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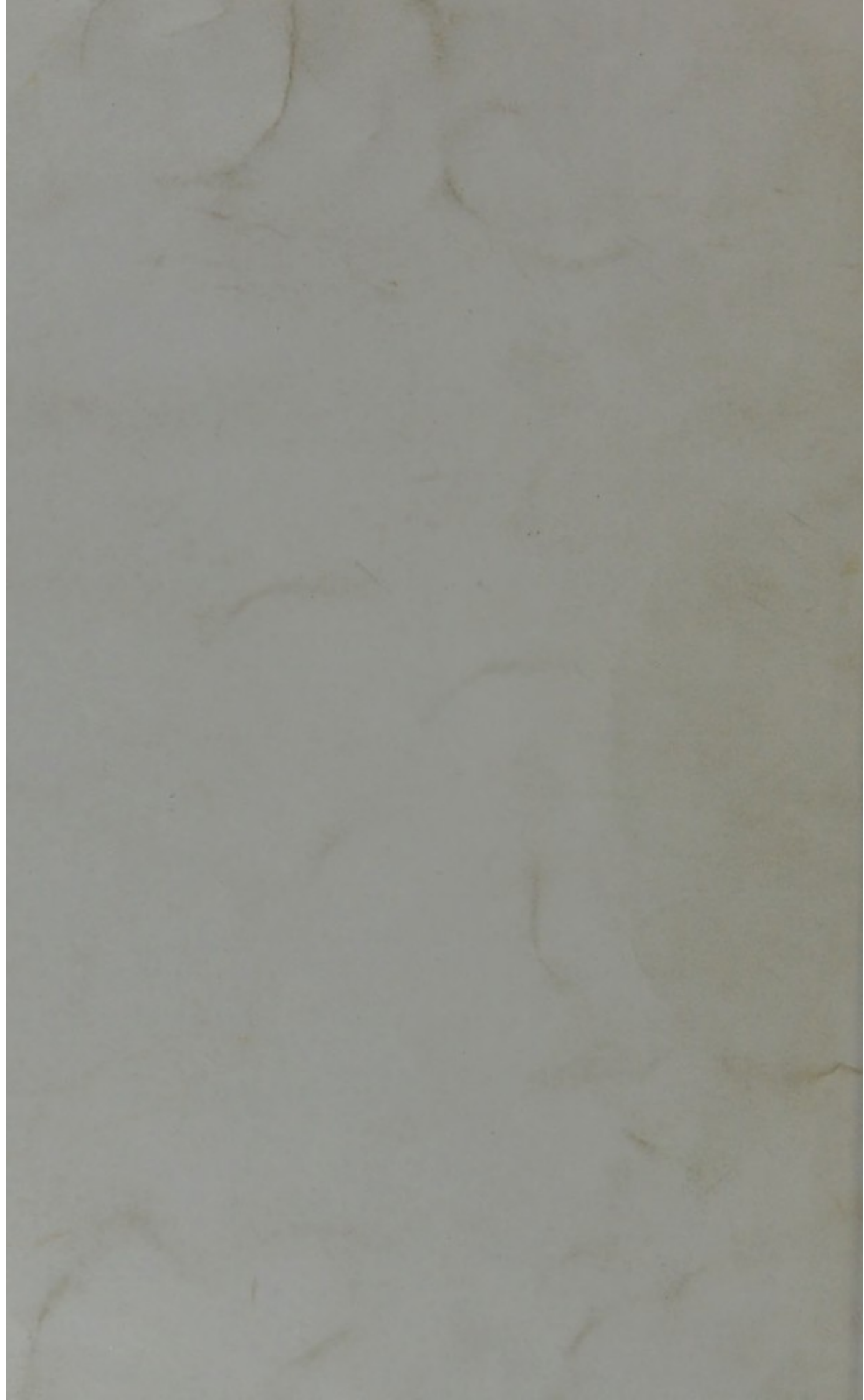
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ON THE ANATOMICAL CHANGES INDUCED AT THE  
ELBOW BY LUXATION BACKWARDS OF THE  
HEAD OF THE RADIUS IN EARLY LIFE.

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(With Lithographed Plate.)

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IN winter session, 1877-8, a male subject brought into the anatomical rooms of this University presented, amongst other abnormalities,\* a very remarkable condition of both elbow joints.

Before undergoing the process of dissection, it was quite apparent that some deformity existed, both arms being in a semi-flexed and a rigid semi-pronated position, but this was at the time attributed to some rheumatic cause, especially as the subject was considerably more than middle aged, and, as a result of this misconception, there was unfortunately neither a cast nor any notes taken of the condition of the external appearances. However, as some care was bestowed in observing the peculiarities met with in the dissection of the left limb, and the osseous parts were afterwards carefully macerated, it is to be hoped that the following description will suffice.

I. RECENT STATE.—The only movements allowed at the elbow joint were flexion and extension, but while flexion was

\* The principal additional abnormalities were—a well developed bi-lateral *sternalis brutorum* muscle, and on each side also there was a well marked example of the *subscapulo-humeralis* which was supplied by a twig of the circumflex nerve. The kidneys presented well marked lobulation, and the right one was placed low down in the pelvis, receiving its arterial supply from below the level of the inferior mesenteric.

as free as is usual in ordinary cases, extension was checked when the forearm formed a right angle with the upper part of the limb. On account of pronation and supination being inadmissible, the muscles which simply produce these movements, and nothing else, were unrepresented—viz., the *supinator brevis* and *pronator quadratus*; while the *supinator longus* and *pronator radii teres*, being used as flexors, were developed in the same proportion as the other muscles of the limb. Ligamentous fibres surrounded the joint, forming a firm capsule, but there was no representative of the orbicular ligament of the radius.

II. OSTEOLOGY.—The condition of the osseous parts explains the foregoing peculiarities. We shall begin with the description of the bones of the forearm.

A. *Radius and Ulna*.—One of the principal and most striking abnormal features exists at the upper ends of these bones, they are ankylosed together superiorly in the position which they normally bear to one another in pronation, this at once explaining the impossibility of supination. More particularly, this fusion is to the extent of three inches, extending inferiorly to below a roughness on the radius, which is the sole representative of the bicipital tuberosity, and superiorly to the summit of the head of that bone, which, instead of reaching only to the level of the coronoid process is prolonged upwards on the outside of the olecranon, behind and beyond the normal position of the lesser sigmoid cavity, to near the summit of the ulna.

Below the point of fusion the shaft of the radius is very much thickened, being as thick throughout as at its carpal end, but it is not otherwise abnormal. On the other hand, the shaft of the ulna is exceedingly diminished in thickness, and is of uniform slenderness the whole way down. The carpal ends of both bones are normal and quite free from one another.

The great sigmoid cavity is increased in width, and is slightly concave transversely. The increase in width is best marked in the coronoid portion, where there is a prominent lip of bone extending outwards in front of that part which corresponds with the neck of the radius. The lesser sigmoid cavity is absent, the portion of the coronoid process which should bear it taking part in the ankylosis between the bones.

The head of the radius is represented by a small, rough, irregularly rounded prominence, which seems not to be so intimately fused with the adjacent part of the ulna as the parts beneath it. A shallow groove circumscribes its upper

margin internally, and its anterior surface bears a flat articular facet, which encroaches partly on the neck, and whose importance is to be seen later on.

The lower portion of the fused parts seems to be made up of the bicipital tuberosity of the radius and that part of the ulna subjacent to the roughness for the *brachialis anticus*—in fact, the parts that are in the normal arm on the same level. The part between this and the head of the radius is the neck of that bone, flattened up against the ulna and fused with it. It measures  $1\frac{1}{2}$  inches, that is, exactly twice the length of the normal radial neck.

B. *Humerus*.—The lower end exhibits the chief peculiarity. The bone under consideration belongs to the left arm, but, when it is placed side by side with a normal left humerus of the same size, the upper ends of both being covered and only the anterior surfaces of their lower thirds exposed, they present the same appearance as the humeri of one subject. The articular surfaces are so altered as to furnish no guide, and the fallacy is only made apparent by uncovering their upper parts, and taking cognizance of the bones in their entire lengths. To understand the meaning of the deceptive appearance it is necessary to articulate the bones at the elbow. It is then found that only the ulna comes in contact with the humerus, and the humeral trochlear surface has its inner lip flattened and apparently worn down to the level of the lower edge of the internal supracondyloid eminence. The outer lip of the trochlea is normal, but the flattening of the inner lip is so great that the pulley-like surface is imperfectly represented. The outer condyle projects far below the inner; this, of course, is partly due to the flattening of the inner lip of the trochlea, but principally to increased downward growth.

That there is such increased downward growth at the outer condyle, distinct from the apparent elongation due to wearing down on the inner side, is a very remarkable circumstance, and easily verified. Its precise amount can be ascertained by the following mode of measurement, suggested by Professor Cleland:—First, the normal humerus is taken, and its posterior surface applied to a straight line drawn on a table, in such a way that the axis of the shaft of the bone and the line correspond. A pin is stuck in the table at the lower edge of the inner epicondyle, and another on the opposite side at a slight rough mark near the lower part of the external supracondyloid ridge, which indicates the place of junction of epiphysis and diaphysis externally. The two pins being left in the table, the normal humerus is removed, and its place supplied by the

abnormal specimen, its shaft being adapted to the line as in the first instance. It is then found that, when the inner condyle touches the pin on its side, the little roughness on the external supracondyloid ridge is half-an-inch below the other; this indicating that an increased longitudinal growth to that extent took place in the outer part of the diaphysis of the bone.

Strictly speaking, the capitellum is not absent, but it is altered in shape, presenting the same appearance as the front of the normal inner lip of the trochlea. This altered surface comes in contact in extreme flexion with the flat surface of the anterior portion of the head and subjacent part of the neck of the radius already described.

When the humerus is viewed directly from behind, no part of the trochlea can be seen; and, although there is an olecranon fossa, it is so very shallow that the septum separating it from the coronoid fossa is a third of an inch in thickness.

As regards the prominences which the bones make at the elbow, when articulated, that of the external condyle is the greatest; the inner condyloid prominence comes next in point of size, and the olecranon is least prominent. The great magnitude of the prominence formed by the external condyle is due to growth outwards, as well as the downward growth above mentioned; but, also, it is dependent, to a great extent, on the inward position of the upper end of the radius. This great alteration in the proportions borne by the prominences to one another, gives additional cause for the regret expressed at the outset, that there is no permanent record of the condition of the superficies; but it may be conjectured that the soft parts did not materially alter them.

The same condition of parts existed in the limb of the right side, but unfortunately the specimen is not now forthcoming.

On comparison with recorded cases, it becomes obvious that the altered conditions in both arms were brought about by dislocation backwards of the head of the radius in early life. The radial head slipped behind the external condyle, and, as the greatly increased length of its neck indicates, grew at a rate greater than normal when not subjected to the pressure of the humerus; also, for a similar reason, the outer condyle of the humerus grew downwards more than the inner, which was pressed on by the ulna.

The other osseous changes may be said to be of a reparative character. The shocks normally transmitted by the radius to the capitellum are, on the *point d'appui* of the head of that

bone being removed from the humerus, then transmitted through the anchylosed parts to the upper end of the ulna, and so upwards to the inner side of the humerus. Then, as the upper end of the ulna has more work thrown on it than usual, it becomes enlarged transversely, this also having the effect of giving the necessary stability to the elbow joint. But as the ankylosis of the bones amounts to the substitution of a rigid uniting medium for the more elastic ligamentous one, so, instead of some of the pressure received by the radius being transferred to the lower end of the ulna by the uniting ligaments, all the shocks pass from the lower end of the radius up through its own shaft to cross at the ankylosis; this mode of transmission accounting for the hypertrophy of the radial shaft while the ulnar one becomes atrophied.

There are several cases on record of alterations at the elbow caused by dislocation backwards of the head of the radius in early life. Dupuytren\* has described two cases; in each the affection was bi-lateral, and the neck of the radius greatly increased in length, but both bones of the forearm were quite free in their entirety.

Cruveilhier† has also described two similar cases which he observed.

R. Adams‡ rather minutely describes a specimen which exists in the Dublin College of Surgeons' Museum, and refers to another one which he saw in Guy's Hospital.§ Both cases seem to be exactly similar to those described by Dupuytren and Cruveilhier, and, like them, are also somewhat different from that described now.

In Adams' case the capitellum is altogether absent, the trochlea extending right across the whole width of the humerus, and the great sigmoid cavity of the ulna being correspondingly wide. The radial neck is twice its ordinary length, and reaches almost to the summit of the olecranon. There is, however, no fusion of radius and ulna, nor is there mention made of any change existing in the lower end of the humerus beyond a flattening of the inner lip of the trochlea.

The only instance on record of a specimen similar to that now under consideration, is one described and figured by Sandifort, so long ago as 1793. || In his case, the bones of the

\* *Injuries and Diseases of Bones.* Sydenham Society's Translation, p. 117.

† *Anatomie Pathologique.* Tome i, p. 479.

‡ Todd's *Cyclopaedia of Anatomy and Physiology*, under article "Elbow" (Abnormal Anat. of.)

§ It may be mentioned that a specimen of the same sort exists in the osteological collection of the Anatomical Museum of this University.

|| *Museum Anatomicum.* Table ciii, figs. 2, et seq.



arm are ankylosed at their upper ends in the position of pronation; the head of the radius reaches above the back of the external condyle, and is almost on a level with the summit of the olecranon; the capitellum is absent, and the great sigmoid cavity greatly widened to articulate with the trochlear surface of the humerus, which extends equally on both condyles, and has both of its lips equally prominent. There is also an increase of the radial and a diminution of the ulnar shafts. In all respects but one, this case agrees with that before us, the difference is in the absence of elongation of the outer condyle of the humerus, but, as will be seen directly, this feature adds additional interest to the case, and serves to elucidate a problem of difficult solution.

Regarding the etiology of these peculiar conditions, all observers are agreed that they are the result of dislocation in early life, but there is a difficulty in determining if this luxation took place prior or subsequent to birth. The statements of different authors concerning this point are very conflicting, for, while on the one hand Dupuytren inclines to the belief that they are congenital, Cruveilhier denies that they had such an origin. Adams, speaking of the specimen which he describes, and reviewing the cases of Dupuytren and Cruveilhier, believes with Dupuytren in their production during intra-uterine life. He is led to form this opinion, partly from the affection being bi-lateral, but principally from the alteration and great elongation which the neck of the radius had undergone, a similar elongation taking place in cases of undoubted congenital dislocation, *e. g.*, the lower end of the ulna in congenital dislocation of the wrist.

In the present instance, those arguments of Adams, in favour of the congenital origin of the dislocation are applicable, and more might be added on the same side. For, not only have we the great elongation of the radial neck, but also a proportionate increase in the length of the outer part of the humerus, and an ankylosis between the bones of the forearm more perfect than that which usually takes place between well formed bones; also, the great alteration of the radial and ulnar shafts might be placed in the same category.

To some these arguments may suffice for absolute proof of the congenital origin of such cases; but it is to be considered that at birth, and for a long time after, a thick layer of cartilage separates the diaphysis from the epiphysis of all long bones, and it is no doubt as likely then as before to undergo great proliferation, when relieved from pressure, resulting in abnormal increase in length of bone. Also,

as the upper ends of the radial and ulnar shafts can be approximated by artificial dislocation of the head of the radius backwards and pronation of the limb, one has no difficulty in understanding how fusion of the two elements would result, no matter whether their close relationship was occasioned, *ante* or *post-partum*. Remembering all this, and, at the same time, not denying that there is a good deal to be said in favour of the congenital origin of the deformity, one is able to appreciate the danger of dogmatising on such a subject of inquiry.

Apart from the question of the congenital or non-congenital origin of the dislocation, another problem may present itself for solution, suggested by the fact of the growth of the displaced bones (radius and outer part of humerus) beyond their normal levels.

The line which this second inquiry takes is concerning the influence, if any, that bones, when articulated, mutually exercise on the growth of the parts beyond their surfaces of contact. It may be asked, Do neighbouring bones check the growth of each other, and is this stunted growth fully developed only when the bones happen to slip past one another? Judging from what is so apparent in this specimen, we are led to believe that such is the case, and, although no increase in the length of the humerus is recorded in other specimens, this exceptional instance of its increase, accompanying that of the radius, tends greatly in our present line of inquiry to enable us to give the affirmative to this question.

From the description given above, it is seen that, although the trochlea is widened, it does not encroach on the external condyle, and only slightly interferes with the capitellum. In the other cases the trochlea is described as extending right across the humerus, totally effacing the capitellum, the great sigmoid cavity being correspondingly increased in width and pressing against both condyles equally. As this has been the case in Sandifort's specimen, which, in other respects, is so like the present one, it is selected for comparison, as we are the better able to judge of the consequences of the discrepancy between them. It is seen, on comparison of the two cases, that where the ulna spread laterally and came in contact with both humeral condyles, one was as prominent as the other; but where the lateral increase of the articular part of the ulna was not so great, the outer condyle, being free, projected, *i. e.*, grew, considerably below the inner.

It may be added, in conclusion, that however forcibly this comparison may strike the observer, it still requires the aid of

experiment before it can be laid down as a definite law that the growth of a bone is checked by the pressure of neighbouring ones.

DESCRIPTION OF PLATE.

- Fig. 1. Radius and ulna seen from the inside.  
Fig. 2. Same specimen, anterior aspect.  
Fig. 3. Abnormal humerus, front view: dotted line opposite the rough mark on external supracondyloid ridge referred to in the text.  
Fig. 4. Lower end of same from behind.  
Fig. 5. Lower end of normal humerus, for contrasting with Fig. 3, the dotted line being placed opposite the corresponding rough mark on outer epicondyloid ridge.



