illustrate the usual history and progress of a considerable number of cases. They certainly were not examples of fracture.

Ephraim Brown, when twelve years old, fell from a tree and struck upon his right foot. Dr. Silas Holmes, of Stonington, Ct., was called. Of the particular symptoms at this time, I have only learned that the leg was not shortened. The doctor laid a plaster upon his hip, and left him without any further treatment. In three days he was able to walk on crutches; in three weeks he walked without crutches, and in four months was at work as usual. There was at this time no shortening or deformity of any kind.

Mr. Brown subsequently enlisted as a soldier in the war of the

American Revolution, and experienced no difficulty in his hip, until after a severe illness which followed upon an unusual exposure, when he was about thirty-five years old. At this period the leg began to shorten, but the shortening was unaccompanied with pain or soreness.

He consulted me, July 17, 1845, at which time he was eighty-three years old, and a remarkably strong and healthy-looking man. The shortening, which had ceased to progress some years before, amounted at this time to two and a half inches.

An officer in the United States army addressed to me the following letter, dated November 13, 1849:

"My mother-in-law, Mrs. S., of D., some three years since fell down a flight of stairs, striking on her side upon a stone, injuring the hip-joint severely; but, upon examination, her physician declared that there was neither a fracture nor a dislocation, and said that she would gradually recover. Something like one year since, the injured limb commenced shortening, so that she can now barely touch her toe to the floor as she walks. She can bear but little weight upon it and is compelled to use a crutch or a cane constantly. So much time has now elapsed, and the limb is so little better, and constantly becoming shorter, I have proposed to ask your opinion," etc.

I need scarcely say that I had no hesitation in pronouncing this a case of chronic inflammation of the bone, accompanied with softening and gradual change of form, either of the neck or head, or of both.

It is proper that I should state briefly, before I leave this subject, what constitute the chief difficulties in the way of union by bone within the capsule.

The persons to whom the accident occurs are generally advanced in life, and consequently the process of repair is feeble and slow.

The head of the bone receives its supply of blood chiefly through the neck and reflected capsule, and, when both are severed, the small amount furnished by the round ligament is found to be insufficient.

When the fragments are once displaced, it is difficult, as I have already explained, if not impossible, to replace them.

The direction of the fracture is generally such, that the ends of the fragments do not properly support and sustain each other when they are in apposition.

The fracture is at a point where the most powerful muscles of the body, acting with great advantage, tend to displace the broken ends.

Aged persons, who are chiefly the subjects of this accident, do not bear well the necessary confinement, and especially as the union requires generally a longer time than the union of any other fracture; so that a persistence in the attempt to confine the patient the requisite time often causes death.

In all cases in which any degree of displacement exists, except it be in the direction of impaction, the ends of the broken fragments are constantly bathed with the synovial fluid, which must be increased by the inflammation resulting from the fracture. Consequently, whatever reparative bony material is furnished by the broken surfaces must be lost, rendering bony union, or even fibrous union from this source impossible.

Lastly, there is never found in these intracapsular fractures anything

like provisional callus; and whatever useful purpose it may serve in other fractures, it certainly renders no aid here.

It remains only to consider what are the most common results of this fracture.

The fragments, more or less displaced, undergo various changes. The acetabular fragment is generally rapidly absorbed as far as the head; and occasionally a considerable portion of this latter disappears also; while the trochanteric fragment appears rather as if it had been flattened out by pressure and friction, it having gained as much generally in thickness as it has lost in length. To this observation, however, there will be found many exceptions. Sometimes the trochanteric fragment forms an open, shallow socket, into which the acetabular fragment is received; or its extremity may be irregularly convex and concave, to correspond with an exactly opposite condition of the acetabular fragment. (Fig. 137.)

Ordinarily the two fragments move upon each other, without the intervention of any substance; but often they become united, more or

Fig. 137.

Intracapsular fracture. Ununited. Opposite surfaces irregularly convex and concave, and polished; moving slightly upon each other. (From a specimen in the possession of Dr. Josiah Crosby.)

Fig. 138.

Mayo's specimen. United by ligament. Patient lived nine months after the accident. The trochanter minor arrested the descent of the head. (From Sir A. Cooper.)

less completely, by fibrous bands (Fig. 133), which bands may be short or long, according to the amount of motion which has been maintained between the fragments while they are forming, or to the degree of separation which exists.

The capsular ligaments are usually considerably thickened, and elongated in certain directions, and not unfrequently penetrated by spicula

of bone. They are also found sometimes attached by firm bands to the acetabular fragment.

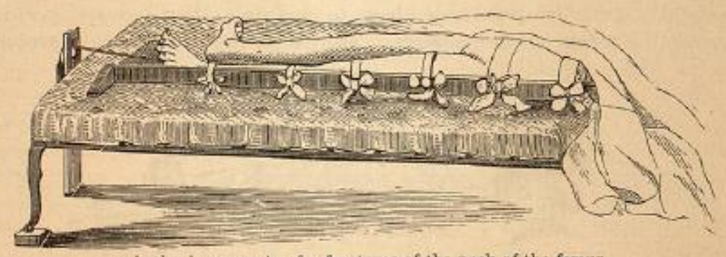
A permanent shortening is the invariable result of this accident; and a few succumb rapidly to the injury, perishing from a low, irritative fever, or from gradual exhaustion, within a month or two from the time of its occurrence. Says Robert Smith: "Our prognosis, in cases of fracture of the neck of the femur, must always be unfavorable. In many instances the injury soon proves fatal, and in all the functions of the limb are forever impaired; no matter whether the fracture has taken place within or external to the capsule—whether it has united by ligament or bone—shortening of the limb and lameness are the inevitable results."

Dr. Frederick E. Hyde, of this city, has made a very careful examination of twenty cases of fracture of the neck of the femur, after several years from the date of the fracture. Thirteen of these had been diagnosticated as intracapsular, and seven as extracapsular. All were shortened; the shortening ranging from three-eighths of an inch to two and a quarter inches in the intracapsular fractures; and from one-quarter to one and a half inches in the extracapsular.

Some of the cases had never been treated by apparatus of any kind, and it was observed that, omitting one case in which the contracted position of the limb did not permit an accurate measurement, the average shortening was one and three-eighths of an inch; while in those which had been treated as fractures, the average shortening was about one inch. All, or nearly all of them were still suffering with more or less pain and stiffness about the joint, and walked with a manifest halt.[1]

Treatment.—In case, then, of a complete fracture within the capsule, existing without laceration of the reflected capsule, or displacement of

Fig. 139.



Author's apparatus for fractures of the neck of the femur.

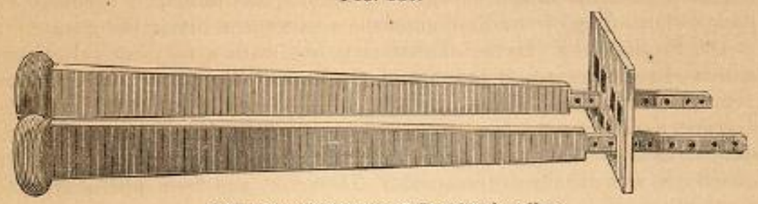
the fragments, and equally in case of a fracture at the same point with impaction, the treatment ought to be directed to the retention of the bone in place, by suitable mechanical means, for a length of time sufficient to insure bony union, or for so long a time as the condition of the patient will warrant.

The means which are, in my judgment, best calculated to fulfil this important indication, are complete rest in the horizontal posture, the limb being secured by the same apparatus which we employ with so much suc-

[1] Hyde, Deformity after Fracture of the Neck of the Femur; 20 cases, arranged and tabulated. Med. Gazette, April 17, 1880, p. 244.

cess in fractures of the shaft. In fractures of the neck, however, whether within or without the capsule, we employ no coaptation splints; and the amount of extension ought to be only one-half of that generally employed in fracture of the shaft, say about ten pounds. The long side-splint, with a foot-board, to prevent eversion of the limb, must not be omitted. In my hands, the apparatus has undergone so many modifications from the original plans of Crosby and Buck, that I shall hereafter find it necessary to designate it as my own.

Fig. 140.

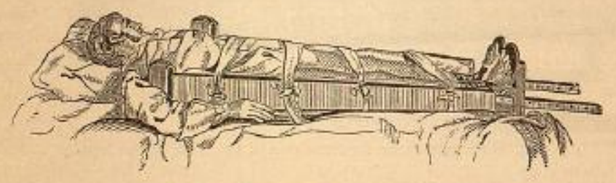


Gibson's modification of Hagedorn's splint.

Another apparatus, formerly employed by me in fractures of the neck of the femur, but for which I have substituted my own, is Gibson's modification of Hagedorn's, in which the sound limb is first secured to the foot-board, and the broken limb is subsequently brought down to the same point. By this method, as by my own apparatus, we may avoid the necessity of a perineal band, which is so painful, insupportable often when the fracture is at the neck.

In treating this fracture, supposing no displacement to exist, no extension beyond that which is necessary to insure perfect quiet can be proper, inasmuch as the fragments are not overlapped; and they need only a moderate assistance to enable them to maintain their present position against the action of the muscles. Moreover, if the fragments are impacted, violent extension would disengage them, and render their displacement and non-union inevitable.

Fig. 141.



Gibson's modified splint applied.

I am prepared to affirm, from my own experience, that more patients will endure quietly the position of extension for a length of time than the flexed position, whether in this latter the patient is placed upon his side or upon his back.

How long the patient will submit to this, or to any other mode of securing perfect rest, is very uncertain, and the decision of this question

must rest with the individual cases and the good sense of the surgeon. Not very many old and feeble people will bear such confinement many days without presenting such palpable signs of failure as to demand their complete abandonment.

Horizontal extension was adopted in Jones's case, and also in the case reported by Fawdington, and is said to have been successful. In Brulatour's case the limb was kept extended two months; in Mussey's second case Hartshorne's straight splint for extension remained upon the limb eighty-four days; in Bryant's case a long splint was used "some weeks."

It is true, however, that other plans of treatment seem to have been equally successful. In the case reported by Adams the limb was placed over a double-inclined plane, made of pillows, five weeks; and in Mussey's third example the limb remained in the same position three months. Chorley laid his patient upon the sound side, with the thighs flexed, for a space of two weeks, and then turned him upon his back, still keeping the thighs flexed. At the end of six weeks he was placed in a straight position.

But in a majority of the examples reported, the existence of the fracture was either not suspected, or bony union was not anticipated or desired, consequently no treatment having in view the confinement of the broken bone was adopted. Yet the success, it was claimed, was as great as that which has followed either of the other plans. Harris's patient was simply laid on a sofa. Field's patient, who broke the neck of both femurs within the capsule at different times, was in each case left without treatment, except that she lay upon her bed. Mussey himself removed all dressings from Dr. Dalton's patient on the eighteenth day, and placed him upon his feet, and Dr. Wakelee removed the apparatus from his mother on the fifth day.

Nor are we without evidence that the careful and judicious application of splints, long continued, and employed under the most favorable circumstances, will sometimes fail. The two following cases confirm these remarks. The first occurred in the practice of Dr. James R. Wood, of this city: "M. J., a young lady, æt. 16 years, of vigorous constitution, perfectly free from any constitutional taint, either of scrofula, syphilis, or cancer, was caught between the wheels of two carriages, the one stationary, the other in motion. The blow was received directly on the trochanter major of the right side. The symptoms which presented themselves showed conclusively that there was a fracture. There were shortening, loss of voluntary motion, and eversion; by placing the finger on the trochanter major, and the thumb on the groin, a well-marked crepitus could be felt on extension and rotation being made. There was no laceration or other complication of the injury. She was placed on Amesbury's splint, with side-splints accurately adjusted, and every precaution taken to insure a perfect union. The limb was kept on this splint without being disturbed for six weeks. At the end of that time it was taken from the splint, and examined with care; the signs of fracture still remained. The limb was replaced on the splint, and the dressings applied as before; everything was attended to in the general management of the case which the doctor thought would be conducive

to perfect union. The patient was kept for three weeks longer on the splint, which was then removed. It was found that there was no union. Patient lived for three years, and was so lame that she was always obliged to use a crutch in walking. At the expiration of three years she died of an acute disease.

"On examination of the cervix femoris, it was found that there had been a transverse fracture of the bone just at the junction of the head and neck. The head of the bone was still attached to the acetabulum by the ligamentum teres. The process of absorption had been going on, and the head of the bone had already been absorbed below the level of the acetabulum, and what remained was soft and spongy, easily broken with the handle of the scalpel. The neck of the bone was rounded off, and covered with a fibrous deposit. This was not a case of diastasis, as has been suggested by an eminent surgeon, who judged simply from the age of the patient. She was full sixteen when the accident happened and over nineteen when she died."

The second was in the person of a man, æt. 25 years, who was at the time of the accident robust and in good health. "He was dancing at his sister's wedding; while cutting a pigeon-wing, he struck the foot upon which he was resting from under him, and fell, striking directly upon the trochanter major. He was unable to rise; a carriage was called, and he was taken directly to the New York Hospital. There he came under the charge of Dr. J. Kearney Rodgers. A fracture was immediately diagnosticated, and for a few days he was kept on the double-inclined plane. The straight splint was then used, and the dressings kept up for six weeks; at the end of that time they were taken off, and the limb examined; there was no union. The limb was continued in the straight splints for three weeks longer, and again examined; there was still no union. The patient was again replaced in the straight splint for two weeks longer, but no union occurred. At the end of three months from his admission he was discharged; he was in good health, but so lame that he was obliged to use two crutches in walking. After his discharge the patient became very intemperate; and in the course of a few weeks he applied for admission to Bellevue Hospital. He was much debilitated, and had an exhausting diarrhœa. Shortly after his admission an immense abscess formed over the joint, which discharged profusely. The man died shortly after from exhaustion, and the specimen came into Dr. Van Buren's hands, the patient having been in his service. Dr. Van Buren was aware of the patient's previous history, the treatment, etc., at the New York Hospital, and a careful examination was made.

"The capsular ligament was destroyed entirely by the suppurative process; there was a formation of callus upon the trochanter major; the ligamentum teres was entirely absorbed; the head of the bone was spongy, as if worm-eaten; the direction of the fracture was oblique, commencing just at the articulating surface of the head, and ending just within the capsule; the upper end of the shaft of the bone showed this same appearance that was marked in the head. These points are beautifully shown in the specimen at the present time. The opinion of Charles E. Isaacs, M.D., the able Demonstrator of Anatomy of the

University Medical College, is, that this fracture was entirely within the capsule."[1]

Such equal results from opposite plans, and unequal results from similar plans of treatment, are not calculated to increase our faith in the testimony which most of the foregoing examples are supposed to furnish of the possibility of bony union. On the contrary, they cannot fail to suggest a doubt as to whether some of them, at least, were not inaccurately diagnosticated.

But admitting that they were not, the testimony which they furnish in relation to treatment is too inconclusive to be made available for instruction, and we are still at liberty to adopt that which seems most rational, without reference to the experience of others.

The reasons why I would prefer my own plan have already been stated in part, to which I will now add, that if an error should occur in the diagnosis—if it should prove finally to have been a fracture without the capsule—then this treatment would be correct, and no injury would come to the patient from the error in diagnosis; but if we adopt Sir Astley Cooper's suggestion, namely, to get the patient upon crutches as soon as possible, perhaps as early as fourteen days, an error in diagnosis might be followed by the most disastrous consequences.

In gunshot intracapsular fractures, if suppuration ensues, the head of the bone and other fragments ought to be removed; and there may occur cases in which the fragments should be removed immediately, as has been done occasionally with satisfactory results. So, also, if after a simple intracapsular fracture, suppuration within the joint were to ensue, resection would be the proper resort; but I cannot agree with Dr. Howe in his report of a case to the New York Academy of Medicine, that, in all cases of intracapsular fractures of the neck of the femur, occurring in persons who were not very decrepit or exhausted, and where crepitus was well marked, at the end of three months of careful treatment, and the patient confined to bed, the operation of excision should be performed without delay.[2] The probabilities seem to be that in most or all of these cases the patient is likely to have as useful a limb without excision as with, and if so, the hazards of the operation, however trivial, must decide the question against its performance. In the case operated on by Dr. Howe, the result is by no means encouraging, and it is apparent that the limb was not judiciously managed before the operation. It was kept too long in splints.

(b) *Neck of the Femur, without the Capsule.* (*Extracapsular.*)

Causes.—Like fractures within the capsule, these also occur most frequently in advanced life. They are not, however, as often met with in extreme old age as are fractures within the capsule; and they are much more often met with in persons of middle age, and in younger persons, than are intracapsular fractures. Of fractures recognized as extracapsular, in Dr. Hyde's tables, ten were under fifty years, and seven at or

[1] Johnson, op. cit., pp. 13–15.

[2] J. W. Howe, M.D., Hospital Gazette, Dec. 20, 1879, p. 660; also the Debate, p. 665, in which other similar operations are cited.

over fifty. The three youngest were respectively thirty, twenty-five, and twenty years of age. Of the 42 recorded by me as extracapsular fractures, I have made no careful tabulation of the ages, but it is certain that in general they belong to a younger class of persons than the cases recorded as intracapsular.

As to the immediate causes, I have already mentioned in the preceding section that fractures without the capsule seem to be the result generally of falls or of blows received directly upon the trochanter; occasionally, also, they are produced by falls upon the feet or upon the knees.

Pathology.—These fractures may occur at any point external to the capsule, but generally the line of fracture is at the base, corresponding very nearly with the anterior and posterior intertrochanteric crests. Almost invariably the acetabular penetrates the trochanteric fragment in such a manner as to split the latter into two or more pieces. The direction of the lesions in the outer fragments preserves also a remarkable uniformity; the trochanter major being usually divided from near the centre of its summit, obliquely downwards and forwards toward its base, and the line of fracture terminating a little short of the trochanter minor, or penetrating beneath its base; while one or two lines of fracture usually traverse the trochanter major horizontally.

In an examination of more than thirty specimens, I have noticed but two or three exceptions to the general rules above stated.

In Dr. Mütter's collection, specimen marked B 115 is not accompanied with either impaction or splitting of the trochanteric fragment; but the neck, having been broken close to the intertrochanteric lines, has, apparently, slid down upon the shaft about one inch, at which point it is firmly united by bone.

Dr. Neill has also a specimen of fracture at the same point, but without union of any kind, in which no traces remain of a fracture of the trochanters. The acetabular fragment has moved up and down upon the trochanteric until it has worn for itself a shallow socket three inches and a half long; the approximate surfaces being smooth and polished like ivory.

The trochanter major is usually turned backwards, the shaft of the femur being rotated in this direction, the same as is usually observed in other fractures of the neck of the femur. I have seen one exception to this general rule in a specimen belonging to Dr. Mütter (No. 29); the trochanter in this instance is turned forwards, so that the neck is shorter in front than behind.

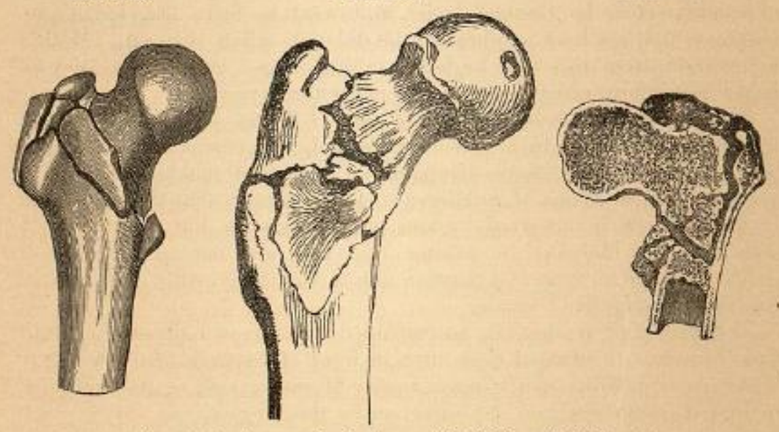
The upper fragments of the trochanter major, whenever the lines of fracture are transverse, are generally inclined inwards toward the neck, as if displaced in this direction by the force of the blow, or perhaps by the resistance offered by certain muscles and ligamentous bands which find an insertion upon its summit.

The neck is found, in most cases, standing inwards at nearly a right angle with the shaft, the head being much more depressed than the outer extremity of the neck; in consequence of which the lower margin of its broken extremity is driven much deeper into the trochanteric fragment than is the upper margin.

Malgaigne believes that impaction, with consequent fracture of the trochanters, is never absent in true extracapsular fractures, unless it be in that very unusual variety in which the trochanter forms a part of the inner fragment (fractures through the trochanter major and base of the neck). Robert Smith entertains the same opinion, although Malgaigne does not seem to have so understood him. I cannot agree, however, with either of these gentlemen that the rule is so invariable, since I am confident that no such splitting has occurred in either of the two specimens to which I have referred as belonging respectively to Drs. Mütter and Neill. It is true these are both old fractures, and to some extent the signs of fracture may have become obliterated, but in Mütter's specimen an abundant callus indicates plainly enough where the shaft separated from the neck, while the trochanter major is smooth as in its normal condition, nor does its summit incline either way from its normal position. Neill's specimen, though less satisfactory, does not fail to convince me that neither impaction nor splitting of the trochanters ever occurred.

It is certain, however, that impaction and comminution of the outer fragment are very constant, and that, whether the fracture is produced by a fall upon the feet or upon the trochanter major. But the impaction does not necessarily continue; sometimes, indeed, it does, and the position of the limb, whatever it may be at the moment, remains unalterably fixed; either very little or considerably shortened, according

FIG. 142. FIG. 143. FIG. 144.



Impacted extracapsular fractures. (R. Smith, and Erichsen.)

to the degree of impaction; rotated outwards or inwards, or in neither direction, perhaps, according to the direction of the force and the amount of comminution. In other cases, owing to the extreme comminution, and to the wide separation of the trochanteric fragments, or to the contraction of the muscles inserted into the top of the femur, or to the weight of the body in attempts to walk, or to injudicious handling on the part of the surgeon, such as forcible rotation, by which the neck is made to act as a lever, and actually to pry the fragments apart, or to

violent extension, by which the impaction is overcome—owing to some one or several of these causes it often happens that the fragments separate, and the leg becomes immediately more shortened, movable, and more inclined to rotate outwards.

Symptoms.—The symptoms which indicate a fracture of the neck of the femur without the capsule, are pain, mobility, crepitus, shortening, and eversion of the limb. The trochanter major is not as prominent as upon the opposite side; and especially where the fragments are not impacted, but are completely separated, it rotates upon a shorter axis. There are also several other signs to which I shall refer when considering the differential diagnosis.

Before considering more in detail the value of these several signs, I wish to call attention to a fact which has been often observed by myself and others, namely, that the patient is able, sometimes, immediately after this accident, to take a few steps; yet never, perhaps, without considerable pain. The same may happen in an intracapsular impacted fracture, but it happens much more often in the extracapsular impacted fracture; but the following case is the most remarkable, in this point of view, of any which has come under my notice: A laboring man, about 50 years of age, presented himself at my clinic at Bellevue Hospital, some time during the fall of 1874, who stated that two years before he had fallen a distance of nine feet, striking upon his side; that after a little he arose, and with the aid of a stick, walked a mile or more to his home. Walking caused great pain in his hip, and he was much exhausted when he reached home, and went to bed; but, having no suspicion that his limb was broken, he did not call a surgeon. Within a fortnight from this time he began to walk about, and a week later he began to perform ordinary labor, yet not without pain.

When this man came before the class I found the limb shortened three-quarters of an inch, the toes everted, the trochanter major depressed—that is, flattened—irregular in form, and much increased in breadth. He is a man of intelligence, and is certain that these changes of form, etc., were observed by him very soon after his recovery. It seems proper, therefore, to assume that this was not an example of gradual change of form and position due to a chronic ostitis, but that it was an extracapsular fracture.[1]

The pain and tenderness, accompanied sometimes with swelling and discoloration, are situated most often in front of the neck of the bone.

Articular mobility exists in a majority of cases; that is, the limb can be moved pretty easily in any direction by the surgeon, but not without producing pain or provoking muscular spasms. In most cases the patient himself is unable to move the limb by his own volition, or he can only move it slightly.

Crepitus is present whenever there exists a moderate but not complete impaction. It is also present generally when, the trochanteric fragment, having been extensively comminuted and loosened, the impaction becomes excessive; and it is only absent when the impaction is such that the fragments are completely and firmly locked into each other.

[1] Canton on Interstitial Apsorption of the Neck of the Femur from Bruise, etc. London Med. Gazette, Aug. 11, 1848.

A shortening is inevitable, at least in all cases accompanied with either temporary or permanent impaction, and we have seen that one of these conditions seldom fails. According to Sir Astley Cooper, the shortening varies from half an inch to three-quarters of an inch; but Robert Smith has established the following distinction: When the fracture is extracapsular and impacted, that is, when it remains impacted, the shortening is only moderate, varying from one-quarter of an inch to one inch and a half; in fourteen cases measured by him the average was a fraction over three-quarters of an inch; but when it does not remain impacted it ranges from one inch to two inches and a half; indeed, Mr. Smith mentions one example in which the shortening reached four inches, and forty-two cases gave an average shortening of something more than one inch and a quarter. Mr. Smith's experience as to the amount of shortening in these cases agrees very nearly with my own.

Eversion of the toes is very constant; but in a few instances upon record the toes have been found turned in, or even directed forwards. During the winters of 1864 and 1865, I found a case of this kind in my wards at Bellevue Hospital. In the specimen referred to as being found in Dr. Mütter's collection, with an inward or forward rotation of the trochanter major, the same relative position of the whole limb must have existed; and in my remarks on fractures of the neck within the capsule, I have referred to several examples, some of which were probably extracapsular.

The trochanter major usually seems depressed or driven in; and when the two main fragments are completely separated, if the limb is rotated, the trochanter will be found to turn almost upon its own axis, or upon a very short radius.

In enumerating the signs of a recent extracapsular fracture, it will be seen that I have, with only slight variations, repeated the signs of a fracture within the capsule. It will become necessary, therefore, to indicate, as far as possible, a differential diagnosis. And without pretending that all of the differential signs which I shall enumerate are thoroughly established, or that in every case, even after a careful grouping of all the symptoms, a satisfactory diagnosis can be made out, I shall state briefly my own conclusions, or rather what seem to me to be the probable facts.

Fig. 145.

Fracture of the neck of the femur. (Fergusson.)

Signs of a fracture within the capsule.	Signs of a fracture without the capsule.
Produced often by slight violence.	Produced usually by greater violence.
A fall upon the foot or knee, or a trip upon the carpet, etc. Possibly a fall upon the trochanter; especially when an old person is the subject of the injury.	A fall upon the trochanter major in nearly all cases.
Generally over fifty years of age.	Often under fifty years of age.
More frequent in females.	Relative frequency in males or females not established.

Signs of a fracture within the capsule (*continued*).	Signs of a fracture without the capsule (*continued*).
Pain, tenderness, and swelling less and deeper.	Pain, swelling, and tenderness greater and more superficial. It is especially painful to press upon and around the trochanter major.
Ecchymosis not often seen.	Superficial and extensive ecchymosis quite frequent.
(The two following measurements to be made from the lower margin of the anterior superior spinous process of the ilium to the lower extremity of the malleolus externus or internus.)	
Shortening at first less than in extracapsular fractures, often not any.	Shortening at first greater, almost always some.
Shortening after a few days or weeks greater than in extracapsular fractures. Sometimes this takes place suddenly, as when the limb is moved, or the patient steps upon it.	Shortening after a few days or weeks less than in intracapsular fractures, provided proper extension has been maintained. That is, the amount of shortening changes but little, if at all, if the impaction continues. If it does not continue, it shortens more.
Measuring from the top of the trochanter to the condyles or to the malleoli, the limb is not shortened.	Measuring from the top of the trochanter to the condyles or to the malleoli, the limb may be found a little shortened.
If there is no impaction, the trochanter major moves upon a relatively longer radius than in cases of extracapsular fractures, the pivot being nearer the acetabulum.	If there is no impaction, the trochanter major moves upon a relatively shorter radius, the pivot being more remote from the acetabulum.
If the patient recovers the use of the limb, not restored under many months, or years.	The patient usually recovers the use of the limb sooner. In many cases, however, very slowly, and walking is for a long time difficult and painful.
No enlargement or apparent expansion of the trochanter major, after recovery, from deposit of bony callus.	Enlargement or irregular expansion of trochanter, which may be felt sometimes distinctly through the skin and muscles, and which is especially manifest after the lapse of some months.
Progressive wasting of the limb for many months after recovery.	The limb preserving more nearly its natural strength and size.
Eventually excessive halting, accompanied with a peculiar motion of the pelvis, such as is exhibited in persons who walk with an artificial limb.	Comparatively slight halt, motions of hip more natural.

Prognosis.[1]—In attempting to establish the differential diagnosis, we have necessarily been led to consider most of the essential points of prognosis. Very little, therefore, remains to be said upon this subject.

Union occurs as rapidly in this fracture as in fractures of the shaft; and perhaps in general more promptly, owing to the existence of impaction.

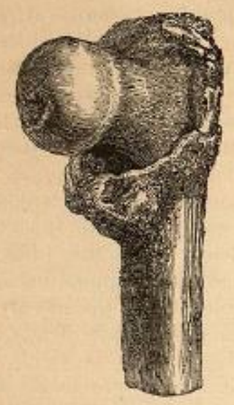
But whether it occurs promptly or slowly, or, indeed, if it does not occur at all, a remarkable deposit of ossific matter almost invariably takes place along the intertrochanteric lines, where the bone has separated from the shaft, and also, not unfrequently, along the lines of the other fractures of the trochanter.

This deposit is no less remarkable for its abundance than for its irregularity, long spines of bone often rising up toward the pelvis and

[1] See observations of Dr. Frederick E. Hyde in preceding section.

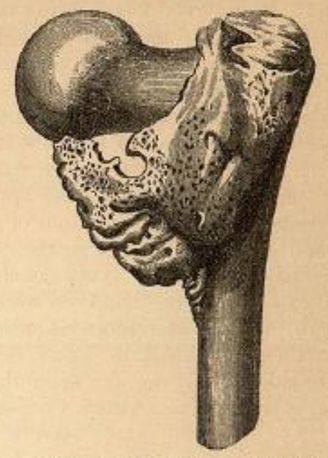
forming a kind of knobby or spiculated crown, within which the acetabular fragment reposes. In a few instances these osteophytes have reached even to the bones of the pelvis, and formed powerful abutments, which seemed to prevent any farther displacement of the limb in this direction, and by some writers they have been supposed thus to fulfil a positive

Fig. 146.



Extracapsular fracture. (Erichsen.)

Fig. 147.



Extracapsular fracture. (R. Smith.)

design. A sufficient explanation of their existence, however, I think, can be found in the fact that they proceed entirely from the trochanteric fragments, whose extensive comminution and great vascularity would naturally lead to such results. The same, but in a less degree, has already been noticed as occurring in impacted fractures at the anatomical neck of the humerus, where certainly such bony abutments could not serve any useful purpose.

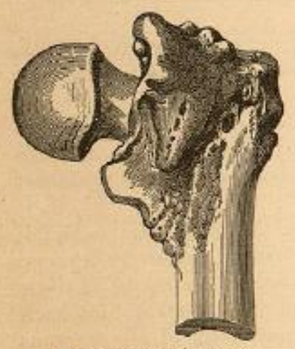
Probably in all, certainly in nearly all cases, the limb will be found, after the union is consummated, more or less shortened, generally between half an inch and an inch. If exceptions ever occur, it must be in those examples in which there is no impaction, and it is certain that such examples are very rare. Such is the united testimony of all surgeons whose opinions have ever been respected as authority; and the same is true of intracapsular fractures. What ignorance of the elementary facts of surgical science, or insincerity, then, do those men exhibit who affirm that they are able to treat *all* fractures of the femur without shortening!

Eversion of the foot is not so constant as shortening, but it will be found to exist in some degree in a large majority of cases, even when the case has been managed in the most skilful manner; yet in this regard something will depend upon the position in which the limb is maintained during the treatment.

Treatment.—The same principles of treatment are applicable here as in fractures of the neck within the capsule; by which I mean to say that, as in all of those examples of fracture within the capsule where

the relation of the fragments is such as to warrant a hope that a bony union may be consummated, namely, where the fragments are not displaced or are impacted, the straight position, with only moderate extension, constitutes the most rational mode of treatment; so also in this fracture, whenever the fragments are impacted and remain impacted, the straight position, with moderate extension, employed only as a means of retention, but not so as to overcome impaction, is the most suitable. It is only by employing this plan of treatment, which no one has yet shown to be inapplicable to either of these two varieties of accidents—I do not speak of the opinions which men may have entertained, but of the practical testimony—it is only, I say, by employing this uniform plan of treatment in both cases, that those serious misfortunes to the patient can be avoided which would necessarily continue to occur if Sir Astley Cooper's advice were followed, namely, to allow the patient in the one case to dispense with apparatus wholly, and to get upon his crutches as soon as the condition of his limb and of his body will permit, when it is certain that in the other case some retentive apparatus is generally necessary. This conclusion is based upon the admitted difficulty of diagnosis. If, as is well understood, the diagnosis between these two varieties of fracture is often impossible during the life of the patient, then how shall we know in any given case which of the two plans to adopt? If we act upon the supposition that it is within the capsule, adopting Sir Astley Cooper's method, and it proves to have been a fracture without the capsule, we may do irreparable injury to our patient. It is precisely here that this distinguished surgeon committed his great error; not in denying that certain specimens were fractures of the neck of the femur within the capsule united by bone, nor in constantly urging upon his contemporaries the improbability of such an event; but in that, while he admitted its possibility, he chose to recommend a plan of treatment which was unlikely to insure such a union, and which, in the uncertainty, if not impossibility of diagnosis, was liable, upon his supposed authority, to be adopted in many cases of extracapsular fractures.

Fig. 148.



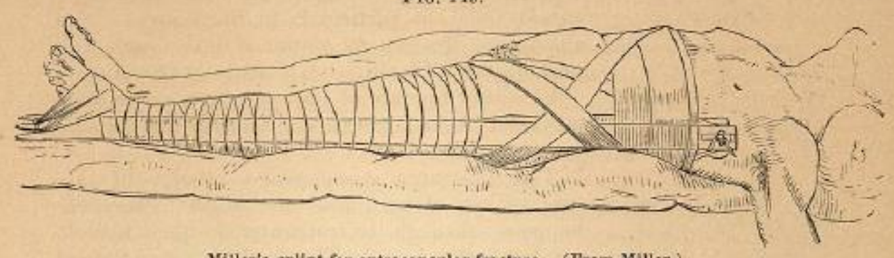
Extracapsular fracture.

Again, if the fracture be extracapsular and not impacted, or the impaction has been, for any cause, overcome; or, if the fracture be intracapsular and not impacted; or if the capsule is lacerated and the fragments are in consequence displaced; then again no injury need result from the treatment, if we adopt the straight position with moderate extension, such as may be obtained from the use of my apparatus. That it is or is not impacted we may know generally by the amount of displacement, although we may not easily decide whether the fracture is within or without the capsule. Now, the amount of shortening will determine properly enough the amount of extension to be employed. In either case, however, we shall not employ as much

extension as in fractures of the shaft; and while if it be an intracapsular fracture we may only gain a shorter and firmer ligamentous union, if it proves to be extracapsular we shall insure a better and more speedy bony union.

If any surgeon, acting upon the suggestions here made, shall confine a feeble or an aged person in the horizontal posture, with or without a straight splint, until the powers of nature have become exhausted, and

Fig. 149.



Miller's splint for extracapsular fracture. (From Miller.)

death ensues, as our readers have already been admonished may happen, we are not to be held responsible for his want of judgment or of skill. We have advised this plan of treatment only for so long a period as the condition of the patient renders it entirely safe, or as it can prove useful. No doubt, then, in a large number of cases, it will have to be abandoned very early, and in not an inconsiderable proportion all constraint will be plainly inadmissible *from the beginning;* and it is for such examples that the treatment recommended by Sir Astley Cooper for all intracapsular fractures ought to be reserved.[1]

(c) *Fractures of the Neck, partly within and partly without the Capsule.*

It is scarcely necessary to say that the line of fracture through the neck of the femur may be such, that it shall be in part within and in part without the capsule; and such fractures will be even more difficult to diagnosticate than either of those forms of which we have just spoken. The symptoms will be mainly, however, those which characterize fractures within the capsule, while the treatment ought to be such as we would adopt in those fractures which are wholly without the capsule. The chances for bony union are increased in proportion as the line of separation extends outside of the capsule, and we ought to be diligent in our efforts, if we have made ourselves certain that the fracture is partly extracapsular, to secure a good bony union; a result which experience has shown may be reasonably anticipated.

The necessity for some extension, and of firm retentive apparatus in this form of fracture, furnishes another argument in favor of the employment of the same means in fractures wholly within the capsule. We

[1] Fracture at the Neck of the Femur. Clinical Lecture at the Bellevue Hospital, by the Author. Priority in Employment of Extension, etc. The Medical Record, March 9, 1878.

shall thus avoid the mischief which might arise from mistaking a fracture of the character of which we are now speaking, for a fracture wholly within the capsule.

§ 2. Fracture of the Trochanter Major.

Under the title of "Fracture through the Trochanter Major," Sir Astley Cooper[1] writes as follows: "Fractures sometimes happen through the trochanter major obliquely, and the cervix ossis femoris does not participate in the injury;" and among the illustrations contained in the same volume, Figure 2, Plate xii., "exhibits," says Sir Astley, "the seat of fracture of the trochanter major often mistaken for fractured cervix femoris; this fracture unites by bone."

FIG. 150.

Sir Astley Cooper's imaginary fracture. From Treatise on Dislocations and Fractures of the Joints, 2d, London ed., 1823, Pl. xii., Fig. 2.

This illustration is supposed to refer to the fracture spoken of by him as one which "sometimes happens" through the trochanter obliquely without involving the neck. The line of this supposed fracture, as shown in the illustration, is from near the top of the trochanter major downwards and inwards, and terminating on the shaft just below the trochanter minor. It does not, therefore, involve the neck, but it severs the thigh-bone completely.

Sir Astley describes briefly in the text the first case of "this kind" he "ever saw." "It was in St. Thomas's Hospital, about the year 1786." Mr. Cline thought it to be a fracture of the neck, but the patient having subsequently died, "the fracture was found through the trochanter major."

It does not appear whether Sir Astley witnessed the dissection, nor is there any statement to the effect that the line of fracture was the same as that indicated in the woodcut.

His second case, which he saw in consultation with Mr. Harris, was not verified by an autopsy; and upon a careful reading of the report as given by Mr. Harris, I am unable to find a particle of evidence that it was such a fracture as Sir Astley supposed it to be. Indeed all that Mr. Harris says upon this point in his report is, that Sir Astley "agreed with Mr. Brodie and ourselves in declaring the fracture to be placed in the trochanter major, where it unites with the cervix femoris." In all probability, therefore, it was an extracapsular impacted fracture, or, perhaps, it was a simple fracture across the base of the trochanter.

Sir Astley believed that he had seen three other similar cases in the course of his practice, none of which, however, were established by dissection.

The example reported by Stanley,[2] of a woman 60 years old, who died three years after having fallen and injured her right hip, was certainly

[1] Sir Astley Cooper, on Dislocations and Fractures of the Joints, London, 2d ed., 1823, p. 158.

[2] Stanley, Med.-Chir. Trans., vol. xiii. p. 504.

not an example of the fracture described by Sir Astley; but in all probability it was an extracapsular fracture, with sufficient comminution to have separated the trochanter major from the shaft of the femur. Mr. Bransby Cooper's case[1] is equally unsatisfactory. The cases described by Waechter[2] and by Clarke[3] have been classified as trochanteric fractures, but they would be more properly called extracapsular impacted and comminuted fractures of the neck and trochanter. The case reported by Waechter may be given as an illustrative example of some of the accidents of this latter class.

A man 71 years old, fell upon his left hip. A week later he was admitted to the hospital. There was no sign of contusion and no crepitation. Outward rotation alone caused pain. Subsequently the limb became flexed, rotated inwards and adducted. Four weeks after the accident he died of pneumonia. "The round ligament was found to be hyperæmic, but there was no effusion within the joint. The upper and inner portion of the trochanter was separated by a line of fracture which lay entirely outside the joint, beginning close by the upper edge of the insertion of the capsule, running downwards and outwards, and then up across the top of the trochanter. The fragment, which was split into two pieces that were slightly movable on each other, was slightly displaced backwards and inwards, and the periosteum was torn in front, but not on the outer side. The tendons of the pyriformis, obturator internus and gemelli, and the anterior fibres of the glutæus medius, and upper fibres of the glutæus minimus remained attached to the fragment. There was no sign of repair; no extravasation of blood. A fissure, three centimetres long in the shaft, made the remaining half of the trochanter slightly movable."

In short, I am compelled to say that the fracture described by Sir Astley unaccompanied with comminution of the trochanter major, has probably never been met with. The illustration which he furnished of this accident was drawn, not from any such specimen seen by himself, but from his own ideas as to what conditions of the fracture would best explain the clinical phenomena presented. Surgeons of Sir Astley's day had not become so well acquainted with the variety of conditions in which an extracapsular impacted fracture may be found. In some cases the penetration being almost imperceptible, while in others the pentration is such as to separate the trochanter into several fragments, some of which may be completely detached and displaced.

Sir Astley Cooper's error in diagnosis, as Malgaigne does not hesitate to call it, has embarrassed and misled many who have attempted to study this subject; and which embarrassment can only be relieved by a complete rejection of all that Sir Astley has written upon it.

And now, having disposed of the fracture imagined by Sir Astley, and having come to the consideration of a true fracture of the trochanter major, it becomes necessary to say that I have not found anywhere reported an example of this fracture demonstrated by dissection, other than epiphyseal separations and the fractures of the trochanter caused by im-

[1] B. Cooper, A. Cooper on Dislocations, etc., p. 192.

[2] Waechter, Deuts. Zeits. für Chir., vol. viii. 1877, p. 104 (Stimson).

[3] Clarke, Amer Journ. Med. Sci., 1836., vol. ix. p. 181, from Trans. Med. Phys. Soc., Calcutta, 1825.