

a point of view it will save the surgeon from many an error. No fracture of any single bone is so frequent. The cause of the fracture is usually a fall upon the palm of the hand. The lower end of the radius is broken more

anterior surface as for fractures of the shaft (Fig. 2208). This may be reinforced by a cuff made of several turns of adhesive plaster about the wrist. The fingers are liberated at the end of a week,* and all splints except the

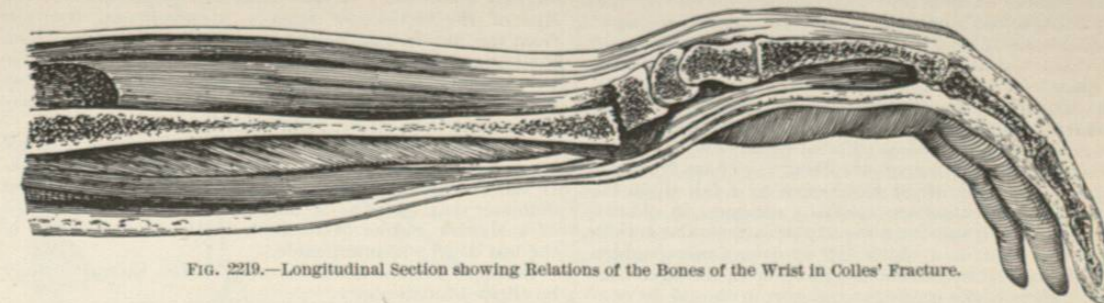


FIG. 2219.—Longitudinal Section showing Relations of the Bones of the Wrist in Colles' Fracture.

or less directly across within three-fourths of an inch of its articular surface. In the young the line of fracture often runs through the epiphyseal cartilage (Fig. 2219). The lower fragment may be displaced backward, but is commonly only tilted in that direction (Plate XXVIII, Fig. 9). It is comminuted as a rule and firmly impacted against the upper fragment. The styloid process or lower end of the ulna is rarely broken simultaneously.* The lateral ligaments of the joint are sometimes torn. The periosteum is stripped up from the posterior surface of the radius and the excessive callus produced under it in old unreduced cases produces the excessive protuberance seen in pathological specimens (Plate XXVIII, Figs. 2 and 3).

The bones of the carpus are carried backward by the tilting of the lower fragment, thus causing the characteristic "silver-fork" deformity, a projection of the back of the wrist with a corresponding depression anteriorly, very aptly compared to the curve of a fork (Fig. 2220). The hand is usually somewhat abducted through the shortening of its radial attachments (Plate XXVIII, Figs. 4 and 5). A more reliable sign of Colles' fracture and one which is never obscured (the above-mentioned deformity is often obscured by excessive swelling) is the elevation of the styloid process of the radius as compared with that of the opposite side. The styloid process of the radius, instead of being a quarter of an inch or so below the tip of the ulnar styloid, has risen to the same level or above it. The ulnar styloid is usually prominent (Plate XXVIII, Fig. 4). There is a line of tenderness over the back of the radius. Crepitus and abnormal mobility cannot commonly be elicited until after the fracture has been reduced.

The treatment of Colles' fracture is simple. Reduction is all important. It is accomplished by grasping the hand firmly as though to "shake hands." At the same time the surgeon grasps the patient's forearm just above the wrist, placing his thumb over the displaced fragment. The patient's hand is then drawn gently backward until he complains of pain. Immediately it is forced sharply backward before he has time to resist and then drawn downward and sharply flexed while the fragment is simultaneously pushed downward by the thumb upon it. These motions performed rapidly and forcibly will usually dislodge the fragment, a result announced by the diminution of the deformity and the appearance of abnormal mobility (and crepitus) where before the mobility was restricted. This method failing, the forearm may be placed on a table, the hand rapidly forced to and fro while the wrist is held firmly at the edge of the table and the fragment is pressed upon. Primary anæsthesia may be employed in rebellious cases.

The fracture once reduced is easily held in place. The usual dressing is a thin padded board along the back of the forearm to the knuckles and another along the an-

terior surface as for fractures of the shaft (Fig. 2208). This may be reinforced by a cuff made of several turns of adhesive plaster about the wrist. The fingers are liberated at the end of a week,* and all splints except the

adhesive plaster cuff removed within three weeks. An anterior or posterior moulded plaster splint is a convenient dressing after the first week. If this method of treatment is followed the bad results will be minimized. Shortening on the radial side is bound to persist in some cases of epiphyseolysis and in others in which the compression of the bone has been such as materially to reduce the size of the fragments. As a result of this, the ulnar styloid remains unduly prominent. In the middle-aged, rheumatic complications may be looked for. The best way to avert them is to employ daily massage from the start and passive motion as soon as possible. Yet the most intelligent treatment often fails in this regard; though it is almost impossible to persuade the patient that the surgeon's efforts are not to blame for the long months of suffering following so slight a fracture.

Reversed Colles' fracture is extremely rare. The impaction and displacement are directed toward the palmar instead of toward the dorsal surface.

Fractures of the Carpus.—In compound fractures the fragments are to be reduced or removed. Simple fractures are most unusual and a diagnosis can scarcely be made without the help of x-rays.

Metacarpal Fractures.—The displacement is usually angular backward, and slight. The fracture is readily recognized. The fist may be bound over a roller bandage for three weeks and after that a simple dorsal pad and spica employed. Beck's splint I have found serviceable. It is made of short pieces of rubber tubing pressed into the spaces between the metacarpal bones and held in place by two adhesive plaster straps, one just above the knuckles, the other near the wrist. The hand is then bound over a roller bandage.

"Bennet's fracture" is the splitting off of a small fragment from the palmar surface of the base of the first metacarpal bone. The backward displacement of the remainder of the bone simulates subluxation. The

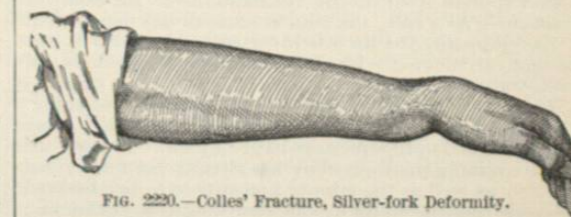


FIG. 2220.—Colles' Fracture, Silver-fork Deformity.

thumb cannot be apposed to the index finger. It is to be immobilized in full abduction. Similar fractures occur in the other metacarpal bones; they are discovered by pressure upon the end of the bone eliciting tenderness at the point of fracture.

* Fluoroscopy shows that the ulnar styloid is broken more often than is usually considered to be the case. Dr. E. A. Codman claims that the ulnar styloid is broken in at least sixty-two per cent. of cases.

* It is essential to liberate the fingers at the earliest possible moment, for they are very quick to become stiffened, especially if immobilized in extension, and slow to regain their full range of motion.

Phalangeal Fractures are often compound. Simple fractures may be immobilized by basswood splints or a plaster encasement, preferably in a position of flexion. After the first two weeks several thicknesses of adhesive plaster suffice. Compound fractures are, however, especially liable to suppuration and necrosis and the prolonged splinting usually results in one or more stiff joints. In such cases, therefore, it is often well to amputate in the first place.

Fractures of the Femur.—Indentations of the head of the femur by impact with the rim of the acetabulum during dislocations have no clinical significance.

Fractures of the Neck of the Femur.—These fractures occur at all ages by direct violence or by a fall upon the knee or foot, but they are specially common in old age when they may result from the slightest muscular action, such as the effort to avoid a fall or even a mere sudden turn. In fact so marked is this liability in the aged that every injury to the hip of an old person should be considered a fracture until this diagnosis has been disproved. This frequency of fracture in old age is due rather to the senile rarefaction of the bones than to the increased obliquity of the angle between neck and shaft.

Pathology: These fractures are classified as fractures through the narrow part of the neck (fracture through the neck, intracapsular fractures, *fractura subcapitalis*) and fracture at the base of the neck (*extracapsular fracture, fractura intertrochanterica*). In the former class the bone is broken close to the head. The vitality of the fragment may be completely lost, but more frequently it is maintained by the vessels in some untorn fragment of the periosteum (the vascular importance of the ligamentum teres is doubtful). In the latter class, the chief line of fracture follows the intertrochanteric lines. There is usually considerable comminution. The great trochanter may be split and the cancellous tissue of the neck is more or less crushed. These fractures, though usually spoken of as extracapsular, are often as much within the capsule as outside of it. They are also said to be impacted, but this impaction consists of a crushing of the neck of the bone which is wedged among the fragments about the trochanters, while true impaction in the sense of fixation is not common. The impaction occurs chiefly in the posterior part of the neck (exceptionally the reverse is true), and consequently the head rotates downward and backward as though hinged upon its anterior border. Hence the shortening and eversion of the thigh.

Symptoms and Diagnosis: The subjective symptoms are usually quite characteristic. There is almost entire loss of function. The patient can bear no weight on the limb, and when lying can move it but slowly and cannot lift the foot from the bed. The limb lies everted, abducted, and slightly flexed. Sometimes the eversion is so slight that it can be determined only as a resistance to inversion. This eversion is not entirely due to the fracture, for it is the position commonly noted in simple contusions. About the hip there is more or less swelling, ecchymosis, and pain. There may be an especially tender spot in front of the trochanter over the point of fracture. As a rule, the pain is elicited only by motion.

Exceptionally the limb is inverted and very rarely the patient can move it with a fair amount of freedom and even walk upon it.

The chief objective sign of fracture is shortening. This symptom is practically constant, although it may not be marked until some days have elapsed. The method of determining the shortening has already been described (p. 250), as well as the minute precautions to be observed in measuring the limbs at the same angle of flexion and abduction. The possibility of a congenital difference in the length of the two limbs is the only thing that renders this test fallacious. If, however, the limb can be proven to be distinctly shorter on the second or third day than it was immediately after the receipt of injury, the evidence is conclusive.

Shortening is also measured by Nelaton's line or Bryant's method (which estimate the elevation of the trochanter), or by measurement from the anterior superior

spine of the ilium to the internal malleolus. Nelaton's line is drawn from the anterior superior spine to the tip of the ischial tuberosity on the same side. It should cross the tip of the trochanter when the limb is uninjured and slightly abducted. Bryant measures the distance of the tips of the trochanter from a perpendicular dropped from the anterior superior spine to the plane on which the patient lies. The estimation in either case is made by comparison with the opposite limb. Shortening may be inferred when the fascia above the trochanter is more depressible than on the sound side.

A relative fullness and tenderness in Scarpa's triangle is another fairly constant sign of fracture of the neck. If the trochanter is split, its increased antero-posterior diameter may perhaps be made out. The determination of a shorter radius of rotation in the trochanter is in the last degree impracticable.

Crepitus should never be sought for, though it may be elicited incidentally.

Diagnosis: The differentiation of fractures through the small part of the neck of the femur from those at the base is rarely practicable and never important. The chief differential point is comminution of the trochanter which so often accompanies fractures at the base of the femoral neck.

When the femur is broken below the neck there is a local spot of pain and deformity, the depressibility of Scarpa's triangle is unaffected, the trochanter is not elevated (though the limb is shortened) and does not partake of rotation imparted to the limb. When the head of the femur is dislocated it is readily felt if the dislocation is forward; and the limb is inverted, when it is dislocated backward. Those rare instances of inward rotation with fracture are usually mistaken for dislocation until the anæsthetic is administered for reduction when the position of the head is made out.

As to the positive diagnosis of fracture of the neck of the femur, it is based upon the signs and symptoms already enumerated. Doubtful cases, especially in the aged, must always be treated as fracture until the lapse of time has proven them mere contusions. The prognosis is good as regards life, though the shock of such a severe injury upon an aged person may prove fatal, through pneumonia, uræmia, fat embolism, or even simple "shock." Stimson says: "I have come to regard the third week as the time when the condition is most likely to change for the worse; that passed, cases usually do well."

On account of the impaction union is obtained with shortening and some loss of abduction and rotation. When the patient is aged the stiffness, pain, and weakness may never entirely wear away, even though union be perfect.

Firm union may be expected except in the aged. Yet even in the unsatisfactory cases, the fibrous union, the interlocking of the fragments, or surrounding tissues (it is usually impossible to tell which) hold the bone well enough in place for the limb to be used with the aid of a cane or stick. Such results follow fracture of the narrow part of the neck far more often than fracture at the base. The possibility of obtaining union several months after the injury by direct pressure over the trochanter (Schaffer) should not be lost sight of.

Treatment: If the patient is aged and infirm he must be put to bed and every care taken for his comfort and nutrition while but little attention is paid to the limb, which is slung in a Hodgen's splint, with as much traction as the patient will bear.

In younger subjects there is no danger to life, and the limb demands more care. Reduction must not be attempted. The patient is kept in bed and some form of traction apparatus is applied. The choice lies between Hodgen's splint and Buck's extension apparatus. The former is the more comfortable, the latter capable of exerting a greater pull.

For a Hodgen's splint (Fig. 2221) a piece of adhesive plaster three inches wide and long enough to reach from the upper part of the thigh, loosely around the foot

and back to a corresponding point on the opposite side of the thigh, is selected. The middle two-fourths of

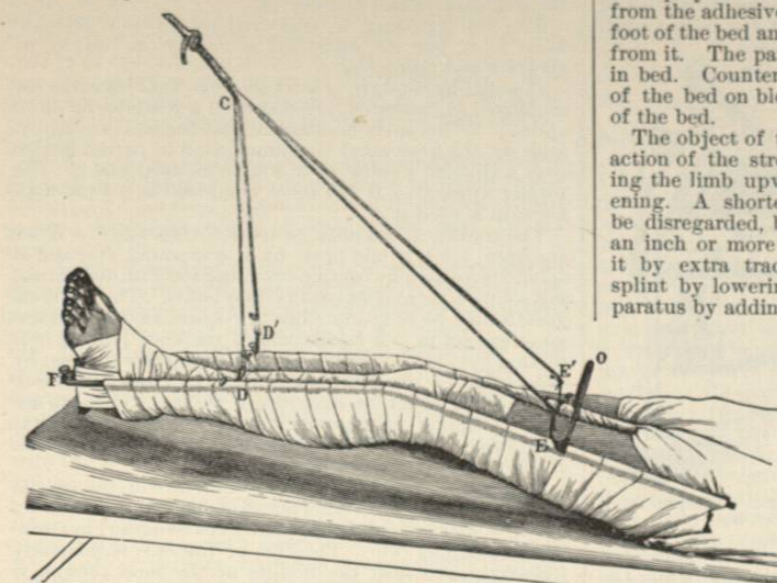


FIG. 2221.—Hodgen's Splint. (From Stimson's work of "Fractures," Lea Bros. & Co.)

this strip is folded twice upon itself (making a triple thickness), and nicked so as to allow the remainder to lie unfolded. A perforation is made at the centre of the strip and against it is fitted a stout perforated piece of wood two inches wide by five inches long (Fig. 2222). A strong cord knotted at one end is passed through the two perforations. A flannel bandage is then applied to the leg and foot, and the ends of the adhesive strip attached over one-half of the inner and outer aspects of the thigh, the middle folded portion lying below and about two inches away from the sole of the foot. Another bandage over the thigh and knee strengthens the grip of the plaster. The frame of the splint, upholstered with compresses pinned tightly from side to side, is then slid under the limb, and the metal half hoop (O) fitted over the ends to prevent them from collapsing. The cords (DE and D'E) are attached as shown in the figure and caught

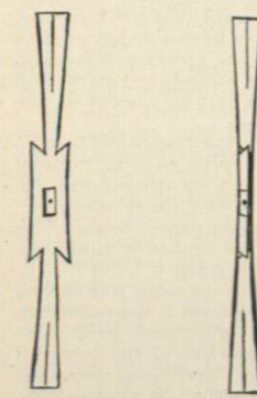


FIG. 2222.—Strip of Adhesive Plaster, Shaped for Use in Extension Apparatus.

by a rope (O) which is attached to a crane at the foot of the bed. The cord of the adhesive plaster is then made fast at F bringing the piece of wood close against the bottom piece of the frame. The compresses are tightened and loosened to fit the inequalities of the limb. The end (O) is drawn tight enough to elevate the limb from the bed, its line of traction being at an angle of 50° to 70° with the horizon.

For Buck's apparatus (Fig. 2223) the adhesive plaster and bandages are applied in the same manner, the outer bandage being made to include the footpiece of a Volkman's sliding foot rest (Fig.

2224), which rests upon a frame in the bed, thus giving more play to the foot, and holding it upright. The cord from the adhesive plaster is then let over a pulley at the foot of the bed and a five- or ten-pound weight suspended from it. The patient must not be allowed to slide down in bed. Counter traction is made by elevating the foot of the bed on blocks or by tying the patient to the head of the bed.

The object of these traction splints is to overcome the action of the strong muscles which are constantly pulling the limb upward and tending to increase the shortening. A shortening of one-quarter of an inch may be disregarded, but if the shortening amounts to half an inch or more an effort should be made to overcome it by extra traction. This is done in the Hodgen's splint by lowering the line of traction, in Buck's apparatus by adding more weights.

Old and feeble patients should be gotten up in a chair within three weeks. Others may be in bed for the full six weeks, or may get up at the end of four weeks and walk about in a traction hip splint of the kind used for hip disease. Pressure made by a band over the trochanter may be beneficial at this stage.

Operative fixation and plaster encasement have been tried and rejected. The so-called ambulatory treatment has but a fictitious value. Those who can use it (the vigorous) do not need it. Those who would

benefit by it (the aged) are too feeble and tottering to use it. Fractures through the trochanter are treated like the

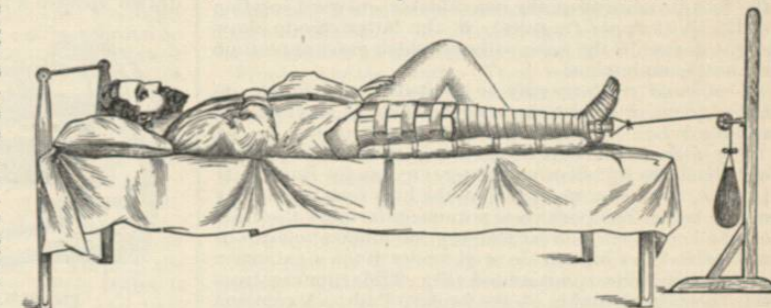


FIG. 2223.—Buck's Extension Apparatus.

above. Fractures of the greater and lesser trochanters are extremely rare.

Fractures of the Shaft.—These are usually caused by direct violence. The line of fracture may be extremely oblique and comminution is common. There may be considerable displacement. The lower fragment rides up behind or to the inner side of the upper one, producing both shortening and deformity. Subsequently outward rotation of either fragment will occur if the trochanter or the foot is not properly supported. Injury to vessels and nerves is rare. An annoying complication is the projection of the pointed end of the upper fragment, when the fracture occurs in the lower third of the shaft, into or even through the quadriceps extensor muscles. An acute serous synovitis of the knee is not uncommon.

The shortening is determined by measurement from the anterior superior spine of the ilium to the internal malleolus. The differential diagnosis between fracture of the shaft and fracture of the neck of the femur has been noted above. Abnormal motility and crepitus may be elicited by gentle manipulation. The less the limb is disturbed the better.

The prognosis is grave. According to Martin's recent statistics of one hundred cases, as a rule children do well. They are usually completely sound five months after in-

jury and the shortening should be less than a half inch. With adults, however, it is different. The disability usually lasts eight months, and an ultimate shortening of an inch and a half may result even if the most skilful treatment is employed. This is in part due to an increased shortening after the

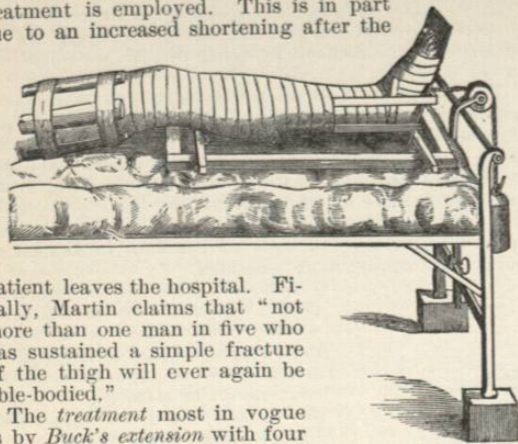


FIG. 2224.—Volkmann's Sliding-rest.

patient leaves the hospital. Finally, Martin claims that "not more than one man in five who has sustained a simple fracture of the thigh will ever again be able-bodied."

The treatment most in vogue is by Buck's extension with four to six short basswood "coaptation" splints (Fig. 2225) bound to the limb with adhesive plaster. Outward rotation of the upper fragment is prevented by a small hard pillow under the trochanter, while the lower one is held up by the Volkmann sliding foot rest. A weight is used sufficient to prevent shortening.

Hodgen's splint seems preferable for very high or low fractures, in the former case for the purpose of allowing slight flexion of the hip, and slight outward rotation of the foot to neutralize the unavoidable outward rotation of the short upper fragment; in the latter case to allow slight flexion of the knee without which good apposition cannot be maintained.

Compound fractures may be treated by the double inclined plane or an anterior suspended splint, or Hodgen's splint.

For infants the best treatment is vertical suspension of both limbs by adhesive plaster, etc., as for Buck's apparatus, in such a manner that the hips rest but lightly on the bed. The position is not uncomfortable, the child can be kept clean, and satisfactory immobilization can be maintained. Children do well under Buck's extension with a long side splint added (Fig. 2226) running from the chest to the ankle of the broken limb. A common oversight is the omission of a thick pad between the femur and the splint. When the broken limb is bandaged to the splint without such a pad it is bowed outward to such an extent as to produce from half an inch to an inch of shortening.

Plaster-of-Paris encasement is not reliable in the first weeks. Some of the above-mentioned traction splints must be kept on for five or six weeks, after which the patient may go about on crutches for three weeks longer

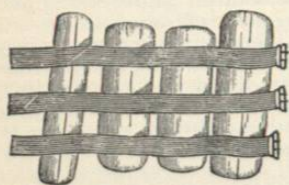


FIG. 2225.—Coaptation Splints used in the Treatment of Fracture of the Thigh by Buck's Extension.

with the limb in a plaster jacket or an orthopedic splint. A perfect limb without shortening is very rarely obtained.

Difficulty of reduction when a muscle is pierced by one of the fragments is met by traction with knee and hip flexed, or, if this fail, by the knife.

Fractures of the Lower End.—The fractures that occur in the lower end of the femur are separation of the epiphysis, intercondylar fracture, and separation of a single condyle. The last is very uncommon.

These fractures are caused by severe local violence or torsion or hyperextension of the knee. The common complications that render the injury serious are hæmar-

throsis, going on to suppuration, compound fracture with the likelihood of a similar result, and laceration of the popliteal vessels and nerves.

The fracture may be obscured by effusion into the knee joint, but the diagnosis is readily reached by inspection and palpation.

If only one condyle is fractured the knee must be immobilized in extension, preferably on a posterior moulded splint. When there is intercondylar fracture or epiphyseolysis, the knee must be immobilized in partial flexion over a Hodgen's splint or a double inclined plane. The former apparatus is the more comfortable. Very little traction is needed.

The complications must be treated vigorously. When the knee joint is laid open by a compound fracture it should be treated by continuous irrigation with decinormal salt solution for at least twenty-four hours. The popliteal vessels may be so lacerated as to require amputation lest gangrene set in. A hæmatoma of the knee joint is best treated by elastic pressure, and if this prove useless, by evacuation of the blood clots through a small incision. This should never be undertaken without the most minute antiseptic precautions, for infection of the joint from this or any other cause threatens at least a stiff joint, at most amputation or death.

Fracture of the Patella.—Fracture of the patella occurs commonly in young adult males. It is caused by the muscular action of the quadriceps extensor, in stumbling, jumping, etc. The line of fracture is generally transverse and near the middle of the bone, though it may be but an avulsion of either tip. Less frequently the bone is broken by direct violence.

A sharp pain in the knee and an immediate complete loss of function call attention to the injury. If the joint is examined immediately the upper fragment is found drawn upward a half inch or so by the quadriceps, leav-

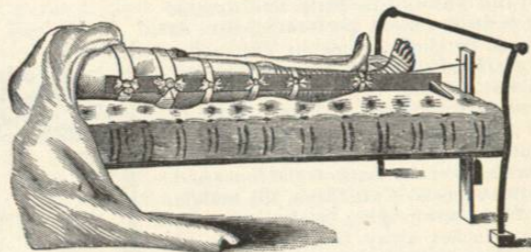


FIG. 2226.—Long Side Splint, with Traction.

ing a manifest gap between the fragments. The joint rapidly fills with blood and this adds to the displacement, which is, however, limited by the lateral attachments of the quadriceps tendon. If the displacement is not remedied, the slow contraction of the muscle, and in a less degree that of the ligamentum patellæ, draw the fragments farther and farther apart until they are separated by several inches. There may be fibrous union even in such a case, yet in spite of this the power of extension is very greatly impaired or lost entirely. Lateral and rotary displacement are unusual, but may occur as late results of contraction in the tissues.

The only accessory lesions are the transverse tears in each side of the capsule. The periosteum in front of the bone is torn irregularly so that its fringes drop between the fragments. Compound fracture is very rare.

The symptoms are pain and loss of extension. The diagnosis is made by palpating the broken bone and appreciating the gap between the fragments.

The treatment of this fracture by the usual mechanical methods has necessitated so prolonged a convalescence and exposed the patient to such unfortunate results (refracture, permanent stiffening, and loss of the power of extension) that operative measures have been welcomed by many surgeons of large experience. It does not appear, however, that operative success lessens the liability to refracture, and although it shortens convalescence

materially, insures a full power of extension, and minimizes the prospect of stiffening, yet operative failure, which is infection, exposes the patient to the loss of limb or life, or at least to an absolutely stiff joint. For the knee joint succumbs to infection more readily than, or at least as readily as, any other region in the body. It is far more susceptible than the peritoneum, and the infection once begun rapidly involves the whole joint and imperils life.

While it is impracticable to detail here the operative successes and failures, or to substantiate an opinion upon which sound surgical judgments are still so much at variance, a moderate series of conclusions may be set down.

1. In the absence of a wide surgical experience and all the aseptic surroundings, assistants and implements, the general practitioner or the occasional surgeon must accept mechanical treatment with all its inconvenience.

2. The surgeon who feels himself sufficiently well equipped to venture operation should bear in mind the highest rule of asepsis, "Be sure your hands are thoroughly clean, and act as though they were absolutely dirty," which is to say, "Keep them from all contact with the wound." Rubber gloves should be permitted to lend no false sense of security.

3. Such compromising measures as the subcutaneous suture, or the use of Malgaigne's hooks, may well be more risky than a clean surgical wound made with no false sense of security, while they do not afford the three chief advantages of an open operation, viz.: the removal of all impediments to union, the evacuation of clots from the joint, and accurate apposition of the fragments.

Mechanical treatment is usually applied somewhat as follows: the limb is immobilized on a posterior moulded splint passing from the toes to the gluteal fold and maintaining the foot at a right angle and the knee extended (if a board splint is used the foot must not be allowed to droop). Hiding the fragments in a plaster encasement is a risky procedure. The limb is firmly bound to this with a roller bandage, after which the fragments are approximated as well as may be by direct pressure and held in place by several strips of adhesive plaster, encircling the limb and splint obliquely. Over all a light (Martin) rubber bandage is applied to hasten the absorption of the blood distending the joint. The rubber bandage does its work within a week (daily massage may aid), after which it is dispensed with. As the patient lies in bed the rectus muscle is relaxed by keeping the foot elevated and thus flexing the hip. This splint is retained for five or six weeks, splint, plaster, and bandages being renewed as often as necessary. An interval of more than a quarter of an inch between the fragments should be considered unsatisfactory. For the second month a hip splint and daily massage are employed (or a plaster encasement for less opulent patients), the patient being up and about. After this the patient is allowed to go free, but is warned to begin exercising gradually and to be especially careful about stooping, going up and down stairs, and such other motions as involve bending the knee. This period of convalescence requires from one to four months longer.

Operative Treatment.—For the reasons already given I shall describe only one operation. A vertical or U-shaped incision is used, according to the fancy of the operator. The fracture is laid bare and while the fragments are retracted the joint is copiously flushed with warm salt solution until all clots have been washed away. The ragged fringe of periosteum is clipped from the edges of the fragments, after which they are approximated and held together by a periosteal suture of catgut or kangaroo tendon. The rents in the lateral expansions may be similarly caught up and the whole reinforced by a circular catgut suture uniting the quadriceps tendon to the ligamentum patellæ, the strands to lie at each side or in front of the patella. This last suture is rarely necessary. During all these manipulations no finger should touch the tissues. The skin is sutured with silk and the limb is bound to a posterior splint. A week later the

silk sutures are removed and a plaster encasement is applied. A week after this the patient goes about on crutches and so continues until the end of the fifth week. After this the splint, preferably a hip splint, is worn only by day and as soon as free flexion is obtainable, during the third month, the splint is discarded altogether; by that time convalescence is complete.

Bony union is expected after operative treatment, fibrous union with an ultimate separation varying from a quarter of an inch to an inch after mechanical union. Yet even in the former case there is usually separation of the anterior edges of the fragments, and bony union may fail after all. In either case restricted motility is rarely due to loss of power. Indeed the quadriceps extensor adapts itself to very wide separations. When some stiffness persists in the joint, as is often the case after mechanical treatment and less frequently after the operative methods, it is due either to organized blood clot within the joint, to prolonged immobilization, or to such a lengthening of the patella as to prevent its slipping smoothly over the condyles. Chopart, who advanced the last theory, excised the upper fragment in one case with marked benefit to the patient. The frequent practical failure of secondary operations which seek to remedy disability by approximating the fragments makes a field for this operation. Slight disability, however, had best be borne as a necessary evil. Refracture may be treated by suture or by splint. Fractures by direct violence are usually associated with little or no laceration of the capsule. Hence there is no displacement and no operation is needed.

Fractures of the Tibia and Fibula.—Fractures of the Upper Ends.—These fractures are rare. They may involve the joint causing hæmarthrosis, may rupture the vessels, and are not infrequently comminuted. Avulsion of the spine of the tibia is a complication of dislocation. Avulsion of the tubercle is an extremely rare result of the muscular action of the quadriceps extensor. Epiphyseal separation at this site has no peculiar features.

Fractures of the Shafts.—These occur commonly at the junction of the lower and middle thirds. The fibula is usually broken at a higher level than the tibia. The fracture of the tibia is often V-shaped and from the point of the V a fissure may descend to the ankle joint. Moreover, muscular contraction usually displaces the lower fragment backward and the sharp point of the upper fragment is likely to pierce the skin either at the time of accident or subsequently.

The fracture of the tibia is readily determined by palpation. The fibular fracture may be neglected unless it occurs alone (by direct violence), in which case pressure along the bone elicits a point of tenderness, and this same tender spot is disturbed by pressure over the shaft of the bone some distance away.

Treatment: Reduction is readily accomplished with the knee flexed to a right angle to relax the muscles. If the tendency to displacement is slight the leg is placed in a Volkmann splint (Fig. 2212) or fracture box (Fig. 2211) for a few days until the primary reaction has subsided, and then later is put up in a plaster encasement, or the advantages of the two splints may be combined in a posterior moulded splint running from the knee to the toes or terminating below in two broad flaps, which overlap over the dorsum of the foot. The Cabot wire frame employed by Scudder also commends itself. Union may be expected at the end of six weeks in simple cases, but if there is much comminution it may be considerably delayed. Such cases as well as all others in which the circulation of the limb is poor are benefited by elevation and daily massage of the injured member, though as routine practice it is best to get the patient out of bed during the first week. Otherwise several extra weeks will be required to overcome the œdema and stiffness felt on first using the limb.

A marked tendency to displacement may be overcome fairly well by traction applied to the ankle. Operative fixation is, however, more generally employed. Ambulatory treatment has been considered elsewhere. A compound comminuted fracture often takes months to heal.

Fractures of the Lower Ends.—Separation of the tibial epiphysis is caused by eversion or inversion of the foot. The line of fracture runs well above the articular surface. The foot is to be immobilized in such a position as to retain the fragment in place. Union may be followed by cessation of growth in the tibia and inversion of the foot from overgrowth of the fibula.

Supramalleolar fractures usually show the same features as epiphyseal separation, but if there is extensive comminution there is the added danger of a stiff ankle.

The fibular epiphysis is often separated in Pott's fracture.

Pott's Fracture.—This is by far the commonest fracture of this region. It is the injury of the ankle quite as Colles fracture is the injury of the wrist, and yet the rational principles upon which the treatment of this fracture must be based are commonly misunderstood, and Pott's fracture is casually spoken of as an injury from which a perfect recovery is not to be expected. On the contrary, it has been my experience that a good result may and should be expected, and will be obtained by appropriate treatment.

Pott's fracture is caused by indirect violence, a twist of the foot. The twist is outward, causing a "fracture by eversion and abduction." Inversion and adduction cause a simple "malleolar fracture" (see below).

The lesions of Pott's fracture (Plate XXVIII., Figs. 10 and 11) are: (1) fracture of the internal malleolus or rupture of the internal lateral ligament; (2) diastasis of the tibio-fibular joint caused by the rupture of the tibio-fibular ligament with perhaps avulsion of the adjoining bone; (3) fracture or epiphyseal separation of the external malleolus; and (4) an outward and backward displacement of the foot. This displacement is due to the tibio-fibular diastasis, which allows the powerful tendo Achillis to draw the foot backward while the lack of support on each side allows the peroneal muscles to hold the foot in the position of eversion and outward displacement into which it has been forced. Compound fracture, which is rare, is usually the result of excessive or prolonged violence, which forces the internal malleolus through the tense skin of the inner side of the ankle while the foot is held abducted. The fragment of the internal malleolus may be so rotated as to require operative reposition.

The symptoms of Pott's fracture vary between the limits of acute continuous pain with entire disability and a mere aching and soreness without any great loss of function during the first hours after injury. The physical signs are, however, constant and definite. There is more or less contusion about the ankle, and in many cases the outward (Plate XXVIII., Fig. 10) and backward displacement of the foot is so marked that the nature of the injury is manifest. There are, moreover, several pathognomonic signs. Three points of tenderness are always present: one over the line of fracture of the internal malleolus, usually near the tip; a second over the fracture of the fibula, usually at the junction of the shaft and malleolus; and a third in front of the ankle between the bones of the leg marking the site of the ruptured tibio-fibular ligament. Another characteristic sign is lateral mobility in the ankle joint. This is elicited by grasping the foot firmly with one hand (the palm of the hand beneath the sole, the thumb under one malleolus, and the fingers under the other) and moving it bodily from side to side, while the leg is steadied by the surgeon's other hand. If there is lateral mobility the astragalus may be felt to glide smoothly from side to side, and may usually be brought up against one or other malleolus with a distinct click. Abnormal forward and backward mobility may also be elicited. It may be impossible to produce crepitus. Extension and flexion of the ankle is painful, but upward pressure on the heel is not.

Treatment.—The backward displacement and eversion are overcome by drawing the foot forward and inverting it sharply. Comparison with the sound limb will readily determine whether the backward displacement has been corrected; the eversion should, however, be overcorrected, for while there is no danger of the foot becoming

fixed in abnormal inversion, hyperinversion pulls the fibular fragment downward and inward into place and at the same time leaves no possibility of any permanent eversion. The foot must be kept at a right angle with the leg.

In splinting care must be taken to maintain the reduction inward and forward and at the same time to prevent a drooping of the foot from traction by the tendo Achillis. Stimson's posterior and lateral plaster splints are admirably suited to this purpose. The posterior splint runs from just below and behind the knee down over calf, ankle, heel and sole, to the toes. The lateral "stirrup" splint begins just below the head of the fibula, and runs down the outer side of the leg, over the sole of the foot (and the posterior splint) and around to the outer side of the dorsum of the foot. The foot is held in proper position while the splints are applied. This apparatus is more secure than wooden splints and allows inspection and correction of the deformity better than the familiar plaster encasement. The patient should be kept in bed a few days with the leg elevated on pillows. He may be allowed about as soon as the primary reaction has subsided (at which time a new splint is usually required). If the splints are not sufficiently strong or are loosely applied, the foot will sag. This is not likely to occur before the second week, when the splints have begun to wear out. The tendency is overcome by applying a new moulded splint, or an orthopaedic splint made with a movable foot-piece on two lateral braces of metal, or even a plaster encasement or by dividing the tendo Achillis.

Union is firm at the end of six weeks, but six weeks more are usually required to limber up the ankle joint and to overcome passive edema. When reduction is properly maintained, a perfect ultimate result may be predicted, if due allowance be made for extreme old age, rheumatism, gout, etc.

Old unreduced or imperfectly reduced fractures are very disabling. The eversion causes a constant drag on the ligaments of the inner side of the ankle, while the backward displacement limits dorsal flexion and makes the gait stilted. The eversion may be corrected by supramalleolar osteotomy, but the backward displacement can be corrected only by opening up the old lines of fracture in the tibia and fibula, chiselling away any exuberant callus, and reducing the fracture as though it were a recent one.

Malleolar Fracture.—The malleoli may be broken by direct violence; but the fracture is commonly caused by inversion of the foot. Only the external malleolus may be broken, usually near its tip, or the internal malleolus as well may be fractured. There is no tibio-fibular diastasis, nor any dislocation of the astragalus, as in Pott's fracture.

The symptoms of disability, pain, and ecchymosis, point to some injury about the ankle joint. Examination reveals one or two points of local tenderness over the external or both malleoli; but there is no tender spot in front of the ankle and the lateral mobility characteristic of Pott's fracture can rarely be demonstrated. Independent mobility of the fragments may sometimes be elicited. In a few cases the fracture of the tibia has been so high as to carry away a large part of the articular surface with the fragment. In such cases lateral mobility and backward displacement of the foot are possible; but the condition may still be differentiated from Pott's fracture by the absence of the anterior tender point, and by recognition of the large tibial fragment, which is displaced upward and inward.

The foot usually requires only fixation at a right angle for five weeks while the fragments unite. When there is any tendency to displacement the foot must be well drawn forward and immobilized in a position of natural right-angled flexion. Hyperinversion would be liable to cause mal-union of the tibial fragment.

The prognosis is generally good, though when the tibial fragment is large the usefulness of the joint may be imperilled by exuberant callus.

Fracture of the Bones of the Foot.—*Tarsal Fractures:* The bones of the tarsus are rarely broken. The only fractures of any clinical importance are those of the astragalus and os calcis. A compound fracture of either or both is readily diagnosed and is treated according to the surgical and mechanical requirements of the case by antiseptics and excision or reposition of fragments. When the fracture is a simple one, the diagnosis may be impossible without the aid of the x-rays. Such cases do well under simple immobilization and massage until the foot will again bear the weight of the body. If a fragment is irreducible it may be excised or replaced by operation. Avulsion of the tendo Achillis does well under expectant treatment. Even when there is marked separation satisfactory union may be anticipated within six or eight weeks.

Metatarsal and Phalangeal Fractures.—These present the same features as the homologous fractures of the hand.

FRACTURE OF THE RIBS AND STERNUM.—*Fracture of the Ribs:* This is one of the commonest of all fractures. It is usually caused by a crushing force, such as a fall upon the chest or a heavy blow. The ribs give and then break. Fractures by direct violence are not uncommon. Multiple fractures are frequent, although the two upper and lower ribs almost always escape. Green-stick fractures occur but usually pass unrecognized. The rib is usually broken between the mammary and mid-axillary lines. Displacement is unusual unless the whole side is caved in. There is localized pain at the point of fracture, which may be elicited by compressing the chest sharply from before backward. Crepitus may be elicited by gentle manipulation of the fragments, and by deep inspiration. It may be inaudible unless a stethoscope is used.

The fracture of a rib is not a matter of great importance. There is usually severe persistent pain for several weeks; yet a contusion may cause as much. There may be puncture of the lung, mediastinum, or heart, resulting in any one of the many conditions due to wounds and contusions of these viscera (*q. v.*); but these internal injuries can and do occur as a result of simple contusion without any fracture, and hence when they occur in connection with fracture it is by no means proved that they are caused by the broken bone. They are not necessarily complications of the fracture, and their symptoms and treatment are not modified by the presence of a broken rib.

Treatment: A strip of adhesive plaster five inches wide and eighteen inches long having been prepared, the patient is instructed to take a deep inspiration followed by a deep expiration. At the depth of expiration the adhesive strap is rapidly applied, beginning at a point close to the spine, on the sound side, and following the curve of the broken bone around nearly to the opposite nipple. This strap, applied as tightly as possible, splints the side and minimizes the movements of respiration which constitute one of the chief causes of pain. Several overlapping straps increase the support. Rest in bed adds to the patient's comfort but is by no means necessary. Union is firm in four weeks.

Fracture of the Sternum: These fractures are rare at best. They are most often breaks at or near the junction of the manubrium and the body of the bone. The lower fragment is displaced forward as a rule. The fracture has been caused by muscular effort. The prognosis depends upon the shock and the internal injuries. Uncomplicated cases do well.

Reduction is accomplished by direct pressure on the displaced fragment aided by hyperextension of the spine, the patient lying over a block or box, and breathing deeply. When manipulative efforts fail, operative reduction may be attempted by such means as drawing the depressed fragment forward with a small corkscrew, or removing the overlapping portion of the anterior fragment. Such operations only may be undertaken with due respect for the vital organs lying directly beneath the bone.

Edward L. Keyes, Jr.

FRAMBESIA. See *Yaws*.

FRANGULA. See *Buckthorn*.

FRANKLIN SPRING.—Franklin County, Georgia.

POST-OFFICE.—Royston.

ACCESS.—Via Elberton Air-line Railroad to Royston, thence two miles by hack line to springs. This spring has had considerable reputation as a resort for invalids as far back as the oldest citizen can remember. Qualitative analysis: Iron carbonate, calcium sulphate, magnesium sulphate, sodium chloride, aluminum sulphate, potassium sulphate, iron protosulphate, sulphuretted hydrogen gas.

This water contains sufficient aluminum to render it valuable in chronic diarrhoea and dysentery and useful as a local application in ulcerative skin diseases. The deposit of iron in the spring was used to some extent during the late war to supply the place of coppers. The temperature of the water is 60° F. and the flow two and one-half gallons per minute. The climate is good and near by is some very fine mountain scenery. There are facilities for bathing and the neighborhood offers numerous features of interest. James K. Crook.

FRANZENSBAD.—An Austrian village on the frontier of Bohemia, 1,300 feet above sea-level, renowned for its mineral springs and baths, ranking next in popularity to Marienbad, and at present resorted to chiefly by women. The climate is mild, but is subject to sudden change.

The springs are eleven in number, namely: (1) Wiesenquelle; (2) Kalter Sprudel; (3) Franzensquelle; (4) Louisenquelle; (5) Neuquelle; (6) Loimansquelle; (7) Stahlquelle; (8) Mineral Sprudel; (9) Salzquelle; (10) Oestliche, and (11) Westliche. Of the numerous gas springs in the vicinity, several are used for charging mineral water and to supply the gas baths. The chemical composition of the principal springs varies so little as to hardly justify the usual division of them into four classes.

The Wiesenquelle, Kalter Sprudel, and Franzensquelle are considered therapeutically most important, resembling in composition the springs of Carlsbad and Marienbad. The Franzquelle, "the mineral spring of Egra," is enclosed in a temple-like building. The fount contains 20,000 cubic inches of clear, sparkling water, of about 50° F. the year round, which is, with slight variation, the temperature of the other springs. Exposed for several hours to the atmosphere, the water becomes turbid from precipitation of carbonate of iron. Its taste is agreeable, though slightly ferruginous. The other springs are provided with equally elegant surroundings. The Kalter Sprudel produces 3,648 cubic inches of water a minute, accompanied by an escape of free carbonic acid so abundant as to produce the sound of a boiling caldron. The Louisenquelle is the largest in water supply. Its fount contains 6,861,738 cubic inches, flowing 27,000 cubic inches a minute, and the escape of free carbonic acid is tumultuous.

COMPOSITION.—Sodium sulphate predominates in all the springs, varying from 10.897 grains in a pint of the Mineral Sprudel to 26.926 grains in the Kalter Sprudel; the Wiesenquelle containing 25.643 grains. The other ingredients are the carbonates of iron, manganese, sodium, calcium, magnesium and lithium, sodium chloride, calcium phosphate, and traces of silicates.

INDICATIONS.—The Franzensbad waters, especially those of the Salzquelle, Wiesenquelle, and Kalter Sprudel, are recommended for: (1) Chronic catarrhs, especially chronic gastritis, constipation and cystitis; (2) hyperæmia and moderate hypertrophy of the liver and spleen; (3) disorders of the uterine system; (4) scrofulous affections and gout; and (5) as an after-treatment to Carlsbad and Marienbad.

The Franzensbad and Stahlquelle have been recommended chiefly for: (1) anæmia after hemorrhage, notably that following repeated miscarriages, and exhausting diseases in scrofulous, rachitic, or scorbutic constitutions; (2) diseases of the abdominal or sexual organs with anæ-