pelvis. I left her in this apparatus after having examined the limb and applied the mechanical bed. As the rotation of the foot outwards is not very great, and the fracture seems probably to be with penetration, I shall not use the double inclined plane, and I shall continue the Scultet bandage, but remove it if I hear the patient complain that it causes pain.

It goes without saying that the nourishment of the patients will be as strengthening as circumstances will permit, and that the sacral region will be watched so as to prevent, by means of lotions of aromatic wine, starch powder, and cotton pads, the eschars whose approach would be indicated by erythema and excoriations.

I shall not leave the patients in bed very long. The horizontal decubitus weakens old people, and predisposes them to pulmonary engorgements. In about three weeks, if the pain has diminished sufficiently, I shall have them sit up in a chair. They will be lifted out and put back by means of the mechanical bed with great precautions. Experience has shown that these few movements do not prevent repair from going on to the extent to which it is possible.

I shall give them crutches at the end of five or six weeks, and a little later they will make use only of a cane.

LECTURE XXII.

FRACTURES OF THE LOWER EXTREMITY OF THE FEMUR.

I. Simple supra-condyloid fracture—Functional and physical symptoms—Projection forward of the upper fragment—Imperfect reduction—Probable penetration—Concomitant arthritis. Treatment. II. Supra-condyloid and inter-condyloid fracture, its production by a wedge-like mechanism—Influence of age upon this mechanism and upon this diagnosis—Reduction impossible. III. Supra-condyloid and inter-condyloid fracture complicated with a wound and projection of the end of the upper fragment—Amputation—Examination of the piece.

GENTLEMEN: I. *Simple supra-condyloid fracture of the right femur.*—The patient in No. 15, 32 years old, told us that yesterday evening he was knocked down by a wagon, and fell upon his right knee. He thinks he is sure that the wheel did not pass over his limb, and that he simply fell in a false position, although he cannot say in what this false position consisted. This, however, is certain, that after having fallen he was unable to rise, that he felt severe pain in the knee, and was brought on a stretcher to the hospital.

This morning, after having removed the Scultet bandage which was applied yesterday, we found:—

As functional symptoms: 1st. The absolute impossibility for the patient to raise his heel from the bed and to make any movement with his right leg; 2d. Quite sharp pain on pressure above the knee.

As physical symptoms: 1st. A moderate swelling, but with fluctuation indicating an incontestable effusion in the femoro-tibial articulation; 2d. An abnormal prominence, a little irregular, but not pointed, at the anterior part of the thigh three finger-breadths above the patella; 3d. An unusual mobility in the transverse direction when I moved the foot alternately outwards and inwards with one hand whilst holding the centre of the thigh firmly fixed with the other.

I did not feel any crepitation, and, carrying my fingers behind into the hollow of the knee, I did not feel any abnormal prominence formed by a fragment of bone.

From these symptoms I do not hesitate to assert that we are in presence of a fracture of the lower extremity of the femur (*Malgaigne's supra-condyloid*).

Undoubtedly, the functional troubles which I mentioned, and the considerable enlargement of the synovial cavity might have made us suppose it to be a violent contusion of the articulation, a sprain, or a fracture of the patella. I do not admit the latter, because I found neither interfragmentary separation nor abnormal mobility of the upper and lower halves of the patella. I do not absolutely reject the idea of a contusion and a sprain; but if these lesions exist they are only a coincidence.

The main lesion is the fracture. The dominant symptom which proves it is the abnormal mobility in the transverse direction. This does not exist in the simple contusion; it is true it may be found in sprains of the severest kind, with rupture of the lateral ligaments. But the mobility which we find here is not that of a sprain, for two reasons: first, because it is much greater and more easily obtained than is that of a sprain; second, because the centre of these unusual movements is plainly above the articulation. Add to that the abnormal projection forwards of the upper fragment, which makes the diagnosis still more positive.

I shall not try to give you any notions upon the etiology, for I know but little about it. The patient, as is always the case, cannot tell us how he fell. His story permits us to infer that the fracture was not produced by a direct blow. But how did the indirect cause act, to produce a fracture at a point where the bone is so large and so strong? This is what remains problematical. I am disposed to believe that the lesion has been prepared by some alteration in the bone, similar to that which takes place in old people in the cells of the cancellous tissue, and which gives this tissue a fragility greater than at other ages. There may have been in him what I call *premature senile alteration.* But this opinion, which I offer here, as for certain almost spontaneous fractures of the shaft, is not thus far susceptible of demonstration.

One word upon the displacement. Since we feel a projection of the upper fragment forward, we infer the existence of a transverse displacement with projection, which we can attribute either to the direction of the fracture, or to the action of those parts of the triceps

which are inserted into the femur. I do not think that there is at the same time longitudinal displacement or overriding; for I found a difference of only a line or two in the length of the two limbs, and this difference might be due as well to the difficulty of exact measurement as to a real shortening. I presume that the fragments have not slipped entirely past one another, and that consequently shortening could not be produced.

I looked carefully to see if there was tipping backwards and downwards of the lower fragment, a kind of displacement which was indicated by Boyer as being habitual in this fracture, and which he attributed to traction excited by the gastrocnemius. It seemed to me that nothing like that existed here, that the lower fragment simply extended beyond the upper one behind, and the upper fragment extended beyond the lower one in front.

Supra-condyloid fractures are not common enough for my own experience to enable me to know in what proportion this tipping backwards of which I have spoken appears. I have never met with it. M. U. Trélat[1] tells us that in nine cases, which he found described by the different authors, this tipping backwards occurred only once. I am, therefore, inclined to believe that it is rare. But as it may occur, I advise you always to see if it exists and if it does not exert, as it may possibly do, an undesirable compression upon the popliteal vessels.

The *prognosis* is simple, in this sense, that our patient's life is not compromised; but it is uncertain, and may be bad upon another point, that of persistent deformity on account of irreducibility.

I told you that there was a projection forward of the upper fragment. I add that I have made every effort to reduce it. While an assistant, placed at the foot of the bed, made extension upon the foot, and another held the middle of the thigh firmly to make the counter-extension, I tried to push back the upper fragment with my hands and to make this prominence disappear, but I did not succeed. I repeated the attempt several times, and it always failed. It is probable that I shall not succeed any better hereafter, and that, consequently, consolidation will take place with persistence of the transverse displacement. Fortunately, the prominence is not great enough to endanger the skin; fortunately, also, there is no considerable overriding, so that this deformity, in reality slight, will have no unfortunate consequences for the functions.

But to what is this irreducibility due? To an anatomical disposition which I have told you is often found in fractures of the extremities of long bones. To the penetration of the lower fragment by the posterior part of the upper one. M. U. Trélat has shown clearly that there is often crushing of the spongy bone found here, as there is in the lower extremity of the radius and in the neck of the femur near the great trochanter, and that one of the points on the circumference of the long fragment penetrates into the body of the lower one, and lodges there in such a way that it cannot be

[1] U. Trélat, Thèses de Paris, 1854.

disengaged. I do not mean to say that penetration always takes place in the supra-condyloid fracture, nor that, when it does so, it is always irreducible; I only say that it happens often, and that it has happened in this case.

The prognosis may be bad in another way, that of consecutive arthritis. I do not believe that the fracture sends a fissural prolongation towards the articulation of the knee. Still, it is not impossible. But the fracture is so near the articulation that, by proximity, the latter is already affected and full of liquid.

If we find arthritis of the knee after almost all fractures of the shaft of the femur, so much the greater reason is there for it to appear when the lesion, without being articular, is so near the joint. It is not that I fear that which would be more dangerous, suppuration. Such a termination, strictly speaking, would be possible; but we find it so exceptional after simple fractures that there is no reason to fear it in the present case. Still, non-suppurative arthritis is the more severe and the more likely to leave behind it a prolonged stiffness, or even incomplete anchylosis, as the articulation is nearer the inflamed seat of the fracture. This part of the prognosis in this case is diminished, it is true, by the circumstances that the patient is young and apparently neither rheumatic nor gouty. But, nevertheless, I cannot guarantee that he will not have a false anchylosis, and that the means with which we can oppose this result will be successful. Upon this point we should always warn the patients or their friends, so that they shall not accuse us, as so many people are disposed to do, of having allowed, through insufficient care, this false anchylosis to be established.

Treatment.—At present we have but one thing to do: set the fragments as well as possible, and keep them in place. I applied, this morning, the Scultet bandage, with which you are acquainted, after having made, unsuccessfully, some attempts at reduction.

In a few days I shall renew these attempts, and again once more a few days later. If I should succeed in replacing the upper fragment, I shall add to my bandage anterior compresses intended to keep this fragment in place; if I remain unsuccessful, which is most likely, I shall content myself with the same dressings, and I shall not think for a moment of applying any apparatus for making continuous extension.

I expect consolidation to go on more rapidly than in other fractures of the femur, for two reasons: first, because, ordinarily, the callus forms more rapidly in the spongy than in the compact tissue; and, secondly, because the circumstance of a persistent penetration favours this rapidity.

If, at the end of four or five weeks, I no longer find abnormal mobility, I shall remove the apparatus and leave the limb free. I shall not let the patient get up; for it is probable that the callus, though solid enough for the horizontal position, is not sufficiently so to support the weight of the body. But I shall tell the patient to move his knee a little while lying in bed; I shall, myself, communicate some movements to it every morning, and I hope that this little

exercise will prevent the formation of an anchylosis, and favour the restoration of motion. You know that this stiffness after fracture is due partly to traumatic arthritis and partly to prolonged immobility. It is to diminish the influence of the latter that I shall remove the apparatus early, and have recourse immediately to communicated movements. I shall thus leave only the influence of the traumatic lesion, but it is true that this influence is so great that I always fear a notable and definitive loss of part of the normal movements of the articulation.

II. *Fracture, supposed to be supra- and inter-condyloid, of the lower extremity of the left femur.*—Here is a man 59 years old, of rather feeble constitution, who fell three days ago upon his left knee, from a stool upon which he was standing to unhook a curtain. When brought to the hospital, yesterday only, he presented the following symptoms:—

Decubitus upon the back; left leg extended, without rotation outwards; inability to raise the heel from the bed; pain at the knee when he tries to move, when movement is communicated, and when the articulation is pressed upon.

The knee is very swollen, and evidently fluctuating; it seems enlarged, and when, raising the foot, we move the lower part of the leg laterally, we feel a very marked abnormal mobility, the maximum of which is evidently above the line of the articulation. It is difficult to feel the patella, because above and a little in front of it is an abnormal bony prominence which is clearly continuous with the shaft of the femur. There is also shortening of the limb to the amount of $1\frac{1}{4}$ inches.

You recognize from these symptoms a fracture of the lower extremity of the femur. But here I have every reason to think that the fracture is not only supra-condyloid but at the same time inter-condyloid, that is to say, that in addition to the line of fracture which passes above the condyles, and which, from the projection forwards of the upper fragment, runs obliquely upwards and backwards, there is a vertical line which passes through the inter-condyloid notch, and separates the two condyles from one another.

The only physical sign upon which this diagnosis is based, is the transverse enlargement of the knee, an enlargement which I suppose to be due to a slight separation of the fragments from one another; but I was unable to detect any abnormal mobility by grasping each condyle and trying to move it backwards and forwards. If, as I believe, the condyles are separated, they are still so firmly held, either by the ligaments or by their connections with the upper fragment, that they cannot be moved separately.

But if I have no other physical sign to support my opinion, I find a probability which is very nearly a certainty, first in the age of the patient, and then in the ideas we have gathered from the examination of several pieces, and from our studies upon the mechanism of wedge-shaped or V fractures.

I say the age of the patient; for, in several pieces which I have examined, in one, among others, which I presented to the Société de Chirurgie, the 21st Nov. 1855,[1] and which I recalled in a report upon the works of M. Lizé in 1858,[2] fracture at the same time supra- and inter-condyloid was observed in patients who, like this one, were more than fifty years old, that is, had reached the period of life in which the spongy tissue of the bone has undergone those modifications which render it more fragile and more liable to split under the influence of violent pressure.

I demonstrated distinctly in these same pieces, by bringing the two condyles together, that there was a depression or loss of substance into which the oblique and more or less pointed extremity of the upper fragment passed. It was sufficient to put the pieces in place to see that, at the moment of the accident, the upper fragment must have penetrated into the lower one, and, acting upon it like a wedge, split it all the more easily because at this point (the inter-condyloid notch) the lower fragment is very short. Pursuing, in a word, the studies upon penetration made by M. Voillemier[3] for the lower extremity of the radius, and by Alph. Robert for the upper extremity of the femur, and those which I had made for V fractures with secondary lines resulting from the pressure of one of the main fragments upon the other, I showed that complex supra-condyloid and inter-condyloid fractures belonged to these varieties (fracture by penetration, wedge fracture), of which our predecessors did not make sufficient mention, and which M. U. Trélat alone had pointed out, without dwelling upon them long enough to make our ideas clear upon this subject. It is to give you precise ideas upon it that I remind you, whenever the occasion presents itself, that this mechanism of penetration is intimately united with that of crushing, that both of them intervene in most fractures of the cancellous extremities in old people, and that the wedge action, the consequence of the penetration and crushing, intervene also in these same conditions, and add the lesion which causes the fracture to communicate with the neighbouring articulation.

To recapitulate then, we have here, in all probability, an articular fracture of the lower extremity of the femur, with projection forwards of the upper fragment, and overriding.

Is this fracture reducible? You saw that in making the manœuvres of extension and counter-extension, I strove in vain against the displacement, and that I was able neither to restore to the limb its length, nor to cause the projection of the upper fragment to disappear. If I meet with the same obstacles in the following days, and it is probable that I shall, I shall find myself once more in presence of an irreducible fracture. Do not be surprised at it, gentlemen; irreducibility is a consequence, I do not say inevitable, but very frequent, of these fractures with penetration and secondary splitting of one of the fragments by the wedge-like action of the other. In certain cases it is due to the fact that the long fragment remains lodged within the short one, and is kept there by a kind of connection for which I find

[1] Gosselin, Bulletin de la Société de Chirurgie, tome vi. p. 262.
[2] Lizé, Bulletin de la Société de Chirurgie, tome ix. p. 148.
[3] Vollemier, Clinique Chirurgicale, Paris, 1861.

no other word than interlocking. This is not exactly the case to-day; for the projecting portion of the upper fragment is so voluminous that it has evidently abandoned, at least in great part, the lower fragment after having split it. It may be, however, that the posterior portion of the first is adherent by some irregular points, and by means of adjoining fragments, and that these prevent reduction. It is probable that the principal obstacle is caused by muscular resistance, as in a certain number of fractures of the shaft of the femur, while the obliquity of the main line of the fracture, and the pulverization and packing of the cancellous tissue of both fragments, favor and render irremediable the shortening produced by this muscular action.

I do not mean to say that all supra- and inter-condyloid fractures are as irreducible as this one is. I say only that it is quite frequent, and that in our present patient it is as marked as possible.

You understand the prognosis: the patient will recover with considerable shortening, and the arthritis will be all the more severe, prolonged, and likely to end in anchylosis, because, on the one hand, the fracture communicates with the articulation, and on the other, the age of the patient predisposes to prolonged arthritis and anchylosis.

As to the treatment, it will consist of repeated attempts to make reduction, and of the application of a Scultet bandage which I shall maintain so long as the abnormal mobility lasts. I fear the consolidation will be slow, because only a small part of the upper fragment is in contact with the lower one, and this disposition is not favourable to the formation of a callus.

III. *Supra- and inter-condyloid fracture with wound and projection of the end of the upper fragment. Amputation of the thigh.*—The patient whom we saw at No. 25, and who is 51 years old, was caught yesterday by the caving in of some earth, and, after a moment's struggle, was overthrown, feeling at the same time severe pain in his left knee, but without knowing how or in what position the knee was injured.

We find the parts in the following condition:—

Through a wound in the anterior portion of the thigh above the patella, projects the upper fragment of the femur, which ends in a hard point. About this wound there is no ecchymosis and no effusion of blood. The articulation is swollen and fluctuating. There is very marked lateral mobility, and an enlargement of the transverse diameter of the knee, with inability to move each condyle separately, backwards and forwards.

We have evidently here, a compound supra-condyloid fracture with issue of the upper fragment. I add, that for the moment this fragment is irreducible, for I have made fruitless attempts to return it to its place. It is also very probable that the fracture is at the same time inter-condyloid, and that consequently the external wound communicates both with the seat of this fracture and the cavity of the articulation. My reasons for thinking so are, the broadening of the knee, the abundant and rapidly formed effusion within the articulation, the form of the upper fragment which is well fitted to penetrate and act like a wedge, and finally the age of the patient. This diagnosis leads to a very serious prognosis.

A large wound like this will inevitably suppurate, and it is also inevitable that the suppuration will extend to the fragments of bone and the articular cavity. Now this suppuration in a hospital, upon a man who is quite old, has every possible chance of terminating in putrid infection during the first few days (grave traumatic fever), or in purulent infection, and in any case by death. Although amputation of the thigh is also dangerous, and although amputation for a traumatic cause especially yields only rare successes, yet I consider that this operation is a little less likely to be followed by death than an attempt to preserve the limb would be. That is why I prefer amputation: the patient accepted it, and we shall now perform it.

This will be an amputation of the kind which M. Hip. Larrey called *primitive*, that is, one which is performed before the development of the traumatic fever. If we should wait until this evening or to-morrow, this fever would undoubtedly be established, and the patient would be in a much less favourable condition.

(We found on examining the piece, that the fracture was inter-condyloid as well as supra-condyloid, and that consequently the wound and the seat of the fracture communicated with the articulation. The patient succumbed on the twelfth day, to a purulent infection which succeeded a very intense traumatic fever.)

LECTURE XXIII.

SPONTANEOUS FRACTURES, AND ITERATIVE FRACTURES OF THE SHAFT OF THE FEMUR.

I. Considerations upon spontaneous fractures—They are due to an abnormal fragility—This is caused sometimes by a cancer, sometimes by a rarefying osteitis, sometimes by premature senile rarefaction—Case of a patient affected with spontaneous sub-trochanteric fracture of the femur—Robert's analogous case—Another case in the Hôpital Cochin. II. Iterative fracture of the left femur, due to not keeping the bed long enough—Means of avoiding this accident.

GENTLEMEN: I. *Spontaneous fractures.*—We have the habit of giving the name *spontaneous* to fractures which are produced so easily that they seem to occur without the intervention of any appreciable cause. Notwithstanding our habit, this designation of spontaneous is not absolutely exact, for in reality we can always attribute the solution of continuity to muscular contraction or the weight of the body. But when it is a question of a bone so voluminous and so strong as the femur, of a bone which serves for the attachment of powerful muscles, and to support the body when standing or walking, you will admit that it is allowable to consider as almost spontaneous