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BY

JAMES P. WARBASSE, M.D.,

BROOKLYN, N. Y.

Chief Surgeon to the German Hospital, Attending Surgeon to the Seney M. E. Hospital.

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By JAMES P. WARBASSE, M.D.,

BROOKLYN, NEW YORK.

CHIEF SURGEON TO THE GERMAN HOSPITAL, ATTENDING SURGEON TO THE SENEY M. E. HOSPITAL.

THE injuries to the elbow joint which demand the consideration of the surgeon are contusions, wounds, dislocations, and fractures. In this short discussion, it is not my intention to take up each of these conditions and systematically consider its surgical phases, but I shall wander away from the general path and briefly call attention to certain features of these injuries, the consideration of which may be of profit.

Contusions of the elbow joint are of interest because of the fact that if the contusion is not great enough to cause a fracture it usually amounts to very little. The three bony prominences—the two condyles and the olecranon—which surround the elbow, stand out so prominently that contusion of the joint structures or of the folds of synovial membrane are almost impossible. One or the other of these prominences may be struck, and the soft parts contused are only the skin and the underlying fascia. How very different this is from the analogous joint, the knee, in which the bony eminences have become rounded off and in which the patella, the analogue of the olecranon, offers no protection whatever

against contusions of the joint structures. In fact, the synovial membrane of the knee is as much exposed to contusion through the patella as the elbow would be were there an ununited fracture of the olecranon. It is for these reasons that traumatic synovitis, so common in the knee, is so rare in the elbow joint.

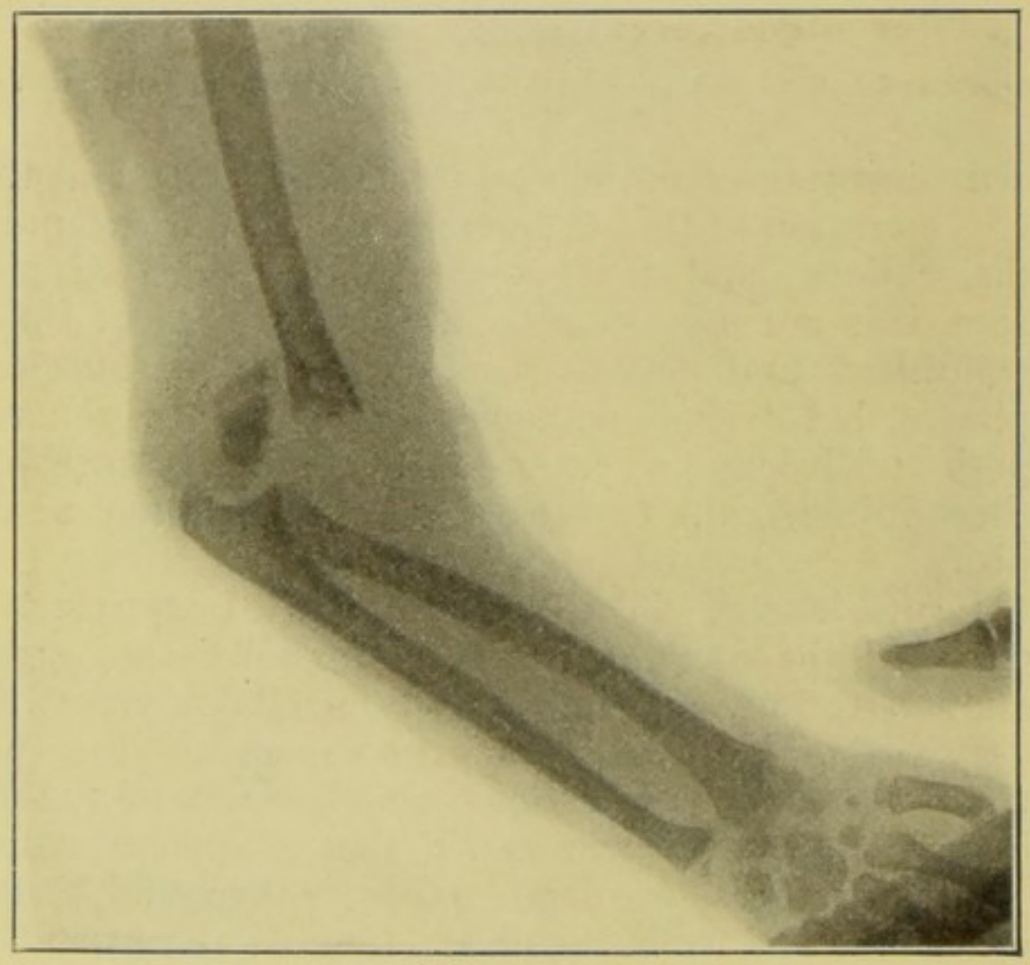

FIG. 1.—K. R. Separation of Lower Epiphysis of the Humerus, showing displacement of the fragment.

There is one injury to this joint to which I desire to call attention and which I have never been able to find described. It may be designated as sprain of the radial flexors, and at first sight simulates fracture of the external condyle of the humerus.

The injury is sustained by falling with the arm twisted under the body. Swelling about the outer side of the joint rapidly develops, but the characteristic symptom is a preternatural prominence of the supinator radii longus muscle. I have seen five cases of this condition, and in all of them, after determining that there was no fracture of the external condyle, the impression was present that the supinator longus originated from the humerus at a higher location than normally. If the elbow is held

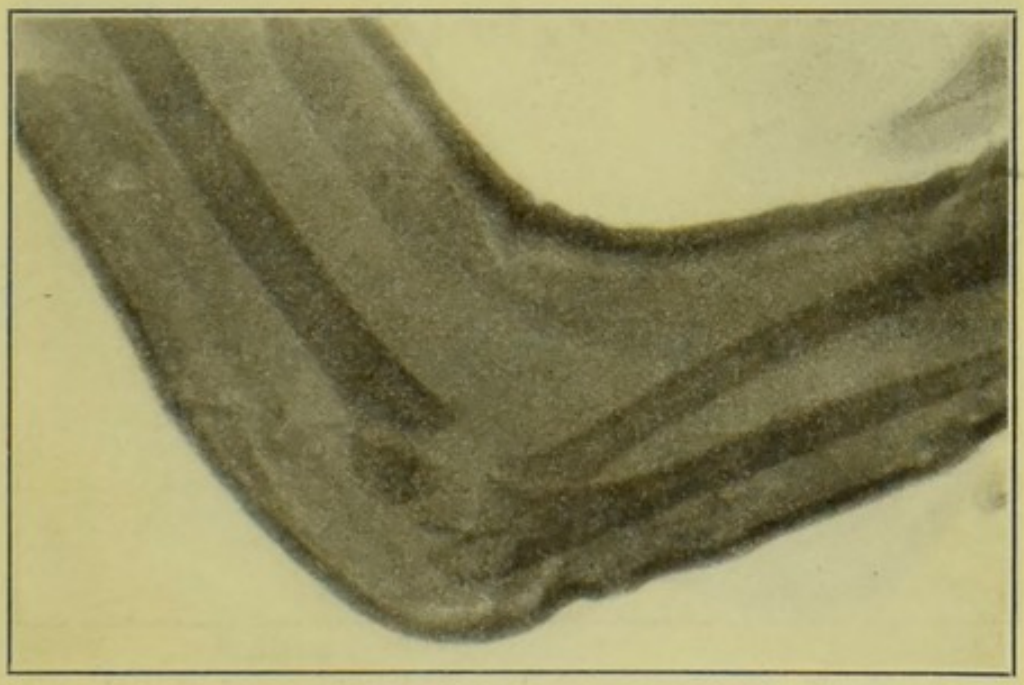

FIG. 2.—K. R. Separation of Lower Epiphysis of the Humerus; flexion at a right angle in plaster-of-Paris, fair position.

at a right angle the angle is obliterated by the muscle, the anterior border of which makes the hypothenuse of a triangle. The muscle looks to be in a state of strong contraction, but palpation shows that it is in a state of semirelaxation, still it seems to originate nearly as high as the middle third of the humerus and to pass down to the middle of the forearm. There is much tenderness and swelling.

Motion of the joint is limited by pain in the region of the radial flexors in front of the external condyle. If the arm is put up with a snug bandage and carried at a right angle in a sling the deformity and pain disappear in a week, and in another week there is no sign of injury. The reason which I

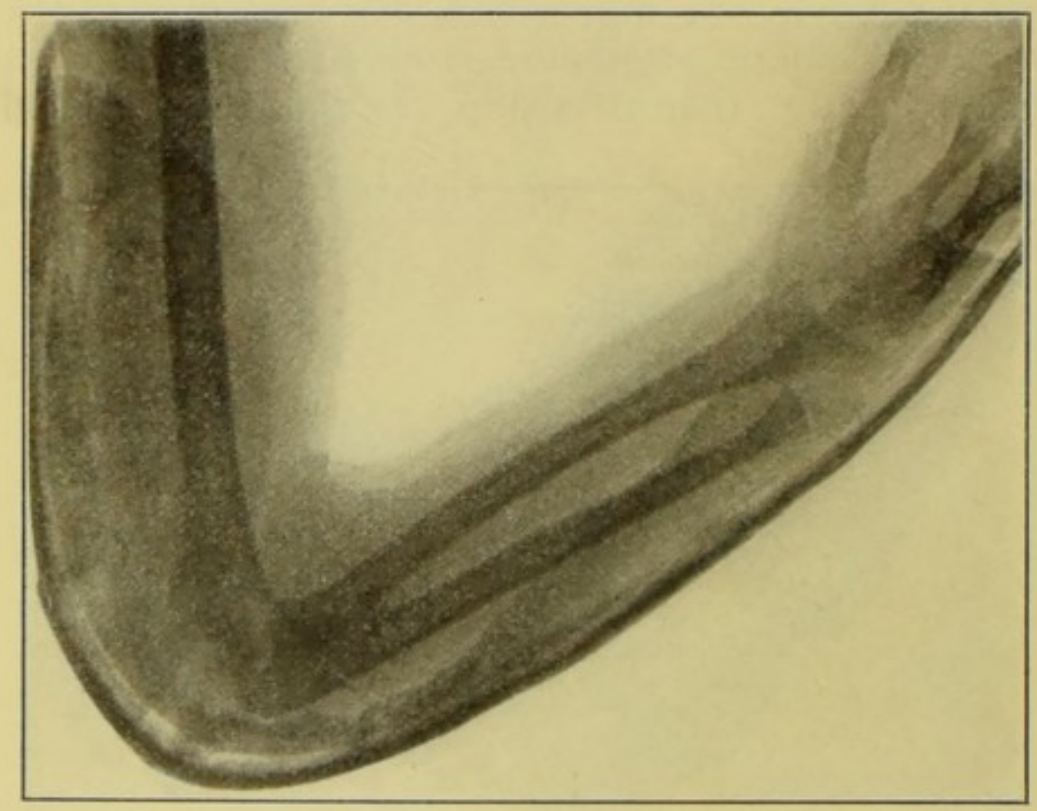

FIG. 3.—K. R. Separation of Lower Epiphysis of the Humerus; flexion at an acute angle; in plaster-of-Paris, better position.

assign for this swelling and unnatural prominence of the supinator is a rupture of the external reflection of the deep fascia, which binds down this group of muscles, and the swelling of the muscles incidental to the contusion. One of these cases I known to have been diagnosed by a competent man as fracture of the outer condyle.

When we come to the consideration of fractures of the condyles, which have had placed upon them

the unfortunate designation of "fractures of the elbow," we will do well to bear in mind the centers of ossification of the lower end of the humerus. This is particularly important because these fractures are among the common injuries of childhood.

At birth the epiphysis is wholly cartilaginous below a transverse line passing through the lower part

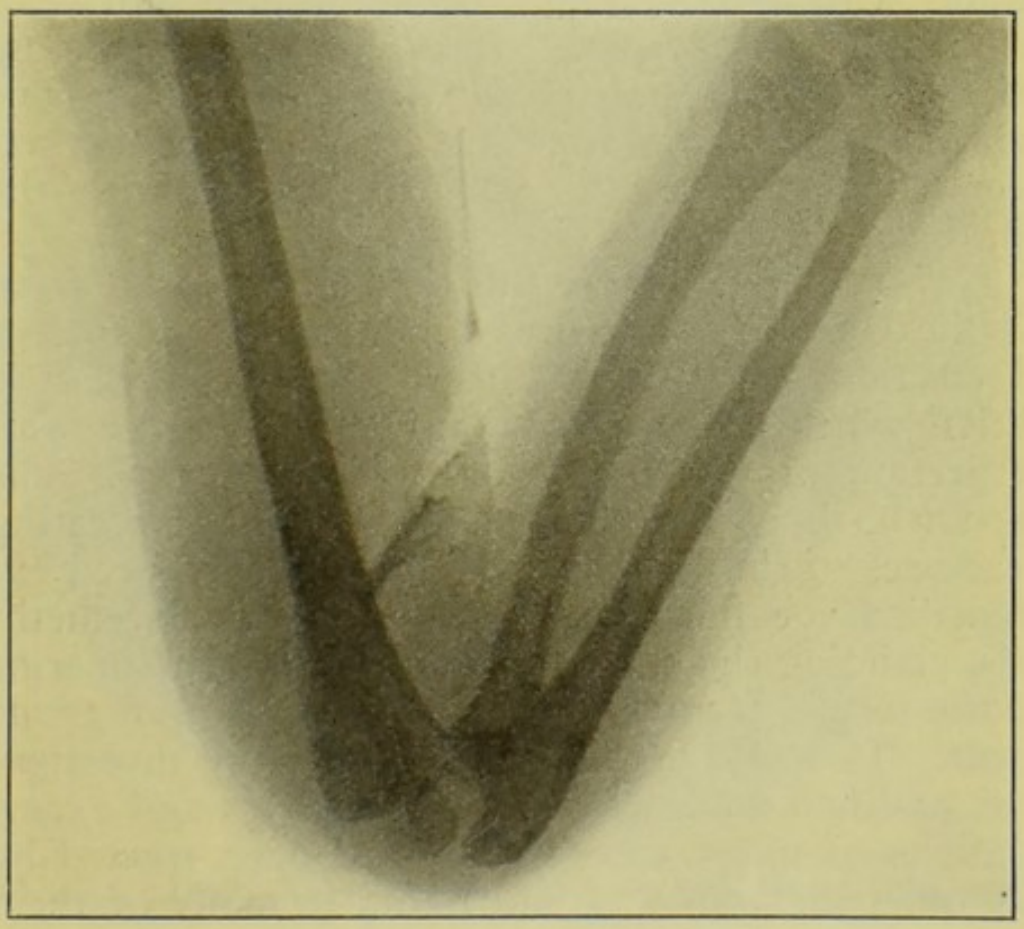

FIG. 4.—K. R. Separation of Lower Epiphysis of the Humerus; extreme flexion, perfect position. These first four figures show the changes of position produced in the same fracture by four different degrees of flexion.

of the olecranon fossa. This line soon descends centrally to the lower edge of the fossa. About the middle of the second year the first center of ossification appears in the capitellum. About the tenth

year this center has enlarged nearly to the trochlea, and an ossific center appears in each epicondyle. The diaphysis has grown down into the inner portion of the trochlea so that the lower epiphysis is a boat-shaped cartilage with its hollow upwards. The capitellum unites with the epicondyle between the twelfth and fourteenth years. After this the last point of ossification appears in the trochlea. This unites with the capitellum about the fifteenth year. Thus there is produced a cup of bone made up of the external condyle and that part of the bone which bears the articular surfaces. About the sixteenth or seventeenth year this unites with the shaft and ossification is complete.

Unfortunately, before this time a large proportion of the condyloid fractures occur; and it is in this connection that I desire to call attention to a condition which has been responsible for much misinterpretation in the treatment of these injuries. The men who have described new methods of treating fractures of the condyles have always evidenced extraordinary enthusiasm over their particular methods, claiming that their results were much superior to the results secured by any other method of treatment. This was because these men were investigators and had made painstaking inquiries and examinations of many cases which had been treated by the older methods and had found in many of them deformities which their own particular method obviated. Now, what is the explanation of this perennial condemnation of the old methods and approval of the new? The answer is very simple if we keep in mind these lines of ossification.

A child under the age of sixteen sustaining the common fracture of the external or internal condyle or the separation of the epiphysis peculiar to that

age, secures a good *immediate* result, but in the healing of the fracture, which properly speaking at this age is commonly an epiphyseal separation, the intervening cartilage is converted into bone and further growth of that particular part of the articu-

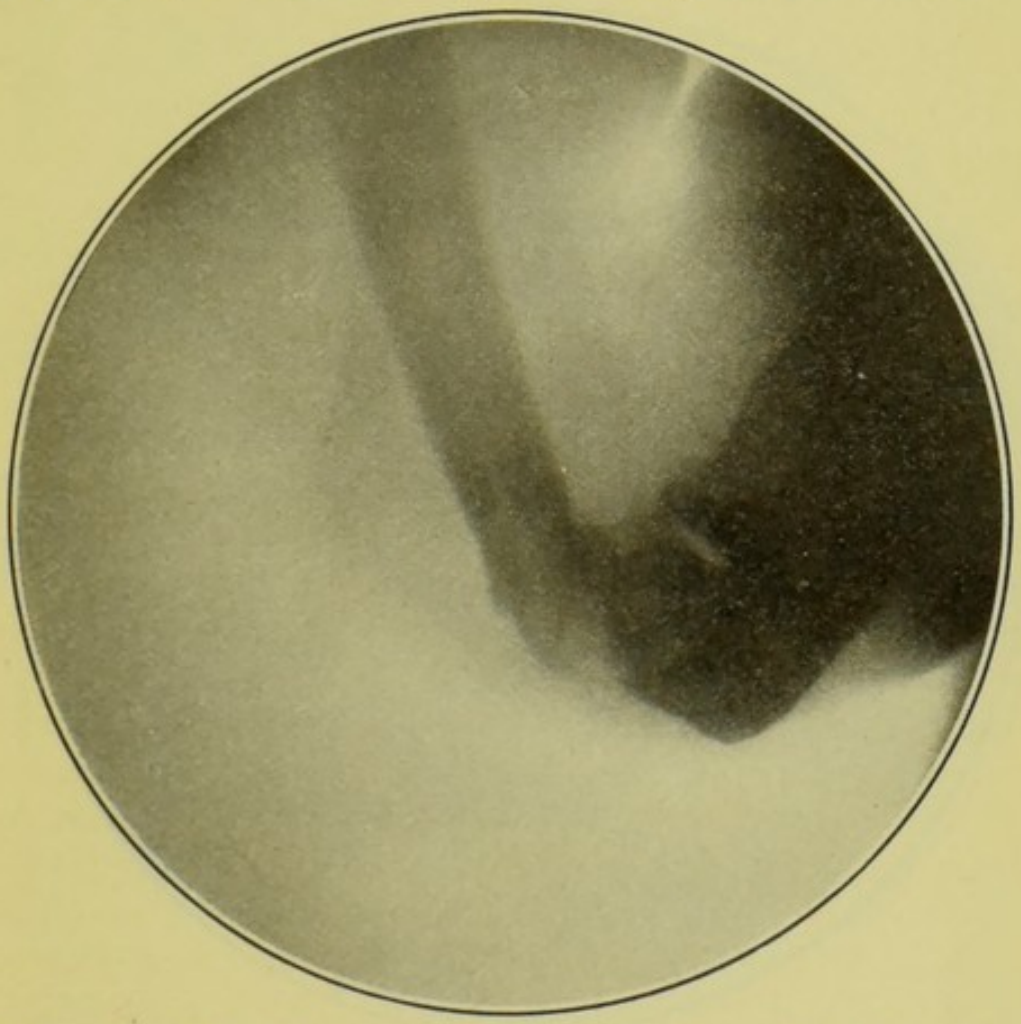

FIG. 5.—Case II. Supracondyloid Fracture; elbow flexed at an acute angle, position of fragments bad.

lar extremity stops. The surgeon who examines the arm *immediately* after the union has taken place now declares it a good result; and it is. But if the child is ten or twelve years old ossification and longitudinal growth of bone has five years more to continue in the parts of the cartilage not involved in the injury. This growth will be unequal unless

all of the osteoblastic tissue is equally converted into bone.

Thus after fracture of the external condyle the ulnar side of the lower end of the humerus continues growing after the radial side has stopped. This

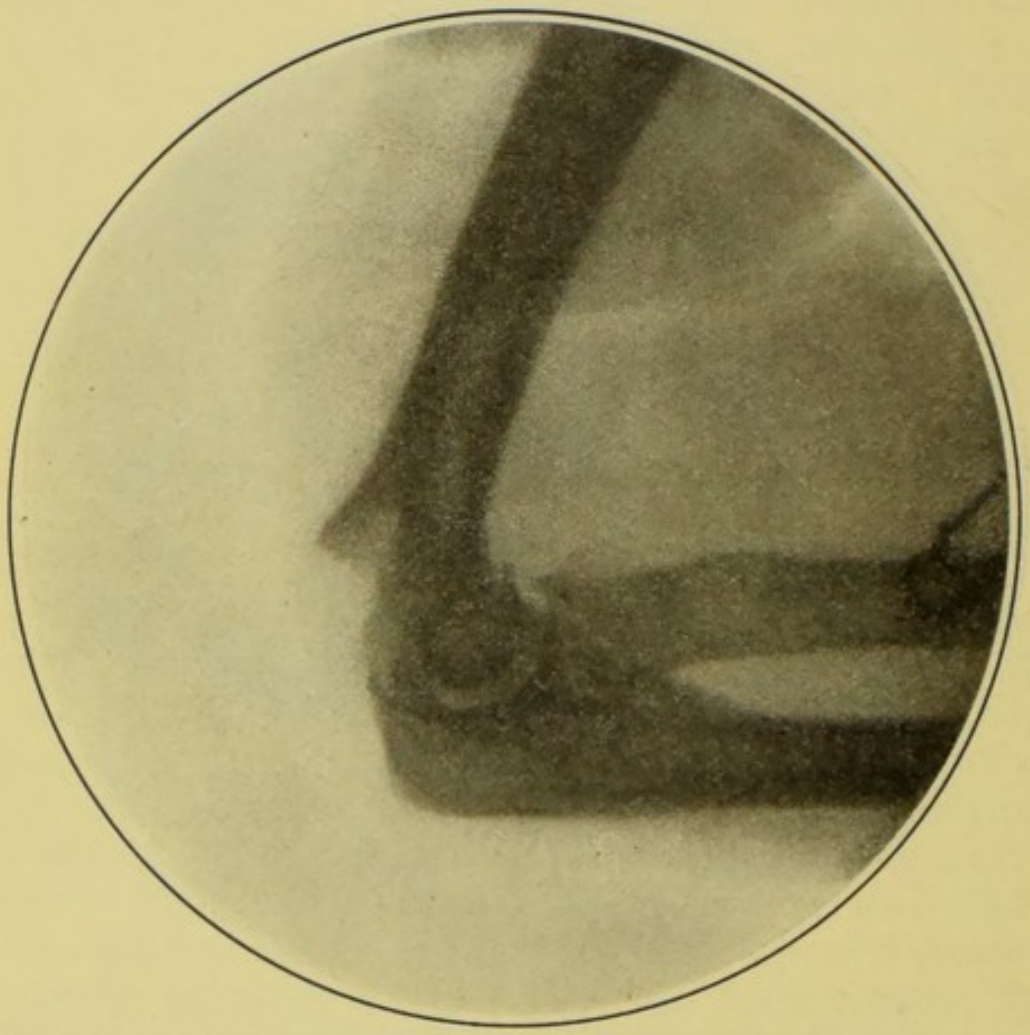

FIG. 6.—Case II. Supracondyloid Fracture; elbow flexed at a right angle, position of fragments fair.

gives a deformity which tends to increase up to the time of ossification. Fracture of the inner condyle, carrying with it the ulnar articular surface in the young, gradually results in obliteration of the so-called "carrying angle," and if growth continues, the next defect in the result which time pro-

duces is an actual adduction of the forearm, cubitus varus, or the "gunstock deformity" which is regarded as the acme of poor results. Fracture which separates the epiphysis without passing through the articular surfaces is probably a more common in-

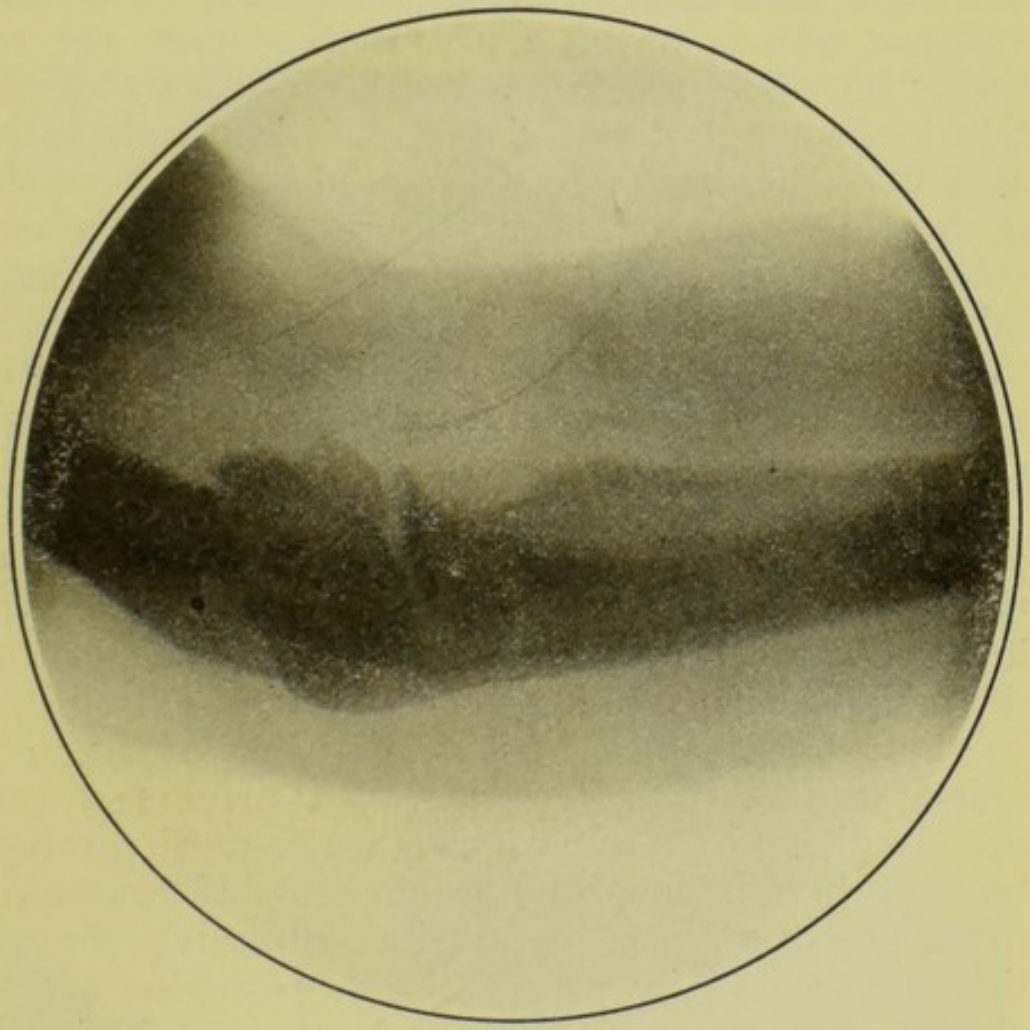

FIG. 7.—Case II. Supracondyloid Fracture; elbow straight, position of fragments good.

jury than it is supposed to be. Stimson has found a number of examples of deformity of the lower end of the humerus, due to fracture in youth, in which the bone shows no line of fracture through the articular surface of the joint. These deformities he attributes to defective healing of a separated

epiphysis, and in a paper read before the New York Surgical Society in 1900,[1] he presents this thesis. These deformities are all attributed to malposition of fragments. Still, as a matter of fact, I think it is quite clear that they are the results of time, and there is no practical means of preventing them. The surgeon who is trying a new method does not see them; his own method has not been under observation long enough to have become subject to these deformities; he has only discovered the bad results in the older methods. But when his cases have been subjected to the mutations of time, with her immutable laws of ossification and osteogenesis, many of the elbows which he reported straight will be cited as examples of bad treatment by some of his successors.

In the most important work[2] on fractures ever published in the English language are shown pictures of humeri with a pronounced curve in the lower extremity to illustrate lateral displacement of the epiphyseal fragment. The lower extremities of these bones show no defective line of fracture union, in fact the union has been so perfect that the positive signs of fracture are not discernible, but still there is the pronounced excess of downward development of the radial side, throwing the articular surfaces inwards. These examples are so clearly the results of unequal bone growth that it is to be wondered at how they could have been attributed to defective replacement of the distal fragments. Such examples of deformity will occur in the practice of every surgeon unless he can bring to bear some force to modify the natural growth of bone.

[1]Stimson: *Annals of Surgery*, Vol. 32, 1900.
[2]Stimson: "Fractures and Dislocations," 1905.

Another point to which I desire to direct attention is the fear of ankylosis in these fractures of the lower end of the humerus. I feel that there is an unwarranted dread of this condition which often is responsible for damage to the arm which otherwise would not occur. I have seen arms irre-

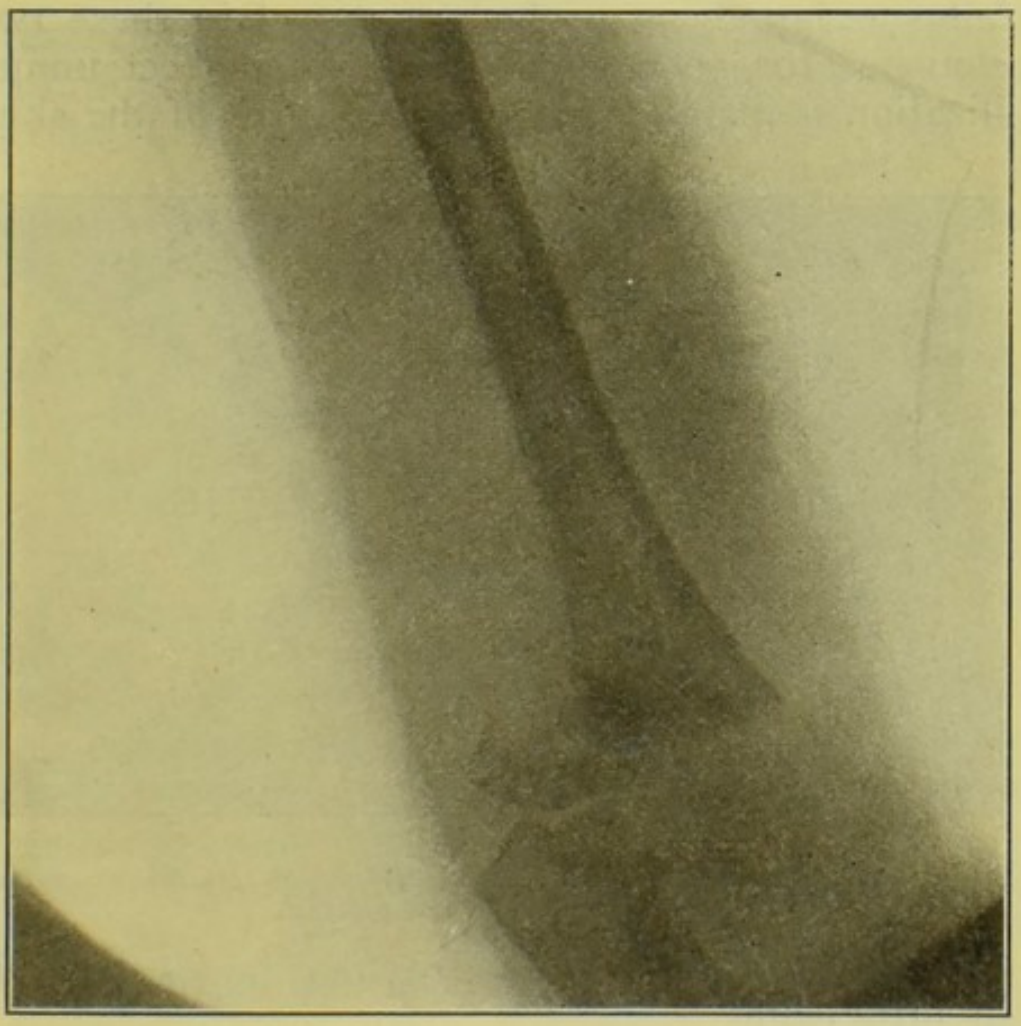

FIG. 8.—L. V. Separation of Lower Epiphysis of the Humerus; arm straight, position bad.

parably damaged by too early attempts at passive motion, which only had the effect of disturbing the apposition. Ankylosis after fracture involving the elbow joint is almost always due to imperfect reduction. If the fragments are placed in good posi-

tion in the young, we need have no fear of a stiff joint, and immobilization should be continued for at least three or four weeks or until the bone has become well united. The most important thing in the treatment of all fractures is perfect replacement and immobilization. The more perfectly these two conditions are met the less will be the callus. Callus is largely a product of defect in these two requisites for good results. Where perfect immobilization is maintained, as in fractures of the skull

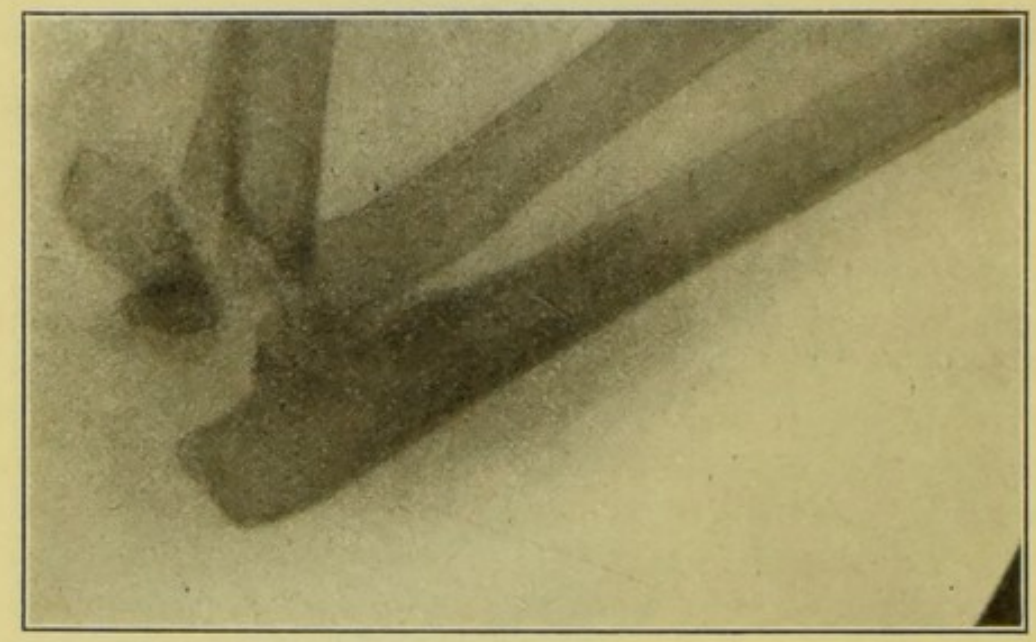

FIG. 9.—L. V. Separation of Lower Epiphysis of the Humerus; moderate flexion, bad position.

or in longitudinal fractures of long bones, there is but little callus.

One of the commonest dislocations is the backward displacement of the elbow, still its differential recognition is sometimes difficult. The surgeon should not be satisfied until he has located the two epicondyles, the olecranon, and the head of the radius. With these landmarks in hand this injury is differentiated from supracondyloid fracture. The

peculiar firmness or rigidity of the elbow is also quite characteristic of this dislocation. In its reduction, the method quite universally practised since the time of Sir Astley Cooper has been traction in the direction of the long axis of the humerus, with the elbow at a right angle, accompanied by traction forward in the direction of the axis of the forearm. An example of how not to reduce a backward dislocation of the elbow can be seen in the "International Text Book of Surgery," 1902, Vol. 1, p. 634. An even more objectionable method than this, commonly practised, consists in grasping the arm just above the elbow with one hand and making forward traction upon the wrist with the other hand, the dislocated elbow being fixed at a right angle. This is the *reductio ad absurdum* as applied to dislocations of the elbow joint.

These two methods are objectionable because they depend upon stretching or tearing the two strong lateral ligaments sufficiently to allow the coronoid process to ride over the trochlea or else fracturing the process itself. They fail to take advantage of the relaxation of the ligament which is already torn in the production of the dislocation, namely, the anterior ligament of the elbow joint. The best results in reducing dislocations are secured by causing the bone to retrace the course back into the joint which it followed in becoming displaced. This dislocation occurs when the arm is nearly in the straight position, and the tearing of the anterior ligament gives the necessary relaxation to permit the coronoid process to ride over the lower end of the humerus. Thus the anterior ligament is already relaxed, and reduction is best accomplished by traction in the direction of the long axis of the arm in the straight position. If the coronoid process engages

in the olecranon fossa, it is easily detached by hyperextension or by horizontal backward pressure. Rosser, as long ago as 1844, showed that hyperextension would overcome this condition, and still I have never had a house surgeon who applied it. When we examine the bones of this joint we find

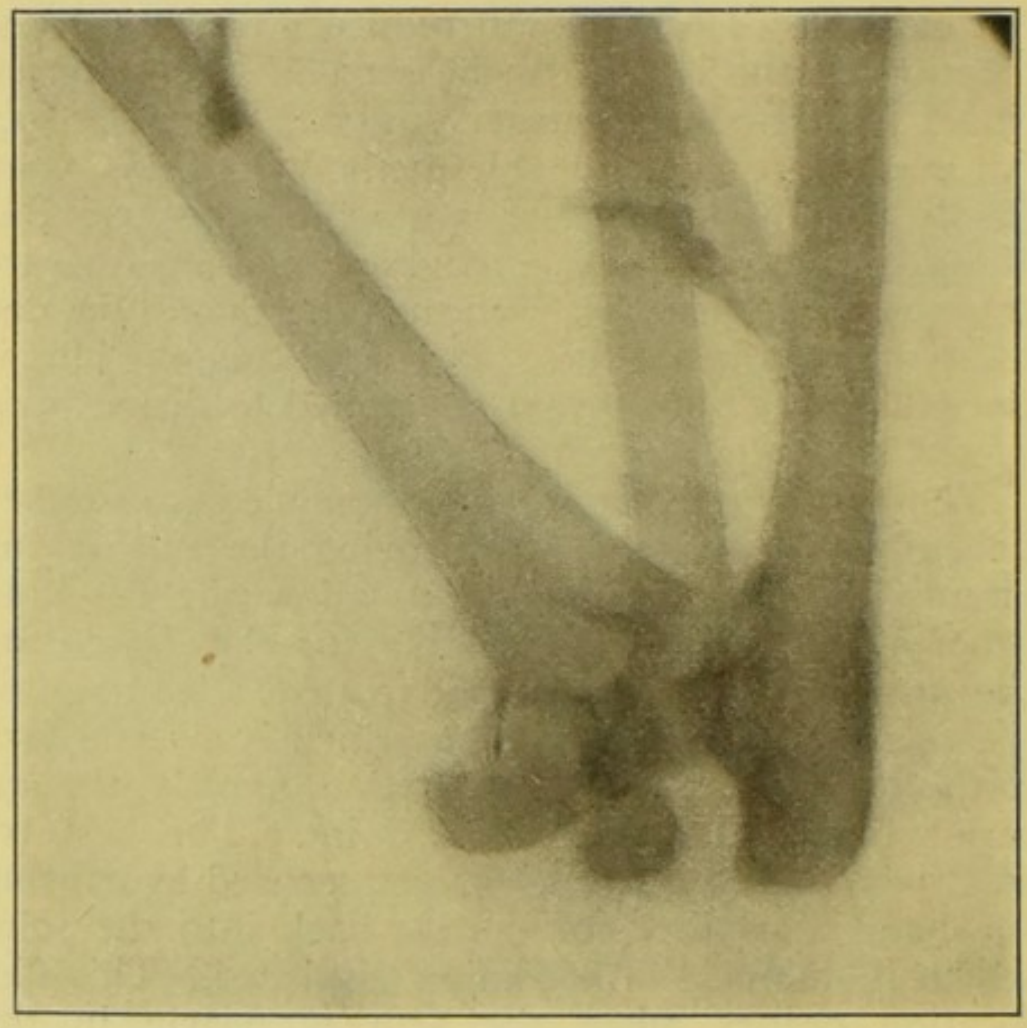

FIG. 10.—L. V. Separation of Lower Epiphysis of the Humerus; extreme flexion, bad position.

that the coronoid process is more than half an inch high, that means that to reduce the dislocation by the commonly applied right angle method the strong lateral ligaments must be elongated to that degree while the process plows over the trochlear surface,

or the process must be broken. The method of reduction which I have described above is, therefore, theoretically the only method, and practically I have found it most efficient.

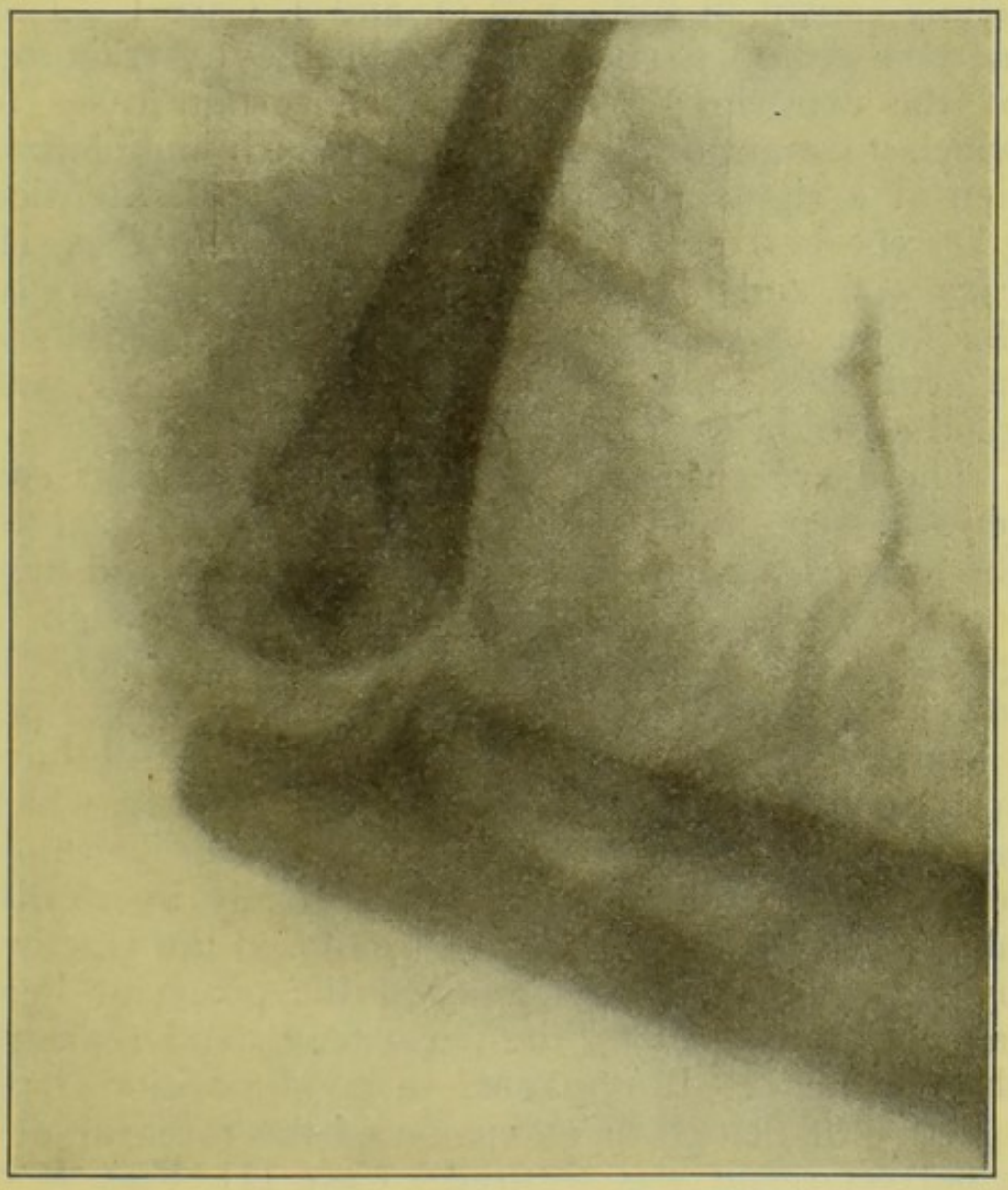

FIG. 11.—L. V. Separation of Lower Epiphysis of the Humerus; one week after operation; good position. Picture taken through the plaster-of-Paris splint.

Without entering into a general discussion of the treatment of fractures of this region, there are a few points which I should be glad to emphasize. In

speaking of treatment, I desire to testify to the value of the treatment by the method of extreme flexion in the majority of fractures of the lower end of the humerus. The effect of flexion is beautifully shown in Figs. 1, 2, 3, and 4, Case I. This method seems particularly applicable to fractures of the condyles. Yet there are certain cases to which it cannot be applied, and in which immobilization at a right angle or with the arm in extension gives the best position. This is shown in Case II, Figs. 5, 6, and 7. Here a supracondyloid fracture of the humerus shows bad position with the elbow in acute flexion, fair position at a right angle, and good position with the arm straight.

There are cases of condyloid fracture and epiphyseal separation with posterior displacement of the lower fragment in which manipulation and flexion fail to bring the fragment forward enough to give a good result. These are cases in which the lower fragment is prevented from moving into position by the strong unbroken ligaments. I have seen such a case of epiphyseal separation in which neither ligaments nor periosteum were broken posteriorly, the fragment being held firmly in its displaced position. In this case I exposed the fracture by a posterior incision, opened the posterior ligament and stripped up the periosteum, and replaced the fragment. It remained in good position, irrespective of flexion or extension of the forearm, and a perfect result was secured. Case III, Figs. 8, 9, 10, and 11.

The first essential in the treatment of elbow injuries is a familiarity with the bony landmarks; this makes accuracy of diagnosis possible. Nor should there be any hesitancy in the use of general anesthesia. For the diagnosis of fracture or dislo-

cation one should expose both elbows and with a pencil or ink mark upon the uninjured joint the three bony points: the tips of the internal and external condyles and the tip of the olecranon. With the arm in a straight position these three points should be nearly in a straight line. With the elbow

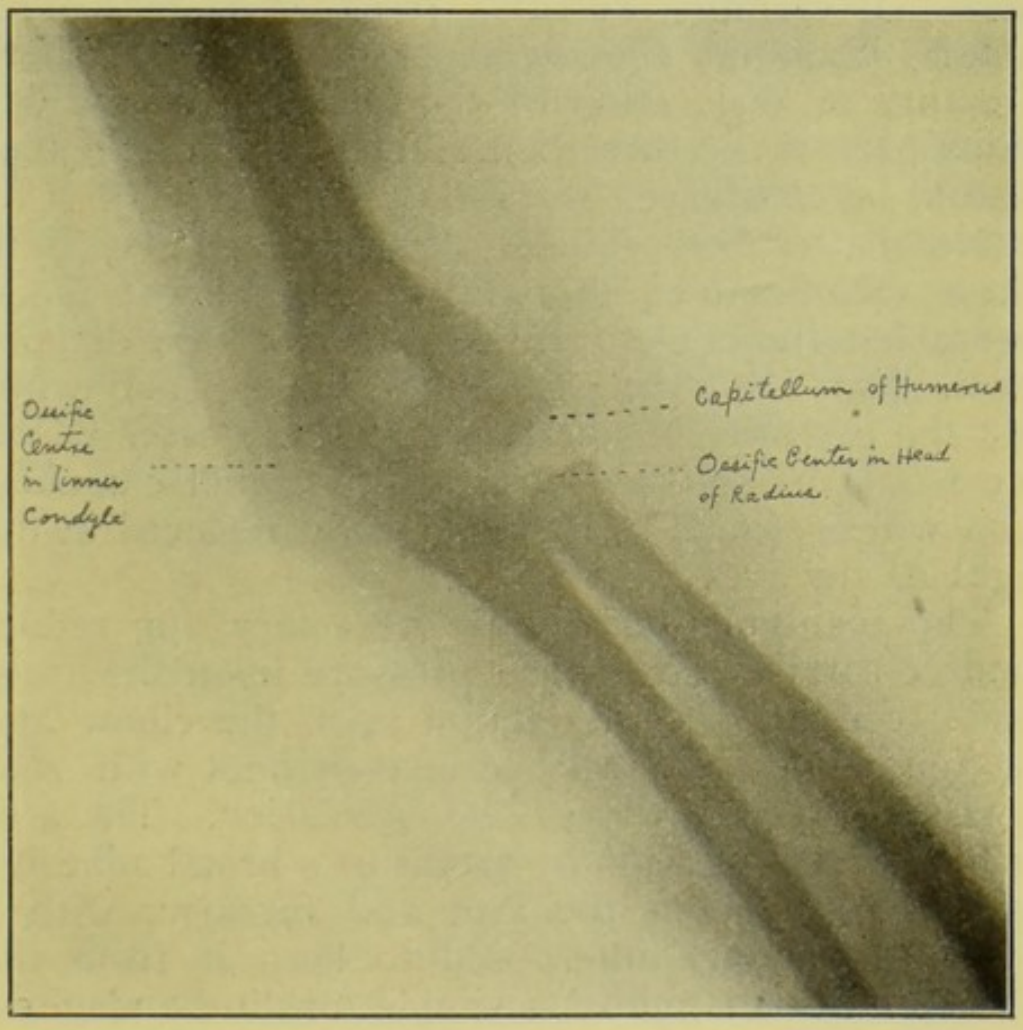

FIG. 12.—Normal elbow of a child aged 12 years.

at a right angle they should make approximately an equilateral triangle. The same marks should be made on the injured side, and the examination proceeded with. Even when there is much swelling, steady pressure will reveal the condyles. The head

of the radius should be identified, and with both arms extended, the carrying angle of the two sides should be compared. These are the important points of inspection. Systematic examination is important. One should take up separately each location and feature of the injury. Is the swelling or ecchymosis localized or diffuse? Locate the point of tenderness. Is crepitus present? Is either condyle movable? Examine the olecranon process. Is there fracture or dislocation of the head of the radius? Each part of the three bones entering into the joint should be considered *separately*.

No matter how skillful and thorough one is in these examinations the *x*-ray is an almost indispensable adjunct to treatment. It makes the diagnosis without inflicting pain or traumatism and without the necessity of anesthesia. Many cases which we would be satisfied with after manual examination will be found to be imperfectly replaced in the light of the *x*-ray.

The manipulation usually necessary for reduction consists in downward pressure upon the fragment, combined with traction upon the elbow and flexion to the strongest degree consistent with comfort and the integrity of the circulation. The arm is held in this position by means of a broad adhesive strap passed about the arm and forearm, with a layer of bandage interposed to keep it from the skin. To this is added a simple muslin bandage to keep the arm to the side and to support the elbow. I like to see an *x*-ray picture of the bones in this position. It sometimes reveals the fact that a trifle more flexion is desirable, or it gives one the satisfaction of knowing that the desired position has been secured. Occasionally we have a case in which extreme flexion does not bring the fragments in

position. This occurs in condyloid fractures through the joint, associated with traumatic relaxation of the attached ligaments, and with a tendency of the fragment to longitudinal displacement. Some of these cases seem to do better put up at a right angle, others in the straight position in extension. I stand upon the middle ground, between the extreme flexionists of Boston and the extensionists of Philadelphia, although, as I have said, flexion is applicable to the majority of cases.

Finally there are cases in which manipulation fails to produce a satisfactory reduction. These cases should have the benefit of operative exposure of the fracture and its reduction by sight and touch. These patients have a right to expect a good joint, and the surgeon should not withhold from them any advantage which his art has to offer.

386 Washington Avenue.