the patient had to be back in America within five to six weeks. (2) That an X-ray examination taken next day revealed that the abscess was considerable in extent. The patient was operated on, on May 11; 3 in. of the tenth rib were removed and the diaphragm stitched to the parietal layer of the pleura and a needle was inserted into what appeared to be an abscess of considerable extent. This was opened and some 12 oz. of thick creamy pus evacuated. A large tube was stitched *in situ* and the closed method utilized, the tube being attached to a second tube which ran into a Winchester quart bottle. The drainage was maintained in this way for some three weeks and the tube being gradually shortened. On June 2, the tube having come out it was entirely removed.

A full course of injections by emetine was started on the day of operation, the patient being given $\frac{1}{2}$ gr. twice daily for ten days. Bacteriological examination of the pus did not show *E. histolytica*. This is not unusual in these cases, though it is sometimes found in scrapings from the wall of the abscess. Special examination of the stools at the end of the course of emetine treatment also failed to show amœbæ. During the emetine treatment the patient received tonic treatment in the form of elixir calisaya, iron and strychnine (P.D.).

He began to put on weight from the first day after operation and the accompanying chart shows his temperature fell immediately. He was allowed to be out three weeks after the operation. The wound at the date of writing (June 7, 1932) is quite healed; the patient's colour, in place of the ashen-grey appearance he had prior to operation, is now healthy and he has gained 10 lb. in weight.

Surgical.

STIFF KNEE FOLLOWING FRACTURES OF THE THIGH.

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It is indeed a sad reflection on the state of our present treatment of fractures of the thigh that limitation of movement at the knee-joint is so frequently seen. It is unnecessary to emphasize the severity of the handicap that is imposed on any wage-earner by a stiff knee: and yet I have seen many cases in which this disability has come as an unpleasant surprise to both patient and surgeon, who were satisfied that the fracture had united firmly and did not consider the possibility of other severe complication. It is to be regretted that our low standard of ideals and efficiency in the treatment of fractures of the thigh is largely responsible for this unfortunate state of affairs. In this article I lay myself open deliberately to the tedium of repetition by insisting that failure to obtain accurate anatomical reposition of the fragments is the responsible factor. A fracture efficiently reduced and maintained in that position by extension—adequate and continued—is not as likely to be followed by a stiff knee, all things being equal, as compared with one less efficiently treated.

The possibility of limitation of movement at the knee-joint occurs in any fracture of the thigh, but for the purposes of illustration I will confine my remarks to fractures

of the shaft of the femur. The actual cause of impediment at the joint itself can be classified under two headings, which will then be considered at greater length. These are : Intra-articular ; extra-articular.

To turn to a consideration of the general anatomy and mechanics of the thigh and knee it will be seen that the full and massive bellies of the quadriceps extensor play over the anterior bow of the femur in a manner which enhances their smooth, graceful and efficient action on the joint. At their insertions the muscles move the joint not only through the patella, but also through the powerful laminated aponeurotic expansions which almost envelop the knee. Normally the position of the joint is maintained by a balance of tone between the agonistic and antagonistic muscles, leaving a strong reserve of ligaments to withstand excessive strains. It is scarcely realized that joints can be submitted to relatively enormous strains without obvious injury, and if a limb is subjected to certain abnormal stresses, particularly torsion, the result may appear as a fracture of bone, a dislocation or a severe joint sprain ; but if, as is possible in many cases, bony and ligamentous injuries often concurrently occur, it is probable that the latter will be overlooked in the presence of the more apparent injury of bone. Whenever an oblique or spiral fracture is seen the mechanism of its causation should be carefully considered in the light of damage to the joint at the same time. This feature is obvious when a fracture extends into or involves the knee-joint, but in other cases it is overlooked, while making a prognosis in the early stages. In the repair of ligaments and soft tissues around the joint, fibrous tissue is formed, and will account for limitation of movement according to its site, the amount produced, the degree of cicatrization, and finally the tacking down of the aponeurotic bands.

It is scarcely possible to imagine a fracture in which injury to muscle and surrounding soft parts is not coincident and in the thigh this is recognized as a factor of importance from the effect it has on the knee. The amount of effusion and hæmorrhage into torn muscle and that poured out between the layer of aponeuroses is responsible for the amount of scar-tissue formed and the necessity of treating these fractures in full extension and immobilized helps to attenuate the cicatrization which might impede flexion of the knee-joint at a later date.

If a fracture is not treated efficiently in the early stages it is conceivable that further muscular laceration, which is occasionally followed at a later date by myositis ossificans and at the same time will greatly enhance the spread of infection in open fractures, will be produced by movements of the jagged fragments. The best chance to minimize the inconvenience caused by scar-tissue is seen when the fracture is treated early by immobilization and by adequate extension, which is maintained, with the result that the effusion absorbs more rapidly and the bone unites with the maximum efficiency and with the minimum of crippling. Factors which alter slightly our considerations include the presence of an open or closed fracture, the former possibly producing more scar-tissue, if infection is introduced and is allowed to persist by the inadequate drainage present, but in some cases reducing the amount, by allowing fluid to escape from the muscular and from other strata.

Apart from the amount of fibrous tissue laid down and left, when splints are removed, the question of the adhesion to bone deserves careful attention. To take the two opposite instances of : (1) A well treated fracture with little callus formation ; and (2) one badly treated with shortening, angulation and excessive callus, it is obvious

that the chances of muscle fibres and fasciæ being nipped, bound down and fixed in new bone are much greater in the latter case. Indeed, it is common to hear nipping of muscle, involvement of muscle in callus, referred to as the most potent source of a stiff knee, but I feel that adjacent fibrosis is an even more important factor and one which is too often disregarded as it is not demonstrable by X-rays, whereas abundant callus spreading into the softer shadows of muscle can readily be made out.

A condition which is not recorded in many textbooks is one of a generalized fibrosis of the bulk of the quadriceps, to an extent greater than that which could be accounted for by laceration. It is true that the best examples are seen after an open operation on the bone; a state of affairs which in itself implies ineffective previous treatment. Almost all the muscle is replaced by dense streaky and white fibrous tissue in a manner which is strongly suggestive of the condition found in Volkmann's ischæmic contracture. The strength and extent of this fibrous strap is such, that the knee is held almost fully extended and offers little hope of any improvement. A patient with 5° to 10° movement in this condition may consider himself lucky. When large plates and so on are present their removal is said to be followed by increased freedom, but the fibrosis is unfortunately absolute. As to the causation, theories have been advanced concerning interference with the blood and nerve supply to the muscles by the pressure of hæmorrhage and effusion, and the damage may often be inflicted at the time of the fracture or at the time of the operation.

Muscular atrophy is an inevitable part of the treatment of any fracture and the speed of its onset consequent on immobilization of the lower limb is often remarkable. Within a few days the wide girth of a powerful thigh is reduced to a thin shank and the region first affected and last to be restored is the internal vastus. When splints and extensions are removed the loss of power is felt severely and in many cases lateral movement at the knee-joint may be obtained in adults. Recovery of muscle-tone and power is a slow process and it should always be realized that the development of the quadriceps and the movement of the knee-joint are largely interdependent. When the knee is fixed the muscle has little or no opportunities for recovery and, contrariwise, a fixed or shortened muscle implies extra-articular fixation of joint movement. A knee, capable of full ranges of movement will only regain full power when the thigh muscles have attained normal dimensions and these are obtained gradually by normal use, which permit the cartilages and other elements of the joint to be fashioned anew and regain their normal anatomical characteristics.

A minor factor that is often overlooked is the practice of using transfixion pins, threads or calipers to the lower end of the femur to obtain adequate extension. Skeletal traction is necessary in many cases of a fractured femoral shaft, but I do not hold with a method which produces an area of scar-tissue between bone and the mobile layers of fasciæ and tendons surrounding the joint; even by inserting the pin through the condyles, as near the posterior surface as is possible, does not overcome the difficulty. If the condyles of the femur formed the arc of a circle it might be possible to calculate and apply transfixion apparatus to a centre of rotation so that the movement of the joint later would be little impeded. As it is, the blending of aponeurosis and muscle to bone by scar-tissue is bound to interfere with the back and forward sliding of the lateral expansions and tendons of the joint, as the knee is flexed or extended. Fortunately, the effect is to some extent mitigated by stretching of scar-

tissue in time, and the fashion of using a fine taut wire (Kirschner's thread) produces less trauma than a stout rod. Mechanically the danger is greatest when the pin is passed through the cancellous condyles close to the joint, partly as the effect of fibrous fixation is mechanically strong and partly as there is a risk of a badly passed pin cutting through the joint itself. If above-knee traction is to be used, a fine wire through the shaft above the condyles is the method that appeals to me most, though personally, as I will record more fully later, I much prefer to employ below-knee traction by means of screws, as a routine procedure.

Finally we come to more remote and less disabling causes of limitation of movement which, however, result from the same basic cause—inefficient treatment. For example, it is not uncommon to find a fracture perfectly “set” and apparently in good position radiographically. But on closer examination it is found that the foot is abnormally rotated to an extent of 20° to 30° , or even 40° . The limb has been perfectly extended and maintained in position, but through lack of proper control the foot has twisted inwards or excessively outwards, until it is too late to rectify this error. The joints in these cases are subjected to abnormal stresses and strains on standing or walking and are more prone to osteo-arthritic changes than the normal. It should also be recalled that osteo-arthritis is a possible legacy of any fracture and may occur in patients of any age, but those about the age of 50 are the more frequent sufferers.

The age of the individual and the site of fracture play a large part in the prognosis of joint movement. Given a similar fracture in a child and middle-aged adult, the accommodation and recovery of youth is vastly superior to that of the aged. Every joint after prolonged immobilization is stiff and takes some time to work out to full voluntary movement, but in a child the movement is often recovered in a surprisingly short space of time without a masseur's aid, while the adult requires much more time and attention to achieve the same result. We are, however, concerned with the more permanent stiffness or fixity which is residual, and in this case also the child recovers movement to a good extent as the years go by, leaving in the adult a problem which taxes the patience and skill of the surgeon. With regard to the site of the fracture it is interesting to note, that as the fracture occurs in the higher sections of the femur so there is a greater range of movement of the joint; for example, a transverse fracture in the lower third of the femur usually yields a worse prognosis than one in a similar fracture in the middle third, while those in the upper third are very rarely indeed followed by any stiffness of the knee—unless the joint has been damaged at the time of the accident.

Mild cases of intra-articular fixation are amenable to treatment, but advanced fibrosis in adults points to a stationary condition in which the patient will have to be content with a very limited range of movement for all time.

Stiff knee is in the majority of cases the result of inadequate treatment, and whereas a certain proportion are inevitable prophylaxis by efficient extension is the keynote. Shortening of the limb and angulation of bone are almost invariably accompanied by limitation of movement with a lack of security at the knee and good radiological results are the only ones in which full restoration of function can be quickly expected. Even then, if the treatment of injured soft tissues is overlooked the results may be disappointing.

Extension of the fragment distal to the site of fracture is essential to my mind in

any fracture of the lower limb. Primarily, shock is brought under proper check and reflex muscular spasm is abolished, the limb is pulled out to its normal length and the distal fragment can be controlled in correct alignment with the proximal end. This traction must be maintained continuously until the union of healing bone is judged firm enough to withstand the effects of gravity in all dispositions of the limb and to resist the recoil of the muscles after the limb is freed of its splinting, particularly if the cleavage is other than transverse. During this period the muscles and ligaments extended are held immobile and on the stretch, a state of affairs favourable for the rapid absorption of effusion and blood. Fibrous tissue formation is reduced to a minimum and is retarded from rapid or early cicatrization. By taking the pull from the tibia, the knee-joint is placed under the best conditions for its repair,—extended in place of its normal compression— should it have been damaged at the time of the accident. Laxity of ligaments, as indicated by lateral movement of the joint later, is evidence of the stretching and need give no cause for alarm, as this invariably disappears when the muscles develop and exert their tonic influence on the joint.

In brief, let me summarize my own methods of treatment of a case of fracture of the femoral shaft.

Extension is obtained at the earliest possible moment in a well-fitting Thomas knee-splint from the upper part of the tibial shaft by screws or by Kirchner's thread, Radiographic control is essential at regular intervals of about four weeks, or after any alteration in splinting, or when manipulation has been undertaken. Attention must be paid to the foot, which should be held in such a manner as to avoid foot-drop and to control rotation: my foot-piece with serrations serves this purpose well. When early but definite callus has made its appearance, say in four to six weeks, and the fracture is in good position, skeleton traction can be substituted by gauze and glue extension with about a 9 lb. pull. At the same time a knee-flexing iron is fitted and movements of the knee-joint can be initiated under the patient's control. From this stage to walking in a caliper is simply a question of time and accurate fitting of instruments. At the end of six months approximately, provided he is walking without a caliper, we know the best or worse of the range of movements at the knee-joint—movements always increase by degrees but more rapidly after the joint begins to carry the full body-weight.

Once stiffness of the knee seems to be established, the more simple and routine measures of physio-therapy, local hot-bathing, swimming and so on, will only produce a small result over a long period of time. Be it far from me to decry wholesale these methods, which I regularly use in the early stages, but if the condition is of long-standing they are practically a waste of time.

Given, then, a case of apparently permanent stiffness of the knee, can anything be done? The answer is not satisfactory; sometimes a little improvement can be expected, but more often the condition will remain stationary. The answer depends mainly on the type of restriction to the joint. Firm extra-articular fixation gives disappointing results in all cases, but some response may be gained from milder forms of intra- or peri-articular adhesions by manipulation and *successive* stretchings. Operations designed to free adherent muscle from callus or to lengthen muscle and fibrous tissue by incision, often make the condition worse than before, by interfering with those remaining contractile muscle fibres which have not undergone complete atrophy of disuse.

Manipulation is about the only procedure of any value, but it cannot be used indiscriminately. Application of force injudiciously has frequently led to refracture or a new fracture of the patella or avulsion of the tibial tuberosity. Mild degrees of adhesions, whose rupture brings credit to the manipulating surgeon, are rarely seen in this connection, for the extremes of movement which cause reflex spasm and arrest of movement cannot be obtained in the cases which we are considering. More powerful, broad adhesions require successive stretchings rather than breaking down, for their forcible rupture might well result in a massive effusion and hæmorrhage which would vitiate the object in view. In cases of doubt it is certainly well worth trying the effect of manipulation, using considerable force, but bearing in mind the generalized bony atrophy that is inevitably present. Audible snapping of adhesions is satisfactory, and if improvement results after having employed massage for some time, it is perfectly reasonable to try the further effect of another manipulation after some weeks.

I am aware that manipulation is frequently practised, but I would suggest strongly that it is reserved for those cases in which some improvement, however slight, can be expected, and the joint should be made as hyperæmic as possible with moist heat, before the procedure. Its indiscriminate use may result in untold damage; several repeated manipulations are superior to one over-energetic attempt.

Treatment of the established condition is as unsatisfactory as anything a surgeon wishes to see, but if the endeavours and energy expended at the end of the treatment were employed at the early stages of the fracture the medical profession would feel that they have less to reproach themselves with than at the present time.

Practical Points of Diagnosis and Treatment in Surgery and the Specialities.

EXCRETION UROGRAPHY.

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EXCRETION urography is the radiological investigation of the excretory function of the kidneys and of the structure of the collecting portions of the urinary apparatus after the intravenous injection of a suitable radio-opaque substance. The substance generally employed and upon the use of which the following conclusions are based is Uroselectan B, a pyridine derivative with 51.5 per cent. of iodine in close organic combination. Fifteen grammes of the substance dissolved in 20 c.c. of a 10 per cent. solution of invert sugar are injected intravenously. The solution is warmed to body temperature and at least two minutes should be occupied in giving the injection. With these precautions I have observed no untoward local or general reaction following its use.

Excretion urography may be employed in all cases of a suspected urinary lesion where clinical and routine radiographic examination fail to yield sufficient information for an accurate diagnosis. In a large proportion of the cases in which it is employed it will indicate the exact site and nature of the lesion

Indications.