

CHAPTER XXII.

FRACTURES OF THE RADIUS.

OF one hundred and twenty-seven fractures of the radius which have been recorded by me, not including gunshot fractures, or fractures demanding immediate amputation, three belonged to the upper third, ten to the middle third, and one hundred and fourteen to the lower third. Of those belonging to the lower third seven were through the shaft, more than two inches above the lower end, two were fractures of the styloid processes, and the remainder, one hundred and five, were Colles's fractures. Five were compound, and one hundred and twenty-two simple. Sixty-nine are reported as occurring in males, and fifty-eight in females; sixty-one as having occurred in the left arm, and forty-one in the right.

Fractures of the Upper End.

a. Fractures of the Head.—Most of the fractures of the head of the radius which have been satisfactorily demonstrated, were longitudinal or nearly so.

I have seen in Dr. Mütter's collection two specimens of fracture of the outer half of the head of the radius. In one the small fragment is slightly displaced downwards in the direction of the axis of the bone; and in the other the fragment is thrown outwards, or to the radial side. Both are firmly united in their new positions.

Stimson says, in his treatise on Fractures, that he met with two cases, in one of which the injury was the result of a direct blow, and the other was accompanied with a dislocation of the radius and ulna backwards. In both cases he practised resection, but he does not say with what result. He has seen, also, one other case treated by Dr. Townsend, of Bellevue Hospital, in which one year after the accident the fragment remained movable, but the motions of the joint were completely restored.

Bruns¹ has collected twenty-two cases of longitudinal fracture of the head, recorded or observed by Hodges,² Verneuil,³ Flower,⁴ Gross,⁵ Gurli,⁶ Weichselbaum,⁷ Lesser,⁸ Hüter,⁹ and himself, respectively. Malgaigne has also mentioned one.¹⁰

According to Bruns, this fracture "may be incomplete, and then the fissure may be single or multiple. When it is complete, a fragment of

¹ Bruns, des frak. des radius kopfchens, Centralblatt für Chir., 1880, No. 22, pp. 353-358.

² Hodges, Bost. Med. and Surg. Journ., Dec. 6, 1866, p. 383, and 1877, p. 65.

³ Verneuil, Javavay, Frac. des Artic., Thèse d'agrég., Paris, 1851.

⁴ Flower, Holmes's Surg., vol. 2, 2d ed., p. 791.

⁵ Gross's Surg., 1859, p. 181.

⁶ Gurli, Handbuch der Lehre von den Knochen, 2d theil, Berlin, 1865, p. 810.

⁷ Weichselbaum, Virchow's Arch., Bd. 57, p. 127.

⁸ Lesser, Deutsche Zeitschrift für Chir., Bd. 1, p. 292.

⁹ Hüter, Verhandl. der Deutschen Gesellschaft für Chir., V. Kongress, 1876, p. 39.

¹⁰ Malgaigne, Poincot, op. cit., p. 332 et seq.

the anterior border is generally found separated from the bone; at times, then, the fracture is entirely intra-articular, and the fragment of bone is loose in the interior of the joint; at others it extends beyond the articulation, and the fragment may be held in place more or less by the annular ligament.

"Fracture of the head of the radius may be isolated (five times out of twenty-two cases), but more often it is complicated with lesions of the neighboring bones (four times with fracture of the external condyle, three times with fracture of the olecranon, of the coronoid process, and of the neck of the radius, twice with fracture of the olecranon and the coronoid process, twice with a fracture of the coronoid process and a dislocation of the forearm, once with fracture of the shafts of the humerus and ulna and dislocation of the radius forwards). As may be seen, the most frequent complication is fracture of the coronoid process.

"Although fracture of the head of the radius is sometimes produced by a direct injury, it is most frequently the result of an indirect cause, such as a fall upon the hand, the arm being extended; in this position, indeed, the external condyle comes in contact only with the anterior part of the head of the radius. This fracture sometimes occurs when the forearm is in a state of extreme flexion; in such case it is probably the result of violent contact of the anterior border of the head with the anterior surface of the humerus."—*Poincot*.

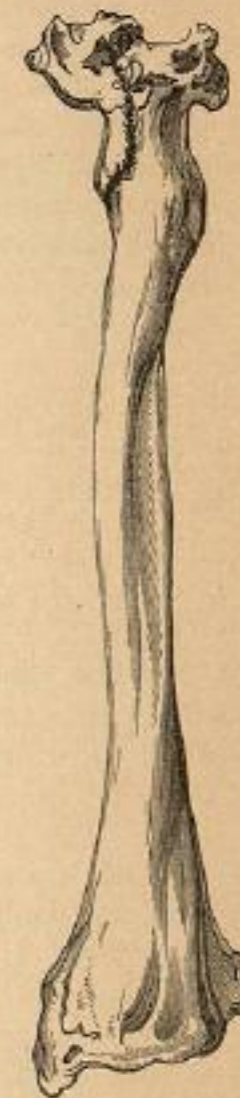
The diagnosis of this accident is in many cases difficult. Occasionally, when the fracture is complete, a movable fragment may be recognized, with crepitus; and in other cases its existence may, perhaps, be inferred from the increased breadth of the head of the radius, the condition simulating a partial dislocation forwards.

Bruns says that out of seven observations where the results could be established, three times bony consolidation occurred, once the fragment united by callus to the coronoid process, and three times the isolated fragment finally became a truly foreign body in the articulation. Hüter, in his case, was obliged to resort to arthrotomy in order to extract this foreign body of a new kind.

Kofmohl¹ affirms that a longitudinal fracture of the head of the radius is more common in childhood than in adult life, he having met with seventeen cases in a total of fifty-two fractures of the forearm, and twelve of the subjects were from one to four years of age. He states, moreover,

¹ Kofmohl, Ueber den intrakap., Bruch des radius, etc., Wiener Med. Presse, No. 12, p. 369, 1879.

FIG. 90.



Fracture of head of radius. (Mütter's Collection. Specimen A, No. 105.)

that it is caused most often by lifting the child by the arms; that the pain accompanying the accident is usually felt at the wrist, and that the results are of the simplest kind, the functions of the limb being completely restored in from three to four weeks. In my opinion, these statements of Kofmohl ought to be received with much hesitation.

In regard to the treatment of this fracture, in case it be recognized, it would seem that it ought to be directed chiefly, as in most other fractures involving joints, to the prevention of ankylosis, by careful but persistent motion of the joint by flexion and rotation. The result might be a fibrous union, or perhaps non-union and necrosis of the fragment; but even this latter result would be no more serious than a permanent ankylosis. Stimson, however, who seems to regard union of the fragments as the most important indication, recommends immobilization; the question of the position of the arm, and the general management, being left to the discretion of the surgeon in each particular case. It is probable, however, that in most cases a more or less flexed position of the arm, with supination, will insure the most satisfactory results. In case ankylosis were to result, the flexed position, at a right angle, would give the most useful arm.

b. Fractures of the Neck.—Fracture of the neck of the radius, as a simple accident, uncomplicated with any other fracture or dislocation, is exceedingly rare; yet, owing to the depth of the superincumbent mass of muscles, and the difficulty of determining, where so many bones and processes approach each other, precisely from what point the crepitus, if any is found, proceeds, surgeons have often been deceived, and they have believed that they were the fortunate possessors of this rare pathological treasure, when the autopsy has too soon disclosed their error. Both B. Cooper and Robert Smith have alluded to this difficulty, and the case reported by Dr. Markoe to the New York Pathological Society, and published in the *American Medical Monthly*, will serve to illustrate the same point; in which case the signs of a fracture of the radius at its neck were such as to deceive that experienced surgeon, yet the autopsy disclosed the fact that it was a dislocation of the head of the radius forwards, with a fracture of the ulna. Indeed, its existence as a form of fracture was doubted by Sir Astley Cooper, and by others has been actually denied. I have seen no specimen obtained from the cadaver, except the doubtful one contained in Dr. Watt's cabinet, and of which I have furnished an account, accompanied with a drawing, in my report to the American Medical Association,¹ and the specimen owned by the late Dr. Mütter, of Philadelphia, of which he has kindly furnished me the following description: "History unknown. The line of fracture seems to have passed through the neck of the left radius, just at the upper extremity of the bicipital protuberance. Union with deformity has resulted. Owing to the fracture having taken place within the insertion of the biceps, that muscle appears to have drawn forward and upward the lower end of the short upper fragment. In consequence of this movement, the articulating facet of the head of the radius is tilted backwards, so as no longer to be in contact with the humerus. As a secondary consequence, the anterior edge of the head of the radius rests

¹ Transactions, vol. ix. pp. 157, 229.

permanently against the articulating surface of the humerus. At this new point of contact a new surface of articulation is seen to have been formed, while the original articulating facet is directed backwards, and lies at right angles to the one of more recent formation. At the inner edge of the new articulation of the head of the radius with the humerus, contact with the ulna has developed another surface of articulation. The upper and lower fragments are united at an angle, and the radius does not appear to have lost in length."

Velpeau has once demonstrated the existence of this fracture in a dissection, but the fracture was accompanied with a fracture also of the coronoid process; and Bérard obtained possession of a similar specimen. I do not remember to have seen a notice of any others. Malgaigne affirms, with his usual frankness, that although he has occasionally believed that he had met with it, the autopsy, whenever it has been obtained, has shown that it was rather a subluxation than a fracture. On the other hand, Mr. South calls it a "not unfrequent accident," but in confirmation of this declaration he cites no examples.

While, therefore, the presence of what appear to be the rational diagnostic signs has compelled me to record one case as an uncomplicated fracture of the neck of the radius, and two others as fractures at this point accompanied either with a fracture of the humerus or a dislocation of the ulna, I am prepared to admit that some doubt remains in my own mind as to whether in either case the fact was clearly ascertained; nor do I think, speaking only of the simple fracture, that it will ever be safe to declare positively that we have before us this accident, lest, as has happened many times before, in the final appeal to that court whose judgment waits until after death, our decisions should be reversed.

Nothing, perhaps, could more fully illustrate the difficulty of diagnosis in the case of injuries received in the neighborhood of the head or neck of the radius than the testimony given in the case of *Noyes vs. Allen*, tried in the Supreme Court at Cambridge, January, 1856, before Judge Bigelow. Mr. Noyes injured his elbow, January 7, 1854, and Dr. Allen, who was called immediately, believed that the ligaments of the joint had been torn, but that no bones were broken or displaced. On the following morning he was dismissed, and Mr. Noyes went home. Three weeks later it was seen by Dr. Dow, who also thought there was no fracture. About eight weeks after the accident a physician examined the arm, and declared the neck of the radius broken, and the fragments displaced; and when the case was finally brought to trial he testified

FIG. 91.



Fracture of neck of radius (Mütter's cabinet). a. Original articulating facet. b. New articulating facet. c. Projecting fragments.

still that such was certainly the fact; and five other physicians, not one of whom, however, we are told, was a member of the State Medical Society, testified positively that the radius was broken at its neck, producing a bony protuberance; that such an injury only could account for the symptoms manifested at the time of the accident, and that no other fractures or injuries of the joint could explain so well the present appearances of the arm. While, on the part of the defence, six of the most intelligent medical gentlemen of the State, Drs. Kimbal and Huntington, of Lowell, and Drs. Townsend, Lewis, Clark, and Gay, of Boston, testified that the head and neck of the radius were not displaced, nor was there any evidence that this bone had ever been broken. There is every reason to believe that these latter gentlemen were correct; yet it is to be presumed that the gentlemen who first testified were not without some grounds for their opinions so confidently expressed.

The case was given to the jury after a trial of five days, who promptly returned a verdict for the defendant.¹

When the fracture occurs, the upper end of the lower fragment will probably be carried forwards by the action of that portion of the biceps which has its insertion into the tubercle; and the displacement in this direction must necessarily be increased in proportion as the arm is straightened. In the cabinet specimen belonging to Dr. Mütter (Fig. 91), the line of fracture, commencing in the neck, has terminated in the tubercle; consequently the biceps, having still some attachment to the upper fragment as well as the lower, has drawn them both forwards.

The same anterior displacement I have noticed in all of the supposed living examples, but whether both fragments or only one had suffered displacement I am unable to say.

A girl, æt. 11, living in Ontario Co., N. Y., fell from a tree, and injured her right arm. Her surgeon, who regarded it as a fracture of the neck of the radius, reduced the fragments, and placed the forearm at a right angle with the arm. On the twenty-eighth day all dressings were removed, and the patient was dismissed, the fragments seeming to be in place. The parents, finding the elbow stiff, now made violent and successful efforts to straighten the arm.

Fifteen months after the accident, the child was brought to me. There was at this time a bony projection in front, opposite the neck of the radius, which I believed to be the point of fracture. The hand was forcibly pronated, and she had only a limited amount of motion at the elbow-joint. The ankylosis was probably due to inflammation directly resulting from the severe contusion; but it is quite probable that the forward displacement of the fragments was alone due to the too early and too violent attempts to straighten the arm; at least, this was the explanation which I ventured to give to the parents at the time.

The second case occurred in a lad eight years old, living in Wyoming Co., N. Y. His parents brought him to me ten weeks after the injury was received, and I then found the forearm bent to a right angle with the arm, and ankylosed at the elbow-joint. The hand was also forcibly pronated, and could not be supinated. In front, and opposite the neck

¹ Amer. Med. Gazette, vol. vii. p. 299.

of the radius, there was a distinct bony projection, which I believed to be the point of union of the bony fragments. The external condyle seemed also to have been broken.

The third example, treated originally by Dr. Nott, of Buffalo, was seen by me six months after the accident. The upper end of the lower fragment seemed to be displaced forwards. There was very little motion at the elbow-joint, and both pronation and supination were completely lost.

In the treatment of fractures of the neck of the radius, we must not neglect to flex the forearm upon the arm, so as to relax, as completely as possible, the biceps, whose advantageous insertion into the tubercle of the radius would be certain to produce displacement, unless this position was adopted. A single dorsal splint, properly padded, should support the forearm, while the surgeon, having placed a compress over the upper end of the lower fragment, proceeds to secure the whole with a roller.

Especial care must also be taken to prevent the forearm from being extended before the bony union is fairly consummated, lest the biceps, now firmly contracted, should draw the lower fragment forwards, as it must inevitably do while the bony union is imperfect; an accident which, there is some reason to believe, occurred in one of the examples which I have already cited.

If the patient be a child, or if there is any reason to suppose that these rules will not be faithfully complied with, it would be well to secure the arm in this position with a right-angled splint.

Fractures below the Insertion of the Biceps, and above the Insertion of the Pronator Radii Teres.—When the fracture occurs at this point, Mr. Lonsdale suggests the propriety of placing the forearm in a condition of supination, at least so far as practicable, for the purpose of securing a proper apposition of the fragments. His argument in favor of this practice is ingenious, and deserves consideration.

When the bone is broken anywhere in this portion, the action of the pronators upon the upper fragment ceases; while that of the biceps, which is a powerful supinator, continues; consequently the upper fragment becomes at once, and completely, rotated outwards or supinated. Now, if the hand, to which the lower end of the radius alone remains attached, should be forcibly pronated, the radius will also be rotated inwards upon its own axis; and although it might be possible in this condition to bring the broken ends into contact, and a bony union, without deformity, might be consummated, yet the power of supination must be forever lost; since the union has been effected while the head and upper fragment are already in a state of complete supination; and if such is the fact, it is evident that the whole bone, together with the hand, will be incapable of any further supination.

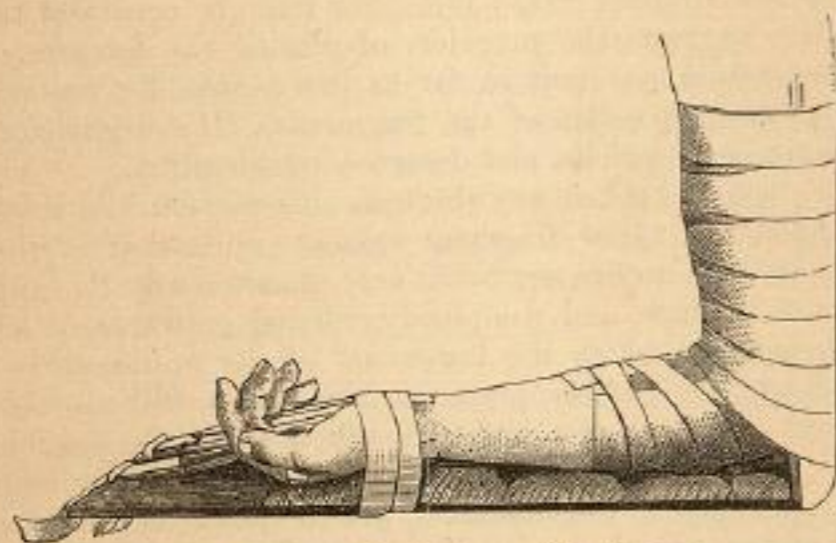
It is not, indeed, the practice with any surgeons, so far as I know, to treat this fracture with the hand placed in a position of extreme pronation; but the case has been supposed for the purpose of rendering the argument more intelligible. The usual practice is to place the forearm and hand in a position midway between supination and pronation, and then to lay it across the body at a right angle with the arm; but it is plain that the same objection, differing only in degree, will apply to this

position as to that of pronation. The axes of the two fragments are not made to correspond, since, while the lower fragment is only half rotated outwards, the upper fragment is completely, and the result of the union must be the loss of one-half the power of supination in the hand.

It is only, then, by complete supination of the hand during treatment that this difficulty can be avoided, and I have no doubt that we ought to adopt this plan, whenever it is practicable to do so, or whenever we are not hindered by serious obstacles; and the only obstacle which occurs to me as likely to interpose itself, is the practical one which most surgeons must have experienced in treating all injuries of the forearm, whether fractures, or only severe contusions of the muscles, etc., namely, the constant and almost uncontrollable tendency of the hand to assume the prone or semi-prone position. This is due, no doubt, to the great preponderance of power in the pronators; and such is the resistance which they afford to supination that it is often quite impossible to lay the hand upon its back while the forearm is across the body, and, if accomplished, the position generally becomes in a few hours so painful as to be intolerable. By extending the arm, however, and laying it upon a pillow, the hand will be found again to rest easily upon its back, because in this way we avail ourselves of the outward rotation of the humerus at the shoulder-joint.

Dr. X. C. Scott, formerly Resident Surgeon to the Brooklyn City Hospital, in his inaugural thesis, submitted in March, 1869, has dis-

FIG. 92.



Scott's apparatus for fractures of the forearm.

cussed very fully the advantages of this position in many fractures of the forearm, and he has devised a very ingenious mode of securing the limb after supination is effected, adding also a moderate amount of extension by adhesive plasters and elastic bands.

Dr. Scott informs me that he has treated twenty-five cases very successfully at the Brooklyn City Hospital and elsewhere, by this method.

Fractures of the Shaft.—It has already been stated that of the whole number of fractures of this bone recorded by me, amounting in all to 127, only 10 belonged to the middle third; an observation which is in

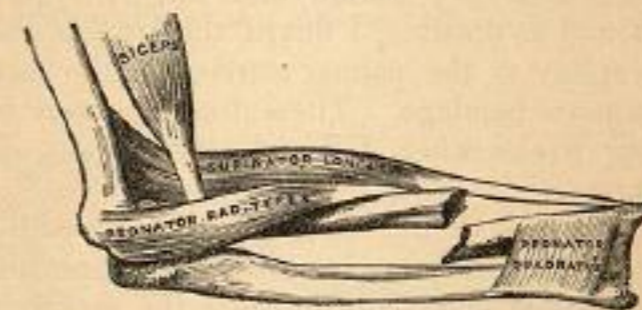
striking contrast with the remark of Chelius, that it is broken most frequently in its middle.

If the fragments are completely separated in the middle third, the lower end of the upper half is drawn forwards by the action of the biceps aided by the pronator radii teres, in case the fracture is below its insertion; while the lower fragment is tilted toward the ulna by the conjoined action of the supinator radii longus and pronator quadratus. But as to the direction of the displacement, much will depend upon the direction of the force by which the fracture has been occasioned.

A laboring man, æt. 35, broke the radius near the lower end of the middle third. On the same day I replaced the fragments as well as I could in the midst of the swelling which had already occurred, and applied two broad and well-padded splints, one to the palmar and one to the dorsal surface of the forearm.

On the twenty-eighth day I first discovered that the fragments were projecting in front, and I at once proposed to thrust them back by force, but the patient declined allowing me to do so. I then applied a compress near the summit of the projection, but not exactly upon it, lest it should cause ulceration, and secured over this a firm splint. At first this seemed to produce a change in the fragments, but after a couple of weeks I found there was no improvement, and it was discontinued. About six months after the fracture occurred, this man had the same arm terribly lacerated in a railroad accident, and I was obliged to amputate near the shoulder-joint; and I thus obtained the

FIG. 93.



Fracture of the shaft of the radius. (From Gray.)

broken radius. The bone was firmly united, but with an angle, salient forwards, of about ten degrees. There was no inclination toward the ulna.

My impression is that these fragments were never completely replaced, a point which I could not well determine at first on account of the rapid effusion. If they had been, I think they could have been retained in place with the appliances used. Almost every day the limb was examined, and as often as every fourth or fifth day the dressings were removed and carefully reapplied. And only once did they become so loose as not to afford the requisite support, and this at a period too late to have occasioned the deformity.

We ought not to be deceived, therefore, and promise too confidently a perfect limb, even when but the radius is broken, since we may not always be certain that the ends are well replaced, or perhaps they may

become displaced subsequently, and in either case we are not likely to discover the deformity until the swelling has subsided, and it is too late to apply the remedy.

In the treatment of fractures of the middle third, the same rules, with only slight modifications, will be applicable, as in fractures of both bones. Two straight, long, and broad splints must be applied after being carefully padded; and especial attention should be paid to the tendency of the fragments to become displaced forwards and toward the ulna through the action of both the biceps and the pronator radii teres; a tendency which may in some measure be provided against by flexion of the arm, but which must be overcome chiefly by steady and well-adjusted pressure, near, but not upon, the ends of the fragments.

Fractures of the Lower End.—Fractures of the lower third, occurring above the line of Colles's fracture, are almost as rare as fractures of the middle or upper third. I have recorded seven; one of which it will be proper to relate as a representative example:

George Vogel, *et. 30*, was admitted to the Buffalo Hospital of the Sisters of Charity, Nov. 2, 1852, with a fracture of the right radius about three and a half inches above its lower end. The hand was prone, and inclined to the radial side; while the broken ends of the radius fell against the ulna, from which it was found difficult to separate them. The lower end of the ulna was prominent, and projecting upon the ulnar margin of the hand.

I was unable completely to separate the fragments of the radius from the ulna, by either pressure with my fingers between the bones, or by seizing upon them with my thumb and fingers. Having, however, adjusted them as well as possible, I flexed the arm, and applied a broad and well-padded splint to the palmar surface of the forearm, securing it in place with a paste bandage. These dressings were finally removed at the end of four weeks, when I found scarcely any displacement or deformity remaining.

Most of these fractures of the shaft in its lower end, when properly treated, result in perfect limbs. In a certain proportion, however, it will be found impossible effectually to resist the action of the pronator radii teres and of the quadratus, and the fragments will unite at an angle resting against the ulna, and sometimes, by the interposition of intermediate callus, they will become firmly united to the ulna. Occasionally, also, especially where the fracture has been produced by a fall upon the hand, and the radio-ulnar ligaments of the wrist have been torn or stretched, the lower end of the ulna will be found to project permanently, and the hand to fall more or less to the radial side. In examples of this kind, of which I have seen one or two, the cause and, to some degree, the manner of the displacement are such as to entitle them perhaps to be regarded as true Colles's fractures; but we have found it convenient to restrict the use of this title to fractures occurring within at least one inch and a half of the joint.

Colles's Fracture.

I have retained the name "Colles's fracture," so long in use by English-speaking surgeons, for the reason that it is familiar to most of

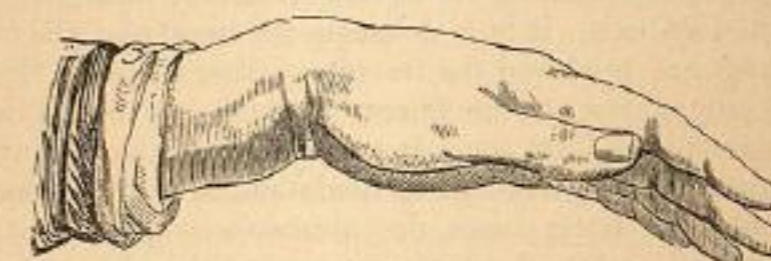
my readers, although it is now well known that Pouteau first described this accident.¹ Of the one hundred and fourteen fractures belonging to the lower third of the radius, one hundred and five were near the lower end, or within from half an inch to one inch and a half from the articular surface; all, except two styloid fractures, being included in that class known as "Colles's fractures," most of which were no doubt true fractures, and probably a small proportion separations of the epiphyses.

Etiology and Anatomy of Colles's Fracture.—In every instance, except one, which has come under my notice, where the cause of a Colles's fracture has been ascertained, it has been occasioned by a fall upon the palm of the hand. The exceptional case was in the person of Mrs. D. B., who fell in getting out of a street-car in the city of New York, May 20, 1865, striking upon the back of her hand while the hand was shut. The displacement was in the same direction as in cases caused by a fall upon the palm. Robert Smith has seen a similar accident cause a displacement of the fragment forwards. I shall refer to the etiology or mechanism of this accident again farther on.

Colles described the fracture as occurring always about one inch and a half above the carpal end of the bone;² but Robert Smith, who has carefully examined all of the cabinet specimens he could find, about twenty-three in number, has never seen the line of fracture removed farther than one inch from the lower end of the bone, and in several specimens it was within one-quarter of an inch of this extremity. Dupuytren has also described the fracture as occurring from three to twelve lines above the joint.

M. Trélat³ thinks that in the fractures of old people the line of separation is ordinarily quite at the inferior extremity of the bone.

FIG. 94.



Fracture of the radius near its lower end. (Colles's fracture.)

Contrary to the opinion of Sedillot and Huel, M. Voillemier affirms that, instead of being oblique, as has generally been supposed, the fracture is almost uniformly transverse from the palmar to the dorsal surfaces of the bone, and only occasionally slightly oblique in its other diameter, or from the radial to the ulnar side. I have seen, however, in the museum of the College of Physicians of Philadelphia, a specimen of this fracture in which the line of fracture is transverse, from side to side, but very oblique from before backwards, and from below upwards. There is

¹ Pouteau, *Œuvres Posthumes*, t. 2, p. 261, 1783; also Nélaton, *Chir. Path.*, t. 1, p. 739.

² Colles, *Ed. Med. and Surg. Journ.*, vol. x, p. 182, 1814.

³ Trélat, *Journ. de Méd. et de Chir. Prat.*, 1877, Avril.

also a line of incomplete fracture extending into the joint. It is united by bone, with the usual displacement backwards; and there are several similar specimens in the New York Hospital museum. My own cabinet contains two such examples. It is my opinion, therefore, that the direction of the line of fracture described by Voillemier is exceptional.

The observations of both R. Smith and Voillemier have shown, moreover, that the displacement of the lower fragment is seldom sufficient to enable it to escape completely from the upper; and that where, in extremely rare instances, and in consequence of extraordinary violence, such complete separation does occur, a disruption of those ligaments which attach the lower fragment to the ulna occurs also, and the deformity becomes at once very great, so that it no longer presents the peculiar features of Colles's fracture, but resembles a dislocation.

In Colles's fracture, the lower and outer border of the radius, or its styloid apophysis, is swung around or tilted, as it were, upon the ulna; the lower and inner border of the same fragment being retained in place by the radio-ulnar and internal lateral ligaments, which do not usually suffer a complete disruption, but only a stretching or partial laceration, possibly by the triangular ligament or by some of its untorn fibres, and by one fasciculus of the anterior annular ligament, which is probably seldom torn. The upper or broken margin of the lower fragment, and also the ulnar margin, undergo very little displacement; while the lower or articular surface, and the radial margin, are carried backwards, upwards, and outwards.

Surgeons have spoken of a falling in of the upper end of the lower fragment toward the ulna, as an almost inevitable result of the action of the pronator quadratus, and against which tendency they have sought carefully to provide; but there is much reason to believe that any considerable degree of displacement in this direction is a rare event, and that, when it does exist, it is in consequence mostly of the direction of the force which has produced the fracture rather than of the action of this muscle, only a few of the fibres of which are usually attached to the lower fragment, and, in some instances, when the fracture is within a half or quarter of an inch of the articulation, not any. Besides, there is actually in these latter cases no interosseous space into which the fragments may fall, and its displacement toward the ulna becomes, therefore, impossible.

Still, however, if one were disposed to speculate upon the condition of these parts after the fracture, it might perhaps be easy to persuade ourselves that the action of the pronator quadratus upon the upper fragment, whose broken extremity was not completely, or at all, disengaged from the lower, would carry both fragments together toward the ulna. But whatever might be the result of our speculations, still the fact, as proved by specimens, is not generally so; and this is not the first time that facts and theories have disagreed.

The truth is, that it is unusual to find any of the museum specimens of this fracture thus united. But they may be found constantly tilted back in the manner I have described, occasionally tilted forwards, and, still more rarely, slightly displaced upon their broken surfaces antero-posteriorly.

The general absence of this internal displacement may find its explanation in the direction of the force which generally produces this fracture, in the occurrence of the fracture sometimes at a point so low as to render its displacement in this direction impossible, and in the breadth of the bone, at the seat of the fracture, which does not permit it to fall laterally without actually increasing its length; a circumstance which its secure ligamentous attachment to the ulna at its opposite extremities, and its complete apposition to the wrist and elbow-joint, do not allow.

The mistake of those surgeons who have attempted to describe this fracture has originated in the appearance presented in nearly all recent fractures occurring at this point. The hand falls to the radial side, and seems to carry the lower end of the lower fragment with it, while the lower end of the ulna becomes unnaturally prominent in front and to the ulnar side; a condition of things which has naturally enough been ascribed to the displacement of the upper end of the lower fragment in the direction of the interosseous space.

But this same radial inclination of the hand, and prominence of the ulna, are present frequently when the radius is broken at its lower end, and no displacement in any direction has taken place; and I have even observed it in simple sprains of the wrist, and in the hands of old or feeble persons where all the ligaments have become relaxed.

It is seen, however, in a more marked degree when the bone is actually both broken and displaced backwards in its usual direction. In short, the deformity in question is due, in a large majority of instances, to the relaxation, stretching, or more or less disruption of the anterior and posterior radio-ulnar ligaments, the triangular fibro-cartilages, and the internal lateral ligaments; to which, I feel satisfied, we must add the influence of the strong and unbroken oblique fasciculus of the anterior carpal ligament. It is probably due to one or all of these circumstances combined that the hand falls to the radial side by a sort of rotatory motion, of which the unbroken external lateral ligaments and the strong fasciculus of the anterior ligament constitute the axis or centre of motion. For this reason, also, because these triangular, internal, and radio-carpal ligaments once lengthened or broken can never, or only after a lapse of many years, be completely restored, this deformity may be expected, in a certain number of cases, to continue, however exact and perfect may be the bony union.

It must be added, however, that so long as the tilting of the fragment remains, the articular surface is actually presenting somewhat to the radial side. While in the normal condition it presents downwards, forwards, and inwards, it now presents, when the displacement is considerable, downwards, backwards, and outwards.

Diday maintained that there existed usually in this fracture an overlapping or shortening of the bone in its entire diameter, and Voillemier thought that the specimens which he had examined proved that an impaction was almost universal, and Tillaux has observed it frequently.

Both of these opinions Robert Smith has sought to combat, declaring that the appearance of impaction is due to the ensheathing callus, which is deposited usually, if the displacement is allowed to continue, in the re-

tiring angle opposite the seat of fracture. Jajavay and Fouchat sustain the observations of Smith, but some recent observations made by Mr. Callender, of Saint Bartholomew's Hospital, London, go far to support the opinion that some impaction generally exists, but rather upon the posterior margin than upon either the radial or ulnar side;¹ and my own observations lead me to conclude that a posterior impaction is quite common.

In a case reported by Dr. Cameron, of Glasgow, resulting in speedy death, the impaction was complete posteriorly, and was accompanied with impaction and comminution of the lower fragment, while the fracture in front was "hardly complete, the periosteum holding the fragments together."²

Comminution of the lower fragment has never occurred in the experiments made by me upon the cadaver, but it is quite common to meet with such examples in dead-house specimens, especially when the patients have fallen from a height and have been killed by the accident. Its existence usually implies the application of greater force than results from a fall upon the hand upon the sidewalk. The latter represents the usual accident, while a fall from a height is the exceptional accident, and the character of the fracture is therefore exceptional.

FIG. 95.



Impacted fracture. (Author's collection.)

FIG. 96.



Comminuted fracture. (Author's collection.)

FIG. 97.



Bigelow's case of comminuted fracture of the lower end of the radius.

In the accompanying woodcut (Fig. 95) is seen an impacted and comminuted fracture of the lower end of the radius. Dr. James Wentworth, of Troy, N. Y., who sent me the specimen, says that the patient, a man, *æt.* 50, in a fit of delirium, jumped from a third-story window, alighting upon the stone pavement. He survived the accident less than one hour.

Fig. 96 is from a specimen presented to me by Dr. William Van Buren, and was found in an autopsy at the New York City Hospital. In this

¹ Callender, *St. Barth. Hosp. Rep.*, p. 281, 1865.

² Cameron, *Glas. Med. Journ.*, March, 1878.

specimen there is comminution, without impaction or displacement. The line of separation between the upper and lower fragments is transverse, and the lower fragment is divided into five distinct pieces, each line of fracture involving the joint.

One curious example of this form of fracture is reported by Dr. Bigelow, of Boston (Fig. 97). The patient had fallen, and, being otherwise seriously injured, ultimately died in the Massachusetts General Hospital. At first he had only complained of lameness at the wrist, as if it had been severely sprained; but at the end of several days the joint became swollen, and from the persistence of the swelling Dr. Bigelow was led to diagnose a stellate crack in the articulating extremity of the radius, he having met with a similar case two years before, when a patient with the same symptoms had died of other injuries, and exhibited a crack in the same place, but less extensive than in this case. There was found, in this last example, a star-shaped fissure on the articulating surface, without displacement. These fissures penetrated the shaft for an inch or more. Dr. Bigelow thought that the bones of the wrist acted as a wedge to spread the corresponding hollow of the articulating extremity, and that this specimen would explain the persistence of some cases of sprained wrist.¹

Robert Smith has described a fracture occurring at the same point, and probably possessing nearly the same characters as Colles's fracture, in which the lower fragment is thrown forwards instead of backwards, and which has generally been the result of a fall upon the back of the hand. There is no such specimen, however, in any of the pathological collections in Dublin, nor has Mr. Smith ever seen a specimen obtained from the cadaver, although he reports a case which fell under his observation in practice.

I have myself seen one such case,² but I regret to say that my examination of the condition of the arm was not such as to enable me to give a very satisfactory account of the cause and symptoms of the accident. Referring, however, to the experiments upon the cadaver detailed in the succeeding pages, it will be seen that I have been able to produce this fracture by forced palmar flexion of the hand.

Fracture of the Styloid Processes Accompanying Colles's Fracture.—Nélaton observes that all the varieties of this fracture which he has seen are often accompanied with fracture of the styloid apophysis of the ulna, and with a tearing of the triangular ligament. Cameron, also, thinks it more common in connection with a Colles's fracture than has generally been supposed; and, in confirmation of this opinion, reports five cases which he has himself observed.³

I believe I have seen two examples of a fracture commencing on the radial side of the bone and terminating in the joint, the separated fragment including considerably more than the styloid process; but neither of these cases has been verified by an autopsy. They were described in detail in the third edition of this book.

¹ Bigelow, *Boston Med. and Surg. Journ.*, vol. lviii. p. 99.

² *Trans. Am. Med. Assoc.*, vol. ix. p. 145.

³ H. C. Cameron, *Glasgow Med. Journ.*, vol. x. No. 3, 1878.

In my experiments upon the cadaver, hereafter to be described, the styloid process of the radius has been broken off twice at its base.

Dislocation of the Lower End of the Ulna in Connection with Colles's Fracture.—Dr. E. Moore, of Rochester, N. Y., has demonstrated, by examinations upon the cadaver and by experiment, that in a certain proportion of cases the internal lateral ligament, and the triangular fibrocartilage give away under the force which has occasioned the fracture, the styloid process is thrust under or through the annular ligament and imprisoned; in fact, the ulna becomes dislocated, and is retained by the annular ligament in its new position; this dislocation being accompanied in some cases with a fracture of the styloid process of the ulna. Nor can the reduction of the fracture of the radius be accomplished until the ulna is released from its imprisonment. Reduction is to be accomplished by extension and partial circumduction; the hand being grasped firmly and extended first to the radial side, then backwards to the ulnar side, and finally forwards, or in the position of flexion. During the entire manœuvre the wrist is held firmly by the opposite hand of the surgeon. The test of reduction is to be found in the presence of the head of the ulna on the radial side of the ulnar extensor.

In order to retain the ulna in place when reduction is effected, Dr. Moore places a thick, firm compress over its lower end, on the palmar and ulnar margins of the forearm, and secures this in place with a broad band of adhesive plaster drawn firmly around the wrist. The forearm is then placed in a narrow sling passing under the wrist and compress. This completes the dressing.¹ The five examples presented by Dr. Moore and verified by an autopsy, must be regarded as exceptional cases; all of them being results of falls from a considerable height, and most of them had proved speedily fatal, thus affording an opportunity for post-mortem inspection. They are not fair representatives of that class of cases which are caused by falls upon the hand in the street, and which have been regarded as typical cases. Dr. Moore concludes, however, from autopsies, and from personal observation of other cases, that "luxation of the ulna exists in more than half of the cases." But I was never able to produce it in any of my experiments upon the cadaver; that is to say, the extensor carpi ulnaris was never dislodged from its groove, and this is what he considers essential to the luxation. By the change of position of the lower fragments of the radius and ulna the extensor carpi ulnaris is less distinctly felt, or it cannot be felt at all, but the dissection always shows that it remains in its groove. Indeed, I feel persuaded that it cannot be torn from its normal position except by great force, such as was applied in all the cases mentioned by Dr. Moore. I shall refer to this matter again in connection with dislocation of the ulna.

In the following case, although the patient fell from a considerable height, and the lower fragment of the broken radius was comminuted, there was no displacement of the ulna. John Borck, aet 62, fell, October 29, 1880, twenty-four feet, and was taken to St. Mary's Hospital, Detroit. He was found to have a rupture of the left gluteal artery, and a fracture of the right radius. Dr. T. A. McGraw tied the gluteal ar-

¹ Moore, New York Med. Rec., April 1, 1870; March 20, 1880.

tery by an external incision, but death occurred on the same day. The autopsy disclosed a Colles's fracture.

"The ulna was found in its place. No ligaments anywhere around the joint were broken or injured in the least, neither was there any extravasation of blood near the fracture. The lower end of the radius was broken into four fragments, which were, however, held together by the periosteum and ligaments. They were broken off the shaft just one-half inch from the articular surface, and were inclined back with the characteristic deformity. It was with difficulty that they could be brought into proper apposition, and only by first making traction, and then bending towards the palmar surface. It was evident that they were held in their acquired position by bony impaction and by nothing else. It was difficult even when the bones were bare of flesh to get much crepitus, owing to the spongy consistency of the bone at that point."

Barton's Fracture, as distinguished from a Colles's Fracture.—In the first volume of the *Philadelphia Medical Examiner* (1838) will be found a description, by J. Rhea Barton, of Philadelphia, of a form of fracture occurring through the lower end of the radius, which is probably much less common than Colles's fracture, and which had hitherto escaped the notice of surgeons. Its peculiarity consists in the line of fracture extending very obliquely from the articulation, upwards and backwards, separating and displacing the whole or only a portion, as the case may be, of the posterior margin of the articulating surface. I have not recognized this fracture in any instance which has come under my own observation, nor have I been able to find a cabinet specimen in any pathological collection. Dr. Barton was not able to prove the correctness of his diagnosis by an autopsy, and the only well-authenticated example which I can find upon record is that to which Malgaigne has alluded, as having been seen by M. Lenoir, and of which an account was published in the *Archives Générales de Médecine*, in 1839. M. Lenoir believed it to be a simple luxation of the hand backwards, but the patient having died, he was able to correct his diagnosis by an autopsy. A considerable fragment had been broken from the posterior lip of the articular surface, the line of fracture being from below upwards, and from before backwards. This fragment had become displaced upwards and backwards, carrying with it the carpal bones, and producing thus the appearance of a simple dislocation.² The possibility of such a fracture must be admitted, since in my experiments upon the cadaver by avulsion, it has several times been produced; but the infrequency of cabinet specimens furnishes a presumption that it is exceedingly rare and exceptional.

Mechanism of a Colles's Fracture.—As to the precise mechanism of this accident—speaking now only of the well-characterized Colles's fracture—there can be very little doubt. In a large majority of examples it is the result, primarily and mainly, of two forces acting in an opposite direction, at an obtuse angle, one being the weight of the body in falling, and the other the impact or resistance of the ground, the bone giving

¹ McGraw, Med. Gaz., Jan. 8, 1881.

² Malgaigne, *Traité des Frac.*, etc., tom. ii. p. 700.

way, as is usual in other long bones, nearest the point of impact, where, owing to the unyielding nature of the resistance as compared with the yielding nature of the impulse (or weight of the body), the vibration is the greatest; and in this particular case, the fracture is not only almost always in the lower end of the bone, but also at or near that point where the bone is less strong than elsewhere, namely, where the compact tissue ends and the more spongy tissue commences.

This view of its mechanism was illustrated experimentally by M. Nélaton.¹ Having amputated the forearm upon a cadaver, and sawn off the olecranon process, he placed the palm of the hand upon a solid surface, the forearm being vertical, and then struck a heavy blow upon the upper end of the two bones. Upon dissection he found the radius broken transversely, twelve to fifteen millimetres from the lower end, the lower fragment being tilted backwards.

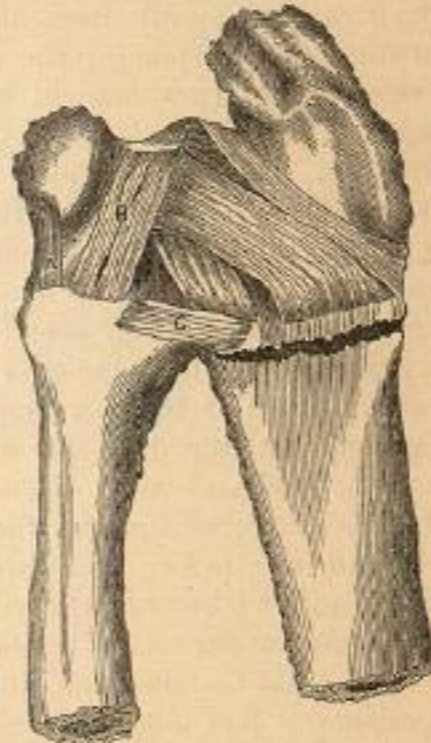
I have repeated this experiment, and with the same result. It is not easy, however, to produce the fracture in this way upon the cadaver, unless we select the bones of young persons or delicate women for the experiment; the force required to cause the fracture being greater than

FIG. 98.



Transverse fracture of the lower end of radius; caused by forced *palmar* flexion; in the cadaver.

FIG. 99.



Transverse fracture of lower end of radius; caused by forced *dorsal* flexion; in the cadaver. A. Internal lateral ligament. B. Third fasciculus of anterior carpal ligament. C. Anterior radio-ulnar ligament.

is required in the living subject, because the muscles are relaxed and the stability of the bones is not well maintained.

We see, then, that in addition to the two forces acting in opposite

¹ Nélaton, *Chir. Path.*, t. I. p. 740.

directions, already mentioned as constituting, in most cases, the efficient cause of the fracture, there must be added, as extrinsic, but important, muscular action, which insures the fixedness of the articulation at the elbow and wrist.

In a few cases also the mechanism of the fracture will admit of another explanation. A Colles's fracture has been caused in the living subject by simply forcing the hand strongly backwards, and without a fall or sudden impact. Thus Voillemier, 1842, relates that he had seen the fracture once caused by a fall upon the lower half of the hand, in which the heel of the hand did not touch the ground; but another case was even more conclusive, the fracture being caused by forced flexion (probably "dorsal flexion") made by a comrade. According to Malgaigne, M. Bouchet was the first to observe this mode of causing the fracture; his observations having been made exclusively upon the cadaver (1834). In trying to dislocate the wrist, he found he could produce only a fracture of the lower end of the radius, sometimes with other lesions, and especially with fracture of the styloid process.¹

In his treatise on Fractures, published in 1855, Malgaigne, while accepting the theory of Bouchet, that is, while regarding the fracture as being produced by the action of two opposite forces—the weight of the body, and the resistance of the soil—declared that the observations of Bouchet and Voillemier led him to believe that cases of fracture by arrachement (a cross-strain of the ligaments) might be more common than had been supposed.

In 1860–61, an important memoir by M. Ozanim Lecomte² appeared, in which that surgeon stated that it was his opinion that the fracture was produced solely by arrachement, and that neither muscular action nor shock had any part in it. This opinion was supported by Duplay, Anger,³ and Tillaux,⁴ the latter of whom says: "I agree with Lecomte in admitting that the classical fracture of the lower end of the radius is always produced by an avulsion caused by the ligaments."

According to Dr. P. S. Conner,⁵ of Cincinnati, Dr. Gordon, of Belfast, in a memoir on Colles's fracture, published in 1875, maintained that the bony lesion is due "to a transverse rupture of the fibres of the lower end of the radius, as a result of forced extension of the hand." Dr. Conner, who made experiments regarding the subject, says that they have demonstrated to him the correctness of that theory.

In May, 1878, Dr. Lewis A. Pilcher, of Brooklyn, N. Y.,⁶ repeating the experiments of his predecessors, came to an identical conclusion, viz.,

¹ Bouchet, *Thèse sur les lux. du poignet*, Paris, July, 1834. From Malgaigne.

² Lecomte, *Archiv. Gén. de Méd.*, Dec. 1860, Jan. and Feb. 1861.

³ Anger, *Frac. et Lux. Atlas*, Paris, 1863.

⁴ Tillaux, *Traité d'Anat. Topograph.*, Paris, 1877, p. 605.

⁵ Conner, *Cincinnati Lancet*, April 23, 1881.

⁶ Pilcher, paper read before the Surgical Section of the New York Acad. of Med., May 16, 1878; *The Med. Rec.*, July 27, 1878, p. 74.

Dr. Pilcher, in his paper read before the Academy, made no mention of the opinions and experiments of Bouchet, Lecomte, Gordon, and others. I was, therefore, led to speak of his experiments, in the sixth edition of this treatise, as new and wholly original. I am now convinced that they were not; and that in so much I did injustice to those surgeons who, before Pilcher, had made a careful study of this subject by the same class of experiments, and had arrived at the same, or nearly the same, conclusions.

that Colles's fracture is due to an arrachement, caused by the dorsal flexion of the wrist. A few of Dr. Pilcher's observations deserve to be mentioned, on account of their importance. For example, he has noticed that if the dorsal flexion of the wrist is carried to extremes, and if the inferior fragment is very much tilted backwards, the periosteum on the posterior surface of the bone, which is reinforced by a certain number of aponeurotic fibres, is torn or detached from the radius, thus allowing the inferior fragment to ascend backwards, and to be penetrated by the posterior border of the superior fragment.

Dr. Pilcher has also observed that the chief cause of the peculiar position assumed by the hand after this fracture was the presence of "a strong oblique fasciculus of the anterior ligament of the wrist, which extended from the cuneiform bone to the anterior border of the styloid process of the ulna. By the backward displacement of the carpus, and the attached radial fragment, that ligament was put upon the stretch, limiting all motion until relaxed."

It will be seen that Dr. Pilcher attributes nothing of the peculiar phenomena to the integrity of the internal lateral, triangular, and radio-ulnar ligaments; but to my mind it is very plain that this view of the subject is too exclusive, and that whenever these latter ligaments remain unturned they contribute to the malposition of the hand.

I have repeated these experiments of Bouchet, Lecomte, and others, many times upon the cadaver; and while they confirm in some measure

the observations of these surgeons, I am far from being convinced that the classical fracture, occasioned by a fall upon the palm of the hand, is due exclusively to the action of the ligaments. I presented to the Surgical Society of New York, March 22 and July 30, 1881, twelve specimens of Colles's fracture, and compared them with a still larger number of specimens in which the fracture had been produced upon the cadaver by forced dorsal flexion. The comparison showed that there was a marked difference between the two classes of fractures, as regards the seat and direction of the lesion.¹ The results of my experiments upon the cadaver may be summarized as follows: 1st. In some there is only a laceration of the anterior annular ligament of the wrist, which, occurring in the living subject, would pass for a sprain of the wrist. 2d. The styloid process of the radius may be alone broken off at its base. 3d. The anterior lip of the radius may be broken off, the line of fracture being transverse, but not involving the whole thickness of the bone. 4th. The line of frac-



FIG. 100.
Fracture at base of styloid process of radius, and laceration of annular ligament; caused by forced dorsal flexion; in the cadaver.

¹ Med. Record, July 25 and 30, 1881

ture is occasionally oblique from the ulnar to the radial side of the radius, commencing outside of the joint and terminating in the joint. 5th. The line of fracture is sometimes transverse, involving the entire thickness of the bone; but it is usually much lower down than when it is caused, in the living subject, by a fall upon the hand; and there is less obliquity in the line of fracture from before back, than in the latter case. 6th. That portion of the carpal ligament which passes obliquely downwards to be inserted into the styloid process of the ulna is always unturned, while rupture of the radio-ulnar, triangular, and internal lateral ligament is occasionally found. 7th. In some cases there is a mere fissure or crack of the bone, not extending through its entire thickness, and which could not have been recognized in the living subject. 8th. In others it is more or less tilted or pressed back, but not overlapped; and these, constituting a majority of the whole, were easily replaced in their natural position by simply pressing the lower fragment forwards, as has been my practice in many cases hitherto. 9th. When the force applied is greater or longer continued the lower fragment is displaced backwards upon the upper, the periosteum is torn up posteriorly; and there would be impaction, no doubt, if the muscles had their normal power of contraction, or if added to the cross-strain there had been the driving force of a fall upon the palm of the hand; and in these cases it was difficult to tilt the lower fragment forwards into line without first relieving the strain upon this periosteal ligament by the method described by Pilcher. 10th. The character of the lesions in the opposite wrists of the same cadaver was generally symmetrical; the same lesion being caused by the same manipulation in one arm as in the other. 11th. Fractures of the radius were produced by forced palmar flexion, but not quite so readily, and the fractures occurred a little lower than is usual in a Colles's fracture.

These are the facts as observed by me in the dead-house experiments, and no doubt they illustrate to some extent the mechanism of this accident as it occurs in life; but it is apparent that in some respects the circumstances differ. There is in the case of the cadaver no muscular contraction to give fixedness to the bones, and to displace the fragments after they are separated, or to maintain them in a position of displacement. The force of sudden impact caused by the weight of the body in falling is not present. In short, the fractures caused by the experiments were the result solely of the action of the carpal ligaments upon the lower ends of the bones; they were fractures by avulsion or cross-strain, while in the examples presented in the living subject they are usually the result of concussion, avulsion, and muscular action combined, of which causes perhaps the cross-strain is not the least efficient.

Prognosis.—One hundred and five examples of Colles's fracture have furnished no cases of non-union, nor indeed do I remember ever to have seen the union delayed; but in a pretty large proportion of cases occurring in the practice of surgeons whose patients have been brought under my notice, some slight or considerable deformity remains, and in most cases the joint remains more or less stiff and sensitive for some months. In one example, the case of a man whose arm was broken in Germany, when he was only ten years old, the fragments of the radius were driven

into each other, or overlapped one inch, and the ulna had been displaced downwards toward the fingers the same distance. This was examined twelve years after the accident, and he had then a very useful arm. Twice I have found the wrist and finger-joints quite stiff after a lapse of one year; in one case I have found the same conditions after two years, in one case after three years, and in two cases after five years.

In cases treated by myself, where I have exercised great care in reducing the fragments thoroughly, and where the bandages and splints have not been applied too tightly, nor kept on too long, deformity to any considerable extent is the exception, and the stiffness is soon dissipated. I say it has been the exception, not intending to claim that under my care considerable deformity has never resulted.

Confining our remarks still to Colles's fracture, the deformity which has been observed most often, after the lapse of several months or years, is a projection of the lower end of the ulna inwards, a phenomenon explained fully in the preceding pages. Rarely it is displaced backwards, and still more rarely forwards. In a majority of cases this is accompanied with a perceptible falling of the hand to the radial side, while in a few it is not. After this, in point of frequency, I have met with the backward inclination of the lower fragment. Robert Smith found this displacement almost constant in the cabinet specimens examined by him; and it is very probable that nearly all of the specimens examined by myself would present more or less of the same deviations upon the naked bone; but in the living examples a slight deviation would be concealed by the numerous tendons which cover this part of the arm, and perhaps by some permanent effusions, of which I shall speak more particularly presently.

There remains for a long time, in many cases, a broad, firm, uniform swelling on the palmar surface of the forearm, commencing near the upper margin of the annular ligament and extending upwards two inches or more. The swelling continues much longer in old and feeble persons than in the young and vigorous. It is pretty generally proportioned to the amount of ankylosis existing at the wrist and finger-joints, and it disappears usually *pari passu* with these conditions. There can be no doubt that this phenomenon is due to effusions along the sheaths of the tendons, and in the areolar tissue external to the sheaths, and it is as often present after sprains and other severe injuries about this part, as in fractures. In many cases, however, its prolonged continuance and its firmness have led to a suspicion that the bones were displaced, a suspicion which only a moderate degree of care in the examination ought easily to dispel. A similar effusion, but in less amount, is frequently seen also on the back of the hand, below the annular ligament. When both exist simultaneously the appearances of deformity and of displacement are greatly increased. Here, then, we shall find a partial explanation of the ankylosis in the wrist and finger-joints, which continues occasionally many months, or even years, if, indeed, it is not permanent; an ankylosis produced in a few instances by extension of the inflammation to these joints, but much more often by the inflammatory effusion and consequent adhesions along the thecae and serous sheaths, through which the tendons all pass in their course to the hands and fingers, and

also by simple contraction of the articular ligaments, as a consequence of disuse, or, as it is usually termed, by passive contraction of these ligaments. The fingers are quite as often thus ankylosed after this fracture as the wrist-joint itself; a circumstance which is wholly inexplicable on the doctrine that the ankylosis is due to an inflammation in the joints. Indeed, I have seen the fingers rigid after many months, when, having observed the case throughout myself, I was certain that no inflammatory action had ever reached them.

The peculiar swellings of the wrist and hand which have been described above, commence to show themselves very early after the receipt of the injury; but I have noticed, also, a swelling which is a little later in its accession, namely, an induration and fulness upon the back of the hand, which corresponds accurately to the position of the carpal bones, and presents an appearance as if all the carpal bones were slightly displaced backwards. This phenomenon is probably due to a swelling and induration of the numerous ligaments which bind together these bones posteriorly. It usually disappears after a few months.

Nor is it any more difficult to show, I think, that the ankylosis of the wrist-joint is not often due to a malposition of its articular surfaces, as has frequently been asserted in the written treatises.

The most superficial examination of the mechanism of this joint ought to satisfy us, that any moderate or even considerable malposition of the lower fragment after a fracture of the radius, is not sufficient in itself to occasion ankylosis. It is true that in the fracture now under consideration, the direction of the articular surface of the radius is often changed, and that, while it was directed downwards, forwards, and to the ulnar side, it is now, perhaps, directed downwards, backwards, and to the radial side. But of what consequence is this so long as the carpal bones, with which alone this bone is articulated, preserve their relations to the radius unchanged?

If any other evidence be demanded, it may be supplied by the experience of most surgeons in examples of ankylosis without displacement, in examples of displacement without ankylosis, but in which the ankylosis has yielded gradually to the lapse of time, while the displacement has continued. The following case is in point: James Ryan, a private in the 15th N. Y. Volunteers, fell from a height into a ditch during the battle of Fair Oaks, Va., May 31, 1862, striking upon the palm of his left hand, and causing a simple fracture near the lower end of the radius, accompanied probably with impaction. I do not know what treatment was adopted, but when he came under my observation, in March, 1863, at the Central Park General Hospital, New York, I found the most extraordinary deflection of the hand to the radial side which I have ever seen after this fracture. The hand could be turned, laterally in the direction of the radius, to a right angle with the arm; the motions of flexion and extension were nearly as perfect as in the opposite arm, and the hand was in all respects as useful as before the accident.

To what I have said as to the prognosis in these accidents, I may be permitted to add the opinion of our distinguished countryman Dr. Mott, given in a clinical lecture before his class in the University of New York.

"Fractures of the radius within two inches of the wrist, where treated by the most eminent surgeons, are of very difficult management so as to avoid all deformity; indeed, more or less deformity may occur under the treatment of the most eminent surgeons, and more or less imperfection in the motion of the wrist or radius is very apt to follow for a longer or shorter time. Even when the fracture is well cured, an anterior prominence at the wrist, or near it, will sometimes result from swelling of the soft parts."

To which the reporter, himself a surgeon in the city of New York, adds:

"As the above opinion of Professor Mott coincides with my own observations, both in Europe and in this city, as well as with many of our most distinguished surgical authorities, I venture to hope that it may assist in removing some of the groundless and ill-merited aspersions which are occasionally thrown on the members of our profession by the ignorant or designing."¹

In evidence that we have not yet attained all that we could desire in the treatment of this fracture, I will quote farther:

"In young subjects, fractures of the lower end of the radius are easily reduced, unite readily, and leave the use of the limb perfectly unimpaired; but in old persons, who, as before stated, are especially liable to this injury, the result is often most unsatisfactory, even after the greatest care has been used during the treatment. It is frequently months before the hand is free from pain and regains its proper motions, and too often an unsightly, crooked, and permanently stiff wrist remains, to the great inconvenience and annoyance of the patient."²

"Union occurs in about a month, but rarely without some displacement."³

"In a large number of cases it is impossible to loosen the impacted fragments."⁴ Ashhurst and Gross express similar opinions. Let me add that several cases treated lately under my observation, by the plaster-of-Paris and by Moore's method, both of which have recently been much employed in this country, have given no better average results than have been obtained by other methods.

Of gangrene as an occasional result of this fracture, I shall speak presently, in connection with the subject of treatment.

Treatment.—The peculiar character of the displacement which characterizes Colles's fracture, and the constant difficulty experienced by surgeons in obviating deformity, have led to much speculation and ingenious invention; and modern surgeons, especially, have thought it necessary to introduce here an essential modification of the usual apparel for broken forearms. This modification consists in employing a pistol-shaped splint, instead of a straight splint, by means of which the hand may be thrown more or less strongly to the ulnar side.

¹ Boston Med. and Surg. Journal, vol. xxv. p. 289.

² Holmes's System of Surgery, Amer. ed., 1870, vol. ii. p. 798.

³ Gant's System of Surgery, London, 1871, p. 463.

⁴ Bryant's Surgery, London, 1872, p. 937. See also opinion of Callender on same page.

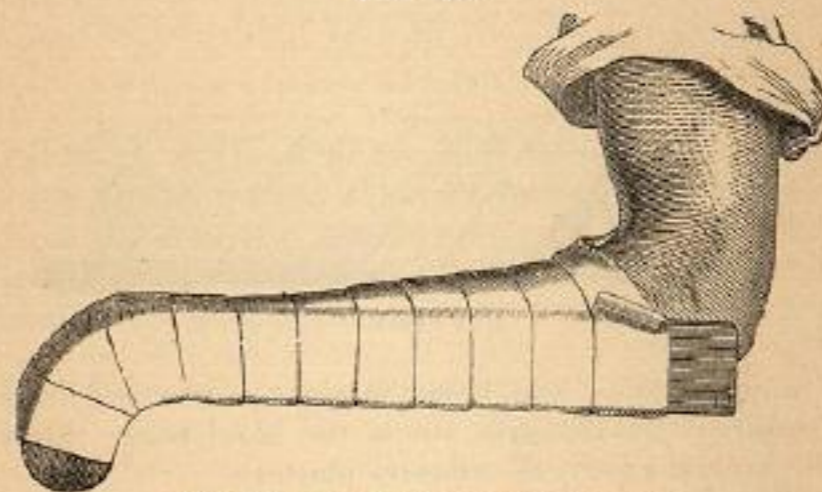
Heister¹ speaks of inclining the hand toward the ulna, while reducing a fracture of the radius, but when the reduction has been effected he recommends a straight splint.

Among the first to advocate the permanent confinement of the hand in this position, were Mr. Cline,² and Dupuytren.³ Mr. Cline, and after him Bransby Cooper,⁴ and Mr. South,⁵ recommend the ordinary straight splints for the forearm, but the rollers by which the splints are secured in place are not permitted to extend lower than the wrist; so that when the forearm is suspended in a sling, in a state of semi-pronation, the hand shall fall by its own weight to the ulnar side.

Dupuytren, and after him Chelius, adopt, in addition to the palmar and dorsal splints, the "attelle cubitale," or ulnar splint; which is a gutter, composed of steel, iron, tin, or some other metal, and made to fit the ulnar margin of the forearm and hand, when the hand is drawn forcibly to the ulnar side. Blandin,⁶ Nélaton,⁷ and Goyraud,⁸ also, under certain contingencies employ the same.

Most surgeons, however, employ either a palmar or a dorsal splint; or both palmar and dorsal splints constructed with a knee, or pistol-shaped,

FIG. 101.



Nélaton's splint for fracture of the radius.

and they thus avoid the necessity of the ulnar splint. Thus, Nélaton,⁹ Robert Smith,¹⁰ and Erichsen,¹¹ recommend this peculiar form only in the dorsal splint; while Bond,¹² Hays,¹³ E. P. Smith,¹⁴ G. F. Shradly,¹⁵ and others, especially among the Americans, place the pistol-shaped splint against the palmar surface of the forearm and hand.

¹ De Lavrentii Heisteri, Institutiones Chirurgicæ, pars prima, p. 203, Amsterdam ed., 1739.

² Malgaigne, Traité de Frac., etc., tom. i. p. 614, Paris ed.

³ Dupuytren on Bones, London ed., p. 140.

⁴ B. Cooper, Lectures on Surg., p. 232, American ed.

⁵ Chelius's Surg., vol. i. p. 613.

⁶ Malgaigne, op. cit., tom. i. p. 614.

⁷ Nélaton, Elém. de Path. Chir., tom. i. p. 747.

⁸ Ibid., p. 746.

⁹ R. Smith, op. cit., p. 168.

¹⁰ Bond, Amer. Journ. Med. Sci., April, 1852.

¹¹ E. P. Smith, Buffalo Med. Journ., vol. ix. p. 225.

¹² Shradly, Am. Med. Times, 2 cases, Dec. 22, 1860.

¹³ Nélaton, op. cit., p. 747.

¹⁴ Erichsen, Surgery, p. 215.

¹⁵ Ibid., Jan. 1853.