PROVINCIAL MEDICAL & SURGICAL JOURNAL.

A COURSE OF LECTURES ON SURGERY,

DELIVERED IN THE

MEDICAL SCHOOL OF CAMBRIDGE.

BY GEORGE MURRAY HUMPHRY, ESQ.,
Downing College, Surgeon to Addenbrooke's Hospital.

LECTURE XIII.

UNUNITED FRACTURES.

Causes of failure of union ; want of reparative vigour ; want of rest ; changes occurring in either case ; treatment ; formation of false joints.—Situations where union oftenest fails.—Cause of failure of union after fracture of the patella, olecranon, os calcis, and acromion. Treatment of these fractures.—Liability of neck of thigh-bone to be broken in old people ; causes of union so generally failing ; changes occurring after the accident ; formation of crutch ; absorption of neck ; circumstances under which bony union may take place ; effects of rheumatic disease may be mistaken for it ; how they may be distinguished ; extra-capsular fractures ; symptoms of fracture of neck of thigh-bone ; difficulties in diagnosis ; general rules of treatment.

It is, I believe, now generally admitted that fractures in any part of the skeleton may, under favourable circumstances, be reunited by bone. That the long and complicated process by which bony union is effected should sometimes fail, and the reparative efforts cease without having accomplished their object, need be no matter of surprise when we reflect upon the various circumstances that may occur to interfere with them. You may perhaps have observed that in ulcers, whose healing has been long prevented, the reparative processes cease to go on, the sore becomes languid and pale, cicatrization stops, and the surface discharges only a little thin fluid. Nature seems content to bear the malady and desists from any further expenditure of strength in futile efforts to cure it. The same thing happens when the reunion of a fracture has been long prevented ; all attempts at reparation are after a time given up, as it were in disgust, and the part falls into a quiet state. How long a period is required thus effectually to tire out the reparative forces is not certain ; no doubt it varies a good deal. You remember the lad lately in the hospital in whom reunion of the femur took place more than a year

after the injury. In his case the reparative processes were not hindered by any want of care or attention to the fracture, but they never set about their work with energy, in consequence, probably, of the weak low-spirited condition of the boy, till he was allowed to get up, thirteen months after the accident, when the other thigh-bone broke near the knee under the weight of his body. He was then again necessarily confined to his bed, and to our surprise, both fractures united in about two months.

The two chief causes which prevent the reunion of fractures in the ordinary way, are deficiency of reparative vigour and want of rest.

The first of these causes is most frequently observed in old people, whose powers of nutrition are scarcely able to maintain the tottering fabric, and are still less able to make the extraordinary efforts required in the repair of injuries. At that time of life atrophy predominates in the skeleton no less than in other parts, and the inflammation consequent on the fracture of a bone gives a stimulus to its absorption if it be unable to overcome this natural tendency to wasting, and by a little further effort, to institute reparation. Here is the broken femur of an old man which remains ununited long after the usual period of healing has passed away, and you can see that scarce any attempts have been made to fill up the breach. There is no callus around the broken ends, and only a soft porous crumbling plug, partially closing the extremities of the medullary canal. The bone is throughout light and spongy, in a state of atrophy ; for some distance above and below the fracture it is very porous and worm-eaten on the outside, and the sharp edges of the fracture are rounded off, as though all idea of attempting reunion had long been given up, if it was ever entertained. We may suppose that a slight degree of inflammation has been set up in the neighbourhood of the fracture, and has occasioned interstitial absorption of the extremities of the bone. That condition of the bone in short, which I have described usually to follow a fracture has existed, but in an exaggerated degree, and the inflammation has accomplished no reparative work, none at least of sufficient solidity to remain after maceration. It has widened instead of closing the breach. Sometimes the ends of the bone necrose, and specimens of this kind look as if they had been the subject of compound fracture, and as if the inflammation, in consequence of its severity, had occasioned only destructive results, viz., interstitial

absorption, ulceration, or mortification. There is, however, this wide distinction, that the destructive effects are in these cases due, not to the *excess* of inflammation, but to the *inability* of the tissue to *bear* that slight modification of the nutritive processes, attendant on reparation, which we call the first stage of inflammation.

The treatment of such cases after union has failed, is not likely to be attended with very favourable results. Generally, the old man sinks under the confinement: bed-sores form or he becomes delirious and paralytic. Sometimes, in consequence of his incessant restlessness and the movements to which the fracture is subjected, suppuration takes place with necrosis of the ends of the bones, the soft parts give way and the bone projects through the wound. All this may be attended with very little pain; the old man seeming to be scarcely conscious of a local ailment dozes and is delirious by turns, and dies at length of exhaustion. Now and then things take a more favourable turn. I remember a feeble man, aged 67, who broke his humerus near the middle. He was very restless at first and the position of the limb was disturbed as soon as rectified. In a few days, however, he became more quiet. Great pains were taken to prevent the displacement of the fractured surfaces, but at the end of six months no union had been effected; the ends of the bone could be felt grating upon one another. Accordingly, an incision was made down to the part, and some necrosed or carious fragments were broken off from one end of the bone with the forceps. Inflammation and suppuration followed, but were not very severe. The wound healed in course of time and the fracture was firmly united in two months. Such success is very rare, and the frequent unfavourable termination of these cases should warn you to pay very great attention to the treatment of fractures in old people, during the early stages. Give them every chance of uniting at first by securing the limb with well-padded splints. Allow rather more liberal diet than the patient is accustomed to. Do not confine him to bed longer than is necessary, rather make use of the egg splints and starch bandage, so that he may get up and move about. The retentive means must be applied longer than under ordinary circumstances, and the work of reparation may be sometimes set going by rubbing the broken surfaces together, or by the application of a stimulating fluid, such as the tincture of iodine, to the skin over the fracture.

When the reunion of a fracture has been prevented by want of rest, the state of the parts contrasts strongly with the specimen I last showed you. There is, in such cases, no want of evidence of reparative force; abundant callus is produced upon each of the broken ends, but the inosculation of the callus between the two extremities across the line of fracture is prevented by the continual movement of one upon the other. I told you that this inosculation across the line of fracture is the most difficult part of the ossifying process. When it has been interfered with for a considerable length of time the uniting medium remains soft and degenerates into fibrous tissue, without, perhaps, ever having attained even the cartilaginous state.

In this specimen of ununited fracture of the clavicle, the broken ends are surrounded by plenty of callus and the surfaces are applied and moulded to one another, but they are joined only by fibrous tissue.

It often happens, when the ossification of this part of the callus has been prevented, and the friction of the broken surfaces upon one another is continued, that the soft uniting medium between the two bones undergoes various changes. Most commonly, as in the specimen I just showed you, it is transformed into tough fibrous structure which holds the parts firmly together, though it permits some movement between them. Subsequently the fibrous tissue may, by continual attrition, be worn away from the centre of the fracture, and a sac, like a bursa, is formed there, which simulates the cavity of a joint, and is surrounded by a capsule of fibrous tissue passing from one end of the bone to the other, at the circumference of the fracture. The resemblance to a joint becomes more complete, if some cartilage have been formed upon the ends of the bone. Frequently the broken ends become smooth from friction upon one another, and acquire the polished porcelain-like appearance which we find in joints where the movements have been retained after the absorption of their cartilages. These instances of want of bony union from incomplete ossification of the callus are called false joints, and the name is not a bad one, for you observe how each of the constituents of a joint—the synovial cavity invested by an external fibrous capsule, the enlarged smooth extremities of the bones, and even the presence of a structure-like cartilage—may be wrought out of the uniting medium when it is subject to the movements of the broken ends upon one another.

If the uniting medium has fallen into any one of the states I have described, it is exceedingly difficult to recal the reparative processes so as to excite again the disposition to form bone. A variety of modes of treatment have been adopted with this view, such as rubbing the broken surfaces together, stimulating applications to the skin, setons passed through the fracture, and even the excision of the ununited extremities. Unfortunately, none of these measures have been attended with sufficient success to justify much confidence in them. Cases too often resist them one after the other, and the patient having undergone much suffering, is content to remain as he was, deriving some assistance from mechanical appliances, or he is even glad to part with a member now useless and cumbersome. I do not mean to say that you should not resort to these measures, for they are now and then successful, and are therefore decidedly worth trying; but you will do well to apprise the patient of their uncertainty before attempting them; at any rate, before determining to cut out the broken ends, I would advise you to give the case a fair trial of continued rest to the fractured part by well-applied splints, and you will be surprised at the benefit which sometimes results from this treatment in cases apparently hopeless. The fibrous structure into which the uniting medium has degenerated may in course of time become ossified if complete rest be permitted; but this is not likely to occur when other changes have

taken place in it, such as the formation of a synovial sac, &c.

The failure of union has been observed more frequently in fractures of the middle of the humerus than in other situations. This is probably explained, in part, by the difficulty of keeping the fracture at rest, while the hand and fore-arm are allowed their liberty, and in part by the humerus being in two-thirds of its circumference here surrounded by the tendinous attachments of muscles; the deltoid, coraco-brachialis, and brachialis anticus are all inserted hereabouts, and the connection of the periosteum with the bone, is in consequence very close. I give this as affording some explanation of the frequent failure of union, because it has been ascertained by experiment, that the periosteum, both in the neighbourhood of epiphyses and near the insertion of tendons is loosened with much difficulty by inflammation, and little bony matter is in consequence deposited in such situations after fracture. Next to the humerus the collar-bone is most frequently the seat of ununited fracture. Failure of union may also take place in the femur, tibia, and in other bones.

It now and then happens that the re-union of a fracture is prevented by great displacement of the broken ends, or by muscular fibres or other structures intervening between them. Even then the broken surfaces are generally bound together by tough fibrous tissue; they are sometimes thickened by the formation of callus upon them, and they become rounded and smooth, and covered perhaps, by a bursa.

I have several times had occasion to notice the slow and difficult manner in which ossification of the lymph effused in the neighbourhood of a fracture proceeds from the extremities of the broken bone. The fractures of the skull are remarkable instances of this, for they are not followed by the formation of bone under the pericranium or upon the dura mater, but they are united by callus springing from the sides of the fissure and inosculating across the chink. This process is so slow, that if the fissure be wide, it will remain open for years. Even when narrow it is seldom quite filled up, especially in its outer part. Indeed, in this situation, the chink is often widened by the absorption of the sharp edges of the bones which bound it, so as to form a groove on the exterior of the skull, marking the course of the fracture for ever afterwards. In ordinary fractures of the shafts of long bones, when the periosteum is much separated, I told you that the ossification of the callus lying between the broken edges of the bone takes place very slowly, never proceeds to any great extent, and that union is for a long time dependent upon callus proceeding from the neighbourhood of the periosteum. The formation of bone is, I grant, effected more quickly upon the spongy or medullary tissue, than on the compact outer wall of the shaft, but even here it is very limited, so much so as to be really of no avail if the fractured surfaces be separated a little distance.

Let me also here again remind you that the periosteum is closely connected with the bones about their spongy extremities and in the neighbourhood of the attachment of tendinous expansions, and is conse-

quently torn through in case of fracture in such situations, nearly on a line with the fissure, without being separated from the sides of the bone, so that very little external or provisional callus is formed; and the reunion of bones so circumstanced is dependent almost entirely upon the ossification taking place between the broken extremities. If, therefore, these be not maintained in close contact, the chances of union by bone are not very great.

Now, you will at once perceive how unfavourably the patella is placed for the reunion—by bone—of its fractures, and will not be surprised that it very seldom occurs. On the one side it is covered by cartilage and exposed to the joint, so that there is no possibility of the formation of any callus in this direction. On the other sides it is invested by a tough, fibrous, closely adherent structure, and covered by fascia, rendering the production of callus here scarcely more probable than on its articular surface. There is no chance, therefore, of assistance from any external callus on either side, and the work of reparation must be entirely conducted between the fractured surfaces, which, as I have told you, can only be done effectually when those surfaces are maintained in close contact. But, unfortunately, the very cause which breaks the patella, almost invariably occasions the separation of its fragments to a distance far too great to be filled up in this manner. The bone is commonly snapped transversely, by a sudden forcible contraction of the great quadriceps muscle, made to prevent the person falling; and the upper and lower fragments are, by the same force, pulled widely apart. It follows as a result of all these unfavourable circumstances, that the fracture is united only by tough fibrous tissue, passing from one portion to the other over the joint. This structure is connected chiefly with the hinder edges of the broken surfaces, in consequence of the position of the fragments, and the direction of the pull made upon them by the muscles.

That the patella is not itself deficient in reparative force, is proved by the enlargement of the broken segments which takes place owing to the formation of bony matter upon their edges and surfaces, each one of the fragments being often found to have attained the size of an ordinary patella. It is further proved by the fact, that under favourable circumstances bony union of the patella will take place as quickly and as well as in other parts of the skeleton. This has in several instances been found to occur in longitudinal fractures occasioned by falls upon the knee, and occasionally in transverse fractures caused in the same way. The experiments of Mr. Gulliver also show that bony union will take place in animals, without difficulty, when the patella is divided transversely, without laceration of its fibrous investment, or separation of the fragments.

The olecranon is circumstanced in a very similar manner to the patella, being on the one side exposed to a joint, and on the other covered by the fibrous expansion of the triceps tendon and a closely adherent periosteum, so that there is very little probability of external callus being formed in either direction. It is generally broken by a blow, but the detached fragment is drawn to such a distance from the rest of the bone,

by the contractions of the triceps muscle, that firm union scarcely ever takes place.

The acromion, hinder part of the os calcis, and some other projecting processes of the skeleton, though not in contact with a joint, are in many respects similarly circumstanced with the patella and olecranon; they are invested by closely adherent periosteum, and furnish points of attachment for muscles, which are constantly pulling upon them, and will drag away from the main bone any fragments that may chance to be broken off. Hence it is that bony union often fails to take place in each of these parts of the skeleton; not because they have less reparative vigour than other bones, (for under favourable conditions they will all unite well enough,) but because the great interval between their divided surfaces cannot be filled up by new bone derived only from the broken extremities; and from the particular structure and close adhesion of the periosteum, very little assistance is furnished in the way of external callus.

In the treatment of the fractures of these parts we place the limb in such positions as will best relax the muscles, whose influence is so pernicious, and we endeavour to bring the fragments into contact by straps and bandages; not that I think these retentive measures are often of much service. We can scarcely expect to secure such close co-adaptation of the broken surfaces as to lead to bony union of them, but it is desirable that they should be as near together, and the fibrous band that connects them as short as possible. Be careful not to allow the patient to use the limb too early, for this fibrous band is a long time in acquiring its full strength, and is liable to be stretched for some weeks after its formation. I give you this caution, because I have known the interval between the fractured surfaces of a patella increase from half an inch to two inches, when the patient was allowed to leave her bed and bear upon the limb, six weeks after the injury, the fibrous bond of union not having even at that time acquired sufficient firmness and power of resisting extension.

The neck of the thigh bone is another part of the skeleton placed in a manner peculiarly unfavourable for the re-union of fractures, and it is especially liable to be broken at the time of life when the reparative forces are least able to overcome a difficulty. It is entirely surrounded by synovial membrane, from which it is separated only by a thin layer of compact fibrous tissue, which supplies the place of periosteum, and it is composed in great measure of cancellous structure. I have already told you that the cancellous parts of the skeleton are more subject to senile atrophy than the shafts and compact tissue of bones. The neck of the femur seems to be peculiarly liable to this atrophy, as well as to undergo the fatty degeneration, and other changes, which impair the structure and diminish the strength of the bones in old age. Hence it is that fractures of this part are so common in elderly persons. The accident is usually caused by a fall. An old man slips down; he may not appear, perhaps, to fall upon his hip, but is unable to get up, and when he is raised the neck of the thigh bone is found to be broken. The liability of this part of the skeleton to give way in old

age is so great, that if the body be subjected to a shock sufficiently severe to break a bone, there is great chance of the occurrence of the accident we are now speaking of. You will not be surprised that such is the case when you examine these thigh bones taken from old people, and see how light and porous they are about their upper ends.

The neck of the femur is most frequently broken near the head, where it is narrowest, and the line of fracture generally runs a little obliquely from above downwards and outwards; it may, however, be broken in any other part. In whatever situation the bone gives way, and in whatever manner the accident has been occasioned, you will generally find that the synovial membrane and fibrous investment are torn through in front, but remain entire behind, to a greater or less extent. This is, I think, sufficiently accounted for by the greater thickness and looseness of the fibrous structure on the hinder surface of the bone, as well as by the slight curve forwards which may be always observed in the neck of the femur. In consequence of this curve, when fracture results from a blow upon the trochanter, the neck yields in an anterior direction, and the fibrous tissue and synovial membrane are torn through in front by the sharp projecting edges of the bone; whereas on the hinder or concave side of the neck, which becomes bent to an angle, these structures escape uninjured.

Suppose a fracture to have taken place in the manner described, passing through some part of the neck of the femur, and separating the head from the trochanters, a slight connection only being maintained between them by some of the untorn fibres of the ligamentous aponeurosis on the hinder surface of the neck. The bone is in the most unfavourable condition possible for reparation; there is no probability of assistance from the formation of external callus, because a few ligamentous fibres on one side, covered by a delicate synovial membrane, only intervene between the fracture and the articular cavity; the prospect of re-union, therefore, depends entirely upon the growth of bone from the broken surfaces, and its inosculation across the line of fracture. We have seen how slowly this formation of bone takes place from the surface of a fracture under ordinary circumstances, especially in old people, and the neck of the thigh bone seems to be even less fitted to carry on any work of reparation than the other parts of the skeleton, because the nutritive functions are less active in it, which may be inferred from the circumstance of atrophy and other senile changes being more marked, and occurring at an earlier period in this than in other bones. The same causes which promote its liability to suffer injury all combine to diminish its power of reparation, and you will be struck, as we proceed, with the very slight efforts at re-union which are found to have taken place in cases of fracture of this part of the femur. It is true that the exact coadaptation of the broken surfaces is not generally maintained, and that some movement of them is permitted, but you will see that the want of union does not depend so much upon a failure of the inosculation of callus across the line of fracture, as upon the absence of any attempts to produce a callus at

all. Now and then, it may be, there is a little bony deposit upon the broken ends, sufficient, perhaps, to close up the open cells of the spongy tissue, but even this is often wanting, and, as a general rule, the absorption of the old bone goes on to a far greater extent than the formation of the new.

Upon what this deficiency of nutritive and reparative energy depends, which leads to the premature occurrence of senile changes in the neck of the bone, and unfits it for the reunion of its fractures, I cannot tell. It seems to be connected with some peculiarity in the development of the bone of a similar kind to that which leads to the formation of the areus senilis in the circumference of the cornea, and the earthy degeneration of certain parts of the arterial tubes. It cannot be owing, as some have supposed, to the small supply of blood furnished to the head of the bone through the ligamentum teres, because its effects are no less remarkable on the side of the fracture next the trochanters; indeed, as I shall presently have occasion to show you, the absorption of the neck after fracture goes on to the greatest extent in this latter direction.

You will understand, then, that the failure of bony union, after fracture of the neck of the femur, depends first and chiefly upon the peculiar position of the bone, and the character of its periosteum, which preclude the formation of any *external* callus; secondly, upon the displacement of the broken surfaces; and, thirdly, upon a want of nutritive energy in the bone itself, occasioning a difficulty in the production of callus at all. These several causes usually coexisting render the osseous reunion of this bone so rare an event, that Sir Astley Cooper and other distinguished surgeons of the last generation in this country were wont to deny the possibility of its occurrence, under any circumstances. More extended observation has shown this opinion not to be altogether correct, though the well marked instances which have been adduced to disprove it are few, and so far as I have been able to judge, they consist of cases in which the broken surfaces were wedged in together at the time of the fracture, so as to prevent any subsequent displacement, and to secure their close and constant adaptation to one another.

The changes actually following a fracture through the neck of the thigh bone are interesting. The extravasated blood is absorbed, and some lymph is effused into the joint. This lymph lines the synovial cavity, and covers the broken surfaces. It is not found in any great quantities in the latter situation, never fills up the interval between the bones, and seldom even extends from one to the other over the fracture, except at the hinder part, when the synovial membrane and fibrous investment remain unturned. In process of time the lymph becomes converted into a tough structure, which assumes the form of fibres, bands, or peduncular growths, upon the inside of the capsule, upon the neck of the bone, and upon the surfaces of the fracture. Sometimes these bands reach from one part of the joint to another, or extend between the broken ends. The latter are generally covered by more or less of

the adventitious substance, and occasionally also by nodules of dense structure, like cartilage, but neither of these formations exist in any great quantities upon the broken bones, and very rarely do they become ossified; indeed, it seldom happens that any new bone at all is produced in this situation; the open cancelli may be blocked up by a little callus, which is the most that takes place, and even this very often does not occur. Not only is the capsule of the joint lined by lymph, which undergoes the changes I have mentioned, but it becomes *thickened* also by the effusion of lymph into its substance, and subsequently undergoes *contraction*, so as to fix the trochanter firmly to the pelvis, and in a measure to supply the place of the broken bone, by bearing the weight of the body. The articular surfaces may remain for a long time unimpaired, or they may become more or less closely adherent together. Occasionally the cartilages are rendered uneven or fibrous by partial absorption, but the bony structure beneath is hardly ever found to have undergone much change.

Although no callus whatever is formed around the broken extremities, and very little upon their opposed surfaces, we, nevertheless, often find in the dissection of these cases, that a good deal of bony deposit has occurred, in nodules and masses, about the line of attachment of the capsule to the base of the neck. This takes place chiefly at the lower part, and forms projecting lumps, which extend nearly, or even quite, to the acetabulum. From the mode in which this callus, so far distant from the seat of fracture, has been observed to support the pelvis, the term *crutch* has been applied to it by Mr. Langstaff. It is no doubt occasionally of much assistance in bearing the weight of the body, and together with the thickened capsule, may supply the place of the neck so well, that the patient is able to walk about with a stick.

Another remarkable change usually follows this accident—I mean the removal by absorption entirely, or in part, of the neck of the bone. This takes place chiefly on the side of the fracture next to the trochanters, and in a slight degree only in the portion which remains connected with the head, so that the extent to which the neck is absorbed depends upon the situation of the fracture. When that has taken place near to the head of the bone, the whole neck is very often removed down to a level with the trochanters, and in course of time, the head and the trochanters coming into contact, their opposed surfaces are polished by the friction of one upon the other. You will meet with many specimens in museums where the neck of the thigh bone has been quite absorbed, and the head and trochanters are polished by mutual attrition in the way I mention. When the fracture has been midway between the head and the trochanters, the external part of the neck only is removed, the internal portion undergoing very little change. This, at least, is the rule, so far as I have been able to judge from the examination of many specimens in different museums, although I cannot be quite certain that such is invariably the case. Mr. Paget has arrived at the same conclusion, for he says, in the "Pathological Catalogue" of the Hunterian Museum, "that it

appears to be a general rule that that part of the neck of the femur which, after intracapsular fracture, remains connected with the head is not absorbed, as that part is which is connected with the shaft."

This absorption of the neck of the femur appears to be analogous to the rounding of the edges of broken bones to which I have called your attention in speaking of fractures of the skull and other parts. In none of those instances, I grant, does anything take place which is in extent comparable with the removal of so large a mass as the entire neck of the thigh bone, and I can only account for the absorption being so active here on the supposition that it is related to the low state of the nutritive powers of this part of the skeleton; that it is connected, in short, with the same causes, probably of a developmental nature, which lead to the early manifestation of atrophy and other senile changes in this part of the bone. You might expect that absorption after fracture would be most marked in bones whose powers of nutrition are most feeble.

It is a singular fact, for which I can offer no satisfactory explanation, that the absorption affects exclusively or chiefly the part of the neck intervening between the fracture and the trochanters. Possibly this depends upon the pressure exerted by the head of the femur and the acetabulum upon the projecting neck, for it appears to commence about the time when the patient begins to bear upon the limb, though I should say that I have not been able to assure myself of this. In one instance the whole neck was found to be absorbed five months after the accident. The patient in this case was confined on a double inclined plane for only a fortnight, and was not afterwards restrained.

It may happen that the head of the bone is found to be firmly united to the trochanters when the neck has been entirely removed. Such a specimen exists in the museum of the College of Surgeons. The neck of the femur is quite gone, and the head is closely connected with the trochanters by a line of tough compact fibrous tissue. I can readily conceive that this fibrous tissue may in course of time become ossified, and that the specimen described in the "Medico-Chirurgical Transactions" by Mr. Langstaff, which is now to be found in the museum of the College of Surgeons, is an instance of such a result. That specimen looks as if the greater part of the neck had been absorbed after fracture, and the head had acquired firm bony union with the trochanters.

It is worth while to remark that, in consequence of the removal of the portion of the neck between the fracture and the trochanters, union, if it takes place at all, is likely to be at the base of the neck, that is to say, close to the trochanters. The want of observation of this fact may have led Sir Astley Cooper and other surgeons to reject, as examples of the reunion of *intracapsular* fracture, some specimens which were probably fair instances of the kind; for although the line of *union* corresponded with the base of the neck, the line of *fracture* might have been nearer to the head, and well within the capsule.

There can, I think, be no doubt that firm bony union of intracapsular fracture may take place under

certain very favourable circumstances. I have already alluded to its occurrence when the broken surfaces are so interlocked from one being driven into the other, that they are maintained in close contact, and no movement between them permitted. Specimen 521, in the museum of the College of Surgeons, is probably an instance of this. The neck of the thigh-bone appears to have been broken close to the head, quite within the capsule, the sharp hinder edge of the neck being driven into the cancellous texture of the head, and fixed there. The fracture has been so nearly repaired, that the eye can scarcely discover its line, except in one situation, where a thin stratum of ligamentous structure intervenes between the broken surfaces.

Certain specimens of disease of the head and neck of the femur of rheumatic nature occasionally simulate the appearances presented by reunion after fracture very closely, and have no doubt been frequently mistaken for it. The neck of the bone may become shortened, and the head depressed below its proper level, by absorption on the upper, and deposition of bony matter on the under side, so as to require careful examination to distinguish it from a case of fracture. Again, the neck of the femur affected by this disease is now and then surrounded by a nodular ring of bony deposit, looking very much like the external callus that you might expect to find round an united fracture. I think that an error may be generally avoided, by attention to the following particulars:—In the first place I have told you that external callus is scarcely ever formed around an intracapsular fracture. I do not remember to have met with a decided quantity of it in any one instance. The presence, therefore, of bony deposit around the neck of the femur, rather militates against the probability of fracture. Secondly, in cases of fracture the *head* of the bone undergoes very little change, even in the course of many years. It may become adherent to the acetabulum, or the cartilage may be absorbed, but it seldom undergoes any material alteration in shape. Whereas, in rheumatic disease, the shortening and alteration of the shape of the bone commences in the head, which undergoes absorption on the surface in an irregular manner, so as to lose its rotundity, and become more or less misshapen; and these changes are attended with deposition of bone upon its exterior, which contributes still further to the alteration of its form. Some part of its surface also usually becomes polished from friction; and the acetabulum undergoes corresponding changes, being widened in some directions, filled up in others, and polished in the same manner as the head. I have not seen changes of this sort accompanying fracture. If, therefore, you find the neck of the bone altered in shape and length, as well as in the direction it takes;—if that alteration correspond with the direction in which fracture is liable to occur;—if, at the same time, there be no deposit of bone in the immediate circumference of the neck;—and if the head retains its proper contour, there can, I think, be little doubt of the existence of fracture at some former period.

We occasionally find that a crack has run partly through the neck without traversing it completely;

and it is remarkable that even in such cases the closure of the chink is effected very slowly. In this specimen, for instance, there is a crack traversing the upper and fore-part of the head and neck of the thigh bone, without passing quite through the lower side of the latter. It varies from an eighth to a sixth of an inch in width, and is filled up by tough ligamentous structure.

I have been speaking hitherto of intrascapular fractures, in other words, of fractures situated between the head and the line of attachment of the capsule of the joint at the base of the neck. The bone is sometimes broken in the last-mentioned situation; or the base of the neck may be driven into the spongy structure forming the trochanteric part of the bone, and, being firmly wedged in there, may become united to the cancelli in its new position by fibrous tissue, or by bone. Sometimes it is driven a little further, and splinters the trochanters into many pieces. In short, fracture at this part of the bone may take place in any direction, and the specimens illustrate some of the more frequent varieties. In whatever manner the bone is broken, osseous reunion may take place, callus being formed both around and between the fractured surfaces as in other situations. The latter, however, that is the internal callus, is sometimes very long in its production, and the surfaces sometimes remain for years united only by fibrous tissue. In this specimen of fracture through the base of the neck, the fragments are held together by clasps of bone passing from one to the other, but there is scarcely any direct union between the broken surfaces. Whereas, in this instance, the base of the neck, driven into the cancellous structure of the trochanters without splintering the surface, has acquired osseous connection there, and scarcely any callus has been formed upon the exterior of the bone.

Fracture of the upper part of the thigh bone has occupied much of the attention of surgeons, not merely on account of the several points of pathological interest connected with it, but also from the difficulty which frequently attends the diagnosis of injuries in this situation. The bone is placed deeply, and surrounded by a thick layer of muscles, so that satisfactory information cannot easily be derived from manual examination as in other parts; and, for the same reason, crepitus is not readily distinguished.

In the majority of cases the diagnosis of fracture through the neck of the thigh bone is easy enough. An old person is found, after a fall, to be suffering pain in one hip, with inability to move the limb, or to do more than execute very slight movements; and severe cutting pain is caused when it is handled by another person. The limb appears to be shortened, and accurate measurement proves that it is so, from half an inch to two inches, it may be more or less. By a little extension continued for a time, the limb may be drawn down to the same level with the other, but soon resumes its shortened position when it is left alone. The limb lies on its outer side, and the patient has no power to roll it in. Perhaps, in addition to all this, crepitus is felt by the hand placed upon the hip when an assistant rotates the limb. This is more likely to happen if he first makes extension so as to bring the broken surfaces

opposite one another. These symptoms leave no doubt as to the nature of the injury.

But, unfortunately, any or nearly all of them may be absent, although the accident of which we are speaking has occurred. The shortening, as I have told you, varies, and may not exist at all if there be no displacement of the broken bone. When the fractured surfaces are much displaced, or wedged in together, there will be no crepitus. It now and then happens that, owing to some unusual position of the broken bones or other cause, the limb is inverted; and patients have been known to stand upon a limb, and execute a considerable range of movements, although the neck of the thigh bone was found after death to be broken.

On the other hand, after injury of the hip without fracture, the limb is often found to be useless, everted, apparently shortened, and great pain is occasioned by moving it. The everted position is that into which the limb naturally falls when the muscles of the hip cease to act upon the thigh bone, and the cessation of muscular action may, of course, result from a bruise of the soft parts, as well as from a fracture of the bone. The apparent shortening of the limb, in such cases, depends upon tilting of the pelvis upwards on the affected side, which is a frequent accompaniment of injuries and diseases of the hip. This symptom is likely to deceive you, unless you take some trouble to ascertain, by measurements from the spine of the ilium to the patella or the internal malleolus, that there is no real difference in length between the two extremities. It is important to investigate this point carefully, for if you can clearly make out a difference in the measurement of the two limbs between corresponding bony points, there must be some fracture or dislocation, and the everted position of the toe will, with very rare exceptions, distinguish the former from the latter. You may derive some assistance in a difficult case from an examination of the movements of the trochanter while an assistant rotates the limb. If the neck be entire, the trochanter will revolve round the head as the centre of a circle, but if the neck be broken, it will move in a smaller circle, or may be felt to rotate on its own axis. This, however, is a point requiring some nicety of manipulation; and it is not always possible to be sufficiently certain about the movements of the trochanter to rely on them as a means of diagnosis.

I do not know of any certain rules by which you can decide whether the fracture has occurred within the capsule, at the base of the neck, or through the trochanters. It would be desirable to form an opinion upon this point, if you could do so, with reference to the treatment you would adopt, because in the one case the chances of union are so slight that it is not worth while to run the risk of injuring the patient's health by confinement to bed and the restraint of splints and bandages; whereas if the bone be broken in either of the two latter situations, a hope of firm union may be fairly entertained.

The treatment of fracture of the neck of the thigh bone is to be conducted on the same plan as that of other injuries of the like sort. I think the straight position, with the long splint applied on the outside of the thigh, is, on the whole, more tolerable to the

patient, and better than Earle's bed or the double inclined plane.

In addition to the ordinary circumstances attending a broken bone, there are two other points to be considered, *iz.*, the age of the patient, and the improbability of union taking place. When you have sufficient reason for thinking that the fracture is within the capsule, you will be wise to allow the patient to sit up as soon as the part is sufficiently quiet to admit of his doing so. At any rate you should watch for the intimations of failing health and bed-sores, and have regard rather to the means of maintaining his strength, than to the appliances for securing the position and rest of the fracture. All the directions which I have given you with reference to the diet and general management of elderly persons, who are the subject of injuries, apply with especial force to these cases.

I have told you that the only instances in which bony union of a fracture within the capsule is likely to take place, are those where the broken surfaces are interlocked together. You will do well to bear that in mind in the examination of suspected cases of this injury, because it might happen that rough handling would separate the broken bones, and destroy for ever the only chance of cure.

CASES OF

CONGENITAL DEFECTS OF THE IRIS.

By AUGUSTIN PRICHARD, M.D.,

Surgeon to the Dispensary for the Cure of Diseases of the Eye, in Bristol.

(Read before the annual meeting of the Bath and Bristol Branch of the Provincial Medical and Surgical Association, July 5th, 1849.)

Wishing to bring before the Society one or two rare cases of affection of the eyes, I have chosen as a short and interesting subject, the instances of "Abnormal congested conditions of the Iris," which have come under my own notice. I have access to the records of cases since the first establishment of the Eye Dispensary by Mr. Estlin, in 1812, to the number of forty-eight thousand.

Two cases have occurred out of this number, both of which I saw myself, in which there were no eyes. The lids were thick, but upon being opened there was no trace of any globe visible, nor could any hard substance be felt in the orbit indicative of the existence of the organ in a rudimentary state. I have never had an opportunity of dissecting a subject with this condition, nor of observing it in the adult.

A second congenital defect to which I shall allude is "Absence of Pigment" in the eye altogether. Albinos, or persons in whom there is no pigment in the body, occur in almost all countries, but either they are more frequent in dark-coloured races and hot climates, or they have been more the object of attention when appearing under such circumstances. Blumenbach says that he has seen sixteen cases in Germany. Among the 48,000 cases of diseases of the eyes, only

three have been brought to the dispensary with this peculiarity. It is well known that the pigmentum nigrum (or *fuscum*, as it is more appropriately called by many foreign anatomists) consists of cells containing dark granules. The cells are mostly of a very regular hexagonal form in the choroid; they are less regular upon the uvea or back of the iris. Hunter* considered that there was a white pigment in albinos, and Hassall, in his "Microscopic Anatomy," says:—"The pigment cells are stated to exist, but to be wanting in their characteristic coloured contents." I have searched in the choroid coat and posterior surface of the iris in the white rabbit—the only kind of albino I have been able to obtain—and have been able to discover nothing at all resembling pigment or epithelium cells. I have not described the appearance of the eyes; every one is sufficiently familiar with them.

It is now well established that cases have occurred in which the pigment has been deposited after birth; that is, where persons born as albinos have, after a time, ceased to be so. One case is recorded by Dr. Graves as having been seen by Dr. Ascherson; another rather doubtful one was enumerated by Michaelis, in the third volume of Blumenbach's "Medicinishe Bibliothek," and one came under Dr. Graves' notice.

I have been fortunate enough to meet with an example of this change in one of the three cases to which I have above alluded, as having been brought to the dispensary, and it is chiefly with a view to introduce this case, that I bring forward the subject of albinos. The following is an account of it:—

E. S., aged thirteen weeks, admitted June 18, 1845. The irides of both eyes are of a light grey colour; pupils circular, but of a deep red hue. She evidently dislikes the light, and rolls about the eyes continually from side to side. (This restless condition of the eye is peculiar to albinos.) Her hair is white. In the latter end of that year she was again brought. Her irides were blue, but the restlessness and intolerance of light remained the same.

July 21, 1847.—The eyes are of a bright blue colour; the pupil black if we look straight into it, but seen obliquely there is a luminous glare. Eyes still oscillating; sight good; skin much sunburnt. I have seen her again on the 30th of May of this year (1849.) Her hair is getting darker; she bears the light well; the pupils are, however, still a little less black than they are in perfectly natural and healthy eyes; her iris is of exactly the same bright blue colour as that of a younger brother who presents no defects.

I have seen two cases in which, as far as I could make out from the history, there was congenital adhesion between the margin of the pupil and the capsule of the lens (*synchia posterior*.) In both the sight was perfect, and there had never been any inflammation in the eyes. A small white point indicated the position of the adhesions. In one case there were two such points, apparently white opacities in the capsule, exactly opposite the margin of the iris, and opposite to each

* Observations on certain parts of the Animal Economy, p. 204.