The following principles should be aimed at in the treatment of fractures: (1) Complete and accurate reduction under radiographic control; (2) absolute fixation of the fragments until firm bony union has taken place; (3) functional use of the limb during the period of immobilization.

The second and third of these can best be attained by a close-fitting plaster cast, augmented in suitable cases by wires or pins through the fragments incorporated in the plaster, and by the use of walking irons in certain lower limb fractures.

The principle of the application of the unpadded plaster cast is the use of supporting plaster slabs which are retained by circular plaster bandages. Plaster bandages should never be applied round a limb unless over a plaster slab. To ensure success and avoid catastrophes, attention to certain points is essential: the use of suitable materials and meticulous attention to details, some of which may appear trivial in themselves, but nevertheless make all the difference to the results.

Materials.

The following have been found the most suitable: (1) Plaster—Terry's Italian Fine or Superfine, put up in airtight tins, sizes 7 lb. or smaller; (2) bandages—Book Muslin No. 14 prepared by R. Bailey and Son of Stockport. Useful sizes are 6 inches by 6 yards and 4 inches by 6 yards.
The Unpadded Plaster Cast

(3) strong scissors for cutting the slabs; (4) muslin bandages, 4 inches; (5) plaster cutters of the Lorenz type.

With properly prepared and applied plaster slabs, the use of strips of metal or other substances to reinforce the plaster is quite unnecessary.

Preparation of the Bandages.

To ensure standard and uniform results it is better that the same person should prepare the bandages, and it is as well for one of the theatre orderlies to be trained for this purpose. Bandages prepared in different wards are apt to vary in rolling and consistency, and are unsatisfactory. A smooth wooden board is used for rolling the bandages. This is dusted over with plaster and a bandage is placed at one end. The bandage is gradually unrolled, plaster dusted on and worked in with the palm of the hand and the bandage re-rolled as the plaster is incorporated. Care must be taken not to roll the bandage too tightly, especially the first few layers which will form the centre, so that when soaked water can penetrate evenly.

The quantity of plaster for each bandage and the correct degree of tightness in rolling can only be learned by experience. If rolled too tightly the water will not permeate through to the centre, if too loosely the plaster dust drops out. The finished bandages should be uniform in weight.

It is useful to mark the outer loose end of the bandage with a blue pencil so that the end is easily seen when unrolling for application. When finished the bandages should be evenly stored on their sides in a metal box with a close-fitting lid.

Preparation of the Plaster Slab.

Rubber gloves should be worn. The plaster bandage is submerged lengthways in a bowl of lukewarm clean water, and left until bubbling stops (one and a half to two minutes). The bandage is then lifted out with both hands, held horizontally, and the ends gently squeezed, so that the water runs out of the middle of the bandage without taking too much plaster with it. The more water allowed to remain in the bandage the wetter the slab will be, and the longer it will take to harden and dry. Large bandages for body casts should be definitely wet as these take longer to dry and thus will give time for moulding and smoothing the cast. Extremely wet bandages are awkward to use as they twist easily in unrolling and the centre then falls out.

Slabs for small casts, e.g., wrist and ankle, may be fairly dry so that the setting is more rapid. Often the reduction of the fracture and extension must be maintained by hand until the cast has hardened. In any case the slab must be quite soft and pliable so that it may be accurately moulded to the part, avoiding wrinkles, folds and dead spaces which will give rise to pressure disturbances.

For making the slab, a stainless steel or glass-topped table is suitable on account of the smooth surface and the ease with which dried plaster can
be removed. The desired length for the slab is now marked off—with a grease pencil on the metal or glass—the moist bandage is unrolled backwards and forwards into superimposed layers until the requisite thickness has been attained. The operator smooths each layer with the ulnar margin of the gloved hand so that all air-bubbles, creases and wrinkles are smoothed out and the layers adhere together. The slab is then slid off the table and is ready for application.

The following remarks apply to casts for the upper and lower extremities.

**APPLICATION OF THE SLABS.**

The smoothed and pliable slab is applied to the part. There is no necessity to shave the skin, as the close fitting plaster adheres to the separate hairs and the pull being evenly distributed is not painful. In about three weeks the hairs die and then removal of the plaster is painless—a fresh crop of hair will grow. In the upper limb the slab is applied to the extensor surface and in the lower limb to the flexor surface. The slab is carefully moulded to the limb with the flat of the hand. At points where the slab has to round prominences, as at the flexed elbow and the heel, the edges are cut with strong sharp scissors, one-third of its width on each side and folded over to prevent wrinkling. At the flexed elbow reinforcement of the cast at the sides is necessary otherwise the cast is liable to crack.

Once the slab has been moulded into position there must be no further alteration of the position of joints as this will produce wrinkles in the plaster and pressure disturbances will occur in the skin. The slab, when moulded on to the limb will adhere to the skin and is retained in position by a muslin bandage. This may be applied wet and should be put on smoothly and not too tight and should not cause folds or unevenness in the cast.

A second slab may be applied to the opposite aspect of the limb if desired and retained with muslin bandages. Wet plaster bandages are now applied round the limb over the slabs to complete the cast. They are applied loosely, the bandage being simply unwound round the part. The turns should overlap by about two fingerbreadths and should form a neat spiral. When sufficient plaster bandages have been applied and while the cast is hardening, it should be carefully smoothed and moulded over the bony prominences with the flat hand. Care should be taken not to indent the plaster with the tips of the fingers or thumb, even when testing the hardness of the cast, as this will cause indentations in the plaster and pressure disturbances will result.

Before smoothing, the gloved hands should be washed to remove adherent particles of dried plaster. Talcum powder dusted on the drying surface and worked in with the hands, gives a good smooth finish which
will not pick up dirt. The plaster at the bottom of the bowl in which the bandages were soaked should not be used for this purpose as it will not set properly, and when dry will crumble and fall off, leaving rough defects on the surface.

Finally dates and data concerning the fracture should be written on the plaster with indelible pencil. A simple sketch from the radiograph showing the site of fracture is also a useful record.

**Observation of the Patient after Application of the Cast.**

After the application of a cast the condition of the patient must be carefully watched. The chief danger of the unpaded cast is obstruction to the circulation. Fresh cases should be seen twice daily and the nursing staff instructed to observe the following conditions and report to the surgeon if in any doubt.

(a) **Swelling.**—After a fracture there is generally swelling of the part due to traumatic oedema. Before the cast is applied this oedema should be dispersed by pressure and massage at the time of reduction. Careful watch must be kept for any increase of swelling of toes or fingers. This swelling can generally be anticipated and prevented by suspension of the limb, which should be part of the routine.

The lower extremity may be elevated on a Braun's splint and the upper extremity suspended by bandages from a frame or elevated on pillows. If swelling occurs in spite of elevation, the cast must be split.

(b) **Colour.**—The colour of the fingers and toes should be normal. A moderate bluish tinge may occur, but definite cyanosis demands immediate relief by splitting the cast.

(c) **Pain.**—After accurate reduction of a fracture and careful application of a plaster cast, there should not be marked pain. Morphia should not be given. Aspirin and bromide should be sufficient to induce sleep. Marked pain usually means interference with the circulation, and if present must be relieved by splitting the cast.

(d) **Mobility.**—Unless there is a nerve lesion, the fingers or toes should be able to be moved as much as the cast allows. Signs of paralysis require immediate splitting of the cast.

(e) **Sensation.**—Skin sensation in the absence of a nerve lesion should be normal.

These five points, swelling, colour, pain, mobility and skin sensation, should be considered as a whole. With added experience more correct estimation of their value comes. If there is any doubt, the cast should be split or even removed altogether. Routine elevation of the limb and splitting the cast are the safeguards.

It will be found necessary to split the cast more often in the case of the lower than the upper extremity.
A Few Points in the Application of Standard Casts to the Upper Extremity and the Leg.

(1) Upper Extremity.—To immobilize a fracture of one or both bones of the forearm, the cast must include the elbow and wrist joints. Proximally the cast should reach to the upper third of the arm.

At the flexed elbow the slab on the extensor surface should be cut one-third of its width on both sides and the edges folded over to avoid folds and wrinkles. The elbow flexure should be reinforced or the cast will crack. For this the posterior slab should be made rather longer than is necessary and two strips about three inches wide cut from the end of the slab. These are dipped again into water and applied to the slab obliquely at each side of the elbow joint, being finally covered in by the circular bandages. Distally, the slab on the extensor surface should reach to the knuckles. It is very important that the plaster on the palmar surface should not limit flexion of the thumb and fingers.

The first metacarpal should be left uncovered by plaster, except in the case of a Bennett’s fracture, so that extension and abduction of the thumb can be carried out. On the ulnar side the metacarpo-phalangeal joint of the little finger must be free so that complete flexion of the joint is possible. The space between the thumb and index finger is padded with gauze to prevent pressure.

(2) Leg Plaster (below the knee).—Proximally, the upper margin of the cast should reach to a line from the top of the tubercle of the tibia obliquely to the back of the knee so that the calf muscles are covered and do not bulge over the edge of the cast, and yet flexion at the knee-joint is not limited. Distally, on the plantar surface the plaster should reach just beyond the extremities of the toes so that flexion deformities may not occur. On the dorsal surface the cast should extend to the clefts of the toes, without preventing extension. If the cast is too short here, marginal oedema will occur—if too long, atrophy of the muscles to the toes will develop.

In most recent fractures of the leg above the ankle it is advisable to split the plaster immediately after application. This is certainly necessary in all cases where swelling is present when the plaster has been applied.

If it is necessary to split the cast, this should be done in a line lateral to the tibial crest to prevent painful pressure by the cast cutters on the tender subcutaneous surface of the shaft.

In these very brief notes some of the elementary principles in the application of casts are described. For further details of plaster work those interested are recommended the following publications: “The Treatment of Fractures,” by Lorenz Bohler, and “The Technique of the Non-padded Plaster Cast,” by Fritz Schnek. From both of these books subject matter for this article has been freely taken and acknowledgment is made.