

A few modern surgeons have not seen fit to adopt this peculiar principle of treatment, or this form of dressing under any of its modifications. Colles¹ recommends a straight palmar and dorsal splint, and does not incline the hand. Barton² advises the same, and Skey, having

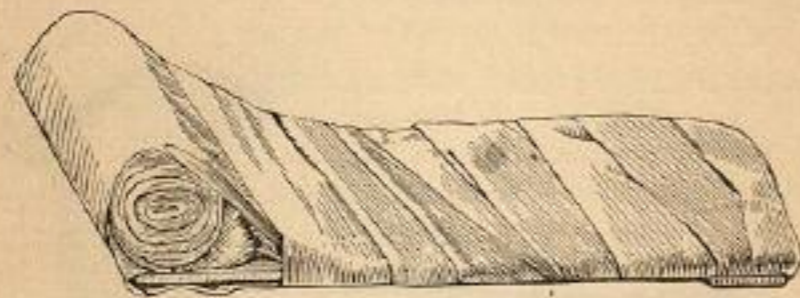
FIG. 102.



Bond's splint.

declared his preference for a couple of broad, straight splints, adds: "Great care should be taken to prevent the hand falling, and this object will be attained by inclosing the entire forearm and hand in a well-applied sling."³

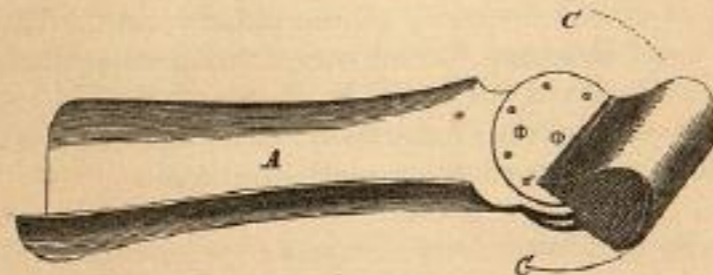
FIG. 103.



Hay's splint.

Stephen Smith employs two broad, straight palmar and dorsal splints, secured in position by adhesive strips, the hand being thrown to the ulnar side by reversed turns of adhesive plaster.

FIG. 104.



E. P. Smith's splint. Surface applied to forearm. A. Forearm piece, made of felt, with incurvated margins.

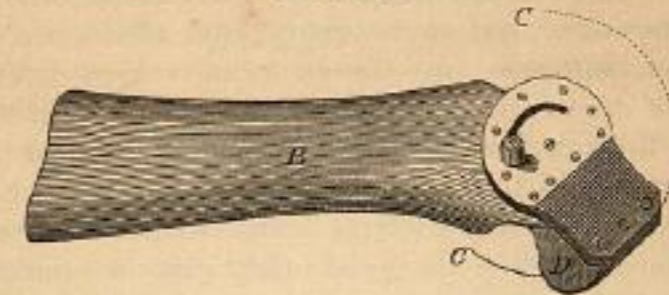
Professor Fauger, of Copenhagen, has undertaken to treat this fracture in some sense without any splint, the forearm and hand being simply laid over a double inclined plane, so as to bring the wrist into a state of

¹ Colles, Lectures on Surgery, p. 325.
³ Skey, Operative Surgery, p. 161.

² Barton, Phil. Med. Exam., 1838.

forced flexion. "The hand having been brought into a position of strong flexion, the forearm is placed, pronated, on an oblique plane, with the carpus highest, the hand being permitted to hang freely down the perpendicular end of the plane."¹ M. Velpeau, in a report of his surgical clinic at La Charité for the year ending September, 1846, says this plan has been tried during the year, and "the result has not been very satisfactory. The experiment, however, has not been decisive upon this mode of treatment."²

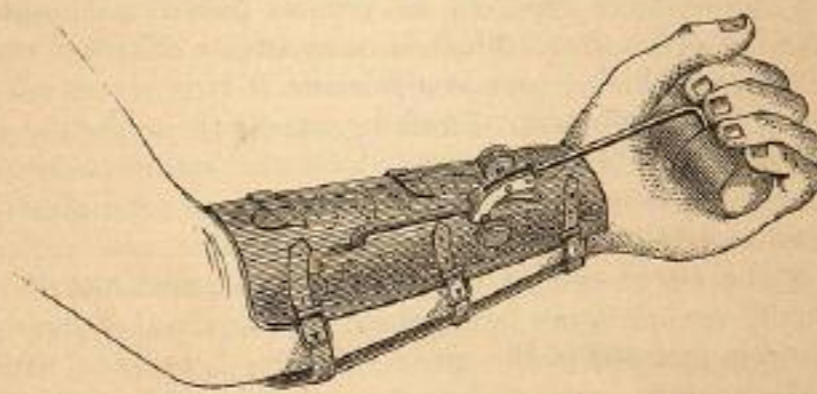
FIG. 105.



E. P. Smith's splint. B. Opposite surface. D, the hand-block, is connected with the forearm piece by two circular brass plates, which move upon each other, in order that the hand-block may assume any desired angle with the arm. In this way it may be adapted to either the right or left arm. It is fixed by a nut, seen on the brass plate. The letters C C indicate the extent of motion allowed to the hand-block.

The late Henry S. Hewit, of this city, devised a very ingenious splint, by which the mobility of the wrist and fingers might be more perfectly retained, and the wrist put into any desirable position. The following is the description given by himself of the apparatus: "The wooden ball grasped by the hand is connected by a rod to a slender bar running

FIG. 106.



longitudinally upon the face of the splint, and capable of being flexed at any desirable length. The rod is attached to the travelling connection by a universal joint, giving play to the ball in limited movements of flexion, extension, pronation, and supination. The natural tendency is for the patient to make these movements, and perpetually to relax and

¹ Fauger, London Lancet, May 8, 1847.

² Velpeau, Boston Med. Journ., vol. xxxv. p. 213.

contract the fingers. The splint upon the inner surface of the arm is antagonized by a plain flat-splint on the outer surface, extending to the superior border of the wrist-joint. This splint has been used for upwards of two years by myself and others, particularly by Dr. W. T. White, at the Demilt Dispensary, and has given good results.¹

We come now to consider how far this peculiar treatment, ulnar inclination, is capable of answering the special indications of the case we are studying.

It is assumed, as I have already intimated, that by bearing the hand strongly to the ulnar side, the fragments of the radius are brought more exactly into apposition, and more easily and effectually retained; an assumption which supposes two things to have been determined: first, that there exists an overlapping of the fragments, either through the whole extent of their broken surfaces or especially toward the radial side, or that the upper end of the lower fragment is inclined to fall against the ulna, or that all of these several conditions coexist; and, secondly, that if such displacements do exist, they can be remedied by this manœuvre.

The first of these suppositions seems to have been sufficiently considered by all those gentlemen who have particularly examined the specimens contained in the various pathological collections, and to whose careful investigations I have already frequently adverted. With rare exceptions, none of these displacements have been found to exist, although, as has been observed, a casual inspection of the arm when recently broken would often lead to an opposite conclusion. I do not here speak of impaction, which is usually upon the posterior margin, if it exists at all.

In regard to the second supposition, namely, that, where such displacements do exist, a forced adduction will aid in the retention of the fragments, I shall have to speak more cautiously, because, so far as I know, my opinions have received as yet no public and authoritative indorsement. In order that adduction may prove effective, there must be some point upon which to act as a fulcrum. It is of no use that we rotate the hand for the purpose of making extension unless there can be found a resistance or fulcrum upon which the rotary motion may be performed. Such a fulcrum exists, no doubt, but to determine its availability we must ascertain its character and position.

It is not in the lower end of the ulna, for the ulna has no point of contact with the carpal bones, and when, in the natural state of these parts, the hand is inclined to the ulnar side, the lower end of the ulna rides freely downwards upon the wrist until arrested by the ligaments which unite it with the carpus, or by the capacity of the joint to admit of motion in this direction. When the lower end of the radius is broken, and the ligaments of the joint are more or less torn, the ulna, although thrust downwards much farther, perhaps, than it could ever descend in its normal state, still fails to find a support, and, spreading wider and wider from the radius as it is thrust further upon the hand, no limit can be given to its progress in this direction. It was thus that, in one

¹ Hewit, Medical Record, April 1, 1873.

example already mentioned, I found the ulna carried downwards one inch or more, and this was the fact in several cases reported by Moore, and verified by the autopsy.

The resistance will, then, in nearly all cases, be found to be in those ligaments which bind the lower fragment to the lower end of the ulna, and the ulna to the carpal bones, viz., the radio-ulnar, the triangular, and the internal lateral ligaments, which in the normal state of the parts constitute the centre upon which forced adduction expends its power, and which still continue to be the point of resistance when the radius is broken. But how feeble and uncertain must be a resistance which depends solely on these injured and often lacerated ligaments! And how painful to the patient must be an extension sufficient to overcome the action of nearly all the muscles of the wrist, which is borne entirely by a few torn and inflamed fibres! Even in health this position, when forced, cannot be endured beyond a few seconds, and it must be difficult to estimate the sufferings which the same position must occasion when the ligaments are torn and inflamed.

I am not to be told that surgeons have not intended to advocate this extreme practice; that they have never recommended forced adduction, but only a moderate and easy lateral inclination, such as can be comfortably borne. If they have not, then they should not have spoken of making extension by this means. An easy lateral inclination has no power to do good so far as extension is concerned, than it has power to do harm. But the fact is, while a majority of surgeons have no doubt used less force than was hurtful, some have used more than was useful or safe; indeed, the sharpness of the curve given to the splints figured and recommended by Dupuytren, Nélaton, and others, sufficiently indicates that their distinguished inventors intended to accomplish by these means a forced and violent adduction.

Malgaigne, speaking of other means of extension applied to the forearm, suggested by Godin, Diday, and Velpeau, intended to operate only in a straight line, and alluding especially to the modes devised by Huguier and Velpeau, remarks: "Without discussing here the comparative value of the two forms of apparatus, I believe that they could scarcely be endured by the patients; and M. Diday tells us that, in the trials which he has made, the pain produced by the extension was so great that he was compelled to renounce it." Which observations cannot but apply equally to this plan of extension by adduction or to any other which might be adopted. Dr. G. S. Porter, of Lonaconing, Maryland, has used for the purpose of extension a padded wire-splint applied to the dorsal surface of the arm and hand, and in which the extension is supposed to be effected by adhesive plaster strips.¹ Notwithstanding the testimony which the experience of this gentleman has furnished of the value of this method, and not doubting that he obtained satisfactory results, I must be permitted to say that probably they were due to the thoroughness with which he reduced the fracture in the first place, rather than to the efficiency of the apparatus; and I will take this opportunity of saying that the success claimed by Drs. Moore and Pilcher for their peculiar modes of treatment, neither of whom employs splints,

¹ Porter, Med. and Surg. Reporter, April 14, 1877.

depends, in my opinion, wholly upon the fact that they have had the good judgment and skill to reduce the fragments effectually in the first instance, after which, as I have already said, there is usually very little probability that they will become displaced. In cases which have been treated under my observation, these methods have given no better results than have other methods; indeed, I have not thought the success equal to that obtained by my own, and some other modes of dressing, for which, however, much less has been claimed.

After all, it must not be inferred that I have concluded to reject this mode of dressing—the pistol-shaped splint—in all of its modifications; for, although I am far from being persuaded of its utility as a means of extension and retention in any case, yet I am not prepared to deny to it some very considerable value in another point of view; and when judiciously employed it can certainly do no harm. It is, I repeat, for another reason altogether than the one heretofore assigned, that I would recommend its continuance, a reason which I cannot so well explain, or hope to render intelligible, except to the practical surgeon. This position throws the whole lower end of both radius and ulna outwards toward the radial margin of the splints, and by keeping the radius more completely in view, it enables the surgeon better to judge of the accuracy of the reduction, and to recognize more readily the condition and situation of the compresses, etc. This alone I have always considered a sufficient ground for retaining the angular splint; although I have treated a great number of arms satisfactorily with the straight splints alone.

Finally, while surgeons have been seeking to meet an indication, the existence of which is at least rendered doubtful, and by means which appear to me totally inadequate, if it did exist, they have probably too often overlooked or regarded indifferently an indication which is almost uniformly present, namely, to press thoroughly forwards the tilted fragment by a force applied upon the wrist from behind, and to retain it in place by suitable compresses. And I cannot help thinking, that, if they had regarded this as the sole indication in most cases, an indication generally so easily met, they would have made fewer crooked arms, and have saved their patients much suffering and themselves much trouble. In support of this opinion, I must be permitted to say again that in my own practice deformity after this fracture is the exception. I never apprehend its occurrence unless there is comminution, or other serious complications.

In other, and somewhat exceptional cases where the lower fragment is driven back until its broken surface overrides the broken surface of the upper fragment, and in addition to the consequent impaction there is added a lifting of the periosteum, as described by Pileher, we must first, as stated by him, increase the dorsal flexion, press the finger against the proximal end of the lower fragment, and then, while making extension from the hand, gradually bring the hand and the lower fragment forwards. And I may add that if, by the method of direct and forcible pressure from behind, or by Pileher's modification of this method, we have once brought the lower fragment thoroughly into place, it will remain in place with little or no retentive apparatus; unless, indeed, the lower fragment

be comminuted. In which case some degree of deformity will ensue whatever plan of treatment we may adopt.

In case the ulna is dislocated also, and is imprisoned by the annular ligament, circumduction with extension, as practised by Dr. Moore, and heretofore described, will be required.

It only remains for us to determine the precise form of splint which ought to be preferred, and to describe its mode of application.

The narrow "attelle cubitale" of Dupuytren is inconvenient; nor can I give the preference to the curved dorsal splint recommended by Nélaton, and employed by Robert Smith, Eriksen, and others. It is not to me a matter of entire indifference, in case only one curved splint is employed, whether this be applied to the palmar or dorsal surface of the forearm. Foreign surgeons, so far as I know, have applied this splint to the dorsal surface, and the straight splint to the palmar; while American surgeons have adopted almost as uniformly the opposite rule—to whose practice, in this respect, I acknowledge myself also partial. It is to the curved splint rather than to the straight that we mainly trust; not simply, or at all, perhaps, because of its form, but because the curved splint is also the long splint. This is the splint, therefore, which ought to be the most steady and immovable in its position. Now, the very irregularities of surface upon the palmar aspect of the forearm and hand, instead of constituting an embarrassment, enable us, when the splint is suitably prepared and adjusted, to fix it more securely. Moreover, upon it alone, after a few days, the surgeon may see fit to rely, and in that case it ought to be applied to that surface of the arm which is most tolerant of continued pressure. The palmar surface, as being more muscular, and as having been more accustomed to friction and to pressure, must necessarily have the advantage in this respect. The palmar splint terminating also at the metacarpo-phalangeal articulations, instead of at the wrist, as the short straight splint must do when the hand is adducted, enables the hand to be flexed upon its extremity over a hand-block, or pad of proper size. Such are the not insignificant advantages which we claim for this mode over that pursued by our transatlantic brethren.

The block, suggested first by Bond, of Philadelphia, is a valuable addition, since the flexed position is always more easy for the fingers, and in case of ankylosis this position renders the whole hand more useful.

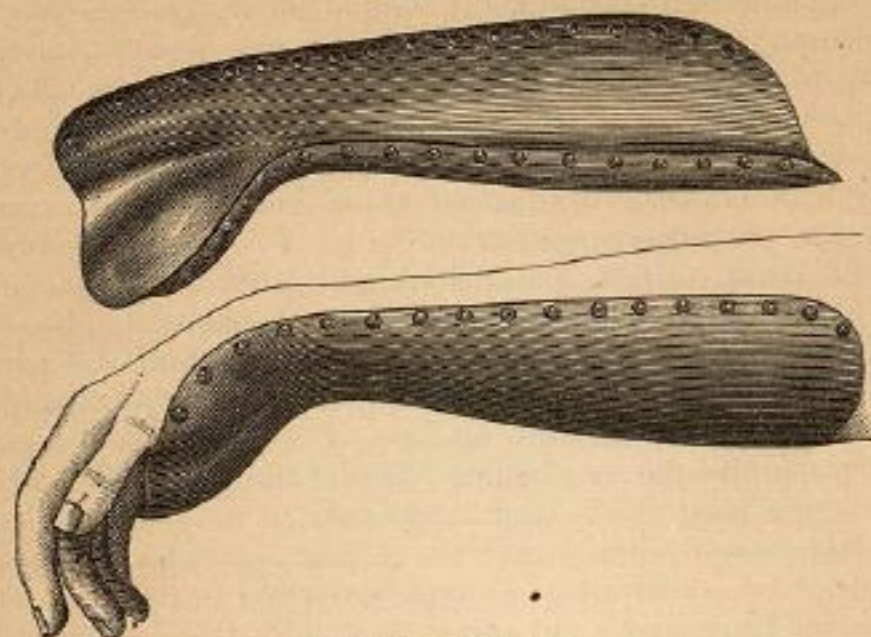
Levis employs a splint made of copper, lined with tin, and furnished with a series of little pointed elevations along the edges to prevent the bandage from slipping.¹

No doubt this splint would answer its purpose well in case it fitted accurately; but to insure this the surgeon must be supplied with a considerable number, differing materially in length, breadth, and form; or it must be made for the patient who is under treatment. I have occasionally employed a splint of this form; once when I had broken my own wrist—a Colles's fracture—and with admirable results; but I have always used for this purpose a pretty thick sheet of gutta percha, which

¹ Levis, R. J. (pamphlet without date).

in a few minutes can be fitted with the most absolute accuracy. Gum-shellac cloth can be adapted, after thorough soaking in boiling hot water, with nearly the same degree of accuracy, and I think sole-leather might also, but in the latter case, after being moulded it would have to be laid aside to dry and harden. The only argument upon which this

FIG. 107.



Levis's metallic splint.

distinguished surgeon can, therefore, justify the use of a fixed form of metallic splint, must be the need of a proper model for the instruction of inexperienced surgeons.

In most cases I prepare extemporaneously a splint from a wooden shingle, which I first cut into the requisite shape and length; the length being obtained by measuring from the front of the elbow-joint, when the arm is flexed to a right angle, to the metacarpo-phalangeal articulations, the fingers being first flexed. It ought, indeed, to fall half an inch short of the bend of the elbow, to render it certain that it shall make no uncomfortable pressure at this point; and the direction to measure with the arm flexed is of sufficient importance to warrant a repetition. The breadth of the splint should be in all its extent just equal to the breadth of the forearm in its widest part, except where it is to receive the ball of the thumb, so that there shall be no lateral pressure upon the bones. If the splint is of unequal breadth, the roller cannot be so neatly applied, and it is more likely to become disarranged. Thus constructed, it is to

FIG. 108.



Author's palmar splint; right arm.

FIG. 109.



Author's dorsal splint; frequently omitted.

be covered with a sack of cotton-cloth, made to fit moderately tight, with the seam along its back, and afterwards stuffed with cotton-batting or with curled hair. These materials may be pushed in, and easily ad-

justed, wherever they are most needed, from the open extremities of the sack. While preparing, the splint must be occasionally applied to the arm until it fits accurately every part of the forearm and hand, only that the stuffing must be more firm a little above the lower end of the upper fragment, and in the hollow of the hand. Between these two points there should be little or no cotton. The open ends of the sack are then to be neatly stitched over the ends of the splint, after which the splint may be laid directly upon the skin without any intermediate compresses or rollers.

The advantages of this form of splint are easily comprehended. They consist in facility and cheapness of construction, accuracy of adaptation, neatness, permanency, and fitness to the ends proposed. There is also no possibility of making painful or injurious pressure upon the arteries or nerves which lie upon the front of the wrist.

The extemporaneous splint recommended by Dr. Isaac Hays, of Philadelphia, is very similar, but it lacks the neatness and permanency of that which I have now described.

In most cases it is better to employ, also, at least during the first fortnight, a straight dorsal splint, of the same breadth as the palmar splint, and of sufficient length to extend from the elbow to the middle of the carpus. This should be covered and stuffed in the same manner as the palmar splint, except that here the thickest and firmest part of the splint must be opposite the carpus and the lower fragment.

Having restored the fragment to place by some one of the methods already described, the arm is to be flexed upon the body, and placed in a position of semi-pronation; when the splints are to be applied, and secured with a sufficient number of turns of the roller, taking especial care not to include the thumb, the forcible confinement of which is always painful and never useful.

Let me repeat that, in most cases, all of our success will depend not so much upon the particular form of apparatus employed as upon whether we have properly reduced the fracture in the early stage of the accident. When once reduced it is, with rare exceptions, easily kept in place.

I cannot too severely reprobate the practice of violent extension of the wrist in the efforts at reduction, when no overlapping or impaction of the fragments exists and the ulna is not dislocated; and that, whether this extension be applied in

FIG. 110.



The author's dressing complete. The curved palmar splint is not in view, only the dorsal. The faint white lines represent the roller. The sling is omitted, for the purpose of bringing the other dressings into view.

a straight line, or with the hand adducted. It has been shown that in a great majority of cases no indication in this direction is to be accomplished; and to pull violently, under these circumstances, upon the wrist, is not only useless, but hurtful. It is adding to the fracture, and to the other injuries already received, the graver pathological lesion of a stretching, a sprain of all the ligaments connected with the joint. I am persuaded that to this violence, added to the unequal and too firm pressure of the splints, are, in a great measure, to be attributed the subsequent inflammation and ankylosis in very many cases.

The first application of the bandages ought to be only moderately tight, and as the application and swelling develop in these structures with rapidity, the bandages should be attentively watched, and loosened as soon as they become painful. It must be constantly borne in mind that, to prevent and control inflammation, in this fracture, is the most difficult and by far the most important object to be accomplished, while to retain the fragments in place, when once reduced, is comparatively easy.

During the first seven or ten days, therefore, these cases demand the most assiduous attention; and we had much better dispense with the splints entirely, as advised by Fauger, than to retain them at the risk of increasing the inflammatory action. Indeed, I have no doubt that very many cases would come to a successful termination without splints, if only the hand and arm were kept perfectly still in a suitable position until bony union was effected.

I must also enter my protest against many or all of those carved splints which are manufactured, hawked about the country, and sold by mechanics, who are not surgeons; with a fossa for each styloid process, a ridge to press between the bones, and various other curious provisions for supposed necessities, but which never find in any arm their exact counterparts, and only deceive the inexperienced surgeon into neglect of the proper means for making a suitable adaptation. They are the fruitful sources of excoriations, ulcerations, inflammations, and deformities.

In reference to the treatment of these fractures, the following cases and the accompanying remarks, by that great surgeon, Dupuytren, are too pertinent not to merit a place in every treatise of this character.

"The two succeeding cases are not only interesting as fractures of the radius, but they are farther deserving of attentive consideration, on account of the serious complications which accompanied them, and which were the consequence of forgetting an important precept. More than once, indeed, it has occurred that the surgeons have been so intent on preserving fractures in their proper position that the extreme constriction employed has actually caused destruction of the soft parts. A piece of advice which I have very frequently given, and which I cannot too often repeat, is to avoid tightening too much the apparatus for fractures during the first few days of its being worn; for the swelling which supervenes is always accompanied by considerable pain, and may be followed by gangrene. It cannot, therefore, be too urgently impressed on young practitioners, to pay attention to the complaints which patients make; and to visit them twice daily, and relax the bandages and straps

as need may be, in order to obviate the frightful consequences which may spring from not heeding this necessary precaution; by carefully attending to this point I have been saved the painful alternative of ever having to sacrifice a limb for complications which its neglect may entail.

"Antoine Rilard, *et.* 44, fractured his right radius while going down into a cellar, in February, 1828, and went at once to l'Hôpital la Charité. When the fracture was reduced (it was near the base of the bone) an apparatus was applied, but fastened too tightly; and, notwithstanding the great swelling and the acute pain which the patient endured, it was not removed until the fourth day, when the hand was cold and œdematous, and the forearm red, painful, and covered with vesications. Leeches, poultices, and fomentations were applied, and followed by some alleviation of the local symptoms, though there was much constitutional disturbance. At the close of a fortnight from the accident, the palmar surface of the forearm presented a point where fluctuation was supposed to exist; but when a bistoury was plunged into it no matter followed. Portions of the flexor muscles subsequently sloughed, and the skin subsequently mortified. The only resource was amputation, which was performed above the elbow six weeks after his admission; and he afterwards recovered without the occurrence of any further untoward symptoms.

"R., *et.* 36, was at work boring an artesian well in 1832, when he was struck by part of the machinery on the right arm; he was instantly knocked down and thrown violently on the right thigh. A surgeon who was sent for detected a fracture of the radius, and applied the usual apparatus, consisting of pads and splints, confined by a roller extending from the extremities of the fingers to the elbow, which compressed the arm so tightly as to give rise to very great suffering. The fingers, hand, and forearm were numbed almost to insensibility, and yet the surgeon in attendance did not think proper to loosen the apparatus. Such was the condition of the patient until he came to the Hôtel Dieu, four days after the accident; the fingers were then black, cold and insensible, and when I removed the splints I found the hand likewise black, especially on its palmar surface. The lower part of the forearm was a shade less livid, but equally cold and insensible; and several vesicles filled with pink-colored serum were apparent on both its surfaces where the splints had pressed; the upper part of the forearm was inflamed, swollen, and very painful. He was bled, and leeches were applied to the inflamed part of the arm; camphorated spirit was applied to the fingers.

"On the following day heat was restored as low as the wrist, but the hand remained for the most part livid and cold, and the radial artery did not pulsate. Seventy leeches were applied to the forearm, and the local application was continued." On the second day after admission thirty more leeches were applied. On the fourth day the hand looked a little better, so as to "encourage some hope of its being saved; but this was again blighted on the sixth day, by the entire loss of heat and sensibility in the part, and increased pain and swelling in the forearm, to which the gangrene subsequently extended. On the twelfth day amputation was performed at the elbow-joint; but the patient did not survive

the operation more than ten days, the immediate cause of death being acute pleurisy. There was a considerable quantity of purulent serosity on the right side of the chest; and abscesses were found in the lungs and liver. On examining the arm, there was found to be a simple fracture of the radius about its centre.

"The above case presents a painful illustration of the neglect to which I have alluded. In nearly every instance the swelling of the limb requires that careful attention should be paid to the bandage or straps by which the apparatus is confined. Similar accidents are likely to result from the employment of an immovable apparatus, of which an example occurred in the practice of M. Thiéry, one of my pupils. He was summoned to visit a young girl, on whom such an apparatus had been applied for supposed fracture of the radius. After suffering excruciating torment, the forearm mortified, and amputation was the only resource; on examining the limb, no trace of fracture could be discovered. Had a simple apparatus been here employed, and properly watched, the patient's limb would not have been sacrificed."¹

Robert Smith mentions, also, the case of a boy, æt. 18, who had a fracture of the lower extremity of the radius, through the line of the junction of the epiphysis with the diaphysis, caused by being thrown from a horse. A surgeon applied, within an hour, a narrow roller tightly around the wrist. On the following day the limb was intensely painful, cold and discolored; still the roller was not removed, nor even slackened. On the fourth day he was admitted into the Richmond Hospital, when the gangrene had reached the forearm. Spontaneous separation of the soft parts finally occurred, and the bones were sawn through twenty-four days after the fracture was produced, from which time "everything proceeded favorably."²

Nov. 21, 1851, a boy, ten years old, living in the town of Andover, Mass., had his left hand drawn into the picker of a woollen mill, producing several severe wounds of the hand and a fracture of the radius near its middle. One of the wounds was situated directly over the point of fracture, but whether it communicated with the bone or not was not ascertained. A surgeon was called, who closed the wounds, covered the forearm with a bandage from the hand to above the elbow, and applied compresses and splints. The lad made no complaint, his appetite remaining good, and his sleep continuing undisturbed, until the third day, when he began to speak of a pain in his shoulder; on the same day also it was noticed that his hand was rather insensible to the prick of a pin. Early on the morning of the fourth day his surgeon, being summoned, found him suffering more pain and quite restless; and on removing the dressings, the arm was discovered to be insensible and actually mortified from the shoulder downwards.

Opiates and cordials were immediately given to sustain the patient, and fomentations ordered.

On the sixth day a line of demarcation commenced across the shoulder, and on the twenty-first day the father himself removed the arm

¹ Dupuytren, *Injuries and Diseases of Bones*, Syd. ed., London, 1847, pp. 145-7.
² R. Smith, *Treatise on Fractures, etc.*, Dublin, 1854, p. 170.

from the body by merely separating the dead tissues with a feather. Subsequently a surgeon found the head of the humerus remaining in the socket, and removed it, the epiphysis having become separated from the diaphysis. The boy now rapidly got well.

In the year 1853 this case became the subject of a legal investigation, in the course of which Dr. Pilsbury, of Lowell, Mass., declared that in his opinion this unfortunate result had been caused by too tight bandaging, and by neglecting to examine the arm during four days.

On the other hand, Drs. Hayward, Bigelow, Townsend, and Ainsworth, of Boston, with Kimball, of Lowell, Drs. Loring and Pierce, of Salem, believed that the death of the limb was due to some injury done to the artery near the shoulder-joint; and in no other way could they explain the total absence of pain during the first two days; nor could they regard this condition as consistent with the supposition that the bandage occasioned the death of the limb.¹

I cannot but think, however, that these gentlemen were mistaken, and that the gangrene was alone due to the bandages. In a similar case which came under my own observation, and in which both the radius and ulna were broken, the roller extended no higher than just above the elbow, and the patient complained of no pain until the bandages were unloosed, yet the arm separated at the shoulder-joint. I shall refer again to this example in the chapter on Fractures of the Radius and Ulna; and shall take occasion then also to speak more fully of the causes of these terrible accidents.

Norris mentions another case of compound fracture of the lower end of the radius which came under his notice at the Pennsylvania Hospital in August, 1837, the arm having been dressed by a surgeon within half an hour after the accident, with bandages and splints. When these bandages were removed at the hospital, on the fifth day, "the soft parts around the fracture were found to have sloughed, an abscess extended up to the elbow-joint, and sloughs existed over the condyle. Severe constitutional symptoms arose, making amputation of the arm necessary."²

A lady, æt. 50, was also seen by Thiéry, who, having broken the radius near its lower end, lost her fingers by the sloughing consequent upon a tight bandage.³

A woman was admitted into one of Dr. Wood's wards in the Bellevue Hospital about the 1st of February, 1863, who had fallen upon her hand a few days before and broken the radius just above the wrist. Her arm was dressed with splints and bandages at one of the dispensaries in this city. Gangrene ensued, and when I saw her on the 8th of February, the death had extended to the middle of the forearm, the dead tissues being dry and black. Dr. Wood amputated the arm, but she died.

The remarks which have now been made in relation to the treatment of Colles's fracture are applicable, with only such slight modifications as would naturally be suggested, to fractures of the lower end of the radius commencing upon the radial side of the bone and extending obliquely downward into the joint (perhaps, indeed, this ought to be

¹ Bost. Med. and Surg. Journ., vol. xviii. p. 281.

² Norris, note to Liston's Surgery, p. 54.

³ Amer. Journ. Med. Sci., vol. xxv. p. 461, from L'Expérience for 1838.

regarded as a variety of Colles's fracture); and it is to this form of fracture, especially, that the pistol-shaped splint must be found applicable. If the fracture actually extends into the joint, it must not be forgotten that, in order to the prevention of ankylosis, the wrist should be early subjected to passive motion.

The following example of a compound comminuted fracture of the radius may serve to illustrate the value of a somewhat novel mode of treatment under certain circumstances:

William Croak, of Buffalo, æt. 30. January 29, 1856, a large piece of iron casting fell upon his arm, crushing and lacerating the wrist, and comminuting the lower part of the radius; he was immediately taken to the Hospital of the Sisters of Charity. I found the whole of the soft parts torn away in front of the joint, and the fragments of the radius projected into the flesh in every direction. The hope of saving the hand seemed to be scarcely sufficient to warrant the attempt; at least by the ordinary mode of procedure. I, however, stated to the gentlemen present, among whom were Dr. Rochester, my colleague, and the house surgeon, Dr. Lemon, that I believed it could be saved if, having removed the fragments of the radius, we practised resection of the lower end of the ulna, and allowed the muscles to become completely relaxed. Accordingly, after placing my patient under the influence of chloroform, I enlarged the wounds so as to enable me to remove six or seven fragments of the radius, leaving others which were broken off but not much displaced. I then removed with the saw one inch and a half of the lower end of the ulna. The hand was immediately drawn up by the contraction of the remaining muscles, but their tension was completely relieved.

The wounds were closed and dressed lightly, and the whole limb was placed on a broad and well-padded splint covered with oiled cloth. The hand, which was very pale and exsanguine, was covered with warm cotton batting.

The subsequent treatment was changed from time to time to suit the indications; but his recovery was rapid and complete, nor was there at any time excessive inflammation in any part of the limb.

I have seen this man frequently since he left the hospital, and while he has recovered only a little motion in the wrist-joint, his hand and fingers are nearly as useful as before the accident. He is able to perform all ordinary kinds of labor with almost as much ease as most other men; and, what is always gratifying to the humane surgeon, he does not fail to appreciate fully the service which has been conferred upon him by the preservation of his somewhat mutilated hand.

I have recently adopted the same treatment with equal success in a case of gunshot wound of the lower end of the radius.

Fracture of the Styloid Process of the Radius Independently of a Colles's Fracture.—I have elsewhere in the preceding pages (p. 331) spoken of this accident in connection with a Colles's fracture, and I wish now to refer briefly to its occurrence independently of a Colles's fracture.

Dr. Butler, House Surgeon to the Brooklyn Hospital, reports a case treated by Dr. J. C. Hutchison of fracture of the right radius at the junction of the middle and lower thirds, accompanied with a fracture

also of the styloid apophysis in the same bone. The accident occurred in a lad fourteen years old, who had fallen from a height of thirty feet upon the pavement. The lower fracture commenced at the base of the styloid process of the radius, and extended down obliquely into the wrist-joint, breaking off about one-fifth of the articular surface. The process was drawn up on the posterior surface of the radius, about one inch and a half, by the supinator radii longus muscle. It was movable, but, in consequence of the contusion and swelling, could not be returned to its place. The hand occupied the same position that it does in Colles's fracture.

On the eighth day an attempt was made to force down the process with a compress secured by adhesive plaster straps; but it could not be done. The hand and arm were confined also to a pistol-shaped splint; ulcerations ensued from the pressure of the compress, and the process was laid bare, but it finally became united in its abnormal position; the motions of the wrist, however, were not impaired, and the power of pronation and supination soon returned.¹

In January, 1879, a lady called upon me having a fracture of the styloid process of the radius, which had occurred about four months previously. The fragment was tilted forwards and carried slightly upwards by the action of the long supinator. It was movable. The motions of the joint were in no way interfered with, and the form of the wrist was natural. She was somewhat advanced in life, and suffered from pains and soreness about the joint, but no more than is usual after severe wrist-joint injuries. The character of the accident was not recognized by her surgeon, and no treatment had been adopted; nor is it to be supposed that the displacement could have been remedied, except by section of the tendon of the long supinator, if its existence had been recognized; and, if this had been done, I doubt whether she would have had a more useful arm than she has now.

Dr. Wm. Hunt,² of Philadelphia, reported a case of this fracture, the result of a fall upon the hand, and accompanied with considerable comminution. It became necessary to amputate the arm, and the opportunity was thus afforded to determine the exact nature of the lesion by dissection.

Epiphyseal Separations.—This bone is formed from three centres, namely, one for the shaft and one for either extremity. The shaft is ossified at birth. About the end of the second year ossification commences in the lower epiphysis, and it becomes united to the shaft at about the twentieth year. The same process commences in the upper epiphysis at about the fifth year, and is completed by consolidation with the shaft at the age of puberty.

I have met with no recorded examples of separation of the upper

FIG. 111.



Radius with epiphyses. (From Gray.)

¹ New York Journ. of Med., 1857.

² Hunt, Phil. Med. Times, Oct. 9, 1880, p. 26.

epiphysis, and the examples of separation of the lower epiphysis have seldom been clearly made out. I have already mentioned one as having been reported by Robert Smith. He speaks also of other cases occurring in conjunction with a separation of the lower end of the ulna, and which, he thinks, are liable to be mistaken for dislocations.¹

Malgaigne says that we have reasons to suspect this accident when the fracture occurs in persons under twenty years of age. Cloquet ascertained its existence by a dissection in a child of twelve years; Roux also in a child whose age is not given, and Voillemier produced it easily in the dead bodies of children, and once in the body of a robust man of twenty-four.² Schmit³ and Girdner⁴ have also noticed the frequency of the epiphyseal separation when, in the case of infants, the fracture is caused by avulsion upon the cadaver. The experiments of Dr. Girdner, made at my request, also showed, that in early life avulsion sometimes caused a fracture just above the epiphysis, sometimes a bending of the bone, without fracture, and sometimes only a rupture of the ligaments. I think I have broken the radius at the epiphyseal junction in some of my experiments of forced flexion in adult females.

The treatment of this accident will not demand any special consideration, since it will not differ essentially from the treatment required in a fracture occurring at the same point.

Delayed or Non-union of Fractures of the Radius.—Muhlenberg in his tables has recorded 23 cases, of which 17 are reported as having been cured, and in 6 the attempts to cure have failed. Resection and drilling furnish the largest percentage of cures. I have never met with an example of non-union in a fracture of the lower end of the radius.

CHAPTER XXIII.

FRACTURES OF THE ULNA.

§ 1. Fractures of the Olecranon Process.

Causes.—My records furnish me with accounts of only 19 of these fractures, and, so far as I have been able to ascertain, all were occasioned by falls upon the elbow, or by blows inflicted directly upon the part. Malgaigne has, however, been able to collect accounts of six examples of fracture of the olecranon, produced, as is affirmed, by the violent action of the triceps; as in pushing with the arm slightly flexed, in throwing a ball, in plunging into the water with the arms extended, etc.; but only four of these reported examples does he think are sufficiently authenticated to entitle them to be received as facts; nor do I think it possible to affirm positively that in any instance, where the whole

¹ Robert Smith, op. cit., p. 164.

² Schmit, Thèse de Paris, 1878, No. 114.

³ Girdner, Jno. H., Med. Rec., Feb. 26, 1881.

⁴ Malgaigne, op. cit.

process is broken off, the triceps alone has occasioned the separation. For example, Capiomont reports the case of a cavalier, who, being intoxicated, was thrown head-foremost from his horse, and, striking probably upon his head, was found to have broken the olecranon process. We do not, in this example, see evidence alone of a forcible contraction of the triceps, but also of violent pressure against the hand and in the direction of the axis of the forearm toward the elbow-joint, by which the olecranon process might have been so thrown forwards against the fossa of the humerus as to cause its separation. The same explanation might apply to several of the other examples.

Point and Direction of Fracture; Displacement, etc.—The process may be broken at its summit, at its base, or intermediate between these two extremes, the last of which is the most common.

It is probable that when the action of the triceps alone has produced the fracture, it will be found that only that portion which receives the insertion of the triceps has been broken off. Malgaigne, who has been able to find upon record only two cases of a fracture of the extreme end of the process, declares that they were both occasioned by muscular action.

Fractures of the middle are generally transverse, or only slightly oblique, occurring in the line of the junction of the epiphysis with the diaphysis.

Fractures through the base are generally quite oblique, the line of fracture extending from before downwards and backwards, so that not only the whole of the process, but a portion of the back of the shaft is carried away; and this accident can scarcely happen, except by a blow received upon the front and lower end of the humerus, while the arm is extended; or by a blow upon the back of the forearm, whether the arm be in a position of flexion or extension, received at a point a little below where the shaft of the ulna joins the olecranon.

The only displacement to which the upper fragment seems to be liable, is in the direction of the triceps; and the degree of this displacement does not depend so much upon the point at which the fracture has taken place as upon the violence which has occasioned it, the extent of the disruption of the ligaments, aponeurosis of the triceps and of the capsule, and upon whether, since the accident, the arm has been flexed or kept extended.

In five instances I have found distinct crepitus immediately after the fracture has occurred, produced by only moving the fragment laterally, showing plainly that little or no displacement had taken place. The following example will show also that this displacement does not always happen even after the lapse of several days, and where no surgical treatment has been adopted.

Samuel Duckett, æt. 14, fell upon the point of the elbow, and two

FIG. 112.



Fracture at the base.