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OF THE
PHILADELPHIA
ACADEMY
OF
SURGERY

VOL. XIV.

1912

TRANSACTIONS

OF THE

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VOLUME XIV

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1912

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ACTIVE FELLOWS OF THE PHILADELPHIA ACADEMY OF SURGERY

1910.* Alexander, E. G., M.D., 1627 Oxford Street. Surgeon to the Out-Patient Department of the Episcopal Hospital; Surgeon to the Out-Patient Department of the Mary J. Drexel Home for Children; Assistant Surgeon to the Kensington Hospital for Women; Demonstrator of Fracture Dressings at the Jefferson Medical College; Demonstrator of Fracture Dressings at the Woman's Medical College.

1905. Allen, Francis Olcott, Jr., M.D., 2216 Walnut Street. Dispensary Surgeon to the Presbyterian Hospital; Dispensary Surgeon to the Methodist Hospital.

† Allis, Oscar H., M.D., 1604 Spruce Street. Surgeon to the Presbyterian Hospital; Member American Surgical Association.

1906. Ashhurst, Astley P. C., M.D., 811 Spruce Street. Surgeon to the Out-Patient Department of the Episcopal Hospital; Assistant Surgeon to the Orthopædic Hospital; Surgeon to the Dispensary of the Children's Hospital; Chief of the Gynæcological Dispensary of the Pennsylvania Hospital; Prosector to the Associate Professor of Applied Anatomy in the University of Pennsylvania.

1898. Boger, John A., A.M., M.D., 2213 N. Broad Street. Surgeon to St Mary's and the Samaritan Hospitals; Surgeon to the Dispensary of the Episcopal Hospital.

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* Figures denote year elected to membership.
† Denotes Original Fellows.

1905. Brooks, Macy, M.D., 1314 Spruce Street. Assistant Genito-Urinary Surgeon, Philadelphia Hospital; Chief of Out-Patient Surgical Department of the University of Pennsylvania and Howard Hospitals.

1907. Carmany, Harry S., 366 Green Lane, Roxborough. Surgeon to St. Timothy's Hospital; Out-Patient Surgeon to Episcopal Hospital.

1909. Carnett, John B., 318 S. Fifteenth Street. Associate in Surgery, University of Pennsylvania, Medical Department; Assistant Surgeon to the University and Philadelphia General Hospitals; Consulting Surgeon to the Phœnixville Hospital.

1896. Da Costa, John Chalmers, M.D., 2045 Walnut Street. Professor of the Principles of Surgery and Clinical Surgery in Jefferson Medical College; Surgeon to the Philadelphia Hospital.

1896. Davis, Gwilym G., M.D., M.R.C.S. (Eng.), 1814 Spruce Street. Assistant Professor of Applied Anatomy, University of Pennsylvania; Surgeon to the Episcopal, St. Joseph's, and the Orthopædic Hospitals.

1896. Deaver, Henry C., M.D., 1534 N. Fifteenth Street. Surgeon to the Episcopal, St. Agnes, Stetson, and Children's Hospital of the Mary J. Drexel Home; Professor in Surgery in Woman's Medical College.

1890. Deaver, John B., M.D., 1634 Walnut Street. Chief of the Surgical Department, German Hospital.

1908. Despard, Duncan Lee, M.D., 1806 Pine Street. Instructor in Surgery, Jefferson Medical College; Chief Assistant in the Surgical Clinic at Jefferson Medical College.

1884. Dulles, Charles W., M.D., 4101 Walnut Street. Lecturer on the History of Medicine, University of Pennsylvania; Consulting Surgeon to the Rush Hospital.

1909. Elmer, Walter G., M.D., 1801 Pine Street. Instructor in Orthopædic Surgery in the University of Pennsylvania and Assistant Orthopædic Surgeon to the University Hospital; Orthopædic Surgeon to the Jewish Hospital; Surgeon to the Presbyterian Hospital Dispensary; Surgeon to the Pennsylvania Training School for Children at Elwyn.

1898. Frazier, Charles Harrison, M.D., 1724 Spruce Street. Professor of Clinical Surgery, University of Pennsylvania; Surgeon to the University Hospital, and Episcopal Hospital.

1899. Gibbon, John H., M.D., 1608 Spruce Street. Professor of the Principles of Surgery and of Clinical Surgery, Jefferson Medical College; Surgeon to the Pennsylvania and Bryn Mawr Hospitals; Consulting Surgeon to the Woman's Hospital.

1902. Girvin, John H., M.D., 2120 Walnut Street. Gynæcologist to the Presbyterian Hospital; Instructor in Obstetrics, University of Pennsylvania.

1892. Harte, Richard H., M.D., 1503 Spruce Street. Associate Professor of Surgery, University of Pennsylvania; Surgeon to the Pennsylvania Hospital, and to the Orthopædic Hospital and Infirmary for Nervous Diseases; Consulting Surgeon to St. Mary's, St. Timothy's, and Bryn Mawr Hospitals.

1882. Hearn, W. Joseph, M.D., 1120 Walnut Street. Emeritus Professor of Clinical Surgery, Jefferson Medical College; Surgeon to the Philadelphia Hospital; Consulting Surgeon to the Phœnixville Hospital, and to the General Hospital of Salisbury, Md.

1890. HEWSON, ADDINELL, M.D., 2120 Spruce Street. Surgeon to St. Timothy's Hospital; Professor of Anatomy, Philadelphia Polyclinic and College for Graduates in Medicine.

1905. HODGE, EDWARD B., M.D., 346 S. Sixteenth Street. Surgeon to the Children's Hospital; Surgeon to the Out-Patient Department of the Pennsylvania Hospital; Dispensary Surgeon to the Presbyterian Hospital; Assistant Surgeon to the Orthopædic Hospital.

1890. HORWITZ, ORVILLE, B.S., M.D., 1721 Walnut Street. Professor of Genito-Urinary Surgery, Jefferson Medical College; Surgeon to the St. Agnes Hospital and the State Hospital for the Insane; Consulting Surgeon to the Jewish Hospital.

1898. HUTCHINSON, JAMES P., M.D., 133 S. Twenty-second Street. Surgeon to the Pennsylvania, St. Timothy's, Methodist Episcopal, Children's, and Bryn Mawr Hospitals.

1900. JOPSON, JOHN H., M.D., 1824 Pine Street. Surgeon to the Presbyterian, Children's, and Bryn Mawr Hospitals, and to the Philadelphia Home for Incurables.

† KEEN, WILLIAM W., M.D., LL.D., F.R.C.S. (Hon.), 1729 Chestnut Street. Emeritus Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Membre correspondant étranger de la Société de Chirurgie de Paris; Membre honoraire de la Société Belge de Chirurgie, Ehrenmitglied der Deutsche Gesellschaft für Chirurgie; Honorary Member of the Clinical Society of London.

1910. KELLY, JAMES A., M.D., 1621 N. Seventeenth Street. Surgeon to St. Mary's Hospital; Associate in Surgery and Pathologist to the Philadelphia Polyclinic Hospital and College for Graduates in Medicine.

1895. LE CONTE, ROBERT G., M.D., 1530 Locust Street. Surgeon to the Pennsylvania and Bryn Mawr Hospitals; Consulting Surgeon to the Germantown and Gynecean Hospitals.

1910. LEE, WALTER E., M.D., 905 Pine Street. Gynecologist to the Out-Patient Department of the Pennsylvania Hospital; Surgeon to the Dispensary of the Germantown Hospital.

1899. LOUX, HIRAM R., M.D., 1614 N. Broad Street. Associate Professor of Genito-Urinary Surgery, Jefferson Medical College; Surgeon to the Philadelphia Hospital.

1885. MCCLELLAN, GEORGE, M.D., 1116 Spruce Street. Professor of Anatomy, Jefferson Medical College; Consulting Surgeon to Howard Hospital; Professor of Anatomy, Pennsylvania Academy of the Fine Arts.

1900. MARTIN, EDWARD, M.D., 1506 Locust Street. Professor of Clinical Surgery, University of Pennsylvania; Professor of Clinical Surgery, Woman's Medical College; Surgeon to the Philadelphia, University of Pennsylvania, and Howard Hospitals; Consulting Surgeon to the Bryn Mawr, Phœnixville, Wernersville, and Norristown Hospitals.

1907. MILLER, MORRIS BOOTH, M.D., 2117 Pine Street. Professor of Surgery, Philadelphia Polyclinic and College for Graduates in Medicine; Assistant Surgeon, Philadelphia General Hospital; Surgeon to the Douglas Hospital.

1904. MITCHELL, CHARLES F., M.D., 342 S. Fifteenth Street. Surgeon to the Germantown Hospital; Assistant Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases; Consulting Surgeon to the Eastern State Penitentiary; Surgeon to the Out-Patient Department of the Pennsylvania Hospital.

1906. MULLER, GEORGE P., M.D., 334 S. Fifteenth Street. Associate in Surgery in the University of Pennsylvania; Surgeon to St. Christopher's Hospital; Assistant Surgeon to the University Hospital, Philadelphia Hospital, and the Home for Crippled Children; Consulting Surgeon to the Chester County Hospital.

1902. MUTSCHLER, LOUIS H., M.D., 2030 Tioga Street. Surgeon to the Dispensary of the Episcopal Hospital; Surgeon to the Dispensary of the Samaritan Hospital; Assistant Surgeon to the Orthopædic Hospital.

1905. NASSAU, CHARLES F., M.D., 1831 Chestnut Street. Surgeon to St. Joseph's Hospital; Consulting Surgeon to the Frankford Hospital; Prosector, Jefferson Medical College (Chair of Regional Anatomy).

1890. NEILSON, THOMAS R., M.D., 122 S. Seventeenth Street. Surgeon to the Episcopal Hospital and to St. Christopher's Hospital for Children; Clinical Professor of Genito-Urinary Diseases in the University of Pennsylvania.

1906. NORRIS, HENRY, M.D., Rutherfordton, North Carolina.

1890. PENROSE, CHARLES B., M.D., Ph.D. (Harvard), 1720 Spruce Street.

† ROBERTS, JOHN B., M.D., 313 S. Seventeenth Street. Professor of Surgery in the Philadelphia Polyclinic; Surgeon to the Methodist Hospital.

1898. ROBINSON, J. WEIR, M.D., 326 S. Sixteenth Street. Assistant Surgeon to the Presbyterian Hospital.

1900. RODMAN, WILLIAM L., M.D., LL.D., 1904 Chestnut Street. Professor of the Principles of Surgery and Clinical Surgery, Medico-Chirurgical College of Philadelphia; Surgeon to the Medico-Chirurgical Hospital, Presbyterian, and the Philadelphia General Hospitals.

1900. ROSS, GEORGE G., M.D., 1721 Spruce Street. Surgeon Germantown Hospital; Assistant Surgeon, German Hospital; Surgeon to the Out-Patient Department, German Hospital; Assistant Surgeon, University Hospital; Instructor in Surgery, University of Pennsylvania; Surgeon to the Stetson Hospital.

1894. SHOEMAKER, GEORGE ERETY, A.M., M.D., 1831 Chestnut Street. Gynæcologist to the Presbyterian Hospital.

1903. SITER, E. HOLLINGSWORTH, M.D., 2038 Locust Street. Surgeon to the Out-Patient Department, St. Agnes' Hospital; Surgeon to the Out-Patient Department of the Children's Hospital; Chief Surgeon, Genito-Urinary Diseases of the University Hospital; Instructor in Genito-Urinary Diseases, University of Pennsylvania, Surgeon of the British Consulate.

1909. SPEESE, JOHN, M.D., 248 S. Twenty-first Street. Instructor in Surgery, University of Pennsylvania; Surgeon to the Out-Patient Department of the University Hospital and the Children's Hospital.

1898. SPELLISSY, JOSEPH M., A.M., M.D., 110 S. Eighteenth Street. Surgeon to the Methodist and to St. Joseph's Hospitals, the Elwyn Training School, and to the Out-Patient Department of the Pennsylvania Hospital; Assistant Surgeon to the Orthopædic Department of the University Hospital.

1890. STEINBACH, LEWIS W., M.D., 1309 N. Broad Street. Professor of Surgery, Philadelphia Polyclinic; Surgeon to the Philadelphia and to the Jewish Hospitals.

1911. STELLWAGON, THOMAS C., JR., 1119 Spruce Street. Chief Clinical Assistant in the Out-patient Surgical Department of the Jefferson Medical College Hospital.

1903. STEWART, FRANCIS T., M.D., 311 S. Twelfth Street. Surgeon to the Germantown Hospital; Professor of Clinical Surgery in Jefferson Medical College; Surgeon to the Out-Patient Department of the Pennsylvania Hospital.

1908. SWEET, J. EDWIN, A.M., M.D., 301 St. Mark's Square. Assistant Professor of Experimental Surgery, University of Pennsylvania.

1890. TAYLOR, WILLIAM J., M.D., 1825 Pine Street. Surgeon to St. Agnes' and the Orthopædic Hospitals; Consulting Surgeon to the West Philadelphia Hospital for Women.

1911. THOMAS, BENJAMIN A., 116 S. Nineteenth Street. Professor of Genito-Urinary Surgery in the Philadelphia Polyclinic and College for Graduation in Medicine; Instructor in Surgery in the University of Pennsylvania; Surgeon-in-Chief to the Out-Patient Department of the University Hospital.

1908. THOMAS, THOMAS TURNER, M.D., 2005 Chestnut Street. Instructor in Surgery in the University of Pennsylvania; Assistant Surgeon to the University Hospital; Assistant Surgeon to the Philadelphia Hospital.

1907. UHLE, ALEXANDER A., M.D., 1831 Chestnut Street. Assistant Instructor, Genito-Urinary Department, University of Pennsylvania; Assistant Genito-Urinary Surgeon, Philadelphia Hospital; Surgeon to Urologic Dispensary of the German Hospital.

1907. WALKER, WARREN, M.D., 1632 Spruce Street. Surgeon to the Out-Patient Department of the Episcopal and Children's Hospitals.

1892. WHARTON, HENRY R., M.D., 1725 Spruce Street. Clinical Professor of Surgery, Woman's Medical College; Surgeon to the Presbyterian and to the Children's Hospitals; Consulting Surgeon to the Bryn Mawr Hospital, St. Christopher's Hospital, and to the Pennsylvania Institution for the Deaf and Dumb.

1883. WHITE, J. WILLIAM, M.D., 1810 S. Rittenhouse Square. John Rhea Barton, Professor of Surgery, University of Pennsylvania; Surgeon to the Rush Hospital.

1902. WHITING, A. D., M.D., 1523 Spruce Street. Surgeon to the Germantown Hospital; Assistant Surgeon to the German Hospital; Surgeon to the Southern Home for Destitute Children; Surgeon to the Out-Patient Department, German Hospital; Assistant Surgeon, University Hospital; Instructor in Surgery, University of Pennsylvania.

1890. WILSON, H. AUGUSTUS, A.M., M.D., 1611 Spruce Street. Professor of Orthopædic Surgery, Jefferson Medical College; Emeritus Professor of Orthopædic Surgery, Philadelphia Polyclinic; Orthopædic Surgeon to the Philadelphia Hospital; Consulting Orthopædic Surgeon to the Lying-in Charity Hospital and to the Kensington Hospital for Women.

1898. WOOD, ALFRED C., M.D., 128 S. Seventeenth Street. Assistant Professor of Surgery in the University of Pennsylvania; Surgeon to the University, Philadelphia and St. Timothy's Hospitals; Consulting Surgeon to Charity Hospital and the State Hospital for the Insane, Norristown.

1910. WOODS, RICHARD F., M.D., 1501 Spruce Street. Gynæcologist, Presbyterian Hospital; Associate Gynæcologist, Gynecean Hospital.

1902. YOUNG, JAMES K., M.D., 222 S. Sixteenth Street. Professor of Orthopædic Surgery, Philadelphia Polyclinic; Clinical Professor of Orthopædic Surgery, Woman's Medical College of Pennsylvania; Associate in Orthopædic Surgery, University of Pennsylvania; Assistant Orthopædic Surgeon, Hospital of the University of Pennsylvania.

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1897. THOMAS R. NEILSON.
1898. O. H. ALLIS.
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1902. J. M. SPELLISSY.
1903. R. G. LECONTE.
1904. G. G. DAVIS.
1905. J. CHALMERS DACOSTA.
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1910. ASTLEY P. C. ASHHURST.
1911. JOHN H. JOPSON.

WINNERS OF THE SAMUEL D. GROSS PRIZE

1895 "Inquiry into the Difficulties Encountered in the Reduction of Dislocations of the Hip."—Dr. Oscar H. Allis, Philadelphia, Pa.

1902 "The Treatment of Certain Malignant Growths by Excision of the External Carotids."—Dr. Robert H. W. Dawbarn, New York, N. Y.

1905 "The Biology of the Microorganisms of Actinomycosis."—Dr. James Homer Wright, Boston, Mass.

1910 "An Anatomical and Surgical Study of Fractures of the Lower End of the Humerus."—Dr. Astley Paston Cooper Ashhurst, Philadelphia, Pa.

HONORARY FELLOWS

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1881 *Sir James Paget.....London, England.
1881 *Theodor Billroth.....Vienna, Austria.
1881 *Bernhard von Langenbeck. Berlin, Germany.
1881 *Willard Parker.....New York, N. Y.
1881 *Lewis A. Sayre.....New York, N. Y.
1881 *Moses Gunn.....Chicago, Ill.
1881 *John T. Hodgen.....St. Louis, Mo.
1881 *W. W. Dawson.....Cincinnati, Ohio.
1881 *T. G. Richardson.....New Orleans, La.
1881 J. Collins Warren.....Boston, Mass.
1881 *W. T. Briggs.....Nashville, Tenn.
1881 *Christopher Johnston.....Baltimore, Md.
1881 *D. W. Yandell.....Louisville, Ky.
1898 Maurice H. Richardson ... Boston, Mass.
1898 George M. Sternberg.....Washington, D. C.
1898 Charles B. McBurney..... New York, N. Y.
1898 *Nicholas Senn.....Chicago, Ill.
1898 *Theodore F. Prewitt.....St. Louis, Mo.
1898 L. McLane Tiffany.....Baltimore, Md.
1898 Nathaniel P. Dandridge... Cincinnati, Ohio.
1898 Roswell Park.....Buffalo, N. Y.
1898 Robert F. Weir.....New York, N. Y.
1898 Frederick S. Dennis.....New York, N. Y.

* Deceased.

1900	W. H. A. Jacobson	London, England.
1900	Theodor Kocher	Berne, Switzerland.
1900	Vincenz Czerny	Heidelberg, Germany.
1906	William J. Mayo	Rochester, Minn.
1906	Dudley P. Allen	Cleveland, Ohio.
1906	Robert Abbe	New York, N. Y.
1906	C. B. G. deNancrede	Ann Arbor, Mich.
1907	*John C. Munro	Boston, Mass.
1908	J. Ewing Mears	Philadelphia, Pa.
1909	Stephen Pilcher	Brooklyn, N. Y.

CONTENTS

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.

BY JOHN H. JOPSON, M.D.,
OF PHILADELPHIA.

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 Omboni [1] in 1884 for gunshot wound, and one by Delorme [2] 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 pyopneumothorax 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 Hopkins [3] 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] Kelly [5]).

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 (Howell [6]).

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 dyspnœa 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 Leland[7]); 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 (Wolf[8]); no less than 35 clinics being so equipped at the beginning of the year 1910 (Robinson[9]). 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, dyspnœa 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 Janeway[11] 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 Fell [12] 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. Meyer [13] 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 Robinson [9] 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's [14] apparatus and a citation of the results obtained by Tiegel in Henle's clinic [10] 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 dyspnœa 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 Lilienthal [21] 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 (Matas[23]), are directly due to septic infection of the pleura or pericardium or of both; in Stuckey's [2] 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 invalided 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 Garré [24] 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 antisepsis 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 Stuckey [2] 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. Möller [25] 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.

Grassmann [26] 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. Wolf [8] 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, dyspnœa, 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 traumatopnœa. 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, gastrohepatic omentum, and kidney. Laparotomy performed the same day, stomach and intestines examined and found uninjured. Temporary improvement, interrupted by streptococcic 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 (Spannungspneumothorax), 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 (Brunswig). 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 (Delagenieves' 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 TUBERCULOUS KIDNEY.

BY GEO. ERETY SHOEMAKER, M.D.,

OF PHILADELPHIA,

Gynæcologist 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 (Koenig). 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]

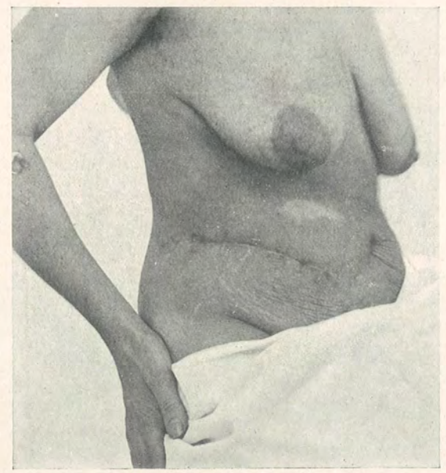
After operation the urine from the remaining kidney showed no tubercle bacilli, no pus, and no casts.

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.

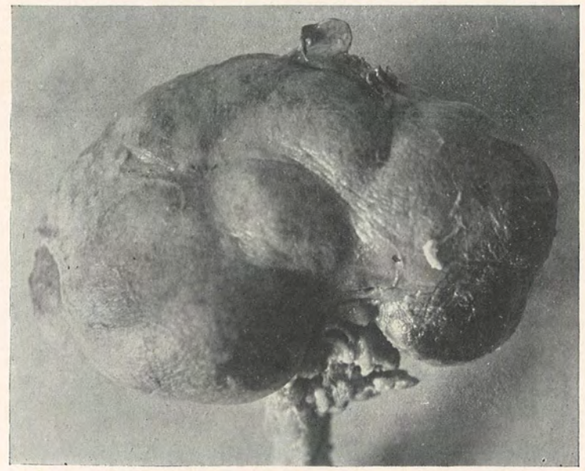
[1] April 1, 1911, gain of 32 pounds within five months.

FIG. 1.



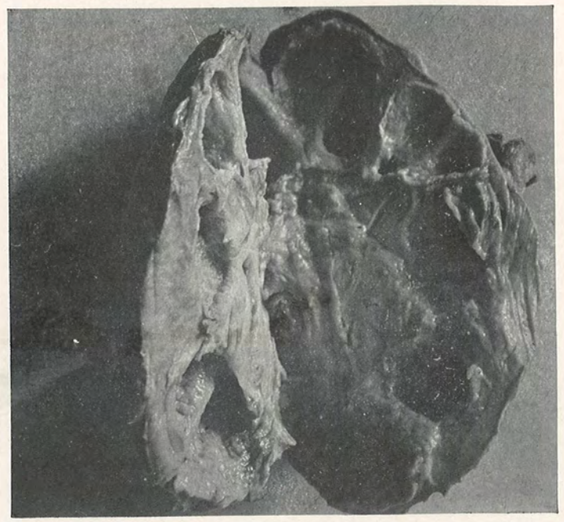
Five weeks after operation, showing location of incision (König).

FIG. 2.



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

FIG. 3.



Kidney bisected, showing pus pockets.

Bovee collected seventeen cases, and later[2] 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

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

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 functionating 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]

By Astley P. C. Ashhurst, M.D.,

Instructor in Surgery in the University of Pennsylvania, Surgeon to the Out-Patient Department of the Episcopal Hospital, etc.

and

Rutherford L. John, M.D.,

Resident Physician at the Episcopal Hospital.

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 psssive 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. Perfect result.	Class II. Slight deformity.	Class III. 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 1 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

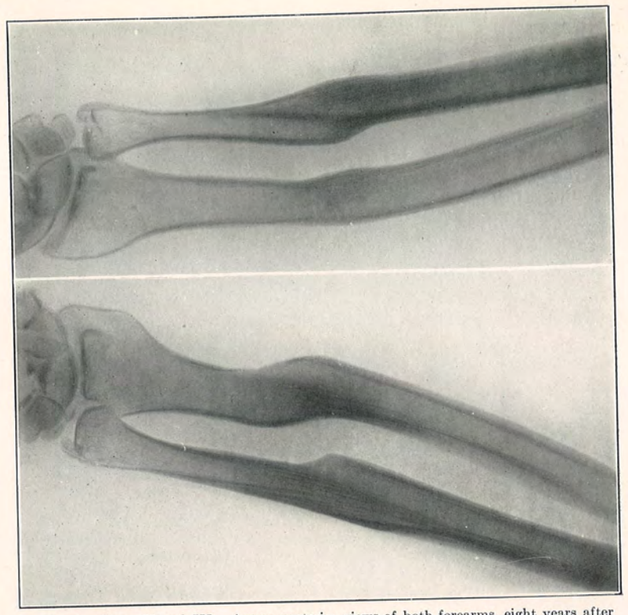


FIG. 4.—Cases II and III. Antero-posterior views of both forearms, eight years after injury. Function perfect.

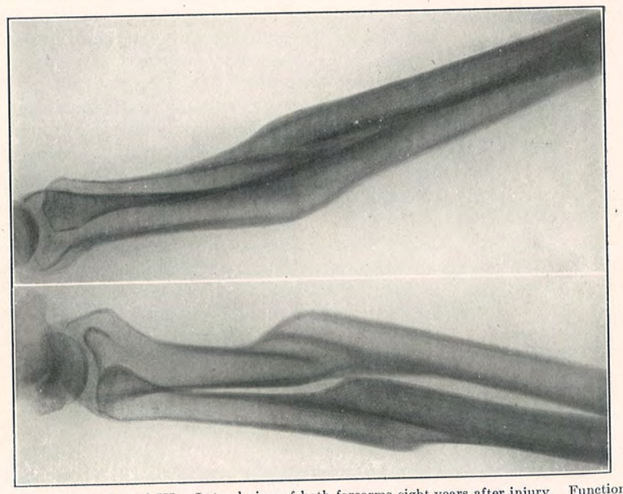


FIG. 5.—Cases II and III. Lateral view of both forearms eight years after injury. Function perfect. Patient first came under the writer's care sixteen days after injury.

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.

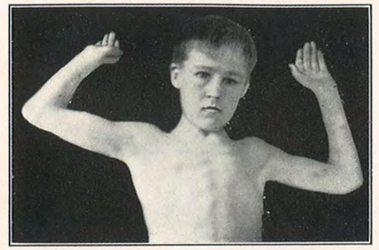


Fig. 6.—Case XXV. Compound comminuted fractures of both bones of left forearm, with compound comminuted fracture of left humerus. No deformity. Perfect function. See Figs. 7 and 8.

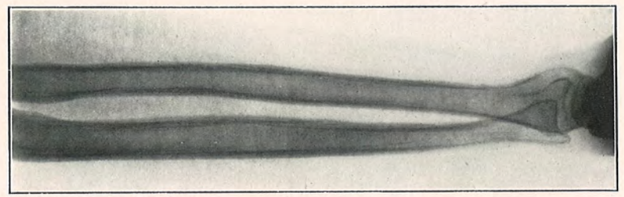


Fig. 7.—Case XXV. Lateral view of forearm five years after compound comminuted fracture of both bones.

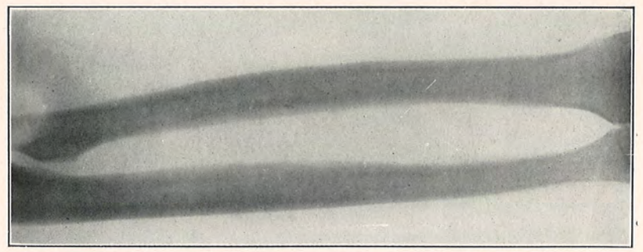


Fig. 8.—Case XXV. Antero-posterior view of forearm, five years after compound comminuted fracture of both bones.

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.

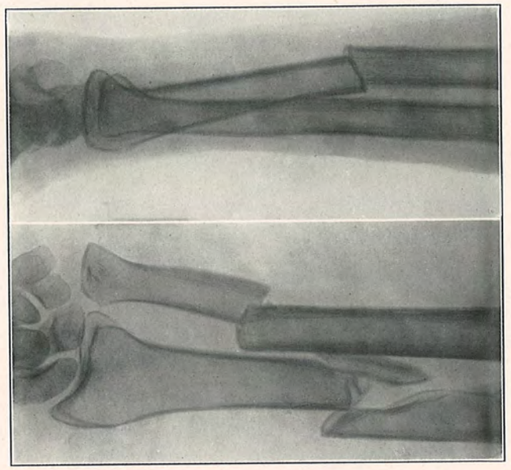


FIG. 9.—Case XXXIX. Lateral and antero-posterior views of comminuted fracture of both bones of forearm, showing best position secured. See Fig. 10.

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.

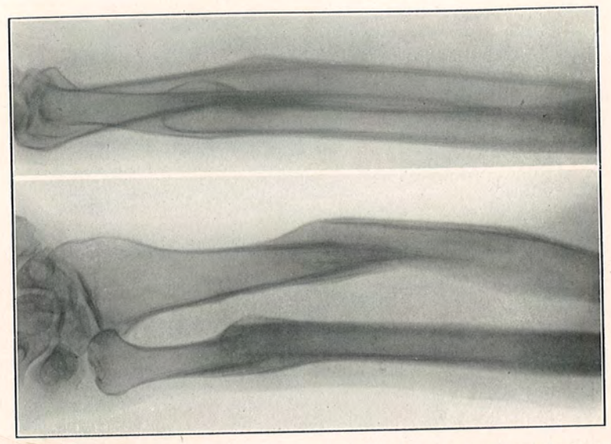


FIG. 10.—Case XXXIX. Lateral and antero-posterior views of comminuted fracture of both bones of forearm, three years after injury. There was delayed union, but patient was out of work only ten weeks in all. This is the worst result in the entire series.

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

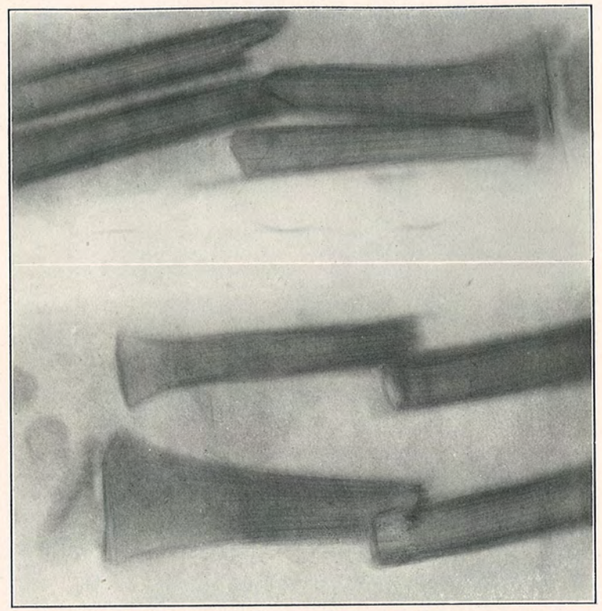


FIG. 11.—Case XLVII.—Compound fracture of radius and ulna, before coming under care of the writers, and while still dressed in mid-pronation. See Figs. 12 and 13.

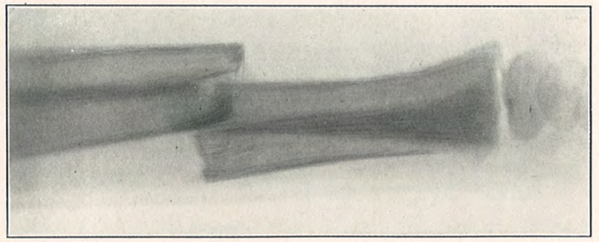


FIG. 12.—Case XLVII. Lateral view, after dressing in full supination, one week after injury.

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.)

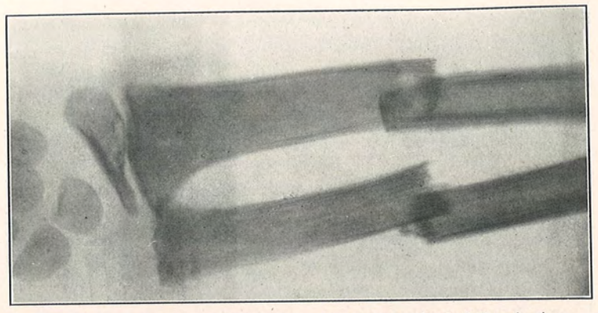


FIG. 13.—Case XLVII. Antero-posterior view after dressing in full supination.

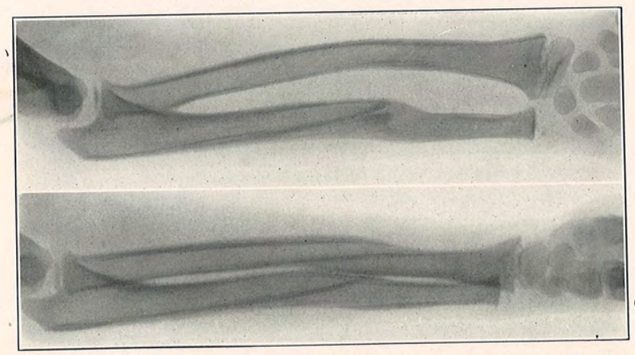


FIG. 14.—Case XLVII. Compound fracture of both bones of forearm five months after injury. Slight callus palpable. No visible deformity. Perfect function.

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

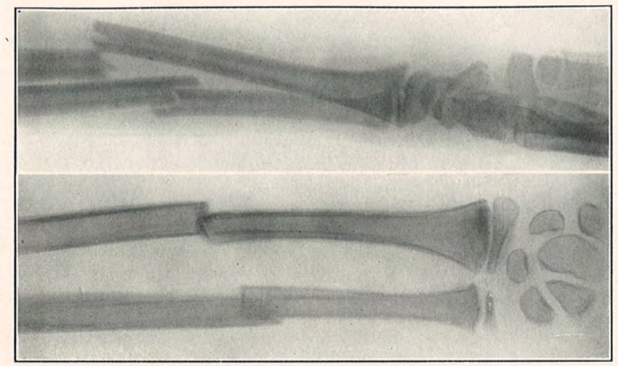


FIG. 15—Case XLIX. Lateral and antero-posterior views after first dressing. See Fig. 16.

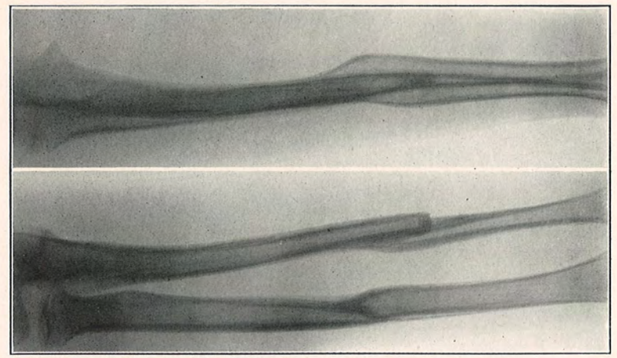


FIG. 16.—Case XLIX. Lateral and antero-posterior views four months after injury. Slight callus palpable. No visible deformity. Perfect function.

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 text-books 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

carpi ulnaris. The epiphyseal line slopes obliquely downward and backward from the articular surface in front, viz., the upper part of the sigmoid cavity. The epiphysis unites with the shaft at the seventeenth year.

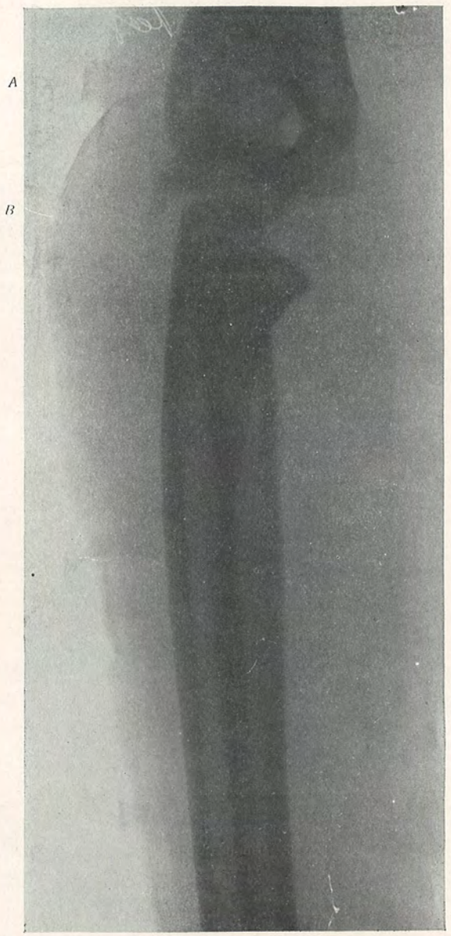
"In regard to age, separation of the whole cartilaginous upper end of the ulna is possible only before the eight year or thereabouts, and pure separation of the olecranon epiphysis can only occur from about the tenth year to the seventeenth or eighteenth, the time of junction with the epiphysis. The rarity of this injury in children, as compared with fractures of the olecranon process in adults, may be accounted for to some extent by the small size and less prominent projection of this process in the former. The posterior aspect of this epiphysis in children before the fourteenth year is on a plane anterior to that of the epicondyles and posterior aspect of the diaphysis of the humerus when the elbow is at a right angle. Consequently, in falls upon the elbow and in other injuries, the force of the blow is much more likely to be received by the epicondyles than by the olecranon.

"The injury is commonly caused by a fall upon the back of the elbow while the elbow is in a flexed position, or by some other direct blow. From indirect violence, either extreme flexion or hyperextension of the elbow may cause disjunction. As for muscular action, it is questionable whether in children violent contraction of the triceps brachii is sufficiently powerful to detach this process, unless it be combined with one or other of the causes mentioned above."

The symptoms, prognosis, and treatment of this disjunction do not differ essentially from those of fracture of the olecranon.

Even fractures of the olecranon before the fifteenth year are rare. Thus, in the table of 2705 fractures treated at the Middlesex Hospital during sixteen years inserted by Flower and Hulke in Holmes's "System of Surgery" (1881, vol. i, p. 845), 76 of the 2705 were fractures of olecranon, and of these 76, 10 occurred before the fifteenth year. The diagnosis of disjunction in this case was suggested by the fact that the patient was in the epiphyseal age,—an important consideration, since, as Poland states, the annual surgical reports of several of the London hospitals mention in their statistics numerous cases of fracture of the olecranon before adolescence, many of which were probably

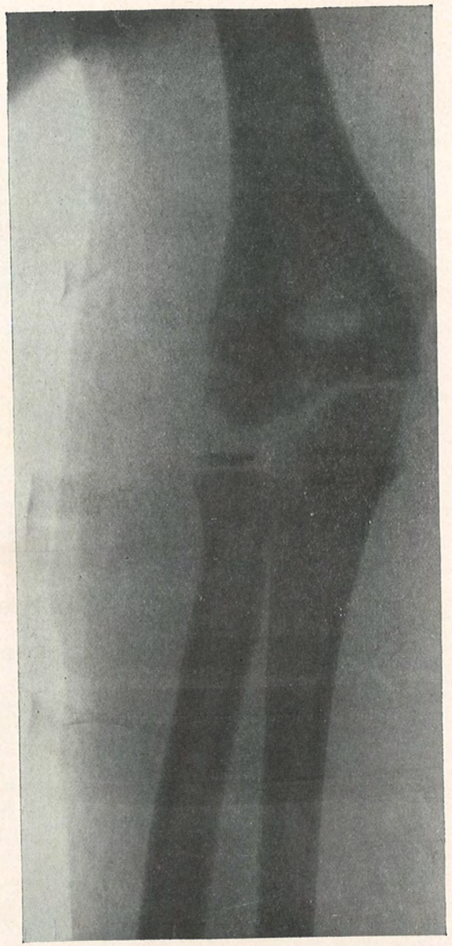
FIG. 1.



Skiagram of ulna showing separation of upper epiphysis.

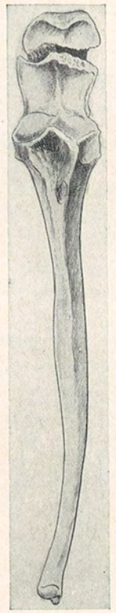
(*a*) Adhesive strip applied over epiphysis.
(*b*) Disjuncted epiphysis.

FIG. 2.



Skiagram of ulna, showing separation of upper epiphysis.

FIG. 3.



Sketch of an ulna from a lad fourteen years of age. Shows extent of olecranon formed by upper epiphysis.

examples of epiphyseal separation. The point may be raised that here, in the case of the olecranon, it is rather an affair more of academic interest than of practical import whether disjunction or fracture has occurred, since in disjunction the growth of the ulna is not interfered with. Yet the speaker thought that many epiphyseal disjunctions in children, especially where no skiagram is made, are mistaken for fractures, and that on the whole it is far better to recognize disjunctions than to stop short of further investigation and diagnose and treat as a fracture. His own working rule in this respect is that since all minors are in the epiphyseal age, severe injuries about the joints should be considered epiphyseal disjunctions until proven otherwise. It is well known that epiphyseal disjunction is more apt to occur than dislocation in childhood, because the epiphyseal unions are weaker than the articular. He believes that in the future epiphyseal disjunctions should be accorded a more prominent place in the text-books than at present. The accompanying sketch (Fig. 3), made by Mr. Erwin Faber, of an ulna from a child aged fourteen, shows just how much of the olecranon is formed by the upper epiphysis.

Examination of the patient at the present time, eighteen months after the injury, reveals perfect function of the elbow-joint.

LAMINECTOMY FOR INJURY AND TUMOR OF THE SPINAL CORD.

WITH A REPORT OF SIX CASES.

BY GEORGE P. MULLER, M.D.,

OF PHILADELPHIA,

Associate in Surgery in the University of Pennsylvania; Surgeon to St. Agnes Hospital; Assistant Surgeon to the University and Philadelphia Hospitals.

PROGRESS in the surgical treatment of injury and disease of the spinal cord seems to make haste slowly and to be the subject of considerable argument and disagreement among those whom we may consider as authorities. At one extreme is the opinion recently given by Estes:[1] "Early operation offers the only chance for life in a case of complete transverse lesion high up in the cord; it may not only preserve life, but also in a few cases restore some degree of usefulness to paralyzed parts when the lesion is from the middorsal region downwards." On the other hand Spiller and Allen believe that a study of spinal cords removed in cases of fracture will induce a very skeptical attitude and doubt as to whether operation is of much advantage and as to whether the chances would not be greater for the patient without it. They believe that the only effect secondary degenerations could possibly have, would be to *prevent* recovery. They do not believe that hemorrhages or œdema are imperative causes for operation. Starr, however, believes that, "if the cord is only partially injured, an operation may do good when it is evident that the symptoms are kept up by a permanent compression." But he believes that, in the majority of cases, it is necessary to refuse operation because without evidence of pressure an operation can have no result, as the nervous symptoms are due to actual permanent destruction of spinal cord tissues *incapable of repair*. Murphy also states that, "in fractures with division of the true cord, operation with suture of the cord is

[1] Amer. Jour. Surg., 1910, vol. xxiv, p. 341.

absolutely worthless, as functional regeneration of the column of gray matter never takes place."

All theoretical reasoning, all experimental evidences, however, seem to be set at naught by the reported instances of recovery of more or less power after complete severance of the cord, in Harte and Stewart's celebrated case, in those of Fowler, Briggs, and Sherris, and in two others recently reported by Estes. Also in the cases of perforation by bullet reported by Pilcher, Pegram, and Haynes.

In the first case reported by Estes he made "a complete section of a disintegrated cord, at the first lumbar vertebra, removed about three-quarters of an inch of the cord, squared the ends, and brought them together with sutures. The man was considerably improved as regards trophic and sensory disturbances, but never regained the use of his lower limbs."

In the second case he resected more than half the thickness of the cord in the lower dorsal region at the level of the ninth and tenth dorsal, leaving the anterior column only intact, and drew the ends of the lateral and posterior columns together by suture. Sensory and trophic paralysis improved almost immediately. The patient finally recovered the use of the left lower extremity, the use of the flexors of the right extremity, and almost entirely the use of the sphincters. By the aid of a brace he can walk with comparative ease.

Such evidence is, of course, impossible to refute, but taking all the evidence bearing upon cord suture, it seems highly improbable that such a procedure can be of any value. Operations for conditions depending simply upon compression of the cord, however, seem to offer sufficient encouragement to warrant operative interference in practically all cases.

Another phase of spinal cord injury is equally as interesting, namely, concussion, a term accepted by some and rejected by others. Stacks of literature have been written about it, and many an expert witness has been paid a fee for testifying to its existence, but "to the impartial observer the conviction must be inevitable that the weight of evidence is against the existence of the condition" (Bailey). Many of the state-

ments in favor of the state of concussion have been derived from the finding by the surgeon at operation of an apparently normal cord, but we now know that tremendous damage may be done to the cord, the white and gray matter being shaken up together and indistinguishable, or one driven like a wedge into the other, and yet no visible external change is discernible. The comparison with a numbed and tingling nerve or with concussion of the brain is not a true one, as the surroundings of the cord are entirely different and the symptoms of its injury never transitory.

With this brief and fragmentary introduction I wish to report the following cases. I will greatly abridge the histories:

Case I.—A man, aged twenty-five, was hit by a locomotive engine on July 4, 1910. He was picked up unconscious, and was sent to the Chester County Hospital. In a few hours he regained consciousness, and it was noted that there was complete sensory and motor paralysis below the tenth dorsal segment. The sphincters were paralyzed, but priapism was absent. As no improvement was noted in 48 hours, the attending surgeon, Dr. Woodward, asked me to assist in the performance of laminectomy. I found the conditions as described and a depression in the back over the tenth dorsal vertebra. We were afraid to attempt to elicit crepitus. There were no tests for heat and cold sensation made. The reflexes were absent.

Laminectomy was performed on July 6, 1910, under ether anæsthesia. I found the posterior spinous process of the tenth dorsal vertebra fractured at its base, and the laminæ of the same vertebra also fractured and the fragments driven in to the neural canal. They were removed and some hemorrhage encountered external to the dura, which membrane seemed œdematous and thickened.

The posterior portion of the ninth vertebra was next removed and the dura opened. The spinal fluid was under tension, and the cord appeared congested at the site of injury, but no other abnormality was noted. There was no hemorrachis. The dura was sutured with fine chromic catgut, the muscles and fascia with chromic catgut, and the skin with silk. A small

cigarette drain was placed between the muscles and removed in 48 hours. Two days after the operation sensation began to improve and four days after operation motion began to appear. On the fifth day control of the bladder was regained. A bedsore developed at the end of the first week and gave considerable trouble owing to the fear of infecting the wound. He was sent to the County House at Embryville in the fall and I saw him on December 7, 1910. He had perfect restoration of sensation as far as I could determine, could walk with ease although a little stiffly, could rise from a chair without using the hands, and had perfect sphincteric control. His back was strong, and he would not wear the brace we had procured.

Case II.—A man, aged thirty, was injured in December, 1909, by a large rock falling on his back. He experienced loss of motion and sensation in the lower limbs and loss of sphincteric control. He remained in a hospital three weeks and at his home seven months without improvement. He was admitted to Dr. Frazier's service in the University Hospital, August 6, 1910.

On August 10, 1910, the patient was examined by Dr. McConnell, who reported as follows: "The patient shows a complete paralysis of both lower extremities, no movement being made by either the thigh or leg muscles. There is very marked toe-drop, with contracture of the flexor tendon and tendo achillis. The palsy of the thigh muscles is flaccid with contraction of the extensors. All reflex in the lower extremities is lost. There is very marked atrophy, relatively more in the thighs than in the legs. He has complete loss of sensation for touch and pain in both legs up to the head of the tibia on the inner side of the leg and in the thighs corresponding very closely to a line drawn from the great trochanter to the inner side of the knee and from here to the pubic spine. This leaves an irregular triangular area in which sensation to touch and pain is preserved. The posterior surface of the thigh between these two lines shows analgesia and anæsthesia, which extend over both buttocks as high as a line drawn from one great trochanter to the other. This area of analgesia and anæsthesia involves the scrotum and the perineum, also the penis. The cremasteric reflex is present on both sides."

Laminectomy, August 15, 1910, under gas-ether anæsthesia. A longitudinal incision was made over the last thoracic and the

first three lumbar vertebræ. The first lumbar vertebra was distorted and evidently the seat of an old fracture. It projected into the neural canal. The posterior portions of the first and second lumbar vertebræ were removed, the dura was opened, and a cystic condition found about the cord extending about one and one-half inches in length and immediately under the first vertebra. The dura was adherent to the vertebra and the cord adherent to the dura. After loosening the intraneural adhesions, the spinal fluid began to flow freely from the upper portion of the canal. The cord seemed to be intact, but was grayish in color, rather hard at its lowest portion, and the roots of the cauda equina were adherent. Several of the roots were freed from adhesions to each (combed out) but this was not extensively undertaken, as it was feared that they might be torn in the process. The dura was then sutured with a continuous catgut suture and the muscle closed with chromic catgut. A small rubber tube was inserted between the edges of the closed muscles and brought out on the back through a separate stab wound. The skin was closed with silk.

Forty-eight hours later the drainage was removed, and at the end of a week the stitches were taken out of the skin; the wound had healed by first intention. Seven days after the operation the patient's condition seemed improved, there was no return of motor power, but the area of sensation had widened. At the end of the second week the patient claimed that sensation had returned in a very slight degree over most of the foot and leg. He was discharged from the hospital two weeks later in the same condition.

If there is such a thing as concussion of the cord, then my first case represents such a condition, and perhaps the man would have recovered just as well without the operation. If such does not exist, a simple contusion or the results of œdema were responsible for the paraplegia, and the removal of the compressing bone must have helped in the recovery. In the second case, immediate operation was not performed, the arch of the vertebra continued to press on the cord, and who knows but what the hopeless result was caused or exaggerated by the organization of a cellular infiltrate caused by the compressing bone? The neurologists who refer to the injury to

the cord as having been done in the twinkling of an eye, and as beyond regeneration or help from the surgeon, speak from the experience of the fatal cases. The literature contains many instances of more or less complete recovery after operation, especially those cases in which the compression is caused by fragments which have been driven forward into the neural canal.

A few years ago C. E. Black reported a collection of 552 cases taken from the literature. Of the cases operated on, 49.2 per cent. recovered and 40 per cent. died; of those not operated on, 25 per cent. recovered and 65 per cent. died. The fracture cases gave the following figures: the mortality of operation in the cervical region was 71 per cent., without operation, 85 per cent.; in the dorsal region 48 per cent., without operation, 64 per cent.; in the lumbar region, 26 per cent., without, 50 per cent. Many of these cases are old and before the technic of aseptic surgery reached its present perfection.

Even as long ago as 1898 Prewit tabulated 49 cases of gunshot wounds of the spine treated since the aseptic era. Of this number 24 were operated on with 13 deaths, and 25 were not operated on with 17 deaths. Haynes collected the cases of gunshot injury from the date of Prewit's paper up to 1906 and found a mortality of 42.5 per cent. in the operated cases and 69.25 per cent. in those not operated on.

I believe that Bailey finds the true solution when he states that "somewhere between the two extreme positions the wisest course lies." In fractures and dislocations of the cervical and high dorsal regions operation should rarely be undertaken, unless there is evidence to show that comminution of the bones has occurred. The X-ray should be employed, as palpation for crepitus is too dangerous. In the lower dorsal, and especially in the dorsolumbar region, early operation offers a better chance for the restoration of function than the expectant plan. The mortality of laminectomy at the present time should be less than 10 per cent. in fractures below the middorsal region.

It may be of interest to recall that Steinmann has recently

collected 20 cases of forcible reduction of cervical dislocations without laminectomy, with 12 recoveries.

Tumors of the Cord.—Some 20 years ago the first successful extirpation of a spinal cord tumor was performed by Horsley.

In 1895 Starr analyzed 123 cases of spinal cord tumor, in 22 of which laminectomy was performed, with 50 per cent. mortality and 6 recoveries. In 1902 Collins collected 70 cases recorded since Starr's paper, with 30 operations and 12 successful results. In 1907 Oppenheim states that recovery takes place in about 50 per cent. of the cases presenting a typical clinical picture of extramedullary growth. Last year Bailey reported 6 cases in which extirpation was attempted, with 3 recoveries, 1 doubtful case and 1 death; Hunt and Woolsey record 11 laminectomies with 1 operative death and 4 successful cases out of 6 where the growth was extramedullary. In 1909 Oppenheim reported that he had obtained cures in 13 out of 25 patients with tumors in the spinal canal.

As soon as the diagnosis of tumor can be made with reasonable certainty an operation is indicated. I am not sure but that if I had symptoms even *suggestive* of spinal cord tumor I would have an exploratory laminectomy performed. In a case reported recently by Inglis, Klingman, and Ballin, an extramedullary glioma was removed quite early from a patient whose only symptom was sharp, circumscribed pain in the area supplied by the seventh thoracic nerve. A complete recovery resulted. Another interesting case with a fine result is reported by Moffitt and Sherman. It is generally impossible to differentiate positively between the intramedullary and extramedullary growths clinically, as pain may be absent and dissociated anæsthesia present in extramedullary growths; the patient should be given the benefit of the doubt. Bailey believes that the absence of anæsthesia contraindicates operation. The operation is supposed to be hazardous, and the statistics of Krause are now being quoted in support of this statement. He operated on 26 patients with 8 deaths. But if we compare Hunt and Woolsey's cases with only 10 per cent. mortality, the results seem better. Elsberg believes that operations for tumors of the spinal cord in the cervical region should be done in two stages, a small incision being made in the dura at the first operation through which the growth will extrude, thereby making it more easy of removal at a second operation.

Case III.—A woman, aged fifty-six, was admitted to the University Hospital August 18, 1910, complaining of weakness in the right hand and right leg. She was referred to me by Dr. D. J. McCarthy, and a more detailed report of the case will be made later.

More than two years ago the patient began to drag the lower limb, and shortly afterwards to weaken in the right upper limb. After a period of rest and treatment, the weakness of the right upper and lower limbs seemed to entirely disappear. In August, 1909, the condition returned and had been gradually increasing until the present time. In January, 1910, severe shooting pain was experienced, shooting from the right shoulder into the finger, which would feel as if drawn at times and the hand was numb. The right hand and arm were slightly swollen and cyanotic and extremely weak.

All of the movements of the right arm were weak and the shoulder motion much impaired. Passive motion was painful. The right lower limb was also weak, especially of the ankle and toes, where the power was slight. Patella reflex was prompt and exaggerated on the right side, but absent on the left. Clonus absent, Babinski typical on the right and uncertain on the left. The patient recognized the movements of the toes upwards and downwards on either side but made mistakes in locating the toe on either the right or left foot.

The sensation of heat and cold was normal in the right lower limb, in the right upper limb, and also in the left upper limb, with the exception that heat and cold were perceived more distinctly in the right hand. Ice water was felt as warmth in the entire left lower limb and left side of trunk, back and front, as far as about the third interspace. Pin prick was normal in the right upper and lower limbs, was greatly impaired in left side of trunk, back and front, as high as the third interspace. Pin

prick was not so acute in left hand as in the right. Tactile sensation was about normal everywhere.

Laminectomy, August 22, 1910, under gas-ether anæsthesia. The incision was made over the fourth, fifth, and sixth cervical vertebræ to the bony surfaces of the posterior spines. After cleaning off the muscles the laminæ of the fifth vertebra were removed and the dura exposed. The bones were extremely thin. The dura appeared normal, but pulsation was extremely faint. It was opened and the cord found normal in appearance and free from adhesions. Upon insinuating the Horsley separator upwards, a mass was felt just above the opening. Accordingly, the fourth and fifth spines were removed and the laminæ of the fourth vertebra rongeured away. After opening the dura still further, a tumor was found on the anterolateral aspect of the cord, oval in shape, and about 1.5 cm. in diameter. The anterior and posterior roots of the fourth segment were tightly stretched over the tumor, and the roots of the fifth were pushed upon. The cord itself was compressed and deviated to the left. The tumor seemed to grow from the pia arachnoid and not from the dura. The fourth root was gently pulled upwards on a blunt hook, and a slight incision made at the junction of the tumor with the cord, and the growth easily shelled out with the handle of a teaspoon. Comparatively little bleeding was encountered and it was soon checked. The dura, muscles, and skin were closed in the usual manner. Microscopic examination of the tumor revealed the appearance typical of endothelioma. The patient made a good operative recovery, and at the present time, six months' after the operation, is alive and well and rapidly improving as regards function.

The following two cases are reported to complete the series:

Case IV.—A Chinaman, aged forty, was referred by Dr. McCarthy from his ward in the Philadelphia Hospital to Dr. Frazier's service, with symptoms of compression of the cord referable to the twelfth dorsal and first lumbar regions. August 14, 1908, I performed a laminectomy of the first, second, and third lumbar vertebræ and found no tumor. September 4, 1908, I again operated and removed the eleventh and twelfth dorsal laminæ, and between these there was considerable connective

tissue, dense in consistency, and seeming to press upon or constrict the cord. It seemed to take origin from the intervertebral disc but was not cartilaginous. It was cut away with scissors and the wound closed. The patient recovered control of the bladder, and somewhat of sensation after operation, but never recovered the power to move the legs. He died in the Philadelphia Hospital one year later. Microscopic examination of the tissue removed showed no evidence of neoplasms, tuberculosis, nor syphilis.

Case V.—A colored man, aged forty-five, also referred from Dr. McCarthy's ward in the Philadelphia Hospital to Dr. Frazier's service, had been operated upon previously in another hospital and his prostate removed. It was said to have been carcinomatous. He was suffering from a paraplegia and intense pain due to compression of the lower portion of the cord and roots. I performed laminectomy, September, 1908, at the Philadelphia Hospital, and found much softening and disease of the third and fourth lumbar vertebræ, but was not able exactly to ascertain whether there was pressure on the cord or not. The muscles and the bones bled considerably during the operation, and twenty-four hours later the patient died from shock.

Cysts.—Circumscribed spinal serous meningitis as a distinct disease has been recognized since 1903, and a number of cases have been reported since then. Last November, in association with Dr. T. H. Weisenberg, I reported [2] a case successfully operated on and discussed the condition. This patient (Case VI) had the laminectomy performed on March 16, 1910, at which time a cyst was found at the level of the tenth dorsal vertebra. At the present time the patient has entirely recovered from the symptoms of compression, is able to work as a stenographer, and to attend dances. At the end of the day her back often feels tired and often aches, but relief is afforded by adhesive plaster stripping.

[2] Amer. Jour. Med. Sciences, November, 1910.

THE RATIONAL TREATMENT OF ACUTE APPENDICITIS.

BY JOHN B. DEAVER, M.D.,

OF PHILADELPHIA.

APPENDICITIS is a disease with which the medical profession has been familiar for many years. It has been carefully studied by many observers. Large series of cases have been gathered, and there is no lack of material for a comparative study of various methods of treatment. In spite of these facts, it must be admitted that there exists among surgeons and medical practitioners a great divergence of opinion as to the proper method of procedure in certain cases and at different stages of the same case.

The appendix in its anatomical relation differs from every other abdominal organ with which we have to deal. It is usually easily accessible. It can be completely removed, unless extensive surrounding disease be present, apparently without in any way interfering with the bodily functions. While we need not consider it a vestigial structure or a functionless organ, nevertheless its removal has in my experience never been followed by bad functional results of any kind. Its removal also is not usually a matter of great technical difficulty, unless complicating conditions place obstacles in the way of the surgeon.

Situated as the appendix is, more or less separate from other structures, it can yet give rise to most extensive inflammatory conditions within the abdomen. It is well known to be the most frequent causative factor in acute abdominal conditions requiring surgical intervention. Appendicitis is by far more frequent, in this country at least, than any other condition within the abdomen, acute or chronic, which is met with in surgical practice.

It seems strange then that since appendicitis is except in

but comparatively few cases easily diagnosed, the organ so often accessible, and its removal, when no complications are present, so easy, that there should still be such a considerable mortality in dealing with acute appendicitis.

This mortality remains more than it should be for four reasons: (1) failure to diagnose the disease sufficiently early; (2) failure to recognize its gravity; (3) postponement of prompt surgical intervention; (4) incorrect treatment in the later stages of the disease.

The diagnosis of acute appendicitis has been sufficiently dwelt upon in many articles within the past twenty years. It is usually easy if a careful history has been taken and a careful examination of the patient made. I am convinced that most errors in the diagnosis of this, as well as of all other of the commoner surgical conditions of the abdomen, depend not so much upon any great obscurity of the symptoms as upon the failure of the medical attendant to carefully construct the clinical picture. Many of us have seen instances in which acute appendicitis has been treated under the impression that the pain was caused simply by gastritis or colic. The examination in such cases is most superficial, and indeed I have seen numerous instances in which a careful abdominal examination had not been made until two or three days had elapsed, or not at all. It is but rarely that the sequence of pain, vomiting, and tenderness, with localization of pain in the right iliac fossa, is not observed, and practically never are local signs absent. The only excusable way in which the physician or surgeon might fail to make a diagnosis, a few cases excepted, is in children too young to state their subjective symptoms or accurately to locate the pain and tenderness.

But while a diagnosis of acute appendicitis can and should be promptly made in practically every case, it is a false refinement of diagnostic methods to attempt to give a definite prognosis early in the disease. We may of course gauge the comparative severity of the lesion by the severity of the onset, the patient's condition, and the rate of progress of the

disease. Yet it must be remembered that often cases in which the symptoms are most severe do not show lesions more grave than those in which the disease apparently had started as a mild process. This leads us to the consideration of the second factor influencing the mortality of the disease, *i.e.*, a failure to recognize its gravity.

It has always been, and still is, my contention that every case of acute appendicitis seen early should have prompt surgical attention—operation, provided, of course, that no absolute general contraindication to operation is present, such as pneumonia or uncompensated heart lesion. There is no one who can say which case of acute appendicitis may progress to recovery and which go on to abscess formation or general peritonitis and death. This has been proved so often that we have no right to postpone operation in any case. It is true that a certain number of cases of acute appendicitis will recover spontaneously under proper non-operative treatment, only to have subsequent attacks. It is equally true that some unoperated cases will die. Could we but differentiate the two classes clinically, our line of procedure would be easy to establish, but, as has already been stated, such a differentiation is impossible. The only safe and proper course, therefore, is to resort to prompt operation when a case of acute appendicitis is seen early. The reason for referring all cases of appendicitis at once to the surgeon has been stated by no one better than by our well-known internist, Dr. M. H. Fussell, who speaks as follows: "I thoroughly believe that at least three-fourths of the cases of appendicitis would recover if not operated upon, but I know there are no symptoms that will tell when a case is approaching the danger line until it is extremely dangerous either to interfere or to wait."

The results justify such a statement. My mortality in acute appendicitis seen early, when the inflammation has been confined to the appendix, has been very small. I believe it to be but little if any greater than that which is incident to an opening of the abdominal cavity whether a lesion be present or not. In 100 consecutive cases of this nature in 1910, from

January 1 to December 31 inclusive, the mortality was nil. Surely such a result (and like ones are being obtained by many operators) justifies itself and puts beyond a doubt the fact that immediate operation is the only proper method of treatment to adopt in early appendicitis.

The third reason for our mortality arises from our failure to recognize and act upon this proved fact in every instance. Delay in operation is the most important causative factor in the mortality of acute appendicitis. The reasons for this are so well known and evident that I need not mention them. If the disease is attacked sufficiently early, the destructive and inflammatory processes are more likely to be limited to the appendix itself, and easily removed. When operation is delayed the infectious organisms have time to penetrate or extend beyond the walls of the appendix, enter the peritoneal cavity, and give rise to the grave conditions accompanying a peritonitis either diffusing or localizing. Could these cases be seen, diagnosed, and *early* sent to the operating table, acute appendicitis would be almost robbed of its dangers and become in the hands of competent surgeons one of the least formidable of abdominal diseases.

The fourth great cause for our mortality in acute appendicitis is the incorrect treatment in cases in which, for some reason or other, the disease has been allowed to progress beyond the confines of the appendix and we have to deal with an acute appendicitis complicated by a more or less severe inflammatory lesion of the peritoneum.

The treatment of the appendicitis becomes then not a question of the lesion in that organ, since this is entirely overshadowed by the secondary conditions to which it has given rise.

A correct understanding of the problem of peritonitis may be facilitated by the recognition of the fact that all cases of peritonitis belong, as Federmann so well states, to one of two great groups—the progressing and the localizing. The former is that in which the tendency of the process is to rapidly spread until it has involved most or all of the peritoneal sur-

face. The localizing type is that in which the process tends to the formation of a localized peritonitis or a localized abscess. The latter is peculiarly apt to occur in connection with appendicitis. We know, for instance, that all cases of peritonitis of the upper abdomen due to acute perforation of viscera are of the progressing type, whereas many cases of peritonitis following appendicitis are not.

But at the outset of any peritonitis, within the first 24 to 40 hours, it has been shown that the process is unconfined, that is to say, lying free between the coils of the intestine. The formation of a limiting wall of fibrin occurs only at a later stage.

Experience also has proved that any peritonitis at this stage is, with few exceptions, amenable to prompt surgical treatment. The results after operation, with modern post-operative treatment are excellent. Indeed the mortality in my hands has been lower than that of any other form of peritonitis with which I have had to deal, unless it be a strictly localized pelvic peritonitis from disease of the adnexa.

In the five years ending with 1909 I operated upon 63 cases of diffuse peritonitis within 40 hours after onset, with but one death in the series. Since then, in 42 consecutive cases of appendiceal peritonitis operated upon at the German Hospital within 40 hours of the onset of the peritonitis, I have had one death, making in all 105 cases with two deaths, mortality 1.9 per cent. While I feel that this is a low death-rate when the desperate character of the disease is taken into consideration, yet it is noteworthy that an extension of the time limit for immediate operation has been accompanied by a rise in mortality. This expresses a fact which I have definitely determined from my own experience, namely, that the mortality rises with amazing rapidity if diffuse peritonitis of whatever origin, when present for more than 40 hours, is treated by immediate operation. It is, no doubt, difficult to say exactly when an appendicitis passes over into a peritonitis. Our guide must be an exacerbation of pain and tenderness in the right iliac fossa, followed by extension of tenderness

to adjacent areas. In fulminating appendicitis it may be taken for granted that the peritonitis has taken its origin very shortly after the onset of the disease itself. I dread early perforations near the base of the appendix which give rise to a rapidly diffusing and severe form of peritonitis. In view of the importance which we place upon the duration of the peritonitis itself, it is necessary to hold clearly in mind that this time may be very different from the duration of the disease. In some cases when a temporizing policy has been adopted, a low grade appendicitis may smoulder for several days or longer before it lights up a diffusing process within the general cavity. The 40-hour limit also is somewhat arbitrary as demarcating the early period of relative safety in immediate operation. One case will be found almost overwhelmingly septic, while in another the march of the peritonitis and the increase in severity of systemic symptoms may be slow. This, however, in general may be taken as the period within which experience has shown that in practically all cases operation may be done and should be done in full expectation of success. I would not feel content if I did not qualify this statement by saying that occasionally in cases of even this short duration there will be found one who exhibits extreme prostration, with capillary stasis perhaps amounting to cyanosis, with a low leucocytosis or none at all, in short with all general and local symptoms pointing to a virulent septic process and low bodily resistance. It is not proper to operate upon such a patient. Mere anæsthesia may tip the scale against him. That these cases are not numerous can be seen from the figures which I have given above and the determination of the pros and cons of operation in such a case should be left entirely to the surgeon, preferably one of large experience in abdominal work. I cannot too strongly insist that these are refinements to be considered only by experts in this class of work, and affect in no way my general position in respect to the necessity for operation in appendicitis. It deals only with the determination of the most favorable moment for operation, not with the advisability of operative treatment. I am thus explicit because

it has been my misfortune recently to be placed in a false light before the public by reportorial garbling of technical statements of this sort which were not intended for the laity and are indeed impossible for them to comprehend in their true light.

It is a matter of agreement amongst surgeons, I believe, that early cases of appendiceal peritonitis, with the possible exception just mentioned, should be promptly operated upon.

When we come to consider an appendiceal peritonitis of more than 40 hours' duration, a different problem confronts us. While it has been the experience of all surgeons that early cases of peritonitis as a rule recover, such, unfortunately, have not been the results in peritonitis of a longer duration. Indeed, peritonitis, diffuse or general, has so far been the one great failure in abdominal surgery. Several conditions must be met under this head.

There may be found a peritonitis of the localizing or second form which frankly is making progress towards or has already reached the stage of local peritonitis or localized abscess. The condition of the patient in such an instance as to temperature, pulse and leucocytosis and general appearance always indicates that the organism is successfully combating the toxins resulting from the peritoneal infection. The temperature is but fairly high, 100° to 102°, the pulse strong though at times somewhat accelerated. The leucocyte count is always high and in most favorable cases over 20,000.

In such an instance immediate operation is indicated unless localization and subsidence of the general symptoms have been rapid, marked, and unmistakable. In the latter condition slight further delay would give the surgeon a still more favorable condition for operation. When improvement has reached a stand-still, operation should be done at once.

Again, we may encounter a peritonitis which, by the general condition of the patient and its favorable course, if it may be so called, is evidently of a localizing type but does not as yet show the distinct signs of local abscess. In these cases we have two factors to guide us—the patient's general condition and the signs of an abdominal mass, even though not of a distinct local abscess. If the patient's condition be good, temperature, pulse, and high leucocytosis as indicative of high resisting power, operation is indicated if we have in addition some signs of a more localized process than is shown by the symptoms only of a diffuse peritonitis, that is to say, if in addition to general abdominal rigidity and tenderness localized in the right lower abdominal quadrant, we have in this area any portion which on careful examination gives the signs of an abdominal mass, however diffuse and indefinite.

When, again, in a localizing peritonitis the local signs are favorable but the general condition of the patient not good, our best course is to delay operation until the latter improves, treating the patient meanwhile under the methods later to be described.

The progressing form of peritonitis presents an entirely different clinical picture. We have in this form of the process also, two clinical aspects, *i.e.*, that one in which the patient's condition and resistance seem satisfactory, and that in which the reverse is true.

Concerning the treatment of this form of peritonitis,—one peculiar to appendiceal and occasionally other forms of pelvic peritonitis,—there has been a wide difference of opinion. We have stated that it is advisable to operate upon practically all cases of less than 40 hours' duration, and have indicated those cases of localizing peritonitis in which immediate operation seems the best form of procedure.

In progressing peritonitis with no signs of the limitation of the process, when the case is seen later than the first 40 hours delay is usually the best policy. This does not apply to other than appendiceal or pelvic peritonitis—in perforation of the upper abdominal viscera into the general abdominal cavity such a lapse of time practically always has brought the case to a hopeless condition.

Particularly must delay be insisted upon in those cases in which the patient's condition is evidently desperate. There can be no doubt that many such cases of appendicitis have been

lost as a consequence of hasty operation. Those that will not improve upon proper treatment during delay and progress to an unfavorable termination do so even more quickly when hastily operated upon.

The question arises when to consider the condition sufficiently localized for operation. Delay until there is absolutely a sharply defined and outlined abscess is not necessary. The patient's general as well as the local condition must be our guide. Operation should be postponed until the temperature and pulse strike an equable level, the leucocytosis is consistently high,—showing good resistance to toxæmia,—and peristalsis is known to be re-established as evidenced by free passage of flatus. Then if we are able to discover the signs of a deep-seated mass or resistance in the right iliac fossa, operation will disclose as a rule a limited peritoneal inflammation.

Finally, when we have the symptoms of a diffusing peritonitis following appendicitis, the decision whether or not to operate must always depend upon the patient's general condition and upon a careful study of the case. It can be taken for granted, however, that when we have the classical symptoms of such a form of diffusing peritonitis,—rapid running pulses, abdominal distention, cyanosis, and the facies Hippocratica,—operation will be almost inevitably fatal and delay may save the patient.

A fact of importance in the consideration of localized collections of pus within the peritoneum is the possibility of leakage into the general peritoneal cavity from the wall of a previously well-localized abscess. The general or diffuse peritonitis which results from this occurrence is often of a particularly virulent type, and in many instances has a most rapid onset, occurring with great suddenness when the symptoms previously have been entirely favorable. The avoidance of this complication is possible only by prompt operation.

To this mode of treatment there could be but two objections. The first and most easily set aside is that from the theoretical point of view. It has been repeatedly stated that it is best to operate upon every case of peritonitis of the acute variety as soon as possible. No one indeed is more positive in

the opinion that every case of acute appendicitis *per se* should be operated upon immediately than I am. But when a peritonitis has set in it becomes in reality a different disease. Appendicitis confined to the appendix is one thing—peritonitis following an appendicitis offers us an entirely different problem.

The statement is often made that a peritonitis is but a form of abscess and that it has been the universal experience that the best treatment for abscess or local suppuration is prompt evacuation and drainage. Pus within the peritoneum, when not seen early and when not sharply localized, differs somewhat from abscess or pus formation in every other portion of the body. Here our experience has often been that the evacuation, even by means of a small incision or puncture, of the enclosed pus is often followed by the rapid diffusion of toxins throughout the body and the death of the patient.

Buxton and Torrey, on the basis of animal experimentation, have concluded that the sudden so-called shock so often rapidly fatal after operations in fulminant peritonitis may be due to the explosive destruction of the bacteria by the immune substances of the body serum and liberation of their toxic contents into the circulation in large quantities. In other words, the too sudden destruction of virulent material within the peritoneal cavity may have even graver results than their activity while living.

From the practical point of view we can estimate the value of any one method of treatment only by the results. Personally, while I am cognizant of the great strides in post-operative treatment which have been made within the past few years, I am convinced that the more favorable results have been largely due to the selection of cases at the proper time for operation, and their proper pre-operative as well as post-operative treatment.

In the treatment of peritonitis both before and after operation, I have followed largely the method brought into prominence by Ochsner, with the addition of the Murphy method of enteroclysis.

When I see a patient suffering from a peritonitis as a

result of appendicitis, the matter first to be considered is operation. If it be decided to postpone this, then the patient is treated in a way which we believe most often tends to conserve his strength and to bring about localization of the peritonitis.

One of the most important causes of the mortality in appendicitis, even among those who are believers in operation, is faulty pre-operative treatment. This is the true field of medical treatment in this disease, and I am certain that the procedures in common use among practitioners are responsible for a goodly percentage of deaths. It is a wellnigh universal custom to administer a purge in the early stage, and if recovery is not prompt to continue more or less drastic purging in the belief that it will favorably influence the disease. I must own that years ago I advocated this method, but I have long since been convinced that it not only does no good but does positive harm in many cases. The physician sees so many cases of colic or enteritis which respond readily to a simple purge that a false analogy has been drawn in respect to its efficacy in appendicitis. Except in those milder cases of catarrhal appendicitis which are only a part of an enteritis or colitis, it is difficult to see any great value in emptying the contents of the bowel, but it is easy to see that in the severe cases, to set up active peristalsis may mean to precipitate a perforation, to inhibit the formation of defensive adhesions, and to spread infective material throughout the peritoneal cavity. In the initial stage, before the diagnosis is readily made between simple colic and appendicitis and before the advent of local pain indicates that the inflammation has reached the peritoneal covering, it is inadmissible to give a rapidly acting purge, such as castor-oil or a saline. After the pain is localized and Nature is endeavoring by stiffening the surrounding muscles to secure rest for the inflamed member, it is irrational to nullify her efforts from within, and every surgeon who has watched this point has observed that in general those cases that have been purged in this stage are likely to be more severe. If it is desired to move the bowels, enemata should be employed,

but given gently, for a forced enema can be as objectionable as a purge. Quiet for the inflamed focus should be furthered by withholding all food and liquid by mouth, and all in this connection must mean all. An ice-bag over the right iliac fossa will cause the patient to lie more quietly in one position, will relieve the pain, and discourage too many examinations. The prevalent idea that it has any specific influence in abating the disease should be abandoned. It is wise to raise the head of the bed or better place the patient in a sitting posture in order to encourage the gravitation of fluid exudates or extravasations into the pelvis. Fluid for the body should be supplied by the rectal instillation of saline solution in intermittent or continuous form.

No morphia should be used, as the pain is rarely too great to be endured, and by its use the patient and physician are too often lulled into a false sense of security until peritonitis is too firmly established for any method of cure. An exception may be made to this rule when operation has been decided upon and the patient is suffering to an unusual degree from nervousness or pain. Then $^1/_{16}$ gr. to $^1/_{20}$ gr. morphia may be given and repeated once if necessary. If a little tact be used it is surprising how seldom anodynes are needed. Extreme degrees of suffering are not common in appendicitis.

Finally, all cases should be treated in the above manner, whether the medical attendant believes them to be serious or not. There is no way of differentiating the case that will get well from the one that will not. If equal care be used in all cases, the surgeon will rarely be requested to act in the capacity of Lord High Executioner upon patients moribund with peritonitis, and deaths in appendicitis will become rare.

Lavage to control vomiting and not medicine such as small doses of calomel, or calomel combined with cocaine, oxalate of cerium or small doses of carbolic acid or dilute hydrocyanic acid, etc., any or all of which are not only useless but likely to aggravate and make the irritable stomach still more irritable. Medicines in this disease are out of place. If anything in medicine has been clearly proven, it is that appendicitis is a

surgical disease, in fact the medical professor or internist, so called, should not be permitted to teach students the treatment of this disease unless he do so along the lines indicated in this paper.

The patient is given absolutely nothing by mouth until peristalsis is established; for it is a well-known fact that the smallest amount of food or even water introduced into the stomach gives rise to peristalsis, and peristalsis, however slight, must tend to prevent localization of the peritonitis. It is sufficient for the patient's comfort to keep the mouth moistened with a cloth. The patient's bodily strength is kept up by the use of continuous saline enteroclysis, continued as long as it is well borne, and at times interrupted for longer or shorter periods. I have found this to be of greater value than the use of saline enemata at stated intervals, even when they contain supposedly more highly nutritious substances in solution. The false, erroneous, absurd idea that patients with acute abdominal inflammation must be given nourishment by mouth has long since been disproven.

Continuous enteroclysis has been most largely used as a method of post-operative treatment, but I have found it of equal value in peritonitis prior to operation.

When vomiting occurs, it can be controlled by prompt and thorough lavage, repeated as often as may be necessary. This is a most essential part of the treatment, for putrefying food within the stomach or regurgitated into it gives rise to virulent toxins and ptomaines, having a profound depressant action upon the bodily economy as a whole. Lavage is also to be employed when there is *great* distention of the stomach, hiccough, or nausea, or the spitting up of small amounts of dark fluid. These as well as frank vomiting are the evidences of retention and regurgitation of putrefying material in the alimentary tract, and call for the prompt use of the stomach tube until the condition is relieved. This also is most useful as a preventive of a possible acute gastric dilatation which I believe to be infectious or toxic.

In addition the use of the ice-bags externally allays pain and seems in a degree to inhibit active peristalsis.

Opium and opiates I use most sparingly in the treatment of peritonitis. While opium and its derivatives stop peristalsis, they do so in a manner which soon produces complete paralytic ileus, with its accompanying obstruction, retention of toxins, etc. The relief of pain also is not to be considered as a prime factor in comparison to saving the patient's life. Moreover, this complete dulling of pain produced by morphine is most deceptive and often makes it impossible to determine correctly the stage of the disease under treatment or its progress. When the patient is in extreme pain or so restless that he cannot be controlled by other means, which is rarely the case, I employ morphine in doses of $^1/_{20}$ to $^1/_{16}$ hypodermically, repeated once if necessary.

The operative technic which I employ in cases of peritonitis associated with appendicitis is that of any other peritonitis. The use of protective pads is most important to prevent the spread of infection. The appendix is always removed except when a circumscribed abscess is present and its removal would be attended by too great danger of diffusing septic material. Lavage of the peritoneum I consider not only useless but harmful. It is my practice to remove the pus by the gentlest means and with special care not to disturb the coating of plastic and protective lymph which is often found on the bowel serosa. It is not this lymph which causes subsequent adhesions. These can most often be attributed to rough handling of the bowel during operation, or the trauma of pads or instruments.

Drainage should be by tube whenever possible. I have found split rubber tubes with a gauze wick serviceable, if the tube be sufficiently rigid to preserve its calibre. Cigarette drains are useful only when there is but little need for drainage. I would call your attention to the importance of pelvic drainage in cases of peritonitis. By this I mean drainage by means of a glass tube introduced into the pelvis through the

incision, or through a stab wound over the pelvis. When, after operation, the patient is placed in the sitting posture, all fluid in the abdominal cavity will gravitate to the pelvic area, and it is this even more than the operative field that we want to drain.

After operation the patient is placed in the sitting position, and the treatment is practically as before operation.

In conclusion I would say that if there is one fact in the field of medicine which has been demonstrated conclusively, it is that the rational treatment of acute appendicitis is in operation, early and immediate if possible; late, postponed, or absolutely contraindicated only by the presence of other conditions which may be complications of the disease itself or entirely independent of it, mere coincidences which render the performance of any operation too hazardous. Advice other than this no man has a right to give.

The following table illustrates the results obtained by this method of treatment during the year 1910 in the German Hospital and in the Children's Hospital of the Mary J. Drexel Home.

		Deaths	Mortality
Number of cases of acute appendicitis	315	9	2.85
German Hospital	235	7	2.97
Mary J. Drexel Home (Children)	80	2	2.5
Number of cases acute appendicitis, no peritonitis	100	0	0
German Hospital	80		
Mary J. Drexel Home	20		
Number of cases appendicitis with peritonitis	215	9	4.13
German Hospital	155	7	4.51
Mary J. Drexel Home	60	2	3.33
Number of cases with diffuse peritonitis	74	6	8.1
Number of cases with localized peritonitis	66	1	1.51
Number of cases with serous fluid	39	0	0.00
Number of cases indeterminate at operation	16	1	6.25

Dr. John H. Gibbon said that the figures of Dr. Deaver point to the value of the Ochsner method of treatment after peritonitis is established. In only a limited number of cases had he himself pursued this policy. It may be of interest in this

connection to take the cases of acute appendicitis (all chronic cases being excluded) occurring in the Pennsylvania Hospital during the past two years, and see what results were obtained there. As a general rule all cases were operated on within a few hours, excepting abscess cases. In considering the mortality of this class of cases it is necessary to include the mortality of cases dying without operation.

These cases had been tabulated by Dr. Billings. These operations have probably been performed by eight different surgeons, comprising the surgical staff of the hospital.

There were 40 acute cases with acute symptoms; nothing outside; no pus. All recovered, being operated upon in an average time of 1¾ hours after admission. These all come within the 36-hour period. Next, serious acute cases, suppurative, without definite abscess wall; 33 of these operated on; average time after onset 2⅓ days; all recovered. Thirty-five cases of appendiceal abscess with well-defined wall and cavity, but no diffuse peritonitis; average time after onset 5 days; all recovered. Of the acute gangrenous cases, there were 39 of these, average time after onset of disease being 2 days. All were operated on within 2 or 3 hours after admission, and all recovered. Of the acute gangrenous cases with perforation of the appendix and general peritonitis, the mortality was high. There were 56 such cases with 43 recoveries and 13 deaths; average time after onset of condition was a little over 3 days. Only two patients died of intestinal obstruction, an important point.

Dr. Gibbon hesitated from these figures to take the ground that the Ochsner treatment ought not to be employed; in fact he did employ it, though not so extensively as has Dr. Deaver. His feeling was that all acute cases of appendicitis should be operated on practically at once. Where there is a diffuse peritonitis, evidenced by clinical symptoms, these cases should be operated upon if within 36 to 48 hours of onset. Of course, the patient's condition must be taken into consideration. Murphy's statistics are striking, he reporting 40 cases of acute perforative peritonitis with but one death, but these were all operated upon within the first 24 or 36 hours of onset. The crux of the matter with hospital surgeons is, what should be done with cases two or three days old? Here a selection must be made which must be the result of individual surgical experience. There is no

question that the mortality to-day is nothing like it was four or five years ago, largely due to the fact that the profession is now beginning to learn that purgation is unwarranted, and that surgeons are realizing that the less traumatism they make, the sooner they get out of the abdominal cavity and establish drainage and enteroclysis, the more chance will their patients have of recovery.

Dr. Edward Martin said that Dr. Deaver implied by his remarks that the diagnosis of appendicitis can always be made. There are exceptions to this which he had seen on the part of most careful practitioners and also on the part of careful surgeons.

He had never seen a case of appendicitis so ill that operation was postponed or foregone because it was a desperate chance. That these cases of acute toxæmia occasionally will recover without operation, he acknowledged, but his experience had been that they recover more speedily after surgical intervention. Surgeons learned years ago from Dr. Deaver to operate the first minute, or the first hour, or the first day that the diagnosis was made, the single therapeutic indication in appendicitis always being operation. A good many lives have been saved by pursuing this policy, and the one which he advocates now constitutes a complicating and confusing addendum to a teaching which admitted of no misunderstanding.

With regard to the use of morphine, he heartily agreed with Dr. Deaver that it is to be avoided if possible, but he has the great bulk of surgeons, especially those who have had their abdomens opened, against him. All of them, even the most rabid antimorphinists, have become converted, when they themselves were suffering from post-operative pangs, and because of the good results from its use many surgeons have become adherents to its routine employment.

Dr. John H. Jopson recalled a former pamphlet by Dr. Deaver entitled "Walled Off," in which he called attention to the danger of allowing appendiceal cases to reach the abscess stage. His early observations of patients treated by this method were made in Dr. Deaver's wards at the German Hospital.

Later in his own service at the Presbyterian Hospital, he was accustomed to seeing one of his colleagues treating patients

on the Ochsner plan, and he saw many recoveries with and without operation, some patients, indeed, refusing operation and leaving the hospital apparently well. He therefore had been adopting this plan of late in cases similar to those mentioned by Dr. Deaver, and with most satisfactory results.

Dr. George G. Ross commented upon Dr. Deaver's claim that peritonitis and appendicitis should be treated as separate conditions, no matter whether the peritonitis follows a perforated appendix or not. Dr. Deaver has always, and does to-day advocate, the taking out of the appendix. He believes that every appendix that has once been inflamed should come out, but also believes that judgment should be exercised as to the proper time at which to remove such an appendix. In peritonitis there is a different problem. Some cases never need operation, and do not come to it. For instance, consider the number of cases of pelvic peritonitis with more or less diffusion of fluid above the ileopectineal line, due to pyosalpinx when both the peritonitis and the tubal infection subside. He knew of one case which had a violent diffuse peritonitis in which the tubes discharged themselves through the uterus. The woman subsequently became pregnant and bore a child at full term. Perforative peritonitis sooner or later will come to operation. There are some cases of appendicitis where the perforation occurs at the base of the appendix, or where the appendix is behind the cæcum with the tip in the pre-kidney fossa, when the infection is into the retroperitoneal space and directly into the lymphatic system; very few if any such cases recover. This space cannot be drained and the poison is taken up so readily and so rapidly that the patient has practically no chance of recovery. He felt more apprehension with an abscess behind the cæcum causing pressure necrosis than he did with the general peritoneal cases.

Dr. John H. Gibbon recalled a case seen by him some months ago. The patient was a girl 14 years of age, who was taken sick in Brooklyn and had been ill for three days before she was brought to the Jefferson Hospital. She had an abdomen tender, not distended, but rigid. She had been vomiting; had a very high leucocyte count, and fever. Appendicitis with general peritonitis seemed the more likely diagnosis, and appendicitis

had been the original diagnosis made in Brooklyn. When he opened her abdomen he found a lot of bloody exudate and a gangrenous ovarian tumor with a twisted pedicle.

If he were to see another such case now, he did not believe he could differentiate it from one of acute appendicitis. Now had he pursued the plan of waiting for a few days in this case, he felt confident the patient would have died. After the operation she made a good recovery.

Dr. Gwilym G. Davis remarked, with regard to the difficulty in diagnosis, that attention should be called to those cases in which the appendix lies in the pelvis, and as it becomes inflamed the pus passes up underneath the small intestines, works over the bladder, and up the left side; there is then an inflamed mass covered with small intestine; such a condition obscures the diagnosis and renders the treatment very difficult.

Dr. George P. Muller thought that in the consideration of the indications for this method of treatment too much attention is paid to the pathology of the disease. Some who had spoken had referred to the dangers of the posterior position, to the fact that perforations near the base are more dangerous than those near the tip, etc. It is impossible to diagnose the pathology of appendicitis with any degree of certainty until the abdomen has been opened, nor did he think that surgeons should accept a certain number of hours as the time limit indicating postponement of operation. What is needed is to find some method by which the resistance of the particular patient can be estimated, so as to determine whether his abdomen should be opened at once or whether delay would enable him to recover from the infection. Mikulicz was engaged upon this subject at the time of his death, and some effort has been made by the use of the so-called "vaccines" to increase resistance, but nothing promising has as yet been brought forward.

Dr. John B. Deaver, in closing, said that the best working rule is that which gives the best results in the majority of cases. He did not wish for one instant for any one to believe that every case of appendicitis operated upon by him was diagnosed as such before operation. He had committed Dr. Gibbon's error in children as well as in adults, and there are other conditions to which he could also call attention, but his paper was not on the diagnosis but on the treatment of acute appendicitis.

In the first edition of his book on appendicitis he urged that every case of appendicitis, whether or not complicated by peritonitis, should be operated upon. He had now learned better. The mortality at the German Hospital under his present treatment as compared with that under former methods is exceedingly gratifying, and he attributed the better results to the present method of treatment and to the better diagnostic powers gained through experience.

He quite agreed that the decision regarding whether or not to wait in cases of acute appendicitis should be made only by the surgeon.

With regard to Dr. Muller's remarks, he considered his suggestion an important one, for the resistance of the patient is the whole secret of this treatment. If he is not in a condition to withstand the toxæmia, then waiting will do no good, but harm. The bulk of patients, on the other hand, who get well without operation, assuming that the diagnosis is correct, may not have withstood the ordeal had surgical interference been instituted.

The question of the time of appearance of the peritonitis can only be calculated from the character of the pain. His rule is not to calculate the peritonitis from the onset of the disease, but from the onset of the most severe pain. In the majority of cases of acute appendicitis during the first hours the pain is general, then there is a history of sharp pain immediately followed by diffuse soreness of abdomen, etc., although this is not absolute.

Dr. Gibbon referred to the question of intestinal obstruction. Formerly the average number of cases of this condition at the German Hospital was about one in 50 or 60; one year they had 13 obstructions. Now in 1910 there were only two cases of intestinal obstruction, so that would refute the belief that the line of treatment recommended predisposes to obstruction.

STATED MEETING, HELD MARCH 6, 1911

The President, Dr. Robert G. LeConte, in the Chair.

Dr. Astley P. C. Ashhurst presented four patients, three from the service of Dr. Chas. H. Frazier in the Episcopal Hospital, and one from the service of Dr. R. H. Harte in the Orthopædic Hospital.

I. AMPUTATION OF LEG BY THE METHOD OF BUNGE.

By the usual methods of amputation, in which no attempt is made to secure an end-bearing stump, the patient is compelled to wear an artificial leg with an inner socket, and to bear his weight almost entirely on the tuberosities of the tibia. This results in a certain amount of *give* at each step, producing decided disability from a lack of elasticity in the gait, even if there is no marked limp. To overcome this disability, and to secure a stump on which the patient can bear his entire weight as he does normally on his foot, Bier (*Deutsch. Zeit. f. Chir.*, 1892, xxxiv, 436; *Arch. f. klin. Chir.*, 1895, 1, 356) devised his osteoplastic method, analogous to that of Pirogoff at the ankle, or of Stokes and Gritti at the knee. Bier's method appears to have been practiced by various surgeons in this country, and has found its way into many text-books of operative surgery; but the much simpler method of Bunge, of Königsberg, seems to be little known. This method was described at length in 1905 (*Beit. z. klin. Chir.*, 1905, xlvii, 808), when the histories of twelve patients were reported. It was proposed on the theory that the tenderness of stump is due to little islets of new formed bone, derived from shreds of periosteum or from marrow cells displaced at the time of operation. Bunge argued that if those could be prevented from developing, and if the bones were to be covered only by a flap of skin, conditions closely approaching the physiological would be present. Accordingly, his proposition involved not only discarding the periosteal flap, but even sawing the bones 2 mm. below the level at which the periosteum was divided, and then scraping out the medulla of the bones for several millimetres above the level of section.

This method was used by Dr. Ashhurst in the case of Edward S., aged forty-seven years, who was admitted Nov. 25, 1910, to the service of Dr. Frazier, in the Episcopal Hospital, for crush of the right foot. Amputation was done five hours later, as soon as the moderate shock present on admission had passed off.

An Esmarch band was applied above the knee; long anterior and a short posterior skin flaps were formed, in the lower third of the leg. The muscles were divided circularly down to the bones at the base of the skin flaps. The periosteum was divided circularly at the same level. Then the periosteum and muscles *below* the section were dissected with most meticulous neatness from the shafts of tibia and fibula, thus absolutely denuding these bones of all tissue for a distance of an inch or more below the level at which the muscles and periosteum had been divided circularly. Then the bones were sawed about one-eighth of an inch *below* the line of section of periosteum and muscle, the fibula being sawed off first, and a little higher than the tibia. Then the medulla of both tibia and fibula was scraped out with Volkmann's sharp spoon for about an eighth of an inch. After ligating the vessels, the Esmarch band was removed, and the skin flaps closed with interrupted silkworm gut sutures, a small rubber drain tube emerging at the outer angle of the incision. This tube was removed on the third day, November 28, without disturbing the deep dressing.

November 30: Light tapping on the end of the stump gave no pain. This tapping was gradually increased in force at each daily visit, never causing any pain; the patient merely acknowledged that he felt it, even when the tapping had increased to a severe thumping with the heel of the surgeon's hand.

December 5: First dressing. Sutures removed. Incision completely healed.

December 10: Patient can now bear without any discomfort all the pressure which can be brought to bear by the surgeon's hand directly on the face of the stump, through thin gauze dressings, so long as this pressure is not suddenly applied.

December 16: Three weeks since amputation. Can stand momentarily on stump, without pain, and with only slight support to hands to maintain balance, and with good leg swinging free of the floor.

December 20: Twenty-five days after amputation the patient

was photographed standing on a chair on his stump, balancing himself with his hands on the back of the chair, and his other leg hanging free in the air.

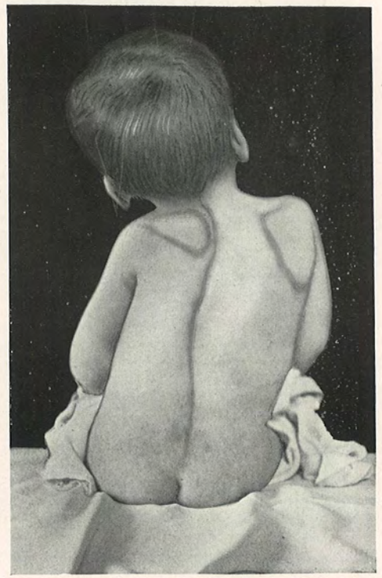
The subsequent conduct of the patient was discouraging. He was discharged from the Episcopal Hospital with directions to apply to the Orthopædic Hospital, where, in the service of Dr. G. G. Davis, it was proposed to have him provided with an artificial leg made to permit use of his end-bearing stump. Within two days, however, of his discharge from the Episcopal, he ordered from another source an ordinary type of artificial leg, with all the weight borne through an inner socket taking its bearing on the head of the tibia; and he merely came to the Orthopædic Hospital to inform his surgeon that the man who made his artificial leg told him that an end-bearing stump was a surgical impossibility; and even though this leg maker had ocular evidence to the contrary, because the patient showed him how he could stand on the end of his stump, yet the leg maker argued that as he had never seen any other stump which could bear the patient's weight, he could not make any other kind of artificial leg than he was in the habit of making.

II. CONGENITAL ELEVATION OF LEFT SCAPULA.

John S., now aged three and a half years, was admitted to Dr. Harte's service at the Orthopædic Hospital Oct. 1, 1908, at the age of 17 months. He was so weakly at this time that it was thought unwise to institute any very active treatment for the deformity, which was very marked. The child could not sit up, but doubled up constantly to the left side. A year later, Oct. 7, 1909, he was admitted to the ward, and kept in bed with head and foot extension for two months, and was discharged Dec. 20, 1909, wearing a scoliosis brace, with head support, and with noticeable improvement in his deformity. He was readmitted for operation when three years old Aug. 4, 1910.

Examination (Aug. 4, 1910).—Head falls to left shoulder, and cannot be brought straight. There is scoliosis, convex to right in dorsal and to left in lumbar region of spine. Skiagraph shows absence of left fourth rib; left third rib is rudimentary, terminating a short distance from the vertebral column. Left second rib is very prominent at costal cartilage, and bends sharply backward across inner wall of axilla. Several skiagraphs

FIG. 1.



Congenital elevation of left scapula, before operation. (Case II.)

FIG. 2.

Congenital elevation of left scapula, three months after operation. (Case II.)

showed no evidence of cervical rib. Left arm is not used properly; supination of forearm is not quite complete; external rotation of humerus is normal in extent. Humerus can be abducted to 90 degrees, and then further elevation is checked by scapula which cannot rotate. Muscles: Pectoralis major, trapezius, and deltoid present; tense band of trapezius runs from occiput to scapula. Left latissimus dorsi apparently is absent. Supra- and infraspinatus present. Left arm can be abducted across patient's back until elbow touches angle of right scapula. Right arm can be abducted across back only until it makes an angle of 10 degrees to left of a sagittal plane passing through right shoulder. Scapulæ: Left scapula is considerably higher than right, which is normal.

Left Scapula.	Right Scapula.
From vertebral border to acromion, 7 cm.	From vertebral border to acromion, 6 cm.
Length of vertebral border, 6 cm.	Length of vertebral border, 8 cm.
Scapula extends from 5th cervical to 2d dorsal vertebra.	Scapula extends from 1st dorsal to 6th dorsal vertebra.

Left scapula is rotated in frontal plane so that lower angle is only 1 cm. from vertebral spine and is immovably fixed there. (The above measurements were made through the soft parts of a chubby child, and therefore are only approximations.)

Operation (Aug. 8, 1910).—Ether, patient prone. Four-inch incision along vertebral border of left scapula; divided trapezius, which contained dense fibrous band running from occiput to upper border of scapula; divided levator anguli scapulæ; divided both rhomboids close to scapula, and excised a cartilaginous band attaching angle of scapula to spine of vertebra (this at once permitted free rotation of scapula in frontal plane); there then remained a few dense bands uniting subscapularis to thorax near angle of scapula, and these were divided. The scapula was then depressed as much as possible, and the rhomboids were resutured to the upper angle of scapula, above its spine, thus rotating its lower angle away from the vertebral column. The wound was closed without drainage. No exostoses or cervical ribs were found.

Recovery was prompt, and improvement in the deformity and function of the left arm very marked. The child still wears his scoliosis brace, with head support; and owing to the congenital absence of two ribs it is not likely that he will ever be very straight. But he now holds his head erect, can put his left hand to his head, to the nape of his neck, and to the back of his waist. He seems to be still improving.

III. EXCISION OF URETHRA, WITH END-TO-END SUTURE.

Frank S., aged nine years, was admitted to Dr. Frazier's service at the Episcopal Hospital Nov. 1, 1909, having passed no urine for ten hours. His bladder was distended above the umbilicus. He gave a history of a fall two months before from a height of 3 or 4 feet, astride an iron bar; this was followed by ecchymosis locally, and temporary passage of blood-clots from the urethra. No further trouble was experienced until three days before admission. On admission a filiform bougie was passed with some difficulty, and by gradual dribbling of urine the bladder was emptied within 24 hours.

Though the filiform remained in place, it never was found possible to pass a Gouley catheter over it. It was therefore decided to operate; and in view of the well-known difficulty of keeping traumatic strictures dilated if they are treated merely by incision, it was determined to excise the strictured portion of the urethra, and to suture the divided ends together; but if this was not possible it was proposed to insert a section of a varicose vein which was removed from another patient about that time and kept in salt solution ready for use.

Operation (Nov. 12, 1909).—A median perineal incision two inches long was made through Colles' fascia, exposing the bulb of the urethra. The bulbocavernosus muscles were then cleared by dissection on each side, until the superficial layer of the triangular ligament was bared. The urethra (still unopened) was then carefully dissected free from the corpora cavernosa, dense cicatricial tissue being encountered close to the urethral canal just in front of the triangular ligament. The urethra was then cut across transversely in front of the strictured area (the filiform remaining in place as a guide), and the distal (bulbous) edges of the urethra were caught in mosquito forceps. The strictured area of the urethra

was then dissected up through the superficial layer of the triangular ligament until healthy tissue was reached, when the urethra walls were again divided transversely, and the proximal (membranous) portion of the urethra was similarly caught in mosquito forceps to prevent its retraction. About one-half or three-fourths of an inch of the urethra was excised in all. To permit of approximation of the severed ends, the distal (bulbous) urethra was dissected loose for about an inch. A catheter was next passed into the bladder through the perineal wound, and the filiform bougie was withdrawn. A Mercier catheter was then introduced through the penile urethra into the bladder, and the first catheter withdrawn. The ends of the urethra were then united (first the roof and then the sides) with four interrupted sutures of chromic gut. A small wick of iodoform gauze was placed against the unsutured chink in the floor of the urethra, and the Mercier catheter was left in place, draining the bladder through the penile urethra. The perineal wound was closed around the gauze drain with interrupted sutures of silkworm gut.

The time of the operation was one hour; owing to the scar tissue and the diminutive size of the parts in a small boy of nine years, it was a rather tedious dissection.

The urine drained well from the penile catheter, but on the fifth day this was found to have prolapsed through the perineal wound, and it was accordingly withdrawn. Thereafter most of the urine passed through the perineal wound, but there was no loss of control. Nine days after operation a No. 14 Fr. steel sound was passed with perfect ease; and this was repeated twice weekly for two or three weeks. Urine ceased to come through the perineum after two weeks, and the perineal wound was entirely healed in four weeks.

During January and February, 1910, Nos. 12, 14, and 16 Fr. steel sounds were passed once weekly; then at intervals of two weeks until April 20, when an interval of six weeks was allowed, until June 1. As Nos. 16 and 18 Fr. passed easily then, an interval of four months was allowed to elapse; and as on October 8, 1910, nearly a year after operation, Nos. 16 and 18 Fr. passed with perfect ease, the patient was discharged. He has had no urinary symptoms since the operation, and to-day seems to be cured of his stricture.

IV. OSTEOTOMY OF RADIUS.

James McP., aged fifteen years, was admitted to the service of Dr. Frazier, in the Episcopal Hospital, Dec. 5, 1910, with very marked silver-fork deformity of the right wrist, following an injury received seven weeks previously, from a fall on the outstretched hand. The wrist had been dressed by his family physician for three weeks on a straight palmar splint with the forearm in full pronation. On admission, in addition to the deformity, supination was possible only to the mid-position, and the boy could not make a fist owing to inability to flex the proximal phalanges, though the distal and middle could be well flexed. There was a large bony mass projecting beneath the flexor tendons above the wrist. A skiagraph showed an unreduced epiphyseal separation of the lower end of the radius.

On December 7, the patient was etherized, and attempts were made to correct the deformity without operation, but without success. Osteotomy of the radius therefore was done about half an inch above the epiphyseal line. Most of the deformity then could be corrected, though the epiphysis of course was still in abnormal relation to the diaphysis. The arm was dressed in full supination on a Bond splint, well padded to maintain the desired position.

The progress of the case was uneventful, and four weeks later the patient could make a good fist; after six weeks all functions were perfect, and only very moderate deformity remained.

ACTINOMYCOSIS.

Dr. J. Chalmers Da Costa presented a patient in an early stage of actinomycosis, or, as he preferred to term it, streptotricosis. Until recently actinomycosis meant disease due to the ray fungus alone. Streptotricosis means a disease of man or animal due to one of the various forms of streptothrix. The manifestations of the disease probably differ in accordance with the forms of causative organism. If organisms of thread form are present the surgeon can be reasonably sure of the diagnosis. If the threads are branched he can be certain of it. The ray fungus is seldom found in humans and is not invariably found in bovine streptotricosis. The appearance of the disease varies with the stage in which it is seen. A description of the surface appearance of an early stage would by no means fit a well-developed or an advanced case. The appearance is greatly changed by mixed

infection with pyogenic bacteria. A severe secondary pyogenic infection may obliterate all appearances suggestive of streptotricosis, and in such a case it may be impossible to demonstrate the streptothrix. Certain persistent abscesses, particularly abscesses connected with the alimentary tract, are due to streptothrix infection and secondary infection with pyogenic bacteria.

Every now and then a surgeon sees a long persisting sinus heal under the administration of iodide of potassium. This event at least suggests that the original cause of the condition was streptothrix infection.

The patient was a man, sixty-two years of age, a native of New Jersey and a resident of that State. Until six weeks ago he was entirely well except for two carious teeth in the left upper jaw. There were no symptoms of antral disease. The teeth were pulled. An area of moderate tenderness developed under the orbit, accompanied by purple red discoloration of the skin. This discoloration spread over the left side of the face, little points formed which contained no "matter," and the lower eyelid became œdematous. The speaker lectured on this man before his class at the Jefferson Hospital and presented him as a case of streptotricosis. This diagnosis was subsequently confirmed by the microscopic findings.

In this patient the stage of sinus formation has not yet been reached. There was no sticky glutinous discharge containing sulphur-yellow granules, in fact there was no discharge at all. The line is irregular and the X-ray pictures which were shown exhibit two foci of disease. There was, in this case, a cutaneous lesion arising secondarily to osseous lesions.

The color of the purple-red area disappeared on pressure, rapidly at the margin, much more slowly at the centre. On the removal of pressure the color rushed back rapidly at the margin and much more slowly at the centre. In other words, there was hyperæmia at the margin and beginning stasis at the centre. The surface may be described as an irregular area of purplish mottling. Each wave-like irregularity or projection was about one-third the size of the little finger-nail. Over the areas of the disease the surface was soft and tender, but individual nodules were not tender. The skin over the nodules was thin and glistening, as though about to vesicate, but there were no sinuses, and no pus ran out on incision.

If this case were not interfered with it would inevitably go on

to sinus formation. Microscopic slides show staphylococci as well as actinomyces, hence sinus formation would be certain to arise. Out of each sinus glutinous purulent material would ooze, and, in a typical case, the material would contain yellow granules. In some cases in which such granules cannot be recognized in the pus they become visible by putting the pus in a test-tube with water and shaking the tube. Then the granules adhere to the side of the tube.

This was the fourth case Dr. Da Costa had seen of human streptotricosis. The first patient was a mattress stuffer, the second a physician, and the third a farmer. The patient shown was a railroad switchman. He had not been in contact with horses or cattle, did not handle hay or straw, and does not go into barns.

In only 10 or 15 per cent. of cases is it possible to trace such a close connection with grains as to make it highly probable that the causative organism was obtained from them.

Dr. JAMES K. YOUNG called attention to a case reported in the American Orthopædic Society Proceedings occurring in a patient of thirty-five years who had actinomycosis of the lumbar vertebra. This began originally in the tonsil, travelled down the backed by a large scapular abscess, and finally involved the vertebra. At the necropsy some of the sections of the vertebræ were removed and given to Dr. Speese for examination. It was at first looked upon as tuberculosis with a mixed infection, but later developments in the skin showed the characteristic yellow-sulphur bodies, and the diagnosis of actinomycosis was confirmed at necropsy.

Dr. CHARLES H. FRAZIER reported a case of actinomycosis in a young man who had been referred to the University Hospital with the diagnosis of acute appendicitis. At the operation two unusual features were observed; a pin was found in the appendix and the whole right iliac fossa was a mass of adhesions and exudate. The appendix was removed only after a tedious dissection and there was so much oozing that drainage was imperative. The drainage tract showed no signs of healing, but suppurated profusely and persistently. A few months later a metastatic abscess was found in the liver and drained, and upon curetting the pus from this collection Dr. B. A. Thomas discovered the actinomycosis. During the course of the next few months the patient developed two attacks of intestinal obstruction relieved by operation under spinal anæsthesia. Bacterin therapy, large doses of iodide of potash, and Röntgen rays were employed, but all to no effect. Neither the abscess in the right iliac fossa nor that in the liver showed any evidence of resolution. Finally the lungs became involved, and the patient died nine months after his admission to the hospital. There was no autopsy.

Dr. ASTLEY P. C. ASHHURST said there had been under his care in the dispensary of the Episcopal Hospital several years ago, a patient in which he made a tentative diagnosis of actinomycosis from the clinical findings. It was an early case, with not much induration. He sent the patient to the laboratory for an examination of the pus, and although the characteristic sulphur-like particles were found, no fungus could be demonstrated, and the pathologist came to the conclusion that it was a case of atypical multiple sebaceous cyst. Some months later in reading a German textbook on surgery he found the statement that sebaceous cysts in the face occasionally assume an actinomycotic appearance, and had been mistaken for this affection by others.

A STUDY OF ACTIVE IMMUNIZATION IN ANIMALS, PARTIALLY AND COMPLETELY THYROIDECTOMIZED

Dr. B. A. THOMAS (by invitation) and Dr. ROBERT H. IVY (by invitation) presented a paper with the above title.

PLASTIC RESTORATION OF LOWER LIP.

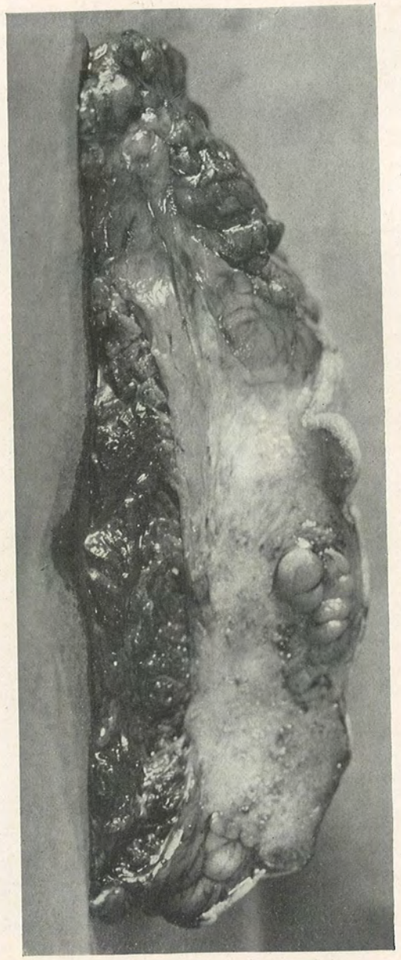
Dr. ADDINELL HEWSON presented illustrations from a case of epithelioma of the lower lip which was submitted to the use of arsenical paste in the hands of a charlatan. When seen by Dr. Hewson this lip was entirely destroyed, and mestastases had taken place in both digastric and both superior carotid triangles, necessitating the removal of the alveolar process of the incisors, canine and first premolar teeth with the involved periosteum on the facial surface of these alveoli and retaining the periosteum on the lingual surface of the alveoli, and finally the removal of four molar teeth and the closing of the wound by the Grant operation. Both facial arteries were ligated in the procedure, and the vestibular surface of the flap on the left side extended as far back as the entrance of Steno's duct. It is needless to say that this was done as a palliative measure and not with any idea of curing the pa-

tient, but to relieve the extensive slobbering which existed. The wound healed rapidly and the man's condition was improved. The use of X-ray, when it was found the recurrences had re-appeared in both sides of the neck, was not beneficial, as marked necrosis in the parts affected appeared.

MULTIPLE DIFFUSED METASTASES FOLLOWING BREAST CARCINOMA.

Dr. Addinell Hewson read the history of a widow, sixty years of age, who was admitted to St. Timothy's Hospital, Jan. 12, 1909, on account of a tumor in her left breast. The patient presented the appearance of a fairly healthy woman with a mass 5 and 8.5 cm. in size, showing signs of skin involvement and about to ulcerate, in the cephalomedian quadrant of the left breast. The necrotic area measured 3 by 2.5 cm. The arteries and veins were prominent in the skin. A small nodule was felt in the left breast beyond the tumor towards the axilla over the course of the long thoracic artery. There was no supra-clavicular involvement; the nipple was retracted in the line of the cephalomedian quadrant, and the area towards the ventral axillary fold was flattened.

On Jan. 30, 1909, a Jabez Jackson operation was performed, removing the breast, both pectoral muscles, and cleaning out the axilla. The connection between the retraction of the nipple and the growth was shown in photograph of the gross specimen (Fig. 3) taken Jan. 31, 1909, immediately after removal. The wound was entirely healed on Feb. 19, 1909, and the patient was discharged to the dispensary for X-ray treatment. X-ray was applied tri-weekly until Oct. 8, 1909, in all seventy-three exposures, on which date the patient reported a small movable nodule about the size of a pea meziad to the mezial line of union, which was hard, movable, elevated, red but not sensitive; was slightly sensitive in the mezial and lateral lines of union. There were no axillary or supraclavicular enlargements palpable. On Oct. 18, 1909, this tumor was removed. On March 8, 1910, the patient, having had in the interval twenty-two X-ray treatments, reported that after a cold her right arm was swollen down to the wrist, and on examination exhibited a small moderately hard tumor about the size of a walnut in the right midaxillary region which was movable. Patient was advised to have this removed but begged off.



Carcinoma. Section at operation of breast (L).

Fig. 3.

FIG. 4.

Rib and femur. Longitudinal section.

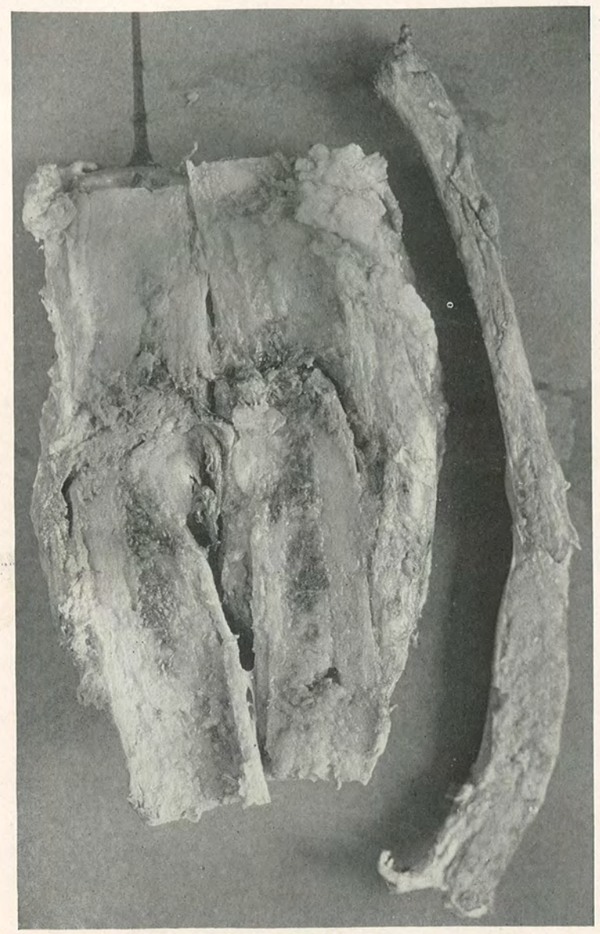
On March 11, 1910, an incision was made over this tumor and the mass enucleated together with the axillary fat, which was submitted to Dr. Swan, the pathologist, for macroscopic and microscopic examination. The diagnosis of soft carcinoma was returned and a Jabez Jackson operation was proceeded with cleaning out the intra-clavicular and axillary spaces. The wound was entirely healed and patient was discharged to the dispensary on April 14, 1910, up to which time the patient had had X-ray alternating each breast seventeen times.

On May 19, 1910, a small nodule showing a tendency to ulcerate at the right extremity of the second operation was noticed and also in the flap of the third operation, *i.e.*, right breast, there was an ulcer about the size of a lima bean with a hardened base but movable on the chest wall, but nevertheless nearer the median line than the ventral axillary fold. The patient was admitted at her request on May 23, 1910, and the fourth operation was performed which enucleated these recurrences.

On May 25, 1910, patient called attention to a hard tumor on dorsal surface of the alveolus of the left first bicuspid tooth. This tumor was fixed, slightly painful, but not inflamed. Patient stated that it had been there ever since the last breast had been removed.

In view of the frequent recurrences it was decided to try a carcinomatous vaccine as prepared by Dr. Coca at H. K. Mulford's laboratory. On May 29, 1910, 12 c.c. of a No. 30 stock solution was introduced into the cellular tissue of both recti abdomini muscles on a level with the umbilicus and over the right external oblique. Patient complained very slightly of pain. There were 24 c.c. in the injections used. On May 30 no complaint from the patient from the injections used. May 31, 1910, all stitches were removed and the wound found entirely healed. There was, however, some slight induration in the cellular tissue over the right rectus muscle as a result of the injection used two days previous. There was nothing however palpable or visible of either of the other injected areas. Sterile dressings were applied over each; the patient was very sensitive about touching the parts and inclined to be fretful. She was discharged to the dispensary on June 9, 1910. Patient was readmitted to the house on June 23 on account of the extreme pain in the back and right side, which was worse on motion. She was given an antirheumatic and reported three days later as free from pain.

FIG. 4.



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On May 19, 1910, a small nodule showing a tendency to ulcerate at the right extremity of the second operation was noticed and also in the flap of the third operation, *i.e.*, right breast, there was an ulcer about the size of a lima bean with a hardened base but movable on the chest wall, but nevertheless nearer the median line than the ventral axillary fold. The patient was admitted at her request on May 23, 1910, and the fourth operation was performed which enucleated these recurrences.

On May 25, 1910, patient called attention to a hard tumor on dorsal surface of the alveolus of the left first bicuspid tooth. This tumor was fixed, slightly painful, but not inflamed. Patient stated that it had been there ever since the last breast had been removed.

In view of the frequent recurrences it was decided to try a carcinomatous vaccine as prepared by Dr. Coca at H. K. Mulford's laboratory. On May 29, 1910, 12 c.c. of a No. 30 stock solution was introduced into the cellular tissue of both recti abdomini muscles on a level with the umbilicus and over the right external oblique. Patient complained very slightly of pain. There were 24 c.c. in the injections used. On May 30 no complaint from the patient from the injections used. May 31, 1910, all stitches were removed and the wound found entirely healed. There was, however, some slight induration in the cellular tissue over the right rectus muscle as a result of the injection used two days previous. There was nothing however palpable or visible of either of the other injected areas. Sterile dressings were applied over each; the patient was very sensitive about touching the parts and inclined to be fretful. She was discharged to the dispensary on June 9, 1910. Patient was readmitted to the house on June 23 on account of the extreme pain in the back and right side, which was worse on motion. She was given an antirheumatic and reported three days later as free from pain.

Patient was discharged to the dispensary on July 1, 1910.

July 7, 1910, patient reported as having a great deal of pain on the left side dorsally, pain extends to the left of the spine ventrad to the scapulæ and running around to the ventral aspect of the chest. On physical examination there was an area of dulness to the left of the thoracic spine running laterally 5 or 6 inches and starting about on a level with cephal margin of the scapulæ, continuing caudad for a distance of about 10 inches. In this area there was increased vocal resonance, increased tactile fremitus, and bronchial breathing; she was very nervous.

Patient was admitted to the house July 8, 1910.

Sept. 4, 1910, while the nurse was bathing her she noticed a swelling in the middle of the left femur. The leg gave the patient much pain on motion. On examination it was found that the femur was fractured and that there was overlapping with a shortening of 2½ inches. The foot was considerably inverted. Buck's extension with 8 lbs. in weight was applied. This was later supplemented by a Physic splint.

Sept. 10, 1910, patient had been fairly comfortable and the extension had relaxed the tension of the muscle about the fracture, but in the meantime a bed-sore had appeared over the sacrum. Patient had involuntary discharges of urine and fæces.

Sept. 14, 1910: While changing the bed a deformity of the right femur was noticed, and upon investigating it was found that the right femur was spontaneously fractured 4 inches below (pedad) the trochanter. Patient was examined by three physicians and diagnosis confirmed. Patient gradually became weaker and died on Sept. 24, 1910, at 11.40 P.M.

Post-Mortem Report.—Both mammary glands have been removed, the operation having extended into each axilla. Over the sacrum was a large excavating bedsore 20 cm. in diameter, with a thick, gangrenous, foul-smelling sloughing mass within it. The left femur was fractured about its middle. Right femur was fractured 4 inches below the greater trochanter. An incision was made on the external surface of the thigh through the intermuscular septum, the femur was sawed through above and below the fracture, and the specimen was removed—this on the left side. The specimen was cut longitudinally, and there was displayed a mass of tissue at the line of fracture about 3 cm. long and 2 cm. wide, the long diameter lying vertically (Fig. 4). There was some attempt at union in the fracture, there having been laid down scar tissue to such an extent as to mask crepitus. The marrow was red about 3 cm. either side of the line of fracture. Beyond this in either direction the color was normal. For about the same distance either side of the fracture the medulla

of the bone was rarefied. An incision was made through the right hip and the head of the femur was disjointed from the acetabulum. The upper portion of the bone was removed to within 4 inches below the line of fracture. At this point there was a deposition of new tissue, dense and white in character, invading the medulla and marrow cavity. This measured about 2 cm. in diameter. Here, likewise, the marrow was red either side of the fracture but beyond this was normal. Both axillas were opened. In the left was found a small flabby gland 1 cm. and 6 cm. thick. Nothing found in right axilla.

Liver: The common duct was patulous and no enlargement of the glands in this region or within the lesser sack of the peritoneum. The left lobe of the liver on its inferior surface was studded with white dense nodules varying in size from 2 to 8 mm. in diameter and sharply outlined, also slightly elevated. About 30 were present. On the superior surface of the left lobe were about 10 such nodules and about 6 on the spigelian lobe. Only 3 were seen on the inferior surface of the right lobe. About these nodules the liver substance was fatty degenerated, being yellowish in color. Aside from these last mentioned areas, general color of the organ was quite normal. On gross section only three small nodules were found within the right lobe, but the left and spigellian lobes were fairly well occupied by this new tissue. No enlargement of glands in the gastro-hepatic omentum or in the gastric splenic omentum. Stomach contained about 300 c.c. of brownish black material liquid in character. Very little post-mortem digestion had taken place in the mucosa. There was no evidence of old or recent ulceration. Stomach was dilated about one-half. Spleen was normal in size, slate gray in appearance, surface was shriveled, cut with increased resistance, scraped surface bled freely, and there was a slight excess of connective tissue in the trabeculæ. No foreign growth present. Pancreas reached from the spleen well over into the curve of the second portion of the duodenum. It was quite normal in appearance, but felt slightly hardened.

Chest: Heart reached from the second to the fifth interspace in the midclavicular line. Lungs were darkly pigmented. Both lungs were adherent, apices both showed partial solidification, in this region and throughout the substance of each there were old dense calcareous nodules. In the lower lobe of both lungs were several masses, which on pressure exuded from their cut surface caseated material. Specimens were taken from these areas.

Ribs and Vertebræ: The fifth, sixth, seventh and eighth ribs on the left side showed small masses or nodules about 4 mm. in diameter on their anterior surface immediately underneath the periosteum and about 10 cm. from the vertebra. The sixth and seventh ribs were fractured at about this distance from the vertebra. Some of these nodules were soft, and when cut exuded a white pus-like material, and in their neighborhood the rib could easily be cut through with a knife. On the right side the fifth, sixth, seventh, eighth, and ninth ribs had these nodules at about the same location as on the left and similar in size and consistency. Sixth, seventh, and eighth ribs were fractured. There were no masses in the intercostal spaces. Chiseling under the vertebra revealed no foreign growth.

A STUDY OF CARCINOMA MASTITOIDES.

By EDWARD A. SCHUMANN, M.D.,
OF PHILADELPHIA, PA.

In examining the very extensive literature of mammary carcinoma, there is occasionally noted a rare and peculiar variety of this neoplasm, designated by various authorities as "mastitis carcinosa," "inflamed cancer," "acute brawny cancer," and other terms. A close analysis of these scattered cases has shown that the tumor described is the same in all of the reports, and that the general characteristics of this growth are, that it is a very rapid, fulminating variety of breast cancer, which by setting up violent irritation, produces a round-cell infiltration closely simulating a primary mastitis. It is to this group or variety that the writer has applied the term carcinoma mastitoides.

The condition appears to have been first described by Volkmann [1] in 1875, and was styled by him mastitis carcinosa. The other later writers have in general dismissed the subject without detail, calling such tumors inflamed or acute cancer. W. R. Williams [2] describes a rare form of cancer, in which the whole of one or both breasts may be simultaneously involved. It arises suddenly, progresses rapidly, and is often accompanied by inflammatory phenomena. No special tumor is formed, but the whole breast becomes enlarged and hard, the skin reddened, œdematous, and adherent, and the subcutaneous veins unduly visible. The adjacent lymph-glands are usually soon invaded, and there is general dissemination of the disease, with death from acute toxæmia, its total duration seldom exceeding a few months. Most cases, but not all, arise in connection with pregnancy and lactation.

The disease usually affects women in the first half of life, and is most frequently associated with late pregnancy or lactation. It spreads with marked rapidity, gives rise to profound toxæmia and early metastasis, death appearing in less than a year from the onset in most of the reported cases.

The growth usually manifests itself as a general, painful, and rapid enlargement of the entire breast, without the presence of any previously noted mass or area of induration. The gland becomes reddened, hot, œdematous, and may present a sense of fluctuation. Appearing, as it most frequently does, shortly after parturition, the similarity to acute mastitis is marked, and many patients have been persistently treated on this basis. The skin shortly becomes infiltrated and brawny, and small areas of necrosis may appear. The nipple may or may not be retracted, and the axillary and supraclavicular glands are early enlarged in the majority of instances. The skin of the thorax immediately surrounding the breast may become indurated and reddened; there is usually some elevation of temperature, and locally the part is hot. A point of interest is, that though small abscesses are occasionally noted, in no case did the breast tissue break down *en masse*. Cachexia is profound and metastasis rapid, death transpiring from toxæmia.

Diagnosis.—The differentiation of this form of carcinoma from an acute purulent mastitis presents the greatest difficulty, and in many cases can only be definitely determined by the microscopic examination of an excised portion of tissue. In general it may be said, that temperature is not so high in carcinoma mastitoides as in mastitis; the skin is usually more brawny and adherent to the underlying tissues, while the early enlargement of the adjacent lymph chain is of no diagnostic value as it may readily appear in both diseases.

On incising such a tumor, there will be found a fairly firm tissue, which may or may not present small abscess cavities. The substance of the growth is usually firm and fibrous, of a purplish red color, and frequently exhibits small, isolated areas of hemorrhage. There are usually scattered throughout the gland small necrotic spots, sometimes abscesses of considerable size. The contiguous skin is markedly indurated and œdematous, the induration extending, in the writer's case, beyond the middle line anteriorly and to the postaxillary line posteriorly.

Prognosis.—The prognosis is uniformly bad, this being one of the most rapidly fatal of all malignant growths. Billroth [3] reports a case in which death from toxæmia occurred within six weeks from the discovery of the tumors.

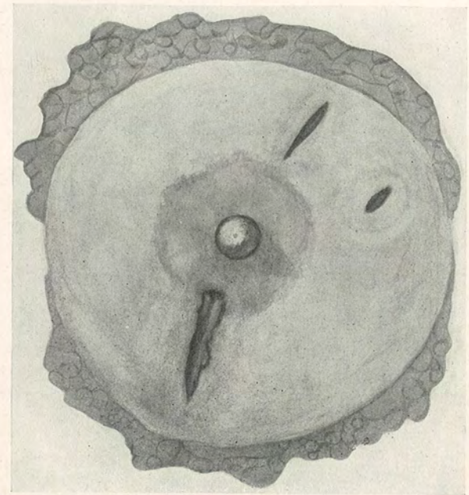
Treatment.—This should, of course, be radical extirpation of the breast and lymph-glands, immediately upon the diagnosis being made. In view of the relatively large number of these cases, it would seem wise to excise for microscopic examination a small portion of the breast in all doubtful cases of acute mastitis which do not yield promptly to antiphlogistic treatment. In the writer's case, the patient had been treated expectantly for three months with a diagnosis of mastitis. The case in detail was as follows:

M. L., thirty-three, married, was referred to me by Dr. R. D. Rhein, Aug. 27, 1910. The family history was irrelevant, and she had previously been a strong, healthy young woman. Five months before, she had been easily delivered of a normal, full-term child. One week after delivery she noticed a "lump" in the left breast, which was treated by the usual rubbings with oils, etc., but steadily increased in size and became hot, tender, reddened, and painful. At this time she had some fever, and the breast was incised without result. She had been seen by several physicians, all of whom confirmed the diagnosis, until she visited Dr. Rhein, who suspected some malignant change.

On examination the patient was found to be a well-nourished young woman, the mucous membranes somewhat pale, chest negative, temperature normal. The right breast was lactating, the abdomen was negative.

The left breast was enlarged to the size of a large grape fruit, was brawny in consistency, purplish red in color. The nipple was somewhat retracted, the skin of the "pig skin" type; the axillary glands appreciably enlarged, and the entire left side of the chest wall indurated and brawny. On palpation there was noticed considerable local heat and a distinct sense of fluctuation deep in the body of the gland. Interstitial mastitis with a deep, small abscess was diagnosed, and under light anæsthesia deep radial incisions were made, to the pectoral muscles. The breast tissue was found to be firm and tense, of a reddish gray color,

FIG. 1.



Carcinoma mastitoides, gross appearance. The diffuse nature of the tumor is shown, with the necrotic radial incisions.

FIG. 2 *B*.

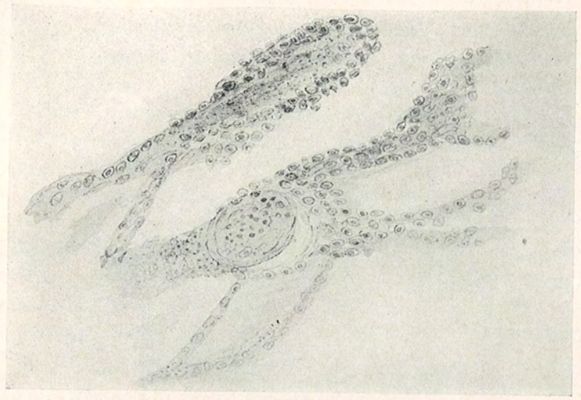
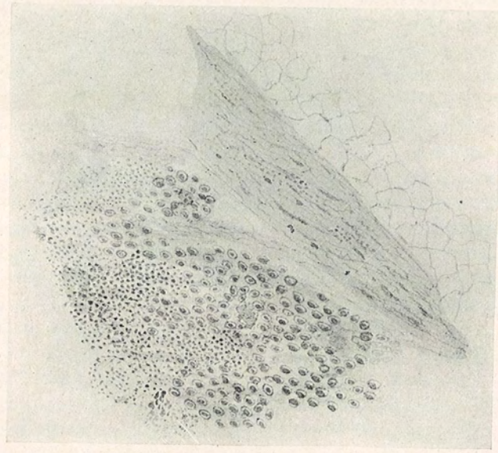


FIG. 2 *A*.



Carcinoma mastitoides. At *A*, is shown the poorly defined nest of cells, invaded and surrounded by a dense round-cell infiltration, with much granular débris. At *B*, is shown one of the papillary growths, a tubule lined with a single layer of carcinoma cells.

FIG. 3 *A*.

FIG. 3 *B*.

A, Dr. McFarland's section of Rodman's case. Notice the absence of stroma. *B*, Dr. McFarland's case. The well-defined cell nests invaded by the infiltrate of leucocytes.

with a few scattered, localized hemorrhagic areas, and several small abscesses. After a few days, the tissue began to break down *en masse,* with a profuse discharge of thick, foul pus. At the expiration of ten days it was found that, though the degenerative process had largely ceased, the breast was, if anything, larger than before and still tense. Accordingly, radical excision was decided upon and performed at the Gynecean Hospital in the presence of several surgeons of prominence, none of whom cared to offer a definite opinion as to the nature of the growth. The enlarged axillary glands were removed together with the breast and the pectoral muscles.

Owing to the induration of the surrounding integument, there was a marked defect in the wound which required skin grafting. The incision healed slowly, and within a week many dark brown, shot-like nodules appeared along the line of the scar. These nodules broke down into shallow ulcers, which healed and were in turn followed by more hard nodules. In November, six weeks following the operation, the patient began to complain of headache, pains in the chest, and a mass in the right breast. She lost considerable flesh, and developed the complexion and weakness of profound cachexia. December 1, the right breast was excised, the mass in its outer lower quadrant having grown to the size of an orange and being somewhat tender on palpation. This breast was unfortunately destroyed by a misunderstanding of the nurse. The wound healed at once and gave no further trouble. December 15 the woman had grown much weaker and suddenly developed very rapid breathing with a left sided pleurisy. About 500 c.c. of clear serous fluid was withdrawn from the left pleural cavity, with some relief. Within a few days she developed a basal meningitis and died in coma December 20, just eight months after the first knowledge of any disease of the breast. Autopsy was refused.

Pathological Examination.—The specimen consists of the left mammary gland. The organ is hemispherical in shape, measures 12 x 12 cm., with a maximum thickness of 6 cm., is hard and indurated, and *in situ* was seated upon a zone of indurated subcutaneous connective tissue, extending from the sternum to the midaxillary line.

The skin is of the "pig skin" variety, of a deep purplish red color, brawny, and thickened. The nipple is retracted and fixed; the areola deeply pigmented and corrugated. Three somewhat broken-down incisions extend from the nipple to the pectoral muscle.

On section, the central portion of the gland is filled with a yellowish necrotic slough. Underlying this is a dense, pink fibrous area, extending throughout the entire depth of the breast. It exudes no juice on section. Areas of fat and small abscess cavities are scattered throughout the tissue. The fascia covering the pectoralis major muscle is much thickened and indurated.

Microscopically, the growth is a somewhat complex one. It has in main the characteristics of a medullary carcinoma, growing with a small amount of connective-tissue stroma, and interspersed with groups of closely packed cell nests of the scirrhus type. In still other areas the field is typical of the carcinoma simplex. The whole picture corresponds closely with that of the latter neoplasm, as described by Rodman.[4] The groups of cells vary greatly in their arrangement, from the dense, almost opaque nest to the long tubule or papillary outgrowth lined with the carcinomatous elements. The important feature of this tumor, however, is the secondary inflammatory reaction evidently set up by its presence. Wherever there is any considerable group of the cancer cells, it is surrounded by dense round-cell infiltration, interspersed with areas of connective-tissue hyperplasia amounting in some fields almost to fibroma. The round cells are mostly of the lymphoid type, and everywhere invade the carcinoma, surrounding isolated cells and separating the various nests from one another by dense masses of cells, granular débris, and broken-down tissue with necrosis. Many small abscesses are scattered throughout the tumor.

Fox [5] in speaking of this specimen lays stress on the fact that the connective tissue is forming but is not at the stage where it could be classified as fibro-adenocarcinoma. He considers the round-cell infiltration secondary and invading the cancer tissue, there being well-marked cell division in the round-cell infiltrate while the cancer cells themselves show no evidence of mitosis. This point is further observed by Gross[6] *q.v.* In a study of the reported cases, this invasion of carcinoma by a round-cell infiltrate, which from its formation appears to have been produced as a result of some action of the cancer cells, is universally noted.

Dr. Joseph McFarland [7] has very kindly loaned the writer two specimens from his collection which are evidently of the variety in question. One of them, a student's slide from one of the German clinics, has no history attached, but the section shows plainly a scirrhus carcinoma growing in well-defined nests, which are separated by thin connective-tissue trabeculæ. Growing in and around the cells is a well-marked round-cell infiltration, which in other fields has entirely replaced the normal breast tissue. This is shown somewhat diagrammatically in Fig. 3 *B*. The second section (Fig. 3 *A*) is from Rodman's case, *q.v.* Here there is a medullary carcinoma, growing without stroma and surrounded and invaded by a dense collection of polymorphonuclear leucocytes. The carcinoma cells are crowded with leucocytes and granular débris.

In the analysis of this special variety of carcinoma, two features are of paramount interest—the pathogenesis and the diagnosis.

It has been seen that morphologically carcinoma mastitoides does not differ from certain forms of carcinoma simplex, and that the marked difference which does exist is due entirely to the interaction of the carcinoma and the profound inflammatory reaction produced by it. It follows, then, that this excessive reaction of these especial cancer cells upon the surrounding tissues—a reaction sufficiently marked to engender a general, diffuse, round-cell infiltrate and connective-tissue hyperplasia so profound as to frequently eventuate in breakdown and abscess formation—must be based either upon some peculiar toxin formed by the cells themselves, or upon a localized loss of resistance to tumor invasion, existent in the breast itself.

Inasmuch as these growths are almost always found in mammæ either in early lactation or the last weeks of pregnancy, when the glands are functionally at the height of their activity, it would seem that this condition is the determining factor. The exact process can only be conclusively described when more complete knowledge of the chemistry, notably the toxin forming power of carcinoma, is attained. It seems a logical deduction, however, that when the essential elements of the mammary gland are in full activity, fulfilling their excessive and occasional function—the secretion of milk—that they must be exceedingly vulnerable to the action of any foreign toxin, as a result of which action the pronounced inflammatory response is a direct sequence. The diagnosis, as has been said, presents the greatest difficulty, and the only scientific pro-

cedure is to excise a small portion of tissue for microscopic examination in all cases of supposed acute mastitis that do not yield to treatment which should ordinarily effect a prompt reduction of the inflammation. The reported cases in brief are as follows:

CASE I (RODMAN [8]).—A woman of forty-five years, who noted a marked retraction of the nipple of the left breast. The entire breast then began to enlarge, the greatest enlargement being in the axillary quadrant, there being, however, no distinct tumor. The process was a diffused and not a discrete one. Three months later a diagnosis of mastitis was made by a prominent surgeon. The gland was vividly red and covered with an eczematous eruption, and, indeed, closely simulated mammary abscess. The axillary and supraclavicular glands were enlarged. The growth proved to be a medullary carcinoma with pockets of pus scattered throughout. Rodman adds in his discussion that many cases of carcinoma and sarcoma may develop in pregnant or lactating women, which, while of rapid growth, cannot be classified as acute cancer, as the inflammatory symptoms are wanting.

CASE II–III (BLOODGOOD [9]).—Two cases of medullary carcinoma, simulating mastitis, with abscess formation are reported. Both of these cases had been treated on a diagnosis of mastitis before being admitted to the clinic.

CASE IV (BILLROTH [8]).—A thin, pale woman aged thirty-six, the mother of seven children, was admitted to the hospital when near the full term of her eighth confinement, with both breasts larger than a child's head and firmly adherent to the overlying skin. The latter was tense, shiny, congested, and marbled by bluish veins. The breast gave no milk or colostrum; there were no obviously enlarged axillary glands. The history she gave was, that five weeks previously hardness set in at the periphery of both breasts, which rapidly spread, with increase of size. The patient died a week later, the total duration of the disease being six weeks. At necropsy, both mammary glands were found invaded by a softish, lobulated reddish growth, from which milky fluid exuded on section. Histological examination revealed epithelial cylinders and alveolar gland-like formations, such as are found in ordinary breast cancers, embedded in a fibrous stroma densly infiltrated with small round cells. Secondary nodules were disseminated in the thyroid, pericardium, etc., but not in the axillary glands.

CASE V (SHEILD [10]).—A woman, aged fifty-two, was admitted to St. George's Hospital. Six months previously the patient struck the right breast, since which she noticed a swelling which steadily increased in size. She lately had much sharp pain and has lost flesh and strength. The right breast was greatly enlarged, the nipple deeply retracted, and the skin marked by the old scars of numerous sinuses, for she had suffered from frequent abscess of the gland. The skin generally was of a deep congested blue color, but over the axillary part of the swelling

it was red and gave the appearance of inflammation. There was considerable local heat, and the axillary glands were not enlarged. The inner part of the right breast contained a hard mass. It was quite uncertain as to whether or not fluctuation existed. Mr. Peck made an exploratory incision, which revealed undoubted cancer. This was hemorrhagic, being infiltrated with blood and breaking down superficially. The whole breast was thereupon removed.

CASE VI (SHEILD).—A healthy looking woman of fifty. The right breast was generally enlarged, skin dusky and red with increase of local heat, nipple retracted and adherent. Exploratory incision with the idea that it was an abscess revealed general carcinoma. The breast was removed, with death following some time after from recurrence.

CASE VII (MORRANT BAKER [11]).—The patient was a lady of thirty-four who had been confined four months before, and who was still nursing her infant. The right breast became large, hot, tense, elastic and painful, and the skin over it was ruddy and œdematous, as if occupied by inflammatory exudation. The surgeon believed that an abscess was forming and had the breast poulticed, and it was not until six months later that the real nature of the case was declared by the appearance of numerous cancerous nodules in the skin and the rapid enlargement of the axillary glands. The mistake here arose because all the circumstances of the case suggested the probability that the breast was the seat of an abscess, and secondly, owing to the youth of the patient and the vascularity of the breast in that patient, the malignant growth was very active and attended with great vascular disturbance, leading to redness, œdema, and heat of the skin.

CASE VIII (BRYANT [12] reports three cases).

A healthy looking single woman of forty-three, with acute disease of her right breast of two months' duration. The whole gland was infiltrated and the skin over it like brawn. The nipple was depressed and lost in the surrounding elevation of the breast. The axillary and supraclavicular glands were enlarged. This patient died in less than three months.

CASE IX (BRYANT).—A married woman of fifty-three, who had borne 11 children, was seen June, 1857. She had an acute brawny infiltration of her right breast and the skin over it, with œdema of the right arm. She had been perfectly well until three months before, when she noticed a swelling in the breast, which rapidly increased and became complicated with pain down the right arm. When seen, the axillary and supraclavicular glands were much enlarged, the breast was like brawn, the skin over it œdematous, and evidently infiltrated with new elements. Death occurred in three months from toxæmia.

CASE X (BRYANT).—A woman of forty-nine who had had six children presented herself with an enormously swollen, œdematous, and indurated left breast of eight weeks' standing. There was severe pain in the part, which was worse at night, and there was at times increase of heat in the gland. The axillary glands were not involved. The integument over the breast was œdematous and pitted on pressure. In

three months the axillary glands became involved, and skin over the breast became tense, reddened, and indurated. Death occurred in nine months, with a development of a similar growth in the right breast.

CASE XI (GROSS[6]).—A sterile, married woman of thirty-nine had a tumor which had acquired the volume of an egg in less than two months and contained an abscess as large as a filbert, filled with greenish pus. The abscess formed at the expense of the infiltrated connective tissue, the epithelial cells themselves not participating in the morbid process.

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STATED MEETING, HELD APRIL 3, 1911

PERFORATING ULCER OF THE SIGMOID FLEXURE OF THE COLON.

DR. GEORGE G. ROSS gave the history of a woman, thirty-five years of age, who was admitted to the Germantown Hospital in a condition of profound shock, with a rigid, tender, and distended abdomen. Symptoms had been developing but a few hours, patient having been awakened during the preceding night by pain in the lower abdomen and nausea.

An incision into the peritoneal cavity was made through the right rectus muscle. As soon as the peritoneum was incised, a gush of rather thick, yellowish fluid came forth, bringing with it lumps of hard fecal matter. There was marked redness over all peritoneal surfaces of the lower abdomen. At this point the etherizer gave notice that the patient's condition was critical. She was cyanosed, pulse uncountable, and respiration suddenly became irregular in both rate and rhythm. The operation was started under primary anæsthetic and had been under way for about five minutes. Ether had to be discontinued on account of the patient's condition. A glass drainage tube was inserted into the pelvis, and the wound closed with three through-and-through silkworm gut sutures. The patient was given an intravenous injection of normal salt solution while still on the operating table. She died about twelve hours later.

Immediately after she died, the stitches were cut, the tube removed, and a search made for perforation of the large intestine. This was considered as necessarily present, as the patient had solid fecal matter free in the peritoneal cavity. Eventually the perforation was found about the middle of the sigmoid flexure of the colon on the inner or the right side, about one inch from the mesosigmoid. The perforation was almost perfectly circular and large enough to admit the thumb of a medium sized hand up to the distal joint.

The entire colon from the ileocæcal valve to the site of the perforation was impacted with fecal matter of the consistency of hard putty. There was no evidence of active tuberculosis, although there was one calcified mesenteric gland found.

CARCINOMA OF THE APPENDIX.

Dr. George G. Ross reported the history of a man, aged thirty-five years, who was operated upon for chronic appendicitis. When the appendix was exposed, it was found to be bound down by adhesions, and about its middle there was found a small mass about the size of a small pea and in appearance not unlike a caseous tubercle, bulging from the serous surface. Adjacent to the appendix, in the mesentery of the small intestine, there was found a mass of lymph-nodes, hard, densely adherent, about one inch in diameter, and about three inches in length. Smaller nodes were palpable in different localities of the peritoneum. The appendix was removed, the stump buried with a few linen sutures, and the abdomen closed in layers without drainage. A small amount of serous fluid was noted in the peritoneal cavity.

The stitches were removed on the sixth day. The incision healed nicely. The patient was discharged on the tenth day. One week later he was readmitted complaining of severe abdominal pain and diarrhœa. Examination revealed that the mass in his abdomen had increased rapidly in size, and that a mass in about a corresponding position under the left rectus was palpable. There was felt also a small mass in the abdominal wall, precisely under the left half of the umbilicus and extending to the left for about one inch. This mass was apparently about one inch in diameter. A section of it was removed for study. The abdomen on this admission was very tense and contained free fluid. Pain was very severe, requiring morphine.

Pathological Report on Appendix.—Dr. Bradbury reported as follows: Small nodule about two mm. in diameter, bulging from about the middle of appendix on serous surface. Microscopic examination revealed this to be a carcinoma simplex, not involving the mucous coat.

The nodule removed from abdominal wall was also reported to be a carcinoma simplex.

COMPOUND COMMINUTED FRACTURE OF THE FOREARM.

Dr. George G. Ross presented also a man who had sustained a compound comminuted fracture of both bones of the forearm, the result of an accident in a gymnasium. When seen by Dr. Ross two weeks after the accident, there was absolutely no union, both bones were badly involved. After waiting another week in order to give the fragments time to harden up, he then cut down

on the radius and wired it with heavy silver wire. Nothing at all was done to the ulna. In six weeks the patient was playing the pipe organ.

TUBERCULOUS ARTHRITIS OF THE ELBOW.

Dr. Ross presented a man, saying that he was operated on originally by Dr. Deaver, who took out a portion of the elbow-joint. Some time after that there were persisting sinuses, with extensive necrosis of the heads of the radius and ulna and end of the humerus. Dr. Ross resected the ends of all three bones, and interposed superficial fascia between them. Patient now has a very good joint; all ankylosis has disappeared.

POSTERIOR GASTROJEJUNOSTOMY DONE TWO YEARS AFTER OPERATION FOR PERFORATING GASTRIC ULCER.

Dr. Morris Booth Miller presented the man whose case was detailed by him at the meeting of February 1, 1909. Operation was done nine hours after perforation, and after a stormy convalescence there was apparently a perfect recovery. He was well for some weeks, but then commenced to develop gastric symptoms again, which, continuing, made it necessary last January to do a formal gastrojejunostomy. He illustrates the point which Dr. Deaver made at the meeting referred to, namely, that in these cases a gastrojejunostomy should have been done at the primary operation. However, Elliot has called attention to the fact that certain cases get well and stay well without that operation. This patient from the secondary operation made an easy recovery, and has had no subsequent trouble.

Dr. Henry R. Wharton said that he thought that in the majority of cases the patients are in poor condition for any prolonged operation, and as to the fact that doing a gastro-enterostomy at this time does not always prevent a second perforation, he recalled a case of perforated gastric ulcer occurring in this city upon which Dr. Deaver operated and at the same time did a gastro-enterostomy; a year later the patient had a second perforation, which Dr. Wharton closed; a little over a year after the second perforation, the patient had a third perforation, for which he has recently been operated upon. As regards the question of doing a gastro-enterostomy at the time the perforation is closed, this is a matter upon which there is some difference of opinion among surgeons; one of the first cases

he operated upon for ruptured gastric ulcer, which was closed six hours after the perforation, has remained well up to the present time, simple closing of the perforation in this case being followed by a permanent cure.

With regard to the liability to second perforation, this is always a possibility. He operated about a month ago upon a case of perforated gastric ulcer, who at the time, about sixteen hours after the perforation, was in very desperate condition. He found the perforation, closed it, and the man did well for nineteen days, then he had a vomiting spell and a second perforation occurred which was closed twelve hours after the first symptoms. The patient only lived eight hours after this second operation.

Dr. George G. Ross reported the case of a man about fifty years of age who had a perforated duodenal ulcer, who was operated upon in an hour and a half after the onset of pain. In this case he would have certainly done a gastro-enterostomy had the patient's condition warranted, but by the time the perforation had been located and was closed the etherizer reported the man as about dead. He therefore did not think he was warranted in doing a gastro-enterostomy, but all his efforts were given to resuscitate the man, who finally recovered, and the wound was closed with pelvic drainage. A week later patient had a recurrence of symptoms, and from these he finally died. A postmortem showed an ulcer, horse-shoe shaped, an inch and a half long. The primary perforation which Dr. Ross had closed was in the stomach end and the second perforation was in the duodenal end. There were four other ulcers on the posterior wall of the duodenum. Had a posterior gastro-enterostomy been done the man's life might have been saved, but under the circumstances he did not feel warranted in prolonging the operation.

Dr. John H. Jopson recalled the case previously reported by him before the Academy, of perforated pyloric ulcer, operated upon two years ago last November, it being one of five cases upon which he had operated. This patient entered the hospital just two years after the original operation for perforation, and he did a gastro-enterostomy for a recurrence of symptoms of ulcer and pyloric stenosis. Since then patient has remained well.

EVISCERATION THROUGH STAB WOUND IN ABDOMEN.

Dr. Morris Booth Miller reported the history of a man, aged twenty-five years, who was admitted to the Polyclinic Hospital on October 8, 1909, soon after having received a stab wound of the abdomen. In the right lower quadrant was a clean-cut wound six inches or more in length, which extended through the entire parietes. It commenced about two inches above the anterior superior iliac spine, and went downward and inward toward a point midway between the umbilicus and the pubes. From it protruded enough coils of small intestine to more than fill the crown of a Derby hat. This mass had not only been contaminated by contact with the clothing, but it was also covered with intestinal contents exuding from coincidental perforations of the gut.

He was immediately taken to the operating room and etherized, his clothing was removed, and the character and extent of the wound was examined. Absolutely no attempt was made to cleanse the abdomen, as to have done so would have involved the replacement of the infected viscera within the abdomen. Instead of the usual scrubbing, the adjacent skin, including the edges of the wound, was covered with several layers of wet towels. The bleeding was traced to the deep circumflex iliac, a vessel in this patient of unusual size and capacity. It was controlled by ligature. There were three intestinal perforations, the largest of which was three-fourths of an inch long; two were about an inch apart, and the other some distance away. These were turned in and closed with Lembert sutures of silk. In addition there was a two-inch slash in the mesentery close to the intestinal border, which was also closed with silk. The toilet was completed by a very thorough and copious flushing with warm normal salt solution, care being taken to remove without insult to the peritoneum all unclean particles as far as possible. The mass of intestine was then returned to the abdomen, and the wound closed with tier sutures of catgut. Drainage was accomplished by the means of two split rubber tubes, one going through a median stab wound down to the rectovesical space, the other passing into the right flank, while close to these were placed two or three superficial wicks of gauze.

The patient was put in bed in the semisitting position of Fowler, and continuous enteroclysis was instituted. He reacted well, but during the night was restless and vomited a considerable quantity of semidigested food. During the night two coils of intestine again escaped outside of the abdomen. He was again etherized, placed in the Trendelenburg position and the loops of

gut returned. This time the abdomen was closed with through-and-through sutures of silkworm gut, suturing the peritoneum with a separate catgut stitch.

The subsequent history was uneventful. There was some infection in the superficial layers of the wound which delayed complete healing, but there was no general peritonitis and no localized peritoneal reaction of any moment. He was discharged cured on the thirtieth day.

STAB WOUND OF CHEST.

Dr. Miller related the history of a man, aged thirty-nine years, who was admitted to the Polyclinic Hospital on January 20, 1911, suffering from a stab wound of the left chest. He was not appreciably shocked, but complained of intense pain in the thorax; temperature was 98°, pulse 42, respirations 18. He stated that immediately after being wounded he had some difficulty in breathing, but this was not appreciable when first examined. Within an hour after admission he expectorated a small quantity of bloody mucus, and soon after there commenced a hacking, spasmodic cough which persisted more or less until his death, fifteen days later. Between the seventh and eighth ribs and just in front of the posterior axillary line there was a transverse knife wound about half an inch long; in this neighborhood there was an area three or four inches in diameter, which was slightly emphysematous. As the wound entered the thorax after passing through an unusually thick cushion of muscles, it seemed hardly likely that penetration had been very deep. However, the patient told us that he had been stabbed with a dirk having a six-inch blade, and he thought it went in up to the hilt.

Examination of the chest showed restricted movements on the left side, slight dulness on percussion over an area the size of the palm, many fine and coarse râles, but it was clear that no lung collapse or extensive intrathoracic hemorrhage had occurred. The breath sounds toward the base were unimpaired. The slow pulse was noted, and the question of heart injury was considered. The cardiac area of dulness was not increased, both the sounds were clear, and aside from somewhat labored action there was nothing abnormal discovered. Despite the history, which pointed to a deep wound, it was thought that only the superficial portions of the lung were involved. The chest was immobilized with adhesive plaster, and quieting doses of opium were administered.

For twenty-four hours his condition seemed satisfactory and he made no complaint except of the hacking cough. On the twenty-second the temperature suddenly shot up to 104.8. Even with this fever there was no marked or, indeed, proportionate increase in the pulse or respiratory rates, the pulse being about 100 and respirations 24. Examination of the chest showed a widened area of dulness, five or six inches in diameter, over which distant bronchial breathing was heard. It was apparent that there was some pneumonic consolidation. Expectoration was profuse and rusty brown in color. Leucocytes numbered 16,300.

In long remissions which gradually decreased, his temperature fell to about normal on the twenty-ninth. By this time the external wound had completely healed and all the emphysema had disappeared, but the area of pulmonary dulness remained the same in size, and physical signs were unchanged. Expectoration was still free, but its brownish, blood-tinged character had entirely cleared up. The patient looked well, slept well, and made no complaint of pain or discomfort.

On February 1 he was transferred to the service of Dr. John B. Roberts, who has supplied the subsequent data. On that day his temperature rose in the afternoon to 103°, to fall to normal the next morning, and thereafter to run slightly subnormal until the end. For the first time he commenced to show signs of respiratory distress and wanted to sit up in bed. With a quickened respiratory rate the pulse remained relatively slow and gradually grew weaker. It was soon realized that his condition was rapidly becoming critical, but the explanation was not so clear.

The patient continued to grow worse and died early on the morning of February 4.

At autopsy the pericardium was found to be greatly distended and incision into it was followed by the escape of fluid under great tension, this fluid being cloudy, yellowish brown in color, purulent, containing a large amount of fibrin, and probably measuring from one to two litres in amount. The pericardium and epicardium were covered with a thick deposit made up of fibrin and detritus. It was impossible to determine the presence of a wound extending into the pericardium from the lung.

Examination of the left pleural cavity revealed a general adhesion of the parietal and visceral pleuræ everywhere, so that it was necessary to remove the pleuræ with the lung in exposing

the latter. At the position of the external scar the course of the punctured wound could be followed through the chest wall, pleuræ, and lung to a point possibly about 3 cm. from the external surface of the latter. Corresponding to the position of the punctured wound the pleuræ were separated from each other by an organized blood-clot, over an area of about 15 cm. in diameter and about 1.5 cm. to 2 cm. in thickness. There was no sign of suppuration to be found in the pleural cavity or the lung.

FRONTAL ENCEPHALOCELE.

DR. MILLER presented photographs (see Fig. 1) of a five-days' old baby who was referred to him from Dr. Hamill's clinic at the Polyclinic Hospital on March 15, 1911, suffering from frontal cephalocele. According to the nurse the mass had been the size of a small tomato at birth, and not unlike that vegetable in color and shape, but it quickly commenced to shrink and dry on its surface so that when seen it was a brownish, ulcerated, somewhat fœtid mass 2 x 1½ inches in area with an elevation of about an inch. It was located over the glabella and spread broadly over the nose; while the eyes were partially covered by the mass they were not affected. The base was broad and appeared to be more on the left side, so that it was diagnosed as of the naso-orbital type in contradistinction to the nasofrontal or naso-ethmoidal forms of frontal cephalocele. There was no pulsation, no fluctuation, and no difference in size was noted when the child cried.

According to Von Bergmann, whose classification is now generally accepted, any congenital protrusion of intracerebral contents through a defect in the skull may be termed as cephalocele. The defects through which these protrusions take place are either frontal or occipital, except very rarely a defect between the sphenoid and ethmoid may give rise to one which appears in the pharynx. These defects are at or close to the median line, though the visible protrusion may be slightly to one side.

Frontal cephaloceles are divided as follows: nasofrontal, those in the region of the glabella; naso-orbital, those at the inner angle of the orbit; naso-ethmoidal, those below the nasal bones. Occipital cephaloceles are divided as follows: superior, where the defect is above the external occipital protuberance and where it may join the posterior fontanelle; inferior, where the defect is below the external occipital protuberance and where it may join the foramen magnum.

FIG. 1.

Frontal encephalocele.

FIG. 2.

Sacrococcygeal cyst.

Cephaloceles occur in three forms, of which hydrencephalocele is the parent type, and encephalocele and meningocele represent retrograde changes from it. Hydrencephalocele consists of arachnoid, a layer of brain tissue, and a cavity containing cerebrospinal fluid derived from the lateral ventricle with which it communicates. It is really a hernia of the lateral ventricle. Covering it are fascia and skin, the latter sometimes natural and sometimes so altered as to be scarcely recognizable. The dura and pericardium do not extend beyond the margins of the bony defect. Encephalocele is a protrusion of brain substance covered by arachnoid. There is no fluid in this form, save, rarely, where there may be a superficial cyst of the arachnoid. It only occurs in the nasofrontal region. In meningocele all brain tissue is absent. Beneath the arachnoid is a layer of cells of the same type as those lining the ventricles, but the communication with the ventricles is almost or completely cut off. In other words, a cyst forms in the subarachnoid tissue, and thickened pia surrounds the cyst. In no form of cephalocele does the dura play any part.

CONGENITAL SACROCOCCYGEAL TUMOR.

DR. ALFRED C. WOOD made some remarks upon the classification and pathology of congenital sacrococcygeal tumors as a preface to a report of a recent case, as follows:

A female child, two months and ten days old, was seen by him at the Charity Hospital, Norristown, Pa., in consultation with Dr. Charles H. Mann, and the family physician, Dr. George F. Hartman of Port Kennedy. Dr. Hartman furnished the following data: The child's father is twenty-three and the mother twenty years of age; both are healthy. The patient was the second child, the first being entirely normal. The labor began at 2 P.M., July 12, 1910. The head and shoulders were delivered at 3 A.M., July 13. Dr. Hartman was called at 10.15 A.M., and the delivery completed with great difficulty. A tumor was then observed attached to the sacrococcygeal region, measuring 19½ inches in circumference, and 18¼ inches from the base anteriorly to the base posteriorly (Fig. 2); this subsequent to the birth gradually increased in size and the child became more emaciated.

The tumor was globular in shape; the overlying skin was very thin, but otherwise normal in appearance. The surface was somewhat irregular in contour, the larger portion having the characteristics of a cyst on palpation, but here and there small areas were felt that were firmer, and apparently solid. The

coccyx could be felt on the posterior surface. It was curved backward instead of forward in the normal manner, and a firm, narrow body like cartilage could be traced for some distance from its tip. The anal orifice presented on the anterior surface and was directed forward. The tumor evidently had its origin within the pelvis; it had no connection with the spinal canal.

As the tumor was enlarging and the child failing, it was decided to operate at once. Ether was administered, transverse elliptical incisions made, and the cyst enucleated. The cyst wall was closely adherent to the rectum from the anus to the level of the promontory of the sacrum, and some time was consumed in effecting its separation, which was finally accomplished without wounding the bowel or opening the peritoneal cavity.

When the incision was sutured, the anal orifice was drawn back into approximately its normal situation, and the general appearance was nearly natural. The operation was not accompanied by any severe hemorrhage, but the amount of oozing from the innumerable points of the large wound was probably greater than appreciated. The child appeared to be in satisfactory condition when it left the table, but death occurred a few hours afterward. Before the operation the child weighed 15 pounds and some ounces; after operation it weighed less than 7 pounds.

The tumor was composed of one large cyst, with thick walls; here and there areas of increased thickness were noted, some of which were small cysts, others were solid. Th fluid was practically clear. Unfortunately, no minute study of the specimen was made.

Dr. John H. Jopson reported the case of a girl about fifteen years of age, who had grown up with this condition, had attended school, had her clothing modified to make it as inconspicuous as possible, and had even ridden a bicycle. The reason her parents sought surgical advice was because one of the cysts had become infected. He aspirated one cyst and drew off considerable fluid. The growth was almost as broad as the buttocks, and rested on the thighs as far down as the knees. Excision was indicated and was suggested, although the operative risks would have been great.

Dr. William J. Taylor said that in consultation with Dr. Mary Griscom he recently saw a child a little over two months of age with a tumor very similar to that described by Dr. Wood. It measured 2½ inches in diameter. As the child was apparently in perfectly good condition, and the mother very anxious to have

something done, the child was etherized and he assisted Dr. Griscom in the operation. The tumor was removed with little or no difficulty. On examining the tumor after its excision he found that there were portions of the coccyx and little cartilaginous masses through it. It was partly cystic, partly fat and fibrous tissue, and partly, he believed, sarcomatous. He did not dissect it carefully as he wished to hand it over to the pathologist, who now has it for examination.

Although directly next to the anus, the wound has healed by primary union. (Since the meeting Dr. Taylor has learned the growth was a teratoma.)

PARAFFIN INJECTION AS A CURE FOR INGUINAL HERNIA.

Dr. Alfred C. Wood presented a specimen which had been removed from the inguinal region of a man aged fifty-five years. The patient was seen in consultation with Dr. S. H. Scott and Dr. Jackson Taylor of Coatesville, Pa.

The man stated that two years ago he had been induced to submit to an injection for the cure of a right inguinal hernia from which he had been suffering. Immediately after the injection, he noticed a large swelling in the neighborhood of the external ring, which has since persisted. The hernia was partially controlled, as it did not descend beyond the upper part of the scrotum afterward. The mass was about the size of a hen's egg, was freely movable, and could be pushed through the external ring into the canal with ease. The overlying skin was normal in appearance. One of the most annoying features according to the patient was the extreme mobility of the lump, which he said caused much more inconvenience than the hernia ever did. During certain muscular efforts, such as coughing, etc., the mass would be drawn up into the canal and forcibly projected downward. This action was plainly shown during the stage of etherization when the patient was breathing deeply; the lump moved upward into the canal and down like a shuttle with each respiratory cycle. The mass was excised. It was found to be in the loose connective-tissue layers of the cord and outside of the sac of the hernia. A capsule had formed by condensation of the connective-tissue layers about it. The sac of the hernia was removed, and the operation concluded according to the Bassini method for radical cure. Recovery was uneventful.

The specimen measured 5.5 x 4 x 3.5 cm., and on section was found to consist entirely of paraffin.

STATED MEETING, HELD MAY 1, 1911

The Vice-President, Dr. John H. Gibbon, in the Chair.

RESULTS AFTER REMOVAL OF AN EPITHELIOMA OF THE MANDIBLE, INVOLVING THE FLOOR OF THE MOUTH, THE CONTIGUOUS SURFACE OF THE TONGUE, AND THE GLANDS IN THE DIGASTRIC TRIANGLE WITH LIGATION OF THE EXTERNAL CAROTID.

Dr. Addinell Hewson presented a man, aged fifty-four years, who, when first seen February, 1909, presented a growth extending from the median line, on the left side, surrounding the roots of the central left lateral incisor and first bicuspid teeth, and extending into the floor of the mouth. It was of almond shape, ulcerated, and in the last six months had bled slightly. Enlargements in the digastric triangle were distinctly palpable. The growth had been very slow, but in the last two weeks had been rapid. The urinary examination was negative, and the blood examination showed no marked leucocytosis. The hæmoglobin was 87 per cent. Slight increase in the lymphocytes and decrease in the polymorphonuclear neutrophiles. The left external carotid artery was ligated as a preliminary to the operation. The incision for the removal of the growth was made in the median line and carried along the caudal margin of the mandible as far as the facial growth. A stout ligature was passed through the tongue, and a Gigli saw introduced, severing the mandible at the right canine tooth. The saw was again introduced, severing the mandible ventrad to the left facial growth, thus permitting the tongue floor of the mouth to be in the grasp of the part removed. The incision was now completed, removing a portion of the growth on the under surface of the tongue, the mylohyoid muscle, the attachments of the glossal and suprahyoid muscles, and the contents of the digastric triangle without involving the incision for the ligation of the left external carotid artery. The glossal muscles and the suprahyoid muscles were fastened to the remainder of the mandible on the right side, the margins of the tongue to the remains of the caudal fornix of the vestibule of the

mouth, the wound closed with interrupted sutures, and a wick introduced in the bottom of each wound. The wound healed with slight stitch abscess, but there was no involvement of the carotid incision. The pathological report of the growth showed the presence of infiltration in the pearly bodies, also some infiltration into the tissue in the floor of the mouth and into the mucous and salivary glands. Some epithelial cells were found in the lymph-glands, and in some there was no infiltration whatever. The patient had an uneventful recovery, and was able to leave the hospital April 1. There was a slight recurrence in the alveolar process about the canine tooth, which was removed in May, 1910. Microscopically, this growth proved to be a slight recurrence. There was, at this time, no enlargement anywhere; patient's health was good, although absolutely adentulous, and compelled to eat soft food. In December, 1910, he reported, complaining of a small tumor about the size of a chestnut in the right supraclavicular region, which was very painful on manipulation. However, no manifestation of any connection with the mouth, and the swelling was treated as a result of cold and soon disappeared. This proved to be a fact, as, when the patient next appeared this growth had disappeared. At this date, May 1, 1911, there has been absolutely no return anywhere. The contraction of the muscles had produced rather a pointed chin, and the interval between the severed portions of the mandible was just the breadth of a finger. The tongue can be protruded to its normal length from the mouth, and the voice sounds give the impression of the patient lisping with a quid of tobacco in the mouth.

THE TREATMENT OF LACERATED AND INCISED WOUNDS OF THE EXTREMITIES.

WITH A REPORT OF FIVE TYPICAL CASES.

BY JAMES A. KELLY, M.D.,

OF PHILADELPHIA.

Visiting Surgeon to St. Mary's Hospital; Associate in Surgery, and Pathologist to the Philadelphia Polyclinic Hospital and College for Graduates in Medicine.

ALTHOUGH marked advances have been made in the technic and treatment of abdominal conditions, our attention is often attracted to the fact that the treatment of lacerated, incised, and punctured wounds of the extremities has not kept pace with the work done in the other branches of surgery, and while the percentage of cases that were treated by primary amputation for destruction of the arterial or nerve supply, or by secondary amputation for gangrene due to thrombosis of infection, is not so great, the fact remains that the ultimate result, as shown in the loss of function, muscular atrophy, contractures, and the often-marked involvement of sutured tendons, nerves, and blood-vessels in one mass of cicatricial tissue, is very poor. This condition greatly limits the usefulness of the individual, decreases his earning capacity, and too frequently ends in prolonged lawsuits for indemnity. It is with the object of bringing this common condition before the attention of the Fellows that I wish to present this report of five typical cases.

CASE I.—*Cartridge shell wound of the arm, involving the brachial artery, basilic vein, and median nerve; circular arteriorrhaphy, circular phleborrhaphy, and neurorrhaphy.*

Mrs. A. G., sixty-six, w. housewife, Germany, admitted to St. Mary's Hospital July 4, 1910. Patient, while walking along the street July 4, 1910, heard an explosion as a trolley car passed and at the same time felt something strike her in the upper arm, accompanied by a sharp stabbing pain in the same region which radiated down the forearm to the hand and fingers. The patient noticed a small amount of bleeding from the wound, and on account of this and the pain went to the hospital.

On admission the arm was thoroughly cleansed and an antiseptic dressing applied. The wound was not considered to be of great importance by the resident physician and he did not notify me until the next morning, when examination showed complete paralysis of the muscles supplied by the median nerve and apparently no injury to other important structures. The arm showed a small transverse wound 1 to 1.5 cm. long on the anterior surface of the right arm about the junction of the middle and upper thirds, through which there was a small amount of blood oozing. The entire inner aspect of the arm was swollen over an area of about three to four inches and was ecchymotic. Radial and ulnar pulses were distinctly palpable, but not as full as on the left side. An X-ray examination showed the presence of a small foreign body about 8 to 10 mm. square.

Under ether anæsthesia longitudinal incision 5½ inches in length was made, with its centre at the wound of entrance. On cutting through the deep fascia a large blood-clot was evacuated, and this was followed by a gush of arterial blood. A tourniquet above the wound and a careful dissection showed a transverse wound of the brachial artery involving half of its calibre, almost complete severance of the median nerve, and a transverse wound of the basilic vein involving its entire calibre. Further dissection revealed a small piece of a cartridge shell about 1 cm. square imbedded in the coracobrachialis muscle. The wound was thoroughly irrigated with hot normal salt solution, the edges of the wound of entrance excised, and the wounds in the brachial artery and basilic vein were closed by circular arteriorrhaphy and phleborrhaphy by Carrel's method. The cut ends of the median nerve were united by means of two fine silk sutures passed directly through the nerve. The operative wound was then closed with continuous catgut sutures uniting the deep fascia and interrupted silkworm gut through the skin. Drainage was provided for through a small stab wound about two inches above the internal condyle, using rubber dam. A dry sterile dressing and an internal angular splint were applied. The wound healed by primary union; the drain was removed in 48 hours, and the sutures at the end of eight days. The patient was discharged at the end of three weeks and recommended to return for massage and passive motion.

Examination three months after operation showed normal

pulsation of brachial and radial arteries, marked atrophy of flexor muscles, anæsthesia over areas supplied by median nerve; marked changes were present in the skin of the hand, particularly the fingers and thumb being thin, smooth, shiny, and cold; the nails were dry, dark in color, striated longitudinally, and there was marked sweating of the palm of the hand. There was marked stiffness of the elbow-joint in a position of semi-flexion, and also of the wrist and phalangeal joints. Voluntary flexion was absent in the fingers, was weak at the wrist-joint, and pronation of the hand was impossible. The patient complained of a general pain throughout the forearm and hand on attempts at movement.

Examination six months after operation showed a moderate return of sensation, muscular power, and a lessening of atrophic changes.

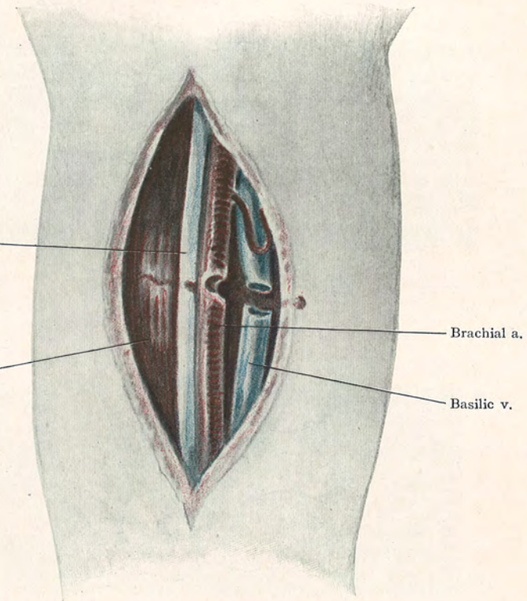
Examination March 30, 1911, showed a moderate degree of muscular atrophy, motions at elbow and wrist free, pronation and supination normal, flexion of fingers fair, still some trophic changes present over terminal phalanges, nails becoming smooth and normal in color at bases. No pain present on motion. General condition satisfactory.

CASE II.—*Lacerated wound of arm, severing biceps, portion of brachialis anticus, brachial artery, basilic vein, median and ulnar nerves; arteriorrhaphy, phleborrhaphy and neurorrhaphy.*

Jacob G., sixty-six years old, U. S., shuttle maker, admitted to St. Mary's Hospital September 23, 1910, at 2 P. M. Patient while at work had his clothing caught in a portion of the machinery and received a lacerated wound of the right arm from a circular saw. Admitted to the hospital in a profound state of shock.

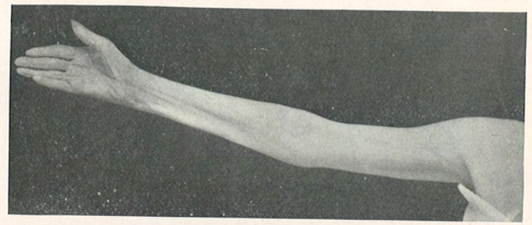
Examination on Admission.—Patient in a profound state of shock. On the right arm there was a lacerated wound about six inches in length, extending from the junction of the middle and upper thirds on the external surface running downward and inward. Inspection of wound showed the biceps muscle, the brachialis anticus muscle, brachial artery, the basilic and cephalic veins, the median and ulnar nerves to be completely severed and the cut ends retracted, and the wound partially filled with blood-clot. The bleeding had been temporarily controlled by means of a cloth tourniquet. The patient was given an intravenous injection of one litre of normal salt solution, a shock

FIG. 1.



Lesion present after exposure by incision. (Case I.)

FIG. 2.

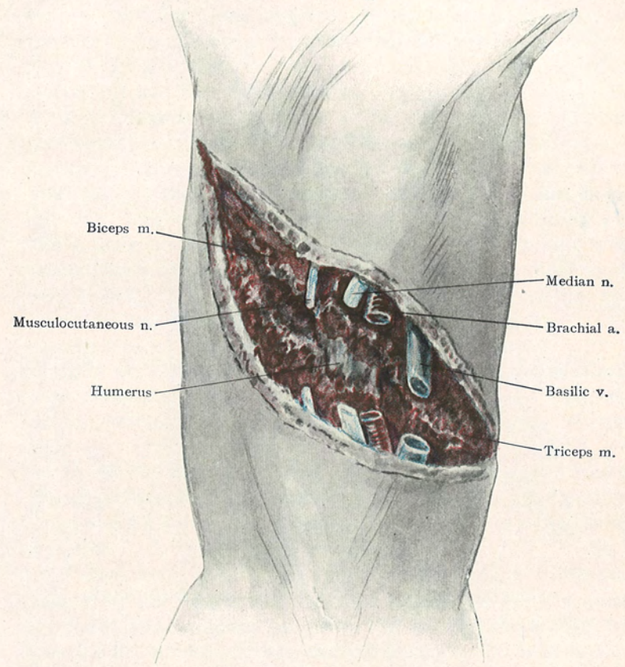


Shows healed wound with scar of punctured wound at centre. Hand in position of full extension. Note the degree of atrophy still present. (Case II.)

FIG. 3.

Shows the degree of flexion present, which is limited entirely by the stiffness present in the phalangeal joints. (Case I.)

FIG. 4.



Showing the extent of the lacerated wound. (Case II.)

enema and a temporary antiseptic dressing placed around the arm. At the end of three hours the patient had sufficiently reacted from shock to warrant operative intervention.

The patient was given morphine ¼ gr., atropine 1/100. The arm was thoroughly cleaned with soap and water and alcohol 70 per cent., and the wound irrigated with hot normal saline solution. Circular arteriorrhaphy of the brachial artery and circular phleborrhaphy of the basilic vein were performed, using the method of Carrel. It was then found necessary to give the patient a little ether to continue the operation. The cut ends of the median and ulnar nerves were sutured with fine silk by the direct method, and the cut portions of the biceps and brachialis anticus muscles were sutured with No. 1 interrupted chromic catgut, the fascia and skin being united with interrupted sutures of silkworm gut and drainage provided for at the lower angle of the wound with rubber dam. A sterile dressing and an internal angular splint were then applied. The patient was fully stimulated, and in spite of everything that could be done he failed to react and died about ten hours after leaving the operating room.

CASE III.—*Incised wound of the arm involving the brachialis anticus muscle; the tendon of the biceps, the basilic vein, the median and ulnar nerves, tenorrhaphy, myorrhaphy, neurorrhaphy.*

M. McD., sixteen years of age, schoolboy, admitted to the Polyclinic Hospital, September 8, 1910, service of Dr. Louis A. Steinbach, to whom I am indebted for the privilege of reporting this case.

Patient while painting the outside of the window frame was supporting his weight with his hand against the window pane, when the latter suddenly gave way and the patient partially fell through the window severely cutting his right arm with a piece of the broken glass. Admitted to the accident room of the hospital in a state of shock with a tourniquet around the upper part of the arm.

Examination on admission showed patient to be in a moderate degree of shock. The right arm presented an irregular incised wound about four inches in length, beginning at the junction of the middle and lower thirds of the arm on the anterior surface running downward and inward. Retraction of the edges of the wound showed complete severence of the

tendon of the biceps, a portion of the brachialis anticus muscle, the basilic vein, the median and ulnar nerves. Under ether anæsthesia the arm was cleaned with soap and water and alcohol 70 per cent., and the wound irrigated with hot normal saline solution. The separated portions of the brachialis anticus muscle and the tendon of the biceps muscles were sutured with No. 1 chromized catgut, the divided median and ulnar nerves were united with interrupted sutures of fine silk, the cephalic vein was ligated, and the fascia and skin closed with interrupted silkworm gut sutures. Drainage was provided for at the lower angle of the wound, and a dry sterile dressing applied. The wound showed a marked degree of infection several days after operation, which necessitated the removal of several of the sutures. The patient was discharged to the out-patient department for subsequent treatment September 24, 1910, sixteen days after admission. (Dr. Butler, Chief Resident.)

Examination March 30, 1911, showed normal flexion at the elbow, restricted motion of the wrist and of the fingers, most marked in the ring and middle fingers, still loss of sensation of index, middle, ring, and little fingers on flexor surfaces. Pronation and supination were still impaired.

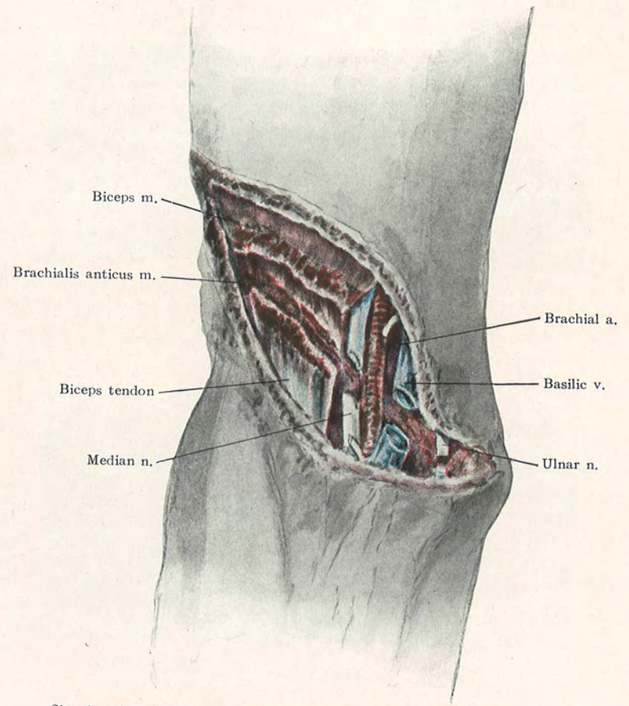
CASE IV.—*Incised wound of forearm, flexor surface, involving the tendons of the flexor carpi ulnaris, palmaris longus, flexor sublimis digitorum, flexor profundus digitorum, excepting the division to the index and middle fingers, the ulnar artery, and the median ulnar nerves; multiple tenorrhaphy, neurorrhaphy.*

E. P., thirty-seven years of age, machinist. Accident occurred January 18, 1911. Patient, while at work at Cramp's shipyard, was struck on flexor surface of right wrist by a piece of a falling arclight globe.

Examination on admission showed a transverse incised wound about two inches in length on the flexor surface of the right forearm one inch about the hand. Through the separated edges of the wound were seen the cut ends of the ulnar and median nerves, the cut ends of the ulnar artery, the divided ends of the tendons of the flexor carpi ulnaris, the palmaris longus, the flexor sublimis digitorum, and the flexor profundus digitorum, excepting the divisions to the index and middle fingers.

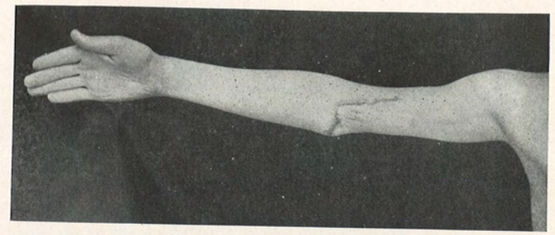
The operation was performed by the Resident Physician, Dr. McBride, without an anæsthetic, as the patient refused an anæs-

FIG. 5.



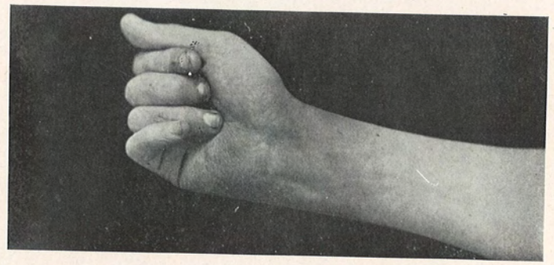
Showing the extent of the lacerated wound and the involved structures. (Case III.)

FIG. 6.



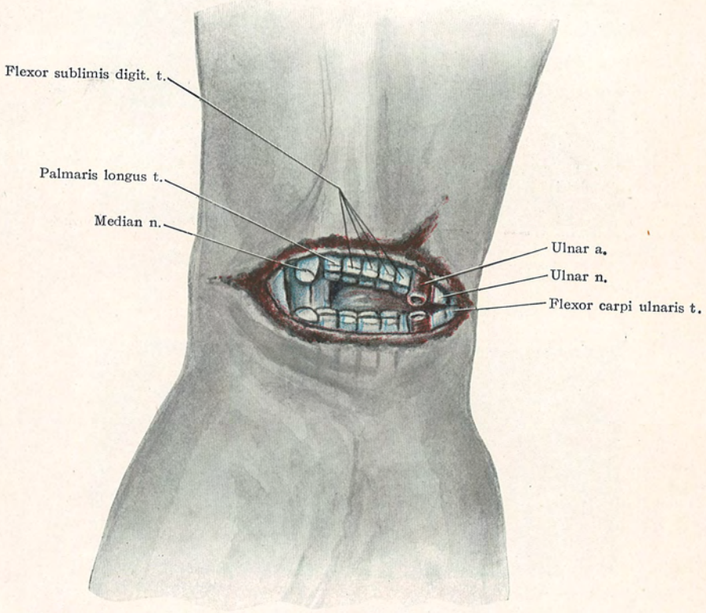
Showing the healed wound, the muscular atrophy, and the degree of extension of the hand. (Case III.)

FIG. 7.



Showing the degree of flexion possible. (Case III.)

FIG. 8.



Showing the extent of the incised wound and the involved structures. (Case IV.)

FIG. 9.

Showing the healed wound and the amount of extension. (Case IV.)

FIG. 10.

Showing the degree of flexion possible. (Case IV.)

thetic. The arm was cleansed with soap and water and alcohol 70 per cent., and the wound irrigated with hot normal saline solution. The severed tendons were united individually with two interrupted sutures of silk, the cut ends of the nerves were united with interrupted silk sutures, the ulnar artery was ligated, the wound closed with interrupted silkworm gut sutures, a dry sterile dressing applied, and the hand dressed in extension on a splint. The wound healed by primary union, the sutures were removed on the eighth day and the splint at the end of two and a half weeks. Massage and passive motion were then instituted.

Examination March 30, 1911, showed the affected tendons to be firmly surrounded by scar tissue and united with the cicatrix of the skin; flexion of all the fingers was limited, particularly that of the ring and little fingers; cutaneous anæsthesia of hypothenar portion of the palm of the hand and the outer side of the ring and of the little fingers. There was marked tremor of the hand, which was cold and perspiring; the finger nails were moderately darkened, irregularly ridged, and longitudinally striated. The skin of the hand was thin, shiny, and bluish white. The scar was very tender and supersensitive. (In this case there is evidently separation of the cut ends of the ulnar nerve and a secondary nerve suture will be required.)

CASE V.—*Incised wound of the flexor surface of the forearm one inch above the wrist-joint, involving the tendons of the flexor carpi ulnaris, the palmaris longus, the flexor carpi radialis, the flexor longus pollicis, the flexor sublimis digitorum, the flexor profundus digitorum excepting the divisions to the ring and little fingers, the median and ulnar nerves, and the ulnar artery; multiple tenorrhaphy and neurorrhaphy.*

F. N., thirty-seven years of age, machinist. While at work the patient fell a distance of about 15 feet onto a skylight, the latter breaking, and he received an incised wound of the right wrist in addition to other injuries. Admitted to St. Mary's Hispital August 3, 1910. Treated by Dr. Wolf, Resident Physician. Ether anæsthesia.

Examination on admission showed a transverse lacerated wound about two inches in length of the flexor surface of the right forearm about one inch above the hand. Separation of the edges of the wound showed complete division of the flexor carpi

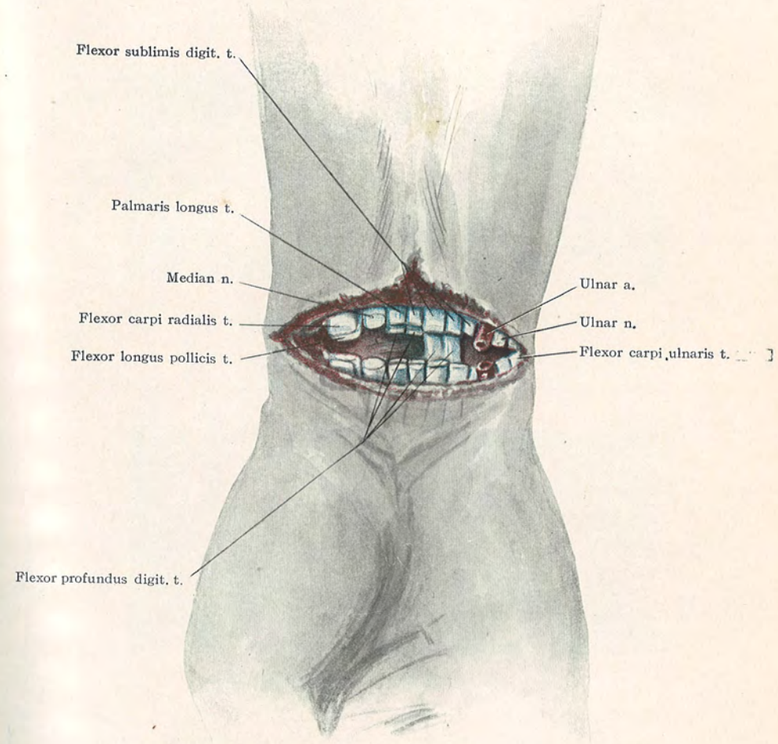
ulnaris, the palmaris longus, the flexor carpi radialis, the flexor longus pollicis, the flexor sublimis digitorum, the flexor profundus digitorum excepting the divisions to the ring and little fingers of the latter; division of the median and ulnar nerves; and of the ulnar artery.

The forearm was thoroughly cleansed with soap and sterile water and alcohol 70 per cent. The wound was then irrigated with hot normal salt solution. The wound was then enlarged; the divided tendons were united separately with interrupted sutures of No. 1 chromicized catgut; the ulnar artery was ligated, and the divided ends of the median and ulnar nerves were separately united with through-and-through interrupted sutures of No. 1 chromicized catgut. The wound was then closed by interrupted sutures of silkworm gut. A dry sterile dressing was applied, and the hand and fingers placed in a position of marked flexion. The wound did nicely until the fourth or fifth day, when it was necessary to remove several sutures on the radial side of the wound, and it was found that there was a moderate degree of suppuration present which eventually resulted in a partial sloughing of the tendon of the flexor longus pollicis and separation of the cut ends. At the end of three weeks the wound had entirely healed. The patient has had very thorough and efficient massage since leaving the hospital, and is now at work.

Examination March 30, 1911, showed very little atrophy of muscles, extension of the fingers was good, excepting that of the distal phalanges; extension of the thumb was limited by the fixation of the distal end of the flexor longus pollicis at the wrist, and flexion was absent for the same reason; and in addition it was apparent that the site of suture had given way, and the cut proximal end had retracted. Flexion of the fingers was good in all, but was still somewhat diminished in the ring and little fingers. Complete flexion was limited by adhesion of the tendons at the site of the injury. Trophic changes were still present, although rapidly diminishing on the fingers; the flexor surface of the fingers felt cold, also tips on extensor surfaces, skin was atrophic, and nails were slightly roughened and longitudinally striated.

The most common cause of incised and lacerated wounds of the extremities is from machinery accidents, gunshot wounds,

FIG. 11.



Showing the incised wound and the involved structures. (Case V.)

FIG. 12.

Showing the degree of extension possible in the fingers, and the fixation of the thumb (Case V.)

FIG. 13.

Showing the degree of flexion possible. (Case V.)

explosions, cuts from scythes, glass, and sharp cutting instruments. In these accidents there is not only division of the superficial structures, but generally also division of muscles, tendons, blood-vessels, and nerves. In addition to the injury of the special structures there is very frequently, in lacerated wounds, a considerable destruction of the skin.

On first examining these wounds many problems are to be considered, dependent upon the extent of the wound and the structures involved. In the severe lacerated and incised wounds, where formerly amputation was the justifiable procedure, to-day entire parts are saved, useful limbs are preserved, and good functional results obtained by suture of muscles, blood-vessels, nerves, and tendons. Very frequently considerable judgment is necessary to come to the best possible conclusion, and in some cases operative procedure should be delayed on account of the shock so frequently present in many of these cases. Our primary interference should be limited to moderate cleansing, the removal of imbedded portions of clothing and foreign bodies, the ligation of small arteries, and an antiseptic dressing applied to the parts until the patient has thoroughly recovered from shock.

One of the most important problems in the treatment of these wounds is that of infection introduced at the time of the accident, either from the patient's clothing, his skin, or from the foreign body that produced the wound. Another very important consideration is the period that has elapsed from the time in which the wound was received and the time of seeing the patient. These two points have a great determining factor in the production of infection. In the treatment of these wounds they must all be generally considered as infected. We, however, know that very many of them can be thoroughly cleansed, and that they will heal by primary union. This is especially so of incised wounds. It is only from experience that we learn which ones should be drained, and which will probably heal without drainage. The chief infections to be feared are tetanus, streptococcus, gas bacillus, and staphylococcus forms. The great determining factors in the production of

infection are the condition of the parts, clothing, and trauma at the time of the injury. A secondary determining factor in the extent of infection is the amount of the destruction of tissue produced by crushing. In addition to infection the most dangerous immediate effect of these wounds is hemorrhage. Fortunately to-day our means of combating hemorrhage are very efficient, and in the use of normal saline solution by hypodermoclysis, proctoclysis, intravenously, and in the more urgent cases by direct blood transfusion we are generally able to meet all of these cases successfully, if the patient is seen early enough and there is not too great a degree of shock present.

In many of these wounds the chances of primary union are not good unless they are caused by clean, sharp cutting instruments and thorough cleansing of the parts is instituted. In a large majority the edges of the wound are primarily grossly infected, crushed, and devitalized, and in spite of the most thorough cleansing, dirt and grease cannot be entirely removed from the skin, and the edges of the wound in its entire depth have been so badly devitalized that either sloughing occurs in clean wounds or the resistance of the parts has been so lowered that infection readily occurs. An interesting form of treatment in these cases is that suggested by Reclus, who prefers never to irrigate with antiseptic solutions, who does not advise primary closure of the wound, and who dresses the wound with antiseptic ointment of vaseline 300, antipyrine 5, boric acid 3, salol 3, iodoform 1, carbolic acid 1, bichloride of mercury 10. He irrigates the wound with hot water under high pressure and then places the above ointment directly to the wound. In the treatment of these wounds I think that the best results are to be obtained from the following methods: thorough washing with soap and water, shaving the entire part, a second washing with soap and water using a firm brush, then washing the parts with alcohol 70 per cent. for two minutes, and in cases where the skin is covered with grease or any other oily substance to wash with ether. The wound should be thoroughly irrigated with hot normal saline solu-

tion, all foreign particles removed, and all badly soiled and devitalized tissue should be cut away with a sharp knife.

After the above cleansing has been performed, a careful examination of the wound should be made for divided muscles, tendons, blood-vessels and nerves. The thorough approximation of these structures, especially the last two, is very important. Very often it will be found necessary to enlarge the superficial wound and to make a rather extensive dissection before the divided ends of all of the cut structures can be found. When deliberate suture has been performed, drainage of the wound must depend upon the degree of soiling by infectious material, the length of time that has elapsed since the accident, the amount of pressure destruction of the edges of the wound, and its position. The importance of a careful search for cut structures cannot be too greatly emphasized. How frequently do we see cases of comparatively trivial superficial wounds, in which division of important tendons and nerves has not been recognized until the resulting paralysis and atrophy call our attention to the nature of the injury!

EXPERIENCES IN THORACIC SURGERY UNDER ANÆSTHESIA BY THE INTRATRACHEAL INSUFFLATION OF AIR AND ETHER.

WITH REMARKS ON THE VALUE OF THE METHOD FOR GENERAL ANÆSTHESIA.

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About two years ago, Meltzer and Auer first described the method of artificial respiration by the intratracheal insufflation of air. In later publications they showed that in animals the method was of great value for experimental investigations in which one or both pleural cavities had to be opened. They described a very simple method by which the animals could be anæsthetized by intratracheal insufflation of air and ether, and expressed their belief that the method would be of great value for thoracic surgery in the human being. Soon afterward, Carrel made use of the method for his operations upon the heart and aorta of dogs, and recommended it for intrathoracic experimental work. At the same time, the writer had been making a large number of investigations on dogs, and with the aid of Dr. Neuhof had performed a not inconsiderable number of operations upon the lungs, the bronchi, and the œsophagus in these animals. Thus we removed one or several lobes of one or both lungs, made incisions into bronchi, with subsequent suture, etc. In all of these operations the method of intratracheal insufflation worked admirably. One or both pleural cavities could be widely opened, and all the necessary intrathoracic manipulations performed and the animals remain in good condition throughout the operations. After the thoracic wall had been closed by suture and the intratracheal insufflation stopped and the intratracheal tube removed, the animals began to breathe again in a perfectly normal manner. Unless death occurred from sepsis or fol-

lowed from an unsuccessful operative procedure, the animals recovered entirely. When the dogs were killed days, weeks, or months after the operations, the larynx, trachea, and lungs were found in perfectly normal condition.

As has been described in previous papers, the insufflation was carried on by means of a very simple apparatus which had been devised by Meltzer and Auer, and no care was taken to filter, warm, or moisten the air which was blown into the trachea. Nevertheless no lesion could be found post mortem in the respiratory tract of these dogs. The anæsthesia was a very good one and seemed to be absolutely devoid of danger. It is well known that it is easy to kill a dog by means of ether given by inhalation, but we have found it impossible to kill the animals with ether given by intratracheal insufflation. This safety is probably due to the fact that so much of the ether escapes upward in the trachea and out through the larynx and mouth.

In previous papers, I have described a simple and portable apparatus for intratracheal insufflation anæsthesia in man. In what follows I shall give an account of our experiences with the method for general anæsthesia and shall report upon the cases of intrathoracic surgery which we have had up to the present time.

The Value of Insufflation Anæsthesia for General Surgery.—We have, at Mt. Sinai Hospital, New York, anæsthetized about 200 patients by means of intratracheal insufflation, and have found the method very valuable for a great many operations. In all but a few cases, the anæsthesia was a very satisfactory one, particularly free from complications and after effects. It is very easy to keep the patients under full anæsthesia, vomiting has never occurred during the anæsthesia, and the patients were never too deeply under the ether. At the conclusion of the operations, the patients awakened very rapidly, especially if pure air was insufflated for a few minutes before the intratracheal catheter was withdrawn. Vomiting after the operation was very unusual no matter what the surgical procedure that had been performed, and the pa-

tients never complained of pain or discomfort in their laryngeal regions. We have thus far not seen any pulmonary complications after insufflation anæsthesia.

In one patient, we failed to obtain complete muscular relaxation so that the necessary intra-abdominal manipulations could be accomplished.

In the case of a young girl, who was to be operated upon for chronic appendicitis, it was found impossible to cause complete relaxation of the abdominal walls. We finally attempted to obtain complete anæsthesia by means of ether given by inhalation, but the patient still struggled. Only when chloroform was given by inhalation was perfect relaxation obtained.

This patient was evidently one who was refractory to ether. It is possible that the intratracheal tube that we used was too small, so that too much of the air and ether mixture escaped by the side of the tube.

Operations under insufflation anæsthesia were performed upon patients suffering from a variety of acute and chronic surgical diseases. Our experience up to the present time will allow us to mention the following operations in which we have found the anæsthesia of especial value. In operations upon the neck and more especially those around the trachea such as thyroidectomy, the method is very useful. Not only is the anæsthetizer never near the field of operation, but the operator can work around the trachea without causing any interference with the breathing. There is no danger of sudden collapse of the trachea when a large goitre has been removed, and no matter how much the trachea is handled, the anæsthesia continues smoothly and evenly. Intratracheal anæsthesia should be very advantageous for the operation of laryngectomy. The intratracheal tube could either be introduced through a tracheotomy wound and the trachea packed with gauze above this point, or the tube could be passed through the glottis in the usual manner, and removed only at the moment when the trachea is to be divided across after the entire larynx is free.

We have found that operations upon the face and jaws

and mouth, where the buccal cavity or pharynx has to be invaded, are made more easy and safe when done under insufflation anæsthesia. No blood or secretions can run down the trachea, for the out-flowing current passing upward in the trachea blows out any fluid that might run down into the larynx.

In operations upon the brain and spinal cord where the patient must often be placed in the prone position, the anæsthesia is very useful. As soon as the intratracheal tube has been introduced and the insufflation has been begun, the patient's head and body can be placed in any position desired and the anæsthesia given from a distance. The anæsthetizer need not be seated underneath the table as is ordinarily necessary.

Experiences with Insufflation Anæsthesia in Thoracic Surgery.—Insufflation anæsthesia is a positive pressure method and was primarily suggested for intrathoracic surgery. On account of the simplicity and apparent safety of the method it may take the place of all the more complicated positive and negative pressure cabinets. The operations upon animals gave such very satisfactory results, that we were very hopeful that the method would give as good results in thoracic operations in the human being. We were very careful in our first human operations, but, with increasing experience, have gained more and more confidence in the efficiency of insufflation in man. In the following are recorded the experiences we have had up to the present time:

CASE I (Reported in the ANNALS OF SURGERY, July, 1910).—*Abscess of the lung; thoracotomy and aspiration of the lung under intratracheal insufflation. Recovery.*

B. F., a butcher, fifty-five years of age, was referred to the II Surgical Service by Dr. Manges with the diagnosis of an abscess of the middle lobe of the right lung.

February 14: The patient was anæsthetized with ether, and the attempt was made to introduce a small catheter into the trachea. The patient took the ether very badly, and I did not have on hand the proper kind of a tube nor the necessary instruments for the intubation. After a number of unsuccessful attempts to pass a catheter through the larynx we determined to put off the intubation until a later time. The operator (Dr. Lilienthal) then resected four inches of the eighth and ninth ribs and packed the wound cavity with gauze.

February 20: Operation by Dr. Lilienthal, intratracheal insufflation by Dr. Elsberg. Ether anæsthesia; larynx and pharynx thoroughly anæsthetized with cocaine. A soft rubber tube, No. 28 French scale, was passed through the glottis by means of a laryngeal forceps and pushed downward until a slight resistance was encountered. The tube was then fixed to the upper teeth by means of a gag. The tube was connected with the insufflation apparatus and a mixture of air and ether blown in under a pressure of 15 mm. of mercury. The patient began to cough violently, therefore the intratracheal tube was withdrawn about one inch. The coughing ceased at once, and at the same time all evidences of mucus in the trachea or pharynx disappeared. The patient's color was good, respirations regular, pulse of good quality. The patient was now turned on the left side and the operation begun.

3.10—No cyanosis, pulse 120; incision 12 cm. in length into right pleural cavity; pulse unchanged, color good, no cough. Pressure of current now raised to 20 mm. Palpation of the lobes of the right lung.

3.20—Pulse 108; respirations 48; color good with slight cyanosis; pleural cavity is wide open.

3.25—Heart action excellent; pulse 96; color good, no cyanosis; aspiration of middle lobe of lung.

3.30—Pulse 105; respirations 42; color good.

3.35—Pulse 108; respirations regular, 40. The current of air is interrupted several times in order to observe the appearance of the lung. When the current is prevented from entering the intratracheal tube the lung collapses and is of a dark green mottled color; when the lung is markedly distended (25 mm. pressure) the lung is of a bluish color with areas of red. When the lung is collapsed the œsophagus and aorta can be seen and examined.

3.40—Suture of incision in pleura. While the last stitches are being passed the pressure is raised to 30 millimetres in order to slightly overdistend the lung so that as little air as possible shall remain in the pleural cavity.

3.45—Pleura closed with small drain; pulse 132 and of good quality.

3.50—Color good, no cyanosis; respirations 32.

3.55—Suture of muscles and skin; voluminous dressing. The intratracheal tube is withdrawn. Pulse now 120, of good quality; respirations regular, no cyanosis.

Four minutes after the patient was taken to his bed he was awake. He said that he did not have any pain in his larynx; he was not hoarse. The morning after the operation the patient was in very good condition. He complained of some pain in the right chest and had considerable mucopurulent expectoration. He was not hoarse and did not complain of any pain in his laryngeal region. The auscultation of the right side of the chest through the bandages was not satisfactory, but breathing sounds could be heard over the entire side.

From this time on the patient steadily improved, the cough and expectoration grew less daily; he was out of bed on March 10 and was discharged from the hospital with his wound almost healed on March 25. When last seen (April 22) he was in excellent condition; the breathing sounds over the right side of the chest seemed normal; he had almost no cough and practically no expectoration; he had gained considerable flesh and strength.

The patient returned to the hospital about six months later on account of a large pulmonary hemorrhage. He had another large hemorrhage from the lungs soon after his admission, to which he succumbed. No autopsy could be done.

CASE II.—John H., fifty-two years of age, admitted to Mt. Sinai Hospital on January 2, 1911, with the history of increasing difficulty in swallowing for ten months. He had lost 40 pounds in weight and was able to swallow only small quantities of fluids. The stomach tube was arrested 12 cm. from the teeth, and an X-ray picture taken after the ingestion of bismuth showed a marked narrowing of the œsophagus at this point.

On January 7 the patient was anæsthetized with ether in the usual manner, a catheter No. 24 French introduced into the trachea, and intratracheal insufflation begun. The patient was turned on the right side, and an incision was made in the seventh intercostal space from the costal cartilage in front to the angle of the ribs behind (Dr. Elsberg). The incision was deepened through the muscles until the pleura was exposed. The lungs were now momentarily collapsed while the incision in the pleura was made. The ribs were now drawn apart by means of the rib spreader and the left pleural cavity widely exposed. The lungs were of a mottled pink color and moderately distended (pressure 30 mm.). Pulse slow and of good quality; very superficial respiratory movements. The lung was now carefully drawn toward the median line and the pericardium exposed; this was also drawn to the right so that the root of the lung was visible as well as the aorta and the œsophagus with the left vagus nerve.

About five inches above the diaphragm there was a hard nodular tumor of the œsophagus of the size of a large plum. There were no enlarged glands at the root of the lung. The tumor was free on all sides excepting where it lay against the aorta. The attempt was made to free it from its attachments to the aorta, but this was found impossible without great danger to the wall of the vessel. The tumor was, therefore, considered inoperable.

The incision in the pleura was closed by a fine running cat-

gut suture, with interrupted sutures of strong catgut around the adjoining ribs. When the last stitches in the pleura were being passed, the anæsthetizer was instructed to raise the pressure to 50 mm. of mercury, so as to distend the lung and expel as much air as possible from the pleural cavity. Then followed suture of the intercostal and pectoral muscles and skin in the usual manner. Large vaseline gauze dressing.

During the entire operation, which had lasted 57 minutes, the patient was in good condition; color of face pink, breathing superficial, pulse of good quality. Insufflation of pure air for three minutes at end of operation; then removal of intratracheal catheter.

Five minutes later the patient was awake and responded to questions. Four hours after the operation the respirations were 24 to the minute, and upon auscultation through the dressings, breathing sounds could be heard all over the left chest.

Convalescence thereafter was smooth and uncomplicated; the patient never had any respiratory difficulty; his pulse and respirations were practically normal; he was sitting up in bed on the third day after the operation.

On the evening of the sixth day after the operation, his temperature suddenly rose to 102°, and he suddenly complained of severe pain in the left chest, his pulse became very rapid and feeble. In spite of active stimulation he soon went into a condition of collapse and died a few hours later.

The post-mortem examination showed that there had occurred an infection of the pleural cavity by direct extension from the ulcerated carcinoma of the œsophagus.

Remarks.—From the stand-point of the insufflation, the operation was highly successful, and all the manipulations within the chest were accomplished with perfect ease. The lungs were distended and collapsed at will, and all parts of the pleural cavity could be well exposed. At no time was the operator disturbed by violent movements of the lung; the slight respiratory movements which the patient made were not at all communicated to the lung, which remained practically immobile. The fatal outcome was probably due to an infection from the ulcerated tumor, although an operative infection may have occurred.

CASE III.—*Abscess of the lung in a man of twenty-four years. Chronic abscess of the middle lobe of the right lung.* Marked cyanosis during the preliminary ether anæsthesia by inhalation. Color became good as soon as the insufflation anæsthesia was begun; pulse good during the entire operation. Thoracotomy; incision of the lung; drainage of an abscess cavity in the middle lobe of the right lung (Dr. E.). Uncomplicated convalescence with persistence of bronchial fistula. Death after several months from a metastatic abscess of the brain.

CASE IV.—Female. *Bronchiectatic abscess of the right lower lobe.* Thoracotomy and exploration of the lung (Dr. E.) under insufflation anæsthesia (pressure 25 to 35 mm.). Condition of patient good during entire operation. The abscess cavity had emptied itself before the operation and could not be found.

CASE V.—Female. *Metastatic abscess of the lung after an infarct following another operation.* Intratracheal insufflation, thoracotomy and drainage of abscesses in left upper and lower lobes (Dr. E.). Condition of patient during operation good. Breathing movements ceased as soon as pressure is raised to 40 mm. of mercury. Recovery from the operation rapid and uncomplicated, but fever persisted. Patient died about six weeks after the operation. The autopsy showed that there were numerous abscesses that had not been drained.

CASE VI.—Female. *Interlobar empyema.* Thoracotomy and drainage under insufflation anæsthesia (Dr. Gerster [1]). Recovery.

CASE VII.—Female. *Gangrene of the lung.* Intratracheal insufflation anæsthesia. Marked cyanosis during preliminary anæsthesia; insufflation of air, oxygen, and ether. Color pink after insufflation was begun. Thoracotomy and drainage of gangrenous areas in right lung (Dr. Gerster [1]). Insufflation anæsthesia very satisfactory; satisfactory recovery from the operation itself. Death about one week after the operation from exhaustion from the sepsis.

CASE VIII.—Male. *Interlobar empyema.* Intratracheal insufflation. Thoracotomy and drainage (Dr. E.). Insufflation anæsthesia very efficient; lungs could be distended and collapsed at will. General condition of patient remained good during the entire operation. Uncomplicated recovery.

[1] I am indebted to Dr. A. G. Gerster for permission to include his two cases.

CASE IX.—Female, operated upon in Worcester, Mass. *Recurrent carcinoma of chest-wall* after extirpation of breast for carcinoma seven years before. Insufflation anæsthesia; catheter No. 24 F. used; pressure 25 mm. of mercury. Radical extirpation of affected area of right chest-wall with parts of two ribs and of the sternum. Large opening in right pleural cavity. When pleura was opened, lungs were found moderately distended and immobile. Opening in pleura closed by continuous suture of fine catgut; while last stitch was passed pressure raised to 40 mm. so as to expel as much air as possible from the pleura. Suture line of pleura covered by a muscle flap from the serratus. Suture of skin with the aid of plastic flaps; large vaseline dressing. Anæsthesia and operation uncomplicated; pulse 90 to 100 during operation; slight respiratory movements during entire insufflation. Patient awake before she had been removed from the operating table. Convalescence thus far uneventful.

In all of the thoracic operations above reported, as well as in a large number of thoracotomies for empyema that we have done, the anæsthesia was a very good one. In not a single instance were any changes in the patient's condition observed when the pleural cavity was first opened; the pulse remained regular and of good quality and the patient's color remained good. In several of the cases, there were adhesions between the visceral and parietal pleuræ, but in most of the patients whose histories are given above, there were no adhesions, and the practically normal pleural cavity was invaded. We have not yet had occasion to operate upon a patient in whom both pleural cavities have to be opened. Such a case would be the supreme test of intratracheal insufflation. There is, however, every justification for the belief—based upon the results of animal experiments in which both pleural cavities were widely opened, and upon the experiences we have had with insufflation as a method of artificial respiration in several patients in whom all respiratory movements had been abolished—that it will be safe to open both pleural cavities if necessary, as far as the dangers from the double pneumothorax are concerned. The cases here reported are too few to allow one to

draw final conclusions, but they do indicate that in the method of intratracheal insufflation we have at last a simple method for the avoidance of those dangers which have prevented the development of surgery of the intrathoracic viscera.

DR. W. W. KEEN said that eighteen months ago he had the pleasure of seeing Dr. Carrel at the Rockefeller Institute do a remarkable series of operations upon animals, using this method, with a very simple apparatus. The etherizer used the foot bellows, and there were two tubes, one going directly into the respiratory tube while by the other the air passed through a bottle of ether, with a clamp on each. Thus pure air or air with ether vapor could be used in any proportion. It was startling to see Carrel with one sweep of a large knife open widely both thoracic cavities, exploring lungs, heart, and pericardium without the slightest trouble. There was no disturbance of the circulation nor any change in the color of the animal so far as one could judge. Carrel was able then to handle the lungs and displace them and the heart freely. He then severed and anastomosed the aorta, first clamping the aorta above and below the point where he did the anastomosis. He had intended originally to introduce a piece of vena cava that had been in cold storage for a number of days, but the specimen proved not to be a good one, and finally he had to abandon this and sutured the two ends of the aorta to each other. The œsophagus was fully exposed and handled. The operation took about an hour and a quarter. The dog at no time was in the slightest apparent danger of death. The lungs were pink, and whenever it was deemed necessary a little more pressure was put on or the pressure was diminished at will, and finally when the operation was completed the lungs were considerably distended to displace all the air in the thoracic cavity, the walls of the thorax were sutured in layers, and in the course of two or three minutes after the conclusion of the operation the tube was withdrawn and the dog was breathing as naturally as if an abdominal and not a thoracic operation had been performed. Dr. Keen was very much struck at the time with the simplicity of the operation, with the possibility of doing almost any operation by means of this method. It is a vast improvement over the expensive differential pressure chambers. The usefulness of this apparatus will be broadened very much.

Dr. Charles H. Frazier said that he had recently witnessed a demonstration of this apparatus by Dr. Elsberg and he had been impressed with its effectiveness and the apparent freedom from risk. The operation, an appendectomy, was being performed by Dr. Elsberg's assistant. Dr. Elsberg gave his attention wholly to the apparatus which worked perfectly, and while it appears rather complicated, one should readily master its mechanism. It will replace general anæsthesia by the ether drop method in a number of instances, particularly in thoracic operations, in all operations in which the patient is in the prone position (face down) as well as in those about the buccal cavity where there is always danger of the possibility of the inhalation of blood with inhalation anæsthesia. Dr. Elsberg has shown by experiment that the force of the outgoing air is sufficient to prevent particles of blood, or as he used in his experiments lampblack, entering the trachea or bronchi. This is a very practical consideration and should not be lost sight of.

GIANT APPENDIX.

Dr. John A. Jopson showed a giant appendix vermiformis. The patient from whom he had removed it was a woman about fifty-eight years of age, exhibiting the symptoms of acute appendicitis, and who was operated upon the fourth day after the onset. The appendix was retrocæcal, pointing upward and adherent to the posterior surface of the cæcum and colon, and from its peculiar shape, size, and color, not easily recognized. It was separated from its attachment to the posterior wall of the cæcum, and when turned downward appeared as a large pouch communicating with the extremity of the cæcum, which was rather short. It lacked a mesentery, was white in color, and apparently undergoing necrosis, a sharp line of demarcation being present at its base. The base was crushed, ligated, divided, and the broad stump inverted by interrupted sutures. A drain was left in the wound to guard against leakage, but none occurred, and the patient, who suffered from chronic nephritis, made a good recovery. The appendix, which was quite empty, measured 7.5 cm. in length, by 4 cm. in diameter (Fig. 1). The wall was nearly a centimetre thick at the base, and there were two points of beginning perforation at the tip. Microscopic examination of sections was made by Dr. Speese, who furnished the following

Fig. 1.

Giant appendix vermiformis.

report: "The examination does not reveal any glandular tissue or any structure which is suggestive of the same. To some extent the section resembles the normal structure of the intestine, in that some lymphoid tissue is present and arrangements suggestive of the normal coats of the intestine. The outline of these areas is, however, greatly distorted, and the muscle tissue separated by granulation tissue, dense in structure and apparently of long standing. There is an organized exudate or what appears to be the serosa, and throughout the appendix blood-vessels are distended and leucocytic infiltration points to an acute exacerbation. It is noteworthy that many eosinophilic leucocytes are present in the tissues. The examination discloses a process which resembles the lesions of acute and chronic interstitial appendicitis."

The appendix in this case would seem to be a reversion to a primitive type, in which the differentiation between the cæcum and appendix was much behind that normally observed in the human subject. It was interesting to compare it with those observed in some of the lower animals, as figured in Huntingdon's diagrams, reproduced with additional drawings in Kelly and Hurdon's work. In their shape and proportions the cæcum and appendix in this case resembled somewhat those normally present in the aard-wolf, the harbor seal, the collared peccary, and the American tapir.

THE SURGICAL CLINIC OF THE PROTESTANT EPISCOPAL HOSPITAL OF PHILADELPHIA.

REVIEW OF 150 CONSECUTIVE OPERATIONS.

BY CHARLES HARRISON FRAZIER, M.D.,

OF PHILADELPHIA.

THE series of cases herein discussed represent the surgical experience at the Episcopal Hospital in a three months' service, excluding a not inconsiderable number operated upon by one of the assistant surgeons or internes.

Morbidity.—Of the 150 operations of our series almost 100 were for lesions of the abdominal organs. Of the total number there were four deaths, a mortality of about 2.5 per cent. Two of these four deaths, as will be seen, may properly be excluded, so that the mortality may be reckoned as 1.3 per cent. The series include 30 operations for appendicitis and its complications, 22 for hernia, 8 for lesions of the stomach or duodenum, 18 for operations on the pelvic organs with 4 hysterectomies, 4 operations on the biliary passages, 14 upon the urinary organs, and 3 thyroidectomies.

Of the four fatal cases one was a case of tuberculous meningitis, which because of certain focal phenomena was regarded before operation as a brain abscess. An exploratory craniotomy seemed justifiable. The patient survived the operation but a short time, and the autopsy revealed the true nature of the lesion. The second was a strangulated umbilical hernia in an aged patient almost moribund, who scarcely survived the initial incision. These two might be regarded as inoperable.

The third death followed a suprapubic prostatectomy and bilateral herniorrhaphy under spinal anæsthesia in a patient 75 years of age. The patient's condition at the end of the operation was excellent and continued so beyond the period at which post-operative shock would have developed. But his

vital processes gradually failed, and he died three and a half days after the operation. The fourth of the fatal series was in a patient who had been operated upon for gall stones. This case presented some interesting features and will be alluded to later.

Technic.—In the preparation of the field of operation the Grossitch or iodine method was used, preceded by a single preparation with soap, alcohol, and bichloride. The addition of iodine to the technic has so diminished instances of accidental infection that I am disposed to omit altogether any attempt at chemical disinfection with alcohol and bichloride. There was but one frank suppuration in our wounds, and in that instance there were a few small pustules at the site of the wound before the operation to which the infection may be attributed.

In the post-operative period, after operations with incipient or advanced peritonitis, after operations in the upper abdomen, and in all cases of advanced years with few exceptions, the patients were put in the sitting posture for at least 48 hours. This I believe minimizes the incidence of pulmonary congestion and in many instances adds materially to the comfort of the patient.

Proctoclysis was employed wherever for any reason the administration of water or liquids of any character by mouth was prohibited.

Anæsthesia.—The selection of an anæsthetic deserves much more attention than it receives at the hands of most surgeons. No matter how skilled the anæsthetizer may be in the administration of ether, there are certain cases where for the comfort and safety of the patient either spinal or nitrous oxide anæsthesia should be employed. While I do not believe nitrous oxide anæsthesia will ever come to be universally used as a substitute for ether, there are many occasions where it is an important factor in the saving of life. In cases of severe toxæmia, where patients are profoundly septic, as in some cases of gangrenous appendicitis, of peritonitis or gangrenous cholecystitis, in empyemata while resecting the rib, in supra-

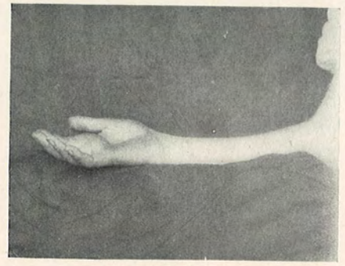
pubic cystotomy for drainage or stone, in kidney decapsulation or nephrectomies in septic cases, or in strangulated hernias; in all these, as in many other minor procedures, there can be no question as to the value of nitrous oxide anæsthesia. Its safety in competent hands is unquestioned; it relieves the patient of the ether discomforts, but above all it minimizes the risk of operation where life is hanging in the balance and the depressing effects of ether would be enough to turn the scale. Where abdominal relaxation is necessary, ether is substituted for a few moments until relaxation is obtained, returning to nitrous oxide.

Spinal anæsthesia, too, has its special indications, it seems to me, particularly in patients with pulmonary tuberculosis and in elderly people, where, because of valvular lesions or myocarditis, the administration of nitrous oxide may be not unattended with risk. In this series I used spinal anæsthesia in the following operations: a colostomy for inoperable carcinoma of the rectum; suprapubic drainage of a large abscess of the pelvic region in a septic patient; in a laparotomy for tubercular peritonitis and another for cirrhosis of the liver; in a suprapubic cystotomy; in a suprapubic prostatectomy; in the repair of a vesicorectal fistula. Scopolamine gr. 1/150 two hours before and morphine sulphate, gr. 1/6 one half hour before the operation so benumbs the sensibility of the patient, that, though conscious during the operation, he suffers from none of the ill effects which might come from fright in a wide-awake patient. From spinal and nitrous oxide anæsthesia there were no ill effects. The only serious complication occurred in an operation for hydrocele. The patient was an alcoholic; after a considerable quantity of ether had been administered without avail, chloroform was substituted, and just as the incision was made the heart stopped beating. Cardiac massage was resorted to by the transdiaphragmatic method, and in the course of a few moments feeble fibrillary contractions could be felt. Gradually the cardiac contractions became more perceptible and regular, and after ten minutes resuscitation was established. The abdominal wound was closed, and the operation on the hydrocele completed. The

FIG. 1.

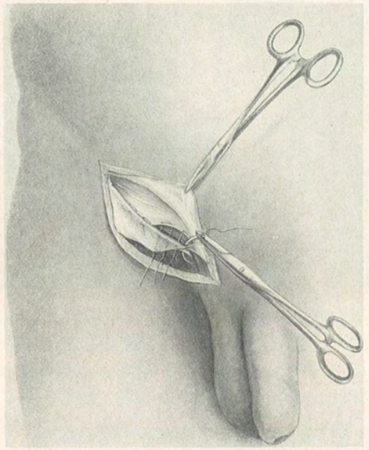
Photograph showing a fibrolipoma of the sartorius muscle mistaken before operation for a hernia. Note protrusion on the anterior surface of the upper portion of thigh.

FIG. 2.



Photograph of a congenital cavernous angioma of the hand with digital extensions.

FIG. 3.



Application of the sutures in the operation for radical cure of inguinal hernia.

FIG. 4.

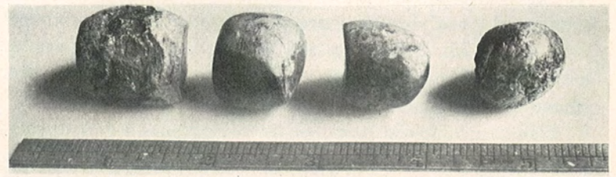
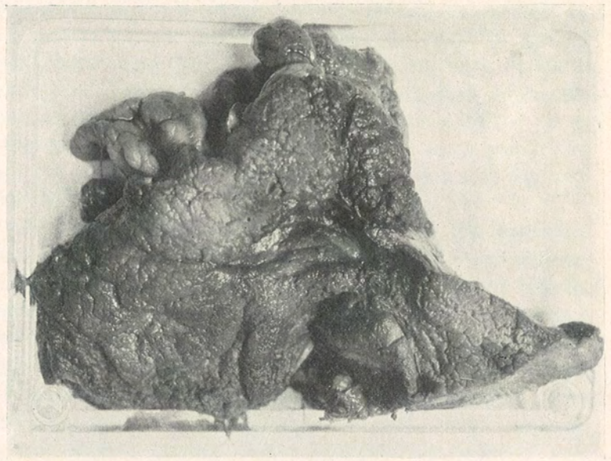


Illustration showing series of gall-stones arranged in column as they were found im bedded in a mass of inflammatory tissue after having escaped from the gall-bladder of a patient who had been free from symptoms until within two months of the date of the operation.

FIG. 5.



Portion of stomach removed, showing in centre of specimen the cavity of an indurated ulcer on the lesser curvature.

patient suffered no relapse, and the subsequent course of events was uneventful.

Tumors.—Curiously enough the district upon which the hospital draws for its material is not a fertile one for tumors. Relatively speaking there are few operations for cancer, exclusive of the uterus, and I have often attributed the paucity of malignant cases in the clinic to the popular impression among the less enlightened classes, that cancer is a disease of the blood and removed by operation always returns in some other place. Of the benign tumors there were three unusual enough to deserve mention. One was a lipoma in the belly of the sartorius muscle, about eight inches below Poupart's ligament (Fig. 1). The tumor protruded above the surface only when the patient contracted the muscle. On first examination the character of the lesion was not suspected; it was thought to be a muscle hernia. The second was a tumor of the breast, which, because of the associated enlargement of the axillary lymph-nodes, was thought to be either carcinoma or chronic cystic mastitis; but upon histological examination proved to be a fibroma. In the third case there was a large congenital angioma involving the palmar surface of the hand (Fig. 2) with digital extensions.

Appendectomies.—In the management of the appendix cases no hard or fast rules were laid down. It was not our practice to attempt to classify our cases as early or late to gratify the statistician, according to whether they were operated upon in the first 48 or 72 hours or later. In the acute cases with few exceptions the operations were performed as soon as the diagnosis was made. To this general rule there were certain exceptions. When the patient was first seen at the end or near the end of a mild attack we consulted our convenience as to the time of operation. Furthermore we advocated the starvation plan in a few cases of the following type: usually some time has elapsed since the onset of the attack; it may be only two days, more likely, however, three to five; the patient looks toxic, he is toxic; his pulse is rapid, over 120; the abdomen is distended and more or less tender everywhere; peristalsis has been altogether or par-

tially arrested, perhaps reversed with vomiting; restlessness and anxiety are written on the patient's face. In other words the infection is a wide-spread one. Sometimes this picture develops earlier, sometimes later, but whenever it comes I am convinced that the best results will be obtained by conservative practice, *i. e.*, by privation as to solids or liquids by mouth, proctoclysis, and posture.

One often hears or reads of bitter disputes as to whether the time limit between the early and late cases should be placed at 48 hours or later. Such discussions are futile, for early or late are but relative terms when applied to a given case. Each case must be a law unto itself, and no rules can be laid down comprehensive enough to allow for the innumerable variations.

It has been said, and very properly, that appendicitis is a surgical disease; no one denies it. The surgeon reserves as his privilege the right to decide upon the operability of a given case; that privilege is usually accorded him. In the exercise of this privilege he selects some cases for the Ochsner treatment and some of those cases may—before being operated upon—die. In the publication of his mortality statistics the surgeon usually excludes these. I believe, however, the time has come when the only means of determining the morbidity of appendicitis is to include in our death-rate those treated by both conservative and operative measures. We used to throw the responsibility on the medical men for all unoperated cases. But we cannot consistently do this any longer, if we take the stand, as I believe we should, that appendicitis is a surgical affection first, last, and always, and reserve the right ourselves to set aside a certain group, as I also believe we should, for conservative treatment. Having assumed entire responsibility for all cases, we must include in our statistics the fatal results in the unoperated as well as operated cases.

Irrespective of the appendices removed incidentally at other operations, there were 30 removed which were found at operation or in the laboratory to be diseased. There were no fatalities in this series, but *apropos* of what has just been said

of the mortality statistics I should refer to the case of a young man, who when first seen on the fifth day of the disease, was desperately sick. I declined to operate, and watched him carefully from day to day. Under the treatment prescribed his improvement with each 12 hours was marked, until four days later the distention had subsided to a marked degree, his tenderness had become circumscribed to the right iliac fossa, the pulse fell to 70, and the clinical picture was transformed from one of general to one of local peritonitis. I had planned to operate on the following day, but in the course of the early morning hours, the patient without warning developed signs of collapse from which he did not rally. No autopsy was performed and the cause of death was a mystery. At the same time it should occupy just as conspicuous a place in my statistics as a death following operation.

The technic of the operation calls for little if any comment save with reference to the matter of drainage. In this I find myself using drainage in an increasingly smaller number of cases, and when drainage is required using less drainage material, rarely anything but split rubber tubing with a wick of gauze. The fundamental principle in draining the peritoneal cavity is the relief of pressure afforded by the opening in the abdominal wall. This need not be larger than to accommodate one or two full sized drainage tubes. I no longer have a wound entirely open and filled with gauze, and I close wounds without drainage sometimes even when there is a small accumulation around the appendix, thoroughly disinfecting the region with alcohol.

Hernia.—Of the hernia series there were 22 cases, of which 13 were indirect and 3 direct inguinal, 2 recurrent, 1 femoral, 2 ventral, and 1 umbilical. There were no unusual types except an irreducible omental hernia in a young adult, a case in which the diagnosis was not established until the operation. Without impulse it presented the earmarks of a lipoma. Of the series there was one fatal case in a large strangulated umbilical hernia of four or five days' duration, in the person of an aged woman who was generously referred to my service by a practising surgeon of a neighboring hospital. The pa-

tient was almost moribund at the time, and did not more than survive the hasty attempt to expose and free the contents of the sac.

The method of procedure in the inguinal type varied according to the character of the hernia; in some instances the simple Ferguson, in some the Bassini, and in others the imbricating method of Andrews was used. In the selection of the method I have always tried to observe the general principle of disturbing in the least degree the normal anatomical relations. Thus in the hernias of children and the incipient hernias of young adults where the rings are not large and the musculature all that could be desired it is not necessary to transplant the cord. After isolating the sac and freeing the neck from its attachments and ligating it an inch beyond the margins of the internal ring, the internal oblique and conjoined tendon were sutured to Poupart's ligament without transplanting the cord; and the wound in the external oblique sutured without imbrication. In complete hernias of longer duration with larger rings the Bassini method was adopted. The remaining group included hernias of still longer duration, where the rings are more or less approximated, all direct hernias, all hernias in elderly people with musculature flabby and without tone, and hernias in which the conjoined tendon is altogether obliterated. Here I invariably resorted to the imbricating method of Andrews, in some cases splitting the sheath of the rectus and using either the belly of the muscle or flap of the sheath to fortify the defective area at the lower portion of the canal. This operation in this particular group is vastly superior to the Bassini method and should always be given preference. In all the operations, the incision in the external oblique is made a little above, instead of directly over, the canal and carried down as Judd recommends above and to the inner side of the internal pillar of the external ring so as to leave this structure intact. In introducing the deep mattress sutures in the reconstructive stage, my practice differs somewhat from the conventional procedure, in that I introduce the needle from the external aspect of the shelving edge of Poupart's ligament, and the knot is tied

in the outer rather than the inner aspect (Fig. 3). This is a matter of but minor consideration, but has been adopted because it avoids the splitting or tearing of the edge of Poupart's ligaments, which sometimes happens when traction in the suture is made to approximate the edges. For this suture I prefer to use a double strand of No. 0 or No. 1 catgut to a heavier single strand, as I always feel a little more confident of the sterility of the finer material.

We are gradually being weaned from the tradition that gall-stones are innocuous in many instances throughout life to be discovered only at autopsy. That many cases of cholethiasis have been treated for many years for stomach trouble we know too well, but in exceptional instances one runs across a patient in whose history there is nothing either indicative or even suggestive of the existence of gall-stones.

Such was the case in K. S., aged fifty, who told me she had never been sick in bed, that she had never been treated for dyspepsia, and had none of the digestive disturbances so common in cholelithiasis much less any of the acute exacerbations of biliary colic or subacute cholecystitis, at least until two months before the operation, when she had attacks of pain in the upper abdomen which had confined her to bed for a while. I questioned her myself with great care, as the physical signs pointed to the biliary passages. There was a mass in the abdomen about the size of a fetal head, extending from the margin of the ribs to the umbilicus. It did not move freely with respiration, and was not continuous with the margin of the liver. Through a right rectus incision I came down at once upon a mass, surrounded by adhesions, which were separated with great difficulty. Finally a cavity was opened containing pus and four large gall-stones (see Fig. 4). These were firmly imbedded in the inflammatory mass, arranged in single column, and faceted at either end where they were in direct contact. There was no escape of bile at any time, and nothing which could be identified as a gall-bladder was seen. The gall-stones, which must have been there months if not years, had ulcerated through the gall-bladder and became imbedded in a mass of inflammatory tissue. For two days the patient's condition was most satisfactory, but on the third day there was for the first time a copious discharge from the wound, which was

believed to be bile. On the fourth day 90 ounces of this fluid were collected.

Her pulse was growing more rapid and weaker, her skin leaky. I was at a loss to account for her rapidly failing strength. I began to suspect the fluid draining in such quantities was not pure bile; specimen examined disclosed hydrochloric acid, and further investigation pointed to a fistulous communication with stomach and duodenum, probably resulting from the trauma incidental to the liberation of the gall-stones from the inflammatory bed. The patient was taken to the operating room again, and through a left rectus incision our suspicions were confirmed. The tissues about the perforation were so fragile that it could not be satisfactorily closed with sutures. Accordingly a gastrojejunostomy was performed and the pyloric outlet closed. The patient did not react and died the following day. Had the true nature of this lesion been recognized sooner, I cannot but feel she would have survived the second operation.

Of the lesions of the upper digestive tract there were in all nine cases, two gastric carcinomas, two gastroptoses, three gastric and two duodenal ulcers. All were operated upon and there were no fatalities. It is interesting to note that in the ulcer cases the proportion of males to females was four to one, a further evidence of the greater prevalence of ulcer in the male sex.

Before discussing the operative procedures in this series I will refer to some interesting facts bearing upon the diagnosis and symptomatology.

In one case, B. F., an engineer, fifty-five years of age, the pre-operative diagnosis was cholelithiasis. There was a history of stomach trouble covering a period of two years, with bilious attacks and occasional vomiting; the patient stated that he had been jaundiced off and on, that his stools had been clay colored, and that discomfort followed eating. There was some rigidity and tenderness over the gall-bladder, and the scleræ were jaundiced. At the operation a typical saddle-back ulcer was discovered, with an unusually extensive infiltration of the gastrohepatic omentum. To the encroachment of this upon the common duct we attributed the signs of obstructive jaundice which led us astray in the diagnosis. The ulcer-bearing area with a portion of the gastrohepatic omentum was resected, and all the symptoms, including those of common duct obstruction, disappeared (see Fig. 5).

The unreliability of the gastric analysis in the diagnosis of gastric or duodenal ulcer or cancer was forcibly illustrated in our cases. As to the presence of hyperacidity or of occult blood in the contents of the stomach or bowel, I am becoming more and more convinced that to wait for such laboratory indications of ulcer is unjustifiable in the presence of a reasonably clear history. It is after all the history upon which we must place the most reliance, and upon which our decision for or against operation must be founded. Unfortunately the "history," so called, is often not an accurate record of the development of the disease in chronologic order, but a collection of isolated facts forced from the patient by a system of cross-examination at the hands of one who often approaches the case with preconceived notions as to the diagnosis and conducts his examination accordingly. A better term, as some one has recently pointed out, is anamnesis, which implies a record of the disease from the patient's recollection, and if the patient is intelligent enough it should be written by the patient and not for him. That one may sometimes be misled, however, by the history is shown in my experience with a young woman evidently neurasthenic in temperament. Although skeptical about the existence of a gross lesion, I was finally persuaded to explore the upper abdomen, because of the very positive evidence of hæmatemesis and of aggravated attacks of vomiting and pain. The findings at the operation were negative and I ascertained afterwards from the patient that she was in the habit of sucking the gums till they bled, swallowing the blood, and then inducing vomiting. Hence the hæmatemesis.

To me an interesting case, because of the difficulty in diagnosis and the duration of the disease, was of a young man then thirty-one years of age, who had been ailing twenty years off and on; at the age of eleven he had an attack of vomiting with abdominal pain which confined him to bed for ten days; and even

prior to that time had what he called indigestion. He had served in the army during the Spanish War, and since then had worked steadily as a machinist. His work had never been interrupted, he ate everything, had never vomited, and never had any blood in stools. His chief and only complaint was pain, worse when the stomach was empty, often having to get up at night for a glass of hot milk or water. There was no occult blood, no hyperacidity, no dilatation of stomach. He was tender over his epigastrium but he was tender also over his appendix. Although the clinical picture did not conform altogether to type, I thought we were dealing with a case of appendicular dyspepsia, a chronic appendix with gastric symptoms, and proceeded accordingly. Through a gridiron incision I explored the appendix, and found it buried in a mass of adhesions, and liberated it with much difficulty. Though there was no doubt as to the existence of a lesion of the appendix, I was still in doubt about the upper abdomen, which I explored through a right rectus incision and found the stomach and omentum plastered to the parietal peritoneum, and on further investigation an ulcer of the lesser curvature. From the extent of the peritoneal invasion there had evidently been at one time some leakage. The operation concluded with a gastrojejunal anastomosis. Recovery was uneventful.

The method of procedure in gastric ulcer necessarily varies. However, I strongly advocate excision of the ulcer when this is feasible, and especially in the large indurative type, including the saddle-back ulcer in patients approaching middle life. It is in this type that carcinoma is most frequently implanted, and for this reason alone, if for no other, we owe it to our patients to practise the more radical procedure. These ulcers should be looked upon as precancerous conditions and treated accordingly. When the ulcer is so situated or so adherent to adjunct structures as to make excision difficult, the pyloric outlet of the stomach should be closed by infolding as the surest safeguard against recurrence and as the most rational way (in the light of our present knowledge of the pathogenesis of ulcer) of securing permanent results. The same practice is indicated, I believe, in duodenal ulcer as well, although in my experience the tendency to recurrence in the latter is not as great as in gastric ulcer. The operations

in this series of gastric cases were carried out according to these principles. In technic the no-loop gastro-jejunostomy, vertical opening was used, the line of sutures protected as Mr. Moynihan suggests with the gastrocolic omentum.

The management of actively bleeding ulcers requires the exercise of one's discretion. Ordinarily I favor palliative procedures.

For example one of our patients, a young woman of twenty-two, with a five-year ulcer history, had three large hemorrhages in five days, once vomiting three quarts and with a large quantity of blood in the stools. On admission she looked exsanguinated, her hæmoglobin was low. I decided not to operate at once, ordered 20 cc. of horse serum given hypodermatically, morphine q.s. to allay pain and restlessness, and small quantities of saline solution by bowel, and an ice bag to the abdomen. After five days of freedom from hemorrhage or vomiting I operated and found an ulcer on the greater curvature. If, on the other hand, the plan of treatment had been of no avail and hemorrhages recurred, with increasing frequency or in increasing amounts, there would then have been but one recourse, immediate operation.

Of the pelvic cases, in fact of the entire series, the most puzzling was in the person of a patient fifty years of age referred to me by Dr. E. F. Walsh. She told me that she had not been well since the birth of her last child three years ago, and prior to that had had one miscarriage, that her menstruation had been regular until the last period now two weeks overdue. She laid emphasis on troublesome attacks of indigestion with vomiting, for which her physician had treated her from time to time. Eight days prior to admission, after a hearty meal, she was seized with a violent pain and vomited. For the next three days vomiting continued but the pain was less severe. She remained in bed with a normal temperature on a liquid diet and on the day before admission she had had another attack of severe pain similar to the first. When I saw her she appeared exsanguinated, her hæmoglobin was 20 per cent., the leucocytes 22,400, and pulse 140; the abdomen was distended, and she referred her pain to the epigastrium and precordium. My first thought in view of the history of digestive disturbance, the intense pain, and attacks of vomiting was hemorrhage from a duodenal ulcer. In

her present condition operation seemed out of the question, so I watched her carefully day by day and gradually the symptoms of the upper abdomen disappeared and were replaced by an area of dulness and tenderness in the lower abdomen. To make a long story short, when her condition justified it I opened the abdomen and found we were dealing with an ectopic gestation. From a pint to a quart of partially organized blood-clot was removed together with the sac. There was no post-operative shock, and convalescence was rapid and uneventful.

Unfortunately the Episcopal Hospital is so far removed from the center of the city as to be inaccessible both for the casual visitor and student alike. This isolation is a great drawback, as there is nothing so stimulating to the whole staff of a hospital, from the highest to the lowest officer, as the constant criticism and searching inquiry of those who are seeking useful information in modern methods of procedure. Because of its isolation the physical equipment of the hospital is known to few of the profession, resident and non-resident. Perhaps the most favorably situated of the larger hospitals for service to the working classes, it has a wealth of material representing the whole field of surgery. Of the lesions of the extremities, there is an extraordinary opportunity to study fractures of every description, and of the abdominal lesions there is a veritable mine of examples of inflammatory conditions of the pelvis, most of which are the result of improper care at childbirth at the hands of incompetent midwives or the patients themselves. To the philanthropically inclined I know of no better object for investment than the establishment of a maternity department for the poor of that district.

The service of this hospital, as of many others, is an interrupted one. The disadvantage of this system pertaining in many institutions is well recognized and so patent as to admit of no dispute. Far better is the European system, where in each hospital a limited number of surgeons devote their entire time to the instruction of young physicians and surgeons and the utilization of the material at their command for the advancement of medicine as a science and an art.

STATED MEETING, HELD OCTOBER 2, 1911

The Vice-President, Dr. G. G. Davis, in the Chair.

EXCISION OF THE ASTRAGALUS FOR FRACTURE-DISLOCATION.

Dr. Astley P. C. Ashhurst presented a man aged 45 years, who was admitted to Dr. Frazier's service in the Episcopal Hospital on August 2, 1911. He had just fallen a height of about 8 or 9 feet, into a hole, landing on his feet, and injuring the left ankle.

Examination showed considerable swelling around the left ankle, but the skin was unbroken. The foot was held in slight plantar flexion but could not be brought up to a right angle with the leg; plantar flexion was possible to the same degree as in the uninjured foot. Lateral motions were very painful and limited. The leg bones were uninjured. The head of the astragalus could be felt beneath the skin, anterior to its normal position, but still articulating with the scaphoid, and retaining its normal relation to the cuboid; beneath the tendo Achillis the posterior margin of the astragalus could be felt indistinctly. The foot was in slight "cavus" position, the anterior tarsus and metatarsus dropping.

A skiagraph (Fig. 1) showed a transverse fracture through the neck of the astragalus, the posterior fragment being dislocated backward leaving only about half of its articulating surface still in contact with the mortise of the ankle-joint. The relation of the posterior half of the astragalus to the calcaneum was not disturbed. The anterior fragment of the astragalus was dislocated forward and outward, the fragments of the astragalus being separated by about one inch and a half.

The dislocation was irreducible, so it was determined to incise the soft parts and if reduction still was impossible, to excise both fragments of the astragalus.

Operation, August 5, 1911, three days after injury. No Esmarch band was employed. An incision about two and a half inches long was made from below the external malleolus forward

to the extensor tendons. A hæmatoma was evacuated from between the fragments; the external lateral ligament of the ankle was found ruptured; the fragments of the astragalus were about an inch and a half apart, and a few loose fragments were present, also belonging to the astragalus. Reduction of either fragment proved impossible. The anterior fragment was then excised without much trouble; but removal of the posterior fragment was very difficult, though finally it was delivered entire, after division of the tendo Achillis (subcutaneous tenotomy). The ruptured external lateral ligament was sutured with chromic catgut, and the wound was closed with buried and skin sutures of the same material. A small rubber tube was introduced into the ankle-joint for drainage, and the foot and leg were encased in plaster of Paris. The time of the operation was about an hour and a half.

The day after the operation the rubber tube was removed through a small window cut in the gypsum case, but the case itself was not removed for six weeks. There was no rise of temperature after the operation, and the wound was found cleanly healed and the sutures absorbed at the first dressing, six weeks after operation. Another gypsum case was worn for a week longer, and the patient encouraged to use the foot in walking.

The photograph (Fig. 3) made seven weeks after operation shows slight thickening and shortening of the foot. Flexion and extension are very nearly normal in extent and painless. Lateral motion is restricted, but sufficiently free, and painless. There is scarcely any disability, and the patient already can walk several squares. Fig. 2 is a skiagraph made eight weeks after operation.

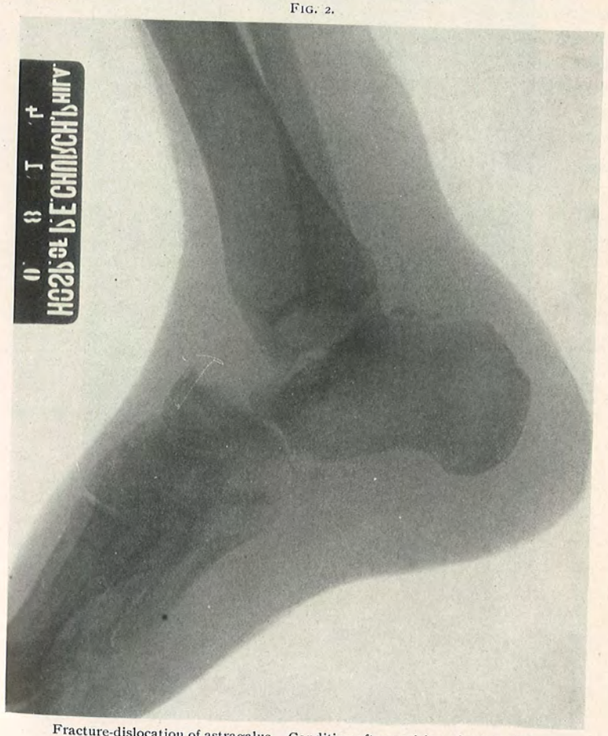
Dr. George P. Müller reported a somewhat similar case seen in the University Hospital in Dr. Frazier's service. The patient, a man 50 years old, had an iron beam fall on his foot. There was a dislocation of the internal cuneiform, inwards and forwards, and a fracture of the second metatarsal, the fragments remaining in good position. He was unable to reduce the dislocation under anæsthesia or after making an incision, and accordingly sawed off the projecting portion. There is now good function.

Dr. G. G. Davis recalled a case of dislocation of the scaphoid in which the bone was still out; it was an old case. It seems that the bone never goes back again, its position not altering much. Dr. Ashhurst's case shows that the good results are lasting, even after as big a bone as the astragalus is removed.

Fig. 1.

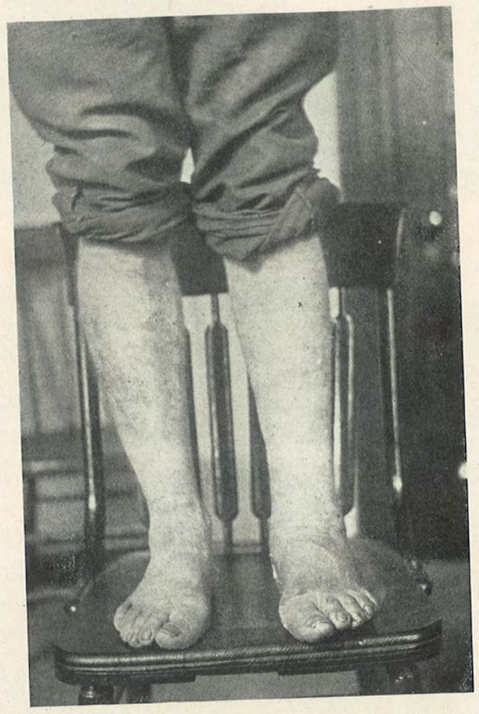
Fracture-dislocation of astragalus.

Fig. 2.



Fracture-dislocation of astragalus. Condition after excision of astragalus.

FIG. 3.



Showing result seven weeks after excision of astragalus for fracture-dislocation.

DR. T. TURNER THOMAS had seen two cases of subastragaloid dislocation, in one of which he knew there was a fracture and in the other he believed there was. His own case, which was not compound, was a subastragaloid dislocation with a fracture of the astragalus. He had a great deal of trouble trying to reduce the dislocation. He looked up the literature, and found in most of the reported cases of subastragaloid dislocation there was great trouble in reduction. It seemed to him that when dislocation is associated with fracture of the astragalus the reduction becomes extremely difficult. Some cases, for some reason, go back easily, others, and these the majority, do not go back in spite of the pushing and pulling. His patient, a man of 60 years, was thrown from a horse; the foot was turned at right angles to the leg. Under ether a vigorous attempt at reduction was made, which was only partially successful. The following day after a consultation with Professor J. William White, the patient was again etherized after Dr. Thomas had made an effort to study out the problem on the cadaver, using one of Dr. Davis's anatomical specimens, upon which he based a theory as to the difficulty to be overcome, and he secured an easy apparent reduction. He put on a plaster case. A week later he took off the case but the reduction was not complete, and he had since had a good deal of trouble with that foot. The last time he saw the patient he was somewhat worse than when he took off the case. In some of these cases the patients have not only lost their limbs, but in some instances their lives.

He had the opportunity of seeing another case with Dr. A. C. Wood at the Philadelphia Hospital less than a year ago. His own case had been of the internal variety while Dr. Wood's was of the external variety. Under ether a pull was made on the foot (Dr. Wood fixed a sling about the foot) and the whole thing slipped easily into place.

A STUDY OF SPRAIN-FRACTURE.

BY GEORGE G. ROSS, M.D.,

OF PHILADELPHIA,

Surgeon to the Germantown and Stetson Hospitals; Assistant Surgeon to the German and University of Pennsylvania Hospitals,

AND

LEVER FLEGAL STEWART, M.D.,

Resident Physician in the German Hospital of Philadelphia.

SPRAIN-FRACTURE, a condition resulting from an increase in tension on tendon or ligament, or from direct violence at the seat of tendinous or ligamentous attachment to bone, is a separation of all or part of that bone to which tendon or ligament is attached, from that bone of which it formed a part.

Callender,[1] in 1870, first described "cases in which some ligament is torn, carrying with it a film or shell of bone into which its fibres are inserted," and called them sprain-fractures. Keen, in 1874, referred to the same pathological condition as "masked fracture." Ross and Wilbert[2] in 1902 drew attention to sprain-fractures in connection with so-called sprains. Bennett[3] in 1906 said, "sprains commonly so called are in quite a large proportion of cases complicated by slight fractures (pathologically 'unimportant');" again, "a fracture can hardly occur without a sprain at the same time, but a sprain may of course and frequently does occur without a fracture." Eisendrath[4] says: "the recognition of sprain-fractures requires the systematic use of the X-ray in every case of severe sprain."

SPRAIN-FRACTURE AT THE GERMAN HOSPITAL.

In the German Hospital during the year 1910, 89 or 15 per cent. of the fractures confirmed by X-ray were sprain-fractures. During the first five months of the present year 56 cases of sprain-fracture were diagnosed, being confirmed by X-ray.

The importance of sprain-fracture as attested by its frequency and its location (for being produced most often through the agency of ligaments or tendons it is found at the attachments of these, therefore mostly at or near joints) prompted the writers to study it from a clinical and experimental point of view.

CASES VERIFIED BY X-RAY.

Case 1.—Jan. 20, 1910, W. H. R., age 37. X-ray findings: sprain-fracture lower end radius.

Case 2.—Jan. 24, 1910, Sarah D., age 47. X-ray findings: old sprain-fracture external malleolus.

Case 3.—Jan 26, 1910, Frank S., age 35. X-ray findings: sprain-fracture internal condyle of humerus.

Case 4.—Jan. 28, 1910, Wilh. F., age 63. X-ray findings: old sprain-fracture acromion.

Case 5.—Feb. 10, 1910, Philip O., age 51. X-ray findings: sprain-fracture internal condyle of humerus.

Case 6.—Feb. 14, 1910, John S., age 30, X-ray findings: sprain-fracture internal condyle of femur.

Case 7.—Feb. 16, 1910, Wm. R., age 27. X-ray findings: old sprain-fracture external malleolus.

Case 8.—Mar. 16, 1910, Herb. S., age 19. X-ray findings: sprain-fracture proximal phalanx thumb.

Case 9.—Mar. 19, 1910, Erw. W., age 22. X-ray findings: sprain-fracture internal condyle of humerus.

Case 10.—Apr. 12, 1910, B. McN., age 21. X-ray findings: sprain-fracture lower end tibia.

Case 11.—Apr. 13, 1910, Anna P., age 49. X-ray findings: sprain-fracture internal condyle of humerus.

Case 12.—Apr. 18, 1910, Phil. Pf., age 24. X-ray findings: sprain-fracture fifth metatarsal.

Case 13.—Apr. 22, 1910, Mike M., age 26. X-ray findings: old sprain-fracture internal condyle of humerus.

Case 14.—Apr. 23, 1910, M. Mat., age 45. X-ray findings: sprain-fracture astragalus and cuboid.

Case 15.—Apr. 25, 1910, J. Ha., age 36. X-ray findings: sprain-fracture first metacarpal.

Case 16.—Apr. 25, 1910, Boers., age 35. X-ray findings: sprain-fracture lower end radius.

Case 17.—May 2, 1910, Geo. H., age 49. X-ray findings: old sprain-fracture lower end radius.

Case 18.—May 3, 1910, Fr. O., age 61. X-ray findings: old sprain-fracture external condyle of humerus.

Case 19.—May 6, 1910, Elan. Es., age 57. X-ray findings: old sprain-fracture acromion.

Case 20.—May 7, 1910, Wm. J. W., age 35. X-ray findings: old sprain-fracture scaphoid.

Case 21.—May 7, 1910, Geo. M., age 36. X-ray findings: sprain-fracture radius, fracture styloid process of ulna, impaction scaphoid, semi-lunar, and radius.

Case 22.—May 9, 1910, Geo. C., age ?. X-ray findings: sprain-fracture external condyle humerus.

Case 23.—May 13, 1910, Roy S., age 17. X-ray findings: sprain-fracture acromion.

Case 24.—May 13, 1910, Fr. S., age 22. X-ray findings: sprain-fracture astragalus.

Case 25.—June 2, 1910, J. Gall, age 36. X-ray findings: sprain-fracture lower end radius, fracture scaphoid and ulnar styloid.

Case 26.—June 2, 1910, McB., age 48. X-ray findings: sprain-fracture upper end of tibia.

Case 27.—June 4, 1910 Dan. R., age 16. X-ray findings: old sprain-fracture upper end of tibia.

Case 28.—June 4, 1910, Lo. Lo., age 42. X-ray findings: sprain-fracture lower end radius.

Case 29.—June 16, 1910, Ed. D., age 21. X-ray findings: sprain-fracture external malleolus.

Case 30.—June 22, 1910, Ash., age 56. X-ray findings: sprain-fracture internal condyle of femur.

Case 31.—June 27, 1910, J. C., age 22. X-ray findings: sprain-fracture external malleolus.

Case 32.—June 28, 1910, M. Mc., age 41. X-ray findings: sprain-fracture external malleolus.

Case 33.—July 12, 1910, Wis., age 24. X-ray findings: sprain-fracture lower end radius.

Case 34.—July 13, 1910, A. H. D., age 50. X-ray findings: sprain-fracture external condyle of humerus.

Case 35.—July 15, 1910, Ma. L., age 55. X-ray findings: old sprain-fracture lower end radius.

Case 36.—July 16, 1910, Fr. G., age 29. X-ray findings: sprain-fracture internal malleolus.

Case 37.—July 22, 1910, Kirs., age 51. X-ray findings: sprain-fracture external condyle of humerus.

Case 38.—July 25, 1910, Wm. B., age 29. X-ray findings: sprain-fracture external malleolus.

Case 39.—July 26, 1910, Ch. M., age 53. X-ray findings: sprain-fracture acromion.

Case 40.—July 26, 1910, J. Th., age 37. X-ray findings: sprain-fracture lower end radius.

Case 41.—July 30, 1910, K. K., age 23. X-ray findings: sprain-fracture upper end tibia.

Case 42.—August 8, 1910, R. McC., age 41. X-ray findings: sprain-fracture external condyle of humerus.

Case 43.—August 18, 1910, D. W., age 25. X-ray findings: sprain-fracture external condyle of humerus.

Case 44.—August 19, 1910, M. McC., age 44. X-ray findings: sprain-fracture external condyle of humerus.

Case 45.—August 31, 1910, H. Ro., age 22. X-ray findings: sprain-fracture external malleolus.

Case 46.—September 8, 1910, R. Oz., age 16. X-ray findings: old sprain-fracture lower end fibula.

Case 47.—September 10, 1910, M. T., age 34. X-ray findings: sprain-fracture first metacarpal.

Case 48.—September 13, 1910, S. M., age 44. X-ray findings: sprain-fracture external malleolus.

Case 49.—September 17, 1910, S. B., age 50. X-ray findings: sprain-fracture acromion.

Case 50.—September 17, 1910, S. Ob., age 52. X-ray findings: sprain-fracture fourth metacarpal.

Case 51.—September 19, 1910, R. G., age 41. X-ray findings: sprain-fracture distal phalanx thumb.

Case 52.—September 19, 1910, E. Long, age 15. X-ray findings: sprain-fracture external malleolus.

Case 53.—September 20, 1910, A. U., age 28. X-ray findings: sprain-fracture external malleolus.

Case 54.—September 23, 1910, E. M., age 26. X-ray findings: sprain-fracture lower end radius.

Case 55.—September 27, 1910, M. K., age 36. X-ray findings: sprain-fracture internal malleolus.

Case 56.—October 7, 1910, J. R., age 20. X-ray findings: sprain-fracture external condyle of humerus.

Case 57.—October 11, 1910, J. Lon., age 13. X-ray findings: sprain-fracture external condyle of humerus.

Case 58.—October 13, 1910, J. B., age 44. X-ray findings: sprain-fracture external malleolus.

Case 59.—October 15, 1910, W. McG., age 44. X-ray findings: sprain-fracture external malleolus.

Case 60.—October 24, 1910, J. H., age 17. X-ray findings: sprain-fracture os calcis.

Case 61.—October 25, 1910, B. S., age 19. X-ray findings: sprain-fracture scaphoid.

Case 62.—October 25, 1910, Fried., age 20. X-ray findings: sprain-fracture external malleolus.

Case 63.—October 28, 1910, Ad. M., age 18. X-ray findings: sprain-fracture external condyle of humerus.

Case 64.—October 29, 1910, G. V., age 17. X-ray findings: old sprain-fracture os calcis.

Case 65.—October 29, 1910, J. C., age 50. X-ray findings: sprain-fracture external condyle of femur.

Case 66.—November 1, 1910, C. B., age 22. X-ray findings: sprain-fracture external malleolus.

Case 67.—November 4, 1910, L. Ab., age 54. X-ray findings: sprain-fracture os calcis.

Case 68.—November 4, 1910, Mike S., age 23. X-ray findings: sprain-fracture internal malleolus.

Case 69.—November 4, 1910, Grif., age 56. X-ray findings: old sprain-fracture head of radius.

Case 70.—November 8, 1910, Gold., age 21. X-ray findings: sprain-fracture external malleolus.

Case 71.—November 9, 1910, Geo. C., age 18. X-ray findings: old sprain-fracture internal tubercle of tibia.

Case 72.—November 10, 1910, P. Cat., age 40. X-ray findings: sprain-fracture internal tubercle of tibia.

Case 73.—November 11, 1910, H. W., age 37. X-ray findings: sprain-fracture astragalus.

Case 74.—November 11, 1910, R. Iz., age 18. X-ray findings: old sprain-fracture external malleolus.

Case 75.—November 12, 1910, Zez., age 30. X-ray findings: old sprain-fracture internal cuneiform.

Case 76.—November 21, 1910, Ch. S., age 39. X-ray findings: old sprain-fracture fourth metacarpal, distal end.

Case 77.—November 22, 1910, M. S., age 52. X-ray findings: sprain-fracture inner tuberosity of tibia.

Case 78.—November 23, 1910, Stu., age 42. X-ray findings: sprain-fracture external condyle of humerus.

Case 79.—November 23, 1910, Ma. M., age 49. X-ray findings: sprain-fracture acromion.

Case 80.—November 26, 1910, E. B., age 50. X-ray findings: sprain-fracture upper end humerus.

Case 81.—November 28, 1910, Wm. S., age 54. X-ray findings: sprain-fracture greater tuberosity humerus.

Case 82.—December 6, 1910, E. S., age 46. X-ray findings: old sprain-fracture greater tuberosity humerus.

Case 83.—December 14, 1910, J. D., age 43. X-ray findings: old sprain-fracture cuboid and os calcis.

Case 84.—December 21, 1910, Al. C., age 29. X-ray findings: old sprain-fracture external condyle of femur.

Case 85.—December 22, 1910, J. Lo., age 48. X-ray findings: sprain-fracture internal condyle of humerus.

Case 86.—December 23, 1910, M. D., age 25. X-ray findings: old sprain-fracture external malleolus.

Case 87.—December 27, 1910, Alex. K., age 41. X-ray findings: sprain-fracture both condyles of humerus.

Case 88.—December 27, 1910, J. B., age 51. X-ray findings: sprain-fracture os magnum.

Case 89.—December 28, 1910, Pat. C., age 30. X-ray findings: sprain-fracture external malleolus.

Case 1.—January 5, 1911, N. C., age 18. X-ray findings: old sprain-fracture proximal end metacarpal.

Case 2.—January 16, 1911, S. R., age 14. X-ray findings: sprain-fracture external malleolus.

Case 3.—January 26, 1911, J. J. K., age 60. X-ray findings: sprain-fracture greater tuberosity humerus.

Case 4.—January 30, 1911, Thos. C., age 23. X-ray findings: sprain-fracture head radius, comminuted fracture olecranon.

Case 5.—January 31, 1911, Al. R., age 55. X-ray findings: sprain-fracture acromion.

Case 6.—February 6, 1911, Al. M., age 21. X-ray findings: sprain-fracture lower end radius.

Case 7.—February 6, 1911, Ed. C., age 25. X-ray findings: sprain-fracture lower end radius.

Case 8.—February 7, 1911, Duer, age 42. X-ray findings: sprain-fracture external condyle of humerus.

Case 9.—February 7, 1911, I. G., age 34. X-ray findings: sprain-fracture greater tuberosity humerus.

Case 10.—February 8, 1911, Ch. C., age 30. X-ray findings: sprain-fracture internal condyle of humerus.

Case 11.—February 9, 1911, L. H., age 52. X-ray findings: sprain-fracture olecranon.

Case 12.—February 17, 1911, A. H., age 28. X-ray findings: sprain-fracture astragalus.

Case 13.—February 20, 1911, J. W., age 48. X-ray findings: old sprain-fracture greater tuberosity humerus.

Case 14.—February 20, 1911, F. P. M., age 33. X-ray findings: sprain-fracture internal condyle humerus.

Case 15.—February 28, 1911, T. D., age 46. X-ray findings: old sprain-fracture lower end radius.

Case 16.—March 2, 1911, J. C., age ?. X-ray findings: sprain-fracture lower end radius.

Case 17.—March 7, 1911, F. H., age 48. X-ray findings: sprain-fracture lower end radius.

Case 18.—March 8, 1911, L. F., age 23. X-ray findings: sprain-fracture cuneiform.

Case 19.—March 14, 1911, A. B., age 22. X-ray findings: old sprain-fracture external malleolus.

Case 20.—March 14, 1911, S. Br., age 62. X-ray findings: old sprain-fracture greater tuberosity humerus.

Case 21.—March 17, 1911, S. H., age 38. X-ray findings: sprain-fracture scaphoid.

Case 22.—March 18, 1911, Ot., age 50. X-ray findings: sprain-fracture greater tuberosity humerus.

Case 23.—March 18, 1911, L. R., age 66. X-ray findings: old sprain-fracture acromion, luxation humerus.

Case 24.—March 18, 1911, C. K., age ?. X-ray findings: sprain-fracture upper end tibia.

Case 25.—March 23, 1911, J. S., age 33. X-ray findings: sprain-fracture external malleolus.

Case 26.—March 23, 1911, M. M. C., age 30. X-ray findings: sprain-fracture post. lip head of radius.

Case 27.—March 25, 1911, Hul., age 35. X-ray findings: sprain-fracture scaphoid.

Case 28.—March 27, 1911, E. A., age 28. X-ray findings: sprain-fracture external malleolus.

Case 29.—March 27, 1911, M. H., age 28. X-ray findings: old sprain-fracture scaphoid.

Case 30.—March 28, 1911, G. W., age 25. X-ray findings: sprain-fracture acromion.

Case 31.—April 8, 1911, F. H., age 41. X-ray findings: sprain-fracture external malleolus.

Case 32.—April 10, 1911, J. G., age 48. X-ray findings: sprain-fracture distal end of third metacarpal.

Case 33.—April 11, 1911, H. M., age 46. X-ray findings: sprain-fracture lower end radius.

Case 34.—April 15, 1911, Pit., age 36. X-ray findings: sprain-fracture outer tuberosity tibia.

Case 35.—April 18, 1911, S. N., age 18. X-ray findings: old sprain-fracture greater tuberosity humerus.

Case 36.—April 22, 1911, J. R., age 72. X-ray findings: old sprain-fracture astragalus.

Case 37.—April 22, 1911, J. Mc., age 41. X-ray findings: sprain-fracture cuboid.

Case 38.—April 22, 1911, C. C., age ?. X-ray findings: sprain-fracture acromion.

Case 39.—April 29, 1911, J. C., age 37. X-ray findings: sprain-fracture styloid process of radius.

Case 40.—May 2, 1911, Ed. F., age 50. X-ray findings: old sprain-fracture greater tuberosity humerus.

Case 41.—May 4, 1911, M. N., age 50. X-ray findings: sprain-fracture cuneiform.

Case 42.—May 4, 1911, Hug., age 29. X-ray findings: sprain-fracture astragalus.

Case 43.—May 5, 1911, C. McK., age 19. X-ray findings: sprain-fracture external malleolus.

Case 44.—May 6, 1911, E. M., age 52. X-ray findings: old sprain-fracture external malleolus.

Case 45.—May 8, 1911, Koe., age ?. X-ray findings: sprain-fracture os calcis.

Case 46.—May 8, 1911, C. S., age 14. X-ray findings: sprain-fracture fifth metatarsal.

Case 47.—May 8, 1911, J. L., age ?. X-ray findings: sprain-fracture lesser tuberosity humerus.

Case 48.—May 10, 1911, Wm. T., age ? X-ray findings: sprain-fracture astragalus.

Case 49.—May 17, 1911, C. K., age 68. X-ray findings: old sprain-fracture acromion.

Case 50.—May 18, 1911, J. DeL., age 28. X-ray findings: sprain-fracture inner head tibia.

Case 51.—May 19, 1911, R. Gerl., age 40. X-ray findings: sprain-fracture distal phalanx little finger.

Case 52.—May 22, 1911, M. H., age 21. X-ray findings: sprain-fracture scaphoid.

Case 53.—May 26, 1911, M. G. Al., age 24. X-ray findings: sprain-fracture external femur.

Case 54.—May 26, 1911, Ben. G., age 47. X-ray findings: sprain-fracture acromion.

Case 55.—May 31, 1911, C. M., age ? X-ray findings: sprain-fracture lower end radius.

Case 56.—June 1, 1911, A. McD., age 26. X-ray findings: sprain-fracture inner tuberosity tibia.

Of these 145 cases, 46 were in the ankle; 25 the wrist; 25 the elbow; 23 the shoulder; 15 the knee; 9 the hand; and 2 were in the anterior foot region. With the ankle and wrist cases the tarsal and carpal bones have been respectively included. Twenty-eight of the ankle fractures were of the malleoli, and of these 24 were of the external malleolus; being within one of the number of sprain-fractures found at the wrist and over 16 per cent. of this series. Thirty-three of these cases were old (aged three weeks or more). All of these cases suffered as a result of either being treated as a sprain or receiving no treatment.

Most of these cases were caused by indirect violence; a few were caused by direct violence.

As to age, 3 were under fifteen years; 14 were between the ages of fifteen and twenty; 37 between twenty and thirty; 24 between thirty and forty; 30 between forty and fifty; 22 between fifty and sixty; and 7 over sixty. Though there are histological differences in the tissues of adults and children, the same pathology and comparative frequency of sprain-fracture is found in children as in adults.

In the experience of the writers it has been possible to diagnose clinically 77 per cent. of the sprain-fractures shown up by X-ray. Of the remaining 23 per cent., 1 was diagnosed osteoperiostitis, 1 luxation, and the rest sprain, or

contusion. In a small percentage of cases that the X-ray did not demonstrate to be sprain-fractures, the diagnosis of sprain-fracture was made. These cases were probably sprain-fractures impossible of demonstration by X-ray.

SYMPTOMS.

There is always a history of application of sufficient force to cause fracture. Pain is seldom very severe. Tenderness, marked and sharply localized over a region of tendinous or ligamentous attachment, is a most important sign. Bone crepitus is very rarely elicited, however joint crepitus is not infrequently present. Preternatural mobility is seldom met with, as these injuries alone are rarely extensive enough to permit of it. Swelling usually occurs and is sharply localized, excepting when synovitis of the joint is present. Deformity is usually present, due most often to swelling at the seat of injury. Ecchymosis, a later sign, is rarely seen. Total disability never occurs and most often there is but little disturbance of function, excepting that disturbance caused by pain.

In old sprain-fractures the tenderness is latent; seldom is it absent. The symptoms of an arthritis are added when actual joint cavities have been involved. Ecchymosis, if originally present, has disappeared at this stage.

EXPERIMENTS IN PRODUCTION OF SPRAIN-FRACTURE.

The following experiments were carried out on dogs, completely anæsthetized with ether, at the Laboratory of Experimental Surgery of the University of Pennsylvania, in order to determine the strength of tendon and ligament as compared with bone. All of the dogs were asphyxiated with gas before recovering from their anæsthesia.

Experiment I.—The skin, ligamentum patella, and all tendon attachments around the left knee-joint were severed. The femur was held in a vice and the leg was grasped with the hand and hyperextended and twisted until the joint was flail-like (subluxated).

Examination showed no gross lesions of the capsule. Further opening of the joint showed the external lateral ligament partly torn from its attachment to the external condyle of the femur; the tear involved the osseous and not the ligamentous tissue (a sprain-fracture). The tear

was due evidently to a lateral twist, as it did not occur in the direction of the course of the ligament.

(The above experiment was done after it was found that weight aggregating 160–175 lbs., hung from the tibia, would not make the joint give way.)

Experiment II.—The right thigh was grasped in the left hand and the corresponding leg in the right hand; twisting and hyperextension were done.

Incision and examination showed epiphyseal separation of the head of the tibia, sprain-fracture at the attachment of the patellar ligament to the tibia (the tendon pulling away with it small pieces of bone), and fracture of the crest of the tibia at the epiphyseal junction. No lesions of the knee-joint ligaments, tendons, or bones were found on exposing the joint.

Experiment III.—The left scapula was grasped in the right hand, and the corresponding humerus in the left hand. All motions encountering resistance were persisted in until that resistance was overcome.

Incision and examination showed the shoulder-joint to be undisturbed; but a badly comminuted fracture extending from a short distance beyond the glenoid fossa throughout the rest of the scapula was found.

Experiment IV.—An incision was made over the left knee-joint. The tendon of the quadriceps extensor muscle was cut and freed laterally, grasped in a vice near the tibial end of the patella, and traction was made by the use of weight pulling from the tibia in the normal direction of the tendon.

The patellar ligament separated at the point where the vice grasped it and also broke away from its tibial attachment at one corner, bringing bony tissue with it. Fibrillar tears were noted in the ligament. Failure to have the patellar ligament grasped throughout its breadth may have influenced the results. The vice grip on the ligament no doubt weakened it at this point of pressure.

Experiment V.—The tendon of the semimembranosus muscle was exposed, grasped near its centre in a vice, and traction was made by weights in its natural direction.

The tendon ruptured at the point where it was grasped. No change in its bony attachment was found. In this as in the rest of the cases the vice grip devitalized the tendon at the point at which it was grasped.

Experiment VI.—Same as Experiment IV. Examination showed no rupture of the quadriceps extensor tendon but division of bone at the point of attachment of the tendon. The tendon had pulled the bony tissue to which it was attached away from the tibia.

Experiment VII.—The tendon of origin of the right biceps was exposed and tension was made in its natural direction in the usual way.

Examination showed that the tendon had pulled away the bony cap to which it was attached. The tendon tissue showed no signs of injury.

Experiment VIII.—All skin was removed from the region of the left ankle-joint. All of the tendons passing between points above and below the joint were severed. The tibia was held tightly in a vice. A two-pronged hook was hung from the foot; one prong was hooked around the

os calcis, while the other was hooked around the foot over the anterior tarsal bones; weights were hung on the hook.

Fracture of the calcaneum involving the surface articulating with the astragalus resulted. No ligamentous tears were found.

Experiment IX.—Same as Experiment IV. Examination showed no rupture of the patellar ligament but rupture of the bony tissue to which it was attached.

Experiment X.—The tendon of the right tibialis anticus was isolated. Tension was applied in the usual way.

Examination showed no tendon injury but a pulling away of the bone to which the tendon was attached.

Experiment XI.—The skin was removed from the right ankle-joint. The tendo Achillis was cut and the distal end of it was grasped in a vice, weights were added, and a pull was made in the direction which the tendon followed. The foot was held in a vice. Vice No. 1 slipped from the tendon, seemingly isolating three parts. The experiment was repeated on that part of the tendon which was overlapped by the other two parts of the tendon.

Bony tissue of the posterior surface of the calcaneum pulled away with the tendon. This portion of tendon last tested was uninjured.

Experiment XII.—Same as Experiment VIII. The hook slipped from its attachment after some pulling force had been brought to bear.

Examination showed that the anterior band of the external lateral ligament of the ankle had pulled away some bony tissue at its point of attachment to the astragalus. No injury of the ligament occurred.

Experiment XIII.—Same as Experiment V. Examination showed that the semimembranosus tendon had pulled away the bony tissue to which it was attached. The tendon was uninjured.

Experiment XIV.—Same as Experiment IV. Examination showed no injury of the patellar ligament which had pulled away the bone at its point of attachment to the tibia.

Experiment XV.—The left hip was exposed; all of the muscular attachments in this region were cut, leaving the articulation surrounded by its capsule alone. The femur was rotated externally and abducted, producing a luxation.

Examination showed a tear of the weak upper postero-external portion of the capsule and a sprain-fracture at the insertion of the ligamentum teres.

In these fifteen experiments done by using pulling force on tendons and ligaments at some distance from the attachment of them to bone, bone gave away in every test but one. This was the semimembranosus tendon which ruptured where it was gripped by the vice. In another instance besides pulling away some bony tissue the patellar ligament ruptured where it was grasped by the vice. In both cases the ligaments were weakened by the vice grip, and in the latter case the

patellar ligament was not grasped throughout its horizontal extent. In a third case showing sprain-fracture at the insertion of the ligamentum teres, luxation of the joint with laceration of the weaker portion of the capsule (that portion of the capsule, the sole function of which is to support the synovial membrane and fluid) was produced. In every other instance (12 out of the 15) bone alone gave way. These experiments show how the frequent occurrence of sprain-fracture is possible, and how rupture of tendon or ligament as a part of the pathology of so-called sprain is impossible.

One striking feature of the experiments was the occurrence of sprain-fracture in the two instances of luxation. The integrity of joints is maintained by strong ligaments, and in order to have a luxation one or more of the strong ligaments must give way; we have shown that ligaments themselves do not give way, but the bony tissue to which they are attached gives way, therefore we think that probably all luxations are permitted by the primary occurrence of a sprain-fracture.

Upon this subject the writers expect to have more to say in the future.

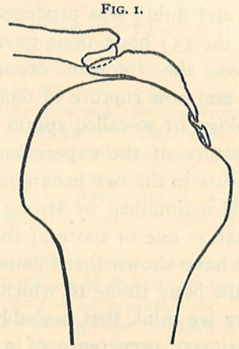
DIAGNOSIS.

The X-ray of course makes diagnosis conclusive when sprain-fracture is demonstrated. Through the courtesy of Dr. A. G. Miller (Skiagrapher to the German Hospital) the writers have been able to make schematic representations of some of his plates (Figs. 1 and 2, 1911, show sprain-fractures easy of demonstration). However, a negative X-ray in the presence of suggestive clinical signs should not exclude the possibility of sprain-fracture, chiefly for three reasons: first, experience and skill are required in the making and interpretation of X-ray plates (Figs. 3 and 4, 1911, and 5, show conditions such as one of little experience might find it difficult to diagnose); second, the X-ray picture if not taken in the proper plane may not show a really quite distinct sprain-fracture (Figs. 6 and 7 represent plates from cases of sprain-fracture that showed no signs of sprain-fracture in plates taken in other planes); third, some sprain-fractures are so slight as to escape the detection of the most capable

skiagrapher (Fig. 4, 1911, may be again referred to as one approaching that class).

Clinically, history of sufficient injury with a small, sharply localized area of swelling and acute tenderness over a region

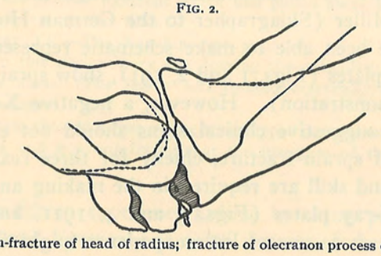
FIG. 1.



Sprain-fracture of greater tuberosity of humerus.

of tendinous or ligamentous attachment is diagnostic of sprain-fracture, and should be considered as such whether or not X-ray verifies the diagnosis. Tenderness of lesser degree

FIG. 2.

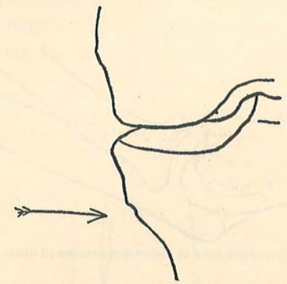


Sprain-fracture of head of radius; fracture of olecranon process of ulna.

may surround an acutely tender area. Tenderness lasts as a rule from five to twenty days, longer in improperly treated cases; however, those few cases with symptoms as given above, in which tenderness disappears within forty-eight hours, are nevertheless sprain-fractures. The acute tenderness which

we have referred to is unmistakable; when the spot is firmly pressed on the patient invariably winces.

FIG. 3.

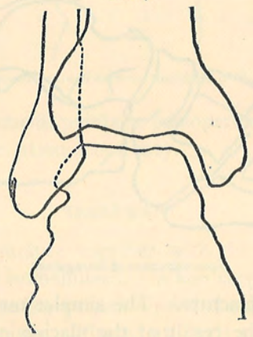


Sprain-fracture of outer tuberosity of tibia.

DIFFERENTIAL DIAGNOSIS.

Tenderness and swelling or both, not sharply localized, with the tenderness not so acute (not causing wincing on firm pressure) are occasionally found in joint regions. These

FIG. 4.

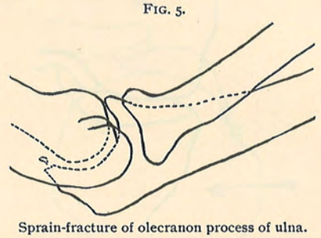


Sprain-fracture of external malleolus of fibula.

symptoms have four causes: the first is contusion, resulting from direct injury; the second is strain, the placing of tension on tendons, ligaments, or other soft parts (nerve injury cannot be confused with sprain-fracture, as symptoms rela-

tive to its origin and distribution are associated); the third is rupture of diseased tendons or ligaments (a very rare occurrence that can be considered only as a complication of disease); the fourth is a luxation that has reduced itself.

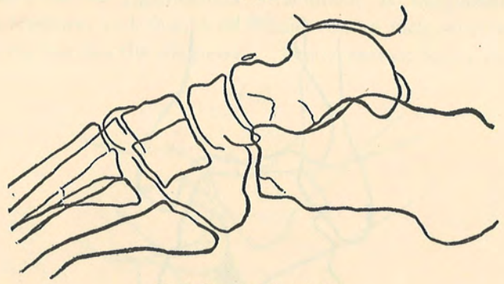
FIG. 5.



Sprain-fracture of olecranon process of ulna.

Bennett gives the old definition of sprain as "a wrench or strain resulting in stretching or laceration of the soft parts without external wound." The writers have proven that laceration of soft parts does not occur; where laceration occurs

FIG. 6.



Sprain-fracture of astragalus.

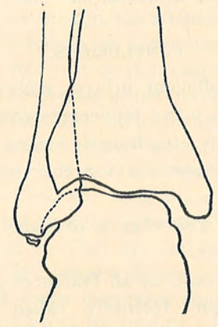
we have a sprain-fracture. The simpler term strain we have already given to the result of the placing of tension on soft parts. The word sprain, standing alone, we eliminate; but using it with fracture the condition formerly looked upon as severe sprain is described. Self-reduced dislocations show in many instances rupture of the weaker portion of the capsule. As intimated before, a more careful search for such a condi-

tion may reveal the presence of a sprain-fracture in luxations, it being of course at a different seat from the tear of the capsule.

A painful swollen joint, generally tender, with no history of injury and a negative X-ray, if you like, speaks for acute arthritis; a similar history, less marked, speaks for chronic arthritis.

A fairly large, tender, indefinite swelling following direct injury, and most likely not seated at a point of tendinous or

FIG. 7.



Sprain-fracture of external malleolus of fibula.

ligamentous attachment, points to osteoperiostitis. X-ray findings make differentiation more easy.

TREATMENT.

The seat of fracture together with the joint nearest the fracture should be immobilized. When carpal or tarsal bones are involved, the wrist- or ankle-joint should be immobilized with the smaller joints. Plaster of Paris serves this purpose best in the upper as well as the lower extremity, and rest of the body, for absolute rest is essential. Casts should be used for three weeks; at the end of this time, moderate motion may be started. Massage should be begun at the end of ten days. In an uncomplicated case, fairly free use of the injured tissues

can be allowed at the end of the sixth week. This treatment is arbitrary, and must of course be influenced by the individual case. General relaxation of joints may follow as a result of treatment, if care is not taken to avoid muscular atrophy. Proper treatment gives excellent results which are permanent.

Lack of treatment and treatment as sprain (drug-store treatment) provide many cases of chronic arthritis, deformity, persistent pain, and weakness; excessive callus formation is a common result; non-union, permitting the free bony tissue to catch between joint surfaces, can occur.

CONCLUSIONS.

1. History of sufficient injury, with a sharply localized area of swelling and acute tenderness over a region of ligamentous or tendinous attachment, means sprain-fracture.

2. X-ray is not essential for the recognition of sprain-fracture.

3. The external malleolus is probably the most frequent seat of sprain-fracture.

4. About 15 per cent. of all fractures are sprain-fractures.

5. That condition, formerly called severe sprain, is sprain-fracture.

6. The condition resulting from stretching of soft parts is better termed strain.

7. Sprain-fracture is probably a part of the pathology of every dislocation.

8. If in doubt as to whether or not sprain-fracture has occurred, treat as sprain-fracture.

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DR. GEORGE G. ROSS said that this question of sprain-fracture is one in which he had long been interested. He had felt that the so-called explanation of sprains was very inadequate. Text-books all say that a sprain is an injury about a joint in which the tendons are stretched or torn. Tendons and ligaments are made of white fibrous connective tissue which is absolutely inelastic and of great strength, being the strongest tissue in the human body. He had felt that it was very difficult, if not impossible, to tear or break a normal tendon or ligament. Fortunately the X-ray then came along to help confirm the suspicion that it was the attachment of the tendon or ligament that gave way, and not the tendon or ligament itself. John Ashhurst's Surgery, next to the last edition, has a footnote in which reference is made to Callender's remark on sprain-fracture. He asked Dr. Stewart to take up this matter last summer and do some experimental work. The present paper records the results of this work. It seemed to him that the pathology as explained by Dr. Stewart's experimental and clinical work is conclusive proof that sprain is fracture, and being fracture should be so treated. This fracture has been termed the drug-store fracture, for after a treatment with liniment it comes to the surgeon with what is called a sprained joint which does not get well but remains painful the rest of the patient's life, because it was a fracture that was not properly treated. It seems important enough to warrant treatment of the same as a gross fracture of a bone. The way it occurs is that sufficient violence, not necessarily great in extent, is exerted when the tendons and ligaments about the joint are in a certain state of tension, as, for instance, when a person turns on the side of the foot, putting the external ligament on a great tension, and then a little additional twist is all that is necessary to detach the ligament.

DR. ASTLEY P. C. ASHHURST remarked that sprains, as he understood them, are injuries to joints consisting in the rupture or laceration of ligaments, due to indirect violence. If ligaments do not rupture in their body they must be torn through in their attachments to the bone. There are certain sprain-fractures so typical and recognized that they have received distinct names, such as *Schlatter's disease*, or "starting" of the upper epiphysis of the tibia; the *epicondylitis* of Momberg, or sprain-fracture of the external epicondyle at the elbow. Then there are such cases

as Dr. Wharton reported to this academy several years ago, and of which he had seen several instances, a sprain-fracture of the tuberosity of the fifth metatarsal. However, this last often is due to direct injury, the patient tramping on the outside of the foot. These three types especially he thought deserving of recognition as typical injuries, but most others he should consider as sprains. To have sprain-fractures occurring in 15 per cent. of all sprains increases the total number of fractures to an alarming degree.

Dr. T. Turner Thomas did not believe that all sprains were really sprain-fractures. He had seen in experimental work on the shoulder-joint of cadavers the tearing of the ligament from the glenoid margin and from the humeral attachment without associated fracture. He had on the cadaver repeatedly produced sprains of the ankle by fixing the foot in the vice and pulling the leg over, every time getting a sprain-fracture. Now, he had been doing some work on dislocations of the shoulder and at the bottom of this work is the idea of sprain and sprain-fracture, a dislocation being nothing more than an exaggerated sprain. He believed that the condition described by Codman as due to a subacromial bursitis is the result of sprain-fracture, at the shoulder-joint. Forced abduction is to the shoulder what a lateral turn of the foot is to the ankle, and what forced dorsal flexion from a fall on the hand is to the wrist. The effect of forced abduction on the shoulder is to tear the ligamentous attachment on the axillary side. Rather frequently a tearing off of a small portion of the internal glenoid margin will be produced. He had often found roughness of the glenoid margin. He had found similar fractures reported in the literature. Far more important, and not recognized as such, is a tearing fracture at the shoulder of the greater tuberosity. As abduction is forced it tears the axillary portion of the capsule, and if abduction is continued, as the humerus strikes the edge of the acromion the head is violently forced out and the external rotators with the underlying portion of the capsule pulling back on it give way. This is an extremely important accident, and occurs more frequently than is credited. If one tears off the greater tuberosity with the underlying capsule, or if the capsule alone is torn from the greater tuberosity and these edges become separated, when the dislocation is reduced the head of the humerus drops and this is always associated with severe paralysis of the upper extremity that never completely recovers. He had found that condition associated with a fracture of the greater tuberosity as shown by the X-ray and as shown in the operations by irregularities of the tuberosity. This idea of fracture of the greater tuberosity from forced abduction is in line with the views of the reader of the paper.

In line with the thought that forcible abduction is an important movement, practically all of the dislocations of the shoulder in the adult are anterior dislocations, and the reason is because they are due to forced abduction which is very common and can produce only an anterior dislocation. As the head goes out and the pull comes on the supraspinatus, the infraspinatus, the teres minor and corresponding portion of the capsule, the capsule may tear, the greater tuberosity may tear off, and the subacromial bursa, which lies on and is intimately adherent to the greater tuberosity and tendons attached to it, must be involved in the inflammation, this is the reason why Codman and others have found adhesions in the bursa. Codman has recently reported two cases in which he sutured the two ends of the torn supraspinatus, and he has very much limited the causative factors in subacromial bursitis. He now believes subacromial bursitis is usually due to tearing of the supraspinatus tendon, and this again is frequently replaced by a tearing of the greater tuberosity, so that inflammation in the bursa should be common. Its importance, however, is secondary to the laceration of the axillary portion of the capsule, which is necessary to the mechanism of the tearing of the tendon or the tuberosity. Wherever there is a fracture of the greater tuberosity of the humerus there has been a dislocation of the shoulder, and in those cases in which there is no history of a dislocation, the latter did occur at the moment of forced abduction, but was spontaneously reduced as the arm fell to the side of the body immediately afterward.

Dr. G. G. Davis was under the impression that the reader in his experiments stated that whenever the tendon was pulled until something gave way, that it was the bone which yielded. That such is not always the case in man is shown by the many cases of rupture of the quadriceps, and the biceps tendons, but it raises the question as to whether or not some of these conditions may not be examples of sprain-fractures. We can account for others by disease of the tendon; he had a preparation which shows the long tendon of the biceps very markedly diseased by osteoarthritis, which caused its rupture at its exit from the capsule.

Dr. John H. Jopson said that the truth as brought out in

these cases lies in a middle ground rather than on the plane which the essayist would have us believe, in other words between his position on the one hand and Dr. Ashhurst's on the other. The essayist says that his cases were not attended by laceration of the ligaments of the joint and were therefore not sprains according to Ashhurst. That all sprains and dislocations are attended by fractures of bones he did not think the majority believed. All have operated on cases in which ligaments or tendons have been torn from bones without fracture of the bone, as in rupture of the long head of the biceps, where it has been torn from its point of origin, and in rupture of the quadriceps tendon so-called where the tendon is torn away from its attachment to the bone, probably as often as its separate fibres are torn through. On the other hand fractures frequently accompany both sprains and dislocations. He had operated on a case of dislocation of the shoulder attended by fracture of the anatomical neck of the humerus in which the anterior lip of the glenoid cavity was torn off.

Dr. George G. Ross rejoined that the point they made is that it is the periosteum and the bone to which the ligament is attached that gives way and not the white fibrous tissue. They believed these so-called sprains are fractures of a minor degree. With regard to the quadriceps extensor above the patella he had seen one case of complete tear of the ligamentum patellæ without fracture. The patient was a colored man of 80 and his tendons and ligaments were all in a state of senile pathology that predisposed toward tearing. He did not deny the fact that he had seen a tear of the tendon of the quadriceps extensors, but the vast majority near the joints are sprain-fractures, and he believed this to be the true pathology of sprains.

Dr. Willis F. Manges agreed with the essayist that the occurrence of sprain-fracture is far more common than has heretofore been appreciated. He found this out by his X-ray work. It is surprising how small a fragment of bone can sometimes be clearly demonstrated. On the shoulder-joint particularly, where the condition is sometimes called a subdeltoid or subacromial bursitis, he had often taken the view that we are dealing with a sprain-fracture to which little attention was paid at the time of injury, and there has ensued an inflammation which remains more or less chronic until a subsequent wrench produces violent pain in that

region. On the other hand, he believed that there are quite severe sprains or injuries around the joints where there is certainly no demonstrable portion of bone torn from the bone. Whether or not the ligament itself tears, or its attachment tears without fracturing the bone, he could not say. He did know, however, that the sprain-fracture is not uncommon.

Dr. Astley P. C. Ashhurst added that he recognized a fracture, a sprain, and a "sprain-fracture," but to call all these injuries, which have heretofore been called sprains, sprain-fractures, he thought would only serve to add confusion to what already is sufficiently clear. As to the possibility of ligaments being torn elsewhere than at their insertions, in the patient he showed earlier in the evening he found that the external lateral ligament of the ankle-joint had been torn through the centre; there was no fracture of the fibula or calcaneum which he could see. The rupture had taken place through the body of the external lateral ligament and he sewed it up again.

Dr. Morris Booth Miller said that a distinction should be made between a sprain which involves solely the ligaments and a strain which is an injury to tendons, fascia, or muscles. A look at the specimens presented by the essayist shows that they represent shells of bone pulled off by tendons and hence are examples of fracture strains and not fracture sprains.

Dr. G. G. Davis added that in making artificial luxations on the cadaver sometimes are found shells of bone sticking to the band-like ligaments, but at other times the bony edges are not broken. As to the question of relative frequency, and to solve this question, more careful radiographic observations must be made.

Dr. Lever F. Stewart (in closing) said that in these experiments, which, by the way, were done on living dogs, it was found that the sprain-fractures were sometimes so infinitesimal that they could not see but could only palpate the fragments. It is quite reasonable to suppose that in these cases the X-ray cannot demonstrate such small lesions. He referred to what had formerly been called severe sprains as sprain-fractures, and suggested that similar cases with symptoms of less severity were better called strain than sprain, providing, of course, that sprain-fracture is not demonstrated in them.

FRACTURE OF THE FLOOR OF THE ACETABULUM.

WITH SEVEN ILLUSTRATIVE CASES.

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AND

HENRY K. PANCOAST, M.D.,

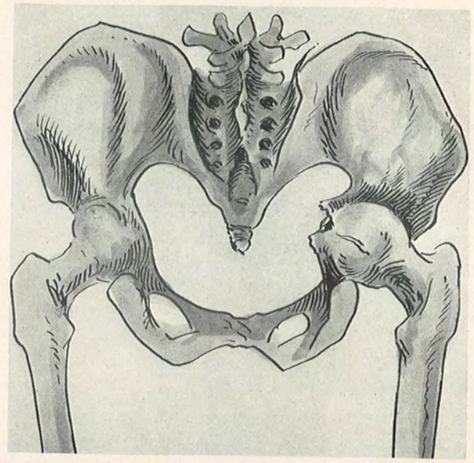
OF PHILADELPHIA.

In dealing with this subject of fracture of the floor of the acetabulum, we shall first present four cases observed by us, then consider the cases hitherto reported in the literature, and finally discuss the subject in general.

Case I.—G. B., male, age forty-three, coachman, admitted June 7, 1911. Fell eighteen months previous to admission a distance of eighteen feet to pavement, landing on right side on greater trochanter of femur. He was laid up for three months in the British Hospital in Hongkong, where he was treated by massage. Since then he has had a limp, which has been getting worse, as well as pain confined to upper anterior part of right thigh. Examination revealed slight atrophy of muscles in right gluteo-femoral region when compared with those of the left side, with motion slightly painful and limited in all directions, but particularly in abduction. Mensuration from internal malleolus to anterior superior spine 33 inches on both sides. The base of Bryant's triangle was equal on both sides; the greater trochanter did not rise above the Roser-Nélaton line on either side; and two lines drawn, one between the anterior superior spines and the other between the tips of the greater trochanters, were parallel. Therefore, there was no demonstrable shortening. Measurements from middle of symphysis pubis to greater trochanters equal on both sides. Therefore, there was no inward displacement of greater trochanter. Rectal examination revealed inward bulging of floor of acetabulum on injured side, but none on opposite side. The skiagram, a diagrammatic sketch of which is shown in Fig. 1, showed inward, tent-like bulging of the middle of the floor of the acetabulum, in keeping with the rectal findings on palpation. In view of the age of the injury (18 months) and the trifling degree of damage to the pelvis, no measures were indicated other than massage and passive motions, which were employed with some benefit until the patient left town.

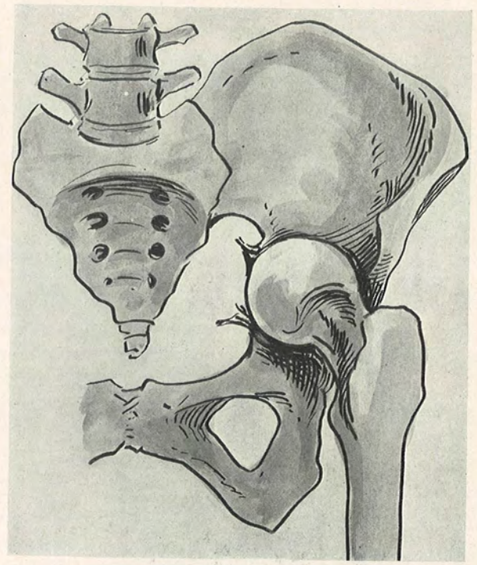
Case II.—J. K., male, age fifty-three, plasterer, admitted

Fig. 1.



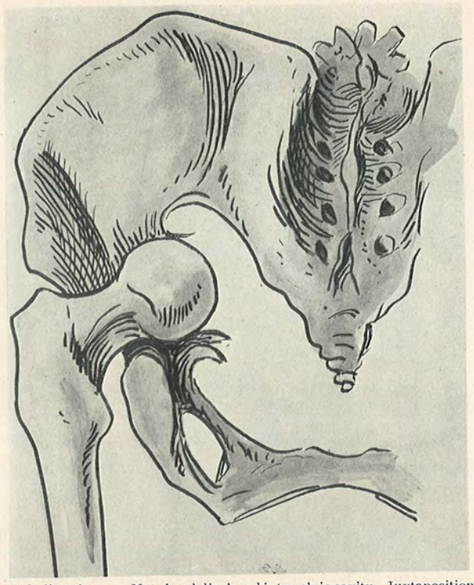
Fractura acetabuli perforans. Note stoving-in of floor of acetabulum, right side. Approximation of greater trochanter to ilium. Posterior view. Sketch from Röntgen plate. (Case I.)

Fig. 2.



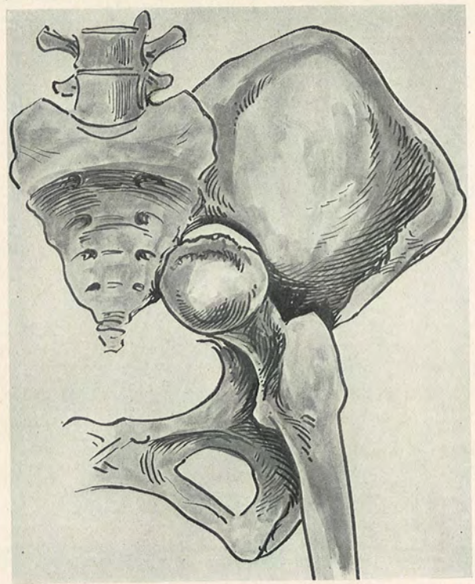
Fractura acetabuli perforata. Note head displaced into pelvic cavity. Juxtaposition of greater trochanter and ilium. Left side, anterior view. Sketch from Röntgen plate. (Case III.)

FIG. 3.



Fractura acetabuli perforata. Note head displaced into pelvic cavity. Juxtaposition of greater trochanter and ilium. Left side, posterior view. Sketch from Röntgen plate. (Case III.)

FIG. 4.



Fractura acetabuli perforata. Note head in contact with sacrum and entrance of greater trochanter into pelvic cavity. Left side, anterior view. Sketch from Röntgen plate. (Case IV.)

October 9, 1911, to service of Dr. John B. Deaver. He had fallen from a height of 20 feet, to the ground, from a scaffold upon which he had been working, striking on the left buttock. Thereafter he could not move, and was admitted to the hospital complaining of disability and pain in hips.

He was immediately catheterized, and ten ounces of clear urine were withdrawn. Further examination revealed a large contusion with ecchymosis upon the left buttock. Pressure upon the pelvis from side to side gave sharp pain in right groin. No crepitus; no dulness in flanks. Rectal examination revealed slight bulging inward of left pelvic wall.

Skiagram showed (1) inward depression of floor of acetabulum (fractura acetabuli perforans) left side, quite identical with the damage shown in Fig. 1; (2) fracture of pubis, horizontal ramus, right side. This lesion was about an inch from the symphysis, and probably resulted from "contre coup." It accounted for the sharp pain in the right groin referred to above.

CASE III.—G. S., male, age thirty-one, admitted January 5, 1904. Fell on left hip 2½ years previous to admission. Complete history not obtainable. Skiagram shows fracture of floor of left acetabulum with head of femur displaced into pelvic cavity (Figs. 2 and 3).

CASE IV.—M. P., male, age thirty-one, admitted December 2, 1910. Fell on left hip 11 months previous to admission. Complete history not obtainable. Skiagram revealed fracture of floor of left acetabulum with displacement of femoral head into pelvic cavity (Fig. 4). This skiagram gives the impression that the femoral head is in contact with the sacrum, in which case there must be in addition either a fracture of the tip of the greater trochanter or else of the upper margin of the acetabulum.

The first recorded case of this injury was rather vaguely described by Henry Callisen in 1788 (*Principia systematis. Chirurgiæ hodiernæ*, 1788). Up to 1904 Arregger (*Deutsch. Zeitschr. f. Chirurg.*, 1904, lxxi, 487) collected 23 cases, including one of his own. In 1909 Schroeder (*Quart. Bull. of Northwest. Univ. Med. School,* 1909, xi, 1, p. 9) collected 49 cases, including three of his own. Somewhat later in 1909 A. E. Halstead added two cases, one his own, bringing the number up to 51. Our four patients make a total of 55 cases reported over a period of 123 years, thus emphasizing the relative rarity of this injury.

Nomenclature.—The Germans refer to this injury as central luxation of the femur (Zentrale Luxation des Schenkelkopfes), thus giving but secondary consideration to the fracture of the acetabulum. Analogous to this is the so-called central dislocation of the jaw, in which the condyle of the mandible is driven through the glenoid fossa at the base of the skull. English authors usually write under the title "Fracture of Acetabulum with Displacement of Head of Femur into Pelvic Cavity" or "Perforation of the Acetabulum by the Head of the Femur." None of these terms appears to us to be sufficiently comprehensive. In the first instance a moment's thought is convincing that we are not dealing with a dislocation in the accepted sense of the term. Holmes defines a traumatic dislocation as "a forcible separation of the articular surfaces of two or more bones, effected by the rupture or stretching of their ligaments." In our injury the floor of the acetabulum is not necessarily separated from the femoral head, and, furthermore, the capsule of the joint is neither torn nor stretched, but, on the contrary, it is made lax and telescoped on itself. Therefore, we have to deal with a displacement, rather than with a dislocation. Again, the injury varies from a slight depression of the floor of the acetabulum, as in Case I, to the passage of the femoral head into the pelvic cavity, as in Cases III and IV. After all, the extent of injury is only a question of the degree of the vulnerating force plus the strength of the bone. For the injury illustrated by our Case I we suggest the term "fractura acetabuli perforans," which implies that the head of the femur started to perforate the acetabular floor but that the vulnerating force expired before the act was completed. For cases where the head of the femur is displaced into the pelvis, we suggest the term "fractura acetabuli perforata," which implies completion of the act and therefore the presence of the displaced head in the pelvic cavity. We believe with the Germans that Latin terminology is not only more exact but also far more expressive.

Etiology.—With but one exception the cause of this injury was indirect violence, most of the patients having fallen a considerable height and landed on the ground upon the

greater trochanter. Others have been struck upon the greater trochanter by a heavy object.

Mechanism.—In falls from a height the acetabulum is passively broken, just as a loose hammer-head is forced upon its handle by pounding the latter upon the floor. When struck by a heavy object, on the contrary, the acetabulum is actively broken by the wedge-like action of the femoral head. The question naturally arises in your minds, when, given a certain vulnerating force, does the acetabulum yield to fracture and when the neck of the femur? While it is difficult to answer, yet several theories suggest themselves. In the first instance, in these injuries the femur has usually been slightly adducted, the force acting upon the greater trochanter in the continuation of the long axis of the femoral neck and head. The cancellous tissue in the head and neck of the femur is arranged as pressure and tension lamellæ, which spring from the inner and outer walls so as to form Gothic arches. It seems plausible, therefore, that these arches would yield least to force applied in the direction of the long axis of the head and neck, so that the force would expend itself upon the pelvis. In our injury the floor of the acetabulum, notoriously a weak place because of its thinness in all ages and of the meeting here in childhood of its three constituent bones, now fractures more or less extensively. If the force strikes the neck of the femur aslant these Gothic arches, however, fracture of the neck may sooner ensue. Variations in the angle of the neck with the shaft, in forward inclination of the neck, as well as in the index of the neck may also act as determining factors in the fracture of one or other bone. But few of the patients were superannuated, and therefore but few of the femoral necks were weakened by the osteoporosis incident to senescence. From this we might conclude that when the neck of the femur is healthy and squarely set, so to speak, it withstands this particular force more stoutly than the floor of the acetabulum. Examination of the macerated innominate bone shows that the non-articular part of the acetabulum is thin enough to transmit light. The area in relation with the articular part of the acetabulum forms an apparently strong and stout buttress, but the thickness here consists solely in two

thin shells of compact tissue between which is sandwiched a large amount of fragile cancellous tissue. Thus it is probable that many of the fractures of the acetabulum are of the variety known as "compression-fractures." As in the skull, the inner shell of compact bone would fracture more extensively than the outer. After removal of the acetabulum, it will be found that the head of the femur can penetrate into the pelvic cavity only about 3 cm., when the greater trochanter impinges upon the ilium. Fracture of the tip of the greater trochanter, however, or of the ilium would permit the head to extend further into the pelvis.

Symptoms.—The symptoms vary naturally according to whether the fracture is perforating or has perforated. The subjective symptoms are pain on motion, localized tenderness, and disability, plus those of whatever complications may exist. Given a macerated pelvis, the objective signs and complications are as easy to read as the handwriting upon the wall. There will be more or less approximation of the trochanter to the symphysis pubis along Morris's line and rectal or vaginal palpation of the stove-in acetabular floor or displaced femoral head. These two signs in conjunction with a good skiagram suffice for diagnosis. There are other signs less distinctive because common to other injuries in this region.

Differential Diagnosis.—In our opinion the most important differential diagnosis is from contusion of the hip. Far more lives will be saved by the correct diagnosis of contusion of the hip than will be lost by overlooking a more patent injury, such as Malgaigne's double vertical fracture of the ilium behind and the pubis and ischium before. The diagnosis of contusion of the hip is really very creditable when correct, for it very properly implies deductions based upon a most careful and painstaking process of exclusion.

Complications.—The complications of this injury but reflect the regional anatomy of the pelvis, and depend upon the extent of the fracture and the shape and character of the fragments. Hæmatomata formed very frequently in the reported cases, due to laceration by a sharp fragment either of

small vessels or of large ones, even the external iliac vein. If the peritoneum is likewise torn, the blood enters the peritoneal cavity as free fluid, instead of forming an extensive retroperitoneal hæmatoma. The obturator nerve, situated in the path of the fragments, is apt to be bruised, lacerated, or severed. Laceration of bowel or bladder is quite within the realms of possibility. The urethra ordinarily escapes because remote, while to reach the ureter a fragment must pass through the thick iliopsoas. The frequency of complications will be lowered in direct proportion to the care and gentleness with which the examination is conducted.

Prognosis.—In the absence of complications the prognosis is good. Stiffness, lameness, and disability of the hip-joint are liable to persist temporarily.

Treatment.—Given a patient with a fresh injury to the hip, we would ignore absolutely any academic paring of the diagnosis until we had satisfied ourselves that the bladder was not ruptured, that the intestines had not been harmed, and that no dangerous hemorrhage was in progress. Now with conscience free to act we would reduce the fracture, put the patient at rest in bed, and apply extension in the axis of the limb in conjunction with lateral traction upon the femoral neck. After a few days, if all goes well, we would apply a gypsum case from the roots of the toes to the costal margin. Having obtained satisfactory union, we would combat the effects of prolonged immobilization of the hip-joint by massage and judicious passive motion.

For the privilege of reporting these four cases we are indebted to Drs. J. William White, John B. Deaver, Charles H. Frazier, and B. A. Thomas, in whose services at the University Hospital they occurred.

Dr. Astley P. C. Ashhurst said that in a recent paper on this subject by Henschen, in which 139 cases were collected, it was said that no attempt should be made to reduce the intrapelvic spicules of bone until the femoral head had been withdrawn from the pelvis; Henschen advised that the thigh be dressed in flexion and adduction in a plaster case, and that the patient should bear no weight on the limb for two or three months.

FRACTURE OF THE SESAMOID BONES

BY GEORGE P. MÜLLER, M.D.,
OF PHILADELPHIA.
Associate in Surgery in the University of Pennsylvania; Surgeon to St. Agnes Hospital.

It is of course common knowledge that the patella is a sesamoid bone and that it is frequently fractured. There does not exist, however, a definite understanding of the fact that the other sesamoid bones may also be fractured; in none of the standard systems or text-books of surgery, nor in the monographs on fractures is there any mention of this condition.

The sesamoid bones are so named from their resemblance in size and shape to the grain sesamum. They are constantly present in the thumb and great toe. In 1892 Pfitzner [1] from an examination of macerated preparations—388 of the hand and 385 of the foot—found that sesamoid bones were present on the ulnar side of the fifth finger in 82.5 per cent., on the radial side of the index-finger in 48.7 per cent., and occasionally on the radial side of the third and fifth fingers. Fawcett [2] in 1897 made the first X-ray study of these bones and found sesamoids in the little finger in 71 per cent. and in the index-finger in 55.2 per cent., in an examination of 38 pairs of hands. Pfitzner found a sesamoid at the interphalangeal joint of the thumb in 69.3 per cent. and Fawcett in 68.5 per cent.

In the feet the sesamoids were found by Pfitzner to occur on the fibular side of the fifth toe in 6.2 per cent., on the tibial side of the fifth in 5.5 per cent., and on the tibial side of the second in 1.8 per cent. of times.

In 1904 Stieda [3] observed two sesamoid bones on the plantar aspect of the interphalangeal joint of the great toe, a tibial sesamoid of the fourth toe and an X-ray showing 9 sesamoids in the five fingers of the hand. He also made the important observation, later confirmed by Dwight,[4] that

there might exist an anomalous division of the sesamoid into two parts, a condition easily mistaken for fracture. In 1907 Momburg [5] reported the instances of two soldiers who injured their feet while jumping from a springing board. The area of tenderness and the X-ray led to a diagnosis of fracture of the sesamoid, but upon X-ray examination of the well feet a similar division of the sesamoid was found. Momburg also records that an examination of his X-ray records reveals 9 instances of a division of the tibial sesamoid, in 3 the bone was in 3 pieces and in 1 in 4 pieces. In 6 the division occurred in both feet. In a second paper Stieda [6] pictures the rare interphalangeal sesamoid of the index-finger, a third or accessory sesamoid at the metacarpophalangeal joint of the great toe and a curious instance of a sesamoid at the web between the great and second toes.

In 1904 Wolff [7] reported 3 instances of a sesamoid in the tendon of the gastrocnemius; in 1909 Pancoast [8] wrote a complete paper on this sesamoid and stated that in about 12.5 per cent. of persons there is a sesamoid in the tendon of the outer head of the gastrocnemius. He calls attention to the possibility of mistaking it for a loose or foreign body in the popliteal bursa.

Dwight notes the frequent occurrence of an isolated bone in the tendon of the tibialis posticus; he terms it the *tibiale externum,* a true part of the skeleton, being found in many mammals and being cartilaginous in the second month of the embryo. In 10 per cent. of persons it is a separate bone; in the remainder it is part of the tuberosity of the scaphoid. Painter [9] reports a sprain-fracture of the tibialis posticus tendon in which operation revealed the isolated bone, the size of a lima bean, seeming to have a false joint between it and the body of the scaphoid.

The sesamoid bones are developed from cartilage and first make their appearance as osseous structures in the toe about the eleventh year, the others a year or two later. They are usually met with in the substance of tendons and in the neighborhood of joints. One surface is usually covered with

cartilage and either enters into the formation of the joint or, separated from it by a bursa, plays on another bone, or on cartilage or ligament. This function is to obviate friction or to change the direction or pull of a muscle. They are to be considered as parts of the skeleton all of which have their places in certain animals, but all of which either are not developed, or if they do appear are again lost in others. Thus, certain sesamoid bones of the finger are frequent in the fœtus and rare in the adult (Piersol). The feet of the armadillo and the forefeet of the mole are provided with many sesamoids; in the horse one of the sesamoids is termed the navicular.

The constant sesamoids of the thumb are two in number, situated on either side of the middle line at the metacarpo-phalangeal joint. They are connected by a strong fibrous band which forms the floor of the groove for the long flexor tendon. Anteriorly they give attachment to the short muscles of the thumb, and posteriorly are smooth. The lateral ligaments of the joint are partly inserted into their sides.

Fracture of these sesamoids seems to have been observed but twice. In 1907 Preiser[10] reported the instance of a woman, 30 years of age, who fell on the right hand and broke both of the sesamoids of the thumb, and in 1909 Morian[11] observed a fracture of the ulnar sesamoids in a girl age 27, who had caught the thumb in a closing door.

The constant sesamoids of the great toe are developed in the tendon of the flexor brevis hallucis and play in a groove on the head of the metatarsal. They are united to both phalanx and metatarsal by stout fibres and laterally are connected with the lateral ligaments of the joint and the sheath of the flexor tendons.

The first instance of fracture of these bones was reported by Schunke[12] in 1901; Marx,[13] Muskat,[14] Momburg,[5] Igelstein,[15] Stumme,[16] Morian,[11] and Painter[9] have also reported cases. Of the 16 cases reported, including my own, 14 were in males, one in a female and one not stated; the ages ranged from 14 to 66 and averaged 37 in twelve where the age was given. Nine occurred in the right foot, 6 in the left. The external or fibular sesamoid was fractured in 1 case, the tibial sesamoid in 9 and in 5 there was a division in the sesamoids of both toes although only one side had been injured. On account of the finding of a division on both sides Momburg doubts the authenticity of the fractures he reports and both Igelstein and Painter are inclined to do likewise of theirs. That fracture is possible has been proven by the pieces excised and by the experiments of Stumme on the cadaver. He proved that forcible dorsiflexion with abduction may fracture the tibial sesamoid. He also believes that we can differentiate a fracture from an anomalous division: by the sharp edge of the line of fracture, by the oval shape of the fragments in the anomalous division, by the history of the case and a normal other toe. The character of injury in the reported cases is variously given as being due to sudden falls on the feet and the dropping of heavy weights on the toe. In 3 of the cases operative treatment was practised, the remainder being treated by plaster of Paris and supports.

I have observed the following case:

A woman, age 35, was injured two years ago by having the foot trod on while dancing. The acute symptoms soon disappeared, but there remained a residual soreness and pain on walking. Examination revealed nothing except slight tenderness over the site of the sesamoid bones of the left great toe. An X-ray made by Dr. Pfahler showed a transverse fracture of the tibial sesamoid with slight separation of the fragments, but no displacement. On June 27, 1911, I removed the sesamoid through an incision about one-half inch above and parallel to the tendon of the flexor longus hallucis. It was necessary to detach the inner head of the flexor brevis hallucis. The capsule was then cut and the joint opened. After removal of the fractured sesamoid the tendon was sutured to the capsule. The wound was closed without drainage. On October 2, 1911, the patient expressed herself as being entirely relieved of all pain and disability.

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[5] Momburg, Deutsche Zeit. f. Chir., 1907, Bd. 86, s. 382.
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[7] Wolff, Berlin. klin. Woch., 1904, Bd. 41.
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[10] Preiser, Arztliche Sachverstand, 1907, s. 400.
[11] Morian, Deutsche Zeit. f. Chir., 1909, vol. clxiii, s. 363.
[12] Schunke, Monatschr. f. Unfallheilk., 1901, s. 242.
[13] Marx, Munch. med. Woch., 1904, Bd. 51, s. 1688.
[14] Muskat, Deutsche med. Woch., Jahr 32, s. 1319.
[15] Igelstein, Deutsche Zeit. f. Chir., 1908, Bd. 93.
[16] Stumme, Fortsche. auf dem Gebiet. du Röntgen, 1909, Bd. 13, s. 312.

NOTE.—There are two instances of luxation of the sesamoids on record, viz., Karschulin (Wiener med. Woch., 1906, No. 17, s. 814) and Perlman (Deutsche Militar. Arztl. Zeit., 1904, s. 474).

STATED MEETING, HELD DECEMBER 4, 1911

DR. R. G. LE CONTE, President, in the Chair.

A CHILD WITH RUDIMENTARY LEFT UPPER EXTREMITY (PEROBRACHIUM).

DR. PENN G. SKILLERN, JR., exhibited the patient. He was a male, aged 5 years, the second youngest child of healthy and normal Irish parents. Five brothers and sisters healthy and well formed. Patient presents no other abnormalities or defects, congenital or acquired.

As shown by the sketch (Fig. 1), the left upper extremity is very rudimentary, extending but little more than half way down the chest wall, to which it is adherent, instead of down nearly to the left knee. The limb terminates in a free foot-shaped projection, of which the heel corresponds to a rudimentary thumb and the remainder to a partially flexed and fairly well-developed index-finger.

Movements of the limb are principally elevation of the shoulder and flexion of the remaining dwarfed segments.

External examination reveals a fairly well-developed clavicle, an acromion, a very small humerus, an elbow-joint, small forearm bones, and in the index small nodules of bone corresponding to a carpal, a metacarpal, and a phalanx. The presence of the elbow-joint was confirmed by Dr. Astley P. C. Ashhurst.

Internal examination by Röntgen rays served to orientate the skeleton of the limb more accurately. The first skiagram taken (Fig. 2) shows a comparatively well-developed clavicle, a rudimentary acromion, coracoid process, humerus, forearm, carpal, and digit bones. As it was afterward determined, the scapular spine was obscured in this picture by the shadow of the clavicle. Because the glenoid rim and elbow-joint were not well shown, another skiagram was taken (Fig. 3). Now the upper extremity of the humerus was found in juxtaposition with a rudimentary glenoid, from which there faded away below an indistinct axillary border. The scapular spine is now shown. The position of the elbow-joint is brought out by the partially flexed forearm. The radius and ulna here form a common shadow.

Epiphyses are lacking, and the bones have advanced but little in development beyond a stage represented by the early months of intra-uterine life.

It is not claimed that this interpretation of the skiagrams is wholly accurate, but it is the result of careful study, in which the author sought the aid of Professors G. A. Piersol, H. K. Pancoast, G. G. Davis, and T. T. Thomas, and the artist, Mr. Erwin Faber. The case occurred in the service of Dr. B. A. Thomas, at the University Hospital.

To crown the interest of the case there is the usual history of maternal impression. The mother, when two months pregnant, answered the door-bell in response to a mendicant who exhibited to her his left shoulder, which bore the stump remaining after a railroad-amputation of the upper extremity.

LITHOTOMY UNDER SPINAL ANÆSTHESIA.

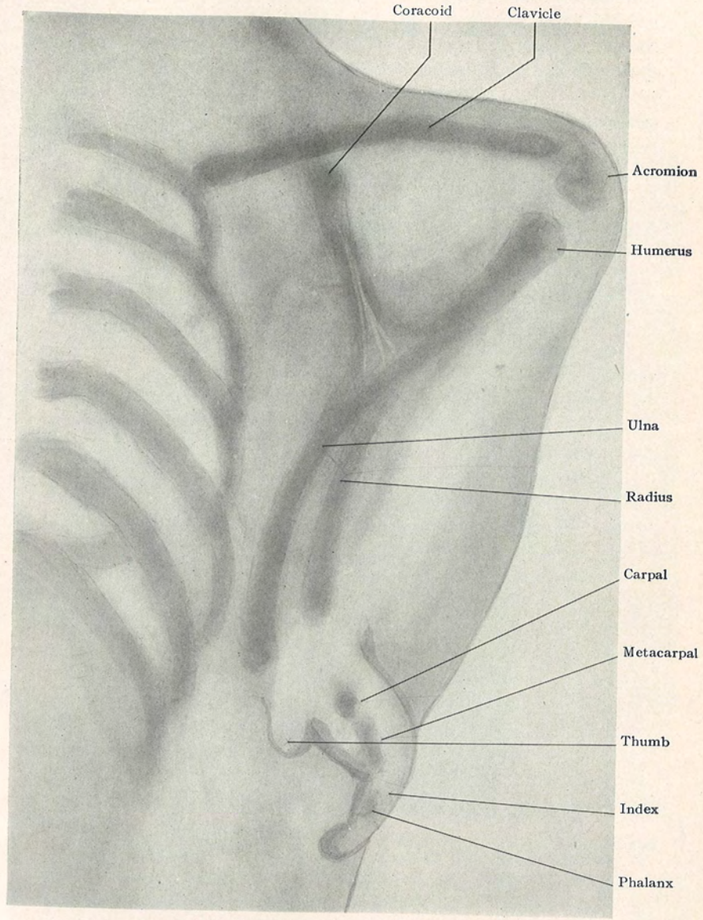
Dr. Harry S. Carmany read the history of a man, 61 years of age, who was admitted to St. Timothy's Hospital with a vesical calculus. On account of a chronic cough it was thought a suitable case for spinal anæsthesia, which was employed according to Professor Bier's original method, between the fourth and fifth lumbar vertebræ, first using ½ c.c. of a 1:1000 adrenalin solution, along with 2 c.c. of normal salt solution, waiting five minutes and then introducing 2 c.c. of a 1 per cent. solution of cocaine. After waiting ten minutes the operation was proceeded with. Anæsthesia was complete from twelfth rib down. Operation was started about 5.10 P.M. and completed about 5.40 P.M. Did not have return of sensation until 7 P.M. and was not complete until 9 P.M., although at 5.50 patient had profuse sweating, was slightly excited, felt a little faint, and had a subnormal temperature. Strychnine and atropine were given with prompt improvement. At 8.30 was given alcoholic rub, as sweating was still profuse. The stone was removed suprapubicly, with drainage tube for four days, when permanent catheterization was instituted for a week or ten days. Convalescence uninterrupted. Suprapubic wound healed four and one-half weeks after operation.

Dr. B. A. Thomas called attention to another method of removing vesical calculi, particularly small ones not more than half a centimetre in diameter, namely, by the use of Young's cystoscopic rongeur. About six weeks ago he had a case in which there were two small calculi which were removed by this method. The device consists of a beaked instrument shaped somewhat like an ordinary urethral sound which opens out on a hinge on its posterior surface like a clam shell, and passing

Fig. 1.

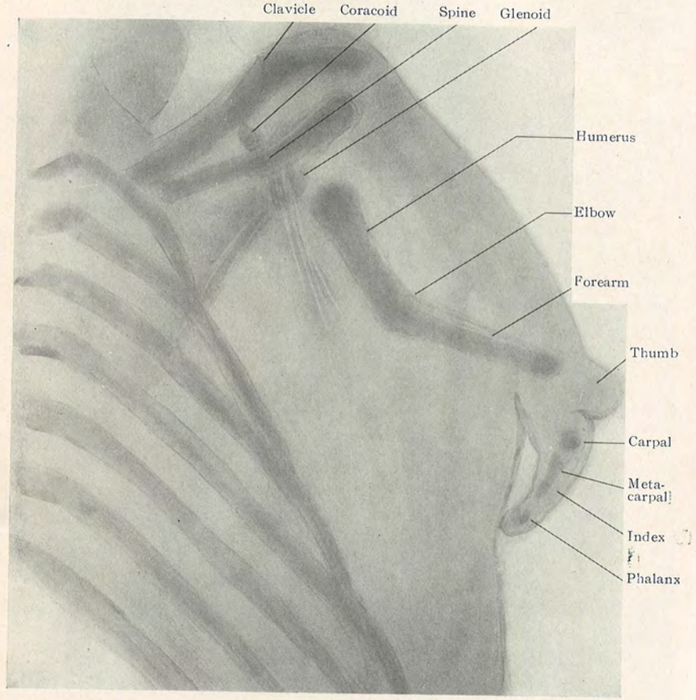
Rudimentary left upper extremity (perobrachium).

FIG. 2.



Rudimentary left upper extremity (perobrachium).

FIG. 3.



Skiagram of left upper extremity taken from behind and mesially forward and laterally.

through the hinge, as it were, is a straight cystoscope through which the stone is seen while grasping it with the expanded tip. One of the two stones removed by the use of this instrument was really larger than is applicable to this method and therefore had to be crushed before it could be removed.

DR. JAMES P. HUTCHINSON said apropos of spinal anæsthesia, that some years ago Dr. Le Conte and he were abroad together, and saw Dr. Tuffier use his spinal anæsthesia. After returning home they tried it regularly in the first fifty or more cases of operation below the umbilicus; it was uniformly successful, but the large majority of patients objected to the mental depression and, in many cases, the headaches that followed its use. They then discontinued its use, but he had recently taken it up entirely in prostatic and bladder cases if the patients would allow it.

It has an advantage which Dr. Carmany did not mention, and that is that there is absolute and complete relaxation of the patient. In a bladder case, using ether, one is apt at times during the operation to get rigidity of the abdominal wall, which never occurs in spinal anæsthesia. Spinal anæsthesia also has a great advantage in that in elderly individuals the patient can be gotten out of bed in four or five hours after the operation, after the effect of the paralysis of the lower limbs has subsided, while with ether they are apt to have nausea and vomiting and be upset for a day or more, with a much greater probability of subsequent pneumonia.

DR. ASTLEY P. C. ASHHURST referred to a recent paper by Dr. Bevan, of Chicago, in which he unqualifiedly condemns spinal anæsthesia. There is no doubt whatever that there are a great many cases where local anæsthesia will do as well. It will not do to use local anæsthesia in removing an enlarged prostate, but it can be used in doing suprapubic cystotomy and even in removing a stone from the bladder. If a surgeon has a little patience and a light hand, and keeps the operating room quiet, he can do many operations under local anæsthesia without resorting to the more dangerous spinal form.

DR. CHARLES F. NASSAU believed with Dr. Ashhurst that if simpler means were tried the same results could be attained without treading on such dangerous ground in many cases. If one has persevered in obtaining a more or less extensive experience with local anæsthesia, infiltration anæsthesia, there are very few operations within reason to which the method cannot be applied. Hernias, bowel resections, exploratory sections, amputations of the arm and thigh can be perfectly well done under

local infiltration and nerve blocking. There is no objection to combining anæsthetics, for instance, in operating for a tightly strangulated femoral hernia, which is one of the more difficult types under local infiltration because it is a little hard sometimes to reduce the constriction without causing the patient some pain. In such a case the patient can be given a few breaths of nitrous oxide. One can benumb the patient thoroughly with morphine before beginning, and personally he would feel that while operation should never be refused if strongly indicated in the aged, yet he would go a long way before he would use spinal anæsthesia, the use of which may possibly result in later trouble. He knew of two patients who, he had been told, are wrecks from spinal anæsthesia used for the purpose of operating on hemorrhoids.

Dr. Robert G. Le Conte said that he had had very much the same experience as Dr. Hutchinson. When they were together some years ago at Tuffier's clinic, they were impressed by his method and technic of administering spinal anæsthesia and with the results obtained at the time of operation. Under this stimulus they tried it on a number of cases at the Pennsylvania Hospital. Their conclusions were that in old people, with bad arteries, bad kidneys, and poor circulation, this anæsthetic was the safest one that could be used. He had done a number of grave operations on patients of this type, without shock or variation in the pulse-rate. He had not had the good fortune to do major operations under infiltration anæsthesia with as little disturbance to the nervous system and to the circulation as under spinal anæsthesia. He had, therefore, become a firm believer in, and a strong advocate of, spinal anæsthesia in this limited group of cases.

Dr. George G. Ross thought one of the great difficulties with regard to stovaine is that there is no standardization of the dose with regard to the weight or age of the patient, and hence what would be an overpowering dose for one man may totally fail to anæsthetize the next one. He had seen one fatality under stovaine in a case of strangulated hernia; in this case he thought a local anæsthetic would have been preferable. The patient died promptly after the stovaine was thrown into the membranes around the cord. He had seen a number of cases where active and violent convulsions resulted from the combination of strychnine and stovaine. It took considerable time and prolonged artificial respiration to tide the patients over the immediate effects.

INDICATIONS FOR AND AGAINST THE OPERATIVE TREATMENT OF SIMPLE FRACTURES.

BY JOHN H. GIBBON, M.D.,

OF PHILADELPHIA,

Professor of Surgery in Jefferson Medical College; Surgeon to the Pennsylvania Hospital.

What I have to say on this important subject will probably cause my readers to place me among those who oppose the operative treatment of simple fractures; and although I should prefer this to being classed with those who recommend operation in practically every case, yet a careful consideration of what is said I believe will show that I belong in neither class. There has been so much written on the open treatment of simple fractures, and the technic has been so much improved lately, that I am afraid we have become too sanguine in regard to our results and too radical in both our teaching and practice. It is important to bear in mind that what follows has to deal only with simple fractures.

The first desideratum in the treatment of a fracture is the restoration of function, and the first step in accomplishing this objective is complete reduction and retention of fragments. Although improper reduction is one of the chief causes of loss of function, injury of the surrounding soft parts and the resulting adhesion of muscles and tendons is just as potent a factor, and when the open treatment is employed there must be more or less injury and adhesion of these structures, which will be in proportion to the mechanical and technical skill of the operator and the perfection of his asepsis. It is extremely important to bear these facts in mind before undertaking the open treatment of a simple fracture.

There are, of course, certain indications for the open treatment which we all recognize and follow, unless they are outweighed by equally positive contraindications, which will be considered later. In the first place, the situation of the bone or the type of the fracture may be a sufficient indication

for operation; this is the case in fractures of the patella, in many fractures near a joint, in an epiphyseal separation which cannot be perfectly reduced, in some comminuted fractures, in those where a muscle or tendon or other tissue is interposed between the fragments, where a nerve-trunk has been caught under one of the fragments, and in all fractures where a fair reduction has not been obtained *after the exhaustion of all rational non-operative means.* Emphasis is laid on this last condition, especially with students and those who look too lightly upon the risks of operative treatment. I say this because it is the beginner or the occasional operator who is often willing to run risks which the most experienced operator never runs, and neglect precautions which an experienced operator always takes.

One of the most valuable lessons which experience teaches is the estimation of risks and the value of precaution. It is the tyro whose boldness causes him to operate where an experienced surgeon recognizes danger, and it is the tyro who considers the refinements of an aseptic technic unnecessary or even looks upon them as fads. It is this type of surgeon who will operate on a fracture without having exhausted the less dangerous non-operative means of reduction, and one reason why he does so is because he sees many worse cases operated on successfully by others. It may be said that this applies to the whole field of surgery, and so it does, but I hold that it applies particularly to the open treatment of fractures, where success depends so largely on the operator's mechanical skill and his practice of an aseptic technic.

A conscientious practice of the rule of exhausting the non-operative means of reduction will obviate the necessity of operation in many so-called irreducible fractures. To prove this statement, one has but to consider a few types of fracture for which operation is frequently employed. First, let us take fracture of the surgical neck of the humerus with abduction and external rotation of the upper fragment, a fracture which by the older methods of reduction and retention gives but a limited restoration of function and a very

indifferent restoration of contour. A mistake commonly made here is that of trying to control the short upper fragment, which is practically uncontrollable, instead of placing the lower fragment or shaft in alignment with the displaced and uncontrollable upper fragment. In many of these cases the simple abduction of the arm with moderate traction even without an anæsthetic will result in an excellent reduction, which can be maintained by dressing the part in abduction on a triangular splint placed against the chest wall, the inner aspect of the arm, and the flexor aspect of the forearm; or by keeping up extension in the abducted position by placing the patient in bed and applying a Buck extension apparatus to the arm. Too frequent an error in these cases is that of fixing the arm against the chest wall and applying a bandage, usually a Velpeau, which makes upward pressure on the flexed elbow and downward pressure on the shoulder; in other words, a dressing which tends to crowd the fragments into angulation or to retain them in this malposition. Traction applied to the elbow with the arm against the chest wall also often corrects the deformity when operation may seem to be necessary. In a number of these cases where there was extremely bad position of the fragments, we have obtained a fair reduction and excellent restoration of function by keeping the patient in bed with an extension on the arm in the abducted position for a week or ten days, and then dressing the part on a triangular splint.

Transverse fractures of the humerus with overlapping can nearly always be reduced by continuous traction applied to the flexed elbow, with fixation of the arm to the chest wall while the patient is in the upright position, or, what is better, by keeping the patient in bed and applying extension by means of a Buck apparatus. Counter-extension should be made, of course, by elevating the foot of the bed and fixing the upper arm to the head of the bed by means of a pad and strap passed under the axilla. In the oblique and spiral fractures of the humeral shaft, the type of fracture which most frequently requires operative fixation, the large majority can be

reduced by the method just described. If it fails, probably due to the interposition of the soft parts, then operation is plainly indicated. The necessity for operation in supracondyloid and fractures of the condyles can often be obviated by the proper employment of the Jones position, which gives excellent functional results, although not such perfect contour as can be obtained sometimes by other forms of dressing and by operation.

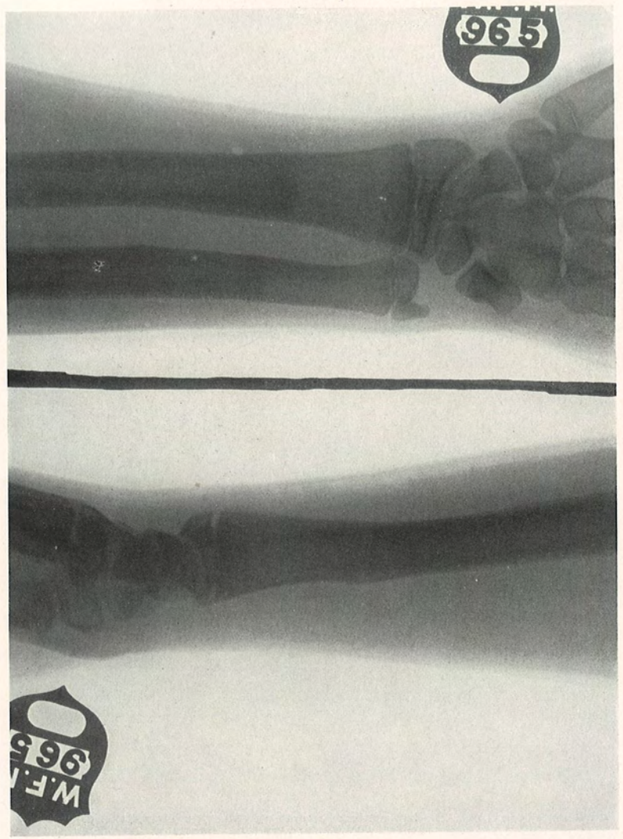
Many fractures of the olecranon require operation because of the wide separation of the fragments and the extensive laceration of the ligaments. But here the simplest means possible should be employed; catgut suture of the ligamentous tissue, as in fracture of the patella, may be sufficient, and a plate in this position is seldom excusable.

In certain fractures of the shaft of the radius and of both bones of the forearm, we encounter some of our greatest difficulties, and may be driven to operation or to accept some deformity with considerable loss of function. In four or five such cases within the past twelve months I have been surprised and gratified to find what can be accomplished by continuous traction extending over a period of from two to ten days. One of the cases at the Jefferson Hospital, X-ray plates of which are shown, was most obstinate (Figs. 1 and 2). My assistant, Dr. Despard, twice tried under ether anæsthesia to reduce this fracture, but the overlapping radial fragments could not be put into line. He then applied a Buck extension apparatus below the fracture, fixed the upper arm to the head of the bed, and elevated the foot of the bed. This treatment, kept up for three days, had little apparent effect on the deformity, and the boy was then anæsthetized with the understanding that I would operate if failure again accompanied efforts at reduction. The treatment had done so much to overcome and stretch the muscles that without much effort reduction was accomplished, and the boy, now eight months after the injury, is playing on a football team, has perfect function, and it is impossible to tell by examining the arms which was the seat of fracture. In another case of

FIG. 1.

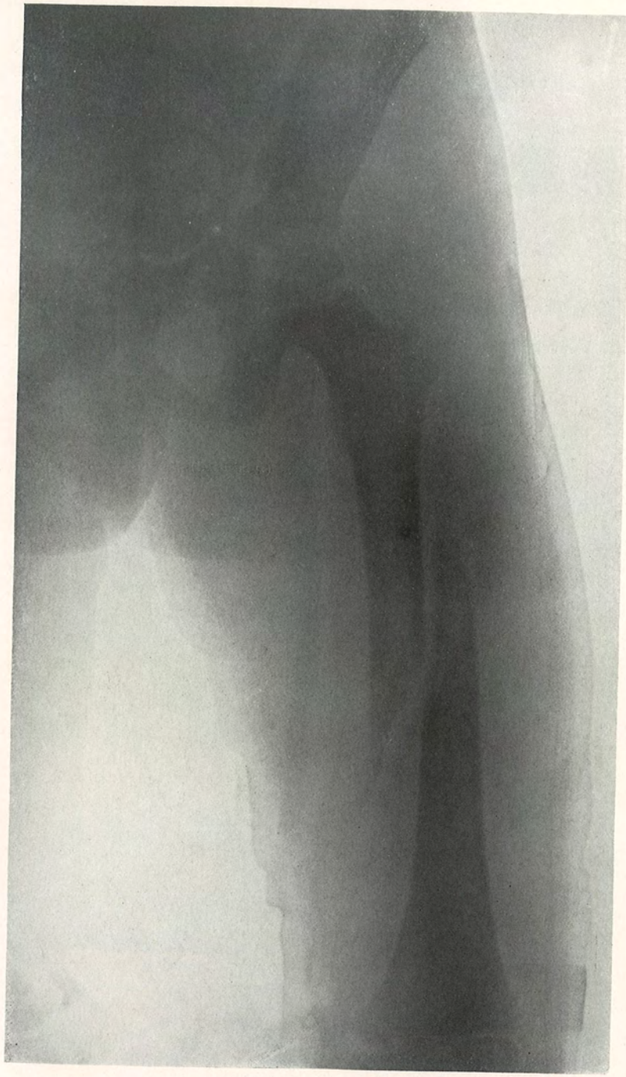
Fracture of both bones. Radius unreduced after two attempts under anæsthetic. Readily reduced after continuous traction of three days.

FIG. 2.



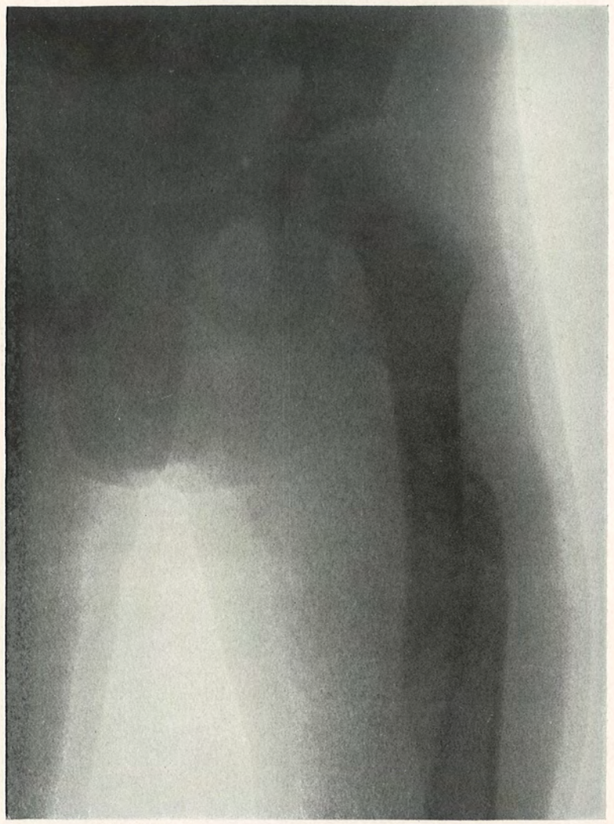
Same case as Fig. 1, eight months after injury.

FIG. 3.



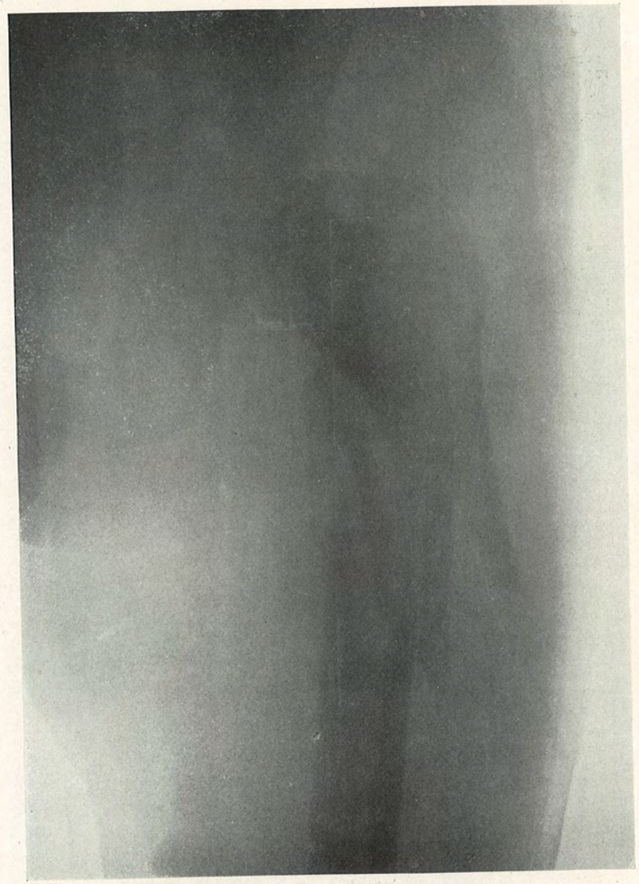
Patient admitted to Pennsylvania Hospital November 27, 1911. Discharged January 18, 1912.

FIG. 4.



Same case as Fig. 3, taken ten weeks after injury. Excellent functional result.

FIG. 5.



Patient admitted to Pennsylvania Hospital December 17, 1911. Discharged February 8, 1912, on crutches.

FIG. 6.

Same case as Fig. 5, taken one week before discharge. Shortening 2.5 cm. Excellent functional result.

overlapping of both bones of the forearm sent into the hospital from the out-patient department, where various efforts had been made at reduction and in which about ten days had elapsed since the injury, treatment by continuous traction for about two weeks resulted in fair reduction and good union. The ultimate restoration of function I have been unable to determine in this case. Other cases have responded much more quickly to the treatment, but these two were cases in which operation seemed inevitable, even after traction had been kept up for several days. This method of overcoming the indications for operation will not work in every case, but it should be tried faithfully before resorting to the open method, which certainly does not give its best functional results in fractures of the forearm and makes a scar which is disfiguring, especially in women. The bones here are closely surrounded by important structures which are apt to become bound down in the cicatrices; the bones are delicate and do not put up with the plates and screws so well as the more deeply situated and larger bones.

The femur is the bone upon which we most frequently have to operate, and yet as the results here cannot always be expected to be perfectly satisfactory, we should by every possible means try to obtain reduction before operating. In children, especially, persistent effort and time will do wonders in restoring the bone to approximately normal lines, and the functional results are often excellent even in the presence of considerable deformity. I have nothing particular to offer here as a means of avoiding operation in the adult, but I would call attention to the fact that in fractures of the upper third of the femur which are so troublesome because of the difficulty of controlling the upper fragment, extension in the abducted and elevated position has not been given one-half the employment it deserves. Most of us use this position in children, but many fail to realize its advantages in the adult. I have had as many as three of these cases in my ward at the Pennsylvania Hospital at one time upon which I have operated, but since I have used the extension with a little

more care and discrimination, and less according to rule, I have operated on fewer cases.

Of fractures of the patella I shall say but a word, as I believe that the indication for operation is clear if the fragments are separated, since bony union of the patella and good healing of the lateral ligaments will rarely take place without it. I have never operated on a fracture of the patella without finding the ligamentous tissue firmly adherent over one or the other of the fractured surfaces. The contraindications will be referred to later.

In fractures of the tibia of the oblique and spiral types, operation is frequently demanded, and yet I am confident that too many of these cases are submitted to operation, especially at the hands of inexperienced men, where better results could be obtained by non-operative methods. I admit that continued improvement in technic may cause me to change my opinion and practice, but I speak now rather from the point of view of a teacher of undergraduates. Greater care, personal effort, the proper use of extension, and constant watching of these cases, which we are apt to turn over to entirely inexperienced internes, will certainly keep out of our operative lists many of these cases. Here, particularly, the operator should understand that if after exposing the fragments he can reduce and maintain them in reduction by a proper dressing, he should not employ a plate or other mechanical device applied directly to the bone, as such is badly borne by the tibia on account of its thin covering. Non-union, especially where the position is bad, is a definite indication for operation, but the best operative results are obtained when the operation is done early; that is, as soon as it is evident that reduction cannot be accomplished. The open treatment of a Pott's fracture is rarely required except in old neglected cases, and here again the situation is not one suited to the use of a plate, the simpler methods of suture, nailing, etc., being better. The word "neglected" is used advisedly, because in the large majority of cases reduction can be accomplished and maintained with the expenditure of but a moderate amount of

care. A certain proportion of Pott's fractures apparently heal in good position, and then the deformity recurs after the patient begins to bear his weight upon the part, and it is this type of case which is most frequently submitted to operation. The redevelopment of the deformity can easily be avoided by following a suggestion made by Mr. Robert Jones, of Liverpool, who, when the patient begins to walk, sees that the inner portion of the heel and sole of the shoe is slightly raised; this gives the ankle an outward turn and prevents stretching of the recently healed ligaments. If every patient upon leaving our wards is instructed to have his shoes altered in this way for six months, there will be fewer cases operated upon in the future than in the past.

Just as I have tried to show that continued traction will often result in reduction where spasmodic and intermittent traction will not, Crile has suggested that with deep anæsthesia, which causes complete muscular relaxation, our attempts at reduction will be far more successful than when we simply employ the anæsthetic to the point of relief from pain and the production of unconsciousness.

The contraindications to the operative treatment may lie in the fracture itself, in the patient's general condition, or in the operator and his surroundings. The contraindications to be found in the fracture itself are few, if, after careful and intelligent effort, reduction has not been accomplished and enough deformity exists to interfere with subsequent use or to distress the patient by its appearance. Local disease and infection of neighboring structures may preclude operation. I have at the present time a fracture of both bones of the forearm, in which there is an infected wound communicating with the ulna, which is in excellent position, and I am prevented from operating on the radius, the fragments of which are overlapped, because of the infection in its neighborhood.

The indications against operation to be found in the patient's general condition are those which would make one hesitate to perform any operation of election. All these, however, must be considered carefully, and they should often make

us refrain from operation on a broken bone when we might operate for some other condition in which infection is less likely to occur, more readily overcome, or less disastrous in its results. A drain may, for instance, save another structure from infection, but we have learned that it has no place in the open treatment of simple fractures, rather inviting than preventing infection. My experience has taught me to look upon chronic alcoholism as a contraindication deserving of great attention, as is also an old syphilitic infection. The extremes of age may often constitute a contraindication, old age because the operation is more dangerous, and childhood because nature does so much in the subsequent growth of the bone to overcome the deformity resulting from fracture. The ultimate results secured in children, even where reduction was but partially obtained, were clearly shown in a series of pictures recently exhibited by Dr. Edward Martin before the Philadelphia Academy of Surgery. The accompanying picture (Fig. 3) of a spiral fracture of the femur in a five year old boy is one in which I expect to get a good functional result, even though I may fail in correcting the position. Such a fracture in an adult I should probably be obliged to subject to operation.

I also show plates of a bad fracture of the femur in an adult, when, in spite of the displacement of the fragments, an excellent functional result without apparent limp was obtained (Fig. 5).

The contraindications to be found in the operator and his surroundings I would emphasize. There are probably but few surgeons who operate upon fractures with the same impunity and confidence that they perform other surgical operations of an apparently more serious nature. If this is true, it behooves us to know the reason. First, I take it, the required mechanical skill is of a different sort from that necessary to the successful performance of most of the surgical operations, even of the most delicate character, and this is acquired only by careful study of the methods in vogue and by much experience; again, more care is necessary in this field

than in any other to avoid infection, as we are dealing with a tissue, the medullary portion of the bone, whose resistance is slight; and still further, it may be said that failure of the operation often leaves the patient in a worse state, a greater cripple, than if no operation had been done. No one realizes these facts more fully than he who does the greatest amount of work in this field, and consequently when we are inclined to imitate the accomplishments of others, we should see that we are equipped at least to some extent as they are, and by equipment I do not mean the special instruments which are, however, most essential, but rather with ability to meet and deal with difficulties and with an aseptic habit and an environment which can be relied upon. If we could feel the same assurance regarding aseptic wound healing in fractures as we do in abdominal operations, half of the difficulties of this work would be overcome, and our results would be ten times better than they are at present. We are apt to minimize our percentage of infections in any type of operation, but I ask a careful study of our own cases and the perusal of any honest report by others, and we will then find that this important question of infection takes first rank when it comes to the open treatment of fractures. In a recent article on this subject, Lund, modestly describing himself as a beginner, reports eleven cases in which he has used the Lane plate, and in four of these he was obliged to remove the plate. If a man of his experience and ability finds this work difficult, it then becomes those with less experience and ability to move in this field of surgery with judgment and precaution.

In concluding this rather discursive paper, I would say that our aim should be to overcome the indications for open treatment by a perfection of our mechanical measures, and to obtain better results when we must operate by improving our operative technic.

Dr. Richard H. Harte said that the operative treatment of fractures which has been so much before the profession of late years is largely the outcome of the imperfect treatment

accorded these patients. Again, it is largely due to lack of interest on the part of many surgeons who should know better how to treat fractures than they do; they rarely take but a passing interest in fractures until they find they are resulting badly, their attention being called to this fact by the house officer.

He was exactly in accord with Dr. Gibbon in regard to the treatment of special fractures. Take fractures of the shaft of the humerus, around the anatomical and surgical neck. Those of the anatomical neck are comparatively rare. There is very little disposition for entanglement and the question here is more of reduction and retaining the arm in position after reduction; a satisfactory result follows in the great majority of cases, particularly if the suggestions presented in this paper are followed. Again, the same thing may be said about the elbow-joint and in the shaft of the humerus. In the treatment of all fractures the question should come up with regard to the displacement: What is causing it, is it muscular, or is it a result of the bones being driven past each other by violence, or due to entanglement? In his experience, except where there is entanglement, one can usually reduce all fractures. By entanglement he meant pieces of muscle, fascia, etc., getting between the ends of the bones, and these can be eradicated only by exposing and removing the obstructing material.

There are certain bones and certain portions of bones in which entanglement is more frequent, each as in the central portion of the bones of the thigh because of the great masses of muscle surrounding them, in the forearm, and also in fractures of the tibia. In fractures of the shaft of the thigh Dr. Gibbon has very properly emphasized the importance of bringing the lower fragment to the upper fragment in fractures high up; Dr. Agnew laid stress upon this point years ago. He used a double inclined plane and made extension a little below the knee.

He was strongly of the feeling that if surgeons will carefully analyze their fractures and find exactly what the displacing element is, they will get better results than they are getting to-day. Often on taking an X-ray, when the fragments are apparently in position it is found that a great deal of displacement exists, particularly laterally; the plane of fracture is almost straight, but the bones are separated from one-half to three-quarters of an inch with tissue between; these cases should be operated upon. He did not know any class of surgery where the judgment of the surgeon

is more taxed than to say what cases should be operated upon and what should not. The reason ununited fractures occur is because a band of fascia or piece of muscle has gotten between the ends of the bones.

Another important point is the necessity of going into these cases before it is too late, not after subjecting them to extension for four, five or six weeks. The surgeon should find out as soon as possible whether he had gotten the fragments in position; then he should not wait too long, because it complicates the operation materially; the changes for repair are much better the earlier the operation.

With regard to Pott's fracture, he had seen such cases operated upon, but he did not think they should be. If treated intelligently, by carrying the foot well in a fracture box with two pieces of bandage and binding the leg around, or putting on the Dupuytren splint, one will get satisfactory results. It gives a chance for the deltoid ligament to recover itself, and a patient after a fracture of this sort should walk on the outside of the foot because the ligament will gradually give way, and in time if the foot is well carried in it will just about balance itself.

Dr. John B. Roberts said that he recalled looking a few months ago over a paper by a New York surgeon, in which were reported quite a large number of cases of fractures of the thigh bone operated upon because they had been united in malposition or because they could not be reduced. He read carefully his statements as to the previous line of treatment and in a large proportion the patients had never been subjected to efficient non-operative surgical treatment. Nearly all of them had been treated by long external wooden splints or other splints, or by an inclined plane, and not by extension with Buck's stirrup and pulley or other methods of maintaining traction. For one to operate on fracture of the shaft of the femur, because it could not be reduced, when he never had tried continuous traction with 25 or 30 pounds weight, is in his opinion an error. If he had previously seen these cases himself and treated them in a rational manner, doubtless operation would not have been considered necessary. He thought Dr. Gibbon to be entirely right in stating that the great majority of fractures can be treated by non-operative means; and that when this is not successful the failure is due to either the patient's own negligence, or to a want of mechanical sense and attention on the part of the surgeon.

It is often due to the fact that the after-treatment is conducted by young medical men or by nurses, who are not familiar with the mechanical principles involved and the anatomical displacements. Each individual case should be treated in accordance with the mechanical and anatomical problems involved. In a great majority of fractures of the humerus or the bones of the forearm and of the bones of the lower extremity, the surgeon will obtain good results without operation, if he has a mechanical turn of mind and gives intelligent and frequent supervision to the patients. It will not do, however, to leave them to doctors or nurses without experience and knowledge of non-operative methods. He discovered not long ago that fractures of the femur treated by him in a hospital had been accustomed to have a bedpan about two or three inches high put under them by the orderly while the broken limb was weighted with from 15 to perhaps 30 pounds. He only found it out by seeing the thing occur as he walked into the ward. That is the kind of thing that surgeons' indifference and negligence in fracture cases have allowed to go on in hospitals; and it perhaps accounts for the lack of good results in many cases. Dr. Gibbon is right, that attentive surgical observation will prevent many bad results.

It seems proper to lay stress on the treatment of fractures by gypsum splints. The average surgeon nowadays pays no attention to the use of plaster of Paris as a means of making a perfectly fitting splint.

The X-ray is a valuable adjuvant in diagnoses; but it is a most incorrect aid unless a surgeon supervises the taking of the picture and then uses his own fingers and clinical sense to act as a source of contrast and addition to the X-ray plate. In some hospitals the patients are taken out of bed, put on a stretcher, and taken to the X-ray laboratory by a probationer nurse or inexperienced resident. It is perfectly possible for the X-ray man to make almost any kind of a picture by changes in the line and angle of the rays. We are liable to pay too much attention to the X-ray picture and think we have a badly set fracture when the truth is that the appearances are factitious. It requires often the combined knowledge of the radiologist and the surgeon to correctly translate the shadow picture.

Dr. Gwilym G. Davis said that Dr. Gibbon's paper brings up one aspect of surgery that is suggestive, and that is the relation of the conservative to the radical, and the question of the conservative treatment of surgical affections of the extremities. When it comes to a discussion as to whether the treatment of certain cases shall be conservative or radical, it devolves upon the surgeon to be qualified to decide that question. In other words, he should know what can be done by conservative means; to be qualified to treat a part conservatively he should understand conservative methods and should be willing to take the time and trouble to become familiar with and carry out such methods. The tendency in the development of surgery during recent years has been toward visceral surgery; the consequence has been to drift away from extremity surgery. Visceral surgery has developed to such a tremendous degree that it has been practically impossible for many surgeons to keep pace with the developments of surgical science in conservative fields, and we therefore see them devoting their attention almost exclusively to operative and visceral surgery, the abdomen, brain, etc., to the exclusion practically of such things as fractures and other surgery of the extremities. Still retaining their position as general surgeons to institutions, these cases of fracture, etc., fall under their care although they have not kept pace with the development of the conservative side of the art. The consequence is that they must do one of two things, either relegate the treatment of these cases to others, or undertake them themselves. Some do one thing, some another. When they undertake the treatment themselves, they are confronted with the alternative of either treating them inefficiently conservatively, or else operating upon them, and likewise inefficiently, and it has been a matter of surprise to him that Mr. Lane's work, commendable as it is along some lines, has aroused such enthusiasm. No one could admire his technic more than the speaker, and yet the choice of his cases leaves much to be desired. Exactly what course will be pursued by the surgical profession is a matter of great interest. If the general hospital surgeon is going to treat fractures in the future, he will have to begin to study fractures from a conservative stand-point, and perhaps after the furor which has recently occupied the surgical world for visceral surgery has passed, there may be a reaction, and then these cases will again receive the attention which they deserve. In the meantime, however, some institutions are finding a solution of the problem by turning such cases over to the members of the staff who are accustomed to deal with things from a more conservative and mechanical stand-point.

Dr. John H. Jopson asked whether the amount of extension applied by Dr. Gibbon relatively to the arm and forearm and thigh. In the past he had often been content with an insufficient amount of extension in the treatment of fractures of the thigh, and lately he had been in the habit of increasing the weight with less regard to the age of the patient, until satisfied with the reduction obtained. He did not know whether in doing this the ligaments of the knee-joint might be injured. The question of the strength of these ligaments must be considered both in the treatment of simple fractures by Buck's extension, and in the newer methods of reduction, for example, that employed by Dr. Lemon of Milwaukee, which he recently demonstrated in this city. In Lemon's apparatus, one in which the mechanical details have been worked out in the nicest manner, the extension which is used to effect reduction is applied to the ankle by means of a special gaiter, which is removed after the plaster cast has set. The amount of extension employed can be carried up to 150 pounds. In Martin's method the extension is applied directly from the upper end of the lower fragment. Lemon's apparatus he applied for in one case and Martin's apparatus as modified and perfected by Eliason he has used very recently, and undoubtedly if there is no danger in the application of this very great amount of force below the knee-joint there is an advantage in the use of Lemon's apparatus, because in Martin's method you have to remove the retractor before pinning or plating the fragments.

Another question in the experience of the author is shock in operating on fractures of the femur, especially in the upper portion. As everyone knows there is oftentimes serious shock in operations on the femur, and in cases where the hemorrhage is slight may it not be that the traction itself can be responsible for this shock?

In spite of the opposition manifested in some quarters to the operative treatment of fractures, one must realize that in selective cases it has come to stay, and that we will be in the future less and less satisfied with incomplete and imperfect reduction of fractures.

Dr. John H. Gibbon (in closing) said that he thought highly of Lane's plates and that there is no technic better than his, but what he had seen is a plate employed in fractures and applied to bones where it should not be used; for instance, on the

olecranon, the internal malleolus, and the patella. Lane has done the best work of any man in the treatment of fractures. His selection of cases, however, seems bad, that is, he takes cases which we would not operate on. A great many of the cases which are reported by many operators are those which the surgeon has not seen until a resident or his assistant says, "We have a bad result and I guess you will have to operate," and this after partial union has taken place and a lot of callus developed. Such a case should have been operated on just as soon as it was discovered it could not be gotten into proper position. Late operations give bad results.

As to the residents: He finds residents get enthusiastic about the same things their chiefs get enthusiastic about. If one shows a certain amount of interest in fractures and demonstrates to the resident what he can do, for instance, in fractures of the upper end of the humerus by abduction, he will be impressed and become interested, and if, on the contrary, one pays no attention to the fracture cases, he will only call attention to them when they are in bad condition for operations and beyond mechanical correction. Surgeons want to familiarize themselves with the improvements that are made in the mechanical treatment of fracture just as much as the improvements in technic. General surgeons are competent to treat fractures, but when it comes to operating on them the man who understands this should be very familiar with such work.

There is one point he wished to emphasize, and that is the matter of continuous traction. Ten pounds kept up for a week will do more than 30 pounds for half an hour. Regarding the shock in thigh fractures, he thought that the shock accompanying and following fractures of the thigh is often one to fat embolism. He had no proof at all, excepting that large amounts of fat are eliminated in fracture by the urine. The student is to-day not receiving the amount of instruction in mechanical treatment of fractures that he should and it must be made up to him during his internship by those under whom he serves.

FRACTURE-DISLOCATION OF THE SHOULDER.

Dr. William J. Taylor reported the history of a man of 50 of lax fibre and poor muscular development, who in the spring of 1910 made a misstep and in jumping forward to regain his balance placed his foot upon a small rug lying upon a hard-wood

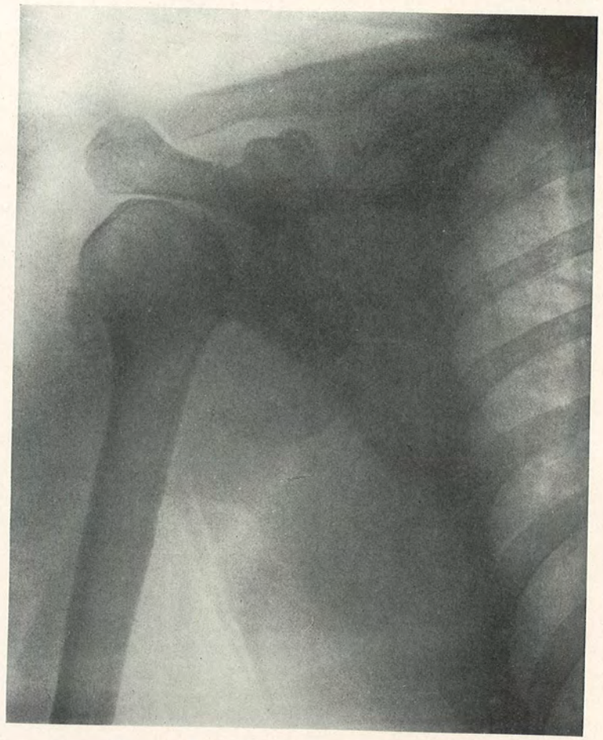
floor. The rug slipped and threw him forward, and in his efforts to save himself from falling, he extended his left arm, his hand coming with great force against a wall. A dislocation of the shoulder resulted. As the accident happened in the country, there was some delay before he could be seen by a physician. Finally a man of large experience and a most excellent practitioner gave him ether and after a careful examination reduced the dislocation without difficulty, using his foot in the axilla. The arm was then bandaged to the side. Forty-eight hours afterwards he came into town and was seen by Dr. Taylor for the first time. Patient suffered great pain; there was marked swelling, and the bandage was so tight that blebs had formed on the forearm. Dr. Taylor could feel the head of the humerus in its broken place, but the swelling about the shoulder was so great that an accurate examination was impossible. There was an extensive ecchymosis. The swelling gradually subsided, but pain was persistent and an X-ray taken of the shoulder showed the true nature of the injury. The anatomical neck, or rather the articulating surface of the bone, had been shelled off and remained against the chest-wall beneath the pectoral muscle.

He operated by making an incision along the posterior axillary fold and dissected down past the vessels well into the axilla. The piece of bone could be easily felt through the wound, but so near to the vessels and nerves that it was impracticable to remove it by this route for fear of doing serious damage. Through the same incision he now dissected below the vessels and toward the pectoral muscle and by splitting it the piece of bone was removed. The remainder of the head of the humerus was in place in the glenoid cavity and the capsule of the joint firmly united. The joint was moved freely and a drain of iodoform gauze introduced into the cavity from which the piece of bone had been removed. Convalescence was uneventful, and the patient has a perfectly useful arm and a movable shoulder-joint.

Dr. John H. Jopson said that he saw a case almost identical with this in an old colored woman in the Polyclinic Hospital Dispensary, with an injury of the shoulder which he diagnosed at first as fracture of the anatomical neck. The tuberosities were pulled upward so that no depression was felt below the acromion. The X-rays showed the head in the axilla, and he made an anterior incision and removed it.

Dr. Charles F. Nassau said that four years ago he had an

Fig. 4.



Fracture-dislocation of shoulder.

exactly similar injury occur to a patient of his. The man was very stout and flabby, extremely poor physical condition particularly due to dissipation, and he fell out of a low window to the porch, was brought to the city, and was supposed to have had a dislocation which was practically reduced, but the pain persisted. An X-ray was taken by Dr. Sweet, and it was after that that he came under his care. He feared very much to do anything with it, but the X-ray, although not good, was sufficiently so to show a thin "butter plate" torn from the head of the humerus and driven down between the head of the bone and the chest wall under the pectoral muscle. He made an incision through the anterior edge of the deltoid, smoothed the edges after removing the loose piece, and closed the wound with not more than three stitches. That man has a perfectly good arm. With persistent and long-continued massage he has obtained a good result with a freely movable joint.

Dr. Gwilym G. Davis said that when he was Dr. T. G. Morton's resident he came in contact with a case very similar to this, in which he made an incision just under the edge of the pectoralis major and withdrew the head of the articular surface as did Dr. Taylor. As a person grows older, the line of fracture recedes until it reaches through the anatomical neck, but in this case it has been a little lower and includes a little portion of the upper part of the tuberosity, and on the illustration will be seen a fragment which looks as if part of the tuberosity had been torn.

Dr. John H. Gibbon said that he had an X-ray picture taken of every fracture he treats. The time to take the picture is after the reduction. It is important to teach men that the thing they must do is to have a picture taken, and if not it is up to the patient, because so frequently patients turn up who never had a picture taken and have a bad position. Everyone taking a fracture must ask for an X-ray plate. As Dr. Harte has shown, it may sometimes mislead. He had seen two fractures that from a clinical point of view were perfectly apparent but which did not show in the X-ray plate because it was only taken in one line. With a stereopticon picture there is no excuse for a misinterpretation. We often do not need it as a diagnostic means, but rather as a confirmation of the proper reduction of the fracture; he does not consider it a criterion as to the result.

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