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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING, HELD JANUARY 16, 1911

The President, DR. ROBERT G. LE CONTE, in the Chair

RECENT ADVANCES IN PULMONARY SURGERY.*

WITH SPECIAL REFERENCE TO DIFFERENTIAL PRESSURE AND WOUNDS OF THE LUNG.

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THE great advances that have been made in pulmonary surgery within a short space of time are apparent to the most casual student. We have been interested in glancing over the contributions in this field to the Transactions of this Society in the last twelve years, and it seemed to us of interest to contrast our attitude ten or twelve years ago, and that which we assume to-day.

Take, for example, the report by Dr. R. N. Downs, Jr., in December, 1898, of a case of stab wound of the chest, operated by Le Conte, whose investigations and views on this subject are so well known and so respectfully quoted (except by some German authorities), and the discussion thereon participated in by the lamented Willard, who years before had pursued careful experimental studies in lung surgery. Le Conte and Willard had firm grasp of the physiological problems encountered, but alas, the modern appliances for solving them were then, with the exception of the Fell-O'Dwyer

*The annual oration, read before the stated meeting, held January 16, 1911.

method, as yet unheard of, while the reaction of the pleura to infection and to pneumothorax was as yet unstudied, except on clinical grounds. Direct treatment of the bleeding lung was only mentioned as a last resort, and the introduction of a drainage tube and the establishment of lung collapse was a measure greatly in advance of any then in vogue. True it is that already at least two cases of lung suture were on record before 1898,—one by Omboni¹ in 1884 for gunshot wound, and one by Delorme² in 1893 for stab wound; but both patients had died, and they were as yet without imitators.

Da Costa's bold treatment of a case of secondary hemorrhage from the lung by thoracotomy and a huge tampon was looked upon, and rightly, with the experience then at our command, as an achievement demanding great surgical courage. Consider Stewart's report in April, 1900, of a pyo-pneumothorax associated with fracture of the ribs, and judging from the symptoms either a laceration or rupture of the lung, and a "tension pneumothorax." Repeated aspirations failed to relieve, and opening of the chest and the introduction of a rubber drainage tube were finally practised, and successfully. How would we then have considered Garre's recommendation that thoracotomy be practised without loss of time and the wound in the lung sought for and sutured? The ingenious Hopkins³ had striven to devise valve systems of drainage for the air-containing and the infected pleura, but these were as yet Wills-of-the-wisp, or as Harte sarcastically remarked, "mechanical toys," and perhaps are little more to-day.

With the passing of time, however, we have learned some things and unlearned others; and at least two cases of suture of the wounded lung are now on record by Fellows of this Academy; although both, we remark with regret, are ignored by the patriotic German authorities (Jopson,⁴ Kelly⁵).

But in this field, we would again emphasize, the advances have been so rapid that authorities are soon outworn, and the articles on chest surgery in our best and most recently published systems miss many of the most vital points of the subject.

It has seemed to us that in considering these revolutionary changes, they embrace from an operative stand-point those measures aimed at overcoming the symptoms, at times appalling and always to be borne in mind, which may attend pneumothorax and lung collapse; and secondly, those pertaining to operative technic, as modified by the nature and resistance to infection of the pleura and the thoracic contents.

We have undertaken a study of some recent literature on these general subjects, as well as on the special subject of the operative treatment of wounds of the chest.

A brief review of the physiological conditions found in the lungs and pleura in relationship to intrathoracic pressure as distinguished from intrapulmonic pressure may be useful and is necessary to a clear understanding of the problems involved in a study of methods of differential pressure. By intrathoracic pressure is meant the pressure in the thoracic cavity outside the lungs, and which is present in the unopened pleura and mediastinum. Intrapulmonic pressure is the pressure found in the air-passages and the alveoli. At the end of both inspiration and expiration the intrapulmonic pressure is equal to atmospheric pressure, as these passages are at this time in communication with the external air. During inspiration this pressure falls and becomes negative. The degree varies with the degree of constriction in the parts above, especially including, under normal conditions, the glottis. During expiration the pressure rises. Under normal conditions of quiet respiration these variations are not great—from 7 to 10 mm. of water as measured by the manometer. If the glottis be closed, the variations in pressure are greatly increased, and these variations have a marked effect upon the heart and circulation (Howell⁶).

Intrathoracic pressure, or that present in the pleura and mediastinum, is always negative under normal conditions; that is to say, it is always less than the atmosphere. The reason for this is, to quote Howell, that the lungs are smaller than the cavity which they occupy. "The lungs are distended to fill the thoracic cavity, and consequently the organs, like

the heart, which lie in this cavity outside the lungs are exposed to a pressure of one atmosphere, minus the force of elastic recoil of the lungs." Howell defines intrathoracic pressure, therefore, "as intrapulmonic pressure, minus the elastic pull of the lungs, and since under usual conditions the intrapulmonic pressure is equal to that of the atmosphere, the intrathoracic pressure is less than an atmosphere by an amount equal to the recoil of the lungs." This negative pressure is greater during inspiration than during expiration, being, according to Heynsius, equal to -7.5 mm. of mercury at the end of inspiration, and to -4.5 mm. of mercury at the end of expiration. If by opening the chest wall and parietal pleura this negative pressure is abolished, the entrance of air into that side of the chest is attended by collapse of the lung, and pneumothorax results on that side.

Space forbids any extensive inquiry into the causes of dyspnoea and collapse which may attend pneumothorax. That these symptoms are not always or even usually present in the human subject when only one side of the chest is opened is well known and long since emphasized by Matas, Trendelenburg, and many others; and many successful operations confirm the view that they may be absent or of but moderate gravity. A dog is killed by wide opening of one pleural cavity unless some form of differential pressure is employed. The thin and easily ruptured mediastinum is the animal's undoing. The rabbit can safely undergo the same operation without fear of collapse (Robinson and Leland⁷); and it has been well said by them that some human subjects have a dog's lungs, and some a rabbit's.

The margin of safety is not large enough to disregard the methods now at hand to guard against an alarming or fatal collapse; and to-day, in Germany at least, every large clinic has a positive pressure apparatus or a Sauerbruch chamber at its disposal (Wolf⁸); no less than 35 clinics being so equipped at the beginning of the year 1910 (Robinson⁹). In this country, Meyer, Green and Janeway, Robinson, Elsberg, Lilienthal, and others are equipped, and are doing

active clinical work. In plain words, haphazard surgery would seem to have reached its limit, and except in cases of emergency, the time is at hand when the surgeon doing thoracic work must equip himself accordingly.

A brief enumeration of the theories advanced in explanation of the dangerous symptoms of lung collapse is furnished by Wolfe;⁸ Murphy and Garré seek the cause in an insufficient fixation of the mediastinal pleura, which flutters to and fro in respiration, hindering both inspiration and expiration, dyspnoea being more common than collapse in unilateral pneumothorax. Rehn attributes them to a displacement of the mediastinum to the opposite side, causing a kinking of the larger bronchi; while Friedrich sees the cause of collapse in circulatory disturbances due to kinking of the great vessels. If we add to these the view of Tiegel,¹⁰ who believes that a deficiency of lung ventilation and of oxygen is the chief danger in pneumothorax, which deficiency might be explained by either of the first mentioned theories, it furnishes us with an explanation of the successful action of the several methods which have been adopted to prevent a collapse of the lung and to maintain respiration, and thus meet the complications of accidental and operative pneumothorax.

Under the head of differential pressure, we include the several methods of prevention of pneumothorax and collapse of the lung.

Differential pressure has been tersely defined by Willy Meyer as a higher pressure within the lungs than outside of them. As is well known, this is produced in one of two ways: either by increasing the intrapulmonic pressure—the positive pressure method; or by decreasing the atmospheric pressure on the surface of the lung—the negative pressure method.

Green and Janeway¹¹ divide the forms of apparatus for artificial respiration into four classes, and this classification will suit our purpose. They are, first, those providing either negative or positive pressure, as the operator desires, the cabinets of Sauerbruch and Meyer; second, the positive pressure cabinets of Brauer, Murphy, Janeway and Green; third, the

positive pressure masks of Robinson and Tiegel; and lastly, the devices for direct insufflation through the larynx or trachea, of Fell, O'Dwyer, Doyen, Matas, Green, Volhard, and Meltzer.

That there is not any essential difference between the results obtained by the positive and negative pressure is acknowledged by many of the experimenters in one or the other field. It would seem to be a case where indeed "The ways they are many. The end it is one."

While to Sauerbruch is due the credit for the tremendous impetus which his introduction of the negative pressure cabinet bearing his name gave to the study of the subject, and while it must not be forgotten that it was he also who pointed out that by a reversal of the position of the patient in his cabinet positive pressure could be produced, it would seem that the early pioneers in the field are to-day scarcely receiving the credit that is their due; and that we in this country at least should not forget that Fell, O'Dwyer, and Matas did yeoman's service in the introduction and development of what is as truly a positive pressure method as any of the forms of apparatus of which we hear so much to-day. A parent is naturally partial to his own child, and we find Fell¹² in a recent article again calling attention to the merits which his apparatus in its latest form possesses. In the earlier forms of negative and positive pressure cabinets the intrapulmonic pressure was static, and the respiratory movements were dependent upon the patient himself. While collapse of the lung was prevented, cessation of respiratory movements would quickly end fatally, and might easily result from paralysis of the respiratory centre, whether produced by poison or shock.

The ease with which Fell overcomes this danger by his method of forced respiration, varying at will the number of respirations from 5 to 50 per minute, following when desirable the autorespirations, and controlling the degree of collapse or inflation of the lung to suit the operator, makes him doubt the flexibility of the mechanism of the cabinets, or what Carrel calls the "classical" types of apparatus. But with the improvements which have been already obtained in some of

these wonderfully ingenious and (although it must be said cautiously to avoid Meyer's sharp criticism) complicated pieces of apparatus, rhythmic changes of pressure sufficient to aid the patient's flagging respiration and to effect exchange of the air in the lung by its alternate collapse and distention can be readily obtained.

To pass on from this reference to Fell's apparatus, which he has modified to meet the demands of both positive and negative pressure, to the consideration of the classical types of apparatus, the cabinets of Sauerbruch, Brauer and Peterson, and their followers, and the masks of Robinson and Tiegel, we find that the mechanical perfection of these forms of apparatus has made great progress since Sauerbruch's cabinet was presented in 1904. Meyer¹³ and his brother have constructed a differential pressure cabinet which permits of the use of either positive or negative pressure, or a combination of the two, and which in the working out of details is the most perfect form of apparatus from a mechanical stand-point yet offered. Of course, the time required for knocking down and transporting such a piece of mechanism practically renders it available in only one institution. So, too, the positive pressure cabinet constructed under the supervision of Robinson⁹ for the Massachusetts General Hospital, while less elaborate, and much less costly, is also open to this objection. But smaller and easily transportable devices are provided in the positive pressure cabinet of Green and Janeway, and the positive pressure masks of Robinson and Tiegel. The cabinet of Green and Janeway permits of a rhythmic rise and fall in the pressure of the inspired air and ether vapor, a true artificial respiration being carried on without any effort on the part of the patient, and it can be used for respiratory failure due to any cause. The inspired air is warmed, thus overcoming an objection which has been urged against positive pressure, and the ether vapor is diluted. The patient's head is under perfect control, and the positive pressure around the patient's head in the cabinet induces a degree of cerebral anæmia, which renders less ether necessary.

A more extensive description of these cabinets is super-

fluous, but the large cabinet of Robinson, where the etherizer sits in the cabinet, connected by megaphone with the outside world, administering the ether in the ordinary manner except for the fact that the pressure in the cabinet is elevated to 10, 15, or 20 mm. of mercury at will, the patient's air passages free and under perfect control and inspection, and the whole interior fed with air by noiseless motor and ventilating pumps, certainly appeals to the imagination at least, as a wholly practicable device.

The positive pressure masks are exemplified in Robinson's smaller apparatus and Tiegel's mask. The description of Tiegel's¹⁴ apparatus and a citation of the results obtained by Tiegel in Henle's clinic¹⁰ lead one to believe that the method he employs may yet be found the most practicable. The apparatus is comparatively simple. The mask is similar to that used in giving nitrous oxide, and can be quickly applied or removed. Tiegel finds that the use of oxygen instead of atmospheric air has certain advantages. It is not necessary to use the same amount of pressure as with air, 1 to 2 cm. of water being sufficient in most cases of unilateral pneumothorax, higher pressure being reserved for cases of tracheal stenosis, double pneumothorax, threatened aspiration of blood, and for fully distending the lung at the conclusion of the operation. The fact that the exposed lung is not fully distended under low pressure renders manipulation easier than in the Sauerbruch method, for example, where the lung is kept in contact with the chest wall. At the same time, while using oxygen, the breathing continues regular, and there is neither dyspnoea nor cyanosis. Distention of the stomach, which has occurred under the use of other forms of positive pressure, is avoided (he cites a fatal case of Küttner's). The pressure supplied from an ordinary oxygen cylinder takes the place of the pump with its complicated parts and liability to internal disorders. The fact that his apparatus has been freely tested, not only on animals but in pressure stenosis of the air-passages, and in stab wounds, rupture of the lung, and resection of the chest wall, has proved its practical value. Experimental

work on healthy dogs is, as Meyer says, different from operations on sick people, and he quotes Tiegel himself as reminding us that "dogs do not drink, smoke, or stay out late at night."

This brings us to the last of the four methods of obtaining differential pressure, viz., that of direct insufflation through the larynx and trachea. We have already alluded to the pioneer work of Fell, O'Dwyer, and Matas in this field. Kuhn of Cassel, with his peroral intubation method; Dorrance, with his intratracheal pressure bulb tube, used in combination with the Matas clinical respiratory apparatus; Volhard and Robinson, have all contributed something to this method, and in a measure paved the way for the reception of the method of Meltzer and Auer,¹⁵ which comes to us with the stamp of approval of Carrel, and has been tested on the human subject by Elsberg and Lilienthal. It is based on the following facts: The exchange of gases in the lung is maintained by a system of ventilation. Internal respiration is the name applied to the exchange of oxygen and carbon dioxide in the tissues and the blood stream, and is dependent upon the flow of blood through the capillaries. In external respiration the movement of the air is accomplished by inspiration and expiration. Meltzer and Auer maintain an artificial respiration by imitating internal respiration, and supplying a constantly flowing stream of air under moderate pressure (15 to 20 mm. mercury) in one direction, which carries the air to a certain distance, the remainder of the distance being covered by diffusion aided by the currents excited. A tube two-thirds the diameter of the trachea is passed through the mouth, larynx, and trachea, down to the bifurcation, and then withdrawn a short distance. The pressure is supplied in the original apparatus by a foot-bellows; the air is passed through an ether bottle, and the pressure measured, of course, by a manometer. Like the masks, it is at once an artificial respiration and etherizing apparatus. There is a backward flowing stream of air which keeps the larynx and pharynx free, and anæsthesia is rapid and complete; and strange to relate, overdosing with ether seems im-

possible. The lungs are distended, breathing is deep and regular, and interruptions of the current or reductions in pressure once or twice a minute permit temporary collapse of the lung, and aid in the diffusion of the gases.

With the aid of this simple apparatus Carrel^{16 17} has done some of his most wonderful work on the lungs, the heart, and great vessels, and the œsophagus, and finds it perfectly satisfactory; while Elsberg^{18 19} has modified and refined it by substituting an electric motor, blower, warming, and filtering apparatus, etc., to meet the exigencies of operations upon man, preserving, however, its principle. Both he^{19 20} and Lilienthal²¹ bear evidence to its satisfactory action in varied types of cases. It is perhaps but natural that this comparatively simple mechanism should excite the fine scorn of Meyer,²² who, in the discussion following its presentation, contemptuously termed it the "blow-pipe method" and opposed its utility in anything but experimental work, viewing it as a backward step of fifteen years. Some of his objections seem valid, while others have been met by the modifications already mentioned, which, as Meyer prophesied, rob it of some of its simplicity. It is a true positive pressure method after all, as Janeway pointed out in discussion, due to obstruction to the backward flow of air. It is not easy to pass a rubber tube unaided into the larynx of an adult, even for one who has had considerable experience in intubation, as we can vouch, and Elsberg uses a Jackson speculum. The interference with the toilet of the mouth and with instrumentation on the œsophagus may also militate against it; as may also a deleterious action of the air and ether vapor on the bronchi, if such be proven (Janeway).

In closing the review of this part of the subject, it will be seen that, as said before, it is generally acknowledged that there is no great advantage of one form of differential pressure over the other, as far as our present knowledge goes. Expansion of the lung can be maintained, and natural or artificial respiration preserved or practised by both methods.

Mention might be made here of the practical application to

many lesions of the thoracic viscera, including the œsophagus, of both forms of pressure. To which modification we will finally come, or whether one form will be found superior under certain conditions and another under other conditions, is still more or less an unsettled question; but that differential pressure has come to stay is certain. With Meyer's universal cabinet he claims that exploratory thoracotomy is as safe to-day as is exploratory laparotomy, thus gratifying Friedrich's wish, which statement, with certain limitations, now to be taken up, may be considered true.

TECHNIC IN THORACIC SURGERY.

The importance of a most rigid technic in all operations upon the pleura, and the direct influence of infection upon the operative results are now well recognized. In both experimental and clinical work infection shares in importance with and outclasses pneumothorax as a most dangerous complication. This has been strongly brought out in an analysis of the deaths after operation in cases of wounds of the heart, 45.4 per cent. of which, according to Guibal (Matas²³), are directly due to septic infection of the pleura or pericardium or of both; in Stuckey's² series of cases of lung suture, infection was the most frequent cause of death. The well-known experiments of Notzel show greater susceptibility of the pleura to infection than is the case with the peritoneum, although less than that possessed by the synovia of the joints. The pleura possesses considerably more resistance when closed than in the presence of pneumothorax. The cessation of lung activity associated with pneumothorax means disturbance of the circulation in both the blood and lymph channels, and the resistance of the pleura at once collapses.

Carrel,¹⁷ in a recent article on the experimental surgery of the thoracic aorta and the heart, reminds us again of the fact that we are in danger of forgetting, viz., that the bulk of so-called aseptic wounds are almost always slightly infected. What would be a negligible infection elsewhere, in the pleura becomes an important and threatening condition. Among

the measures which favor such infection, Carrell includes handling with forceps and retractors, sponging, walling off with gauze, and the exposure of large surfaces to the air. Hence the innovation he practises. These are: the covering of the lung with silk compresses impregnated with vaseline, to prevent evaporation and drying of the tissues, and these covered in turn with thick flannel to prevent cooling; the exclusion of blood from the pleural cavity, and the avoidance of handling and sponging. Moreover, the operating room is kept at a high temperature, and using these precautions, he operates successfully on the œsophagus, the lungs, and the pericardium, discarding many of the suggestions, appliances, and methods of technic found necessary by other experimenters in the same field.

The relationship of pneumothorax to infection, the loss of pleural resistance associated with its presence, and the added resistance afforded by complete closure and air exclusion, will be seen to be of prime importance in considering the whole question of operations on the lung, and more acutely, the question of drainage. From our own slender experience it has always seemed that while the pleura was easily infected, and while drainage was usually followed by infection, it was rather quickly thrown off if the drainage was adequate. But such a position is no longer tenable, if taken as an excuse for the use of drainage as a routine measure or even in cases of doubt. Nearly all the statistics quoted by Matas, in his masterly article on heart wounds in Keen's "Surgery," support the view that a patient's chances are better without pleural drainage; and a study of the more or less exhaustive papers on wounds of the lung, published within the last two years, from the clinics of Körte, Trendelenburg, and Brunner, confirm this opinion. Only by the restoration of the normal physiological conditions, in whole or in part, can infection be satisfactorily controlled.

The practical applications of these considerations in regard to technic leads us to the question of wounds of the pleura and lung, and of these the latter are by far the most important.

WOUNDS OF THE PLEURA AND LUNG.—In another part of this paper we alluded to the views which were commonly accepted and those which were new some ten or twelve years ago. The conservative treatment of such wounds is familiar to every medical student. Rest, with sealing, suture, or tamponing of the external wound, strapping of the chest, cold externally, and morphia are routine, and for the attending surgeon, easily applied and satisfactory measures. What are the untoward consequences to the patient of a too universal application of such treatment? He may continue to bleed into his pleura, and a huge hæmothorax result. If a large bronchus be wounded, with each inspiration air will be pumped into that sac, and failing means of escape externally, compress first the wounded lung, and then by pushing over the mediastinum to the opposite side, displace the heart, press upon the sound lung, and cause kinking of the great vessels and the large bronchi, and result in suffocation from "pressure pneumothorax;" or emphysema may appear, in the presence of a wound in the chest wall, or extend through the mediastinum into the root of the neck and such escape give only temporary relief from pressure. If the patient survives or escapes these immediate dangers, infection frequently develops later, introduced from without through the chest wall or from within through an open bronchus, and empyema results; or secondary hemorrhage, the result of a wound from a small calibre jacketed bullet, may finally carry him to his grave, a complication especially noted during the Boer War. Even if he escapes these accidents, experience has shown that a patient who does well in the early period may be invalidated by the development of respiratory and circulatory crippling, the result of hæmothorax, as noted in the Russian-Japanese War (Küttner). Besides the conservative and expectant treatment, it behooves us to consider the other measures which have been recommended. Aspiration for the removal of blood and air from the pleura is the most frequent minor measure. The permanent insertion of a tube between the ribs, either to favor collapse of the lung and thereby en-

courage hæmostasis (Le Conte), or to allow the escape of air under pressure, in the latter case providing it with some valve mechanism to prevent admission of air from without (Hopkins, Tiegel), have both been advocated. Thoracotomy, followed by evacuation of the blood from the pleura and direct control of hemorrhage, is the most recent and apparently the ideal method.

To Garré²⁴ of Königsberg is due much of the credit for pointing out the urgent necessity in a certain number of cases for the institution of active surgical measures for direct control of hemorrhage from a wounded lung. In this epoch-making article, read before the Thirty-fourth Congress of the Deutsches Gesellschaft für Chirurgie in 1905, he presented the results of a statistical study of 700 wounds in the lung treated conservatively, dwelt upon the high mortality under such methods of treatment, and exposed some of the fallacies which had long influenced the treatment of these lesions. He pointed out that the general mortality was over 40 per cent.; in ruptures of the lung, uncomplicated by other injury it exceeded 50 per cent.; while stab wounds and gunshot wounds in the antiseptic era exhibited a death-rate of 38 per cent. and 30 per cent. respectively. He also clearly demonstrated that antiseptics as ordinarily applied could not favorably influence the internal wound which opened the lung itself; that the small calibre jacketed bullet was as dangerous as the old-fashioned projectile; and also asserted that the often repeated view that bleeding spontaneously ceased in the collapsed lung had neither clinical nor experimental confirmation. The prime indications for operation, according to Garré, were hemorrhage, abundant, persisting, or recurring, and pressure pneumothorax not yielding to aspiration. While they were only present in 5 or 6 per cent. of cases of lung injury, they demanded prompt interference. He collected nine cases of suture of the lung, including one case of ruptured lung (his own) with six recoveries. The principles of treatment, as he laid them down, are not very different from those found useful by his followers; nor has

his technic been greatly modified, except as influenced by the facilities afforded by the development of differential pressure and a better understanding of the influences of pneumothorax and its relationship to drainage.

Since the appearance of Garré's article, a number of other important contributions have appeared, including those of Küttner, Sauerbruch, Hotz, Stuckey, V. Möller, Wolf, and Grassmann. The last three, coming from the clinics of Körte,²⁵ Trendelenburg,²⁶ and Brunner,⁸ have appeared within a year or two, and set forth what may be accepted as the authoritative teaching at this time as contrasted with the extremely radical views advanced by Stuckey² of St. Petersburg, which have received wide publicity.

In determining the indications for operation in lung wounds, it would seem desirable to restore as completely as possible the normal physiological conditions of the pleura, to check hemorrhage, remove infection or the conditions favoring its development, and prevent absolutely all danger from those accidents which we have enumerated as possible sequels of such wounds. This would seem to be the ideal treatment, and it may be that in a short time we will resort to operation as promptly as we do in gunshot wounds of the abdomen. This is practically the ground taken by Stuckey, who reports from one hospital no less than 25 wounds of the lung subjected to operation and suture—an enormous number when contrasted with the sum total of those gathered from the literature by a number of investigators. Stuckey advises thoracotomy and suture in every stab wound of the chest seen within twelve hours of the time of its infliction. His cases showed a mortality of 36 per cent., and combining his cases with 7 cases of suture for stab wound from the literature, the series shows a mortality of 31.27 per cent., which he contrasts with the mortality of 38 per cent. in conservatively treated cases cited by Garré.

This paper led Körte to suggest a study of the cases in his clinic from 1891 to 1909, and V. Möller²⁵ reports them *in extenso*. This paper represents the more conservative

attitude which would restrict operation to cases exhibiting certain well-defined symptoms. In 48 gunshot wounds there was a mortality of only 14.6 per cent., while of 19 stab wounds the mortality was nil. Of 23 cases of subcutaneous rupture of the lung, 9 died, a mortality of 39 per cent. The operations included aspiration, the most frequent operative procedure; thoracotomy only twice; one suture of the lung; one tamponing of the pleura; and one or two laparotomies. V. Möller argues that in only two of the fatal cases of penetrating wounds could death have been prevented by prompt operative treatment, using our modern technic; nor was empyema more frequent than in Stuckey's series; and the lack of mortality and the much shorter period of healing in his stab wounds, is in striking contrast to Stuckey's results.

Grassmann²⁶ takes a view very similar to that of V. Möller, in restricting thoracotomy to certain rather sharply defined conditions.

The favorable outcome of some of the most desperate cases, without operation, is the stumbling block in determining when to interfere. Wolf⁸ reports four cases recovering after suture of the lung—one of rupture, a very rare case, two cases of gunshot wounds, and one of stab wound, operated by Trendelenburg himself. Positive pressure was used in the first case throughout the operation, and in the last case to remove the air from the pleura and to distend the lung before closure of the chest wall. Drainage was dispensed with in all.

The binding indications for operation in penetrating wounds of the chest would seem to be as follows:

1. A wound which from its situation and direction would render likely a penetration of the heart, pericardium, or diaphragm.
2. Severe primary or recurring hemorrhage, as shown by the physical signs of hæmothorax or external bleeding, or by severe hæmoptysis with threatened aspiration of blood into the other lung.
3. Secondary hemorrhage, especially to be looked for in gunshot wounds.

4. Severe pneumothorax, especially when accompanied by symptoms of mediastinal and cardiac displacement, dyspnoea, cyanosis, and threatened suffocation, and which is not relieved by aspiration; also when extensive and increasing external emphysema is present.

5. Secondary pneumothorax, which is always due, according to V. Möller, to suppuration or sloughing of lung tissue.

6. Empyema.

It seems certain that with the improvements in our technic, which include greater familiarity with methods of differential pressure, that these indications will increase in number rather than diminish, and that the ideal treatment, already mentioned, will in time become the accepted one; but a checking up of the results from time to time by our mortality and morbidity statistics should accompany the gradual adoption of more sweeping indications.

In a very limited series of chest wounds under our own observation, the following cases were operated:

1. A stab wound of the chest in the fifth interspace, anterior axillary line, left side, with free external and internal hemorrhage. Treated by prompt rib resection, suture of the wound in the lung, drainage of the thoracotomy wound, and posterior drainage, according to the method of Delageniere. Recovery.

2. A stab wound of the chest in the eighth interspace, anterior axillary line, left side, with moderate external bleeding and traumatopnoea. Treated within a few hours by enlargement of the wound, exploration of the pleura, lung, and diaphragm, cleansing of the pleura, and closure of the wound, with superficial drainage only. Recovery.

3. A stab wound of the chest in the second right interspace, two and a half inches from the sternum, which entered obliquely and divided the internal mammary artery. Operated for recurrent hemorrhage the same day. Ligation of the artery. Partial closure, with drainage. Death from hemorrhage.

4. A case of stab wound in the second interspace, left side. Admitted during Dr. Wharton's service, and treated at first by conservative measures, and later by aspiration on two occasions. Empyema developed, and we resected a rib five weeks after his admission. Recovery.

5. A stab wound of the chest penetrating the pleura between the scapula and the spinal column, and associated with multiple non-penetrating wounds of the back. Operated within a few hours for persisting hemorrhage and hæmothorax. Owing to the position of the wound exploration was unsatisfactory, and tamponing was resorted to. Infection of the pleura followed, and rib resection and drainage were finally necessary. Recovery.

6. A gunshot wound of the chest, self-inflicted, in the third interspace, left side, one and a quarter inches from the sternum. Operated the same day for suspected wound of the heart. Thoracotomy and formation of a quadrilateral chondroplastic flap. Pericardium uninjured. Temporary control of hemorrhage by insertion of large gauze laparotomy pads. Spontaneous cessation of hemorrhage, and closure of the wound with superficial drainage only. Death in four days from delirium tremens.

7. A gunshot wound of the chest below the precordial region on the left side, with penetration of the diaphragm, gastro-hepatic omentum, and kidney. Laparotomy performed the same day, stomach and intestines examined and found uninjured. Temporary improvement, interrupted by streptococcal throat infection, otitis media, and symptoms of lung infection on the right side, with sudden unexpected death several days later. No autopsy.

8. We have also operated upon one case of rupture of the lung, in which the most alarming thoracic shock was present for 36 hours, and which developed empyema later, for which rib resection was done. This patient recovered.

It seems to us that this list, small as it is, emphasizes some of the accidents, immediate and remote, which are frequently met with in chest wounds and injuries. It includes only one case of wound of the diaphragm, treatment of which by the transthoracic route has certain advantages which are now recognized. Nor does it include any well-defined case of "tension" or "pressure" pneumothorax so called (*Spannungs-pneumothorax*), which is one of the most urgent indications for operation, or any wounds of the pericardium or heart. But our experience has been sufficient to convince us that the too optimistic views often voiced in regard to chest wounds, and an over-conservative attitude in their treatment, will sooner or

later lead us all into trouble, and that the attitude which we are now forced to assume is one which is based not alone on physiological and experimental but on truly clinical grounds.

Operative Technic.—Where differential pressure is available, it will usually be employed; or if not used throughout the entire operation, it is useful at its termination before closure of the opening in the thorax, to distend the lung and abolish pneumothorax. It has been used in a number of cases of wound of the lung with the greatest satisfaction, five cases being collected by V. Möller.

Elsberg^{27, 28} emphasizes the fact that both in experimental and clinical work the patient breathes better if lying in the prone position when the chest is opened, and he has recommended this position in operations on the lungs and pleura. The weak anterior mediastinum receives more support in this position, and coughing and respiratory disturbances were absent in empyema cases so operated, while the exposure was excellent. We have tried it in several cases with good results.

The remarks on the aseptic technic, already quoted, are to be borne steadfastly in mind. They need no repetition.

In the presence of a wound, the opening in the chest wall should usually be planned to include it, unless in operating late for infection alone, when the site for drainage is chosen according to the indications common to empyema cases of other origin. Resection of one or more ribs or the formation of an osteoplastic flap is advisable. Intercostal incision, with the use of a powerful rib spreader, is feasible. The lung is at once seized and pulled outward into the wound, using the hand and holding the lung with moist compresses, as Rehn recommends, or adopting the suggestion of covering the rubber glove with a cotton glove to obtain a firmer grasp. Instruments are prone to lacerate the lung tissue. Traction on the lung, drawing it into the wound, as recommended by Rehn, is especially useful when differential pressure is not used, as entrance of air into the pleura is in a measure prevented, while the traction on the mediastinum steadies it

and helps to overcome the respiratory and circulatory disturbances incident to pneumothorax. An examination of the surface is then made for wounds and lacerations. Wounds are sutured whether bleeding is present or if it has ceased, unless situated at the hilus and not accessible for suture, when tamponing may be necessary. In such cases Bramann recommends suturing the wound in the parietes around a large tube provided with a rubber tissue valve. In gunshot wounds the wound of exit from the lung must not be forgotten; failure to suture it may result fatally, as recorded in one case (Delbet).

Lacerated and badly soiled areas may call for excision, preferably wedge-shaped, while clots and foreign bodies are to be removed. The sutures, either of silk (as Talke prefers) or catgut, passed with a round pointed needle, are inserted near the edge of the wound, and penetrate the entire depth, being tied firmly enough to secure hæmostasis and occlusion, but not so tightly or so closely as to cause atelectasis. The visceral pleura may then be sutured over the wound to secure early occlusion. The lung tissue itself heals readily when the wound edges are neatly approximated. Broad lacerated surfaces may be sutured into the wound, shutting off the general pleural cavity (Jonnesku); especially if suturing fails to control hemorrhage (Brunswick). The pleura is cleansed of blood and clots, and preparations made for closure of the wound. Where differential pressure is not used to secure expansion of the lung, it is recommended by Bayer to suture it to the wound in the parietes before closure, as this favors expansion; otherwise it is released and the wound closed by layer suture with superficial drainage. Drainage of the pleura in primary cases is usually contraindicated for the reasons already given. Wolf's report of four successful cases, including one stab wound, two gunshot wounds, and one of rupture of the lung, all treated without drainage, is very convincing.

When packing is necessary in an inaccessible wound, or when gross infection is present, as shown by pleural exudate, and exceptionally under other circumstances, as when a large bronchus is wounded and cannot be sutured, drainage will be

necessary, and under such circumstances drainage posteriorly is preferable (Delagenievs' method).

Of 26 cases of gunshot wound collected by V. Möller, operated according to the usual indications of hemorrhage, pneumothorax, emphysema, or suspicion of heart injury, 11 died (42 per cent.); 20 were sutured with 7 deaths; 2 were sutured to the opening in the pleura, with 1 death; 2 in which the lung was resected died; and 1 in which the pleura was packed, recovered.

Of stab wounds he collected 10; 7 were sutured, with 1 death; and 3 were treated by tamponing the pleura, with no deaths. There were also 19 unclassified injuries to the lung, of which 18 were sutured, with 7 deaths; and 1 case treated by tampon, which recovered.

Stuckey's cases, operated without regard to the usual indications, are not included in these statistics, which are the most elaborate and most recent, although not complete as regards the American literature.

In *rupture* of the lung the question of operation is also to be carefully considered before interference is practised or discarded. The mortality is higher than in the case of penetrating wounds, being 50 per cent. after deducting all deaths due to accompanying injury to other organs (Richter-Wolf). If operation is to be of value, it must usually be practised early, as the lacerated lung, lying in a pleura filled with blood, soon becomes infiltrated and hepatized, as shown by Garré. The pneumothorax which is due to a limited laceration of the parenchyma, like that associated with small penetrating wounds, may be of trifling significance; but if a large bronchus be torn, air may be pumped into the pleura with each inspiration, and its exit hindered by a valve-like closure of the bronchus. Dangerous or fatal pressure on the heart and the opposite lung quickly results under these conditions. Profound shock is a familiar picture in these cases, and after it passes away, hæmothorax, pneumothorax, and wide-spread emphysema often develop. The cases associated with fracture of the ribs give the highest mortality. Wolf says that if, after the period of initial shock has passed the patient's facies

show an increasing paleness and cyanosis, or if signs of hæmothorax, with difficult breathing, small frequent pulse, and anxious expression are present, operation is indicated. Garré operated for rupture of the lung on the fourth day after the injury, too late to save his patient, but Wolf was more fortunate in his case. He operated under positive pressure, sutured a tear in the lower lobe 5 cm. in length (the site of active hemorrhage), cleansed the pleura, elevated a depressed and fractured rib, sutured it in place, and closed the pleura without drainage. The patient recovered, a triumph of surgery.

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DR. HENRY R. WHARTON said that most of the cases of lung injury which he had treated had been by the conservative method. He had seen a large number of very serious injuries of the lung recover. The majority of these cases were injuries of the chest from the passage over it of heavy wagons; at the Children's Hospital there were formerly a great many such cases, and although some of them died, quite a number of those even sustaining a rupture of the lung finally recovered. In adults he did not believe that the statistics of rupture of the lung complicated with fracture of the ribs are quite so favorable as in children. The last case under his care was an Italian boy at the Presbyterian Hospital, who had fracture of the ribs on each side, with laceration of the left lung, hæmothorax, pneumothorax, and extensive emphysema. Aspiration was done a number of times; this boy was desperately ill; finally a rib was resected so as to drain his chest on the left side where the rupture of the lung had occurred, and he recovered.

With regard to gunshot wounds of the lung, the majority of his cases had been treated on the expectant plan and had done well. The case to which the reader of the paper referred was that of a stab wound of the lung, which was aspirated several times on account of pneumothorax and hemorrhage; finally there was a resection of a rib for an empyema, with recovery.

SACRO-ILIAC ARTHRITIS FOLLOWING TYPHOID FEVER.

DR. WALTER G. ELMER reported a case which he believed presented certain features of interest, more especially in regard to the diagnosis. He also thought the lesion to be a rare one.

A young girl, nineteen years of age, was admitted to the surgical ward of the Presbyterian Hospital in the service of Dr. Oscar H. Allis on June 2, 1910.

During the preceding February and March she was quite ill with typhoid fever and was in bed for eight weeks. During her convalescence, about the middle of March, she developed swelling with severe pain of her right lower limb from hip to ankle. This swelling persisted for about six weeks, or until the first of May, when it subsided and all the pain became centred in the region of the right hip and back. Pain was worse at night, of a dull boring character, and patient had night-sweats.

On admission to the hospital, June 2, the temperature was 100°, pulse 112. After the first two days the temperature rarely rose above the normal and then only a fraction of a degree. At times the pulse was rapid. The patient complained of a good deal of pain in the back and right hip.

A physical examination of the heart and lungs revealed nothing abnormal. The kidneys were not unduly movable. The patient preferred to lie turned partly to the left side with the right limb slightly flexed.

At times the patient was seized with sudden, intense, agonizing pain, so great that she would give piercing cries, and then, making a brave effort at self-control, would lie moaning, her hands gripping the sides of her pelvis, tears running down her face, her whole body trembling and held rigidly in a fixed position apparently unable to move, and dripping with sweat. If any one approached her bed she begged that she should not be touched. The intense suffering was very real and it was quite pitiful to witness. There was no element of hysteria about it.

These attacks would sometimes come on at night, when the girl's cries would awaken and alarm the other patients in the ward. Hypodermic injections of morphia were necessary to give relief—sometimes two being required before the patient could relax. She would then suffer a good deal of pain for perhaps a day, it would finally disappear, and perhaps for days she would be quite comfortable. Then without any warning she would be seized with another attack of intense pain.

Pressure over the sacrum and right innominate bone revealed tenderness, and also if the patient made any pronounced voluntary movement, even though lying in bed, she had pain. Manipulation of the right limb showed that the muscles of the lumbar spine and right hip were on guard and resisted movement. Side pressure upon the innominate bone caused pain in the lumbar region.

The lower limbs were equal in length. No abnormal mobility of the pelvic bones could be demonstrated. The urine showed a very faint trace of albumin, but was otherwise always normal and never showed any evidence of the presence of a renal calculus. The leucocytes ranged between 7550 and 7800. A differential count of the leucocytes showed nothing unusual. The hæmoglobin was 77 per cent. An X-ray plate of the lumbar spine and pelvis gave no assistance.

The patient had been placed upon a rather firm bed with fracture boards beneath the mattress; a folded sheet was placed under the hollow of her spine, and with this in position she could lie on her back with considerable comfort.

The speaker happened to enter the ward one day when she was in intense pain in the midst of one of her attacks. He turned her carefully on her back with the support under her lumbar spine, and slowly and forcibly flexed her thigh up to the full limit on her trunk. The movement gave her great pain. She cried out and was wet with sweat. Pretty firm pressure at the full limit of flexion, however, gave her relief from pain, and he was able then to slowly lower the limb until it rested on the bed beside the other one and the patient was relaxed and the suffering almost entirely relieved.

The indications for treatment were rest in bed for an indefinite period and nourishing food. The advisability of applying a fixation dressing was considered, but it was concluded to allow her to assume any position in bed which gave her the greatest comfort until the disease should run its course.

The patient continued to have attacks of pain at intervals of several days or a week. They grew less frequent, however, and less severe.

On August 7, a plaster jacket was applied, and the patient allowed to get up. She was discharged on September 5 still wearing the jacket. Two months later she had regained her normal weight, had a good color, and was in perfect health. Her plaster jacket had been discarded a month previously. She could go up and down stairs, stoop over and rise again, walk long distances, all without inconvenience, and had no symptoms whatever.

Here was a patient who, long after the acute symptoms of typhoid fever had subsided, suffered from excruciating attacks of pain, as agonizing in character as that caused by the passage of a gall-stone through the common duct or a renal calculus through a ureter.

The explanation of these attacks seems to be clear. The phlebitis of the right limb was in all probability a direct result of the typhoid fever infection, and it in turn resulted in an infection of the right sacro-iliac joint. The joint surfaces became exquisitely tender and sensitive to abnormal pressure. The ligaments of the joint had become relaxed as a result of

the long illness which the patient had suffered, permitting an undue mobility in the joint. The acute arthritis caused the dull aching pain in the sacrum and lumbar region and hip and thigh.

During sleep, when the muscles were somewhat relaxed, and the patient perhaps turned in bed, the joint surfaces slipped slightly on each other, bringing pressure on acutely inflamed areas which had not been bearing it—then the intense pain, the waking of the patient, the sudden gripping of the muscles upon the bones as the reflex spasm returned with the added pain of the increased pressure, and the patient's body becoming rigid from the paroxysm of pain. If the joint surfaces could be restored to their normal apposition the pain promptly grew less, as was demonstrated on one occasion.

In due time the infection ran its course, the tender surfaces returned to their normal condition, the structures about the joint regained their normal tone, and the patient's recovery was complete.

THE SURGICAL ANATOMY OF THE PARATHYROID GLANDS AND ALLIED LYMPH-NODES.

DR. NATE GINSBURG read a paper with this title.

REMOVAL OF THE URETER WITH A TUBERCU- LOUS KIDNEY.

BY GEO. ERETY SHOEMAKER, M.D.,

OF PHILADELPHIA,

Gynecologist to the Presbyterian Hospital; Consulting Surgeon to the Woman's
Hospital of Philadelphia.

AN Italian multipara, thirty-five years old, was admitted, November 4, 1910, to the Presbyterian Hospital. She had been well until five months before, when frequent urination began, with pain in the bladder and right abdomen. Pain became severe, with irregular fever and sweating.

Examination showed a rounded tender mass extending an inch below the level of the navel in the right inframammary line, confirmed by the X-ray, which showed no stone. Left kidney not palpable. In the vagina a firm cord began abruptly forward and to the right of the cervix, passed outward upward and backward until it disappeared behind the uterus. On the opposite side no corresponding cord was felt in the region of the other ureter end. Uterus of normal size but carried bodily to the right of the median line. Hæmoglobin 73 per cent., leucocytes 11,500. Cystoscope showed capillary injection of the bladder, no growth and no deep ulceration. The left ureteral opening was to the right of the median line, being carried over with the uterus by intrapelvic inflammation and subsequent contraction. It was a well formed slit with flexible lips, and spouted blue urine freely within 18 minutes of injection into the buttock of 20 c.c. of water in which was dissolved a tablet of indigo-carmin. Farther to the right of it was a dark red, granulating patch, in the centre of which rose an irregular, yellowish white mass resembling a pile of small worms. This mass proved to be made up of cheesy casts apparently coming from a concealed right ureter. No blue urine escaped with this cheesy detritus.

Diagnosis.—Dead right kidney, ureter involved, probably tuberculous.

Operation (November 11, 1910).—(a) A vaginal incision one and a half inches long to the right and forward from the cervix exposed the cord-like ureter, which was isolated without

difficulty by blunt dissection. Being quite rigid and fragile, it was unfortunately broken off while being hooked down. The short end was teased out until the bladder insertion rose as a cone on traction. It was tied off with catgut and cut away. The upper end was teased out well into the broad ligament and then temporarily left, a suture was placed in each end of the incision, and a wick of gauze inserted. The bleeding was slight.

(b) The patient was turned on the left side and an incision made opposite the navel, slightly inclined downward (König). It extended back to the edge of the quadratus. Peritoneum pushed forward and inward, opened and no disease found in other regions, no fluid. Opening immediately sutured with catgut. Kidney enucleated around to the vessels, the cava was exposed, the vessels were freed from fat, and tied with chromicised catgut without bleeding. Pelvis rigid, as was the ureter. With gauze covered finger the pelvis and ureter were enucleated retroperitoneally from a bed or sheath of inflammatory tissue, the iliac vessels were exposed and passed, the dissection continuing through the broad ligament until the lower end was released where it had previously been freed below. No leakage of pus, no large vessels required ligature, no bleeding of importance. Wound closed over small tube drain. Convalescence uneventful. Gauze drain out of vagina in a week. Aseptic healing of abdominal wound, no sinus.

One month later weight had increased eight pounds, general improvement, the cystoscope showing the patch around the right ureter paler and flattened.¹

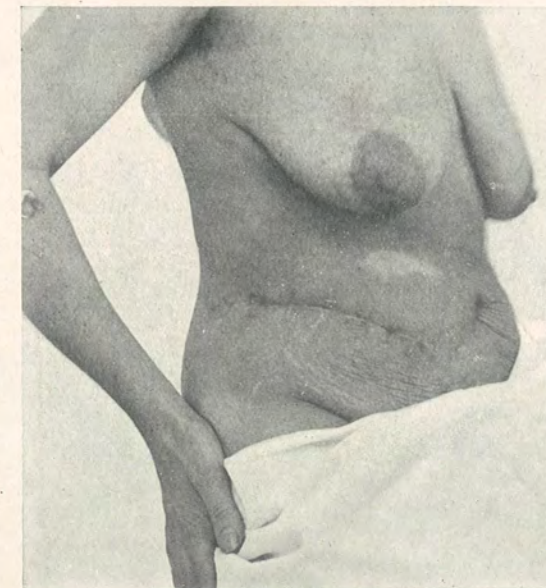
After operation the urine from the remaining kidney showed no tubercle bacilli, no pus, and no casts.

On section the pelvis and calices of the kidney were found filled with creamy fluid which yielded a pure culture of the *Bacillus alkaligenes*. In the laboratory of the hospital serial cross sections of the ureter were made at various levels. These sections as well as those from the kidney showed many tubercles and giant cells, with inflammatory infiltration. Diagnosis: tuberculosis of kidney and ureter.

The operation of simultaneous removal of the kidney and ureter was first done by H. A. Kelly in December, 1895, Dr. A. J. McCosh operating a month later. In 1903 Dr. J. W.

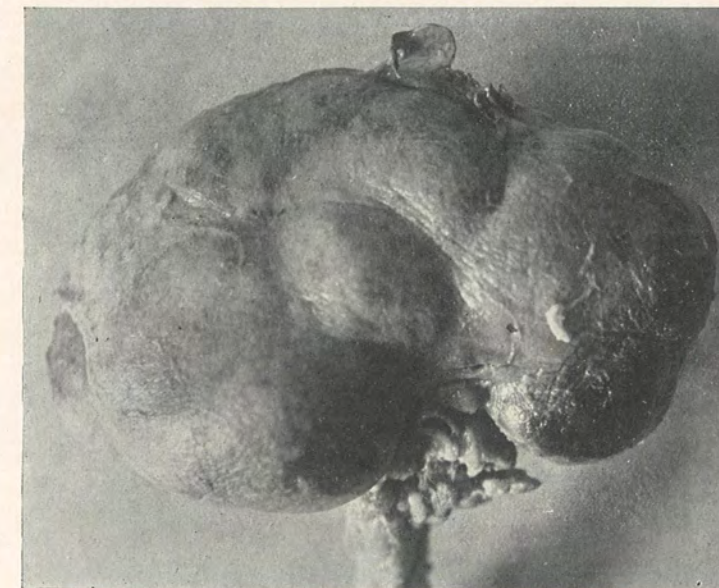
¹April 1, 1911, gain of 32 pounds within five months.

FIG. 1.



Five weeks after operation, showing location of incision (König).

FIG. 2.



Kidney irregularly distended with pus. The enlarged ureter is seen below.

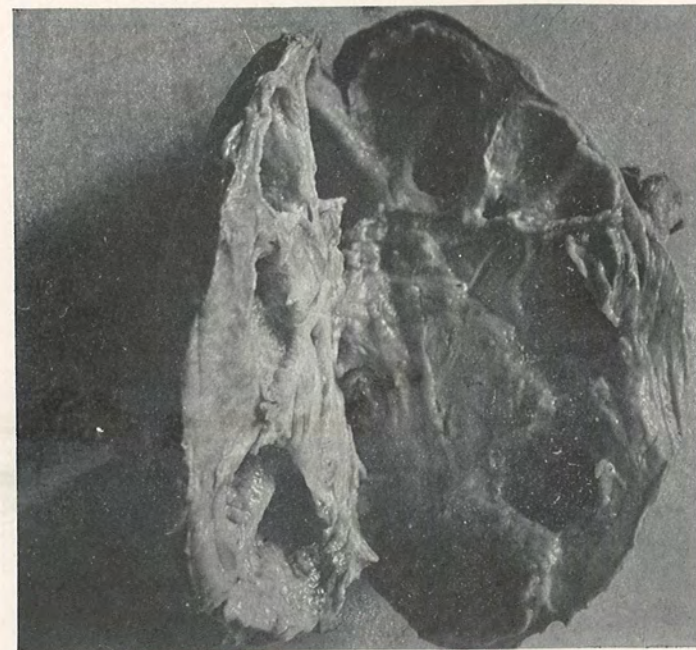
Bovee collected seventeen cases, and later² reported four others of his own. Operators have recommended various routes, transperitoneal or retroperitoneal; some working entirely from above, some reaching the lower part by a second incision near the semilunar line or in the vagina. Following Bovee I found the Koenig or transverse incision back from the semilunar line to give much easier retroperitoneal access than one in the loin, particularly as in this case the organ was prolapsed and well forward. Experience in many combined vaginal and abdominal operations for other conditions has convinced me that vaginal work should be done first, as the strain begins when the peritoneum is invaded above, and the patient should be returned to bed as soon afterward as possible.

Collated experience is proving that the ureter does not usually require removal in nephrectomy for tuberculosis. When, however, it is greatly enlarged and hardened all the way down, it is likely to give rise to a troublesome sinus if not removed. The ureteral catheter is not necessary even if it could be passed, as when the firm, hard cord can be felt in the vagina, no other guide is needed, and if this cannot be felt, the ureter may be left in, at least low down. After removal of the kidney which has been pouring infectious material through the bladder, the tendency of that organ to recovery is so great that it appears not necessary to remove bladder wall around the ureteral opening, unless the cystoscope shows deep invasion sharply localized.

DR. JOHN B. SHOBER said that three years ago he removed a large tubercular kidney with a very much thickened ureter from a patient who had a persistent sinus following a psoas abscess opened five years before. Tuberculosis of the kidney, in his opinion, is a secondary process in the vast majority of cases, and the primary focus should be sought for and reported more often than it is. This patient was operated upon in a similar manner to that described by Dr. Shoemaker, although the incision was more perpendicular, beginning at the costal cartilages at about the tip of the eleventh rib and following a

²Jour. Amer. Med. Association, Oct. 23, 1909.

FIG. 3.



Kidney bisected, showing pus pockets.

line obliquely down about one inch inside Poupart's ligament. The peritoneum was reflected from the lateral and posterior walls, the kidney and ureter were located and removed with ease; the ureter was followed down to the broad ligament, then to the bladder, and then ligated as one ligates an appendix from the cæcum. It was quite easy to almost purse-string the stump of the ureter after it was ligated close to the bladder. This case was reported somewhat in detail before the Obstetrical Society of Philadelphia, in Feb., 1908, and published in the *Therapeutic Gazette*, June 6, 1908. The subsequent history is interesting.

About a month or two after the patient was operated upon, she developed symptoms suggesting a tuberculous pelvic peritonitis involving the Fallopian tubes.

Operation showed this was not the case, but there was a fibrous uterus with chronic inflammation of the tubes, necessitating hysterectomy. At the same time the appendix was removed. She made an uneventful recovery. At neither operation was the speaker able to follow the sinus which led to the vertebral column. It continued to discharge for a year or more. In the meantime patient had gained about 45 pounds. In order to cure the sinus he injected bismuth paste successfully. After injecting the bismuth vaseline paste he took an X-ray picture and found that the sinus led by a rather straight route to one of the lumbar vertebræ, ending in a bulb, which extended across the vertebræ to the opposite side.

It required ten injections of the paste to close the sinus permanently. However, about eighteen months ago another psoas abscess developed on the opposite side. This was promptly opened and treated by a few injections of the bismuth-vaseline paste, after which it closed permanently.

DR. GEORGE G. ROSS reported the case of a woman who had been suffering for six or seven years from a painful swelling in the right side of the abdomen. At the German Hospital, upon exposure it was found that she had a perinephric collection, which when opened, showed a collection within the kidney itself and a large tuberculous ureter. The entire mass was adherent to the diaphragm, the posterior abdominal wall, and to the peritoneum in front. Recognizing his surgical limitations, he left the kidney in. She did very well for a while, draining urine

and pus through the opening in the loin; the sinus healed and finally she got into such good condition that she started for home. She got as far as Baltimore, when the sinus broke out again; she returned immediately to the hospital and he again operated with the hope that the kidney had gone down to a size possible to remove. On exploration, however, he found practically the same condition as at the first operation. The kidney was smaller but still too large and adherent to remove. The sinus was dissected out and the kidney wound sewed up; patient had repeated ureteral catheterizations with washing out of the pelvis of the kidney. This was three years ago. She has now a perfectly functioning organ without sinus, pus, or discomfort. She has, however, a bad hernia.

DR. JOHN H. GIBBON thought that tuberculosis of the urinary tract usually starts in the kidney. Very often there is no evidence of inflammation of the kidney, nothing to indicate which is the kidney pouring the pus into the bladder, but the cystoscopic examination clears up the situation. If there is a tuberculous kidney there will not be a normal ureteral opening in the bladder. Occasionally we will have difficulty in making a cystoscopic examination. He encountered such difficulty some years ago in the case of a physician who had so much pus and blood in the bladder that he was unable to see the ureters. He did a suprapubic drainage of the bladder and examined it through a speculum and found extensive ulceration around the right ureter and around the base of the bladder but could not tell whether or not this involved the left ureter. He therefore followed Freeman's suggestion, that in order to make sure there was a normal kidney on the unsuspected side this kidney should first be exposed. Therefore, at a second operation he exposed the left kidney and found it to be perfectly normal. He then removed the right kidney but did not remove the ureter, and the abatement of symptoms was very prompt; before operation the patient voided urine every two hours at night and every half hour during the day, and before leaving the hospital, within two or three weeks, did not empty his bladder at all during the night.

The significant point here is that after the removal of a kidney which had been pouring pus into a bladder filled with ulcers, this bladder condition clears up. This seems to show

that it is not necessary to remove the ureter unless it be very badly involved. The speaker said he had not taken out the ureter in tuberculous kidneys, nor sterilized it, but nevertheless the results had been good. If an ulcerated bladder will clear up after removal of a tuberculous kidney, the ureter also will do so provided we remove it as far down as possible. He had seen Mayo inject pure carbolic acid into the remaining portion of the ureter for sterilization. He said he had done it a great many times and had had no bad results. His feeling was that this might very easily cause a stricture of one part of the ureter and make trouble, but he had had no such trouble.

DR. GEORGE ERETY SHOEMAKER (in closing) said that in the diagnosis of these lesions the intramuscular injection of a color solution has a great advantage over the use of the catheter. He felt quite a little hesitancy in putting a catheter through an unsound field into what may be a sound field. If one will take the time to watch and count the spurts of colored urine, it is usually easy to recognize the kidney which is actively at work and compare it with one which is doing very little or nothing. So many accidental variations, such as clogging by minute clot or detritus, mechanical variations in calibre of the lumen, reflex inhibition, etc., affect the outflow that estimation of relative activity by the catheter is not reliable. Some tubercular ureters if not removed create a sinus, but fortunately most do not require removal.

Extracted from the American Journal of the Medical Sciences,
June, 1912, No. 6, vol. cxliii, p. 843.

**THE TREATMENT OF FRACTURES OF THE FOREARM, WITH
NOTES OF THE END RESULTS OF 52 CASES
TREATED WITHOUT OPERATION.¹**

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NEARLY four years ago, in a paper discussing the end results of 61 cases of fracture of the femur, treated without operation, which was presented before this Academy,² it was stated that it seemed incumbent on those surgeons who advocated operative treatment as a matter of routine in cases of recent fracture "either to demonstrate the evil results which they regard as a necessary consequence of accepted" (that is, non-operative) "methods, or to bring forward proof that by operation still better results can be obtained, and without unjustifiable risk to the patient." It was further stated: "The advocates of operative treatment, in short, should either be able to show that the methods they propose will not increase the immediate mortality and will greatly diminish or altogether prevent the unfavorable results of conservative treatment; or, failing this, they should at least convince conservative surgeons that the functional results of the accepted forms of treatment are such as can no longer be tolerated."

To our knowledge no series of cases has been published, of fractures of any long bone in the body, demonstrating either the inadequacy of conservative measures or the superiority and equal safety of operative treatment. It is to show that a fairly large series of cases of fracture of the forearm, involving both bones

¹ Read before the Philadelphia Academy of Surgery, February 5, 1912.

² Ashhurst and Newell, *Annals of Surgery*, 1908, ii, 748.

in some part of their shafts, may be treated with satisfactory results without a single resort to operation, that we now present a study of these 52 cases. From this series are excluded cases of fractures involving the elbow or the wrist joint, and cases of Colles's fracture of the radius complicated by fracture of the ulnar styloid. Fractures of the forearm, thus limited to injuries of the shafts of the ulna and radius, do not form a large proportion of the cases of fracture seen, but they have been selected for this analysis because, next to those of the femur or leg bones, they are at present the type most often (and we believe usually quite unnecessarily) subjected to operation.

These patients were treated in the services of one of the writers at the Episcopal Hospital and at the Children's Hospital. In almost every case the patients first apply for treatment out of dispensary hours, soon after the accident which produced the fracture. They are dressed then by the surgical interne on duty in the receiving ward at the time, skiagraphs are made, and the patients are referred to the out-patient department for further treatment. Although in the very busy dispensary services in which they are treated it is not always practicable, our aim always has been to examine and dress with our own hands *all the recent fractures*, and to continue to dress them with our own hands *until union is fairly firm*. We have never relegated any cases of fracture to the care of orderlies or nurses, nor have we ever turned them over to the internes until we have ascertained by repeated and persistent personal instruction and supervision that the particular interne on duty was capable of applying the dressings in a satisfactory manner. In the treatment of fractures, as in many other important departments of surgery, one must remember that "eternal vigilance is the price of safety."

REDUCTION. "Reducing" a fracture is a relative term, since comparatively few broken bones can be accurately restored to their original form; and in the case of *shafts of long bones* it is not always necessary that reduction should be accurate. Nevertheless, the aim must be to secure as accurate reduction as possible, and in the case of fractures near joints (especially the elbow) accurate reduction is extremely important; but in the middle of the shaft of a long bone it is sufficient to secure *firm bony union*, with *no appreciable shortening*, and with *preservation of the normal axis of the limb*. For the first and second results to be obtained it is necessary for the fragments to be in contact "end-on," not only by lateral contact; and for the lateral displacement, not to exceed two-thirds of the diameter of the bone.

Anesthesia rarely will be necessary in reducing a fracture of the forearm if the surgeon takes advantage of the relaxation of the muscles which may be secured by position of the limb. *Full supination of the forearm* is the position preferred, with the elbow

flexed to a right angle. Correct replacement of the ulnar fracture usually can be determined clinically, as this bone is subcutaneous; but the radius is buried among so many muscles that a skiagraph frequently is necessary to ascertain the position of the fragments if the fracture is above the middle of the bone.

The forearm is then dressed *in full supination*³ between two straight splints, specially cut to fit each individual patient. They should be a little wider than the forearm, so as to prevent crowding the bones together laterally, but not so wide as to permit rotation of the forearm within the splints. The palmar splint extends from the bend of the elbow to the tips of the fingers, while the dorsal splint extends from the olecranon to the wrist. These splints should be smoothly but thickly padded with raw cotton. A longitudinal pad placed between the bones, in an effort to wedge them apart is not only useless but harmful. Extra compresses, however, may well be placed over any of the fragments that tend to project. The splints are then strapped snugly around the forearm by bands of adhesive plaster at the wrist and below the elbow, and are held securely in place by a roller bandage. A large "handkerchief" or "triangular" sling is applied, supporting the forearm throughout its length, and the forearm is carried against the chest, but always in full supination. In very small children, and in adults where the seat of fracture is near the elbow, this joint is immobilized by employing an anterior angular splint, known in Philadelphia as Hartshorne's, instead of the straight palmar splint.

The position of full supination is employed not only because supination is the most difficult part of rotation to regain,⁴ if once lost, and because the upper fragment of the radius usually is kept in supination by the biceps; but because it was found by one of the writers when the forearm was dressed in mid-pronation, as commonly advised now, and as formerly employed by him, that the fragments sagged by the force of gravity, and that the patients recovered not only with lost supination, but with angular deformity of both bones toward the ulnar side. If attempt is made to correct this deformity by adjusting a coaptation splint over the angular projection of the ulna, this may indeed be overcome, but the surgeon will succeed merely in forcing the ulna nearer the radius which cannot be influenced by such an appliance; and the dis-

³ According to Malgaigne (Fractures, Paris, 1847, p. 591) this position was condemned by Hippocrates, though used by his contemporaries. Its advantages were pointed out by Paré, who was opposed to the semi-prone position until he learned that the latter had been approved by Hippocrates, whereupon Paré resumed the use of the semiprone position. Malgaigne thought he was himself the first of modern surgeons to return to the use of full supination, advised in his *Anatomie Chirurgicale* (1838), until he learned that Lonsdale (London Med. Gaz., 1832, ix, 910) had preceded him.

⁴ The patient regains pronation by active use of the hand; very few motions require extreme supination.

ability as regards rotation will be increased. However, fractures in which no tendency to displacement exists, such as greenstick and subperiosteal fractures, may be treated successfully in the semi-prone position.

Often it is exceedingly difficult to keep these fractures even approximately reduced during the first week or ten days; and it is during this period that impatient surgeons are apt to urge operation as the only solution of the difficulty. But usually a little better position can be secured at each dressing, and when the ends of the bones begin to become sticky, during the second week, it will be found that deformity daily becomes less, and what looked at first (to the inexperienced) like a hopeless case, will result in a very useful arm, and one with slight or with no visible deformity. Skiagraphs are valuable and interesting, but a surgeon never should be terrified by the appearance of the forearm bones in a skiagraph into thinking that only operative treatment can give his patient a good result. If he uses the eyes in the ends of his fingers, he will secure by conservative means quite as good, and in many cases a much better result than by operation, and in a shorter time.

AFTER CARE. This involves removal of the dressing frequently enough to make sure that the soft parts are in good condition, and that reduction is maintained by the dressings employed. The surgeon never should neglect to see the patient on the day after the dressing is first applied, and to ascertain for himself that the limb is in good condition, and that the dressing is comfortable. An uncomfortable dressing always is inefficient, even if not positively harmful; but if the dressing is comfortable it is not desirable to redress the limb more than two or three times weekly at first, and less often as union progresses. As the splints and bandages are being removed for re-dressing, the patient sits facing the surgeon, and the forearm lies supine on the patient's thigh. The palmar splint is lifted carefully off without moving the forearm, and the flexor surface and sides of the forearm and hand are gently bathed in dilute alcohol; then without rotating the forearm at all it is gently raised as a whole from the dorsal splint, and the extensor surface is bathed similarly, correct apposition of the fragments being maintained all the time. Any undue haste or rapid movement or attempts at rotation will be painful, will evoke muscular spasm, and may cause displacement of the fragments.

We do not approve massage or mobilization in the treatment of fractures, except in so far as they are unavoidable in procuring proper care of the soft parts; and while we acknowledge the truth of the dictum of Lucas-Championnière that "a certain amount of motion between the fragments encourages the formation of callus," we are firmly of the opinion that even the most careful immobilization by splints allows, and proper care of the soft parts,

as above indicated, provides that "certain amount" of motion which is desirable; and that any surgeon who attempts more, in the vain idea that he is following modern teaching, will succeed either in stirring up such an amount of callus (especially in children) as to cause deformity and injurious pressure on the soft parts, or (in most adults) will leave his patient with an ununited fracture.

When the ends of the bones become "sticky" and no tendency to displacement exists, the surgeon may then begin to make very limited degrees of passive motion in the neighboring joints at each dressing, meanwhile maintaining support at the seat of fracture. Under no circumstances should the passive motion cause pain. When union is firm enough for all external support to be discontinued, function usually will be more comfortably and quickly recovered by active movements by the patient himself, than by further attempts at passive motion; and if a fracture has been treated properly in the first place, massage very rarely will be necessary to accelerate the cure.

OPERATIVE TREATMENT OF SIMPLE FRACTURES. We believe there are only two indications for the "open method" of treating simple fractures: (1) If the fracture cannot be properly reduced without operation, and (2) if proper reduction cannot be maintained without direct fixation of the fragments.

1. *When Proper Reduction is Impossible.* Impossibility is here a relative term, since what is impossible for one surgeon may not be so for another; and the qualification "proper" reduction is employed because we do not wish to imply that operation is indicated whenever accurate, exact, perfect, anatomical replacement is impossible, but only when such degree of reduction, as has been described in a previous paragraph as requisite for proper function, cannot be secured without open operation. Less perfect reduction is requisite in children than in adults, since in the former compensation is more rapidly established; and oblique fractures require less close and accurate apposition of their ends than do transverse fractures.

2. *When Subsequent Displacement Cannot be Prevented.* This also is a relative condition, depending on the skill of the surgeon in devising and applying efficient retentive apparatus, and upon the extent to which displacement occurs.

After operation the process of union often is slower than it would have been if no operation had been employed; and in a fair proportion of cases operated on by the average surgeon a mild degree of infection occurs, and only fibrous union results.

STATISTICS. These cases form a continuous series, absolutely unselected, running through a period of ten years. Of 66 patients treated, the end results are known in 52 cases; 43 of the fractures occurred in males, and only 9 in females. None of the female patients was older than fifteen years. Of the males, 31 were less

than fifteen years of age, and 12 were older. The youngest patient (a girl) was seventeen months old, and the oldest (a man) was fifty-seven years. The right and left arms were affected nearly with equal frequency.

For estimating the power of rotation, a special instrument (Fig. 1) was devised, and was constructed for us by D. W. Kolbe Co. For establishing a standard, the average normal rotation was ascertained by testing one hundred normal forearms of fifty persons (25 male, 25 female). The instrument consists of an indicator, kept vertical by gravity, and centred on a circular protractor. This protractor is attached to an upright board which itself is

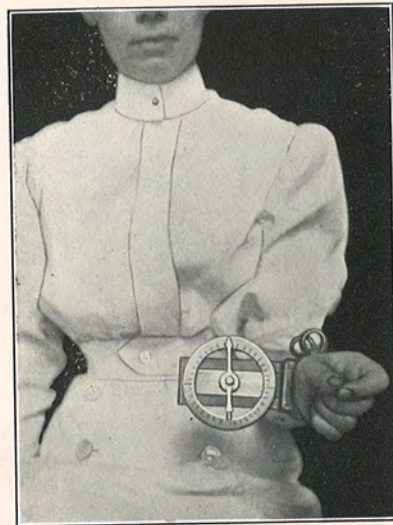


FIG. 1.—Pronometer, or instrument for measuring the degree of pronation and supination. Indicator points to zero degrees in supine position.

fastened at right angles to a horizontal board. The horizontal board is strapped on the flexor surface of the wrist, the forearm being in full supination. In this position the indicator points to 0 degrees. If still further supination is possible, this is recorded as a *minus* quantity, of say 5, 10, or 15 degrees. As the forearm is rotated into pronation the protractor also rotates, but the indicator remains vertical and passes over the rotating scale from 0 degree up to 135 degrees or 140 degrees or more, according to the extent of pronation possible (Fig. 2). During this examination, it is needless to say, the patient's humerus should be kept immovably applied to the side of the thorax, and no deviation of the body from the vertical should be permitted.

NORMAL ROTATION. Our examination of 100 normal forearms gave the following results:

Ages varied from fourteen to seventy-seven years; average age, twenty-nine years.

Supination: Greatest	-45.00 degrees.	Least	15.00 degrees.
Average	-11.72 degrees.	In males	- 7.42 degrees.
		In females	-16.02 degrees.
Average of right forearm -7.24 degrees;		of left -16.2 degrees.	
Pronation: Greatest	180.00 degrees.	Least	120.00 degrees.
Average	147.77 degrees.	In males	148.24 degrees.
		In females	147.30 degrees.
Average of right forearm, 147.24 degrees;		of left, 148.00 degrees.	

Greatest range of rotation in any one patient, from -45 degrees to 155 degrees, or 200 degrees.
 Least range of rotation in any one patient from 0 degree to 122 degrees, or 122 degrees.
 Average rotation from -11.72 degrees to 147.77 degrees, or 159.49 degrees.



FIG. 2.—Pronometer. Indicator points to 90 degrees when forearm is in "mid-pronation."

RESULTS. In studying the end results of these 52 cases, it may first be stated what was not secured: there was no case of gangrene of the soft parts or of necrosis of the bones; there was no case of ischemic contracture; none of nerve lesion; none of ununited fracture; none of conspicuous deformity. There was one case of delayed union (Case 37), but this patient cured himself, by returning to his work as a blacksmith at the end of ten weeks. There were several cases in which some thickening or irregularity could be felt at the site of fracture; but none in which these were appreciable at a glance. There was no case of disability, even slight. And these results were obtained without excluding 9 more or less complicated cases, as follows: 1 case of badly comminuted fracture (Case 39); 1 case of fracture of both bones of both forearms (Cases 2 and 3); 3 cases of multiple fractures of the upper extremity (Cases 1, 25, 26) involving both the humerus and the bones of

the forearm, two of which were compound comminuted fractures; as well as 3 other cases of compound fracture (Cases 7, 32, 47). None of the cases of compound fracture, however, was such as to require operation on account of the condition of the soft parts.

The end results may be seen at a glance in the following table. Under the heading "perfect result" we include only such cases as have recovered without palpable deformity, and with preservation of perfect function. If, in spite of preservation of perfect function, there is palpable deformity, as in Cases 2 and 3, the patients are recorded in the second column, as "slight deformity, but perfect function." If there is limitation of function the cases are placed in the third column; in none was there any limitation of function except in rotation; and in none was there any disability.

END RESULTS OF FIFTY-TWO CASES OF FRACTURE OF BOTH BONES OF THE FOREARM.

Character of fracture.	Class I.	Class II.	Class III.
	Perfect result.	Slight deformity.	Rotation limited.
Greenstick	10	1	0
Simple complete	22	8	4
Simple comminuted	0	0	1
Compound	1	1	1
Compound comminuted	1	0	2
Total	34 (65.4%)	10 (19.2%)	8 (15.4%)

The skiagraphs of end results, which we have chosen for reproduction here, are those of cases in which the prognosis seemed least favorable, and represent, therefore, much worse than the average skiagraphic results. As far as cosmetic results are concerned, there was no visible deformity in any of these cases except in Cases 2, 3, 26, 39, 48, and 51; and in these patients a mere glance at the bared arm will not detect any deformity.

In Class I we have included Cases 1, 4, 5, 6, 8, 10, 11, 12, 14, 16, 17, 18, 19, 22, 23, 24, 25, 27, 28, 29, 31, 34, 35, 36, 37, 38, 41, 42, 43, 44, 45, 46, 50, 52.

In Class II are included Cases 2, 3, 20, 21, 30, 33, 40, 47, 48, 49. In Class III are included Cases 7, 9, 13, 15, 26, 32, 39, 51.

We are greatly indebted to Dr. Thos. S. Stewart, radiographer to the Episcopal Hospital, and to his assistant, Dr. A. R. W. Wilkinson, for the interest they have taken in providing us with numerous skiagraphs for the purpose of this study.

ABSTRACTS OF CASE HISTORIES.

CASE 1.—Michael C., aged fifteen years. May 6, 1902. Episcopal Hospital. Multiple fractures of right upper extremity (surgical neck of humerus, both bones of forearm, compound of ulna). Recorded as Case I in a paper on "Multiple Fractures" (Ashhurst,

Annals of Surgery, 1907, ii, 263). Full supination. Examined February 20, 1907. No visible or palpable deformity anywhere. Does heavy laboring work, and would not know arm ever had been injured. Perfect result. Class I. (Fig. 3.)



FIG. 3.—Case I. Five years after compound fracture of both bones of forearm, and fracture of humerus. No deformity. Perfect function.

CASES 2 and 3.—Augustus F., aged thirty-five years. March 16, 1903. Episcopal Hospital. Fracture of both bones of both forearms, sixteen days previously; has been dressed on internal angular and short dorsal splints, in position of mid-pronation. Arms gave constant pain. No attempt at union, because fragments were not in contact and were not immobilized. By putting forearms in full supination better position was secured, but complete reduction was impossible. However, pain was immediately and absolutely relieved. Two weeks later, good union. Examined October 28, 1911. Says he never knows arms were broken; was out of work only fourteen weeks in all, and has worked as machinist ever since with perfect function. There is no visible deformity, but the displaced fragments are still palpable. Supination in both forearms complete; pronation on right to 135 degrees, and on left to 130 degrees. Without seeing the skiagraphs made recently (Figs. 4 and 5), the results might be considered perfect. Class II.

CASE 4.—Harry H., aged ten years. September 1, 1903. Episcopal Hospital. Right. Treated in supination. Examined October 28, 1911. Full supination, pronation to 165. Class I.

CASE 5.—Phoebe G., aged two years. October 15, 1903. Episcopal Hospital. Right, greenstick. Examined October 28, 1911. Full supination, pronation to 160. Class I.

CASE 6.—Adolph W., aged ten years. October 19, 1903. Episcopal Hospital. Right. Examined, January 28, 1912. Broken

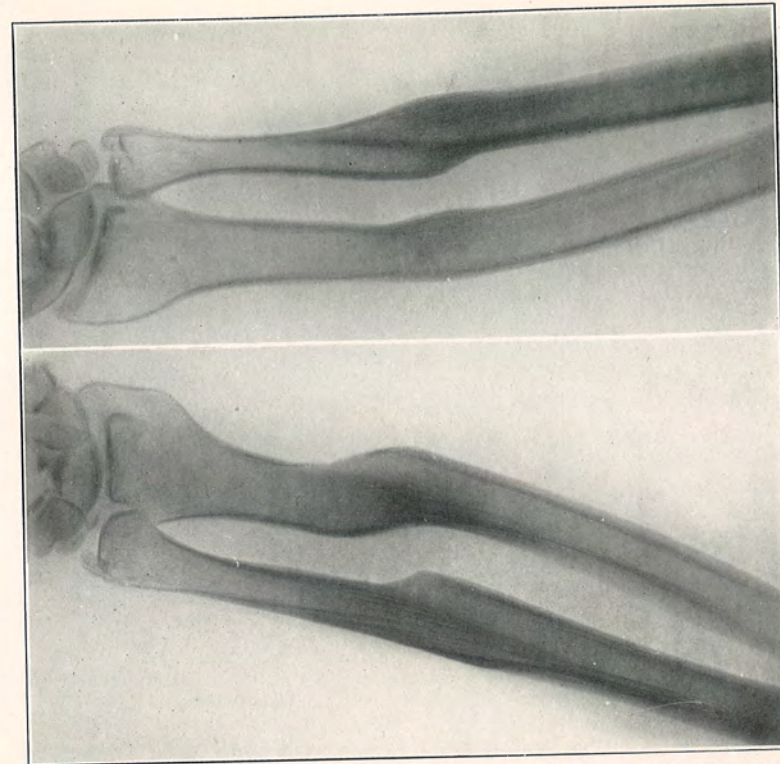


FIG. 4.—Cases II and III. Antero-posterior views of both forearms, eight years after injury. Function perfect.

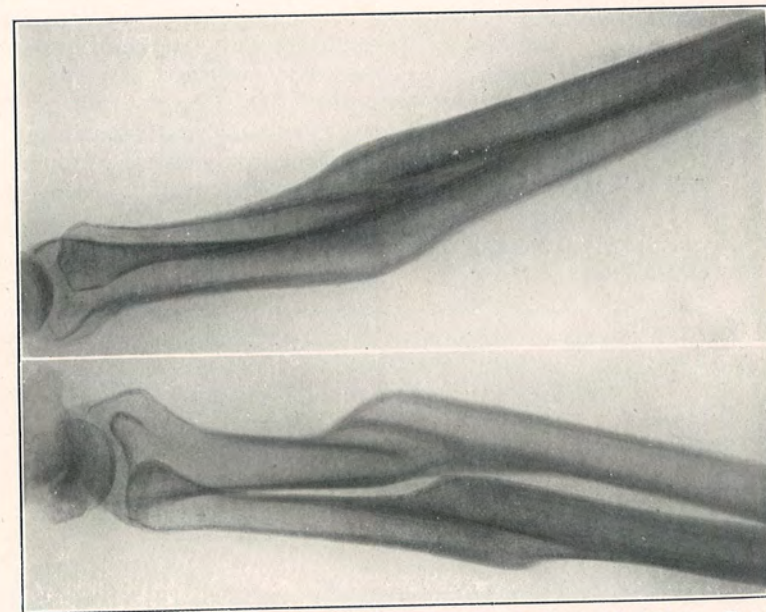


FIG. 5.—Cases II and III. Lateral view of both forearms eight years after injury. Function perfect. Patient first came under the writer's care sixteen days after injury.

arm, supination -20 degrees, pronation 130 degrees; normal arm, supination -15 degrees, pronation 135 degrees. Class I.

CASE 7.—William T. S., aged forty years. January 18, 1904. Episcopal Hospital. Right, simple of radius, compound comminuted of ulna. Examined five weeks later. Function good, but some limitation of supination. Class III.

CASE 8.—Fred. S., aged fifteen years. January 18, 1904. Episcopal Hospital. Dressed in full supination. Examined March, 1904. Class I.

CASE 9.—Thomas M., aged twenty-five years. January 19, 1904. Episcopal Hospital. Left, above middle. Great and persistent overlapping, with projection of upper fragments of radius and ulna on extensor surface. Dressed in mid-pronation, on internal angular and short dorsal splint. Examined March 12, 1904. Very slight deformity; no supination beyond mid-position. Class III.

CASE 10.—George H., aged twenty-eight years. January 23, 1904. Episcopal Hospital. Left, middle third. Dressed in mid-pronation. Examined, March 12, 1904. Class I.

CASE 11.—Emma L., aged two years. January 31, 1904. Episcopal Hospital. Greenstick. Examined March 3, 1904. Class I.

CASE 12.—William A., aged twelve years. April 12, 1904. Episcopal Hospital. Left, treated in mid-pronation. Examined October 28, 1911. Supination full, pronation to 135 degrees. Class I.

CASE 13.—Fred. H., aged sixteen years. April 15, 1904. Episcopal Hospital. Right, dressed in mid-pronation. Had refracture of same forearm in November, 1904. Examined January 27, 1912. No deformity, no disability. Right: supination, 25 degrees; pronation, 120 degrees. Left: supination, 20 degrees; pronation, 145 degrees. Class III.

CASE 14.—Albert S., aged thirteen years. September 1, 1904. Episcopal Hospital. Greenstick. Treated in mid-pronation. Examined October, 1904. Class I.

CASE 15.—James M., aged eight years. September 8, 1904. Episcopal Hospital. Left lower third. Very great cellulitis. Treated in mid-pronation. Examined October, 1904. No deformity, but little supination beyond mid-position. Class III.

CASE 16.—Thomas McG., aged fourteen years. December 7, 1905. Episcopal Hospital. Right; of radius above insertion of pronator teres, and greenstick of ulna, same level. Treated in full supination. Examined December 29, 1905. No deformity, full supination, pronation good. Class I.

CASE 17.—Anna D., aged fourteen years. December 23, 1905. Episcopal Hospital. Right. Treated in full supination. Examined January 15, 1906. Class I.

CASE 18.—John F., aged thirteen years. December 29, 1905. Episcopal Hospital. Middle third. Treated in full supination.

Examined October 28, 1911. Full supination, pronation 165 degrees. Class I.

CASE 19.—Juliette J., aged eight years. July 3, 1906. Children's Hospital. Greenstick, middle third. Treated in full supination. Examined August 2, 1906. Class I.

CASE 20.—Carrie C., aged six years. August 2, 1906. Children's Hospital. Injury two weeks ago at Atlantic City, and dressed in mid-pronation. On admission today, fracture at junction of middle and lower thirds of right forearm; no union, fair position; but bowing of ulna to extensor surface. Treated in full supination. August 21, union good, no deformity; full supination and pronation. Examined August 28, 1906. Upper fragment of ulna displaced slightly posteriorly; functions perfect. Class II.

CASE 21.—John S., aged twelve years. August 6, 1906. Children's Hospital. Left, junction of middle and lower thirds. Fell from tree; was stunned. Upper fragment of ulna projects beneath skin of flexor surface; both lower fragments displaced toward extensor and radial surfaces. Treated in full supination. August 10. Deformity persists; pad over upper fragment of ulna. August 14. Position better; growing firmer. August 21. Position fair; bones firm. Examined September 5, 1906. Little deformity, no disability; supination and pronation complete. Class II.

CASE 22.—William G., aged seven years. November 3, 1906. Episcopal Hospital. Left, greenstick, middle third. Dressed in full supination. Then patient visited another dispensary, and when splint applied there fell off of itself, he returned to Episcopal Hospital, November 19, with marked dorsal bowing of both bones. Bones were re-fractured, deformity reduced, and forearm dressed in full supination. Examined December 10, 1906. No visible deformity, but a little callus palpable over radius. Full supination and pronation. Class I.

CASE 23.—Albert S., aged eleven years. November 15, 1906. Episcopal Hospital. Right, complete of radius, greenstick of ulna. Dressed in full supination. Examined December 12, 1906. Class I.

CASE 24.—Hugh F., aged fourteen years. November 21, 1906. Episcopal Hospital. Left, above wrist. Full supination. Examined October 28, 1911. Supination complete, pronation to 180 degrees. Class I.

CASE 25.—Andrew M., aged fourteen years. December 22, 1906. Episcopal Hospital. Left; compound comminuted fracture of both bones of left forearm with compound comminuted fracture of left humerus. (Reported as Case VI in paper on "Multiple Fractures," in *Annals of Surgery*, 1907, ii, 263.) Treated in ward for nine days, then in dispensary. Forearm dressed in full supination. Fig. 6 is from a photograph taken three months after the accident. Examined October 28, 1911. Supination and pronation

complete. No deformity. Figs. 7 and 8 are from skiagraphs made in January, 1912. Class I.

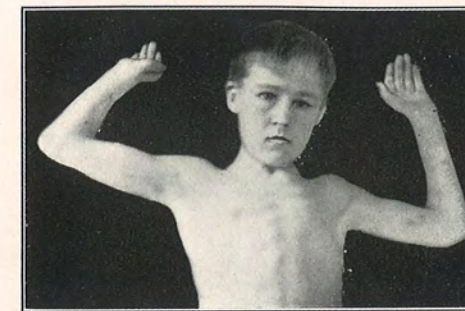


FIG. 6.—Case XXV. Compound comminuted fractures of both bones of left forearm, with compound comminuted fracture of left humerus. No deformity. Perfect function. See Figs. 7 and 8.

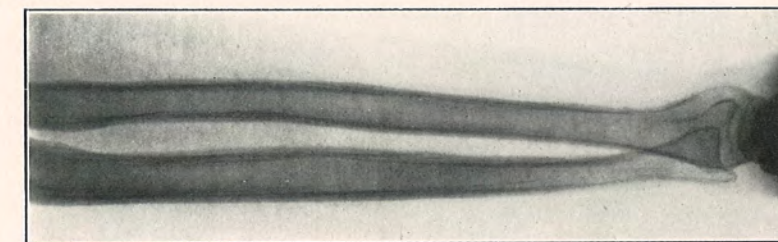


FIG. 7.—Case XXV. Lateral view of forearm five years after compound comminuted fracture of both bones.

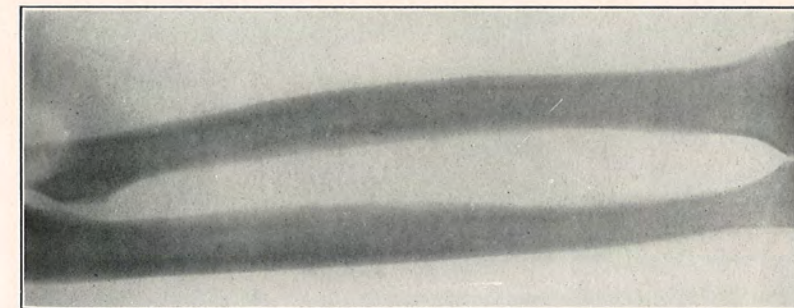


FIG. 8.—Case XXV. Antero-posterior view of forearm, five years after compound comminuted fracture of both bones.

CASE 26.—Henry D. E., aged fifty-seven years. November 26, 1906. Episcopal Hospital. Left. Compound comminuted fracture of both bones of left forearm, with comminuted fracture of left humerus. (Reported as Case V, in paper on "Multiple Fractures," in *Annals of Surgery*, 1907, ii, 263.) Treated with

forearm in full supination. Examined January 21, 1912. Was out of work (saw-maker) for four months. Complete function not regained for one year. Since then has experienced no disability whatever. There is considerable deformity in forearm, bones being bowed to radial side. Left forearm: supination, 0 degrees; pronation, to 85 degrees. Right forearm: supination, 0 degrees; pronation, to 155 degrees. Class III.

CASE 27.—Albert B., aged three years. March 5, 1907. Episcopal Hospital. Right, greenstick, two weeks old; bones bowed to extensor surface, some callus; inability to supinate completely. Refractured, and dressed in full supination. Examined April 4, 1907. No deformity, supination and pronation complete. Class I.

CASE 28.—Harriet B., aged two years. March 29, 1907. Episcopal Hospital. Left, greenstick. Full supination. Examined April 26, 1907. Supination and pronation complete. Class I.

CASE 29.—Charles G., aged fourteen years. January 9, 1908. Episcopal Hospital. Left, full supination. Examined February 13, 1908. Class I.

CASE 30.—Harry W., aged thirty months. July 8, 1907. Children's Hospital. Left, greenstick. One month's duration. Very marked angulation just above wrist, about 135 degrees, angle being open on extensor surface. Refractured (ether) and dressed in full supination. July 15, no union yet. July 20, some union. Examined, August 15, 1907. Slight radial deviation of hand, due to rachitic deformity, same as in other arm. Supination and pronation complete. Class II.

CASE 31.—George W. D., aged fourteen years. July 23, 1907. Children's Hospital. Right, lower third. Full supination. Examined August 29, 1907. Supination complete, pronation about 140 degrees. Class I.

CASE 32.—Dillman F., aged five years. June 21, 1907. Children's Hospital. Right; compound of ulna. Dressed in mid-pronation. Examined August 8, 1907. Supination not quite complete, pronation complete. Some callus over radius, and slight deformity to flexor surface. Functions perfect. Class III.

CASE 33.—Clark W. B., aged four years. July 29, 1907. Children's Hospital. Left; same forearm was broken two years ago. Dressed in full supination. Examined August 29, 1907. Both bones bowed slightly to radial aspect; rotation from full supination is good. Class II.

CASE 34.—John H., aged twenty-two months. January 13, 1908. Episcopal Hospital. Left, greenstick. Full supination. Examined February, 1908. Class I.

CASE 35.—Marcus D., aged sixteen years. April 14, 1908. Episcopal Hospital. Epiphyseal separation of radius and greenstick of ulna above styloid. Full supination. Examined October 28, 1911. Class I.

CASE 36.—Louis S., aged fourteen years. April 22, 1908. Episcopal Hospital. Left, lower fifth. Full supination. Examined June 2, 1908. Class I.

CASE 37.—Charles W. H., aged 18 months. January 4, 1909. Episcopal Hospital. Left, greenstick. Full supination. Examined March, 1909. Class I.

CASE 38.—Clara Y., aged nine years. February 10, 1909. Episcopal Hospital. Right, two inches above wrist. Dressed on Bond splint, in mid-pronation, there being no tendency to deformity. Examined October 28, 1911. Class I.

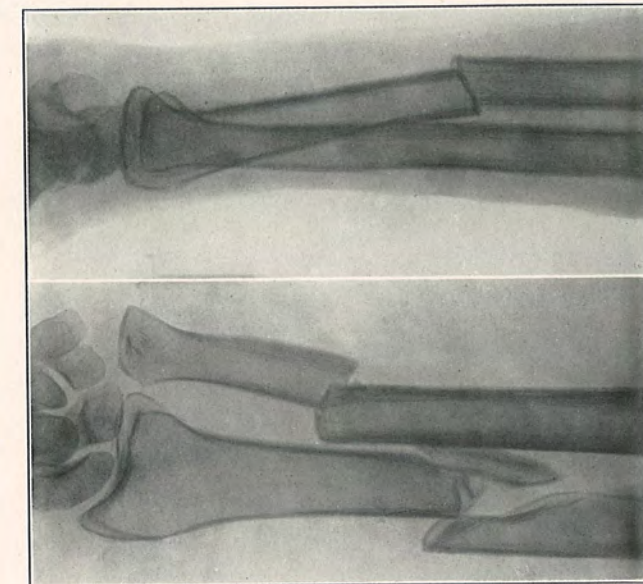


FIG. 9.—Case XXXIX. Lateral and antero-posterior views of comminuted fracture of both bones of forearm, showing best position secured. See Fig. 10.

CASE 39.—Michael S., aged fifty-three years. February 25, 1909. Episcopal Hospital. Right; comminuted; was caught in machinery. Dressed in full supination; accurate reduction not secured (Fig. 9). Delayed union. After ten weeks returned to his work (blacksmith), and two months later had firm union. Examined January 20, 1912. Right forearm: supination, 15 degrees; pronation, 105 degrees. Left forearm: supination, 0 degrees; pronation, 140 degrees. There is slight palpable bony deformity, but no disability whatever (Fig. 10). Class III.

CASE 40.—Victoria K., aged seventeen months. February 16, 1910. Episcopal Hospital. Right. Dressed in mid-pronation. Examined ten weeks later. Slight extensor bowing of ulna; supination and pronation complete. Class II.

CASE 41.—Wilson McC., aged fourteen years. March 23, 1910. Episcopal Hospital. Right, lower third. Full supination. Examined, January 20, 1912. No deformity palpable. Right forearm: supination, -35 degrees; pronation, 125 degrees. Left forearm: supination, -40 degrees; pronation, 140 degrees. Class I.

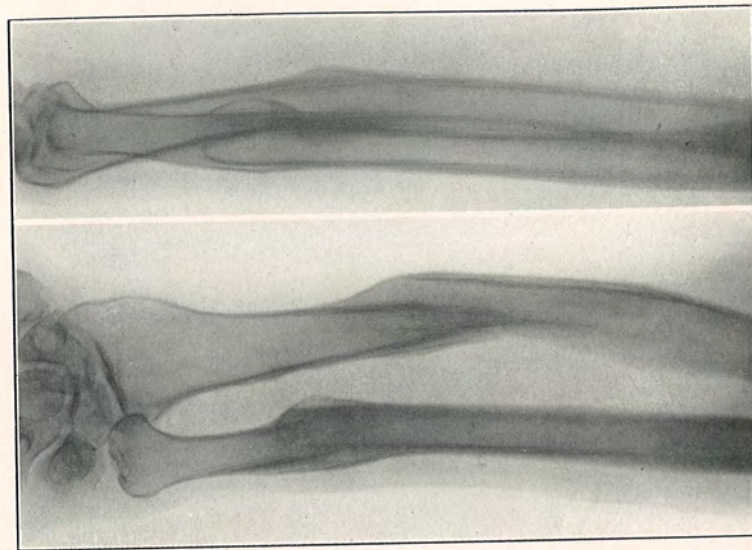


FIG. 10.—Case XXXIX. Lateral and antero-posterior views of comminuted fracture of both bones of forearm, three years after injury. There was delayed union, but patient was out of work only ten weeks in all. This is the worst result in the entire series.

CASE 42.—William E., aged fifteen years. January 18, 1911. Episcopal Hospital. Right, above wrist. Full supination. Examined October 28, 1911. Class I.

CASE 43.—Helen K., aged three years. January 28, 1911. Episcopal Hospital. Right, greenstick. Full supination. Examined October 28, 1911. Supination complete, pronation to 170 degrees. Class I.

CASE 44.—John L., aged seventeen years. August 11, 1911. Episcopal Hospital. Complete of radius, greenstick of ulna. Full supination. Examined October 28, 1911. Perfect result. Supination complete, pronation to 160 degrees. Class I.

CASE 45.—George S., aged nine years. August 11, 1911. Episcopal Hospital. Middle third, left; has been dressed in mid-pronation at another hospital. Examined October 27, 1911. Supination complete, pronation to 135 degrees. Class I.

CASE 46.—Harry M., aged thirteen years. August 16, 1911. Episcopal Hospital. Right, above wrist. Full supination. Ex-

amined October 28, 1911. Supination complete, pronation to 135 degrees. Class I.

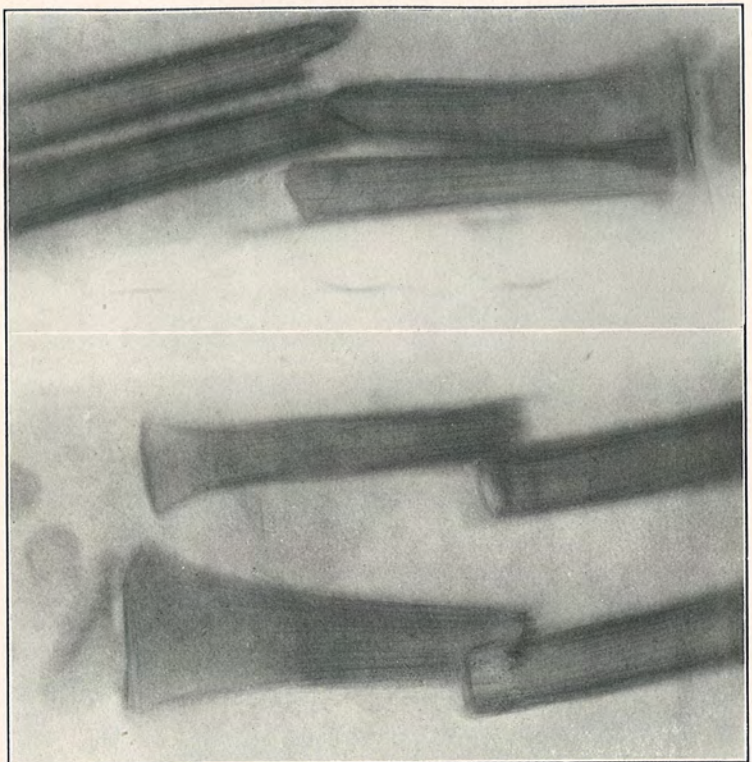


FIG. 11.—Case XLVII.—Compound fracture of radius and ulna, before coming under care of the writers, and while still dressed in mid-pronation. See Figs. 12 and 13.

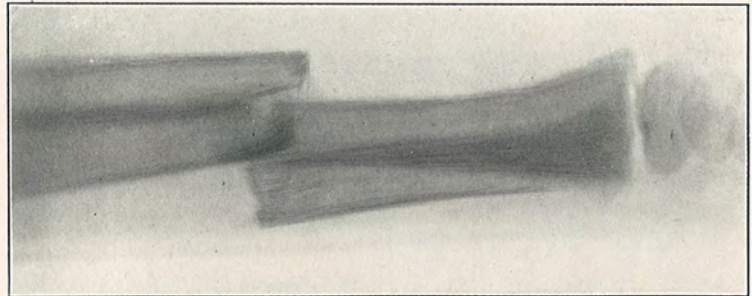


FIG. 12.—Case XLVII. Lateral view, after dressing in full supination, one week after injury.

CASE 47.—Roger McB., aged nine years. August 17, 1911. Episcopal Hospital. Injury one week ago, and was referred as suitable for operation; had been dressed in mid-pronation (Fig. 11).

Better position secured by dressing in full supination (Figs. 12 and 13), and no operation recommended. Compound fracture of radius and ulna, wounds on flexor surface of forearm. Examined January 20, 1912. Slight amount of callus palpable. Injured forearm: supination, -30 degrees; pronation, 130 degrees. Normal forearm: supination, -20 degrees; pronation, 135 degrees. Class II. (Fig. 14.)

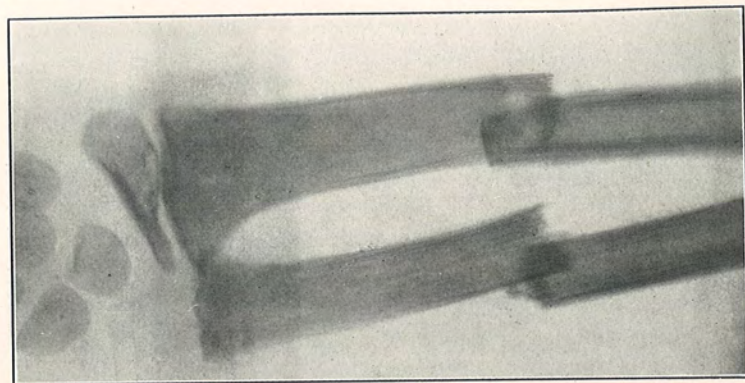


FIG. 13.—Case XLVII. Antero-posterior view after dressing in full supination.

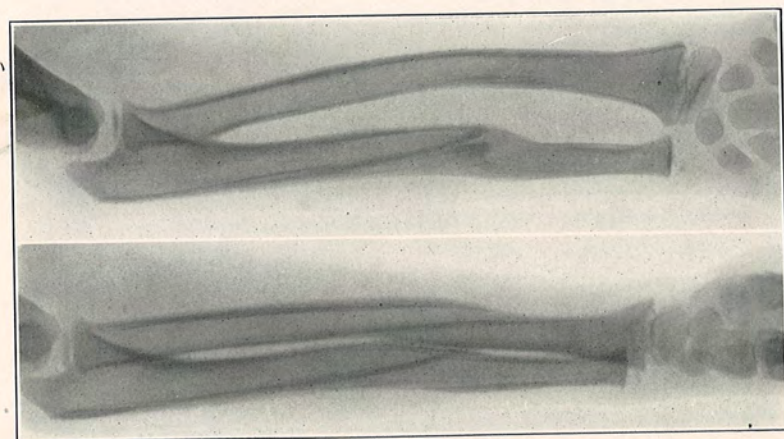


FIG. 14.—Case XLVII. Compound fracture of both bones of forearm five months after injury. Slight callus palpable. No visible deformity. Perfect function.

CASE 48.—Tony M., aged fourteen years. September 8, 1911. Episcopal Hospital. Left; injury one week ago, junction of middle and upper thirds. Had been dressed in mid-pronation. Better position secured by dressing in full supination. Examined January 21, 1912. Slight posterior bowing of both bones. Left forearm: supination, 20 degrees; pronation, 150 degrees. Right

forearm: supination, -5 degrees; pronation, 140 degrees. Class II.

CASE 49.—Richard W., aged thirteen years. September 23, 1911. Episcopal Hospital. Left, middle third. Full supination. Skiagraph (Fig. 15) showed lower fragment of radius displaced

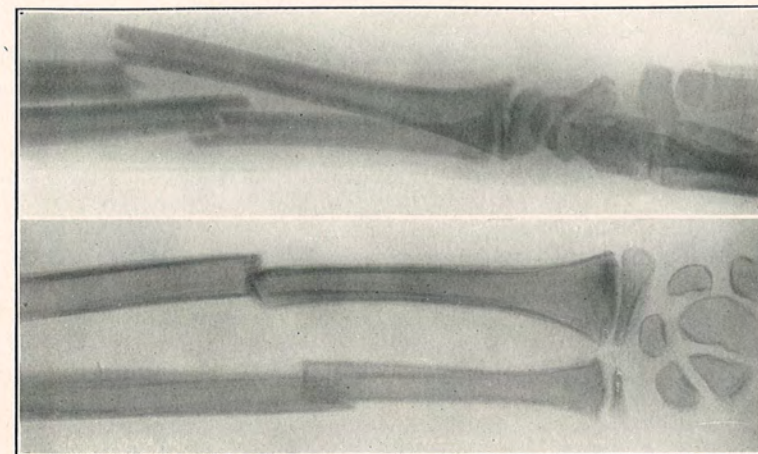


FIG. 15.—Case XLIX. Lateral and antero-posterior views after first dressing. See Fig. 16.

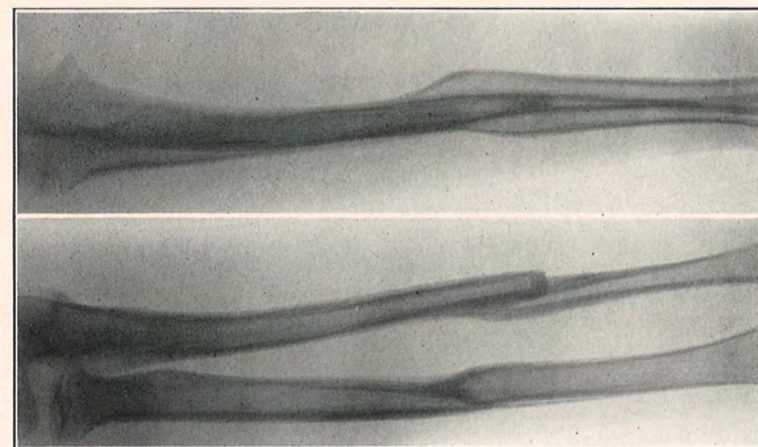


FIG. 16.—Case XLIX. Lateral and antero-posterior views four months after injury. Slight callus palpable. No visible deformity. Perfect function.

to flexor surface. Examined, January 17, 1912. No visible deformity, slight callus palpable on flexor surface of radius (Fig. 16). Left forearm: supination, -15 degrees; pronation, 125 degrees. Right forearm: supination, -10 degrees; pronation, 135 degrees. Class II.

CASE 50.—Herbert T., aged fourteen years. September 26, 1911. Episcopal Hospital. Right, middle third. Dressed in full supination. Examined January 21, 1912. Some callus palpable. Right forearm: supination, —10 degrees; pronation, 155 degrees. Left forearm: supination, —10 degrees; pronation, 140 degrees. Class I.

CASE 51.—John D., aged eighteen years. October 10, 1911. Episcopal Hospital. Right, junction of middle and upper third. Full supination. Some projection of upper fragment of radius on flexor surface. Examined January 28, 1912. Slight callus of radius. Right forearm: supination, 40 degrees; pronation, 135 degrees. Left forearm: supination, —5 degrees; pronation, 120 degrees. Class III. (This patient was under the care of the writers only seventeen days.)

CASE 52.—Stanley C., aged fourteen years. October 10, 1911. Episcopal Hospital. Left, lower third of radius, and through lower epiphysis of ulna. Full supination. Examined January 27, 1912. Left forearm: supination —15 degrees; pronation, 160 degrees. Right forearm: supination, —5 degrees; pronation, 160 degrees. Class I.

STATED MEETING, HELD FEBRUARY 6, 1911

DR. GWILYM G. DAVIS in the chair.

DISJUNCTION OF UPPER EPIPHYSIS OF ULNA.

DR. PENN G. SKILLERN related the history of a boy aged 9 years who presented himself at the surgical dispensary of the Children's Hospital September 10, 1909, with the history of a fall from a height of 10 feet onto his left elbow. In the absence of Dr. Ashhurst he was examined by Dr. Skillern, who discovered moderate pain, moderate swelling about the elbow, and localized tenderness at the upper extremity of the ulna. At this point a small fragment corresponding to the olecranon tip could be grasped and moved from side to side. Between this fragment and the triangular subcutaneous surface of the olecranon was a depression admitting the tip of the little finger, which was rendered more distinct on flexing the forearm and diminished by extending it. Approximation of the fragments in complete extension elicited muffled crepitus. The arm was splinted in complete extension and the epiphysis held in juxtaposition with the bone by an adhesive strip. A skiagram revealed disjunction with slight mesial displacement of the upper epiphysis. (Figs. 1 and 2.)

Dr. Skillern said that this injury is not mentioned in the textbooks or in the literature of surgery. It is, however, referred to in Piersol's "Anatomy" (p. 285), and receives full consideration in Poland's work on "Traumatic Separation of the Epiphyses" (p. 457), in which it is stated that: "the olecranon epiphysis is but a small process, occupying little more than a third of the whole olecranon at about the tenth year. In this cartilage ossification appears at the summit of the olecranon as a single nucleus usually at this period—in rare cases a year or two sooner—and rapidly invades the whole. In the fully ossified state, at the fifteenth year, the epiphysis comprises the upper aspect of the olecranon with the insertion of the triceps, part of the attachment of the posterior ligament of the elbow-joint, and a small portion of the upper part of the triangular subcutaneous surface posteriorly; on the inner side it is above the tubercle for the flexor