TRANSACTIONS
OF THE
PHILADELPHIA
ACADEMY
OF
SURGERY

VOL. XVIII.

1916

TRANSACTIONS

OF THE

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ACADEMY OF SURGERY

VOLUME XVIII

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1916

NOTICE

The present volume of *Transactions* contains the papers read before the Academy from January, 1915, to December, 1915, inclusive.

The Business Committee thinks it proper to state that the Academy holds itself in no way responsible for the statements, reasonings, or opinions set forth in the various papers published in its *Transactions*.

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PHILADELPHIA ACADEMY OF SURGERY

FOUNDED APRIL 21, 1879
INCORPORATED DEC. 27, 1879

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1879.

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PRESIDENT.

ELECTED		ELECTED	
1880	SAMUEL D. GROSS	1902	RICHARD H. HARTE
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VICE-PRESIDENTS.

ELECTED		ELECTED	
1880	D. HAYES AGNEW	1900	HENRY R. WHARTON
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1900	RICHARD H. HARTE	1912	CHAS. H. FRAZIER
		1914	EDWARD MARTIN

SECRETARY.

ELECTED		ELECTED	
1880	J. EWING MEARS	1896	WILLIAM J. TAYLOR
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ELECTED

1880 THOMAS G. MORTON

Office abolished after 1889 by amendment to By-Laws.

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ELECTED

1880 WILLIAM HUNT
1891 WILLIAM G. PORTER

ELECTED

1904 JAMES P. HUTCHINSON
1911 EDWARD B. HODGE

RECORDER.

ELECTED

1880 JOHN B. ROBERTS
1881 DEFORREST WILLARD
1881 O. H. ALLIS
1884 C. B. G. DE NANCREDE

ELECTED

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1902 JOHN H. GIBBON
1905 JOHN H. JOPSON

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ELECTED

1880 O. H. ALLIS

Office abolished after 1889 by amendment to By-Laws.

PATHOLOGICAL HISTOLOGIST.

ELECTED

1880 SAMUEL W. GROSS

Office abolished after 1889 by amendment to By-Laws.

COUNCIL.

ELECTED

1880 JOHN ASHHURST, JR.
1880 JOHN H. BRINTON
1894 WILLIAM BARTON HOPKINS
1895 HENRY R. WHARTON

ELECTED

1898 THOMAS R. NEILSON
1900 W. JOSEPH HEARN
1902 ROBERT G. LECONTE
1906 THOMAS R. NEILSON

1910 J. CHALMERS DACOSTA

With President, Secretary, Treasurer and 1st Vice-President.

PUBLICATION COMMITTEE.

ELECTED

1880 JOHN H. PACKARD

ELECTED

1880 WILLIAM W. KEEN

With Recorder.

Office abolished after 1894 by amendment to By-Laws.

BUSINESS COMMITTEE.

ELECTED

1895 WILLIAM J. TAYLOR
1895 DEFORREST WILLARD
1896 RICHARD H. HARTE
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ELECTED

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1902 JOHN H. JOPSON
1905 GEORGE G. ROSS
1908 FRANCIS T. STEWART

1914 JOHN SPEESE

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1884–1891

D. HAYES AGNEW
SAMUEL W. GROSS
J. EWING MEARS
SAMUEL ASHHURST
WILLIAM HUNT

1892–1893

J. EWING MEARS
SAMUEL ASHHURST
WILLIAM HUNT
JOHN ASHHURST, JR.
WILLIAM W. KEEN

TRUSTEES OF THE SAMUEL D. GROSS PRIZE FUND AND LIBRARY.

1894

J. EWING MEARS
JOHN ASHHURST, JR.
WILLIAM W. KEEN

With SAMUEL ASHHURST and WILLIAM HUNT to serve with them on distribution of the prize.

1895–1899

J. EWING MEARS
JOHN ASHHURST, JR.
WILLIAM W. KEEN

1905

WILLIAM J. TAYLOR
DEFORREST WILLARD
RICHARD H. HARTE

1900–1901

WILLIAM W. KEEN
J. EWING MEARS
J. CHALMERS DACOSTA

1910

WILLIAM J. TAYLOR
RICHARD H. HARTE
JOHN H. GIBBON

1902–1904

WILLIAM J. TAYLOR
WILLIAM L. RODMAN
JOHN B. ROBERTS

1915

WILLIAM J. TAYLOR
JOHN H. JOPSON
EDWARD B. HODGE

ACTIVE FELLOWS OF THE PHILADELPHIA ACADEMY OF SURGERY

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

1905. Allen, Francis Olcott, Jr., M.D., 2216 Walnut Street. Assistant Surgeon to the Bryn Mawr Hospital; Dispensary Surgeon to the Presbyterian, Pennsylvania, and Children's Hospitals.

† Allis, Oscar H., M.D., 1604 Spruce Street. Consulting Surgeon to the Presbyterian Hospital.

1906. Ashhurst, Astley P. C., M.D., 811 Spruce Street. Instructor in Surgery in the University of Pennsylvania; Surgeon to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases; Associate Surgeon to the Episcopal Hospital.

1915. Billings, Arthur E., M.D., 252 South 16th Street. Assistant Surgeon to the Bryn Mawr Hospital; Assistant Out-Patient Surgeon to the Pennsylvania Hospital; Chief Clinical Assistant in the Surgical Department B. of the Jefferson Hospital.

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

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

1905. Brooks, Macy, M.D., 1321 Spruce Street. Assistant Genito-Urinary Surgeon to the Philadelphia Hospital.

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

1909. Carnett, John B., M.D., 123 South 20th Street. Associate in Surgery in the University of Pennsylvania; Chief Surgeon to the American Stomach Hospital; Surgeon to the Philadelphia General Hospital; Assistant Surgeon to the University Hospital; Consulting Surgeon to the Phœnixville Hospital and to the Phipps Institute.

1896. DaCosta, John Chalmers, M.D., 2045 Walnut Street. Samuel D. Gross Professor of Surgery in the Jefferson Medical College; Consulting Surgeon to the Philadelphia Hospital.

1896. Davis, Gwilym G., M.D., M.R.C.S. (Eng.), 1814 Spruce Street. Professor of Orthopædic Surgery in the University of Pennsylvania; Chief Surgeon to the Widener Memorial Industrial School; Surgeon to the Orthopædic Hospital; Consulting Surgeon to St. Joseph's Hospital.

1896. Deaver, Henry C., M.D., 1415 N. Broad Street. Professor of Surgery in the Woman's Medical College; Surgeon to the Episcopal Hospital, to the Kensington Hospital for Women, and to the Children's Hospital of the Mary J. Drexel Home.

1890. Deaver, John B., M.D., 1634 Walnut Street. Professor of the Practice of Surgery in the University of Pennsylvania; Surgeon-in-Chief to the German Hospital; Surgeon to the University Hospital.

1908. Despard, Duncan Lee, M.D., 1806 Pine Street. Demonstrator of Clinical Surgery in the Jefferson

Medical College; Associate in Gynæcology in the Philadelphia Polyclinic; Surgeon to the Abington Hospital; Assistant Surgeon to the Jefferson Hospital.

1915. ‡ Dickson, Frank D., M.D., St. Regis Apartments, Kansas City, Mo.

1884. Dulles, Charles W., M.D., 4101 Walnut Street. Consulting Surgeon to the Rush Hospital.

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

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

1899. Gibbon, John H., M.D., 1608 Spruce Street. Professor of Surgery in the Jefferson Medical College; Surgeon to the Pennsylvania and Bryn Mawr Hospitals.

1914. Gill, A. Bruce, M.D., 318 South 15th Street. Orthopædic Surgeon to the Abington Hospital; Assistant Surgeon to the Presbyterian and Orthopædic Hospitals; Assistant Surgeon to the Widener Memorial Industrial School for Crippled Children; Assistant in the Orthopædic Department of the Episcopal Hospital.

1914. Ginsburg, Nathaniel, M.D., 1704 Pine Street. Associate in Surgery in the Philadelphia Polyclinic; Instructor in Anatomy in the University of Pennsylvania; Surgeon to the Jewish Hospital; Assistant Surgeon to the Mt. Sinai Hospital.

‡ Non-Resident Fellow.

1902. GIRVIN, JOHN H., M.D., 2120 Walnut Street. Associate in Obstetrics in the University of Pennsylvania; Gynæcologist to the Presbyterian Hospital.

1892. HARTE, RICHARD H., M.D., 1503 Spruce Street. Associate Professor of Surgery in the University of Pennsylvania; Surgeon to the Pennsylvania Hospital; Consulting Surgeon to St. Mary's, St. Timothy's, the Bryn Mawr, and the Abington Hospitals.

1882. HEARN, W. JOSEPH, M.D., 2119 Spruce Street. Emeritus Professor of Clinical Surgery in the Jefferson Medical College; Surgeon to the Philadelphia Hospital; Consulting Surgeon to the Phœnixville Hospital and to the Peninsula General Hospital of Salisbury, Md.

1913. HEARN, WILLIAM P., M.D., 334 South 42d Street.

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

1905. HODGE, EDWARD B., M.D., 346 South 16th Street. Surgeon to the Presbyterian and to the Children's Hospitals; Surgeon to the Out-Patient Department of the Pennsylvania Hospital.

1898. HUTCHINSON, JAMES P., M.D., 133 South 22d Street. Surgeon to the Pennsylvania, Methodist Episcopal, and Bryn Mawr Hospitals.

1915. ‡ IVY, ROBERT H., M.D., First National Bank Building, Milwaukee, Wis.

1915. JONES, JOHN F. X., M.D., 1815 Spruce Street. Surgeon to the St. Joseph's Hospital; Surgeon to St. Vincent's Home; Assistant Surgeon to the Philadelphia General Hospital; Clinical Assistant to the Jefferson Hospital.

1900. JOPSON, JOHN H., M.D., 1824 Pine Street. Professor of Surgery in the Philadelphia Polyclinic; Associate in Surgery in the University of Pennsylvania; Surgeon to the Presbyterian, Children's, and Bryn Mawr Hospitals; Consulting Surgeon to the Philadelphia Home for Incurables.

† KEEN, WILLIAM W., M.D., LL.D. (Hon.), F.R.C.S. (Eng. and Edin.), 1729 Chestnut Street. Emeritus Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Membre Correspondant Etranger de la Societe de Chirurgie de Paris; Honorary Member of the Societe Belge de Chirurgie and of the Clinical Society of London; Ehren mitglied der deutschen Gessellschaft fur Chirurgie.

1914. KEENE, F. E., M.D., 116 South 19th Street. Instructor in Gynæcology in the University of Pennsylvania; Gynæcologist to the Chestnut Hill and Abington Hospitals; Assistant Gynæcologist to the University Hospital.

1910. KELLY, JAMES A., M.D., 1510 North 17th Street. Associate in Surgery in the Philadelphia Polyclinic and College for Graduates in Medicine; Surgeon to St. Mary's, St. Joseph's, and St. Timothy's Hospitals.

1913. KLOPP, EDWARD J., M.D., 1223 Spruce Street. Instructor in Surgery in the Jefferson Medical College; Assistant Surgeon to the Germantown Hospital; Chief Clinical Assistant in the Surgical Department of the Jefferson Hospital; Assistant Surgeon to the Out-Patient Department of the Pennsylvania Hospital.

1914. LAWS, GEORGE M., M.D., 2033 Locust Street. Assistant Instructor in Surgery in the University of Pennsylvania; Instructor in Anæsthesia in the Presbyterian Hospital; Assistant Surgeon to the Out-Patient Department of the University Hospital; Dispensary Chief and Assistant in the Hospital for Diseases of Women and the Presbyterian Hospital.

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

1910. LEE, WALTER E., M.D., 905 Pine Street. Surgeon to the Glen Mills School; Assistant Surgeon to the Germantown Hospital; Gynæcologist to the Out-Patient Department of the Pennsylvania Hospital; Surgeon to the Dispensaries of the Episcopal, Bryn Mawr, and Children's Hospitals.

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

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

1915. MERRILL, WILLIAM JACKSON, A.B., M.D., 1927 Chestnut Street. Instructor in Orthopædic Surgery in the University of Pennsylvania; Assistant Orthopædic Surgeon to the University, Howard, and Jewish Hospitals; Consulting Orthopædic Surgeon to the Germantown Hospital.

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

1904. MITCHELL, CHARLES F., M.D., 332 South 15th Street. Surgeon to the Germantown and Bryn Mawr Hospitals; Surgeon to the Out-Patient Department of the Pennsylvania Hospital; Consulting Surgeon to the Eastern State Penitentiary.

1906. MÜLLER, GEORGE P., M.D., 1729 Pine Street. Professor of Surgery in the Philadelphia Polyclinic; Associate in Surgery in the University of Pennsylvania; Surgeon to the St. Agnes Hospital; Assistant Surgeon to the University Hospital; Consulting Surgeon to the Chester County Hospital.

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

1905. NASSAU, CHARLES F., M.D., LL.D., 1831 Chestnut Street. Assistant Professor of Surgery in the Jefferson Medical College; Chief Surgeon to the Frankford Hospital; Surgeon to St. Joseph's Hospital; Assistant Surgeon to the Jefferson Hospital.

1890. NEILSON, THOMAS R., M.D., 1937 Chestnut Street. Professor of Genito-Urinary Diseases in the University of Pennsylvania; Emeritus Professor of Genito-Urinary Diseases in the Philadelphia Polyclinic; Surgeon to the Episcopal Hospital and to St. Christopher's Hospital for Children.

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

1915. OWEN, HUBLEY R., M.D., 2046 Pine Street. Chief Surgeon, Bureau of Police and Fire; Surgeon to the Philadelphia Hospital; Assistant Surgeon to the Orthopædic Hospital; Assistant Surgeon to the Medical Reserve Corps of the United States Navy.

1912. PFEIFFER, DAMON B., M.D., 2028 Pine Street. Instructor in Surgery in the University of Pennsylvania; Director of the Clinical Laboratory in the Presbyterian Hospital; Pathologist to the German Hospital; Surgeon to the Abington Memorial Hospital; Assistant Surgeon to the University Hospital; Assistant Surgeon to the Out-Patient Department of the German Hospital.

1890. ROBERTS, JOHN B., M.D., 313 South 17th Street. Professor of Surgery in the Philadelphia Polyclinic.

1898. ROBINSON, J. WIER, M.D., 326 South 16th Street.

1913. RODMAN, JOHN STEWART, M.D., 2106 Walnut Street. Assistant Professor of Surgery in the Medico-Chirurgical College; Assistant Surgeon to the Medico-Chirurgical Hospital; Surgeon to the Dispensary of the Presbyterian Hospital; Assistant Surgeon to the Out-Patient Department of the Pennsylvania Hospital.

1900. RODMAN, WILLIAM L., M.D., LL.D., 2106 Walnut Street. Professor of the Principles of Surgery and Clinical Surgery in the Medico-Chirurgical College of Philadelphia; Surgeon to the Medico-Chirurgical, Presbyterian, and Philadelphia General Hospitals.

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

1913. RUGH, J. TORRANCE, M.D., 1616 Spruce Street. Associate in Orthopædic Surgery in the Jefferson Medical College; Orthopædic Surgeon to the Methodist and Philadelphia General Hospitals; Assistant Orthopædist to the Jefferson Hospital.

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

1903. SITER, E. HOLLINGSWORTH, M.D., 1818 S. Rittenhouse Square. Instructor in Genito-Urinary Diseases in the University of Pennsylvania; Genito-Urinary Surgeon to the Philadelphia General Hospital; Chief Surgeon to the Out-Patient Department for Genito-Urinary Diseases in the University Hospital.

1913. SKILLERN, PENN GASKELL, JR., M.D., 241 South 13th Street. Instructor in Anatomy and Surgery in the University of Pennsylvania; Instructor in Surgery in the Philadelphia Polyclinic; Assistant Surgeon to the Out-Patient Department of the University Hospital.

1909. SPEESE, JOHN M., M.D., 2206 Locust Street. Associate in Surgery in the Philadelphia Polyclinic; Instructor in Surgery and Surgical Pathology in the University of Pennsylvania; Surgeon to the Children's Hospital; Assistant Surgeon to the Presbyterian Hospital.

1898. SPELLISSY, JOSEPH M., A.M., M.D., 110 South 18th Street. Attending Surgeon to the Methodist Hospital; Attending Surgeon to St. Joseph's Hospital; Physician in Charge of Photo A Department in the University Hospital.

1911. Stellwagon, Thomas C., Jr., M.D., 1831 Chestnut Street. Assistant Professor of Genito-Urinary Surgery in the Jefferson Medical College; Assistant Surgeon to the Philadelphia Hospital.

1903. Stewart, Francis T., M.D., 311 South 12th Street. Professor of Clinical Surgery in the Jefferson Medical College; Surgeon to the Germantown Hospital; 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 in the University of Pennsylvania.

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

1911. Thomas, Benjamin A., M.D., 116 South 19th Street. Professor of Genito-Urinary Surgery in the Philadelphia Polyclinic and College for Graduates in Medicine; Instructor in Surgery in the University of Pennsylvania; Surgeon-in-Chief to the Out-Patient Department of the University Hospital.

1911. Thomas, Thomas Turner, M.D., 2005 Chestnut Street. Associate Professor of Applied Anatomy in the University of Pennsylvania; Associate in Surgery in the University of Pennsylvania; Surgeon to the Philadelphia Hospital; Assistant Surgeon to the University Hospital.

1915. Thomas, W. Hersey, M.D., 1445 North 17th Street. Assistant Professor of Surgery in the Medico-Chirurgical College; Assistant Surgeon to the Medico-Chirurgical Hospital.

1907. Uhle, Alexander A., M.D., 1701 Chestnut Street. Assistant Instructor in the Genito-Urinary Department of the University of Pennsylvania; Assistant Genito-Urinary Surgeon to the Philadelphia Hospital; Surgeon to the Urologic Dispensary of the German Hospital.

1892. Wharton, Henry R., M.D., 1725 Spruce Street. Surgeon to the Presbyterian and Children's Hospitals and to the Girard College; Consulting Surgeon to the Bryn Mawr Hospital, St. Christopher's Hospital, and to the Pennsylvania Institution for the Deaf and Dumb.

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

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

1898. Wood, Alfred C., M.D., 2035 Walnut Street. Assistant Professor of Surgery in the University of Pennsylvania; Surgeon to the University, Philadelphia, Howard, and St. Timothy's Hospitals; Consulting Surgeon to the Charity Hospital and to the State Hospital for the Insane, Norristown.

1902. YOUNG, JAMES K., M.D., 222 South 16th Street. Professor of Orthopædic Surgery in the Philadelphia Polyclinic; Clinical Professor of Orthopædic Surgery in the Woman's Medical College of Pennsylvania; Associate Professor of Orthopædic Surgery in the University of Pennsylvania; Consulting Orthopædic Surgeon to the Women's Hospital of Philadelphia; Visiting Chief on the Orthopædic Staff of the Philadelphia General Hospital.

LIST OF FELLOWS WHO HAVE DELIVERED THE ANNUAL ADDRESS

1881. S. D. GROSS.
1882. D. HAYES AGNEW.
1883. WILLIAM HUNT.
1884. JOHN H. BRINTON.
1885. JOHN H. PACKARD.
1886. R. J. LEVIS.
1887. J. EWING MEARS.
1888. C. B. G. DE NANCREDE.
1889. JOHN B. ROBERTS.
1890. DE FORREST WILLARD.
1891. WILLIAM G. PORTER.
1892. T. G. MORTON.
1893. C. W. DULLES.
1894. W. B. HOPKINS.
1895. JOHN B. DEAVER.
1896. JAMES M. BARTON.
1897. THOMAS R. NEILSON.
1898. O. H. ALLIS.
1899. WILLIAM J. TAYLOR.
1900. NONE.
1901. H. R. WHARTON.
1902. J. M. SPELLISSY.
1903. R. G. LECONTE.
1904. G. G. DAVIS.
1905. J. CHALMERS DACOSTA.
1906. RICHARD H. HARTE.
1907. EDWARD MARTIN.
1908. CHARLES H. FRAZIER.
1909. JOHN H. GIBBON.
1910. ASTLEY P. C. ASHHURST.
1911. JOHN H. JOPSON.
1912. GEORGE G. ROSS.
1913. WM. L. RODMAN.
1914. ALFRED C. WOOD.
1915. FRANCIS T. STEWART.

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 Micro-organisms 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.

1915 "Surgery in the Treatment of Hodgkin's Disease."—Dr. John Lawrence Yates, Milwaukee, Wis.

HONORARY FELLOWS

ELECTED.

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. de Nancrede	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, JANUARY 4, 1915

The President, DR. JOHN H. GIBBON, in the Chair

CARCINOMA OF FLOOR OF MOUTH

DR. ASTLEY P. C. ASHHURST presented a man, aged fifty years, who over a year ago began to have trouble in the floor of the mouth, between the frænum and the symphysis. When first seen by Dr. Ashhurst in August last, there was present a foul odor, and the man was dizzy from weakness on standing. It seemed to be an inoperable case. On August 4, he injected eucaine into the lingual nerves and tried to divide them. Ten days later he gave him ether by the intrapharyngeal method and cauterized the mouth. Then the man gained seven pounds in two weeks. He was able to eat and sleep well, and went home for a holiday. Two weeks afterward, under intratracheal insufflation anæsthesia, he removed the glands on the left side of the neck, including the sternomastoid muscle, but leaving important nerves that could be saved. This shocked him very much and he lost ten pounds. Four weeks later he operated on the right side of the neck, in a similar manner. In the second operation he had to sacrifice the spinal accessory and hypoglossal nerves. At both operations on the neck the floor of the mouth was thoroughly cauterized from the neck wounds. There are now, more than three months after the last operation, no signs of carcinoma in the floor of the mouth. He has good use of the neck and head and eats and sleeps very well and can make himself understood in conversation, though the tongue is almost immovable. He has gained thirty-one pounds in weight.

The pathological report showed involvement of the glands of the upper part of the neck but not of the lower.

The interesting point in this case is the value of the cauterization of the floor of the mouth, with the cautery almost at a black heat, first from within the mouth, and subsequently from the neck wounds. The disease certainly has been arrested.

RECOVERED EMPYEMA

Dr. Nathaniel Ginsburg presented a man upon whom a partial rib resection for empyema of the thorax had been done at the Philadelphia Hospital, in February, 1914, the incision being located in the midaxillary line, removing a portion of the rib. When first observed by Dr. Ginsburg, there was a foul profuse discharge from the drainage tract, with temperature, loss of weight and great prostration.

He injected bismuth paste into the sinus, and for a time marked cessation of the discharge resulted, but later the man grew rapidly worse and impending death seemed certain. A skiagraph showed what was interpreted by the radiologist as a large subphrenic collection of pus in the right pararenal area. After a careful exploration of the kidney area through a loin incision, no subphrenic collection of fluid was discovered. At a second operation, a week later, Dr. Ginsburg removed the ninth rib from the post-axillary line to the costochondral junction, and found that the picture of a subphrenic abscess proved to be a collection of decomposed bismuth paste which filled a long, isolated tract, extending anteriorly to the cartilage of the sternum. The reporter stated that he wished to emphasize, in reporting this case, that it is one of empyema in which the so-called posterior drainage to which Dr. Thomas has recently called attention, and which at an earlier date had been discussed by some of the French School of Surgeons, and also recommended by Kocher in selected cases, was not feasible. He believed this patient gives reason for believing that many cases of pyothorax cannot be so reached, but must be drained at the point of aspiration. From the beginning this man apparently had a pus cavity which never would have been touched by posterior incision. Free exposure of the whole cavity and healing from the bottom removed the trouble. The case is the only one of four old cases of empyema recently seen which finally recovered.

RUPTURE OF THE BICEPS FLEXOR CUBITI *

WITH A REPORT OF EIGHT CASES

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Rupture of the biceps muscle or its tendon is a rather rare accident. It may be of interest to the Academy, therefore, to present eight of these cases, especially as five were operated upon and the exact location of the rupture was determined. Literature reviewed on the subject cites only 74 cases, 5 of which were operated upon.

Case I.—M. C., aged twenty-six years, white, male, laborer. Admitted to the Episcopal Hospital January 9, 1914.

History.—On the day of admission, while at work cleaning out an endless chain elevator shaft, the elevator suddenly started and one of the buckets caught his right arm, crushing it against the side of the shaft. He was held in this position for forty-five minutes before being liberated. The shock following the accident was so great that it was necessary to remove him to the hospital in the ambulance. On admission to the hospital the patient was in a state of severe shock. He was unable to raise the right arm or flex the forearm.

Examination.—Showed a contused wound of the right chest wall and right arm. No bones were broken. The right arm anteriorly from the shoulder to the elbow was markedly swollen and ecchymosed. On deep palpation over the upper part of the biceps, where the swelling was greatest, a distinct furrow could be felt. This furrow was about the width of the index finger. The width of the furrow could be increased by extending the forearm. On account of the great swelling of the arm no bulging appeared at any point over the biceps on extending or flexing the forearm. A diagnosis of rupture of the belly of the biceps was made and an operation advised. On account of the bruised condition of the tissues the operation was postponed for several days.

On January 11, 1914, under ether anæsthesia, the patient was operated upon and a rupture of the belly of the short head and a partial rupture of the belly of the long head of the biceps were found. The ends of the muscles were properly approximated

*Read before the Philadelphia Academy of Surgery, January 4, 1915.

and sutured with twenty-day chromic catgut. The arm was dressed with the forearm in flexion, so as to relieve any strain on the sutured muscle. Primary union followed. Firm union took place between the ruptured ends. This could readily be determined by grasping the biceps over the seat of rupture and flexing and extending the forearm. On account of the marked atrophy of the humeral group of muscles which followed the accident, the return of power in the patient's arm was very slow, and massage and electrical treatment were given. At the time of his discharge from the hospital the biceps still showed marked atrophy, but the patient had good use of the arm and forearm. The usefulness of the arm has steadily improved and the patient is now able to follow his usual occupation.

CASE II.—F. L., aged fifty-three years, white, male, cloth finisher. Admitted to the Episcopal Hospital on January 16, 1914.

History.—In 1910, while putting a large belt on a fly-wheel, he lost his balance and fell, striking his right shoulder and arm against a machine. When he struck the machine he felt something give way in his arm, experienced a sharp pain at this point, and heard "a sound like the report of a revolver." Immediately his arm became swollen, "black and blue," and a "lump" appeared at the lower part of the arm over the belly of the biceps. For a short time following the accident he was unable to use the arm. He consulted a physician for the injury, who prescribed a liniment. No fixation apparatus was applied. The ecchymosis and swelling disappeared in one or two weeks, but the "lump" remained. He continued working at his trade but his arm was so weak that he finally gave up his position and sought an easier one. Since the accident he has been able to do only light work, as his forearm under muscular effort will often give way. The weakened condition of the arm and forearm has persisted, although he has been treated with electricity, massage, etc. He has never had rheumatism, gout, typhoid fever nor lues.

Examination.—His right arm, when either the forearm was flexed or extended, showed a marked bulging of the belly of the biceps. The bulging was greatest when the forearm was forcibly flexed to a right angle and the flexion strongly resisted. The entire biceps muscle was soft and flabby. Above the belly of the biceps, which terminated very abruptly, it was impossible to feel the tendon of the long head. There was no difference in the power of flexion of the forearm, whether it were supinated or pronated. A diagnosis of rupture of the tendon of the long head of the biceps was made. As four years had elapsed since the accident it was with some hesitancy that an operation was advised, but as

FIG. 1.—Case I. Five weeks after operation.

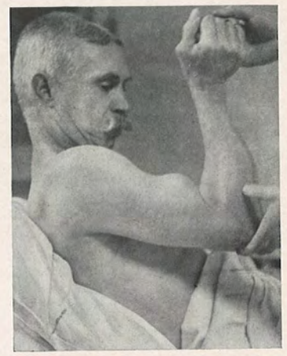

FIG. 2.—Case II. Before operation.

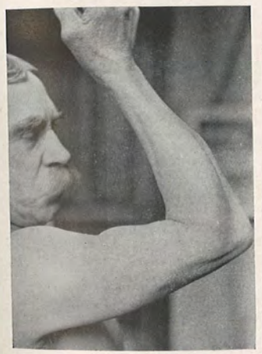

FIG. 3.—Case II. End result.

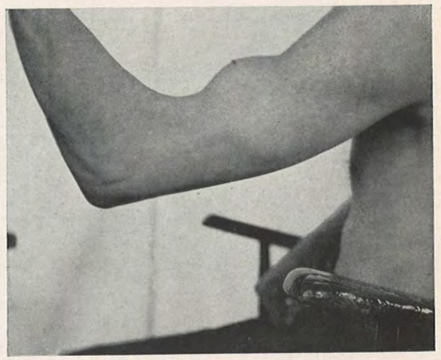

FIG. 4.—Case V. Before operation.

the patient was practically incapacitated it was hoped that an operation might better his condition.

On January 19, 1914, under ether anæsthesia, he was operated upon. An old rupture of the tendon of the long head at its junction with the belly was found and fibrous union had taken place between the tendon and the muscle. This cicatricial tissue, about one and one-half inches, was excised. The end of the tendon was split for about three-quarters of an inch and the muscle brought in between the two ends of the split tendon and sutured with twenty-day chromic gut. The arm and forearm were dressed as in Case I. Primary union followed.

The case progressed most favorably and the patient now states that he has been much benefited by the operation. A slight bulging still persists at the site of the old rupture.

Case III.—P. McC., aged sixty-one years, white, male, punch helper. Admitted to the Episcopal Hospital on March 21, 1914.

History.—The patient came to the Medical Dispensary of the hospital on account of pain (rheumatism) in his right shoulder and weakness of his arm. In examining him the physicians found that he had, besides a chronic articular rheumatism, a rupture of the biceps muscle. Although the bulging was very great the patient had never noticed it. The patient stated that about six weeks before he came to the dispensary for treatment, while at work in a punch shed, he tripped and fell, striking his right shoulder. The injury caused him some pain and was followed by some stiffness of the shoulder. Since the accident he has noticed that his arm and forearm are weaker and that the weakness is increasing.

Examination.—Symptoms similar to Case II, the only difference was that in this case the bulging was greater and the muscle more flabby. Hüter's sign was not present.

On March 26, 1914, the patient was operated upon and a rupture of the tendon of the long head at its junction with the belly found. I was unable to find the tendon of the long head although I searched for it up to the bicipital groove. I did find a fibrous sheath, which I took to be the sheath of the tendon; there was, however, no tendon within it. As the sheath was not strong enough to suture the muscle to, the stump of the belly of the long head was sutured to the tendon of the short head.

The patient's arm was treated as in Case II. Primary union followed. Anatomically, the patient does not appear to be very much benefited, as he still has quite a bulging of the muscle. Functionally, he has been greatly improved and now says he is sure he is able to return to his former work, which he had had to give up on account of the weakness of his arm.

This patient, I feel sure, ruptured his biceps muscle much longer ago than six weeks before the operation. The interesting point is that although he had quite a bulging of the muscle he had never suspected any trouble.

Case IV.—G. C., aged fifty-three years, white, male, machinist. Admitted to the Episcopal Hospital April 27, 1914.

History.—Six months before admission, while working on a lace curtain machine, he attempted to stop the wheel by catching it as it revolved. He succeeded in stopping the wheel, but it gave his shoulder quite a " wrench " and he felt something " give way " in his arm and heard " something snap." On flexing the arm he noticed a bulging over the biceps. Although he noticed that his arm was much weaker the accident did not completely disable him. The weakness was progressive and for this reason he came to the hospital. There was no history of gout, rheumatism, typhoid fever or lues.

Examination.—Symptoms similar to Cases II and III. Hüter's sign was present. (Hüter calls attention to the fact that flexion of the forearm in pronation when the biceps is tense is more forcible than when the forearm is supinated and the biceps is relaxed.) On April 20, 1914, under ether anæsthesia, the patient was operated upon and a rupture of the tendon of the long head at its junction with the belly found. The tendon was readily found, but it appeared more as a small fibrous cord than as a tendon. On account of the weakened condition of the tendon, I did not think it advisable to suture it to the muscle, but instead, sutured the belly of the long head to the tendon of the short head. The case was treated as the preceding. Primary union followed. The patient has a very satisfactory result. There is very little bulging of the muscle on forced flexion of the forearm and the arm and forearm are much stronger than before the operation.

Case V.—W. S., aged forty-one, white, male, laborer. Admitted to the Episcopal Hospital on December 9, 1914.

History.—On the morning of admission to the hospital, while lifting a bag of coffee, he was suddenly seized with pain and heard something snap in his left arm. He said it felt as if " somebody had hit him with a club." As he was unable to use his right arm after the accident, he came immediately to the hospital. There was no history of typhoid fever, gout or lues, but an indefinite history of a mild attack of rheumatism in the left shoulder.

Symptoms were those of a rupture of the long head of the biceps. No hæmatoma or other signs of recent injury were present. Hüter's sign was not present.

The patient refused to be operated upon and left the hospital the same day that he applied for treatment.

This patient was operated upon one week after the accident by Dr. G. G. Davis at the University Hospital. The operation disclosed the tendon of the long head relaxed. A rupture had taken place at some point between its origin and the bicipital groove. The tendon was not pulled out of the groove, but the slack portion was taken up and the tendon sutured to the tendon of the short head.

Case VI.—R. McF., aged sixty years, white, male, fish dealer. Admitted to the Episcopal Hospital on December 15, 1914.

History.—Three months before admission, while attempting to lift a barrel of fish, he was suddenly seized with a severe pain in his left arm. He dropped the barrel and rested the arm for a few minutes until the pain subsided. The night following the injury he suffered greatly with pain in his arm, forearm and fingers. Since the accident, on account of the weakness of his arm, he has been unable to do heavy work. He says that his left arm frequently " goes to sleep." No history of typhoid fever, rheumatism, gout or lues, but is a heavy whiskey drinker.

Examination.—Symptoms similar to Cases II to V inclusive. Hüter's sign not present. The muscle showed quite a bulging and was very flabby. Blood-pressure 180 systolic. No symptoms of nerve involvement.

Diagnosis.—Rupture of the long head of the biceps, probably at the junction of the tendon and muscle. As the patient was in very poor physical condition no operation was advised.

Besides the six cases reported above, two other cases have been treated this year in the Medical Dispensary of the Episcopal Hospital.

Case VII.—Wm. M., aged eighty-four years, white, male, insurance agent. This case came to the Dispensary on account of a traumatic arthritis of the left knee. In the examination of the patient it was discovered that he had a rupture of the long head of the biceps muscle of the left arm. The probable seat of rupture was at the junction of the muscle and tendon. The Dispensary notes state: " No symptoms at time of rupture or afterwards; no history of rheumatism, typhoid fever or lues."

Case VIII.—Wm. L., aged fifty years, white, carpenter. The patient was admitted to the Dispensary for treatment for chronic endocarditis and myocarditis. He was treated six years ago in the Episcopal Hospital for a severe attack of acute articular rheumatism. The lesion in this case was of the long head of the biceps of the left arm. The rupture, as in Case VII, was probably at the transition point between tendon and muscle. This case, as the preceding, had " no symptoms at time of rupture or afterwards."

Unfortunately, in the above two cases, no note was made as to whether the patients were right- or left-handed.

Loos [1] reports 66 cases of rupture of the biceps, 44 of which were of the muscle, and 18 of the tendon. Four of these were his own.

Petit,[1] according to Loos, collected 83 cases. In this series the point of rupture was as follows: Muscle 21; belly of the long head 9; tendon of the long head 43; at junction of belly of the long head and tendon 7; the tendon of insertion 3. I failed to find an article on the subject by Petit, so was unable to verify the statistics as given by Loos.

Wiesmann [2] reviews the literature on this subject and reports a case of rupture of the tendon of insertion caused by the lifting of a table. He operated upon the case and obtained a successful result.

Davis [3] reports 4 cases, as follows: Rupture of the tendon of the long head 3; rupture of the tendon of insertion 1.

Castret [4] reports a case of rupture of the belly of the biceps due to slight muscular contraction. The case was treated by electricity.

Hollos [5] reports "two cases of biceps rupture by paralysis." I have been unable to find his article.

Keen [6] reports a case of rupture of the tendon of the long head and also one of DaCosta's, of a tearing off of the long head from the margin of the glenoid cavity. Both of these cases were successfully operated upon.

Gerster [7] reports a case of laceration of the long head of the biceps due to a fall down stairs. The case was successfully treated with a sling.

In 64 of the cases reported, in which the histories were given in sufficient detail to locate the lesion, 16 occurred in the tendon, 44 in the muscle, and 6 at the junction of the tendon and the muscle. As only 5 of the cases reported were operated upon the exact site of the rupture in the others could not be ascertained.

Davis [3] believes that true rupture of the tendon is rare and "when a tendon does rupture it is very likely to have been diseased." In Case IV of this series it appeared as if the tendon was either diseased or malformed.

From the cases reported it appears that rupture may take place through the belly of the long or short head, through the belly of the muscle proper, at the transition point of the belly and tendon, through the tendon of the long head or the tendon of insertion, and even as in DaCosta's case, at the origin of the tendon of the long head.

Of the cases reported, 4 have been the result of muscular effort alone. Only 2 cases are reported in which the accident occurred in women. Only 2 cases are reported of rupture of the belly of the short head; one of these was due to direct injury, a threshing machine accident, in which the belly of the short head and the tendon of the long head were both injured, an accident very similar to Case I of

this series. The other case occurred in an attempt to reduce a dislocated shoulder.

The causes of the rupture may be either direct force, muscular contraction, or possibly an indirect force, such as a fall on the shoulder, that would throw a great strain on the long tendon; also disease or malformation might be an underlying cause.

Since the great majority of the cases occur among working men, and since the right biceps is the one usually affected, it seems that muscular contraction is the most potent etiological factor.

In Cases II, III and IV of this series the rupture occurred at the transitional point between tendon and muscle. As tendon is stronger than muscle it is natural to believe that the rupture occurred on the muscle side of the tendon and that the underlying cause might possibly have been a myositis. This cause is suggested in Case III, where the entire muscle was markedly relaxed and very flabby, although only the tendon and belly of the long head were implicated in the accident. The cases reported show that rupture is most apt to occur after forty years of age. As this is the period that degenerative tissue changes are most apt to make their appearance it is very probable that disease of muscle or tendon plays a very important causative part in the rupture.

That rupture of the tendon or belly of the long head is more frequent than at any other site, I believe to be due to the fact that the tendon, by its position in re-inforcing the shoulder-joint, is subjected to all strains that may be thrown upon the head of the humerus. Cases II and III may have occurred in this manner.

The symptoms at the time of injury may be trivial, the patient noticing nothing wrong, or they may be quite severe and immediately incapacitate. Swelling and ecchymosis do not always accompany the rupture.

The physical findings will differ somewhat, depending on the site of the rupture. If the rupture is through the belly of the muscle a furrow can be felt between the two ends, this can be widened by extending the forearm. In rupture of the tendon of insertion, flexion and supination of the forearm may be interfered with and the belly of the muscle would be drawn up nearer the shoulder.

In rupture of the long head, whether it be a tearing away at its point of origin, in the continuity of the tendon, at the transition point between tendon and muscle or through the belly of the long head, the symptoms are almost identical. A bulging of the biceps at a point nearer the elbow than normal, a flabby condition of part or all of the muscle, an abrupt termination of the bulging above and an inability

to feel the tendon above that point, all point to rupture of the muscle or tendon. In rupture of the tendon or muscle of the long head the short head stands out prominently, and to its outer side, where the long head and tendon should be, a sulcus running upward and slightly inward is found.

Hüter's symptom was present in only one of this series. It was not tried for in Case I.

The treatment in the great majority of cases has been either none at all, or bandage, sling, electricity, etc. No doubt many cases have been operated upon. I have only been able to find, however, 5 cases treated in this manner.

Von Hochstetter[8] reports a case of a man forty-six years of age, who ruptured the tendon of the long head at its junction with the belly. This case was operated upon two months after the injury. The tendon was sutured to the belly with silk. Result successful.

Bazy[9] reports a man, aged forty years, who ruptured the tendon of the long head at its point of origin. He operated upon this case, resected the tendon, and sutured the stump to the tendon of the short head. Result successful.

Keen[6] reports a case of a man, aged fifty-four years, who ruptured the tendon of the long head. The tendon was sutured with twenty-day chromic gut. Result successful.

DaCosta,[6] reported by Keen, operated upon a man, aged fifty-two years, who in lifting a bucket tore the tendon of the long head away from its point of origin. In this case the upper portion of the tendon was resected and the stump was attached to the short head by splitting the latter and suturing. Result successful.

Wiesmann[2] reports a case of rupture of the tendon of insertion, caused by lifting a table. The case was successfully operated upon.

Conservative methods of treatment have given satisfactory results in a few isolated cases only. Since successful results have been gained by operation in cited cases, it is evident that the operative treatment is to be recommended.

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Dr. John H. Jopson exhibited a patient showing the results of an operation for rupture of the long head of the biceps muscle, who was one of two upon whom he had operated for rupture of the long tendon.

This patient was injured a year ago in an accident on a schooner. He was raising a sail and was caught by a rope, which wound around his arms in such a manner that the left arm was practically torn off and was later amputated a few inches below the shoulder. The right shoulder and upper arm were also injured. When Dr. Jopson saw him some months later, he exhibited the usual symptoms of rupture of the biceps muscle and, in addition to this, there was marked limitation of abduction and forward extension of the arm. He was operated on at this time and it was found that the long tendon had been torn about 3 cm. above the belly of the muscle and the two fragments were connected by a thin, flaccid strand of connective tissue. The tendon was plicated and sutured to the short head of the biceps. The result was satisfactory as regards the power of flexion of the arm, although there is still some depression above the belly of the muscle. The limitation of abduction and forward movement of the arm caused the patient to return for further treatment. The head of the humerus was then exposed through an anterior incision between the deltoid and pectoralis major muscles and the lesser tuberosity was found to have been fractured and was attached at a lower level than normal, while the head of the bone was above and in front of the glenoid cavity. The lesser tuberosity was chiselled off subperiosteally, which permitted the head of the bone to be brought down nearer its normal location, and the arm was dressed at a right angle to the body and kept in this position for several weeks. The patient now shows marked improvement in the movements which were formerly almost abolished, viz.: abduction and forward extension, although the head of the bone is still above its normal location. With treatment by massage and passive motions further improvement is probable.

The other patient was a man, aged sixty-eight, who, while attempting to catch a heavy bunch of bananas, was struck by it, the weight falling on his arm. In this case, operation showed that the tendon had been torn from the edge of the glenoid cavity. It was sutured to the common tendon of origin of the short head of the biceps and the coracobrachialis muscles through a second incision just below the coracoid process, the tendon being made taut before it was attached. He had not been able to trace this patient.

PROLIFERATING EPITHELIOMA OF THE SIGMOID

Dr. George G. Ross reported the history of a man aged seventy, who suffered some 20 years ago from various digestive disturbances and some nervous symptoms which he thinks were due to his habits

of life. Under treatment he improved and remained fairly well until two or three years ago when he began to fail. About the same time his wife's serious illness caused considerable anxiety and stress. After the result in her case became apparently hopeless, he himself ran down rapidly and has continued so until now. Has lost about 70 pounds in the last year or year and a half. His color, however, remained fairly natural. He has lately had some intestinal symptoms which seemed to point to the sigmoid region or perhaps lower. He is habitually constipated and constantly takes laxatives. He has discharged blood from time to time; sometimes several times a day. No particular local pain or soreness. On examination there is some hardness of the sigmoid region but no very definite indications of a mass. He is decidedly emaciated but not cachectic. Constant starvation diet may account for some of this. No renal symptoms of a definite kind. Urine shows as follows: Negative except for a heavy indican reaction; specific gravity 1022; a few casts. X-ray shows an incomplete obstruction of the sigmoid about the middle. This was best shown by X-ray of the bismuth injections from below. Blood count: Red blood-cells 4,520,000; white blood-cells 7,000; 79 per cent. polynuclears; 66 neutrophiles; 27 lymphocytes; 3 large mononuclears; 0 transitionals; 4 eosinophiles.

Operation (December 3, 1913): Left rectus incision. Hard mass in middle portion of sigmoid demonstrated. Outer layer of meso-sigmoid incised to mobilize the sigmoid. Bowel clamped to either side of tumor. Sigmoid cut through with actual cautery between clamps, proximal and distal to tumor, and five inches of sigmoid, containing the tumor (Fig. 1) removed. End-to-end anastomosis, proximal and distal end of sigmoid, using chromic gut for mucosa and muscular layer reinforced by linen suture for serosa. Anastomosis reinforced by epiploic appendages which were sewn over side of anastomosis with linen suture. Colon tube passed to point above anastomosis. Colon tube sewn to anus with one silkworm-gut suture. Wound closed in layers. Dry dressing.

The day following operation the patient developed a bronchitis without temperature. The rectal tube was removed on the third day and the patient had a formed stool. He subsequently showed abdominal distention, diminished urinary output, and finally died seven days after operation from uræmia.

FIG. 1.—Proliferating epithelioma of the sigmoid.

THE OPERATIVE TREATMENT OF ARTERIAL THROMBOSIS AND EMBOLISM*

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Our interest in the subject which forms the title of this paper has been aroused principally by the study of three cases in which efforts have been made to relieve arterial obstruction by surgical means. Two of these cases, in which the femoral artery was concerned, were reported in full to the Philadelphia Academy of Surgery in May, 1907, and are here reproduced in abstract. The third case, one of embolism of the abdominal aorta, is now published for the first time.

The operative methods that have been proposed for dealing with thrombosis and embolism of the arteries are (1) ligation, (2) arteriovenous anastomosis, (3) arteriotomy, (4) arterial resection, (5) arterial catheterization.

1. *Ligation* of the affected artery, distal to the point of obstruction, has been suggested in order to prevent the detachment of emboli. Whether this suggestion should be adopted or not depends, to a large extent, upon the frequency with which emboli are liberated from the point of obstruction, upon the damage that such emboli may produce after they are set free, and upon the possibility of recognizing an intra-arterial clot when it is most likely to launch particles into the blood stream.

The constant attrition of a strong current of blood on a growing mural thrombus is surely conducive to fragmentation of the more recently formed layers of that thrombus, and it is our belief that minute particles of blood clot, which are, however, too small to cause mischief unless laden with bacteria, are always washed from a non-occluding thrombus and from an occluding thrombus that has reached the parent stem of the vessel in which it lies. The process is a microscopic, symptomless embolism, and it accompanies the healing of all wounds involving blood-vessels, hence may be regarded as a normal phenomenon of repair.

In contradistinction to this physiologic embolism, pathologic embolism from a developing arterial thrombus or an arrested embolus

* Annual oration, read before the Philadelphia Academy of Surgery, January 4, 1915.

is rare, at least so far as can be estimated from a clinical study of the subject. One of the reasons for this rarity is that the separated clot must be of a proper size to cause symptoms. If it is of microscopic dimensions and aseptic it is incompetent to work harm. If it is of great size, almost as large as the original clot, it becomes impacted immediately distal to the original clot and not in one of the branches of the affected vessel. Despite the greater blood-pressure in the arteries, which fact might lead to the inference that an intra-arterial clot would be more liable to suffer disintegration and dispersion than a clot in a vein, arterial thrombosis is decidedly less apt to result in harmful embolism than venous thrombosis. Owing to the composition of the arterial blood, a thrombus in an artery forms more slowly than one in a vein, hence is firmer in consistency. The walls of an artery are thicker than those of a vein, consequently a thrombus in an artery is less liable to be displaced by pressure from without. The arteries diminish in size in the direction of the blood current, as a result an occluding thrombus in an artery cannot be driven farther; whereas in a vein, which increases in calibre in the direction of the blood current, a thrombus may be washed *en masse* from its moorings.

Even though observation leads to the conclusion that emboli of proper size to cause trouble seldom arise from an intra-arterial clot, if the damage to the tissues deprived of blood by such emboli were great, ligation might still be urged to avert that damage. A small clot floating from a partly occluded artery is not likely to inflict more harm than total occlusion of that artery by ligation, whether the artery be the aorta, the brachial, the femoral, or the carotid. A small clot freeing itself from a mural thrombus which later becomes occlusive might, however, seriously interfere with the development of a collateral circulation, and the same result might be caused by a small clot thrown from an occlusive thrombus.

Even with the possibilities just mentioned in mind, however, ligation cannot, as a rule, be recommended, because the greatest danger of detachment of emboli is when the thrombus is forming, in other words, when the diagnosis of thrombosis cannot be made. When the diagnosis is certain, the thrombus is occlusive, and the danger of embolism is probably passed. Small particles can no longer be driven from the clot, and it cannot be displaced *en bloc,* because the vessel beyond is smaller than the thrombus.

2. *Arteriovenous anastomosis,* above the point of arterial obstruction, in order to induce the arterial blood to flow through the veins towards the periphery, and so reach the undernourished tissues, is an

operation which has enthusiastic advocates and strong opponents. Probably most surgeons are in a state of indecision as to the merits of this procedure. According to some experimenters, reversal of the circulation in the veins is impossible, owing to the resistance offered by the valves. Other experimenters, notably Carrell, have succeeded by arteriovenous anastomosis in filling the veins with red blood. None has demonstrated, however, that this red blood passes through the capillaries before returning to the heart.

It is probable that with time the valves might be forced to yield to the constant bombardment of the blood diverted from an artery into a vein, and that, aside from actual tearing or stretching of the valves, they might easily be rendered incompetent by the dilatation of the vein in obedience to the increased intravenous pressure. In either event, however, the time would have to be brief if the part threatened with gangrene is to survive, and the constant hurling of the blood against the valves with the consequent eddies in the stream would surely predispose to thrombosis, especially if the valves were lacerated, instead of simply bent back or separated. In addition to these theoretic considerations we have undisputed clinical evidence that in certain cases of varix and arteriovenous aneurism the blood flows centrifugally in the vein.

Reversal of the circulation in the capillaries and arteries, however, would seem to be possible only in an organ with a terminal circulation. If the veins, as is the case in the extremities, have numerous anastomotic branches, the arterial blood diverted to the principal vein will always seek these branches, and return to the heart in collateral venous channels, in which the pressure is feeble, rather than overcome the greater resistance of the capillaries and thus reach the arteries. Here again, *i.e.,* in the arteries, the presence of anastomotic branches, if functionating, would offer an insurmountable obstacle to a centripetal flow of blood from the capillaries, since the red blood in these anastomotic branches would quickly distend the main artery, below the site of the artificial arteriovenous junction, with greater force than that of the dark blood accumulating from the capillaries. This dark blood, even if regurgitated into arterioles without anastomotic branches, would, in most instances, only hasten their obliteration by thrombosis, since, in addition to the coagulative tendency of used blood, the arteries would be, in most instances, badly diseased and, owing to the fall of blood-pressure consequent upon their assumption of the function of veins, much reduced in calibre.

It is probable that in most of the cases of arteriovenous anastomosis

for threatened gangrene in which the results are reported as favorable the operation was a failure, *i.e.*, that thrombosis occluded the vein and the artery at the site of anastomosis, and that the amelioration noted in the symptoms was due, not to increased blood supply, but to interference with the venous drainage. This probability is supported clinically by those cases of Raynaud's disease temporarily benefited by the application of elastic constriction to the base of the limb, and also by von Oppel's experience in securing, by means of ligation of the popliteal vein, a return of warmth, color and sensation in a leg menaced by gangrene. If the arteriovenous fistula remains patent the chances are, unless our theories are entirely wrong, that the blood shunted from the artery to the veins does no more than hinder the return of blood in those veins, thus contributing to passive hyperæmia. Another explanation, applicable to a few of the "successes" in preventing gangrene, especially in the upper extremities, is that, owing to an adequate collateral circulation, gangrene would not have occurred without operation.

If the collateral circulation is adequate, and the anastomosis is made immediately above the point of arterial obstruction, the only harm that could be done, aside from the evil possibilities attending all operations, is obliteration of the vein by thrombosis, and perhaps this might prove, as pointed out above, beneficial rather than injurious. If, however, the collateral arterial circulation is not competent to irrigate the limb, and there is still some blood passing through the artery, or if functionating arterial branches exist between the point of obstruction and the anastomoses, failure of the operation, *i.e.*, thrombosis, would increase the danger of gangrene.

Since 1902, when San Martin reported the first case, arteriovenous anastomosis for restoring the circulation has been done about 70 times: Once between the carotid and the internal jugular, twice between the brachial vessels, four times between the popliteal vessels, once between the anterior tibial artery and the internal saphenous vein, and the rest between the femoral vessels. The indications were hemiplegia, probably embolic, in one case; embolism in two cases; traumatic destruction of the vessels (excision for sarcoma and aneurism, gunshot wound, rupture of the vessels from lightning stroke, crushing accident) in five cases; and to prevent or to limit arteriosclerotic gangrene (including Raynaud's disease) in the remaining cases. In about 20 per cent. of these cases the results are said to have been satisfactory. Most of these apparent "successes" are seriously questioned by unprejudiced observers, and it is highly probable that the operation is never successful

in so far as reversing the circulation is concerned, but that improvement in the symptoms, at least, temporary, occurs in a few instances there can be no doubt.

In view of this fact, and despite the theoretic objections to arteriovenous anastomosis, it cannot be condemned utterly. It may be that circumstances occasionally will arise under which the conscientious surgeon, forced to a decision between this operation and eventual amputation, will be willing, after laying the experimental nature of the proceeding before the patient, to perform an arteriovenous anastomosis, in the hope that he may do no harm and possibly may effect some good. It may be, too, that future experimental or clinical evidence will force us to alter our views of this operation.

If arteriovenous anastomosis is decided upon, the method to be employed should receive serious consideration. The method which is physiologically ideal, so far as the effort to obtain complete reversal of the circulation in the vein and the artery is concerned, consists in severing the artery and the vein and then uniting, end-to-end, the central segment of the artery to the distal segment of the vein, and the distal segment of the artery to the central segment of the vein. There are, aside from its technical difficulties, three important objections that may be lodged against this procedure. The vessels are crossed at the point of suture and exert pressure on each other, thus retarding the flow of blood through the anastomoses and predisposing to thrombosis. If the artery below the point of anastomosis is patent and its connections with collateral arteries undisturbed, part of the blood from these collateral branches will stream up the artery and into the vein, and thus be diverted from the capillaries where it is so greatly needed. If thrombosis occurs at the point where the peripheral arterial segment is joined to the proximal venous segment, a portion or the whole of the thrombus may be driven or drawn into the vein and be carried to the pulmonary artery or one of its branches. These objections may be overcome by sacrificing the physiologic ideal and tying the peripheral end of the artery and the proximal end of the vein, trusting that the blood which is driven into the distal segment of the vein may find its way back to the heart through collateral venous channels. The same result, *i.e.*, shunting the arterial blood into the vein and forcing the blood to seek channels other than those of the main artery and vein in its journey back to the heart, may be obtained by performing lateral anastomosis and then tying the vein proximal and the artery distal to the anastomosis, by implantation of the upper end of the artery into the side of the vein, with ligation of the vein above the anastomosis and

ligation of the distal arterial segment, or by implantation of the lower end of the vein into the side of the artery, with ligation of the artery below the anastomosis and ligation of the proximal venous segment. All of these substitutes for end-to-end anastomosis deflect and deform the blood stream as it passes from the artery to the vein, which irregularities in direction and form are important factors in coagulation. Further, these substitutes all lack the advantage of smoothness in the neighborhood of the anastomosis, the first leaving two pockets, and the second and the third each leaving one pocket, in which a propagating thrombus is likely to develop. Without ligation as described above, lateral anastomosis and lateral implantation of artery into vein short circuit the blood that finds its way into the vein, it being easier for this blood to follow the normal direction of the venous current than to flow towards the periphery. Lateral implantation of vein into artery, without ligation of the artery distal to the anastomosis, and lateral anastomosis with ligation of the vein proximal to the anastomosis, may seem to possess some elements of innocuousness, in that while part of the blood is diverted to the vein the circulation in the artery is not suppressed, thus permitting it to carry nourishment as far as it is patent. This plan for dividing the arterial current is a compromise between a frank effort to reverse the circulation and "watchful waiting," and is less likely to succeed than either. It predisposes to thrombosis in the artery because of the decrease in intra-arterial pressure consequent upon the leak at the site of anastomosis, and because of the decrease in intra-arterial pressure the blood which passes through the artery is less apt to permeate the capillaries. Further, the amount and the force of the blood diverted to the vein are necessarily less than when the whole arterial stream is directed into the vein, and the blood so diverted, instead of penetrating to the venous radicals, escapes into the returning collateral veins through the first anastomotic branches, unless in the meantime it solidifies into a thrombus.

3. *Arteriotomy,* for the purpose of removing an embolus, was attempted first by Sabanajew in 1896. The embolus, which was supposed to be in the femoral artery, was not found, however, and the limb was amputated at a lower level.

The first report of a successful embolectomy was made by the author to this Academy in May, 1907.

A man, aged sixty-one years, was suddenly stricken with excruciating pains in the right foot, followed by gangrene of the foot and the lower two-thirds of the leg. Pulsation could not be felt in any of the vessels below the bifurcation of the femoral. Thirty-six hours after the onset of the pain the femoral artery

was opened, the embolus extracted, and the artery sutured. Pulsation immediately reappeared in the femoral below and in the popliteal, but not in the tibial vessels, and this pulsation continued for eight days. The gangrene did not extend after operation. Forty-two days later the leg was amputated below the tubercle of the tibia. About 15 ligatures were necessary and the bone bled freely on section. The popliteal artery contained a small clot, and a probe passed up into the artery for several inches caused a slight flow of blood.

In 1907 three additional arteriotomies for embolism were reported. Doberauer opened the right axillary artery and removed an embolus 52 hours after its impaction. Thrombosis occurred within a few hours and the artery was again opened and the clot extracted. The thrombus reformed and two days later an anastomosis was made between the artery and the vein, whereupon the gangrene ceased to spread.

Handley attempted to aspirate and to wash an embolus from the left common iliac artery, 12 hours after its impaction, by passing a catheter through the deep femoral, the common femoral, and the external iliac. He succeeded in inducing a pulsating flow of red blood, but death occurred 24 hours later.

Moynihan removed an embolus that had lodged in the popliteal artery; the patient died four days later. The condition of the leg after the operation was not mentioned.

Arteriotomy for embolism of the pulmonary artery, which was suggested by Trendelenburg in November, 1907, and which has thus far always been followed by death, we have excluded from our discussion, as the pulmonary artery belongs physiologically to the venous side of the circulatory apparatus.

In 1909 Murphy incised the femoral artery four days after the onset of acute ischæmia in the left lower limb, and dislodged an embolus from the common iliac by fragmentation, using a catheter and forceps. The lower limb was already gangrenous, and amputation was performed four days after the arteriotomy.

In the same year Schiassi extracted an embolus from the femoral artery, and amputated through the thigh four days later.

In 1911 two cases appeared in the literature. Proust removed an embolus from the femoral artery 12 hours after its impaction. The patient died the following day.

Mosny and Dumont removed an embolus from the left femoral artery six hours after the onset of symptoms. The limb did not become gangrenous.

In 1913 three new cases were brought to light. Key's patient complained of sudden, violent pain in the left popliteal space, with coldness and numbness in the leg. Seven hours later the dorsalis pedis was exposed by incision and found to be empty; next the popliteal artery was laid bare and it too was found to be empty. Then the femoral was uncovered, opened, and an embolus removed. The wounds healed kindly and gangrene did not follow, although, probably as the result of ischæmia, there was slight paralysis of the peroneal muscles and some contraction of the muscles of the calf.

In Matti's case likewise, the symptoms were referable to the foot and leg, although no arterial pulsation could be obtained lower than a point 3 cm. below

Poupart's ligament. Thirteen hours after the trouble began the femoral artery was incised near its bifurcation, and a clot 3 cm. long withdrawn from the superficial femoral, and one 2 cm. long from the deep femoral. Later, owing to absence of bleeding from the lower part of the superficial femoral, this vessel was milked from below upward, and a clot 15 cm. long forced out through the wound. This was followed by copious bleeding and the artery was then sutured. After several days thrombosis recurred in the superficial femoral artery. The gangrene was limited to the toes, the superficial parts of the heel, and a narrow area of skin along the inner surface of the leg. The patient died two months after operation from cardiac disease and pneumonia.

BAUER'S case we give in detail because it is the first, and, indeed, with the exception of our own, the only one in which the abdominal aorta was opened to remove an embolus. The patient was a man, aged thirty-nine years, suffering from chronic articular rheumatism and mitral disease. Suddenly severe pain was experienced in both legs, which became useless, and in the lower abdomen. The pulse was irregular and the face cyanotic. Over both lower limbs, and over the abdomen as far as the umbilicus, the skin was cold and livid. No pulse could be felt in the femoral arteries. Sensation was abolished in the feet and the legs, and only partly present in the thighs and over the lower abdomen. Operation was performed three hours after the onset of the embolic symptoms. An incision was made in the linea alba, the small intestine drawn from the abdomen and laid on the right side of the abdominal wall, the posterior parietal peritoneum incised, and the aorta isolated. After the aorta had been compressed by the finger of an assistant an incision 2 cm. long was made into the artery just above its bifurcation, and the embolus extracted. The arterial wound was then closed with six sutures of silk. Pulsation was immediately felt in both iliac arteries. The operation lasted one hour and forty minutes. The embolus was about 3 cm. long and had the form of a molar tooth with two short roots; the "crown" lay in the aorta, the "roots" in the iliac arteries. Symptoms referable to the lower limbs promptly disappeared, except for some pain in the left foot and calf. The patient left his bed on the twenty-fifth day and was discharged on the thirty-second.

The history of our case of aortic embolectomy, hitherto unpublished, is as follows:

S. A., female, aged forty-nine years, had always been in good health up until a few years before admission to the Jefferson Hospital, when, following an attack of acute articular rheumatism, she began to suffer from dyspnœa. About three weeks before operation she was compelled to go to bed because of dizziness, cough, weariness, and severe headache. One week after this she suddenly lost her voice, and, although not unconscious, seemed unable to comprehend what was said to her. A few days later it was noticed that she frequently rubbed both legs and especially the right one, which quickly became dark in color. At the time of entering the hospital the patient was restless and constantly moaning. The voice had partly returned, but only a few words could be uttered distinctly. The pupils were small, equal, and

reacted to light. There was no paralysis of the tongue or face, no jaundice, and no enlarged lymph-glands. The tongue was heavily coated, the thyroid gland distinctly palpable. There was slight impairment of resonance and increased harshness of the breath sounds over the apex of the right lung. The heart was enlarged and very irregular in action, the apex beat diffuse, feeble, and in the sixth interspace, about 13 cm. from the median line. Over this point a presystolic thrill and murmur were present. The radial arteries were slightly atheromatous. No abnormalities were discovered in the abdomen. Pulsation of the abdominal aorta could be made out by palpation. Pulsation could not be felt in the external iliacs, or in any of the arteries in the lower limbs. The right foot was black and shrivelled, the lower two-thirds of the right leg purplish, with loosening of the epidermis and bleb formation. The left leg was painful, tender, useless, warm (because of the presence of external heat), and pale, except over an indurated area, about two inches in diameter, just external to the middle of the tibia, where the skin was reddened and œdematous. The urine showed a trace of albumin but no casts, the blood a negative Wassermann reaction and 21,600 leucocytes (polymorphonuclears 84 per cent., hyaline 5 per cent., lymphocytes 10 per cent., eosinophiles 1 per cent.). There was no fever.

In view of the advanced and extending gangrene in the right leg, with only prodromal symptoms of gangrene in the left leg, it was thought that an embolus had lodged in the right femoral artery sometime preceding the impaction of a second embolus at the bifurcation of the aorta, or that an embolus had been arrested at the bifurcation of the aorta, which embolus had completely occluded the right iliac artery and at first only partly occluded the left iliac artery, the obstruction of the latter vessel becoming complete at a more recent period as the result of a superadded thrombus proceeding from the embolus. As no induration could be felt along the right femoral artery the second explanation seemed to be the better, and indeed proved to be the correct one. The red indurated area in the left leg was considered to be due to a small embolus from the heart, or from the clot accumulating at the origin of the left common iliac artery.

Although, by reason of the feeble action of the heart, it was recognized that an effort to clear the aorta would be attended by great risk, it was deemed imperative to make the attempt, not only for the purpose of saving the right thigh and the left lower extremity, but also for the purpose of relieving the cardiac embarrassment that always accompanies aortic obstruction. The alternative was abstention, gangrene of both lower limbs, and death.

The operation was performed January 5, 1914, under ether,

administered by intratracheal insufflation. The abdomen was opened in the median line below the umbilicus, the small intestine segregated in the right side of the abdomen, and the sigmoid pressed to the left. The iliacs were motionless; the aorta pulsated to a point near the bifurcation, at which point it was hard. The posterior parietal peritoneum was incised, and a silk ligature passed beneath the aorta at a point one and one-half inches above the bifurcation. This ligature was not tied, but it was placed so that it could be tied in the event of bleeding that could not be controlled otherwise. While an assistant compressed the aorta with a finger a longitudinal incision, extending upwards from the bifurcation for three-fourths of an inch, was made in the anterior wall of the aorta. After removing, in several pieces, a dark friable clot, evidently of recent formation, which lay beneath the incision and protruded into the left common iliac artery, the embolus itself was uncovered, and easily forced through the wound by pressure, from below upward, on the right common iliac artery, into the orifice of which the lower end of the embolus had been driven. There were apparently no firm adhesions between the obstructing mass and the intima, which appeared to be smooth and undamaged. The embolus, or perhaps we should say the embolus with the old thrombi which had gathered about it, measured 3.1 cm. by 1 cm., weighed .75 gramme, and was bullet-shaped, the distal end being bluntly rounded, the proximal end irregular, as though a portion had been broken off. The ends were dark red in color, and separated by a white band, .7 cm. in width, which sent a narrow prolongation toward the proximal end. After milking several more small fragments of clot from the left common iliac, pressure on the aorta was relaxed for an instant, in order to wash any remaining coagula through the wound, and the aorta closed with a continuous through-and-through silk suture, over which a second continuous suture, including the outer coats only, was inserted. The posterior parietal peritoneum was drawn together with a continuous suture of catgut, the abdominal wall with interrupted stitches of silkworm-gut.

The operation, which lasted about one hour, had little immediate effect on the patient's general condition. The temperature remained normal, the respirations continued at the rate of 40 to the minute, and the pulse, which could be felt in both femoral arteries, was slightly accelerated, varying, as nearly as could be estimated, between 75 and 130. On the following day the pulse failed in the right femoral artery, the temperature rose to 101°, a small quantity of bright red blood was coughed up, and numerous moist râles could be heard over the chest. On the second day dulness appeared over the lower lobes of both lungs, the heart

became more feeble, and pulsation could not be felt in the left femoral artery. On the third day death occurred from cardiac weakness and pulmonary œdema. An autopsy could not be obtained.

On first viewing the patient whose history has just been related we discarded operation, because of the long time the embolus had lain in the aorta. Later, however, we realized the significance of the striking difference in the appearance of the right and the left legs and considered operation mandatory. In addition to this narrow escape from making an inaccurate "snap" diagnosis, several other features in this case stand out as highly instructive for the future building of the living pathology of embolic obstruction of the arteries, viz., the absence of occlusive thrombi in the femoral arteries, permitting them to resume their function after a number of days of inactivity; and, despite the long duration of the arterial obstruction, the absence of perceptible adhesions between the embolus and the intima, and the macroscopic smoothness of the intima, findings that allow us to entertain the possibility of restoring the circulation in the large vessels even after it has been interrupted for a long period. It may be that if our patient had survived, and the heart had contracted with a vigor approaching normal, thrombosis at the site of operation would not have occurred; it may be that cessation of femoral pulsation shortly before death was not due wholly or even principally to the alterations in the intima and the changes brought about by the arterial wound.

Notwithstanding the possibility just mentioned it cannot be emphasized too strongly that, in order to preserve a part from impending embolic gangrene, the embolus must be removed as soon after its impaction as possible, not only because of the increasing injury suffered by that portion of the intima which lies in contact with an unremoved embolus, which injury predisposes to thrombosis after arteriotomy, but also because impending quickly becomes actual gangrene, and dead tissues cannot be resuscitated. Further, in embolism of a large artery the early relief of the strain put upon the heart should be kept in mind.

The prompt diagnosis of embolism of the extremities generally presents no great difficulties, but even careful observers have, at times, been unable definitely to locate the exact site of the arterial obstruction. In four of the cases mentioned above (Sabanajew, Murphy, Handley, Key) and in another to be cited later (Stewart) the artery was incised some distance below the point of occlusion. In one of these cases the obstruction was not found, in two it was removed by indirect means

through the original incision, in the other two by a subsequent incision directly over the clot. An accurate diagnosis cannot be made from the symptoms of ischæmia merely. Pain, according to our observations, is acute in the region deprived of blood, and, despite the usual teaching, absent or trivial over the site of the obstruction in the artery. Pallor, fall of temperature, hypæsthesia, and paresis followed, in the event of local death, by the discoloration of gangrene, anæsthesia, and paralysis likewise are limited to that portion of the limb in which the circulation is arrested. All of these symptoms are indicative of ischæmia solely, and the area of ischæmia never reaches the level of the arterial obstruction. The reasons for this, although obvious, are often overlooked, and the site of obstruction is thought to be much lower than it really is. If the affected artery can be palpated there is no excuse for a mistake in the localization of the obstruction. At the site of obstruction the artery may be hard and tender; above this point it pulsates, below it does not pulsate. If the site of obstruction cannot be palpated one may find pulsation in the vessel or its superficial branches at a higher level and fail to find pulsation in the vessel or its branches at a lower level. These observations, with the knowledge of the usual site of embolic impaction, *i.e.*, where the vessel suddenly diminishes in size as the result of giving off a large branch or bifurcating, will generally suffice to determine with fair accuracy the point of occlusion. If the artery is exposed by incision at the suspected point and found to be pulseless throughout the length of the incision the artery should not be opened in this situation to determine whether it is empty or not (palpation suffices for that) or to permit the passage of probes or catheters, both of which are dangerous in that they injure the delicate lining membrane of the artery; but the vessel should be followed by lengthening the incision in the overlying tissues, or by making another incision, until a point is found above which there is active pulsation. The artery may then be incised, evacuated, and, with due regard to the rules laid down for angeiorrhaphy, sutured.

Arteriotomy for embolism, despite its rational and seductive character, must, of necessity, be followed by many disappointing results. All of the patients thus far operated upon were suffering from cardiac disease, most had atheromatous arteries, and in at least five cases there were evidences of previous embolism of arteries other than the one operated upon. Because of this tendency to embolic showers one can never be sure that the embolus that he is extracting is the last one to be thrown into the circulation. Notwithstanding these gloomy reflections we believe that, in view of the five cases in which undoubted

benefit has followed evacuatory arteriotomy, the procedure has attained a permanent place in operative surgery, and should be resorted to more frequently in the future with increasingly beneficent results. Aside from the technic necessary for successful angeiorrhaphy, and in addition to an early accurate diagnosis followed by immediate operation, the best results after embolectomy are likely to be obtained in a young patient with young arteries and a strong heart. Further, since obstruction is, generally speaking, more dangerous in a large than in a small artery, and since operation is easier upon a large than upon a small one, the greater the size of the affected vessel the more gratifying the results.

Arteriotomy for thrombosis was performed first by Lejars in 1902. His patient, a man aged twenty-six years, developed thrombosis of the femoral artery and gangrene of the foot following a severe contusion of the left inguinal region. Six days after the accident the artery was opened, a thrombus removed, and the artery sutured. Thrombosis recurred, and the leg was amputated below the knee. In 1905 we attempted a similar operation on the femoral artery with a similar result, as will be related in the next section of this article. In 1908 Lecène, and in 1909 Ranzi, each opened the brachial artery, the former for so-called spontaneous thrombosis in a tuberculous subject, the latter for traumatic thrombosis; in each instance the thrombosis recurred.

The results in these cases, with the knowledge of the lesions occurring in traumatic and "spontaneous" thrombosis, force us to the conclusion that simple removal of the thrombus is useless, or worse than useless. The cause of the thrombosis, *i.e.*, multiple fissures in or curling up of the intima (following a contusion) or endarteritis, is not suppressed; indeed, in view of the additional injury perpetrated by arteriotomy, the conditions are rendered more favorable for coagulation in the vessel.

4. *Resection* of a contused and thrombosed segment of an artery, followed by end-to-end union, would, if the vessel were healthy, offer as fair a chance for re-establishment of the circulation as circular arteriorrhaphy for accidental wounds, which operation we have on several occasions performed with success. Unfortunately, in many of the cases designated traumatic thrombosis injury is only one, and not always the chief, contributing factor; in these cases the artery is already diseased, and suffers obliteration from a contusion that might have failed to rupture the intima of a normal artery. Our only experience with resection for traumatic thrombosis was obtained in June, 1905, and related in this Academy in May, 1907.

The patient was a man, aged sixty years, with mitral regurgitation and advanced atheroma. Twelve hours after a contusion of the left inguinal region he complained of severe pain, first in the popliteal space and later radiating down the leg to the foot and toes, which pain was followed by the prodromal symptoms of gangrene. The femoral artery could not be palpated because of the swelling consequent upon the contusion. Owing to this fact, to the absence of ischæmia in the thigh, and to the seat of the initial pain, we made the mistake to which we called attention in an earlier paragraph, and concluded that a large clot embolus had been swept from the point of injury and lodged at the bifurcation of the popliteal artery; consequently about 24 hours after the injury we opened the popliteal artery and, finding no clot, passed a probe gently up into the vessel for about six inches, without encountering any obstruction, thus committing, according to our present ideas, two more mistakes, *i.e.*, opening an empty artery to see if it were empty, and extending the injury to the intima by probing the superjacent segment. After suturing the popliteal artery, the femoral artery was opened and the thrombus removed. It was then found that, like a valve, a calcified portion of the intima had been turned into the lumen of the vessel, probably occluding it one-half. The atheromatous plate was removed and the artery sutured. As pulsation below the injured point ceased almost immediately the arterial sutures were removed, the new thrombus extracted, and the artery resutured. After a brief period the thrombosis recurred. The injured portion of the artery was therefore excised and an end-to-end anastomosis performed. This likewise failed to reëstablish the circulation and the gangrene progressed rapidly, finally necessitating amputaion through the thigh. The patient recovered.

The only hope of success in arterial resection for "spontaneous" thrombosis would be in a case in which the causative lesion is a narrowly limited band of endarteritis; in all other instances of "spontaneous" thrombosis the tendency to coagulation would only be accentuated by contact of the blood with an arterial wound.

The amount of artery that may be excised, without rendering circular arteriorrhaphy impossible of execution, varies somewhat with the situation; in the neighborhood of joints, flexion of the limb can be utilized to diminish tension on the anastomotic suture; in regions in which the artery is bound to the surrounding tissues by branches anastomosis, after the removal of a large extent of artery, would be impracticable without severing these branches, an expedient that would generally be contra-indicated. Enderlen was able to approximate the ends of the popliteal artery after resecting 4 cm. for aneurism; Kümmel, the ends of the femoral artery after resecting 5 cm. during the excision of a carcinoma of the inguinal region.

The length of the resected segment could be greatly extended if, instead of directly uniting the ends of the artery, a section of another vessel were interposed between these ends. Since to repair a large artery by sacrificing another artery of equal size would, even is successful, simply transfer the danger of ischæmia from one part of the patient to another, or, if an obliging friend or relative would surrender the needed bit of vessel, from one individual to another, an arterial graft would necessarily have to be taken from a fresh cadaver or from one of the lower animals. So far as we are aware only one attempt, which failed, has been made to transplant a segment of artery from a fresh cadaver to a living individual, and that by Delbet, who thus filled a gap between the ends of the femoral artery, after the excision of an aneurism. Owing to the cytolytic effect of the blood and the body juices on alien tissue, homoplastic transplantation, particularly from a cadaver, and heteroplastic transplantation would seem to be of little promise in vascular surgery, in which even slight degenerative changes in the vessel wall are sufficient to induce thrombosis.

Whether autoplastic venous transplantation, which at once suggests itself as a simple method for overcoming the difficulties mentioned above, will prove reliable or not can be determined only by the results which future trials may bring to light. At the present time, however, the remarkable and stimulating experiments of Carrell, and the favorable clinical reports of venous grafting for conditions other than vascular obstruction, encourage the hope that a portion of a vein might be induced to functionate permanently for a thrombosed segment of an artery. In 8 of the 13 cases thus far published (Goyanes, Omi 2, Tuffier, Pringle 2, Mantelli, Lexer 2, Goecke, Krause, Enderlen, Pirovano), in which a venous graft was employed to replace a corresponding extent of artery (popliteal, femoral, brachial, axillary) that had been excised for aneurism or malignant disease, the immediate results were satisfactory (Moure).

Which vein should be chosen for transplantation depends upon the artery involved. If the artery has two venæ comites one of these could be selected. If there is only one venous satellite it should, as a rule, be spared, because in the event of failure both artery and vein would be obstructed. If the companion vein must be preserved the surgeon might employ a vein which does not accompany an artery, *e.g.*, the saphenous or the external jugular, or one of the venæ comites of an artery other than that affected.

It should not be forgotten that a venous transplant containing valves must be placed in such a way that the valves will not interfere with the passage of blood through the transplant. Another matter, to which attention should perhaps be directed, is the support of the walls of the transplant. Under the impact of the arterial stream the grafted vein dilates to twice the size of the artery, thus causing the blood to

swirl in eddies and, as in aneurism, predisposing to thrombosis. Efforts have been made to prevent this dilatation by turning the vein back on itself, like a cuff, and by suturing the surrounding tissues over it. We suggest a third method, which might be employed in suitable cases of thrombosis. Since in many instances of intravascular coagulation the intima alone is at fault, it has occurred to us that, instead of resecting the artery, its internal coat might be peeled out, and replaced by a piece of vein. This would leave the outer coats of the artery as a firm support for the vein, and the vein would form a new lining membrane for the artery. In some cases of traumatic thrombosis it would probably not be necessary to remove even the tunica intima before placing the vein in position.

5. *Catheterization* of the arteries of a stump left after amputation for arteriosclerotic gangrene, in order to remove clots and thus minimize the risk of necrosis of the flaps, was suggested by Severeanu in 1894. As the passage of catheters and probes into an artery can serve only to injure its delicate endothelial lining and encourage thrombosis, we believe the procedure to be harmful rather than beneficial.

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STATED MEETING, FEBRUARY 1, 1915

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

INGUINAL LYMPHOMA

Dr. D. L. Despard presented a man who had been operated on at the Jefferson Hospital for enlarged inguinal glands. The glands on the left side, smaller than those on the right, were not removed; the largest of the glands of the right side measured, three or four days after removal, 4 cm. in diameter. Microscopic examination showed simple hyperplasia of the lymphatic glands, without increase in the fibrous tissue and no evidence of eosinophiles except here and there; nothing to suggest sarcoma or Hodgkin's disease. The cells had the appearance of ordinary lymph cells. History was practically negative. There was no venereal history; Wassermann, negative. He had, however, a leucocyte count of 12,000. The red cells were increased in number to 6,200,000. Beyond this the blood picture presented nothing unusual. The differential count showed polymorphonuclear cells of 66 or 67 per cent., in other respects it was practically normal. The reporter said that he had never seen an ordinary hyperplasia in which the glands were as large as those on the right side in this case. The question is whether this is an incipient Hodgkin's disease or a pre-sarcomatous condition.

Dr. John H. Jopson said that this case is similar to one in which he had operated for polyglandular enlargement of one side of the neck. Some of the glands were found to be broken down at the time of operation, and the appearance seemed to disprove the possibility of Hodgkin's disease or sarcoma. Pathologists in two laboratories reported the condition tuberculous. There was local recurrence and a second operation was done some months later. This time the glands were examined by Dr. Canby Robinson who reported typical Hodgkin's disease.

OPERATION FOR OLD FRACTURE OF THE PATELLA

Dr. John H. Jopson presented a woman thirty-nine years of age, weighing over 200 pounds, who fell in 1912 and fractured her left patella. She was treated by another surgeon without operation, some form of an extension apparatus being applied to the muscles of the thigh to aid in bringing about apposition of the patellar fragments. She was in bed for two months; there was marked stiffness of the knee following the removal of the apparatus. Four months after the original accident, the fragments became separated during passive

motions. She was again in bed for one month. Considerable stiffness persisted and she had some effusion of the joint, but finally she got around with a cane.

In December, 1913, she fell again, injuring this knee. When examined by the reporter, February, 1914, a wide separation of the patellar fragments was found, at least two inches when the limb was extended and correspondingly more when it was flexed. The femoral condyles were plainly felt between the fragments and there was apparently no union. There was a complete loss of power of extension in the knee and the patient could walk only with a cane and had no confidence at all in the strength of the limb. X-ray examination showed two fragments, each of good size, widely separated (Fig. 1). At operation, in March, 1914, the fragments were exposed by the usual curved incision, convex downward. The fragments were connected by a broad, very thin, relaxed sheet of fascia, which permitted complete flexion, but was of no service in extension. There were many adhesions around the fragments and the quadriceps muscle. The broken edges were covered with a thick layer of fibrous tissue. The first step toward approximation of the fragments was a division of the lateral expansions of the quadriceps and loosening of the under surfaces of the two fragments from their adhesions to the underlying bones. A plastic operation was done on the quadriceps tendon by making a V-shaped incision with the apex downward, which manœuvre diminished by about two-thirds the distance between the fragments. The vastus internus and externus were extensively mobilized. As it was still impossible to approximate the fragments, they being about three-quarters of an inch apart, the tubercle of the tibia was chiselled loose from the bone, remaining attached to the patellar tendon and the periosteum on each side, which permitted of its being elevated about ¾ of an inch and the fragments of the patella could then be brought into contact, there being some slight tilting of the lower fragments. Both fragments were drilled and a heavy silver wire and two chromic catgut sutures were used to fasten them together. A wire nail was driven through the separated tubercle into the head of the tibia at its new level. The lateral expansions were sutured, the quadriceps tendon repaired, the thin, tendinous flap formerly uniting the fragments used to overlap them. The fat, fascia and skin wounds were sutured, and drainage provided at either angle, the wound being dressed on a posterior splint. There was some superficial necrosis of the fat due to the prolonged manipulation at operation, otherwise convalescence was normal. A splint was worn for three months, passive motions

FIG. 1.—Separation of patellar fragments. Before operation.

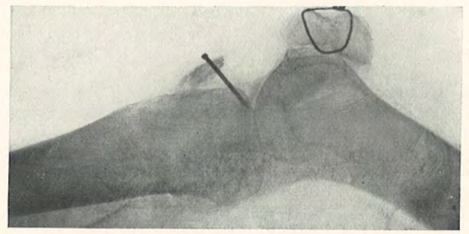


FIG. 2.—Condition after operation; patellar fragments in apposition, tibial tubercle moved upward and fastened by pin.

being practised after the wound was healed. There was marked stiffness at first, but this yielded to passive motion and massage. At the present time, the result is as follows: Flexion is almost complete, extension is strong to a point 15 or 20 degrees from the straight line, passive extension is perfect. The patient can walk long distances. She can stand with all her weight on the leg. The patella is movable and the only disability is in going up and down stairs, when she still fears to bring the injured knee ahead of the other. The X-ray (Fig. 2) shows excellent apposition and union of the fragments, union of the tubercle of the tibia with some tilting, and the nail, which still remains, has worked into an oblique position in the head of the tibia, but causes no annoyance. The incompleteness of extension is probably due to the high insertion of the patellar tendon with some loss of lever action in consequence.

The case illustrates what can be done in old fracture of the patella, with wide separation, by a combination of a plastic operation on the quadriceps tendon with von Bergmann's method of elevation of the tibial tubercle. Either of these measures alone would have been insufficient to secure approximation in this case, and, while the former has been criticised for resulting in a weakening of the muscle and the latter for not accomplishing very much in the way of approximation, the combination of the two in this case has resulted in a strong, useful limb. One criticism which might be aimed at the elevation of the tibial tubercle is one used by Turner, that it may prejudice the mobility of the joint. There is some slight loss of the power of complete extension here, although this may in time be overcome.

Dr. George G. Ross spoke of a case in which the interval between the time of the accident and of operation was five years. There was a separation of from 2¼ to 2½ inches between the fragments. He was able to bring the two fragments together, apparently in perfect apposition, secured by heavy silver wire. Fourteen days later, the patient being still in bed, the wire was snapped by a contraction of the quadriceps muscle, producing a ⅜ inch separation. She went about in this condition for a year and then the broken end of the silver wire produced a sinus, for which operation was done. While under the anæsthetic another attempt was made to bring the fragments together. They did not get bony union but a good strong fibrous union with good functional result, giving the woman a very useful limb. The problem in this case to be overcome was atrophy and shortening of the quadriceps muscle. No operation upon the tendon was done. It was forced down, but was not successful in entirely overcoming the shortening of the muscle.

TRANSPLANTATION OF ENTIRE BONES WITH THEIR JOINT SURFACES*

By A. Bruce Gill, M.D.
of Philadelphia, Pa.

The following experiments in bone transplantation were undertaken to determine whether or not it is possible to secure the healing in of entire bones with their articular surfaces, and whether or not such bones, if they do become healed in, will remain alive and unabsorbed, and, finally, to observe any other conditions that may have a bearing upon the subject of bone transplantation in general.

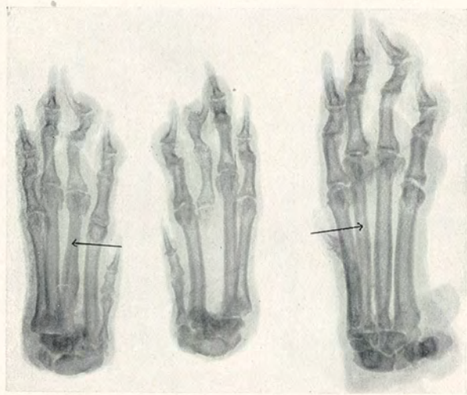
Full-grown dogs were operated upon under complete surgical anæsthesia by ether. The second long metatarsal bone was excised in the front paws and each one was implanted in the opposite paw. The ends of the bone were held in position by chromic catgut sutures. Tendons and fascia were sutured over it with interrupted sutures of silk floss. Asepsis was attempted by shaving the paws and painting the skin with tincture of iodine and by clamping the margin of the incision to sterile towels. After the incision was closed it was painted with tincture of iodine. No dressings were applied and the dogs were permitted to walk about. This they usually did on the day following operation without any evidence of pain.

Experiment No. 1.—Operation January 30, 1914. Periosteum scraped from the bone implanted in the right paw. Both skin wounds broke down a few days after the operation. The left paw was entirely healed on February 18, but the right presented a discharging sinus. On March 9, the exposed metatarsal was removed from the right paw under ether anæsthesia. April 4, both paws healed, dog walks and runs on both feet without a limp. October 16, dog killed. X-ray picture of paws shows the metatarsal present in left paw. Marrow cavity narrowed and irregular but persistent throughout the length of the bone except at proximal end, which shows evidence of the suppuration that occurred after the operation. The metatarsophalangeal joint is apparently normal. In the right paw only about one-half of the distal extremity of the transplanted bone remains.

Experiment No. 2.—Operation February 19, 1914. February 24, both wounds wide open to the fascia. February 26, dog killed, as a part of the left transplant was exposed. The other half of it was found to be firmly embedded in granulation tissue which was firmly adherent to the bone except at the joints. The other transplant was completely embedded in granulation tissue which was

* Read before the Philadelphia Academy of Surgery, February 1, 1915.

Fig. 1.—Experiment No. 1.



No. 3. No. 4.

Fig. 2.—Experiments No. 3 and No. 4.

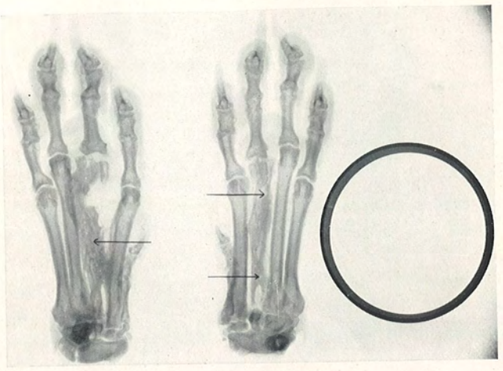


FIG. 3.—Experiment No. 5.

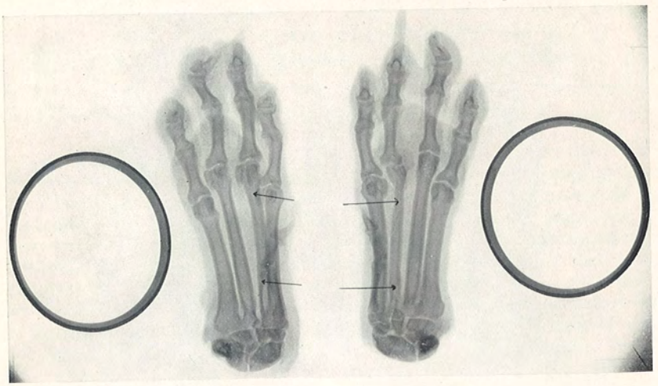


FIG. 4.—Experiment No. 6.

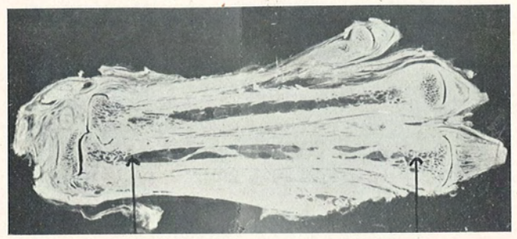


FIG. 5.—Photograph of section of paw.

FIG. 6.—Photograph of section of paw, mounted in celloidin.

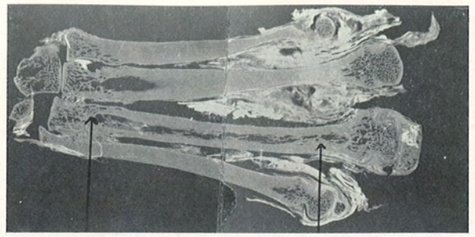


FIG. 7.—Photograph of section of paw.

FIG. 8.—Photograph of section of paw, mounted in celloidin.

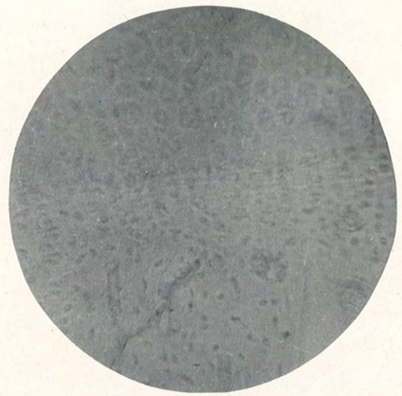


FIG. 9.—Microphotograph of transplanted bone, showing joint cartilage above and bone below. Cells of both are well stained.

firmly adherent to the bone except at the joints. The bone was torn out with considerable force, and soft tissue remained clinging to it.

Experiment No. 3.—Operation February 25, 1914. One metatarsal broken in removal and not implanted. March 17, small sinus present. Dog walks without limp. May 6, small persistent sinus. June 15, healed. October 16, dog killed. X-ray shows transplanted bone present and apparently normal, except for slight irregularity in proximal end. Both joints apparently normal.

Experiment No. 4.—Operation February 26, 1914. March 9, skin wounds open to the fascia, right discharging pus. March 17, almost healed. Dog has distemper. April 29, small sinus in right paw, left remains healed. May 6, right paw healed. October 16, dog killed. X-ray of left paw: Transplanted bone all absorbed except small distal fragment. Right paw: the bone is present, marrow cavity very narrow, proximal half of bone thick and irregular. Distal joint normal, proximal joint obscure. The other metatarsals and the tarsal bones also present evidence of the suppurative process.

Experiment No. 5.—Operation March 18, 1914. March 25, wounds both open to the fascia. April 2, wounds healed above and open below. April 29, suppuration in both paws. October 9, healed. October 23, dog killed. X-ray of left paw: Transplanted bone shows marked evidence of the long suppuration; thickened, irregular, proximal end absorbed for about one-fourth inch. Right paw: Bone much distorted, proximal ends of two other metatarsals also slightly involved. Distal joint good.

Experiment No. 6.—Operation March 19, 1914. March 25, left is healed, did not break down. Right is open below. April 2, both healed, no lameness. October 23, dog killed. X-ray of left paw: Transplanted bones present, a little thinner than normal; proximal extremity a little irregular, otherwise like other metatarsals, dislocation of distal joint. Right paw: Transplanted bone apparently normal throughout.

Summary.—Eleven bones were transplanted. One dog was killed a week after operation, before healing in of the bones had occurred, and in another dog one transplant was removed under ether. The remaining eight transplants healed in after more or less suppuration of all wounds but one. The dogs were killed from seven to eight and one-half months after operation. One of the eight healed-in transplants was found to be almost all absorbed. Another is badly distorted and a second moderately changed as a result of osteomyelitis following operation, but they appear to be serving their function and they present evidence of new bone formation. The remaining five transplanted bones are practically normal in appearance. The articular ends of the bones are apparently normal and the joints have perfect function except in those cases where the end of the bone was destroyed by the suppurative process.

Microscopic examination of the transplanted bones that healed in with little or no suppuration of the wounds shows no evidence of dead bone anywhere. The bone cells as well as the cells lining the marrow

cavity and the cells of the periosteum are well stained. If there was necrosis of the transplanted bone, the necrotic part has all been absorbed and replaced. The joint cartilage also appears normal.

The operations were performed by the writer without assistance. This rendered it necessary to fasten the paws of the dogs securely to blocks of wood. The straps caused venous constriction which prevented complete hæmostasis and delayed the operations. These conditions probably caused the breaking down of the wounds and the subsequent suppuration. In experiment No. 6 this condition of venous constriction was avoided and the one paw healed by first intention and the other healed promptly after it had opened up slightly. I believe that practically all cases could be operated upon with primary union under favorable conditions and consequent healing in of all transplanted bones.

The fact that so many of them healed in under unfavorable conditions and in the presence of infection shows the marked resistance of the transplant. The articular ends of the bones and the joint cartilage show an equal ability with the remaining portion to maintain their life and resist infection. In these experiments the joints emerged from their trials in fully as good condition as the bones proper, and it should follow that the transplantation of half-joints and entire joints should present no greater difficulty or uncertainty than the simple transplantation of bones of equal size.

The fact that the dogs went about on their paws almost immediately following the operation does not necessarily affect the transplanted bone adversely. To the contrary, the functioning of the transplant may be a favorable factor in its life and regeneration.

These experiments would seem, therefore, to indicate that the smaller long bones with their articular surfaces are readily transplantable in the dog under unfavorable conditions, and that the joints are re-established and preserved thereafter.

In the successful transplantations the bones are found at the end of seven to eight and one-half months to be normal in outline and structure, to be living and to show no evidence of necrosis or absorption of any of their parts, in short, to be indistinguishable from normal bone. They have not been in contact with other bones except through their articular surfaces. We must therefore conclude either that the transplanted bone has retained life in itself or that it has been completely regenerated in all of its parts by a process of metaplasia of cells derived from the surrounding soft tissue. Murphy's theory that

a transplanted bone is only osteoconductive and that it must contact with fresh living bone is absolutely inapplicable to these experiments.

The metaplasia theory of bone regeneration from the surrounding connective tissue cells is maintained by Baschkirzew and Petrow, whose views, based on animal experimentation and clinical observations, are entitled to some consideration, if only to expose their fallacy. They state that the majority of bone transplants soon die: although a few stronger or better nourished ones may live a long time, until they also die of exhaustion. Some few heal in and regenerate new bone. Young connective tissue cells are the chief factor in the regeneration of new bone in a transplant which is imbedded in muscle. They penetrate into the vascular and the Haversian canals and are converted into osteoblasts and bone cells. The transplanted periosteum and endosteum become in part necrotic, while the remaining part is possibly capable of bone regeneration. But the persistence of such new bone is questionable and its differentiation from the bone which grows from the connective tissue cells is often impossible. The preservation of the periosteum is not essential to the life of the transplant, but it evidently is useful in causing more rapid union between the transplant and the surrounding tissues, in hindering resorption of the transplant, and in giving the first impulse to new bone formation.

This view of metaplasia does not agree with the views of most other investigators of this subject. Nor, if pushed to the limit, does it seem tenable. If the entire transplant has died and if later we find the transplant to be alive, then it is necessary to suppose that all its parts, periosteum, marrow, endosteum, bony tissue, have been regenerated from young connective tissue cells from the surrounding structures. But if these tissue cells are capable of such metaplasia, why do they not perform such function at all times, why do they wait until a dead transplant is thrust into their midst, or why do they not do it when a piece of decalcified bone or other porous substance is implanted? It becomes necessary to suppose that in some unaccountable manner the dying transplant stimulates the metaplasia. The same process must necessarily occur in every simple comminuted fracture. And all this theory in the face of the fact that bone contains within itself the elements necessary to its growth and regeneration. Why then should it borrow from the outside?

As a matter of fact, Baschkirzew and Petrow do not push their theory to its rational conclusion. They admit that certain parts of the transplant do regenerate new bone, but say that such bone often cannot be differentiated from the bone which grows from the connective tissue

cells. How then can they differentiate the latter from the former? Finally, the thorough microscopic studies of Phemister, Mayer and Wehner and many others show that certain parts of the transplant are osteogenetic. The latter investigators give careful consideration to Baschkirzew and Petrow's theory and point out the errors in their experiments in not excluding bone derived from the osteogenetic layer of the periosteum and from adjacent Haversian canals.

All the evidence and all the weight of authority is against the view of regeneration by metaplasia. We must conclude that a transplanted bone retains life in itself and is capable of its own regeneration as far as is necessary.

For clinical purposes this is all that is necessary to be certain of in the transplantation of bones. And yet it may be of value to know, for example, whether or not we should remove the periosteum from the transplant. This opens up to us the entire question of the rôle played by each part of a bone transplant, what parts live and what parts die, what parts regenerate bone and what do not.

At first view one is confused by the opposing views of such men as Barth and Murphy, Axhausen, Macewen, and Baschkirzew and Petrow with their numerous followers or predecessors. Their views are often diametrically opposed and they cannot all be right. But much of this confusion will disappear on careful study and comparison of the various statements and theories, and I think we are able at the present time to arrive at conclusions fairly close to the truth.

In the first place, certain words, such as periosteum, marrow, bone graft, do not have the same meaning and content to all writers on this subject. When Macewen and others state that they have removed the periosteum in certain experiments they mean that part of the periosteum which is easily stripped from the shaft of the bone. But Mayer and Wehner and various histologists have shown that the cambium, or osteogenetic layer of the periosteum, which Macewen ignores or denies to exist, is applied so closely to the bone and so penetrates into the bony canals, particularly at the cancellous ends of the long bones, that it cannot all be removed even with a rasp. This fact must vitiate practically all such experiments unless it has been microscopically proved that there has been no osteogenetic layer of the periosteum left on the transplant.

Again, when Axhausen speaks of bone regeneration from marrow or medulla, he means regeneration from the endosteum which lines the marrow cavity and the Haversian canals. Like the periosteum this too cannot be completely stripped from the bone.

Likewise, there is some confusion in the use of the term bone graft. In some cases it means all the parts of a bone from periosteum to marrow, and again it means only the compact bony tissue, and frequently its meaning is not stated or indicated. When Gallie says a bone graft always dies, he is speaking of one probably without periosteum and with little or no endosteum.

In the second place the views of certain writers have been somewhat modified and we must consult their most recent utterances. Axhausen at first stated that bone regeneration occurs only from the periosteum, but he now maintains that the marrow, or endosteum, and joint cartilage are likewise transplantable, *i.e.*, they remain living and are capable of regeneration. Albee at first stated that a bone graft without periosteum is as good as one with it, but now he is careful to retain both periosteum and endosteum in the graft.

And, finally, most authors have disregarded Roux's law of functional adaptation. The final result of a bone transplanted into soft tissues where it bears no weight and serves no other function may be entirely different from that of a bone placed where it will serve a mechanical function. Function stimulates growth and regeneration both in normal and in transplanted tissues.

Let us now examine very briefly the various theories of bone transplantation. The old theory of Barth, recently restated by Murphy and others, that a bone transplant always dies and is absorbed and is replaced, if it be replaced, by bone from the recipient or contacting bone, must be definitely rejected. It is based on insufficient and defective evidence and is directly disproved by a large mass of experiment by Axhausen, Ollier, Albee, McWilliams, Nicholls, Phemister, Cotton and Loder, Hass, Lexer, Mayer and Wehner, Tomita, Trinci and others. In the experiments of the writer the transplanted bones did not contact with other bone except through their joint surfaces, which, of course, effectively prevent osteoconduction. The recent study of Gallie need not be considered as corroborative of the above theory, as it merely shows that some bone grafts without periosteum and with little or no endosteum may die and be replaced by bone from the recipient bone.

Macewen believes that the bone cells of the transplant occupying the lacunæ of the bony substance itself are the active agents in the life and regeneration of a transplant, and that the periosteum is only a limiting membrane and takes no part in osteogenesis. He makes the mistake of presenting no microscopical evidence and of entirely neglecting the consideration of the cambium layer of the periosteum. His experi-

ments are all open to a misunderstanding because he does not exclude the possibility of bone formation from this structure, nor, moreover, from the endosteum and the lining of the Haversian canals. It would appear from the work of Axhausen, Phemister, McWilliams, Mayer and Wehner, and others that part of the bony substance of a transplant may live indefinitely although most of it soon dies, and it seems even possible that there may be regeneration from some of the bone cells which receive early and sufficient nutrition after the transplantation. Therefore, Macewen may have been partly correct in stating that the bony substance including Haversian canals lives and regenerates. But such regeneration must be far less than he supposed it to be, as it is now proved unquestionably that the preponderating part of regeneration is from the periosteum and the endosteum.

McWilliams' experiments show the great value of the periosteum to the life and regeneration of the graft, in that he records 100 per cent. of successful transplantations with the periosteum, against 48 per cent. without it; but he is content to ascribe this to the influence of the periosteum in maintaining the nutrition of the graft. He fails to recognize the importance of the cambium layer of the periosteum, although he states that periosteum transplanted into soft tissues may produce new bone. And his experiments with transplants free of periosteum are open to the same criticism as most similar experiments, that frequently all the osteogenetic layer is not removed. Nor is any mention made of the endosteum, although it seems to have been present in many or all of his cases. In my judgment his studies do not support the view of Macewen that the adult bone cells of the graft are the active element in its life and regeneration; and he directly contradicts him as to the importance of the periosteum.

The metaplasia theory of Baschkirzew and Petrow has already been discussed.

There remains a consideration of Axhausen's teachings and an attempt to arrive at a true understanding of what occurs after bone is transplanted.

Axhausen, in brief, states that transplanted bone cells at first remain unchanged during an indefinite stage, and that then some cells die while others continue to live. Eventually all bone cells die and the bony tissue is replaced by regeneration chiefly from the periosteum and secondarily from the marrow. Bone tissue histologically is not transplantable. Joint cartilage, however, is transplantable both histologically and clinically, and epiphyseal cartilage is to a limited degree clinically.

Axhausen's views appear, in the main, to be fairly correct according to a large number of observers, but probably he falls a little short of the truth.

I think it is no longer to be questioned that the inner, or osteogenetic, layer of the periosteum is of prime importance in the life and regeneration of a bone graft. Histologists have long taught that the periosteum is the main factor in the growth of the bone. Nicholls shows that periosteum will regenerate complete shafts of bones that have been destroyed or excised. Oechsner and others confirm this work. Ollier in 1859 showed that bone is regenerated from the periosteum chiefly and in smaller part from the cellular elements of the marrow and the Haversian canals. McWilliams says over reliance must be placed upon the periosteum.

Lass' experiments emphasize the value of this tissue and Lexer adds the weight of his authority in saying that the bony tissue of a transplant is gradually absorbed and is replaced by bone formed from the periosteum chiefly and from the medulla in part, and that the periosteum also aids in cementing the graft to the wound and in stimulating capillary invasion and early nutrition.

Joko produced new bone in six out of ten cases by injecting emulsion of periosteum of tibiæ of young dogs beneath the skin or into the muscles.

Trinci showed that transplanted periosteum is capable of early bone regeneration.

Tomita states that new growth is from the inner layer of the periosteum and from the marrow cells.

Phemister and Mayer and Wehner confirm the periosteal osteogenesis by very painstaking and thorough experiments. In all of Murphy's published cases the periostum was retained in whole or in part, although he states that the periosteum is not osteogenetic except when it carries osteoblasts on its inner surface.

If we view his entire process of the life and regeneration of a bone graft from the embryonal and histological point of view it seems very simple and reconciles the observations of many experimenters. The position of many of the bones is indicated in the embryo by the deposition of embryonal cartilage. But this cartilage is never directly converted into bone. It is replaced by bone formed from the osteogenetic layer of the periosteum. This layer sends bud-like extensions into the ossified centres, and proceeds to the formation of true bone. The lining of the marrow cavities, in other words the endosteum, the lining of the Haversian canals, and the external covering of the bone, the

osteogenetic layer of the periosteum, are all one and the same thing. They are continuous at least for a time and have been derived from the periosteum. This internal and external lining is a connective tissue and its young cells are only specialized connective tissue cells called osteoblasts. All bone is formed through the agency of these cells. Some of them become imprisoned by the deposition of lime salts and separated from their fellows and they are then called bone cells. These are simply adult imprisoned osteoblasts.

The remaining bones of the skeleton that are not developed in embryonal cartilage are formed directly from the osteogenetic layer of the periosteum.

When the bones of the skeleton have attained their full growth the osteoblasts of the periosteum, the Haversian canals, and the endosteum cease their activity in large part. Piersol states that "after the cessation of peripheral growth and the completion of the investing layer of compact substance, the osteogenetic layer of the periosteum becomes more condensed and less rich in cellular elements, retaining, however, an intimate connection with the last-formed subjacent bone by means of the vascular processes of its tissue, which are in continuity with the marrow-tissue, within the intra-osseous canals.

"In addition to being the most important structure for the nutrition of the bone, on account of the blood-vessels which it supports, *the periosteum responds to demands for the production of new osseous tissue, whether for renewed growth or repair, and again becomes active as a bone forming tissue, its elements assuming the rôle of osteoblasts in imitation of their predecessors.*"

Does not this render the entire matter clear at once? Osteoblasts are present in the internal and external lining of bone and in the canals that partially connect these two linings which are thus essentially one and the same tissue. In adult bones these osteoblasts are reduced in number and are comparatively quiescent, but they are ready to respond to any demand made upon them for renewed growth or repair.

When a piece of bone or a whole bone is transplanted it is all temporarily deprived of its blood supply. But this does not necessarily mean the death of all the elements of the transplant. It would appear that in the transplantation of animal tissues the more highly specialized elements are less resistant to injury or deprivation of nourishment. Probably in bone the adult bone cell is less resistant than the young connective tissue cell, for example. Now as soon as the transplant is placed in its new position a process of re-vascularization commences. Those cells of the transplant which retain life until their source of

nutritive supply is reëstablished naturally can continue their life and function. Such cells probably are those which are the more resistant in themselves and which receive earliest a fresh supply of nutriment. This may reach them from the tissue juices that surround the transplant or from the blood-vessels that are reëstablished in it. The cells of the transplant lying near its surface therefore would have the best opportunity for maintaining life. And the smaller the transplant, the larger is its surface in relation to its mass, and the greater is the chance for the life cells in the transplant. Macewen's observations have confirmed this. Furthermore, the cells lying along the vascular channels would have a better chance than those lying in the lacunæ of the compact bone. And the very tissue that does line the outer and inner surfaces of the bone and the Haversian canals is the osteoblastic tissue, composed of young connective tissue cells, the osteoblasts, which are just waiting for the opportunity to exercise their especial function. The adult bone cells are imprisoned in hard compact bone and are doomed to death in large part. Even if some of them do survive and live for a long time, is it their function to form new bone to take the place of that which dies?

In practically every live bone transplant, therefore, there are osteoblasts, whether in the inner layer of the periosteum which closely lines the bone and sends numerous fingers into all the canals that open on the surface and which cannot be entirely removed by stripping off the periosteum macroscopically, or whether in the endosteum of the medulla, or whether in the Haversian canals, which are simply prolongations of the medulla. Many of these osteoblasts must be favorably situated to receive nutriment, and they stand as good a chance for the preservation of life and function as any transplanted tissues ever can. Therefore Macewen can strip off periosteum in whole or in part and the osteoblasts of the medula and Haversian canals will remain; Cotton and Loder can maintain the prime importance of endosteal proliferation; while Nicholls and Axhausen and many others can secure bone growth from the periosteum alone. But if the graft contains all three portions of osteoblastic tissue, its chances of life and development must surely be multiplied. Therefore McWilliams secures 100 per cent. of successes with the periosteum included, to only 48 per cent. without it. When Mayer and Wehner have rigidly excluded with metal caps the ingrowth of the periosteum on the surface of compact bone they have found no bone regeneration from the bone cells. Such adult bone cells probably are not capable of bone regeneration, they are no longer osteoblastic. But I am not sure that we should yet accept this state-

ment as the final truth in all circumstances. Possibly even adult bone cells may revert to their original function under favorable or exceptional conditions.

And, finally, why need we adopt the metaplasia theory of Baschkirzew and Petrow when we have right at hand in the transplant live young connective tissue cells that have been formed and have for generations been accustomed to do just this one thing, regenerate bone.

McWilliams and Phemister in particular have dwelt upon the importance of an early and effective blood supply to the transplant. And the latter has well presented the importance of Roux's law in determining its ultimate fate. If it is in a position where bone is necessary to the welfare of the organism the transplant will survive and develop to a size necessary to its function. If it is in a useless position it will soon cease its growth and will probably be ultimately absorbed.

CONCLUSIONS

Certain conclusions which are of practical clinical value in surgery are readily drawn from the above experiments and discussion.

(1) Bone is only a particular form of connective tissue and is readily transplantable.

(2) It contains within itself all the elements necessary to its life, function, and regeneration provided it receives sufficient nourishment.

(3) Periosteum, medulla, and bony tissue should all be included in the graft.

(4) After transplantation the bone grows and moulds itself to perform its function efficiently.

(5) As early performance of function as is consistent with its fixation in its new position is of great advantage.

(6) A mild infection is not necessarily fatal to the graft.

(7) Transplantation of long bones with their joint surfaces is clinically possible. The inclusion of cartilage and joint surface in no way adds to the difficulty of the transplantation. While this statement is particularly true of the smaller bones, yet there seems to be no reason why as large a bone may not be transplanted with its joint surfaces as may be transplanted without such surfaces. Bier reports a large piece of tibia used to replace almost the entire shaft of the humerus, which has been under observation for 15 years. If a large bone should be transplanted it might be well to remove a portion of its shaft longitudinally in order to permit the ready access of a blood supply to the medulla.

Goebel reports the successful transplantation of the proximal phalanx of the second toe to replace the proximal phalanx of the fourth finger which was removed for enchondroma. Full motion finally resulted in all the joints of the finger. A piece of cartilage from a rib was used to replace the phalanx of the toe. The X-ray showed that at the time the case was reported the cartilage had not been transformed into bone.

Katzenstein reports the implantation of the phalanx of the great toe to replace the metacarpal bone of the thumb which was removed because of tuberculosis.

Galeazzi transplanted a metatarsal bone for a metacarpal which had been removed for neoplasm. There was good function after seven years.

Sievers also transplanted a phalanx to take the place of the middle phalanx of the ring finger removed for giant-celled sarcoma.

Wolff reports a successful similar case.

Lexer in 1907 transplanted a phalanx obtained from an amputated limb.

(8) Half joints are clinically transplantable. Lexer, Küttner, Rovsing, Wolff, Enderlen, Perthes, von Haberer, Walther, and De Gouvea, have reported successful cases.

(9) Whole joints have been successfully transplanted. Lexer has had under observation for six years a knee-joint in which motion and function are perfectly free and satisfactory, although the joint shows under the X-ray certain changes similar to those found in arthritis deformans.

Goebel and Eloesser have reported each a case of implantation of a toe-joint with unopened capsule to replace a finger-joint. A big difficulty in the transplantation of large joints is in the securing of suitable material. Lexer has discarded material obtained from the cadaver and now uses that obtained from freshly amputated limbs. Buchmann has transplanted the first metatarso-phalangeal articulation into the elbow-joint in two cases.

It has not yet been demonstrated, to my knowledge, that a small entire joint can be substituted for a larger one and grow in size to meet the necessities of the joint. It may be possible that the law of functional adaptation would apply even here.

In conclusion I wish to express my gratitude to Dr. J. E. Sweet for permission to carry out these experiments in the Laboratory of Surgical Research of the University of Pennsylvania and for many helpful suggestions in conducting them.

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Dr. Gwilym G. Davis thought that the question, whether or not the bone transplant is absorbed, is perhaps not of great importance. Some of Albee's work, and the work of others, have shown that if the bone is replaced it is replaced almost absolutely in the size and shape of the original bone as inserted. Therefore, whether it is replaced or not replaced, the effect is the same. Suppose if a person has a fracture in the shaft of a long bone, nobody would say that after healing either fragment had been entirely replaced by a new bone. Suppose a fracture occurs close to the articular end, as in Colles' fracture of the radius, does not the distal fragment live? In an osteotomy for hallux valgus back of the articular surface in which the bone is brought straight, does the head of the bone become absorbed and replaced? He hardly thought so. In one such case he took the head of the bone completely out, put it back, and closed up the wound. Healing occurred and the condition was as satisfactory as in the opposite side in which the head of the bone did not come out. Was the transplanted bone absorbed or not absorbed? Experiences like this are not rare even though one cannot positively explain the process from an academical point of view. The implant seems at least to retain its vitality and live very largely in the shape in which it has been implanted. Some of Albee's specimens are very marked illustrations of that. It seemed to him to be begging the question when one sees some of his transplantations of bone of the spine in which the implant is fused absolutely *in situ* and remains almost exactly as when implanted, to question the process. Of course, when a bone dies the death is more or less *en masse* and such grafts come away as sequestra.

NASAL OSTEOCHONDROMA

Dr. Nathan P. Stauffer presented a man, aged thirty years, who had been operated upon two years ago in the Jefferson Hospital for an obstructive growth in his nose. When first seen he had great pain in nose and was unable to breathe through either nostril.

A large hard mass protruded from the right nostril. It pressed the septum over, occluding right and left nostrils. Postnasally it could be seen extending to the uvula and appeared to be of connective tissue, well supplied with blood-vessels which easily bleed. X-ray report stated that the growth was in or extended into the right maxillary sinus. A tentative diagnosis of sarcoma of the nose was made and immediate operation advised. Operation refused and postponed on account of his wanting to keep a newly acquired job.

September 15, 1914, four months later, he returned with more pain in his nose and severe darting headaches and diminishing vision. Externally nasal bones were pushed out and the face much swollen. He was sent to the Presbyterian Hospital for operation, where on the following day he was anæsthetized by the Meltzer intratracheal method. The tracheal tube was lightly packed into the pharynx with two long strips of gauze to prevent inhalation of any blood *via* postnares and mouth, hæmostats were attached to these to keep them in place; the lips being elevated by a retractor, a labiogingival incision made, and the mucosa elevated to the inferior nares. He then cut through the inferior nasal mucosa from below and retracted the tissues but could not get around the growth. The incision was then enlarged by chiselling through the lower portion of the pyriform opening. The tumor was found apparently attached to the anterior end of the inferior turbinal bone. With the scissors this was severed and a large piece shelled out with a broad curette. The growth extended posteriorly, and piece by piece it was dissected from the mucosa of the right side. A large perforation was found in the septum and the growth filled the entire left naris, partially eroding the left maxillary antral wall. Finally with a finger in the postnares the rest of the mass was easily dislodged. Dr. Speese with the electric needle cauterized the inferior nares where it had been attached and the nose was irrigated with bichloride and packed with iodoform gauze. The labiogingival wound was stitched with catgut and the intratracheal apparatus and postnasal gauze were removed, as the anterior nasal packing was considered capable of controlling hemorrhage. His only bleeding came from the labiogingival wound, which was readily controlled by packing with a strip of one inch gauze. The subsequent convalescence presented no serious complication and he returned home at the end of two weeks. The pathologist reported the growth to be an osteochondroma.

Two months and a half later, December 12, 1914, renewed examination revealed a growth springing from the middle third of the inferior turbinal, possibly with a base in the maxillary antrum.

The operation succeeded in giving him good breathing space day and night, relieved his headaches, increased his vision and relieved his embarrassment while eating.

The question of recurrence is to be determined but the growth can be removed more readily now that it can be seen when first starting and as it is destructive apparently only by pressure this can be prevented by operating. The only other report of a case of nasal osteochondroma that he could find is by Dr. Robert Myles in the *Laryngoscope*, page 305, and is interesting in that he had to ligate the external carotid artery to control the hemorrhage.

CYSTADENOMA OF THE PANCREAS WITH EXTENSION TO THE ABDOMINAL WALL TEN YEARS AFTER DRAINAGE OF A PANCREATIC CYST

Dr. John J. Speese reported the history of a woman aged forty-nine years, who was first admitted to the Presbyterian Hospital in 1904, where she was operated upon by Dr. Duer for a large cyst of the pancreas.

The cyst wall was so adherent to the omentum and intestines, and the condition of the patient such that prolongation of the operation for the purposes of exploration was not warranted. The neck of the cyst was accordingly sutured to the abdominal wound and a considerable portion excised. The patient made an uninterrupted recovery, the sinus healing completely at the end of two months. Examination of the cyst contents showed pancreatic ferments; the histological examination of the cyst wall revealed fibrous tissue and no lining.

The patient was readmitted to Dr. Jopson's service on October 13, 1914, with a tumor of the abdominal wall which began three years ago as a small ulcer in the region of the umbilicus. Recently the growth has been rapid, measuring at present 5 cm. in diameter, and presents an ulcerated red surface, projecting slightly above the surrounding skin (Fig. 3). The edges are hard and indurated, the tumor is friable and bleeds easily, there is an offensive watery discharge which is non-irritative. The umbilicus is apparently involved in the tumor mass.

The growth was regarded as a primary carcinoma probably originating in the umbilicus, and was removed by a circular incision. The base of the tumor, however, was found to be attached to the abdominal organs by a definite pedicle, and on opening the abdomen, multiple

small cysts were found, the small intestine and the transverse colon were so firmly adherent that it was impossible to explore the region of the pancreas or to do any form of radical operation other than removal of the superficial tumor from its pedicle. The wound was closed as in the Mayo operation for umbilical hernia, and a small drain inserted down to the stump of the pedicle. The patient made a slow convalescence, the sinuses gradually closing, but draining a small quantity of fluid when last seen, February 1, 1915.

The examination of the patient's stools showed no abnormality in digestion. The urine contained small amounts of albumen but no sugar. The quantity of fluid in the cysts removed with the tumor was too small to examine for ferments.

Pathological Examination.—The specimen consists of a tumor which is entirely surrounded by an intact area of skin. The mass projects 1 cm. above the level of the skin, is round in shape and measures 5 cm. in diameter and 3 cm. in thickness. The tumor is bright red in color, the surface presenting small areas of ulceration, and at its lower pole is partially covered with skin to which it is firmly attached, while at the upper margin there is a distinct furrow between the tumor and the skin. The base of the tumor contains a smooth glistening membrane (peritoneum) to which several masses resembling omentum are attached. A cross section shows that the mass is composed of tissue which is white in color, dense in consistency and contains numerous cysts varying in size from a pinhead to cavities 1 cm. in diameter. The cysts contain a colorless mucilaginous fluid, the walls are smooth in appearance.

On microscopic examination the sections show a process consisting of a dense connective tissue stroma in which are embedded glandular elements presenting various stages of activity. For the most part the acini are fairly large and present a very moderate degree of dilatation. In these acini and in the smaller cysts the lining is composed of high cylindrical epithelium containing many goblet cells, and the cysts are filled with a blue mucoid material containing desquamated cells. In many of the cysts the epithelium is greatly compressed and is flattened in appearance; in others it is thrown into folds by reason of fibrous ingrowth so that many minute papillary processes are present. Toward the superficial portion of the tumor the cystic nature is less marked and the acini more numerous. The slightly dilated glands are found immediately beneath the skin surface, the squamous lining of the latter has become broken and in some places is in direct apposition with the cells of the acini. In this area the stroma contains a round-cell infiltration and traces of blood pigment. Many blood-vessels are found in the stroma, but no evidence of normal pancreatic tissue can be found anywhere.

The diagnosis of a *proliferating cystadenoma of the pancreas* with extension to the abdominal wall at the point of drainage ten years previously, is based upon several factors. There can be little doubt concerning the original diagnosis of pancreatic cyst as ferments were found in the fluid. The findings at the second operation coincide with the picture frequently met with in such cases, and the histologic examination points to the same conclusions.

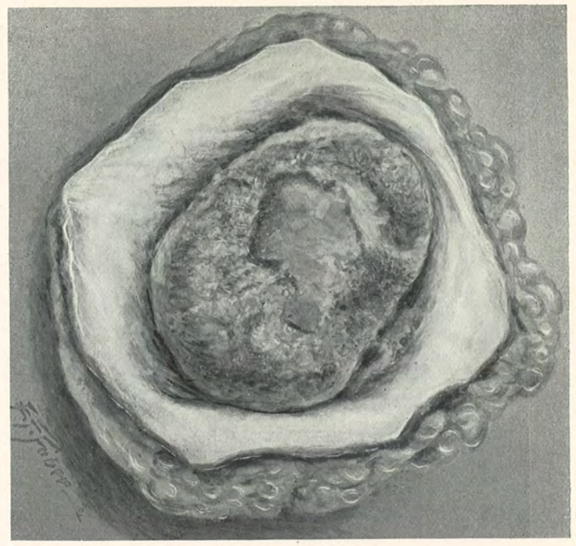

FIG. 3.—Cystadenoma of pancreas extending to abdominal wall.

FIG. 4.—Cyst of median nerve.

Of the many interesting facts brought out by a study of the case, emphasis can be made upon the very benign and comparatively mild course of the new growth, a fact noted by all writers on this subject. It would seem that drainage of the large cyst retarded further growth for many years, and doubtless many more would have elapsed without trouble if extension of the process had not been favored by the attachment of the large cyst to the abdominal wall. It is also noteworthy that sugar was not present in the urine during either stay in the hospital and that the growth had little or no effect upon the general health or nutrition of the patient.

CYST OF THE MEDIAN NERVE

Dr. Speese also related the history of a woman, aged sixty years, who struck her forearm two years ago in falling. She experienced very little pain from the injury, but noted shortly afterward that there was a distinct swelling above the wrist, and that this gradually enlarged but caused no discomfort. Three weeks ago she felt a sudden sharp pain in the forefinger, the pain radiating to the elbow. The severity of the pain has increased, becoming constant, at times interfering with sleep, and is unrelieved by any local or general measure. The patient asserts that the pain never arises in the tumor itself, always in the forefinger, radiates upward, and rarely is localized to the swelling in the wrist. She is able to use the fingers although motion causes some pain; there is no loss of sensation or atrophy of the hand. On examining the swelling, pain was caused by pressure over the tumor, which was oval in shape, three inches above the wrist and in the line of the median nerve. There is no pulsation, the enlargement presented the characteristics of a cystic formation.

The tumor was exposed under local anæsthesia, the slightest manipulation causing great pain until the median nerve was blocked by an injection of cocaine solution. The nerve above and below the cyst was exposed, at the upper pole the nerve fibres divided and many could be traced running over the external surface of the cyst from which they were dissected. The patient, a sufferer from a severe form of cardiac disease, insisted that the operation should afford permanent relief from pain and that she felt unable to undergo another operation. It was therefore necessary to divide the remaining fibres, and thus remove the cyst. The loss of nerve tissue was too great to approximate the cut ends, although there were several fibres uniting the nerve.

The patient was entirely relieved of the pain, the nerve fibres which were preserved evidently supplied the thumb, for sensation partially persists here, but sensation and motion are lost in the second and third fingers.

Pathological Examination.—Specimen consists of a round cystic tumor measuring 3.5 by 3 cm. The wall of the cyst is 4 mm. in thickness, is white and fibrous in consistency. At one pole of the cyst a section of nerve is seen from which small fibrils radiate and spread out over the external surface of the cyst. The cyst is filled with a blood-tinged fluid, its wall is smooth and contains traces of brownish pigment.

On microscopic examination the cyst wall is composed of two layers, the outer consisting of bundles of hyaline fibrous connective tissue containing comparatively few cells and a few blood-vessels. The inner portion or that which corresponds to the lining of the cyst is composed of a very cellular tissue, many new blood-vessels, a small amount of fibrous tissue and traces of blood pigment. The appearance resembles granulation tissue. Sections stained by Weigert's method do not reveal any nerve tissue in the inner portion of the cyst wall, but show remnants of nerve fibres attached to the external coat. The nerves are surrounded by a considerable amount of fibrous tissue and are the seat of degenerative changes.

The diagnosis of a blood cyst in the substance of the median nerve can be made from the above findings. This condition seems exceedingly uncommon as no mention of it is made in numerous text-books. It was unfortunate that the relief of pain was the chief indication for operation, as preservation of sensation and motion might have been maintained by less radical measures.

STATED MEETING, HELD MARCH 1, 1915

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

SPLENECTOMY FOR GUNSHOT WOUND

Dr. Thomas F. Mullen (by invitation) presented a colored man, twenty-eight years of age, who was brought to the Pennsylvania Hospital at midnight of January 6, 1915, one-half hour after having received a shot wound from a thirty-eight calibre revolver, in the hands of a man standing a few feet distant. The point of entrance was in the left mid-axillary line on a level with the tenth rib, which was comminuted. The patient was in profound shock, temperature 96°, pulse 160, respiration 48; the abdomen was diffusely tender and rigidity was marked, especially on the left side. On percussion, there was shifting dulness in both flanks. The abdomen was opened, beginning twenty minutes after admission; incision was made at the margin of the left rectus, and later enlarged by dividing the muscles transversely to the left, for a distance of three inches. Upon opening the peritoneum, there was a gush of dark fluid blood which, after packing off the intestine, was seen to be flowing from the region of the spleen. The spleen was grasped and lifted into the wound. It was found that the bullet had passed through the upper pole of the spleen, downward and backward, severing the vessels of the pedicle, which was clamped and ligated *en masse,* with catgut. Gauze drainage was instituted and the wound was hurriedly closed, as there was no apparent injury to any other structure. At the close of the operation, the pulse was imperceptible and twenty ounces of normal salt solution were given intravenously. The patient reacted quietly and vomited once during the following day. The drains were removed on the fourth day and the wound appeared to be clean. From this point his convalescence was uneventful, with the exception of a severe chill which occurred on the twenty-sixth day after operation, and was repeated on the twenty-eighth and thirtieth days. An examination of the blood at this time revealed, in fresh and stained specimens, many malarial organisms of the tertian type, and the symptoms promptly disappeared after the use of quinine. On the third day after operation, examination of the blood showed 48 per cent. hæmoglobin, 2,430,000 erythrocytes, 15,000

leucocytes; on the eighth day, 50 per cent. hæmoglobin, 3,160,000 erythrocytes, 20,000 leucocytes; on the sixteenth day, 50 per cent. hæmoglobin, 3,230,000 erythrocytes, 22,000 leucocytes; on the twenty-fifth day, 53 per cent. hæmoglobin, 3,928,000 erythrocytes, 15,000 leucocytes; on the thirty-fifth day, 70 per cent. hæmoglobin, 4,000,000 erythrocytes, 15,200 leucocytes. The erythrocytes were normal in size and shape. Skiagraph showed the bullet lodged just anterior to the transverse process of the first lumbar vertebra on the left. Patient was discharged on the thirty-fifth day after operation as cured. Since his discharge he has been working at his usual occupation and appears to be perfectly normal.

RUPTURE OF THE BICEPS MUSCLE

Dr. Gwilym G. Davis presented a man who ruptured the long head of his left biceps muscle, approximately seven weeks ago, in lifting a bag of coffee weighing 130 pounds. The man says he had pain in the shoulder before he injured it, although there is no other distinct history of rheumatism. He had the typical swelling below. An incision was made along the edge of the pectoralis major; the long head, which was ruptured clear up into the joint, was pulled down, and brought over to the short head of the biceps muscle, which is attached to the coracoid process. Chromic catgut was used for the suture. The wound healed nicely. He now flexes and extends his arm perfectly. The operation presents no especial difficulty, except that it is rather hard to draw back the pectoralis major muscle sufficiently to get a good exposure. This was the second case in which Dr. Davis had operated.

Dr. John H. Jopson said that he had recently seen a case of this injury with a most unusual history. The man was a railroad engineer who in July, 1913, slipped in getting out of a boat and fell a short distance, striking his shoulder against the edge of a railroad tie. The injury was followed by some ecchymosis but there was no marked trouble with the arm for some time. It was not until months later that he suffered much pain, and when he did go to a hospital, more than a year after the injury, he was told that he had a rupture of the biceps muscle. Meanwhile he had been working steadily at his occupation as an engineer. He was operated upon by Dr. Gibbon but he still presents some of the characteristics of rupture of the biceps, in the way of bunching up of the belly of that muscle and on flexion of the forearm, and he complains of pain and disability in his arm with tenderness, just below the acromion process, between it and the head of the humerus.

Dr. John H. Gibbon said that he recalled very well the case referred to by Dr. Jopson and particularly the history of the man. It illustrated the point remarked upon by Dr. Alexander in the paper which he read before the Academy, that the history of not knowing that the rupture had occurred was not an unusual one. Some of the men in Dr. Alexander's series apparently did not know that they had ruptured their biceps and had gone ahead with their work, and the correct diagnosis was not made for some months afterward. In the case which he operated upon he sutured the ruptured tendon to the other tendon. The man had excessive blistering from iodine on the inner side of his arm, and from these infected blisters the wound became infected, so that they did not get a very good result. Some time after healing of the wound he developed much pain in the region of the deltoid. He had been at a loss to understand why he should have had it. It was thought that possibly a nerve was involved but there was no atrophy of the deltoid. The man was asked particularly whether he had this pain in the shoulder before his operation and he stated distinctly that he had not.

THE BONE GRAFT PEG IN THE TREATMENT OF FRACTURES OF NECK OF FEMUR*

AUTHOR'S TECHNIC

By Fred H. Albee, M.D., F.A.C.S.
of New York

Fracture of the neck of the femur is by all means the most disabling of all types of fractures. These fractures were formerly regarded as occurring mainly in old age. Recent personal statistics, as well as those of other surgeons who have large fracture clinics, show a large number of fractures of the femoral neck occurring in individuals below the age of forty-five or fifty. Senile osteoporosis, associated with thinning of the cortex and absorption of many of the lamellæ of the spongiosa of the neck, is the chief cause of the increased frequency of this fracture in the aged, and, as would be expected, traumata of much less severity cause fracture in the aged more frequently than in younger individuals.

There seems to be no object, so far as treatment or prognosis is concerned, in classifying these fractures further than the single term, "fracture of the neck." The terms intracapsular and extracapsular are inaccurate and misleading. The capsular insertion to the neck of the femur is oblique, thus causing the joint to include more of the neck on its anterior and inferior surfaces than on the posterior and superior. Then, again, most fractures are oblique and diagonal, and are only infrequently strictly transverse. If any classification is used, that of Stimson is by all means the preferable one, *i.e.*, subcapital, or fracture through the neck, and fracture at the base of the neck. A fracture is apt to occur in one of these two places, either at the junction of neck with head, or with the trochanter. The associated outward rotation in epiphyseal separation or fracture occurs as frequently and is often more pronounced than in fractures of the neck, which fact cannot be explained by the more fragile posterior portion of the neck. The predominance of the external rotators, especially the short trochanteric muscles, is believed to be the more tenable explanation. Shortening depends upon the lessening of the angle between the femoral neck and the shaft or a sliding by of the fragments.

* Read before the Philadelphia Academy of Surgery, March 1, 1915.

TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR

In speaking of the poor results obtained in treatment of fractures of the femoral neck by the conventional methods, an authority states: "At first one can hardly appreciate how startling these results are unless he has carefully studied various series of statistics; and wherever the usually accepted principles of practice are employed, the long side-splints with Buck's extension, there the average results are uniformly unsatisfactory."

Of value in this connection are the conditions existing in 16 cases of fracture of the limb observed by Scudder many years after the accidents. "In only 2 cases, or 12 per cent., could it be said that the leg was functionally useful."

Walker studied the records of 112 cases of fracture of the neck of the femur treated in Bellevue Hospital between 1906 and 1907. Only 15 cases, or 13 per cent., recovered good function.

The British Fracture Committee tabulated 91 cases, in which 87 of the patients were over fifteen years of age. Only 20 of the adults, or 23 per cent., recovered good function.

Unquestionably Whitman's abduction method offers better results than the foregoing. Certain men, however, have not obtained the favorable results secured by Whitman.

Cotton offers the following objections to this treatment: "First, many men are inclined to doubt the locking of the upper fragment at the limit of abduction, believing rather that tension on the abductor muscles gives the limit of abduction; second, there is real danger that in less expert hands the fragments may be forced by one another, not jammed together; third, plaster spicas in stout patients do not hold abduction firmly."

At best, fracture of the neck of the femur is one of the most difficult problems in all surgery. The anatomico-mechanical conditions, the poor blood supply, the sluggish osteogenesis, and the difficulty of fixation are all potent adverse influences to securing satisfactory union and good functional results, and it is believed that if ever radical measures are justifiable they are indicated in the treatment of this desperate condition. Realizing this, certain surgeons have employed the metal spikes to assure better approximation and fixation than could be obtained by non-operative measures. This method has not given uniformly good results because of the failure of sufficient callus formation.

An illustrative personal case was that of a woman thirty years of age, suffering from a fracture of the neck of the femur ununited after eight weeks. There was no destruction of the fragments from friction, nor was there any systemic disease to inhibit callus formation. It was a favorable case, and a tin-plated square steel spike, three and a half inches long, was driven into good position longitudinally through the centre of both fragments of the neck, which were in excellent apposition. The convalescence was uneventful. The wound healed by primary union, and at no time was there a temperature above half a degree, after the day following the operation. The operation, however, resulted in failure, and non-union occurred. Fig. 8 is a skiagram taken four months after the operation, showing that the spike, owing to its own weight and some destroying influence, had dropped through the lower portion of the capital fragment and no longer engaged it. The metal spike had not only destroyed bone, but it had inhibited callus formation in a region where osteogenesis is at a low grade, to such a degree that it prevented union or, at any rate, was a contributing cause to non-union.

To avoid the disadvantages of metal the author began, in 1912, to use a bone graft peg as a substitute for the metal spike. (For report, see author's report in *Murphy's Clinics,* June, 1913.) If these bone pegs are placed in the cervical fragments by the technic described elsewhere, an equally satisfactory amount of internal fixation is furnished at the same time that the disadvantages of a metallic foreign body are avoided, and the advantages of a living bone graft gained.

A strong autogenous bone peg, accurately fitted into a hole drilled longitudinally through the neck of the femur, with the fragments in good position, offers unquestionably the most ideal condition for the rapid and satisfactory union, in good position, of this difficult fracture. In other words, the influences adverse to union, enumerated elsewhere, are better overcome by this procedure than by any other treatment; also every argument for the autogenous inlay graft in ununited and selected fresh fractures of shafts of long bones holds equally in fractures of the neck of the femur.

Soft tissues are removed, if present, from between the ends of fragments; the fragment ends are secured in good apposition; callus formation is stimulated by the presence of the graft at the same time that the graft produces bone growth itself; and an osteogenetic bridge, capable of conducting both blood-vessels and bone-cells from one fragment to the other, is furnished.

Indications for Bone Graft Peg in Fracture of Neck of Femur.—This operation is believed to be indicated in all ununited fractures of the neck of the femur; in most unimpacted fresh fractures in oper-

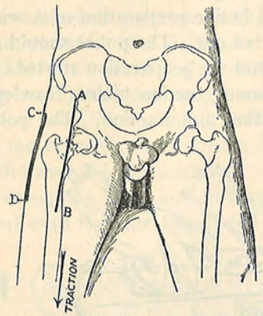

FIG. 1.—Drawing representing patient on Hawley traction table. *A B* and *C D* are skin incisions.

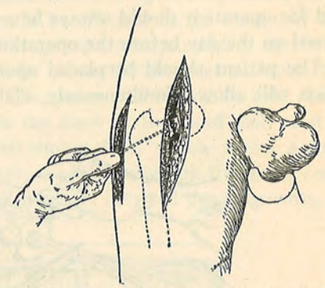

FIG. 2.—Drawing to illustrate author's method of determining with small hand drill the proper situation and direction for the motor drill. This hand drill is withdrawn as the motor drill is inserted (see Fig. 3).

able subjects under fifty years of age; in all old fractures of the neck or at the epiphyseal cartilage where malunion has resulted, with the neck depressed in a coxa vara relationship with the shaft. The bony

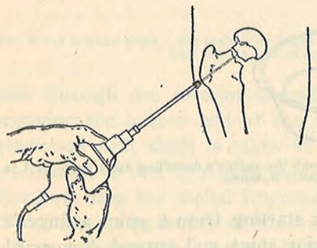

FIG. 3.—Insertion of motor drill.

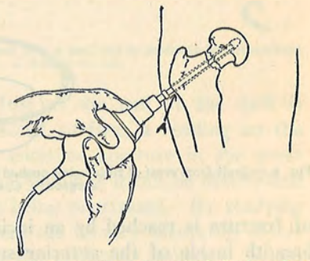

FIG. 4.—When the end of the burr has reached the space between the fragments and is ready to enter the capital fragment, a reading on the graduated shaft of the burr is taken at *A*, one is then able to tell just how far the burr should penetrate this fragment.

deformity is corrected by either a cuneiform or linear osteotomy, and placing the limb in full physiological abduction (Whitman). After the operative correction of these two latter conditions by the usual

cuneiform osteotomy, Hitzrot states that weight-bearing should be prohibited for at least a year. The employment of the bone graft peg reduces this time by at least six months.

Technic of the Author's Bone Graft Peg Operation for Fracture of the Neck of Femur.—A most careful iodine preparation of a wide field for operation should always be carried out. The pubes should be shaved on the day before the operation and the preparation started.

The patient should be placed upon some traction table (Hawley) which will allow, simultaneously, abduction and traction. The point

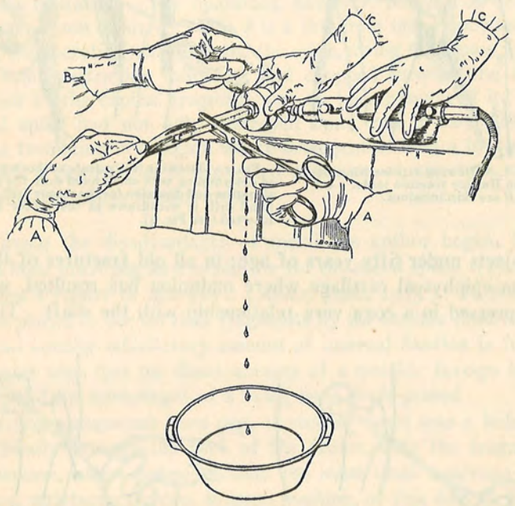

FIG. 5.—Graft from crest of tibia being pushed through the author's dowelling apparatus. *A A* is surgeon; *C C*, assistant; *B*, nurse.

of fracture is reached by an incision starting from a point a finger's breadth inside of the anterior superior spine and curved downward three to five inches along the inner border of the sartorius. The inner border of the muscle is exposed and retracted outward. The tendon of the rectus femoris is also exposed and retracted outward. The iliopsoas muscle is next exposed and retracted inward. The point of fracture is exposed and all soft tissue is cleared from between the fractured ends, which are curetted and freshened.

The limb is now placed in abduction and sufficient traction applied

to bring the fragments into good apposition as determined by both sight and palpation through the anterior wound. An incision two to three inches long is then made over and just below the great trochanter, which is exposed. With a small hand drill, the proper direction for the motor drill is determined by trial, as shown by observation through both wounds. The drill hole should be situated in the centre of the neck of both distal and proximal fragments, and parallel to the neck. The small hand drill may have to be reinserted in order to locate the proper tract for the motor drill. The motor drill should be held ready by the operator for insertion into the tract of the hand drill as it is withdrawn by the assistant. The motor drill, which forms a hole three-eighths of an inch in diameter, is pushed through the distal fragment until the burr end of the drill appears between the fragments, as

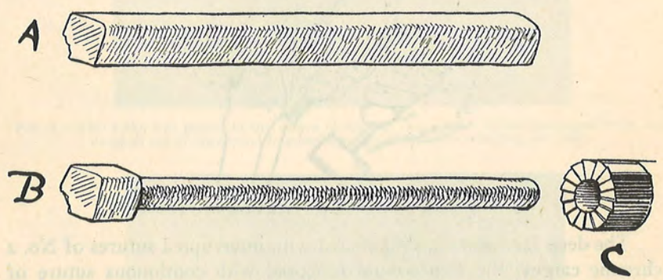

FIG. 6.—*A* is tibial graft. *B* is graft after being shaped into a peg, and is ready to be driven into burr hole in neck of femur. *C* is lathe cutter.

seen through the anterior wound. Just as the end of the drill is engaging the broken end of the proximal surface, a reading on the graduated drill shaft is taken at its entrance aperture in the great trochanter, so that by making additional readings it can be determined just how deep the capital fragment is being penetrated. By studying the skiagram, the length of this fragment can be very accurately determined, and hence the desired depth of the drill-hole obtained. When the fracture has occurred near the head and the proximal fragment is consequently short, the drill-hole should extend close to the articular cartilage of the head.

The drill is disengaged from the motor and left in place, to avoid any possible displacement of the fragments while the tibial graft is being procured.

The crest of the lower portion of the tibia is laid bare, and an area

of the desired size and shape is mapped out in the periosteum with a scalpel. The desired length of graft can be determined by the graduated scale on the motor drill. The cross-section of the graft should be just large enough to be shaped into the peg when the dowel shaper is used.

When the graft peg is ready, the drill is withdrawn from the femur and the peg inserted. The fit must be accurate because the dowel cutter is the counterpart of the drill used. This accuracy of fit is very important. Too tight a fit is undesirable because a pressure anæmia of the surrounding cancellous bone would be produced. Too loose a fit, or an irregular, inaccurate fit, would not produce good fixation or favor an immediate bony union of graft to the host fragments.

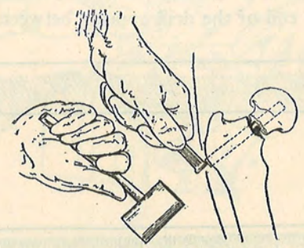

FIG. 7.—Drawing representing graft peg being driven home.

The deep fasciæ are approximated with interrupted sutures of No. 2 chromic catgut; the skin wound is closed with continuous suture of No. 1 chromic catgut.

The limb is put up in abduction (Whitman's position) in a plaster-of-Paris spica extending from the toes to the axilla. Three weeks after the operation, windows are cut in the plaster, and the wounds dressed. The dressing should be replaced with cotton for the purpose of restoring the tension of the plaster splint and retaining the fixation. The long spica should be continued for six weeks and followed by a short one for six weeks longer.

DR. JOHN H. JOPSON said a word in defence of silver wire in certain locations. He had used it in fractures of the patella and of the olecranon for years, and had never had occasion to take it out of either of these locations, and had never seen it give any trouble. He had never seen it break unless there had been a re-fracture of the part. It may be, as has been long taught, that the chemical action about silver in the tissues is different from that of other metals. When

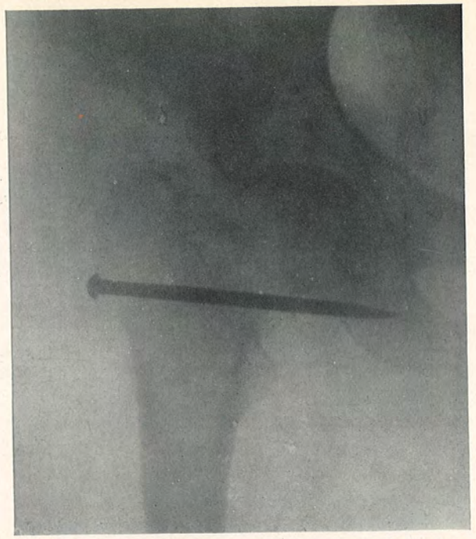

FIG. 8.—This spike was placed in the centre of head at operation. It has destroyed bone and dropped out of the capital fragment entirely, non-union resulting (see text).

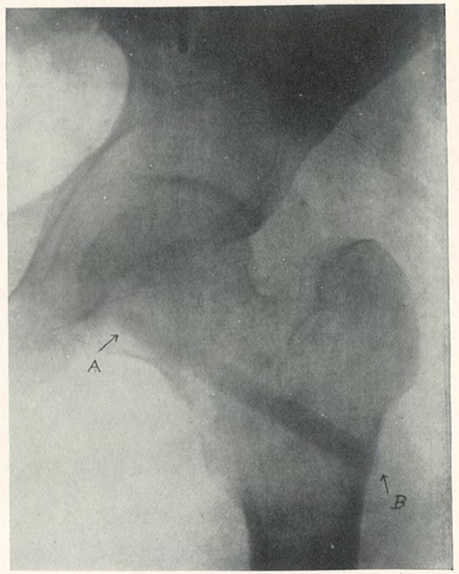

FIG. 9.—*A B* is bone graft peg three months after insertion. Firm bony union resulted immediately. It has been six months since operation and the union is firm. The graft was placed lower than it was intended, but did not interfere with the result.

silver plates have been used and required removal subsequently, it is often found that it was the plated or steel screws rather than the silver plate itself that caused the trouble. In the case of one young woman upon whom he had operated for ununited fracture of the tibia and from whom he had to remove the plate years afterward, it was found that the abscess had originated around the screws, which were rusted. The silver plate had caused no irritation. It was firmly embedded in the tibia, which had to be chiselled away before it could be taken out, after removal of the screws.

Dr. William L. Rodman said that he had had very excellent results with silver wire in fracture of the patella and elsewhere. One case operated upon fifteen years ago is still in good condition. He had also had good results in the use of plates, particularly the plate of Dr. Estes, of Bethlehem. But he believed that plates of all descriptions were for the exceptional, not the average, case and that the very frequent use of plates now in vogue was hardly necessary. In many cases the plates do harm.

Dr. Charles F. Nassau said that he had used silver wire in fractured patellas for many years without being obliged to remove it because of any trouble for which it was responsible. He believed that silver wire in the tissues is harmless. It may be recalled that for a time abdominal incisions were closed with silver wire; in fact, during the first seven years of his operative work in Philadelphia, he closed every abdominal incision with silver wire—even after operations on such cases as pus-tubes—and was obliged in two cases only to remove the wire. This is not a large percentage in seven years. In one of these cases, three of the six sutures were removed, and in the other case, all the sutures had to be removed because the resident had introduced a probe into the wound within 48 hours after operation. He did not recall, at this moment, ever having removed a silver wire after operation upon a simple fracture. In compound fractures, of course, subsequent removal of the wire is frequently necessary.

Dr. Penn G. Skillern, Jr., recalled the classic comparison between bone and the soft tissues. Bone, after all, is nothing but soft tissue plus earthy salts, and one should deal with it as such. One would not deliberately put metal into soft tissue; rather, remove it when accidentally introduced: why, then, should surgeons put metal into bone? Bone, being living tissue, tries to throw the metal off as a foreign body. One sees this in the plating of fractures. With the plate *in situ* at operation, the fragments are firmly held together, but later, before callus formation has progressed very far, osteoporosis

around the screws causes them to loosen, with consequent shifting of the plate. Those plates that remain *in situ* for several years are merely exceptions to the rule. It is most illogical to put metal into bone, and he foresaw that Dr. Albee's bonegraft inlay and peg methods had sounded the knell of all metal fixtures.

Continuing the comparison between bone and soft tissues, take, for example, a nerve that has been divided for some time. There are bulbs of scar-tissue at the ends. The ends are perfectly contacted, but one never gets union. Why? Because the nerve-fibres cannot penetrate the barrier of scar-tissue. When, on the other hand, the bulbous scarred ends are removed until the brush-like ends of the fibrillæ stand out, and the freshened ends are *accurately* contacted, regeneration occurs, and the nerve resumes its property of conduction. The same state of affairs is met with in an old, ununited fracture. The ends of the fragments are sclerosed (scar-tissue), and with the plate we get contact without union, for the same reason, unless the ends be resected. By the bonegraft inlay method of Albee, on the other hand, healthy bone spans the sclerosed area, and assures union by its osteogenetic, as well as osteoconductive, properties.

Dr. Albee, in closing, said that he had seen silver wire break in several instances in fracture of the patella, in one case coming through the skin. Silver wire in ununited fractures is most untrustworthy. Fixation is a secondary consideration. Something is required to span the sclerosed bone and complete the contact with healthy bone beyond the point of fracture, something that will not only supply bone callus but that will stimulate osteogenesis, and this the bone graft does. He was equally certain that in relatively large grafts a varying part of the central portion acts as a scaffold for migrating bone-cells from the fragments. The reconstruction of the graft is a physiological affair. Regarding extrusion of the graft, there was one case where the graft was applied to the jaw, and the wound connected with the oral cavity, in which practically all the graft came out. In only two in 400 cases has the whole graft been extruded. He had had in several cases little slivers come out. The whole graft has been laid bare by an infected wound and has become covered up with granulations; perhaps little shells have come off, but the graft has served its purpose. It is a most trustworthy surgical agent and of an entirely different class from metal. It has a definite resistance to infection. He had had no experience in the use of the graft in jaw fractures. Some of his cases of fracture of the neck of the femur had been of long duration (*i.e.*, up to two and one-half years).

STATED MEETING, APRIL 5, 1915

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

GYNÆCOMASTIA

Dr. Nathaniel Ginsburg presented a man, nineteen years of age, in whom for six months the left breast has slowly and steadily increased in size without evidence of pain, and at present presents the appearance of a young female breast about puberty or a little later (Fig. 1). There is prominence of the nipple and distinct mammary tissue hypertrophy, with an areola of pigmentation about the nipple which is more marked than present on the right side. There is no record of antecedent injury, unless his occupation (a shoemaker) has predisposed him to occupational traumatism to this region. The breast tumor is a diffuse, somewhat circumscribed, enlargement, corresponding anatomically to the normal young adult breast outlines. There is no fixation or retraction of the nipple. There is no mammary secretion and no enlargement of the axillary lymph-nodes. Dr. John Speese (Annals of Surgery, April, 1912) regards this type of benign tumor in the young male breast as an adenofibroma and I am in agreement with his views, believing this case will histologically conform to that type of tumor. I do not believe this case in its inception could have been termed "Adolescent Mastitis" unless this is synonymous with adenofibroma.

Dr. John H. Gibbon (Transactions of the Philadelphia Academy of Surgery, April, 1912) reported the case of a young man twenty-one years of age, also a shoemaker, upon whom he had operated; and examination of whose tumor showed it to be an adenofibroma of the breast.

This is an unusual and rare breast tumor in the male, and since it is steadily increasing in size, with a view of removing the malignant potentiality present, I have advised and shall perform a plastic resection with preservation of the nipple.

Note.—Plastic resection of the breast and histological examination showed the breast enlargement to be a case of gynæcomastia.

Dr. Penn G. Skillern, Jr., disagreed with Dr. Ginsburg in his diagnosis of neoplasm, and regarded it as a case of unilateral gynæcomastia, or physiological metamorphosis of the male breast into the

female type, of which there are now about one hundred and ten cases on record. In support of this view, he related the history of the following case, which was seen by him in the Surgical Out-patient Department of the University Hospital (Case-record 39964), March 4, 1914, and reported, together with a photograph, in *International Clinics,* 1914, 24th series, vol. ii, p. 238.

A white male, aged nineteen years, single, student, stated that for the past two years he has noticed a gradual enlargement of the left breast, and that as the result of conversation with some medical students he feared he was getting a cancer. Examination revealed no neoplasm, but a well-developed left breast, corresponding to that of a sixteen-year-old girl. The right breast, the genitalia, and the sexual instincts were wholly masculine. Chiefly for cosmetic reasons, but also to anticipate the malignant degenerations to which anomalous structures are notoriously liable, a plastic operation was performed a year later.

Gynæcomastia may be bilateral or unilateral, and when one breast alone is involved, it is more often the left. Many cases are associated with anomalies of other portions of the reproductive apparatus, such as hypospadias, absence of pubic hair, etc. At times there is a familial predisposition. It might be expected that such an anomaly would show degenerative changes, such as increase in the amount of fibrous tissue, and atypical architecture of the mammary tissue itself. These changes, however, must be considered as part and parcel of this condition, and, *per se,* do not justify the microscopical diagnosis of neoplasm. A tumor could hardly make a male breast mimic so perfectly a female.

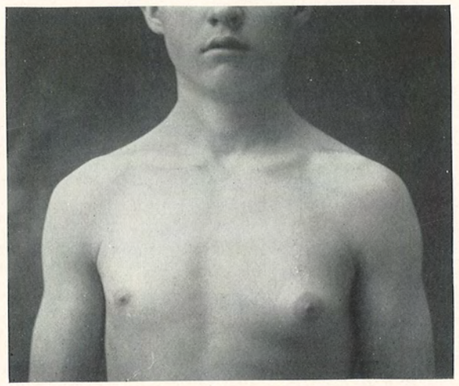

FIG. 1.—Hypertrophy of breast in a young adult male.

ON FRACTURES OF THE SESAMOID BONES OF THE THUMB*

By Penn G. Skillern, Jr., M.D.

of Philadelphia

instructor in anatomy and surgery, university of pennsylvania

The following case represents the fourth example of fracture of a sesamoid bone of the thumb to be recorded in the literature.

E. B., male, white, aged twenty-six years, civil engineer, reported at the Surgical Out-patient Department of the University Hospital (Case record 61996) on March 2, 1915, with the history of having fallen three days previously in such manner that the left thumb was traumatized against the granite Belgian block pavement.

This hand had never been injured previously. Clinical examination revealed moderate swelling of the left thumb, ecchymosis along the thenar eminence, and "wincing" tenderness both at the head and at the base of the first metacarpal. A clinical diagnosis was made of a "chipping" fracture of the metacarpal head. Skiagram (Fig. 1) revealed a fracture of the ulnar sesamoid bone opposite the head of the first metacarpal, the smaller fragment being separated distally, and there being a definite, dentate line of fracture. There was also an oblique fracture at the base of the metacarpal, separating the ulnar corner and entering the carpo-metacarpal joint at its middle. The thumb was immobilized in extension and slight abduction by a spica sodium silicate bandage.

Re-examination after the reading of the skiagram brought out two additional facts. In the first instance, the patient was loose-jointed, and could hyperextend both thumbs normally at the metacarpo-phalangeal joint. In the second place, there was definite "wincing" tenderness, localized to the ulnar sesamoid bone. After four weeks the immobilizing dressing was removed, and massage instituted.

While the clinical diagnosis of "chipping" fracture of the metacarpal head was inaccurate, yet it was close enough to lead to the detection of the fracture of the sesamoid bone. In order to parry the question of a congenitally bipartite sesamoid, a skiagram of the right thumb was taken (Fig. 2), but no abnormality of the sesamoids was revealed. This fact, together with the history of a fall upon the thumb, the clinical localization of "wincing" tenderness to the sesamoid, shown

* Read before the Philadelphia Academy of Surgery, April 5, 1915.

involved by the skiagram, and the dentate line of the fragments in the skiagram contrasted with the smooth line of a bipartite sesamoid, points to a fracture.

The other three cases were found only in the German literature.

The first case was reportd by Preiser, in 1907 (*Aerztl. Sachverstaendigen-zeitung*, 1907, No. 19, S. 400). The patient was a woman, aged thirty years, who had fallen upon the right hand, fracturing both of the sesamoids of the thumb.

The second case was observed by Morian, in 1905, but not reported until two years later, nor published until 1909 (*Deutsch. Zeitschr. f. Chirurg.*, 1909, H. 102, S. 394). The patient was a man, aged twenty-seven years, whose right thumb was caught between a closing door and the jamb. Skiagram revealed a comminuted fracture of the ulnar sesamoid bone.

The third case was presented by Maas, in 1912, in an inaugural dissertation entitled: "Ueber Sesambein-Frakturen" (*Emil Ebering*, Berlin, 1912, 18pp.), which reviews the subject and gives references to the literature, and which is the latest article that could be found at the time of preparation of this paper. The patient was a man, aged fifty-three years, a wheelwright by trade, who was struck upon the left thumb by the end of an unfinished metal tire. The skiagram Maas shows reveals a fracture very similar to that in my case, and involving the ulnar sesamoid bone. In this case the tire was grasped between the thumb and the index finger, resting upon the ulnar sesamoid bone, which was thus directly exposed to trauma. Skiagram of the right hand showed a normal state of the bones.

As to the nature of the violence that produced the injury, whether direct or indirect, it is difficult to decide, for the mechanism of the fall was such that the one could operate as well as the other, and arguments could be brought forth in favor of either form. The absence of comminution of the fragments, and their similarity in the skiagram to fractures produced experimentally by indirect violence, however, lead one to conclude that the latter variety of violence was effective. The three previously reported cases, on the contrary, were due to *direct* violence. But Morian criticises Preiser for rejecting indirect violence as the cause of the fracture in his patient, who, like mine, also fell upon her outstretched thumb.

Experimentally, fractures have been produced by both forms of violence. Preiser obtained results by direct violence, but could produce none by indirect violence. Morian found it easy to procure fractures by direct force, and then made eight attempts to secure fracture by indirect force, in five of which he succeeded. Of these five, in four both bones were broken (compare Preiser's case), while in the fifth the ulnar alone was involved. In all, the line of fracture was transverse or oblique, and a small fragment was separated as often proximally as

FIG. 1.—Fracture of ulnar sesamoid bone of thumb. Fracture of base of first metacarpal bone.

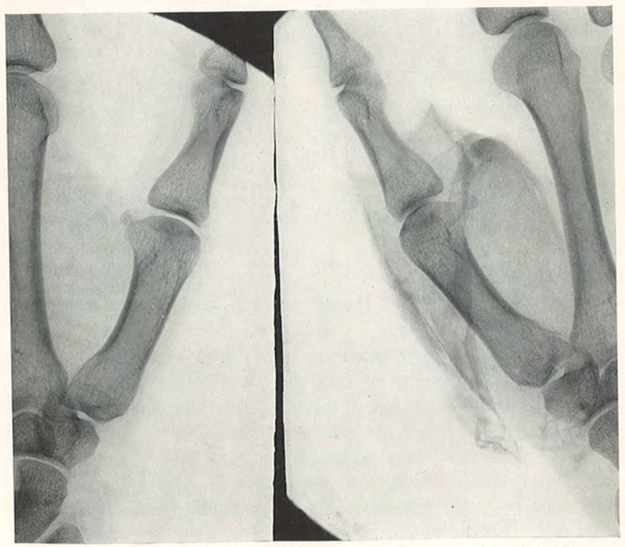

FIG. 2.—Same as Fig. 1. The normal right thumb is shown for comparison.

distally with one exception, a radial sesamoid that was broken through the middle. Clinically, fractures by indirect violence, as obtains in fractures of the patella from a similar cause, are associated with more extensive laceration of the capsule of the joint.

In an attempt to clarify the subject I examined 22 thumbs in the Anatomical Laboratory, some of the results of which are shown in the cuts (Figs. 3 to 9). The first sketch (Fig. 3) shows the normal sesamoids *in situ*. The radial is typically larger and oval, and the ulnar smaller and round, and situated more distally. Both rest upon, or close to, the anterior border of the base of the proximal phalanx.

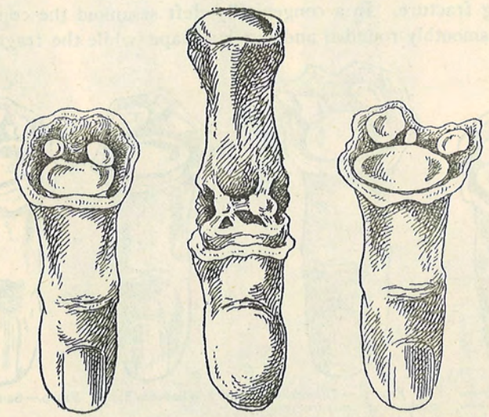

FIG. 3. — Dissection showing normal sesamoids of thumb *in situ*. Radial is large and oval; ulnar is small and round.

FIG. 4. — Dissection showing ligaments connected with sesamoids. One intersesamoid; two radial; three ulnar.

FIG. 5. — Dissection showing bipartite radial sesamoid. Note smooth, even edge.

Both are embedded in the capsule, receive insertions of muscles from the thenar eminence, and form a groove through which passes the long flexor tendon.

The second sketch (Fig. 4) demonstrates what I have been unable to find any description of, namely, definite ligaments connected with the sesamoids, aside from that which binds the two bones together. In this specimen five definite capsular thickenings were found, of which two were associated with the radial, and three with the ulnar, sesamoid. These recall in miniature the picture of the patella with its quadriceps tendon and ligamentum patellæ, and the effect of sudden, forcible hyperextension upon the sesamoids seated upon the border of

the phalanx is fairly comparable with the patella resting upon the trochlea of the femur when subjected to similar strain. Instead of the ligament itself tearing it avulses a shell of bone, as in any other tear fracture.

The third sketch (Fig. 5) shows a congenital division of the radial sesamoid: a similar condition of the same bone was also found by Preiser in his experimental investigations. Morian saw clinically a like state of the ulnar sesamoid in a patient whose daughter had a congenitally-cleft sesamoid of the great toe. But for the following points of differentiation, as emphasized by Stumme, one might be deceived by diagnosing fracture. In a congenitally-cleft sesamoid the components possess a smoothly-rounded and regular shape, while the fragments of

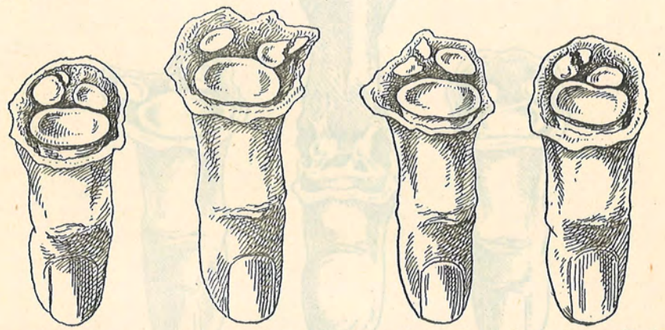

FIG. 6.—Dissection showing tear-fracture of ulnar sesamoid experimentally produced.

FIG. 7.—Dissection showing tear-fracture of radial sesamoid experimentally produced.

FIG. 8.—Same as Fig. 6.

FIG. 9.—Same as Fig. 6

a broken sesamoid show an irregular, dentate edge on the side that corresponds to the line of fracture.

The remaining sketches (Figs. 6, 7, 8 and 9) show a series of tear-fractures. Each specimen was prepared as follows: The thumb was disarticulated at its junction with the carpus. The muscles were removed without disturbing the joints. The metacarpal bone was fixed in a vise, and with a wooden mallet a blow was struck upon the front of the thumb near its tip. Not always did the sesamoid fracture, however. In some cases the phalanx, in others the metacarpal broke into or near the joint. But of the breaks obtained the four shown are fairly typical of what one might expect in the living. In these four cases the ulnar sesamoid yielded three times (Figs. 6, 8 and 9) and the radial once (Fig. 7). In no instance were both sesamoids broken.

FIG. 10.—Hand showing a complete set of ten sesamoids opposite the metacarpal heads. An additional sesamoid is seen opposite the head of the proximal phalanx of the thumb.

The removal of the muscles showed that they play no part in the fracture.

Failure to detect a fractured sesamoid might be regarded as an inconsequential matter, but it must be remembered that the thumb is a very highly-specialized digit, capable of delicate and intricate movements, and that its crippling might be an affair of serious moment to a wage-earner.

The treatment is by immobilization in a neutral position, and for this purpose a sodium silicate dressing, left undisturbed for four weeks, fulfils all indications. It must not be forgotten that the sesamoid, like the scaphoid, is bathed by synovial fluid, and therefore heals slowly.

As to the remaining fingers, the sesamoid bones are inconstant. Citing Pfitzner, Dwight (*Variations in the Bones of the Hands and Feet;* Philadelphia, J. B. Lippincott Company, 1907, p. 11) tabulates the findings in 1440 adult hands as follows:

	I	II	III	IV	V
R.....	99.9	48.7	1.4	0	2.1
U.....	100	0.1	0	0.1	82.5

In his thesis, Maas evidently overlooked this table of Pfitzner's, for he states that the radial sesamoid of the middle finger has never been observed. According to the table, the ulnar sesamoid of the middle finger and the radial sesamoid of the ring finger were not found. I chanced upon a skiagram that shows the complete set of ten, and an additional sesamoid opposite the distal interphalangeal joint of the thumb (Fig. 10). Pfitzner has observed congenital division of the ulnar sesamoid of the little finger, as well as of the radial sesamoid of the index. I have found no instance of fracture of the sesamoid bones of the fingers, but it is quite probable that examples will be reported in the future.

DIPHTHERIAL AND PSEUDODIPHTHERIAL PRIMARY CUTANEOUS INFECTION*

By Arthur E. Billings, M.D.
of Philadelphia, Pa.

We find, after a rather careful review of the literature, that primary cutaneous diphtheria, unassociated with infection of the mucous membrane by the Klebs-Löffler bacillus, is an unusual condition. I also am unable to find any report of case or cases of primary cutaneous diphtheroid infection, or infection due to the pseudodiphtheria bacillus, as proven by animal inoculation. A number of wound and complicated abscess infections of the pseudo-bacillus type have been reported and successfully treated with vaccines by Heath. There is such a close relationship between diphtherial and pseudodiphtherial infections of the mucous membranes, where they have been heretofore compared, that a reference to cutaneous diphtheria must first be made, cutaneous involvement secondary to faucial, nasal, conjunctival, or vaginal diphtheria is seen much more frequently. However, this is not an extremely common condition, as shown by the statistics compiled by Filatow from St. Anne's Hospital, Vienna, from 1894 to 1902, where only 23 cases were seen among 2217 diphtheria patients treated. The infection in this type of cutaneous diphtheria occurring secondarily to mucous membrane infection takes place first by continuity of structure from mucous membrane to skin—as in extension from the nares on to nose and lips, as in vaginal extension to the external genitalia—or, as is occasionally seen in the laryngeal type, with an extension from a tracheotomy wound on to the surface of the neck; and, second, by transplantation of the bacilli to distant parts, the implantation occurring on an abrased surface, a scratch or a blister as in one of the cases reported by Guthrie, who, while suffering from a faucial diphtheria, developed pneumonia, for which he was blistered on the back, and subsequently developed cutaneous diphtheria at the site of the blister. A number of cases illustrating this type have been reported. McCollom states that diphtheritic lesions of stomach and duodenum are occasionally found. Durk, Gunther and Müller have reported intestinal cases, and Schodel has isolated the diphtheria bacillus from the fæces; these findings might explain the few cases of perianal diphtheria on record. The perianal region in infancy or early childhood is frequently the site

*Read before the Philadelphia Academy of Surgery, April 5, 1915.

of excoriations, intertrigo, eczema, etc., which are etiological considerations in the development of such a lesion.

I have found reports of 25 cases of primary cutaneous diphtheria without simultaneous or subsequent mucous membrane involvement, and in order to make clear the clinical appearances with which the infection may clothe itself, it is necessary to recall, in a brief way, portions or extracts of the clinical reports of some of these cases.

Bolton and Schöttmuller report diphtheritic ulcers in groins of two children under two years of age; Bolton's case developed extensive paralysis. Heelis and Jacob make a most interesting report of four cases from the same dormitory of an orphanage, which had been quarantined on account of a case of faucial diphtheria. Two of these patients were suffering from frost-bitten blisters on dorsum of toes, a third from the same condition on her heel; all three developed cutaneous diphtheria at the named locations; the fourth developed a similar lesion on the dorsum of her hand. Hassenstein, Toch, Freymuth, and Petrusky report diphtheritic ulceration of the umbilicus in infants. Fleisch's case was that of an infant, 2½ months old, previously burned, who was kissed by a person suffering from diphtheria of the throat. Patterson's case concerns a young woman with a lesion on her right forefinger, who subsequently developed paralysis of all extremities. Gunther reports a case in a girl, two years old, suffering from an acute phlegmon of the abdominal wall with vesiculation resembling erysipelas. Ehrhardt reports 3 such cases without mucous membrane involvement, and 1 with subsequent throat infection. Sowade's case showed multiple ulcers on the right arm and thorax, soon after vaccination, in a child of nine months. Guthrie quotes Rosenthal, as follows, in describing the death of Griesinger: "A perityphlitic abscess had been opened, which subsequently became infected with Klebs-Löffler bacillus after it had healed. He later developed a wide-spread paralysis involving all extremities, speech, deglutition; dying on the seventieth day from respiratory paralysis." Post's case was that of an adult male, who had cared for his brother-in-law, wife and child during their illness from diphtheria. His lesion was on the foreskin, complicated with an acute phimosis, and was 4 weeks old on his entry to the hospital. A dorsal incision, having been made by his physician, was covered with the diphtheritic membrane, from which bacilli resembling morphologically the diphtheria bacillus were obtained, but not until bilateral ciliary and paralysis of all extremities had supervened. McCallom adds that several similar cases have been observed at the South Department of the Boston City Hospital, and that diphtheria of the penis is more frequent than is generally supposed. Kerr, Sack, Gerloczy, Dutschlander and Schucht have observed cases of cutaneous diphtheria unassociated with mucous membrane infection, in addition to these just referred to. There have been reported by Toch, Freymuth, Petrusky and Reichold, Veiel, Sharp and Bertelli, 5 cases of primary cutaneous diphtheria, with secondary mucous membrane infection. In Sharp's case the lesions were multiple over the chest and face, with secondary involvement of the throat; Bertelli's case, confirmed by animal inoculation, was a colleague who had a blister on the upper lip while treating a case of diphtheria of the throat; the blister became the seat of a diphtheritic infection, covered with membrane, and subsequent throat infection, which yielded promptly to antitoxin subcutaneously, without causing improve-

ment in the cutaneous lesion (to this he applied Bandis bivalent serum; the wound healed in a few days). Slater reports a case of 3 years' duration in a female, with multiple lesions on the body, probably originating in the conjunctiva, with later ear and vaginal involvement. The case had received all sorts of local treatment and had been under antisyphilitic treatment for 2 years. Finally, after careful bacteriological study, the cause was determined, and treatment by the use of antitoxin subcutaneously instituted. At the end of 5 weeks, all lesions had healed and the patient was considered cured.

CASE REPORTS

CASE I.—I wish to add the report of a male, forty-seven years old, school janitor, referred to Dr. Gibbon's service at the Jefferson Hospital by his physician, Dr. Roberts, of Llanerch, Pa. About November 12, he was helping to fumigate, and scrubbing the floor of a school then quarantined, on which a child supposed to be ill with diphtheria had vomited. During this time he suffered an abrased wound of the left middle finger on the dorsum of the second phalanx, a "blood-blister" resulting. Two days later, yellowish-gray streaks appeared about the wound, with pain, swelling and stiffness of the distal joint. On the third day, his physician incised it, applied antiseptic dressing, and later flaxseed poultices; at the end of a week, a membrane or grayish slough had appeared. Similar treatment was continued for some time at the Dispensary of the Jefferson Hospital, without improvement. He was suffering slight constitutional disturbance, vague, shifting pains over body and extremities, with loss of appetite. Two Wassermann reactions had been done and found negative. The wound at this time was covered with a dirty, yellowish-gray slough, fibrous and adherent, extending down to the extensor tendon. The edges were slightly elevated and indurated, presenting an indolent appearance, and covering all of the dorsal surface between the second and third joints (Fig. 1). At this time Dr. Rosenberger was asked to make bacteriological studies, and his report is as follows:- "Inoculations were made from the wound upon agar and incubated for 24 hours at 37° C.; at the end of this time, an abundant growth developed, which was of a light lemon-yellow color; spreads made and stained with Löffler's methylene blue, and by Groves method, showed bacilli (Gram-positive) possessing the morphology of diphtheria bacilli, together with few staphylococci; a guinea-pig was inoculated with 2 c.c. of a 48 hour old bouillon culture, which was absolutely negative as to tonic effects. In bouillon, the growth was manifested by a sediment, in gelatine no liquefaction nor gas production. A vaccine was made from a 24 hour old growth upon agar, and each cubic centimetre of vaccine contained approximately 500 million bacilli; 1 c.c. of the vaccine was given at a time, and four doses were

FIG. 1.—Case I. Diphtheritic ulcer of finger.

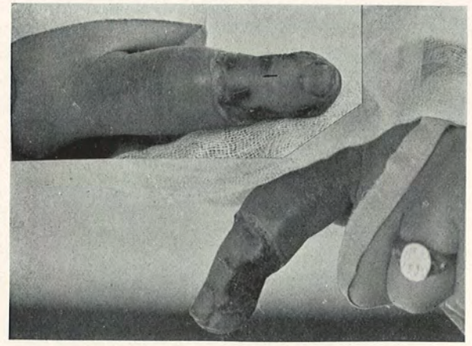

FIG. 2.—Diphtheritic ulcers of finger (condition presented in Case II).

given at four-day intervals, the patient soon began to improve and the wound healed without further trouble."

CASE II.—A girl of seventeen years, with lesion on dorsum of left index finger, almost encircling it, between second and third joints (Fig. 2), began six weeks before admission to Pennsylvania Hospital, Out-patient Department (service of Dr. Stewart), which was January 19, 1915. The trouble began with a pin-scratch; she was treated at another hospital for four weeks, and by her physician, Dr. Hickby, who referred her to the hospital, for two weeks. The wound edges were sharply defined and slightly elevated, showing some redness and induration; the surface of the wound was covered with the characteristic grayish fibrous membrane, and was difficult to remove, which exposed the extensor tendon and matrix of the nail. She had slight constitutional symptoms, with little elevation of temperature that was never recorded above 100°, and the pain seemed less than in the usual acute infection.

Bacteriological examination showed bacilli possessing the morphological characteristics of the Klebs-Löffler bacillus with a few staphylococci. The treatment consisted in the local use of diphtheria antitoxin in the form of a wet dressing on gauze covered with rubber dam to maintain moisture. This dressing was changed every 24 hours for 5 days, when the membrane had disappeared, leaving a clean granulating surface, which healed in about 4 weeks. Unfortunately, the first culture was destroyed before animal inoculation was done, and we were unable to get another after the employment of the antitoxin in spite of repeated efforts.

A summary of the review of these cases of cutaneous diphtheria would seem to show that it is usually secondary to mucous membrane diphtheria; that primary cutaneous diphtheria is an infrequent infection which may manifest itself in a single lesion, or in multiple concomitant lesions distributed over a wide area, or in the form of cutaneous and subcutaneous phlegmon, with considerable induration without marked pain, and without fluctuation or suppuration, if not complicated with pyogenic bacteria; and, finally, it may appear in the form of cellulitis with vesiculation resembling erysipelas. The infection is most apt to take place in wounds offering the most blood serum for the growth of the bacillus, as in blisters. Paralysis, as in other forms of diphtheria, is not an unusual complication, or sequel, and is usually widespread. We also find that pseudodiphtherial cutaneous infection occurs as it does on mucous membranes, and the clinical picture presented is identical with that of cutaneous diphtheria, and cannot be differentiated

except by animal inoculation. It is obvious that the clinical manifestations resulting from cutaneous infection by the diphtheria bacillus may be as diverse as the changes of environment governing the infection, which only make the appearance of the lesion or lesions more deceptive to the diagnostician. Hence the ease with which it has been mistaken for some of the syphilitic lesions, a tubercular process, a phlegmon, or some widespread skin affection. The treatment of cutaneous diphtheria resolves itself into that of diphtheria of any other part, viz.: the use of antitoxin subcutaneously or locally, or both, and for pseudodiphtherial skin infections, the use of the autogenous vaccines would seem to be the treatment of choice, and, of course, local surgical cleanliness in both conditions.

I am deeply indebted to Doctors Gibbon and Despard for the privilege of reporting the first case, and to Dr. Stewart for the privilege of reporting Case II, and to Dr. Rosenberger for his careful bacteriological study and the preparation of the vaccine in Case I.

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Fleisch, Gunther, Gerlosczy, Müller, Neisser, Sowade, Reichold, Schodel, Schottmuller, Toch, Veiel: Quoted by Bertelli.

Dr. J. Stewart Rodman related the history of a little girl operated on three years ago at the Medico-Chirurgical Hospital for appendicitis with abscess. The wound was allowed to remain open for drainage. When drainage had about ceased and when the granulating wound was perfectly healthy, a diphtheria epidemic broke out in the children's ward. Several days after the outbreak of this epidemic a grayish membrane appeared on the granulations in the wound, which kept reforming in spite of being stripped off when the wound was dressed. Finally it occurred to some one that it would be well to have a bacteriological examination made, and there proved to be a local infection of the wound with diphtheritic infection. The child was removed to the Municipal Hospital, made a complete recovery and was subsequently operated on for ventral hernia.

ARTHROPLASTY OF THE ELBOW*

By Astley Paston Cooper Ashhurst, M.D.
of Philadelphia

I have adopted arthroplasty of the elbow-joint in five patients: twice for bony ankylosis, and three times for marked limitation of motion following fracture.

Technic of the Operation.—1. *Exposure of the Joint.*—The skin incision (Fig. 1)[1] begins on the external supracondylar ridge of the humerus, about 5 cm. above the joint, and is continued straight downward to the joint level where it is curved slightly backward toward the extensor surface of the forearm; its entire length is about 10 cm. This incision is carried down to the supracondylar ridge above the joint; below the joint level the deep fascia is exposed but is not incised. The soft parts are then cleared from the humerus: the brachioradialis and the extensor carpi radialis longior are displaced forward and the triceps backward, *thoroughly* exposing the external condyle, the anterior capsule of the joint, and the external lateral ligament with the origin of the extensor muscles (Fig. 2). The external condyle is then detached from the humerus by osteotome, the bone section entering the elbow-joint on the capitellar surface of the humerus. In most cases even when the ulno-humeral joint is ankylosed the radio-humeral joint is free, and the external condyle may be easily turned downward on the external lateral ligament as a hinge, exposing the joint (Fig. 3). If ankylosis is present between the radius and humerus it is easy to separate them by gouge without injury to the external lateral ligament. In order to turn the condyle downward sufficiently to expose the joint thoroughly, the capsule must be snipped with scissors in front of and behind the external lateral ligament.

2. *Dislocation of the Joint.*—If ankylosis exists between the ulna and humerus these bones are separated by a suitably shaped gouge, driven transversely across the joint by smart blows from a hammer. When the union has been almost completely divided, the remaining fibres on the inner side of the joint may be ruptured by abrupt, short, forceful movements of flexion and extension applied to the elbow-

*Read before the Philadelphia Academy of Surgery, April 5, 1915.

[1] The accompanying illustrations (Figs. 1 to 10) are from photographs of preparations in the Laboratory of Operative Surgery in the University of Pennsylvania.

joint. If one fears injury to the ulnar nerve a small incision may be made over its course between epitrochlea and olecranon, and the nerve may be drawn away from the bones. Only in one case did I find this necessary.

Ankylosis having been overcome, or in cases where no ankylosis is present, the elbow-joint is dislocated by adducting the forearm around the internal lateral ligament, as a hinge, until the forearm lies almost parallel with the upper arm, causing the ends of the humerus, radius and ulna to come into full view (Fig. 4).

3. *Shaping the Bone Ends.*—As little as possible is done to the ulna, especially when the head of the radius is healthy. Reliance is placed on resection of the humerus for shaping the new joint (Fig. 5). If ankylosis exists in the upper radio-ulnar joint it is simpler to resect the head of the radius than to turn in a flap between radius and ulna. For shaping the humerus a Gigli wire saw mounted in a bow-shaped frame (the saw of Pierre Delbet) is the most convenient instrument; with this a series of cylindrical sections can be removed from the humerus until enough room is secured between the bone ends. Seldom is it necessary to remove any bone above the level of attachment of the internal lateral ligament at the base of the epitrochlea.

4. *Interposition of the Flap.*—The bones being temporarily restored to their normal relations, the original skin incision is extended backward from its upper end across the posterior surface of the arm (Fig. 6). The triangular skin flap thus outlined is raised, including a fair amount of subcutaneous fat, until the superficial surface of the triceps, or of the fat and fascia covering it, is fully exposed. An interposing flap of fat and fascia is then raised from the superficial surface of the triceps, with its base at the olecranon (Fig. 7). It is best to include some of the triceps aponeurosis and muscular fibres in this flap. The elbow-joint is then partially dislocated again, and the flap is attached to the internal lateral ligament of the elbow, and to the anterior and posterior capsules of the joint, by a few interrupted sutures of chromicized catgut (No. 0), thoroughly covering the articular surface of the humerus (Fig. 8).

5. *Closure of the Wound.*—The forearm is restored to its normal relation with the arm, and the external condyle is brought up in front of the pedicle of the interposing flap, and is fixed to the humerus (Fig. 9). For this purpose I prefer Lambotte's self-boring screws; in the accompanying illustration a nail was employed because at the time (in the Laboratory of Operative Surgery) no such screws were at hand. I have also used chromic gut and phosphor bronze wire

sutures, but have found them inferior to the Lambotte screws in obtaining secure fixation. Two screws are better than one. If much bone has been removed from the humerus, it will be necessary to trim the external condyle to fit.

The triceps is then sutured accurately to the brachioradialis and extensor muscles, the deep and superficial fasciæ are accurately approximated, and finally the skin wound is closed (Fig. 10). No drainage is necessary. Interrupted chromic gut sutures (No. 1 or No. 2) are employed throughout. Rarely is a single ligature required.

The average time I have consumed in the operation is about one hour and thirty minutes.

CASE HISTORIES

CASE I.—*Malunion of fracture of external condyle; limited motion and cubitus varus.* James W., aged five years. Treated in Dr. Frazier's service at the Episcopal Hospital. Fractured the external condyle of his right humerus in July, 1908; and first came under my care in October, 1908, for limited motion (50 to 145 degrees) and cubitus varus (200 degrees). A skiagraph showed a fracture with outward rotation of the external condyle, but bony union. For six weeks subsequently light massage and passive movements were employed, but the range of motion improved only 10 degrees in flexion (40 to 145 degrees). Fig. 11 gives a photograph taken before operation.

Operation (November 18, 1908).—Usual external incision. Enough of the external condyle was removed (without detaching it from the humerus) to permit full extension of the elbow, as well as to overcome the cubitus varus. The olecranon fossa on the posterior surface of the humerus was also deepened. A fatty fascial flap from the superficial surface of the triceps was turned in over the denuded external condyle and the wound closed. The elbow was dressed in hyperflexion.

At the first dressing, ten days later, the wound was healed and the skin sutures absorbed. Motion was free and painless from 45 to 90 degrees. The arm was now carried in a sling. On December 5 there was motion from 40 to 140 degrees.

In May, 1912, three years and a half after operation, the boy was presented at a meeting of the Philadelphia Academy of Surgery, exhibiting perfect function, no varus deformity, full flexion, but extension only to 150 degrees (ANNALS OF SURGERY, 1912, ii, 647). Fig. 11 shows photographs made in March, 1915, more than six years since operation.

CASE II.—*Malunion of fracture of lower end of humerus; limited motion and cubitus varus.* William G., aged eighteen years.

Treated in Dr. Harte's service at the Orthopædic Hospital. Referred by Dr. E. H. Kistler, of Lansford, Pa. When three years old this boy had fallen out of bed, landing on his left elbow. He recovered with Volkmann's contracture of the forearm, cubitus varus, and limited motion in the joint (40 to 110 degrees). When first seen, August, 1912, the Volkmann's contracture caused him no inconvenience, but the limited extension in the elbow was a serious handicap in his work in the mines, and his elbow was weak from the varus deformity and pained him if he used it much. Photographs made before operation (Fig. 12) show the distortion of the bony points at the elbow and the limit of extension (× indicates head of radius; the condyles and the olecranon are indicated by dots).

Operation (September 2, 1912).—Through the usual external incision the head of the radius, which projected far backward (Fig. 13), was exposed posterior to the external lateral ligament, and was excised. The external condyle was then detached, the joint luxated, and a curved section was removed from the humerus, with Butcher's saw, much more bone being removed from the radial than from the ulnar side of the humerus, so as to overcome the varus deformity. Fig. 14 shows the portions of bone removed, that from the humerus having been removed in three sections, until the sawn surface fitted the ulna and the varus deformity was abolished. A flap of aponeurosis and muscle was secured from the triceps in the usual way. The epicondyle was re-attached to the shaft of the humerus with chromic gut. A drainage tube was placed at each end of the incision. The tubes were removed after three days. It was not necessary to have employed them. The arm was dressed on a straight anterior splint, at an angle of 160 degrees.

September 5: Motion from 90 to 135 degrees is easy.

September 19: Out-patient. Sinuses (resulting from unnecessary use of drainage tubes) have healed. Motion 90 to 160 degrees is easy. He carries his arm in a sling.

October 3: Motion 65 to 135 degrees. Ordered massage and light passive movements three times weekly.

October 17: Treatment discontinued. Motion 65 to 160 degrees. Returns to work.

July 31, 1913: Eleven months after operation the patient was again photographed (Fig. 12), to show the range of motion (40 to 170 degrees). There was no cubitus varus and perfect function. The elbow is stable. He works on a breaker engine at the mines.

CASE III.—*Bony ankylosis from metastatic arthritis.* Gertrude T., aged twenty-three years. Treated in Dr. Harte's service

at the Orthopædic Hospital. In May, 1912, when about seven months pregnant, but without any evident cause (such as preceding tonsillitis, influenza, vaginitis, etc.) this patient developed an acute polyarthritis and was confined to bed for seven weeks. The pregnancy terminated normally after convalescence, but the left elbow and right knee were ankylosed. When first seen at the Orthopædic Hospital, in March, 1913, about ten months after this attack of arthritis, the elbow was fixed in bony ankylosis at an angle of 110 degrees; fortunately the radio-humeral joint and the upper radio-ulnar joint were not involved, as rotation in the forearm was normal.

Operation (May 1, 1913).—Arthroplasty of elbow by usual technic. A small incision was also made over the ulnar nerve and this was drawn away from the internal condyle until the bone ends were properly shaped. Flap obtained from triceps as usual, and epicondyle reattached to humerus by wire suture. No drain. Dressed on internal right-angled splint.

May 12: First dressing. Inner incision healed; outer incision healed all but one spot, between two sutures at upper end, over the cavity resulting from cutting the triceps flap. A little serous ooze occurred at this point. Motion of 30 degrees free and painless. Can get hand to mouth. Arm carried in sling.

May 15: Motion from 70 to 120 degrees without pain. Rotation in forearm normal. Can put hand to back of neck.

May 23: Passive motion from 65 to 160 degrees without pain. Active movement from 70 to 120 degrees. Arthroplasty of the knee was done to-day (*Trans. Coll. Phys. Phila.*, 1914, xxxvi, 236), and on this account the patient had to remain in the hospital longer. Fig. 15 shows the condition on admission, and Figs. 16 and 17 show respectively the limits of flexion and of extension in elbow and knee three months after operation. Figs. 18 and 19 are from skiagraphs made before and after arthroplasty of the elbow.

October 17, 1914: Eighteen months after operation there was motion in the elbow from 45 to 150 degrees, there was active power of extension in the triceps, and the joint was quite stable. She does all her own housework, and finds it a very useful arm.

Case IV.—*Malunion of fracture of lower end of humerus, with limited motion.* Benjamin F., aged fourteen years. Treated in Dr. Ashhurst's Orthopædic Service at the Episcopal Hospital. In the summer of 1912 this boy fell on his elbow and sustained a fracture-dislocation of the type Posadas (diacondylar fracture of the humerus with forward displacement of the lower fragment and posterior dislocation of both bones of the forearm). Neither the fragments of the humerus nor the dislocation of the elbow had been reduced, and 16 months later the boy applied to the

Fig. 1.—Arthroplasty of elbow; skin incision.

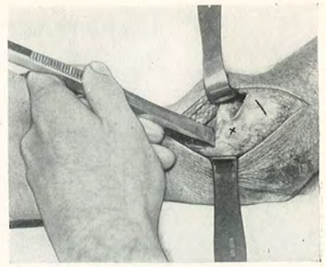


Fig. 2.—Arthroplasty of elbow; external condyle (X) and head of radius (—) exposed, and osteotome applied to external condyle.

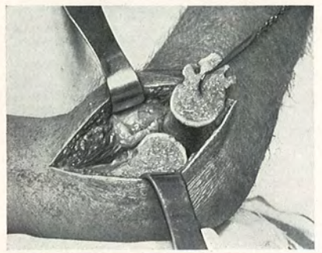


Fig. 3.—Arthroplasty of elbow; external condyle turned down, exposing joint.

Fig. 4.—Arthroplasty of elbow; joint luxated around internal lateral ligament as a hinge.

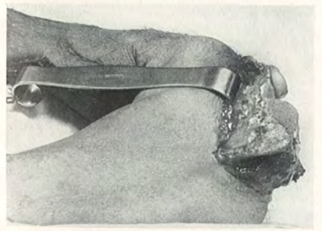


Fig. 5.—Arthroplasty of elbow; articulating surface of humerus removed with saw. Joint is viewed from outer side; the external supracondylar ridge and the surface from which the external condyle has been detached face the reader, and the joint surface of the humerus (freshly sawn) is directed toward the right of the picture.

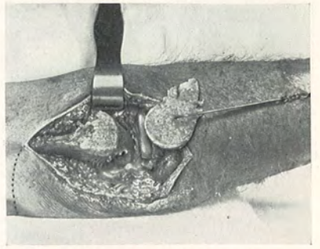


Fig. 6.—Arthroplasty of elbow; bones replaced; dotted line indicates extension of primary skin incision, to expose triceps.

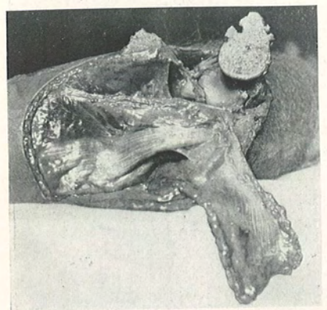


FIG. 7.—Arthroplasty of elbow; fat and fascia pedicled flap cut from surface of triceps.

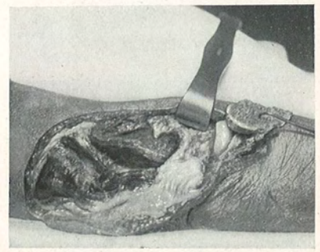


FIG. 8.—Arthroplasty of elbow; flap turned into joint covering articular surface of humerus. Same view of joint as Fig. 6.

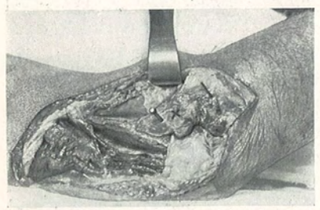


FIG. 9.—Arthroplasty of elbow; external condyle has been replaced and fastened by a screw or nail.

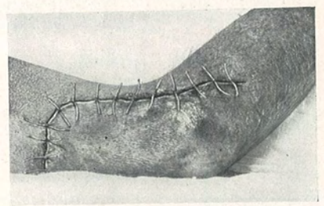
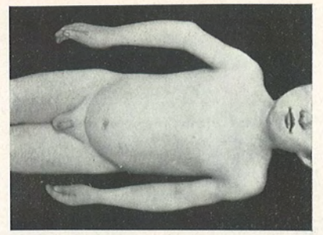
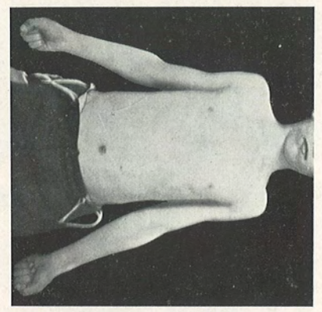


FIG. 10.—Arthroplasty of elbow; skin sutured.



A



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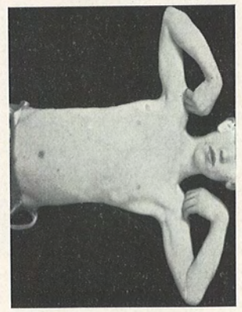

C

FIG. 11.—Case I. *A* is a photograph taken in 1908, just before operation, showing cubitus varus. *B* and *C* are photographs taken in 1915, showing restoration of carrying angle and limits of extension and flexion.

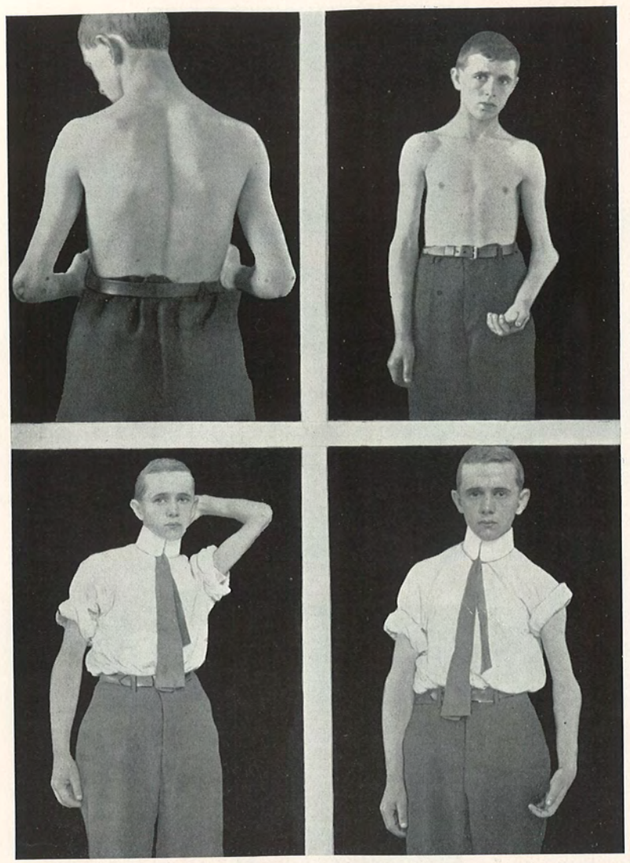

FIG. 12.—Case II. The first two photographs were made before operation, showing distortion of bony landmarks (× indicates head of radius) and limit of extension. The other two photographs were made eleven months after operation, showing range of flexion and extension, and restoration of carrying angle.

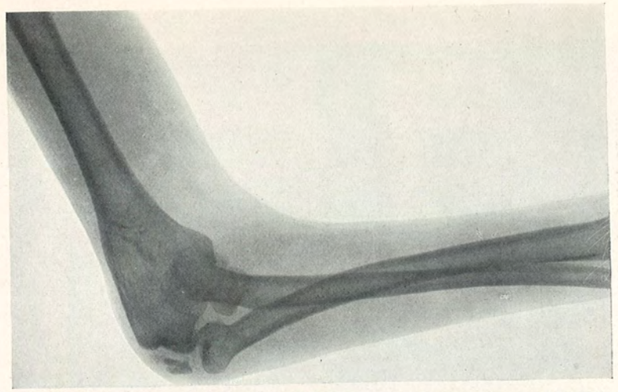

FIG. 13.—Case II. Skiagraph before operation, showing marked cubitus varus and limitation of extension.

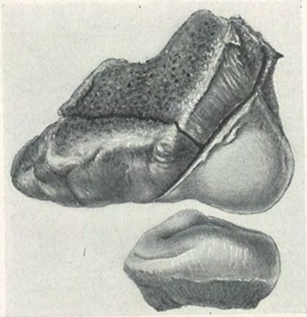

FIG. 14.—Case II. Arthroplasty of elbow; portions of humerus and head of radius excised (September, 1912).

FIG. 15.—Condition of Case III on admission.

FIG. 16.—Showing amount of possible flexion in Case III on discharge.

FIG. 17.—Showing amount of extension possible in Case III on discharge.

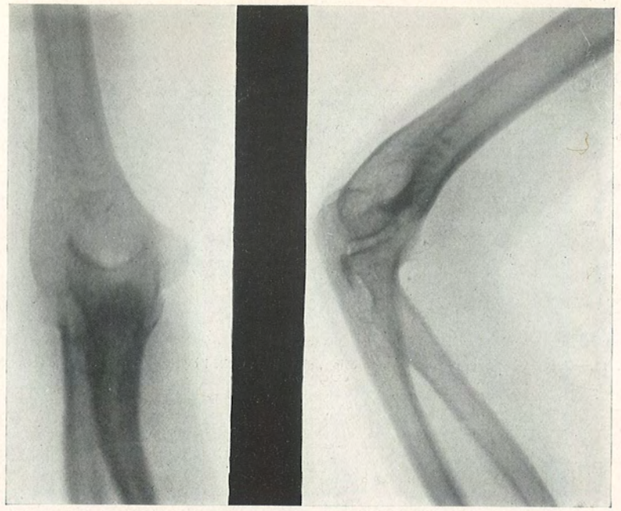

FIG. 18.—Case III. Skiagraphs showing ankylosis of elbow before arthroplasty.

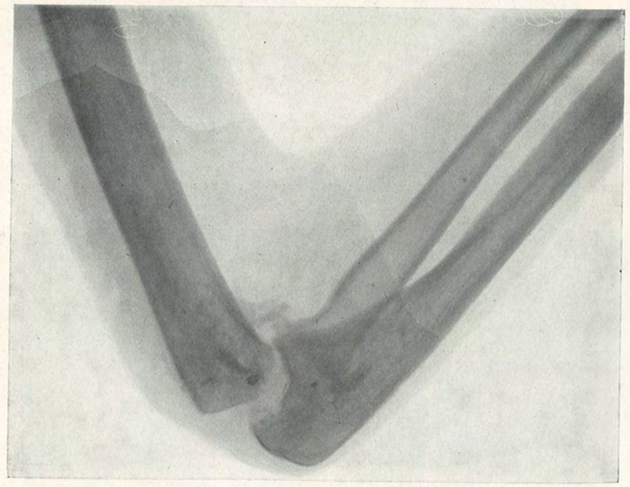

FIG. 19.—Case III. Result of arthroplasty. From skiagraph seven weeks after operation.

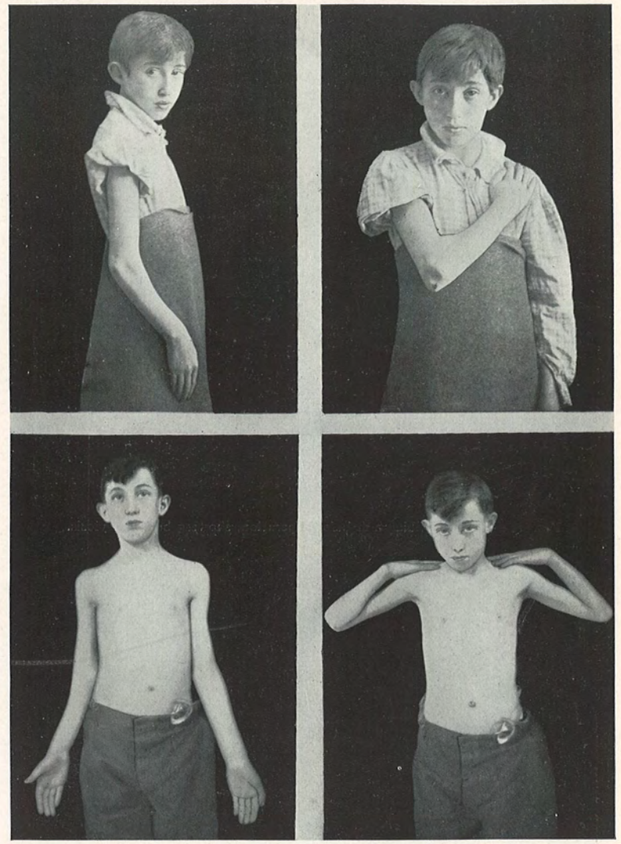

FIG. 20.—Case IV. Upper photographs show limits of extension and flexion before operation. Lower photographs were made five months after operation, showing results of arthroplasty.

FIG. 21.—Case V. Skiagraph before operation, showing bony ankylosis.

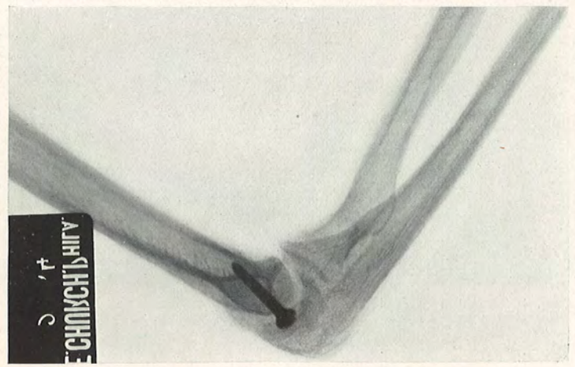

FIG. 22.—Case V. Skiagraph six weeks after arthroplasty.

orthopædic department for disability from limited flexion and extension (65 to 150 degrees) (Fig. 20).

Operation (November 26, 1913).—Arthroplasty by the usual technic. After trimming the end of the humerus to proper shape with the bow-saw, it was found the ulna tended to stay in posterior luxation; so the olecranon was removed, preserving the periosteal attachments of the triceps. The radial head and the greater sigmoid cavity of the ulna were not disturbed. A flap from the triceps was inverted as usual, and the epicondyle was re-attached by chromic-gut sutures. No drain. Dressed on internal right-angled splint.

November 29: Discharged from ward. Skiagraph shows subluxation backward of radius and ulna.

December 1: Out-patient. First dressing; some sloughing of edges of skin flap turned back to expose triceps. Wound is clean. Elbow dressed in hyperflexion.

December 15: Skin granulating well. Free motion from hyperflexion to right angle. Arm in sling.

December 22: Motion 45 to 120 degrees. Out of sling.

January 5, 1914: Incision healed. Motion 40 to 145 degrees.

January 12: Motion 40 to 150 degrees.

January 19: Motion 40 to 160 degrees.

March 9: Motion 10 to 160 degrees.

April 27: Five months after operation (Fig. 20). Motion 10 to 180 degrees. In full extension radius and ulna luxate backward. There is free lateral motion in elbow, though external condyle is firmly attached to the humerus. Very slight power of extension in elbow, good power in flexion.

June 29: Seven months after operation. Can chop wood holding axe in both hands, indicating a considerable improvement in the stability of the elbow.

CASE V.—*Bony ankylosis of elbow from septic arthritis.* Sarah M., aged twenty-seven years. Dr. Ashhurst's service at Episcopal Hospital (orthopædic). In December, 1913, this patient suffered from a "heavy cold" with cough; she was in the habit of carrying her eighteen months' old baby on her left arm, which gradually became stiff and painful. In less than a week matter formed, and an abscess on the inner side of the joint was lanced by her family physician. She was admitted to Dr. Frazier's service in the Episcopal Hospital on January 8, 1914, and on January 20 Dr. Frazier opened the sinuses more freely and put in drainage tubes. Cultures of pus at this time gave a pure growth of streptococcus pyogenes. The elbow became stiff. She went home in the end of February, and the sinuses were all healed early in March, 1914. Since then there has been no pain or tenderness.

Examination in May, 1914, showed ulno-humeral ankylosis at an angle of 110 degrees. She could not get her hand to her mouth, nor even to the top of her head. Rotation in the forearm was about half normal, supination being lost. Fig. 21 is from a skiagraph before operation.

Operation (May 30, 1914).—Arthroplasty by the usual technic. All told, sections about 0.5 cm. in thickness were removed from the humerus by the mounted Gigli saw. A flap from the triceps was interposed, and the external condyle re-attached by a screw. No drain. Dressed on internal right-angled splint.

June 6: First dressing. Wound healed. Can put hand to face with ease.

June 8: Went home.

June 15: Out-patient. Motion 70 to 100 degrees. Massage ordered.

July 13: Motion 85 to 110 degrees causes pain at limits named.

August 31: Free and easy motion 90 to 120 degrees. Rotation normal. Refuses to have forceful motion under an anæsthetic. Fig. 22 is from a skiagraph made six weeks after operation.

SUMMARY OF RESULTS IN FIVE CASES OF ARTHROPLASTY OF ELBOW

Case	Before Operation			After Operation		
	Flexion	Extension	Deformity	Flexion	Extension	Deformity
I	40°	145°	Varus	35°	150°	None
II	40°	110°	Varus	40°	170°	None
III	110°	110°	Ankylosis	45°	150°	None
IV	65°	150°	Posterior dislocation	10°	180°	Posterior dislocation (only in extension)
V	110°	110°	Ankylosis	90°	120°	None

DR. GWILYM G. DAVIS said that the results obtained by Dr. Ashhurst show that arthroplasty in this joint is more satisfactory than in most others. This accorded with his own experience. It would seem, therefore, that surgeons are justified in carrying out more radical procedures in cases with limitation of motion in the elbow than in joints of the lower extremities in which weight-bearing tends to detract from the good results. The question arises of the necessity of retaining the lateral ligaments. In the majority of his own cases he had not retained these ligaments. Instead of making one large flap he had made two, taking one flap from each side. One of the difficulties of the operation is shown in one of his cases in which there was some trouble with the vitality of the flap. This is a serious difficulty in arthroplastics, especially of the knee. The necessity of using in the arm flaps from other parts of the body, like the fascia lata, is not so urgent as in the knee and hip. While very fair results can be obtained by ordinary resection, this resection without the interposition of flaps necessitates the removal of one to one and a half inches of bone to insure movement. When an arthroplasty is done only sufficient bone to allow interposition of the flaps needs to be removed, and this is less than half the amount necessarily removed in an ordinary resection. The arthroplasty, even without the retention of lateral ligaments, if there is no mishap, is almost certain to give a stable joint.

THE OPERATIVE TREATMENT OF FRACTURES OF THE FEMUR, HUMERUS, AND TIBIA

DR. GEORGE P. MÜLLER presented lantern slides illustrating his subject.

NOTES ON FRACTURES*

By William J. Ryan, M.D.
of Philadelphia, Pa.

The following report is based on the "follow-up" records of 121 fractures treated in the Surgical Dispensary of the St. Agnes' Hospital, of Philadelphia, from February 1, 1914, to August 1, 1914, and in Dr. Müller's Clinic in the Polyclinic Hospital during 1914.

Seventy-four patients were traced, and, while we were disappointed in the limited scope of the investigation, certain details seem of interest.

	Total cases	Traced
Nose	3	0
Inferior maxilla	4	1
Zygoma	1	0
Ribs	6	3
Clavicle	10	6
Acromial process	1	0
Humerus	18	13
Radius	31	23
Ulna	7	4
Radius and ulna	6	4
Metacarpal	10	7
Phalanges of finger	6	3
Tibia	7	4
Fibula	7	4
Metatarsal	4	2
Total	121	74

One fracture of the inferior maxilla was heard from. This case had no disability or deformity but complained of occasional slight pain when exposed to cold.

Of 3 fractures of the ribs traced, 1 had died of pneumonia, and 2 had had pleurisy. They were all men over fifty. The pneumonia case died out of town and we could get no definite information regarding his illness. One of the cases of pleurisy was on the affected side. Examination a year after the injury revealed no deformity along the line of the fractured ribs.

Six cases of fractured clavicle heard from showed excellent functional results. Two of them, of twenty and thirty years of age, showed considerable callus formation. Fortunately, both were men.

Thirteen fractures of the humerus were traced; 2 of the upper end; 2 of the shaft; and 9 of the lower end. The first were both

* Read before the Philadelphia Academy of Surgery, April 5, 1915.

impacted fractures of the surgical neck. One man of forty-five, a bookbinder, is back at his regular employment. The other, a man of seventy-four, has good firm union but has considerable pain on forced flexion and internal rotation. Of the shaft fractures, 1, a four-year-old girl with a fracture below the insertion of the deltoid, has a perfect result, both anatomically and functionally. A man who had an oblique fracture at the middle of the shaft with 1 inch shortening has some bowing backward of the humerus, but no shortening, and the functional result is excellent. Nine fractures of the lower end were seen or heard from; 2 of the internal condyle; 5 of the external condyle; and 2 supracondylar. All were in children and all were due to falls on the elbow which makes the greater frequency of the fractures of the external condyle rather extraordinary. These were uncomplicated and all had good results. One supracondylar fracture has limitation of extension, but flexion is as good as in the other arm. This supracondylar fracture was accompanied by a fracture of both external and internal condyles, the line of fracture of both condyles converging as they extended downward. There was extreme swelling and extensive bleb formation, which delayed active treatment of the fracture for four days.

Radius.—Of 31 fractures of the radius, 23 were traced. These involved the upper end once, the shaft 4 times, and the lower end 18 times. The fracture of the upper end was a chip off the flange-like head. The case was a week old with a history of a fall on the hand which caused the elbow to bend, and the back of the forearm came in contact with the ground. Jones's position gave an excellent result, there being no impairment of motion in the elbow, nor interference with pronation and supination.

Four fractures of the shaft were traced, 3 being transverse cracks without displacement, and 1 oblique fracture about 4 inches from the lower end of the radius. The obliquity was from behind downward and forward. The functional result in this case was only fair, there being some interference with supination six months after the injury, due to failure of the patient to keep up his massage treatment. He returned again for massage and now has almost complete power of supination.

Eighteen of 23 fractures of the lower end were traced. Sixteen were within 1½ inches of the lower end, and 2 were fractures of the anterior edge of the articulating surface. Seven of the 23 fractures showed the classical silver fork deformity, the latter varying in degree. All 7 were accompanied by a fracture of the styloid process of the ulna. These were treated with anterior and posterior straight splints,

the posterior being notched to keep from pressing on the prominent lower end of the ulna. All gave good functional results, but in all 7 there was a loss of the prominence of the lower end of the ulna. This alteration was not present in the following 9 cases, which were treated with a Bond splint. Seven were transverse fractures of the radius with little or no displacement, and 2 were epiphyseal separations. All have good functional and anatomical results.

I might remark here that 3 cases of this year's series with marked deformity and accompanied by fracture of the styloid of the ulna were treated with a Bond splint and, six weeks to two months after the injury, show no loss of prominence of the lower end of the ulna.

The two Barton's fractures were treated with anterior straight splint and have good functional results.

Ulna.—Of the 7 fractures of the ulna, 4 were traced; 2 of the olecranon, 1 of the shaft at the junction of the lower and middle third, and 1 of the styloid. All were simple and showed good results.

Radius and Ulna.—Four out of 6 were traced. Two were complete of both bones, with considerable displacement; 1 a girl eight years of age and 1 a woman of forty. One was greenstick of both bones, and 1 was a complete fracture of the radius with a greenstick of the ulna, the type reported by Dr. Skillern before this Academy last year.

The fracture in the young girl was difficult of reduction because both lower fragments were split longitudinally about 1 inch, and the upper fragments wedged loosely in the split, the fracture occurring about 3 inches above the wrist. It was successfully reduced though and she has a good result both functionally and anatomically.

The result of the fracture in the woman is bad. She was struck on the back of the arm by a heavy poker, and on admission her forearm was sharply angulated at the junction of the lower and middle third. X-ray showed both lower fragments to be badly comminuted with encroachment by the radial fragments on the interosseous space. Plating was advised, but she refused, and we attempted to mould the fragments into position without much success. She has fairly good motion in her wrist but she can not completely close her fingers. Pronation and supination are also limited. There is slight bowing backward of both bones.

The greenstick fracture of both bones was simple and gave a good result. The case of Skillern's fracture has an excellent result. At the time of admission there was some backward angulation but we were able to reduce it without making the greenstick fracture of the ulna complete. All these cases were treated in full supination.

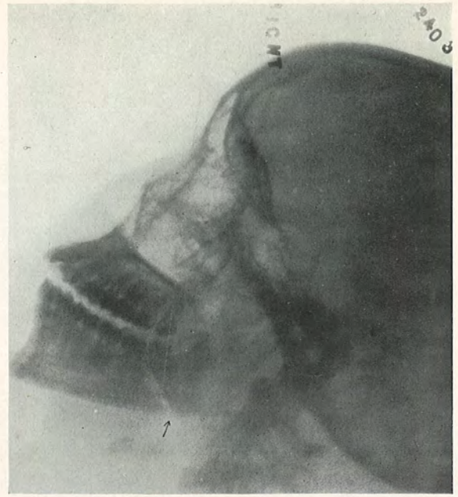

FIG. 1.—Fracture of jaw, of three months' duration before treated. Anatomical and functional results good. Some pain in damp weather.

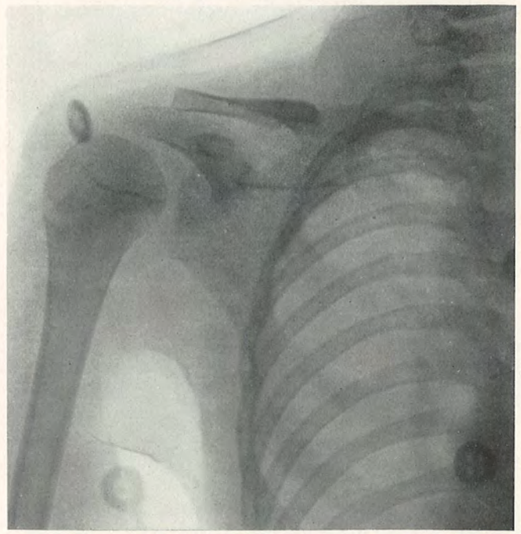

FIG. 2.—Fracture of middle of clavicle. Three weeks old on admission.

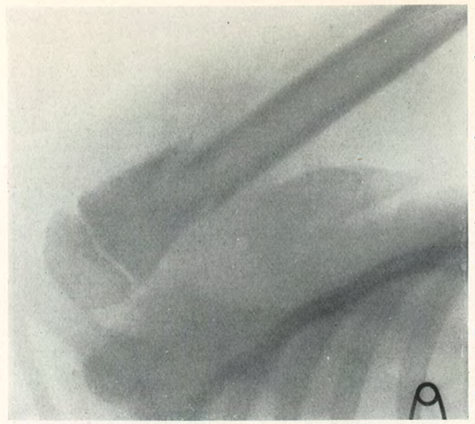

FIG. 5.—Fracture of surgical neck of humerus. Anatomical and functional results excellent.

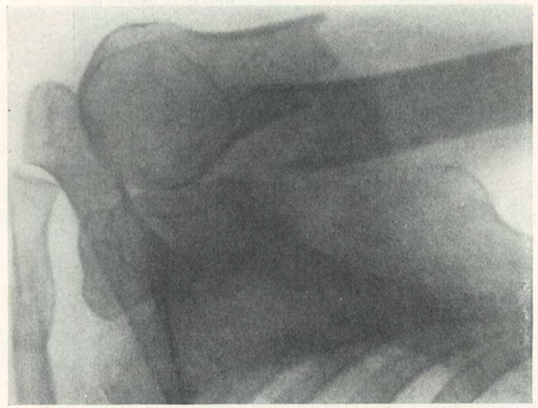

FIG. 4.—Fracture of upper end of shaft of humerus. Excellent result both anatomically and functionally.

FIG. 3.—Male patient, aged seventy-eight. Fracture of upper end of humerus and surgical neck; fracture of head including greater tuberosity. Result: good union; fair function; pain on extreme flexion and extension.

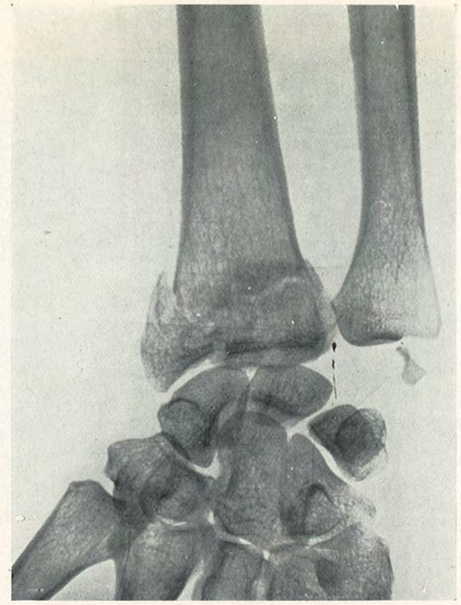

FIG. 6.—Fracture of lower end of radius; comminuted fracture of styloid of ulna. Anatomical result: slight bulging in front of wrist; functional result good.

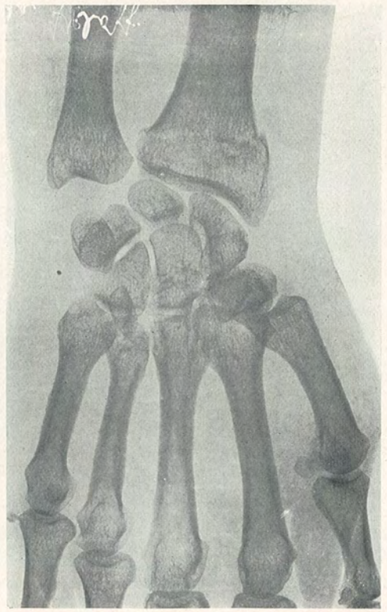

FIG. 7.—Impacted fracture of lower end of radius.

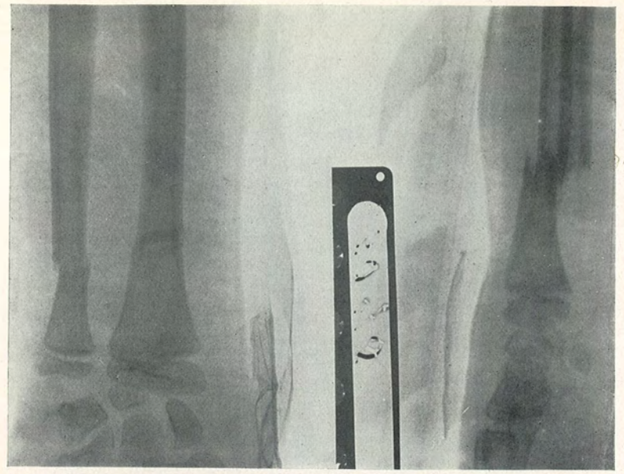

FIG. 8.—While playing, fell from top step, striking pavement with hand outstretched. Examination disclosed backward bending of forearm about two inches above wrist. Anterior and posterior straight splints in position midway between pronation and supination. This plate taken after first attempt at reduction. This plate illustrates the case in which the upper fragments were split and in which the upper ends of lower fragments were caught in the split. See text, page 295.

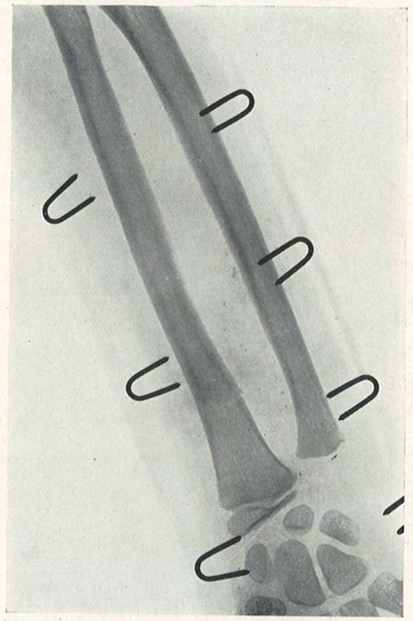

FIG. 9.—Greenstick fracture of both bones of the forearm. Result excellent.

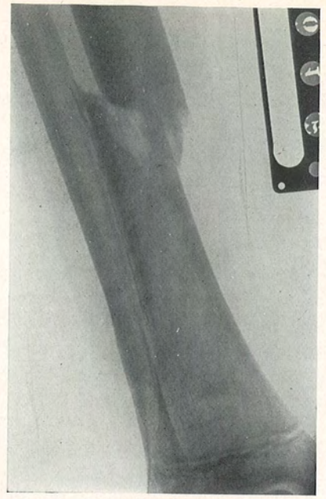

FIG. 10.—Fracture of shaft of tibia, treated by extension and plaster cast. Anatomical result: slight prominence of lower end anteriorly; functional result excellent.

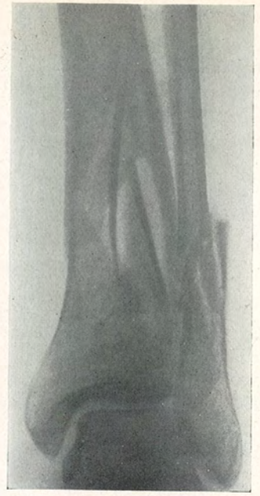

FIG. 11.—Fracture of both bones of the leg; considerable comminution. Functional result fair, there being some stiffness of flexion.

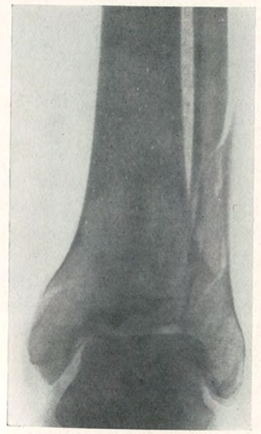

FIG. 12.—Comminuted fracture of lower end of fibula.

FIG. 13.—Comminuted fracture of first metatarsal with fracture of proximal phalanges of first and second toes.

Metacarpal.—Seven cases were heard from; 1 of the first, 4 of the second, and 2 of the fifth. All were accompanied by great swelling. The fracture of the first involved the head and extended into the joint. Dressing in full abduction and early massage gave a good result. The other 6 were simple without displacement and have excellent results.

Fractures of the phalanges were simple and uncomplicated and need only be mentioned.

Tibia.—Four cases of fracture of the tibia were heard from. One of these cases was very interesting. The patient was a boy, ten years of age, who while running struck his leg against a sharp spike of an iron fence which had been bent outward towards the sidewalk. Close examination of the lacerated wound showed that a groove had been made in the antero-external surface of the tibia about ¼ inch deep and about 1 inch long. There was no evidence of other fracture and a careful röntgenogram showed no fracture other than the groove. The other 3 cases were in children: 2 greenstick and 1 spiral fracture which was easily reduced. Plaster cast was used in these 3 and they have excellent results, all being able to run and play as before.

Fibula.—Of 7 fractures of the fibula 4 were heard from. Three were Pott's fractures without involvement of the internal malleolus. Two were treated in the house in the usual manner and discharged in a week to return to the surgical dispensary. One was ten days old on admission and a plaster cast was applied in dispensary. The fourth case was at the junction of the upper and middle thirds and was caused by the kick of a horse. There was displacement backward of the lower fragment about ½ inch. After reduction a plaster cast was applied from the toes to the middle of the thigh. This man has now a hypertrophic arthritis of the knee of the injured leg, though X-ray at the time of injury showed nothing abnormal in the knee.

Metatarsal.—Two fractures of the first metatarsal were heard from. Both were in the middle of the bone and were due to the fall of a heavy weight on the foot. One was accompanied by a fracture of the first and second proximal phalanges. It was greatly comminuted, the bone really being smashed; the other, by the first and second proximal and the third distal phalanx. In both there was entrance swelling and ecchymosis which required small incision. In first no displacement occurred. In the second there was angulation toward palmar surface. Both cases were treated with a moulded binder's board splint and a wide bandage over instep. (The functional result of the first is good, but the other case has to wear an arch support to relieve pain.)

STATED MEETING, MAY 3, 1915

The President, Dr. John Gibbon, in the Chair

RESULT OF LATE NEURORRHAPHY

Dr. Edward B. Hodge presented a girl who had been in the Widener Memorial School, under treatment for tuberculosis in the left knee-joint. During her stay in the School she fell from a small express wagon and sustained a bad compound supracondylar fracture of the right humerus. A good result was obtained with the arm in Jones' position. During the treatment it was found that she had complete wrist drop. There was complete paralysis of the musculospiral nerve. This was treated expectantly and three months later Dr. Willard cut down upon the nerve, finding it contused but apparently not severed. No improvement in function followed. In January, 1914, 5 years after injury, the speaker cut down upon the nerve, traced it down and found that it had been completely sheared through, the proximal portion continuing past the elbow as a fibrous cord. The distal portion of the nerve was buried under muscle and adherent to the humerus below the fracture. After reaching into normal nerve tissue, the ends were united with 2 silk sutures with the elbow in acute flexion to relieve tension. Later a cast was applied with the wrist hyperextended and still later massage and passive motion employed. At the end of ten months some improvement was shown, and now at the end of a year and a half there is pretty fair power. She has nearly complete power in extension of the wrist, good supination, and everything but complete extension of the fingers. The case was reported to encourage late attempts at neurorrhaphy. At the time of operation, there was partial reaction of degeneration in the muscles involved.

OLD POSTERIOR DISLOCATION OF SHOULDER

Dr. Hodge presented a young woman who had been the subject of a posterior dislocation of the shoulder of unusual etiology, which had become replaced in an unusual manner. The shoulder was luxated either from receiving a blow with a broom in sweeping, or in the motion of putting the hand to the head to do up her hair. This was followed by complete disability, swelling and pain. Dr. Hodge saw the patient at the end of five or six weeks. The arm was swollen and

painful and there was almost complete disability. Below the acromion there was a considerable gap, the elbow was against the chest and forward, the head could not be felt in the axilla. A series of skiagraphs demonstrated a posterior dislocation below the acromion. An effort to obtain reduction under ether was about to be made, when during the anæsthetization the nurse who was holding the patient's hand left it for a moment to attend to a detail of the service and the arm dropped off the edge of the table. When Dr. Hodge grasped the arm to manipulate, he found the head already in the glenoid. Dr. Wharton was in the next room at the time and he confirmed the reduction. The patient has had complete comfort since though she has greatly limited function.

END RESULTS IN FRACTURES OF BOTH BONES OF THE LEG*

By Rutherford L. John, M.D.
of Philadelphia, Pa.

In presuming to bring forward the subject of fractures of both bones of the leg, this paper has no intention of discussing the question of treatment. It will limit itself to a statement of the end results in a series of 40 cases, that being the number I was able to follow up of 288 cases treated in the Episcopal Hospital between the years 1905 and 1915.

Of the forty cases followed, 6 were compound and 34 not compound fractures, *i.e.*, they were either simple or comminuted.

Group I classes cases as to age, sex, and leg involved, as follows:

Years	No. cases	Male	Female	Right	Left
0–14	7	6	1	3	3
15–44	22	13	9	13	8
45–59	9	7	2	5	4
60–	2	0	2	2	0
	—	—	—	Two cases unnoted	
Total	40	26	14	23	15

As can be seen from the table, by far the greater number of cases occurred between the ages of 15 and 44 years, 22 out of 40, or 55 per cent. Males were involved in 65 per cent., and 57.5 per cent. of the fractures occurred in the right leg.

Group II gives us one of the most interesting classifications of the series. Here I have endeavored to show the effect of the anatomical result on the period of disability. The period of disability has been taken to mean the number of weeks the patient was kept from his work. The measurements were made from the lower border of the patella to the internal malleolus.

Group II a. (All Cases)

Anatomical result	Amt. of shortening	No. cases	Aver. period disability
Good	0–0.99 cm.	17	14.8
Moderate	1.0–1.99 cm.	16	21.7
Bad	2.0– cm.	6	45.3

The above group includes all cases. The following table gives the same data for cases not compound:

*Read by invitation before the Philadelphia Academy of Surgery, May 3, 1915.

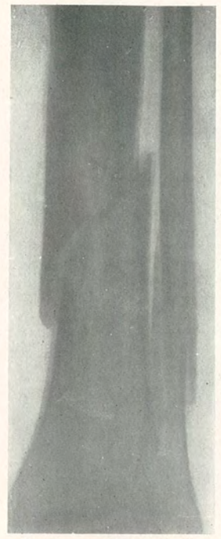

Fig. 1.—Comminuted fracture of tibia and fibula before treatment by Steinmann nail traction. See Fig. 2.

Fig. 2.—Comminuted fracture of tibia and fibula treated by Steinmann nail traction (sixteen pounds). Five months after injury; no shortening.

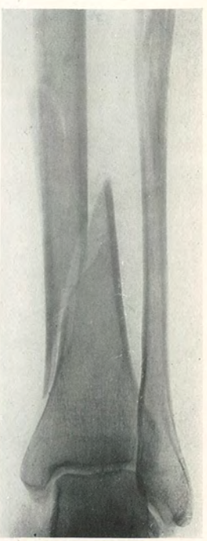

Fig. 3.—Comminuted fracture of tibia and fibula before treatment by Steinmann nail traction. See Fig. 4.

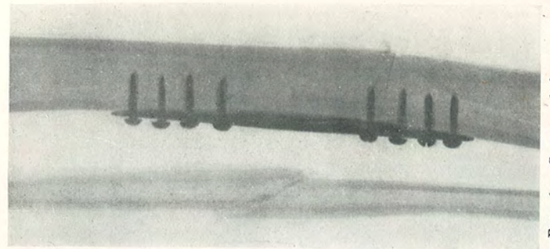

FIG. 6.—Compound fracture of tibia and fibula. Tibia plated eighteen days after injury; shortening 1 cm.

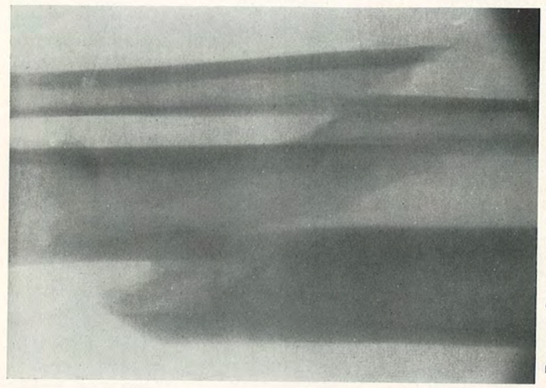

FIG. 5.—Compound fracture of tibia and fibula after Steinmann nail traction for twelve days (twenty-two pounds). See Fig. 6.

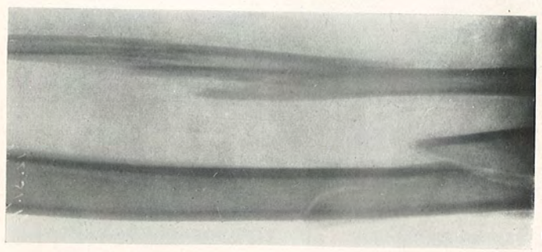

FIG. 4.—Comminuted fracture of tibia and fibula treated by Steinmann nail traction. Twenty days after injury; no shortening.

GROUP II B. (CASES NOT COMPOUND)

Anatomical result	Amt. of shortening	No. cases	Aver. period disability
Good	0–0.99 cm.	15	14.5
Moderate	1.0–1.99 cm.	14	20.1
Bad	2.0– cm.	4	42.0

While in the above tables, a shortening of from 1.0 to 1.99 cm. is classed as a moderate *anatomical* result, yet in practically all of these cases there was a very good *functional* result, the patients being able to do their former work without any loss of endurance or knowledge of the shortening of one leg.

Of all of the cases followed, there had been no open operative treatment in any of the simple or comminuted fractures. Two cases of comminuted fractures (X-ray photographs, Figs. 1, 2, 3 and 4) were treated by the Steinmann nail traction. Both of these cases healed with no shortening. The average period of disability for these two cases was 12.5 weeks, as compared with the average period of 15 weeks for the other 15 cases in the same group. Both cases were badly comminuted and, aside from the more rapid recovery and the perfect anatomical result, the Steinmann nail traction allowed these patients, while under constant traction, to move about a bit in bed, a fact which gave them considerable comfort and of which they speak with gratitude. That traction by means of the Steinmann nail is not always so satisfactory can be realized from a glance at Fig. 5. This case of compound fracture of both bones had a Steinmann nail driven through the os calcis on the sixth day after injury and twenty-two pounds of weight applied for twelve days, with no apparent reduction of the deformity. The bones were then exposed and the tibia plated, with an ultimately good anatomical and functional result (see Fig. 6).

The six compound cases of the series are grouped in the following table to show age periods and operative treatment:

GROUP III

Years	No cases	No. oper.	Immed. oper.	Delayed oper. (after 10 days)
0–14	2	1	1	
15–44	4			4
45–59	0			
60–	0			

Group IV shows the compound cases grouped as to amount of shortening and average period of disability:

GROUP IV

Amt. of shortening	No. cases	Aver. period of disability
0–0.99 cm.	2	16
1.0–1.99 cm.	2	24
2.0– cm.	2	52

The following table gives the average period of disability in weeks for each region of bone considered, according to age periods.

GROUP V

AVERAGE PERIOD OF DISABILITY

Years	Upper ⅓		Middle ⅓		Lower ⅓	
0–14	11.5	(2)	15	(2)	15	(3)
15–44	0		16	(2)	23+	(19)
45–59	0		86	(2)	21.4	(8)
60–	0		0		9	(2)

The figures in parentheses represent the number of cases in each region. While Pott's fractures are not included in the series, it will be noted that the great majority of cases occurred in the lower third of the leg.

The conclusions to be drawn from these tables point to neither a strictly conservative nor a radical operative treatment as giving the best ultimate results. As so often stated, the majority of fractures occurred in males, between 15 and 40 years of age.

1. The right leg was affected in 57.5 per cent. of cases.
2. The average period of disability is directly dependent upon the anatomical result.
3. A moderate anatomical result may mean a perfect functional result.
4. Traction by means of the Steinmann nail would seem to be a hopeful compromise between a conservative and an operative treatment of obstinate cases.
5. The lower third of the bone is the most often involved but this fact has no apparent relation to age or period of disability.
6. The average time for reduction was on the day of injury except in four cases of compound fractures.

DR. GEORGE C. ROSS, in connection with extension by the Steinmann nail, asked whether any of the Fellows had used a method for extension in this type of fracture when the fracture is so close to the ankle that the limb cannot be put in a box. The device consists of an old shoe with the heel and toe cut out. To this a piece of heavy cord is attached bearing 20 to 25 pounds weight. The shoe is laced around

the man's ankle. This makes satisfactory extension and if persisted in gives very good results.

DR. JOHN, in closing, said that the measurements were made from the lower border of the patella to the internal malleolus in all the cases. The old shoe method suggested by Dr. Ross is valuable in quite a number of cases except where there is much œdema of the foot, under which condition there is considerable danger of sloughing. In the presence of possible sloughing a heavy felt placed over the instep before the shoe is laced up is of advantage. The Steinmann nail, however, obviates this danger (of sloughing) and causes no pain to the patient while it is in use.

FRACTURES OF THE FEMUR

WITH END RESULTS IN 62 CASES

By Carl R. Steinke, M.D.

of Philadelphia

Instructor in Surgery, University of Pennsylvania School of Medicine

The poor functional and anatomical results in fractures of the long bones of the extremities led the American Surgical Association and the British Medical Association to investigate the causes for such results. A waning interest in fractures has been renewed, and with the form-blanks covering all the important facts to be obtained concerning fractures, more uniform, complete and exact data are being gathered.

Much has been written concerning fractures of all bones but the femur presents some of the greatest difficulties to be encountered, while its anatomical and physiological importance accentuates the necessity for a good result.

In considering fractures of the femur it is well to take them up in different groups according to the portion of the bone fractured, such as those of the upper end (neck and through the trochanters), the shaft and the lower end. The varieties, manner of production and treatment of fractures have been so thoroughly dealt with in the special fracture number of the *American Journal of Surgery* for March, 1915, by such authorities as A. Lane, W. L. Estes, A. P. C. Ashhurst, F. H. Albee, J. B. Walker and others, that they will not be considered in this paper except as they concern reported cases.

With the more general use of the Röntgen rays we are enabled to see the exact position of the fragments before and after treatment, so we can follow cases to observe how kind nature is in producing generous callus to cover our defective reductions, with resultant solid union (Figs. 1, 2, 3, 4, 5, 6 and 7). The anatomical relation of the fragments may be bad and still give a good functional result (Table IV).

The basis of this article consists of the fractured femurs from Dr. Charles H. Frazier's service at the Episcopal Hospital during the 10 years from 1905 to 1915, and I am indebted to him for the privilege of reporting the cases.

Of the 109 cases on record we were able to follow 62 (57 per cent.), 15 fractured through the neck, 6 through the trochanters, 36 of the shaft, and 5 of the lower end. A number of the cases have been previously reported more in detail before this Academy and elsewhere

* Read before the Philadelphia Academy of Surgery, May 3, 1915.

by Dr. A. P. C. Ashhurst.[1] Of the 47 fractures not followed there were 4 each through the trochanters and of the lower end, 15 of the neck and 24 of the shaft; the condition of the patients at the time of discharge was as follows: 10 cured, 24 recovered, 10 improved, 1 at own request, and 2 refused treatment.

Considering the fractures of the neck there were 10 females and 5 males, with ages ranging from 14 to 84 years (average 64½). All were simple fractures produced by indirect violence. The time in the hospital ranged from 2 to 29½ weeks (average 6⅔), while the average time from work of those who survived was 22½ weeks. Of the 8 cases dying in the hospital (5 intracapsular) 6 were females and 2 males, with ages ranging from 65 to 84 years (average 74½). The cause of death was given as 1 each from uræmia, senility and carcinoma of the stomach (autopsy confirmation), 2 from pneumonia, while in 3 it was not stated. A peculiar fact is noted in that 6 of these occurred during the services of 1905 and 1906, but no definite explanation for this was found. The functional and anatomical results are given in Table I.

There were 6 cases of simple fracture through the trochanters (Table II), all being of the male sex and treated non-operatively. Three were caused by direct and 3 by indirect violence. The number of weeks in the hospital averaged 7 with extremes from 4 to 10, while the time from work averaged 34 weeks, varying from 12 to 93. The earning power was less in 4 cases, each having a moderate anatomical result with moderate to bad functional result, while the 2 with the same earning capacity had both good anatomical and functional results.

Of the 5 cases where fracture occurred at the lower end of the femur, again they were all of the simple type produced by direct violence, all males with ages ranging from 6 to 61 years (average 34). One case with bad position of the fragments was plated with resultant good apposition but only moderate return of function. Here the time in the hospital varied from 2 to 11 weeks (average 5½), the patient going out in 2 weeks had the limb in a plaster cast returning later for the removal of the cast. The earning capacity in these cases was the same in 2 and less in 2; the fifth developed delirium tremens and died after 3 weeks. Functional and anatomical results are shown in Table III.

Over half the cases followed were fractures of the shaft, 33 males and 3 females with ages from 3 to 74 years (average 23 1/3). Five of the cases were plated because of the inability to obtain proper re-

[1] Ashhurst, A. P. C.: Fractures Through the Trochanters of the Femur. Annals of Surgery, Philadelphia, 1913, October, p. 495; also, The Prevention and Treatment of the Disabilities Following Fractures of the Limbs. American Journal of Surgery, 1915, xxix, 114.

duction; 3 good and 2 moderate anatomical results followed, and 4 good and 1 moderate functional result. The time in the hospital ranged from 1 day to 59 weeks (average 10 weeks). One case died of shock the day of admission, while another died on the third day of a fractured skull. The disability period was between 8 and 115 weeks (average 16.9), giving 29 good, 4 moderate, and 2 bad functional results from 25 good, 6 moderate and 4 bad anatomical results. The case who stayed in the hospital 59 weeks and was out of work 115, developed delirium tremens, got the leg in bad condition, causing sloughing of tissue, when a cast was applied, with both bad anatomical and functional results. Thirty cases were of the simple type, while Cases 3, 9, 19, 26, and 27 were comminuted, and Case 11 compound, the fracture having been produced by indirect violence (see Figs. 2 to 7). Twenty-four fractures resulted from direct and 12 from indirect violence.

Tables V, VI, VII, VIII, and IX have been compiled so that the various summaries of results, such as age groups, disability periods, etc., of the different classes of fractures may be noted at a glance.

As to treatment the non-operative gave as good results, functionally, as the operative, although the plated cases were selected, which without operation most certainly would have given poor results. Anatomical results were based on röntgenograms when they were employed and in the other cases on the amount of shortening or deformity. The latter is faulty in that good approximation and alignment of the fragments is not necessary for a straight and unshortened limb. The skiagraph is the only accurate basis for our conclusions, but unfortunately not all had röntgenograms after completed treatment.

The mortality of 11 cases was not due directly to the fracture of the femur excepting in the one dying from shock, while in a number of the others it was a contributing factor.

In conclusion from the facts gathered:

1. Fractures of the neck were more frequent in the aged of the female sex, indirectly cause a high mortality because of the age of the patient and the lowered resistance, and give a moderate disability period.

2. Fractures through the trochanters were all males and gave a long disability period with lowered earning capacity in two-thirds of the cases.

3. Fractures of the lower end of the femur gave an average disability of about 6 months while a good functional result was obtained in about one-half of the cases. They were all males.

4. Fractures of the shaft gave the best results and had the shortest disability period. They were the most frequent and were mostly males.

5. The mortality from fractures of the femur other than of the neck was low, being about 2 per cent. in this series.

FIG. 1.—J. F., aged fifty years, who had broken his left femur shaft thirty years previous to this X-ray. He has two and one-half inches shortening, wears a high shoe and makes good wages, but says he could make one-third more if not for his disability. He has some pain in region of fracture during damp weather. Plate shown to illustrate the way nature cares for defects, giving moderate functional result.

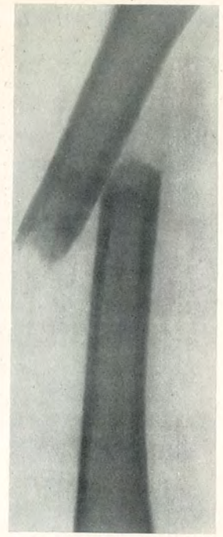

FIG. 2.—Case 11 of Table IV, under Fractures of the Shaft, which was compound. E. F., girl seven years of age. Lateral view before setting under ether. Had 3 cm. shortening. Left femur.

FIG. 3.—Same case as Fig. 2. Anteroposterior view before setting under ether.

FIG. 4.—Same case as Fig. 2. Lateral view after setting under ether.

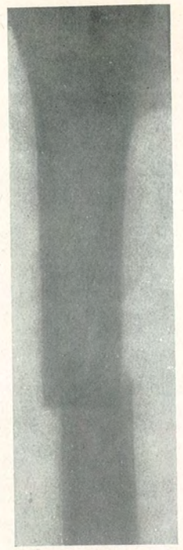

FIG. 5.—Same case as Fig. 2. Anteroposterior view after setting.

FIG. 6.—Same case as Fig. 2. Lateral view six months after setting.

FIG. 7.—Same case as Fig. 2. Anteroposterior view six months after setting.

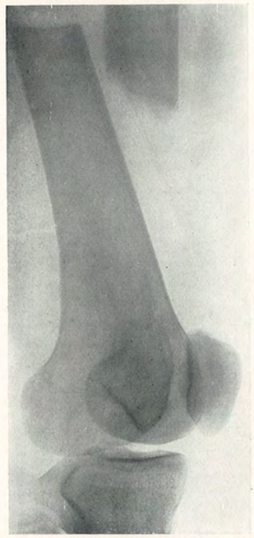

FIG. 8.—G. O'N., twenty years of age, fracture of femoral shaft. Lateral view.

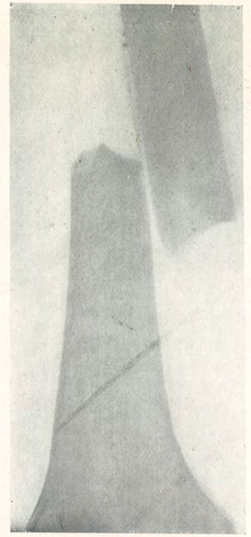

FIG. 9.—Same case as Fig. 8. Anteroposterior view.

FIG. 10.—Same case as Fig. 8. Dr. C. H. Frazier's service, Episcopal Hospital. Operated by Dr. A. P. C. Ashhurst, November 17, 1914, with good result. X-ray of limb four weeks after Lambotte plate was applied.

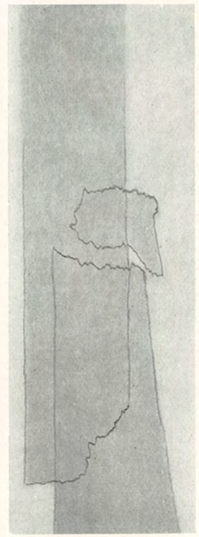

FIG. 11.—F. R., twenty-six years of age. Fracture of femur.

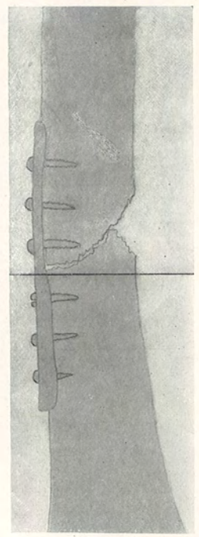

FIG. 12.—F. R. Same as Fig. 11, six weeks after operation (late).

TABLE I

FRACTURES OF NECK OF FEMUR

No.	Sex	Age	Treatment		X-ray		Weeks in hospital	Weeks from work	Earning power	Functional result			Anatomical result			Died
			Operative	Non-operative	Early	Late				Good	Mod.	Bad	Good	Mod.	Bad	
1	M	14	..	C	*	*	6	10	Same	*	..	..	*	..	..	
2	M	30	..	†	*	..	4	30	Less	..	..	*	..	..	*	
3	F	58	..	†	*	*	29½	Idle	Idle	..	*	..	..	*	..	
4	F	60	..	E and L	..	..	6	24	Same	*	..	..	*	..	..	
5	M	63	..	E	..	..	11	Idle	Idle	*	..	..	..	*	..	
6	M	65	..	†	..	..	2½	..	..	..	..	..	..	..	..	Pneumonia.
7	F	67	..	E	..	*	6½	26	Same	*	..	..	*	..	..	
8	F	70	..	E	*	..	17	..	..	..	..	..	..	..	..	Uræmia.
9	F	70	..	†	*	..	2	..	..	..	..	..	..	..	..	Cause not stated.
10	F	74	..	C	*	..	2½	..	..	..	..	..	..	..	..	Carcinoma of stomach.
11	F	75	..	E and C	..	..	3	..	..	..	..	..	..	..	..	Senility.
12	F	76	..	†	..	..	4	Idle	Idle	..	*	..	..	*	..	
13	F	77	..	†	..	..	6	..	..	..	..	..	..	..	..	Cause not stated.
14	M	82	..	E	..	..	2	..	..	..	..	..	..	..	..	Cause not stated.
15	F	84	..	†	..	..	2	..	..	..	..	..	..	..	..	Pneumonia.
Total	M F	Ave.					Ave.	Ave.	Same 3							
15	5 10	64½	0	15	6	3	6⅔	22½	Less 1	4	2	1	3	3	1	8
									Idle 3							

NOTE.—Case 3 died 3 years later. Case 5 died 5½ years later.

Key to tables:

Mod.=Moderate.
B=Buck's extension.
L=Lateral extension.
VE=Vertical extension.
C=Plaster-of-Paris cast.
H=Hamilton splint.
S=Splint.
Splint=Coaptation splint.
SB=Sand bags.
†=Type not stated.
Idle=Not working, being too old or for other cause.
*=Time X-rays were taken and end result in each case.

TABLE IV
Fractures of Shaft of Femur

No.	Sex	Age	Treatment: Operative	Treatment: Non-operative	X-ray: Early	X-ray: Late	Weeks in hospital	Weeks from work	Earning power	Functional result: Good	Functional result: Mod.	Functional result: Bad	Anatomical result: Good	Anatomical result: Mod.	Anatomical result: Bad	Died
1	F	3	..	E	*	..	7	13	Same	*	..	..	*	..	..	
2	M	3	..	VE	*	..	8	8	Same	*	..	..	*	..	..	
3	M	3	..	H and E	*	..	8	8	Same	*	..	..	*	..	..	
4	M	4	..	E and C	..	..	9	12	Same	*	..	..	*	..	..	
5	M	4	..	E and C	..	..	6	9	Same	*	..	..	*	..	..	
6	M	5	..	E	*	*	9½	11	Same	*	..	..	*	..	..	
7	M	5	..	H and E	*	*	8	9	Same	*	..	..	*	..	..	
8	M	6	..	H and E	*	..	12	17	Same	*	..	..	*	..	..	
9	M	6	..	H and E	*	..	6	8	Same	*	..	..	*	..	..	
10	M	6	..	C	*	..	7	9	Same	*	..	..	*	..	..	
11	F	7	..	E and C	*	*	8	10	Same	*	..	..	..	..	*	
12	M	7	..	H and E	*	..	11½	11½	Same	*	..	..	*	..	..	
13	M	8	..	E and SB	..	..	8½	13	Same	*	..	..	*	..	..	
14	M	10	..	E	..	..	6	9	Same	*	..	..	*	..	..	
15	M	11	Plate	....	*	*	11	14	Same	*	..	..	*	..	..	
16	M	13	..	E and C	*	..	6½	12	Same	*	..	..	*	..	..	
17	M	13	..	C	..	..	7	14	Same	*	..	..	..	*	..	
18	M	14	Plate	....	*	*	15	19	Same	..	*	..	*	..	..	
19	M	15	..	E	*	*	12½	30	Same	*	..	..	..	..	*	
20	M	16	Plate	....	*	*	12	20	Same	*	..	..	..	*	..	
21	M	18	..	Splint	*	*	13	17	Same	*	..	..	*	..	..	
22	M	18	..	Splint	*	*	13	17	Same	*	..	..	*	..	..	
23	M	21	..	†	..	..	1 day	..	....	..	..	..	..	..	..	Shock.
24	M	23	Plate	....	*	*	13	21	Same	*	..	..	..	*	..	
25	M	34	..	E and C	..	..	7½	19	Less	..	*	..	*	..	..	
26	M	34	Plate	....	*	*	10	26	Same	*	..	..	*	..	..	
27	M	38	..	Splint	*	*	8	24	Same	*	..	..	*	..	..	
28	M	45	..	C	..	..	9	20	Same	*	..	..	..	*	..	
29	M	47	..	E and C	*	*	59	115	Less	..	..	*	..	..	*	
30	M	50	..	†	..	..	3 days	....	....	..	..	..	..	..	..	Fractured skull.
31	M	50	..	C	..	*	6	12	Same	*	..	..	*	..	..	
32	M	50	..	E and SB	*	*	6½	9½	Same	*	..	..	*	..	..	
33	M	52	..	HE and C	*	*	7	21	Same	..	..	*	..	..	*	
34	M	53	..	E	..	..	15	26	Less	..	*	..	..	*	..	
35	M	73	..	E and C	*	*	14	Idle	Same	..	*	..	..	*	..	
36	F	74	..	†	..	..	7	Idle	Same	*	..	..	*	..	..	
Total 36	M F 33 3	Ave. 23⅓	5	31	24	17	Ave. 10	Ave. 16.9	Same 31 Less 3	28	4	2	24	6	4	2

TABLE II
Fractures Through Trochanters

No.	Sex	Age	Treatment: Operative	Treatment: Non-operative	X-ray: Early	X-ray: Late	Weeks in hospital	Weeks from work	Earning power	Functional result: Good	Functional result: Mod.	Functional result: Bad	Anatomical result: Good	Anatomical result: Mod.	Anatomical result: Bad	Died
1	M	42	..	S and C	*	..	8	27½	Less	..	*	..	..	*	..	
2	M	45	..	B	*	..	6½	12	Same	..	*	..	..	*	..	
3	M	48	..	B	*	..	4	48	Less	..	*	..	..	*	..	
4	M	54	..	B	*	..	4½	9½	Same	*	..	..	*	..	..	
5	M	54	..	B and S	*	..	10	93	Less	..	*	..	..	*	..	
6	M	70	..	†	*	..	8	over 14½	Less	..	*	..	..	*	..	
Total 6	6	Ave. 52	0	6	6	0	Ave. 7	Ave. 34	Same 2 Less 4	2	2	2	2	4	0	

TABLE III
Fractures of Lower End of Femur

No.	Sex	Age	Treatment: Operative	Treatment: Non-operative	X-ray: Early	X-ray: Late	Weeks in hospital	Weeks from work	Earning power	Functional result: Good	Functional result: Mod.	Functional result: Bad	Anatomical result: Good	Anatomical result: Mod.	Anatomical result: Bad	Died
1	M	6	..	C	*	..	4	4	Same	*	..	..	*	..	..	
2	M	30	..	B and C	*	..	11	7½	Same	*	..	..	*	..	..	
3	M	35	Plate	....	..	..	11	28	Same	*	..	..	*	..	..	
4	M	38	..	B and C	*	..	34	34	Less	..	*	..	..	*	..	
5	M	61	..	†	..	..	2	28	Less	..	*	..	..	*	..	
Total 5	5	Ave. 34	1	4	3	0	Ave. 5½	Ave. 23½	Same 2 Less 2	2	1	1	3	1	0	Delirium tremens.

TABLE V

FRACTURE OF FEMUR

FRACTURE LEVEL ACCORDING TO AGE WITH AVERAGE DISABILITY IN WEEKS

FRACTURE LEVEL	Total	Under 15 years		15 to 45		45 to 60		60 and over	
		Non-operative	Operative	Non-operative	Operative	Non-operative	Operative	Non-operative	Operative
Neck	15	1	..	1	..	..	..	12	..
Trochanters	6	..	..	1	..	4	..	1	..
Upper	5	2	..	2	1	..	..	..	..
Middle	28	13	2	4	1	7	..	1	..
Shaft, lower	1	..	..	..	..	..	..	1	..
?	2	1	..	..	1	..	..	..	..
Total	(36)	(16)	(2)	(6)	(3)	(7)	..	(2)	..
Lower end	5	1	..	2	1	..	..	..	..
Sum totals	62	18	2	10	4	11	0	15	0
Average disability		10	....	30 27.5	....	....	....	....	....
		....	....	....	....	....	....	25 14.5	....
		....	....	....	....	....	....	....	....
		....	....	....	....	....	....	....	....
		....	....	....	....	....	....	....	....
		11.3 4	....	....	21.7 22	....	....	....	Over 52.*

* The 11 cases which died early are not considered in Average Disability.
? Region of shaft not stated.

TABLE VI

FRACTURE OF FEMUR

DISABILITY PERIOD ACCORDING TO ANATOMICAL RESULT AND AGE

	Total	Anatomical result				Under 15 years	15–45	45–60	Over 60
		Good	Moderate	Bad	Died				
Under 6 weeks	11	1	..	..	10	1	1	1	8
6 to 12 weeks	16	16	..	..	..	12	..	4	..
3 to 6 months	19	11	5	2	1	7	7	2	3
6 to 9 months	8	4	3	1	..	..	6	1	1
9 to 12 months	1	..	1	..	..	..	..	1	..
Over 12 months	4	1	2	1	..	..	..	2	2
Not stated	3	..	3	..	..	..	..	1	2
Total	62	33	14	4	11	20	14	12	16

TABLE VII

FRACTURE OF FEMUR

FUNCTIONAL AND ANATOMICAL RESULTS ACCORDING TO AGE (NON-OPERATIVE AND OPERATIVE)

	Total	Under 15		15 to 45		45 to 60		60 and over	
		Non-operative	Operative	Non-operative	Operative	Non-operative	Operative	Non-operative	Operative
Functional:									
Good	36	18	1	5	3	5	..	4	..
Moderate	9	..	1	2	1	3	..	2	..
Bad	6	..	..	2	..	3	..	1	..
Death	11	..	..	1	..	1	..	9	..
Anatomical:									
Good	33	17	2	5	2	4	..	3	..
Moderate	14	1	..	2	2	5	..	4	..
Bad	4	..	..	2	..	2	..	..	..

TABLE VIII

FRACTURE OF FEMUR

FUNCTIONAL RESULTS ACCORDING TO ANATOMICAL RESULTS

	Total	Functional		
		Good	Moderate	Bad
Anatomical:				
Good	33	30	3	..
Moderate	14	5	6	3
Bad	4	1	..	3
Total	51	36	9	6

TABLE IX

FRACTURE OF FEMUR

SUMMARY TABLE

Location	Number	Sex: Male	Sex: Female	Age in years: Average	Age in years: Old	Age in years: Young	Treatment: Operative	Treatment: Non-operative	Time in hospital in weeks: Total	Time in hospital in weeks: Average	Time in hospital in weeks: Long	Time in hospital in weeks: Short	Weeks absent from work: Total	Weeks absent from work: Average	Weeks absent from work: Long	Weeks absent from work: Short	Earning capacity: Same	Earning capacity: Less	Functional result: Good	Functional result: Moderate	Functional result: Bad	Anatomical result: Good	Anatomical result: Moderate	Anatomical result: Bad	Died
Neck	15	4	11	64½	84	14	0	15	100	6⅔	29½	2	90	22½	30	10	7	8	4	2	1	3	3	1	8
Trochanter	6	6	0	52	88	46	0	6	41	7	10	4	204	34	91	9½	2	4	2	2	2	2	4	0	0
Shaft	36	33	3	23⅓	74	3	5	31	362	10	59	½	571	16⅙	115	8	31	5	29	4	1	25	6	4	2
Lower extremity	5	5	0	34	61	6	1	4	27½	5½	11	2	94	23½	34	4	2	2	2	1	1	3	1	0	1
Totals	62	48	14	37	88	3	6	56	530	9	59	½	959	20	115	4	42	19	37	9	5	33	14	5	11

	Under 15 years	Over 15 years
Neck	1	14
Trochanters	0	6
Shaft	19	17
Lower end	1	4

Result of Operated Cases

Shaft.....4 good and 1 moderate functional.
4 good and 1 anatomical moderate.
Lower end.....1 good anatomical and moderate functional.

NOTE:
Neck.....
Trochanters.....
Shaft.....
Lower end.....

DR. A. P. C. ASHHURST said it is surprising to find, in these two series of fractures of the leg bones and of the femur, that there is very little difference in the period of disability. One is apt to think of a longer period of disability following fractures of the thigh than those of the leg. He had recently been going over hundreds of case reports of fractures for the American Surgical Association, and had found that the period of disability in all fractures was much longer than is commonly supposed. Such results are not very creditable. It is only by studious and painstaking investigations such as these of Dr. John and Dr. Steinke that one is able to realize that the patients are by no means cured when they leave the hospital, but that often a long period of disability follows. It should be the object of surgeons not only to get good functional results, but to get such results in as short a time as possible.

DR. JOHN B. ROBERTS said that what Dr. Ashhurst had said was perfectly true and the reason is perfectly plain. Surgeons do not get good results in fractures of the lower extremity because most of these cases are put to bed and are not given mobilization early and massage all the time as is more apt to be done in fractures of the upper extremity. There are many illustrations to be found showing how few cases of fractures of the lower extremity are properly taken care of by orderlies, nurses and resident physicians; whereas, similar injuries of the upper extremity are more apt to be seen not only by the resident physician, but also by the chief. A study of the results reported by the British Fracture Committee and the reports of the Committee on Fractures of the American Surgical Association, shows that the great faults in the treatment of fractures are (1) want of anæsthesia and reduction; (2) want of early mobilization and gentle massage. It is not only the fractured bone that needs treatment always; but also the soft parts surrounding and near the bone. The neglect of the soft parts is largely responsible for many poor functional results. He had in his possession a series of pictures and clinical reports, obtained some years ago, in which there is very great anatomic deformity according to the photographs and X-ray prints, but good functional result. These patients were treated by men who believed in early mobilization and massage, but did not pay as much attention to the anatomical reconstruction of bones at the point of fracture as many American surgeons are accustomed to do. The great defects in treatment of fractures of the lower extremities have been, neglect of reduction under general anæsthesia, poor attention to the soft parts, and the want of proper early mobilization and light massage from the

very beginning,—light massage, not the vigorous motions and kneadings used by the average graduate of a massage school for lazy manhood and overfed women. The fragments should first be put in place under anæsthesia, and then the soft parts given as much attention as surgeons have usually given to bad sprains and formerly gave to the bones alone in fractures which they personally treated in private practice. Such methods will greatly lessen the need for direct metallic fixation of broken bones. Post-graduate teaching should emphasize the non-operative treatment of fracture and hospitals should provide proper ward service for these injuries.

Dr. Gwilym G. Davis emphasized the point to which Dr. Ashhurst had called attention, namely, the period of cure, particularly in relation to the question of treatment. The charter of most hospitals requires that a person must be admitted to the hospital if application is made within twenty-four hours of the injury. The treatment of fractures by operative means is probably the result of the effort to shorten the period of disability. This attempt is going to be more definitely emphasized on account of the passage of the workmen's compensation act. There should be more definite means of treating patients after they have been discharged from the general hospital and have become walking patients until the time they are again able to resume work.

SARCOMA OF THE CLAVICLE AND THE SCAPULA

Dr. A. Bruce Gill reported the following case which occurred in the orthopædic service of Dr. Ashhurst at the Episcopal Hospital.

A woman aged fifty-one years presented herself complaining of a lump on her left shoulder and of pain in the shoulder, particularly on motion. The mass had first appeared about 4 weeks before her coming to the clinic and had gradually increased in size. For 2 years prior to her admission she had been having pain in her left shoulder on motion of the arm. This pain was sharp, paroxysmal, and was referred down the arm. It was relieved by heat and increased by massage and motion. The patient could ascribe no cause for the pain and the appearance of the tumor and stated that she had never suffered any injury to the arm or shoulder.

She was admitted to the Hospital on July 28, 1914. She was pale and poorly nourished and had been losing weight. On the top of her left shoulder in the neighborhood of the acromioclavicular joint was a mass about 1½ inches in diameter, rounded, soft, fluctuating, slightly red and warm, and slightly tender. It was not painful except on motion

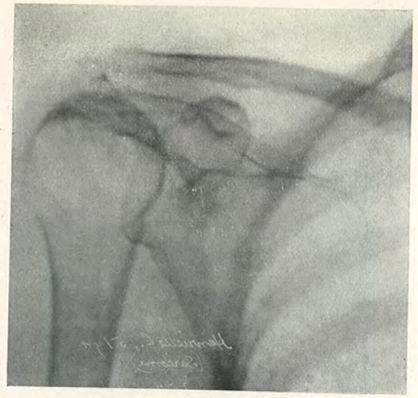

Fig. 1.—Sarcoma of clavicle.

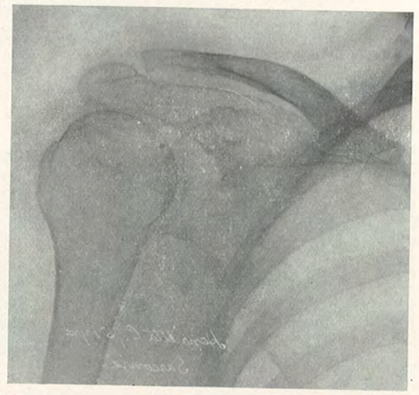

Fig. 2.—Sarcoma of clavicle, four months after first operation.

Fig. 3.—Recurrence three and one-half months after first operation (November 5, 1914).

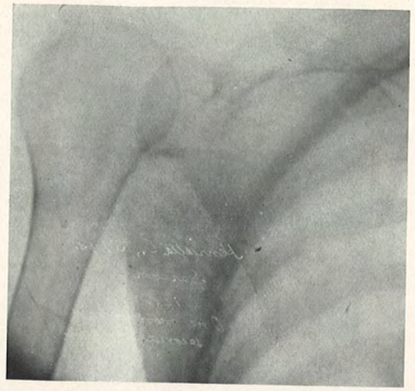

FIG. 4.—Sarcoma of clavicle, after excision of outer end of clavicle, acromion and coracoid.

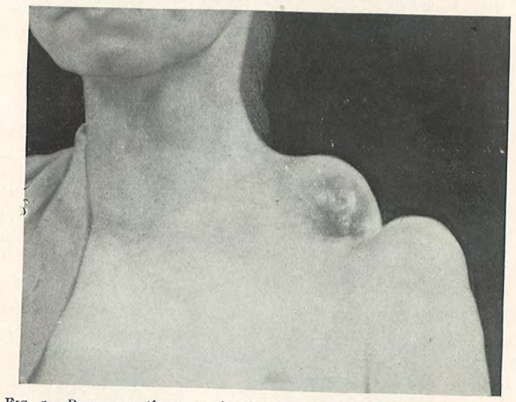

FIG. 5.—Recurrence three months after second operation (February 8, 1915).

of the shoulder when the pain became severe. The X-ray plate (Fig. 1) showed a mass about the acromioclavicular joint with possibly slight atrophy of the acromion and the acromial end of the clavicle. A tentative diagnosis of tuberculous abscess was made.

Operation was performed on July 29, 1914, by Dr. Gill. A curved incision was made in front of the tumor and a skin flap dissected upward. The tumor lay close beneath the skin and was soon penetrated. A mass of soft tissue resembling a soft blood clot in consistency but grayish in color oozed out abundantly. Hemorrhage was quite free. The tumor mass was cleaned out as thoroughly as possible with finger, sponges, and curette. It seemed to be enclosed in front, at least, by a thin capsule lined with large veins. The lower surface of the acromial end of the clavicle felt roughened. Otherwise there appeared to be no other bony origin of the tumor. Bleeding was controlled by packing tightly with iodoform gauze and a few sutures were placed to close the incision in part. Diagnosis was made of sarcoma of the clavicle. Microscopic section of the tumor showed it to be of the spindle-celled variety.

The use of Coley's fluid was begun shortly after the operation and was continued in ascending doses until considerable reaction was produced. The wound healed on August 18, 1914. But in less than 2 months the tumor gave evidence of recurrence (Figs. 2 and 3). On November 7, 1914 Dr. Ashhurst operated and removed in one mass a third to a half of the clavicle, the acromion, and the coracoid process together with the surrounding soft tissues. More of the deltoid and trapezius muscles were then removed until no evidence of tumor remained. The skin was approximated and sutured with the arm abducted to a right angle.

The use of Coley's fluid was continued, and the wound was healed by December 19, 1914 (Fig. 4). About the middle of January the tumor appeared to be recurring in the trapezius and the scapula.

On February 8, 1915 the tumor appeared as shown in Fig. 5. At this time the mass was dark in color, owing to hemorrhage within the tumor substance. She was readmitted for operation. Spontaneous rupture of the tumor occurred after her admission and about a pint of blood was lost before the hemorrhage could be controlled by packing.

On February 17, 1915, Dr. Ashhurst performed the third operation consisting of complete excision of the scapula with the exception of the lower angle and the glenoid, and of the trapezius half way to the occiput. Very little hemorrhage occurred owing to the fact that the line of incision was carried wide of the tumor. Part of the clavicle was

removed although it did not appear to be involved in the tumor. The brachial plexus was freely exposed, but was not injured in the operation. The skin was approximated and sutured again with the arm in abduction.

The patient failed to recover consciousness after the operation and died three hours later. Autopsy showed sarcomatous metastases in the lungs.

Coley has reported 10 cases of sarcoma of the clavicle. Of these 8 gave a distinct history of antecedent trauma. In the case recorded above there is no such history. Coley in his report (ANNALS OF SURG., 1913, p. 556) of a case discusses the literature briefly and confirms his conclusions expressed in 1910 that:

1. Primary sarcoma of the clavicle is one of the most malignant of all neoplasms.
2. While a rare condition, it requires early diagnosis and very radical treatment.
3. The mortality of the operation itself should be small.
4. The danger of local and general metastases is very great.
5. The use of Coley's fluid is strongly indicated as a routine measure immediately after operation.

GIANT-CELL SARCOMA OF PELVIS

DR. GUY BLAIR DENIT reported the case of a lad, fourteen years of age, who was admitted to the Orthopædic Hospital under the care of Dr. A. P. C. Ashhurst. He was complaining of severe pain in the right hip and small of the back. Six weeks previously he had strained his back by lifting one end of an elevator weight, weighing 300 pounds. That night he suffered severe pain in his back radiating from the lumbar region to the right hip. In several days the pain ceased. One month later, while playing at school, he was knocked down and struck his right lumbar region against a stone wall. This caused him much pain and he was taken home and put to bed. He remained in bed for a time, and then on crutches until December 1. On December 1 he was taken to a hospital and treated for rheumatic arthritis of the right hip. He was admitted to the Orthopædic Hospital on December 28. On admission he was suffering with severe pain in the right lower quadrant of the abdomen and in the right hip. His pain was paroxysmal in character, lasting an hour or more at a time. He was a fairly well nourished boy about average size for age.

In lumbar region on the right side there was a large mass, semisolid in consistency, occupying the whole of the right lumbar region and right

lower quadrant of the abdomen. On palpation this mass was extremely tender.

An incision was made through the bulging mass in the loin, and a portion of the tumor was excised and sent to the laboratory for examination. The wound was sutured and drained without further operative procedure.

One specimen of the tumor was examined by Dr. C. Y. White, director of the Pathological Laboratories of the Episcopal Hospital, and another by Dr. E. P. Corson White, Pathologist to the Orthopædic Hospital. The report from both laboratories was that the tumor was a giant-cell sarcoma.

Matthew J. Stewart (*Lancet*, ii, 1236) gives the following classification of giant-cell sarcoma: "Giant-cell sarcoma is used in its widest sense as a term to include all sarcomata in which giant-cells of blastomatous origin constitute an important part, it may be the essential feature of the microscopic picture. This large class is made up of two groups of cases: (1) the myeloid sarcomata (myelomata of some authors) and (2) the malignant giant-cell sarcomata. The latter are equivalent to mixed-cell sarcomas, as there are cells of all sizes, but in some the giant-cells are so numerous as to justify special recognition in the term used. Giant-cells of the myeloid sarcoma resemble osteoblasts and clasts, not myeloplaxes or mononuclear giant-cells or bone marrow. Cytoplasm is abundant especially at periphery and presents a homogeneous ground glass appearance. Vacuoles mostly peripherally situated are often present and may be of large size when they not infrequently contain cell inclusion. The nuclei are uniformly small in size and when not closely packed together are round or oval in shape. There are no mitoses in these giant-cells even when mitoses are present in cells forming matrix of the tumor. The nuclei in smaller giant-cells and in many of the larger are uniformly distributed through the cytoplasm, but in larger giant-cells they often are grouped in the centre in 'whorls.' The peripheral ring-like distribution of the nuclei, so characteristic of tubercular giant-cells, is practically unknown in cases of myeloid sarcoma. N. B. There are no transitional forms between the giant-cells and other cellular constituents of the growth, every cell is either a giant-cell or not a giant-cell without any doubt whatever.

"In malignant giant-cell sarcoma, as in myeloid sarcoma the stroma may be round, spindle or mixed celled, and as in it the number of giant-cells varies greatly in different parts of the same growth. Cells of the stroma are very irregular and almost always one can find transition forms from smallest to the largest. Mitoses are very frequent both in

giant-cells and in the matrix. The giant-cells and especially their nuclei are the chief distinguishing characteristics. The nuclei are extremely irregular in size and shape, often presenting lobes and indentations while most of them are of large size. Enormous nuclei may be met with and the giant-cells may be mononuclear. The number of nuclei seldom exceeds six, and most cells have from one to five only. Usually they are clumped together and it may be difficult to count them precisely. Vacuolation of cytoplasm is rare."

The tumor in this case belonged to the first group of cases, the myeloid sarcomata.

On January 22, three weeks after the operation the first injection of Coley's fluid was administered. The first injection, 1/10 minim, was given into the buttocks. Seventeen weeks after the beginning the dosage had been gradually increased until minims 42 were being given. At no time during these weeks were the reactions severe. He was then given a rest from treatment for a period of three weeks, at the end of which time the injections were resumed, beginning with minims 42 and gradually increasing the dosage until minims 48 were being given. Again he was given a rest over a period of three weeks, at the end of which time the injections were resumed, beginning with minims 48. From this time on the reactions were rather severe, the temperature often going above 102° and at times reaching 103.2°. Chills accompanied the temperature and there was always severe pain at the site of the needle puncture.

The injections were discontinued on September 18, 1914, eight months after the beginning of the treatment, at which time he was given minims 56. This caused a severe reaction, the temperature going up to 103.8°, and a severe chill accompanied the temperature. However, his condition was at no time alarming.

As stated before, the injections were given over a period of eight months with only six weeks rest from treatment. As a rule these injections were given every other day; however, three or four days often elapsed between injections.

The fluid was first injected into the buttocks. First on one side and then on the other. They were then given nearer and nearer the tumor until the tumor in the loin itself was injected. There was always severe pain at the site of the needle puncture and often marked skin reactions. The constitutional reactions were on the whole very mild, but at times they were rather severe. At no time was it necessary to give stimulants, but morphine, codeine and aspirin were frequently given for the relief of pain. At no time were the injections given daily. Twice the patient

was given a rest of three weeks from treatment, during which time his general condition improved a great deal. The bowels were always kept open and tonics were given at intervals during the treatment. The injections were given deeply in and around the tumor in the loin and at no time were the reactions so severe as to cause alarm.

The directions as prepared by Dr. Coley were followed except as to dosage; as stated before, the first injection was minim 1/10, and the highest dosage was minims 56, this being, so far as I can find out, the highest dosage of the fluid that has ever been administered. In a recent letter received from Dr. Martha Tracy, of Germantown, Phila., whose preparation of Coley's fluid was used, she states that the highest dosage that has been administered by Dr. Coley himself was minims 26, but states that she knows of one surgeon who has given as high as minims 30. She further states that Dr. Coley believes there are few cases in which minims 26 would be safe. In a statistical study prepared by Dr. Tracy she finds about ten per cent. of the cases of sarcomata in general are benefited by the treatment.

Results of the treatment. As to the actual time in which the tumor began to diminish in size it is somewhat difficult to state owing to the position of the tumor. However, there was marked diminution in the pain two weeks after the first injection, at which time the patient was allowed to sit up several hours daily. Soon after this he was able to walk around the ward without discomfort, but he had a distinct limp on the right side. There was always a local reaction at the site of the tumor when the injections were made into it. This mass retained its somewhat semisolid consistency until the last of September, at which time it began to become softer and softer and increased in size. Several days later the mass broke down and discharged through the scar of the incision in the loin. From this time the mass in the loin diminished in size and became harder and harder in consistency and at the time the injections were discontinued the mass had the consistency of a bony tumor. This tumor seemed to be adjacent to the fourth and fifth lumbar vertebræ in the right loin.

The patient was discharged November 10, 1914. He had none of the symptoms which were so prominent on admission. No tumor could be palpated through the abdominal wall, the mass in the loin had decreased in size and assumed the form of a bony tumor. There was no pain on walking or running. His general health had improved a great deal. A skiagraph taken at this time shows a small tumor adjacent to the fourth and fifth lumbar vertebræ.

On December 1 the patient was readmitted to the Hospital for

examination. There was no sign of an increase in the size of the tumor. There had been no return of pain or lameness. A skiagraph taken at this time shows the tumor to be about the same as at the time of his discharge in November.

At the present time the patient goes to school, he rides a bicycle, plays base-ball and has no difficulty in running and playing. There has been no return of pain. He now weighs 103 pounds; while at the time of his discharge he weighed 76½ pounds. A skiagraph taken May 1, 1915, shows that there has been no change in the size of the tumor since his discharge in November, 1914.

Dr. A. P. C. Ashhurst called attention to the marked contrast between the cases reported by Dr. Gill and by Dr. Denit, the former a typically malignant sarcoma, and the latter a so-called giant-cell sarcoma. In both the tumor was curetted, and the patients were treated by Coley's fluid. In both patients, likewise, the tumors recurred after operation in spite of this treatment. But in the case of the woman (Dr. Gill's case) death followed the operation for the second recurrence, only 7 months after the first operation; while in the boy (Dr. Denit's case) the recurrent tumor gradually melted away under the influence of the toxins, seemed to become more and more bony, and the patient is at present apparently in perfect health, more than 7 months after cessation of treatment, and 17 months after the first and only operation.

As to the real nature of giant-cell sarcomas, many papers have been written by surgeons setting forth their views; but the pathologists really are wiser, for like Socrates they admit that they know nothing. In the *Lancet* some months ago is a paper by Stewart (*Lancet*, 1914, ii, 1236), the Clinical Pathologist at the Leeds General Infirmary, based on a study of about 50 cases of giant-cell sarcoma. He concludes that the benignancy or malignancy of the tumor can be predicated absolutely upon the characters of the giant-cells present; whereas it is Bloodgood's contention that it is the stroma which is especially characteristic, and that in the benign growths it resembles granulation tissue. Then there is Barrie of New York (Annals of Surgery, 1913, i, 244) who goes still further, claiming that it is really granulation tissue, and calling the disease hemorrhagic osteomyelitis.

AN ANATOMICAL STUDY OF FEMORAL HERNIA *

TOGETHER WITH A REPORT OF SIX CASES OF INGUINAL HERNIA OF SPECIAL INTEREST THREE WITH PROTRUSION OF THE BLADDER

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of Philadelphia

Interesting herniæ are rather frequent in the surgical service of the Philadelphia General Hospital. All but one of the cases upon which the present report is based were operated on last year during a three months' service and that of Dr. A. C. Wood, to whom I am indebted for the privilege of operating on and reporting the cases admitted to his service. I shall briefly report, first, the inguinal hernia with some important facts concerning bladder hernia, taken from Eggenberger's excellent paper and not generally accessible, and then present a brief anatomical study of femoral hernia.

Case I.—*Inguinal hernia with cystocele.* Man, fifty-eight years, admitted to service of Dr. A. C. Wood February 20, 1914, with a right-sided, direct, inguinal hernia of about two years' duration. Bassini operation the following day. The sac was opened to facilitate the stripping of it from the surrounding tissues, during which there was seen to its inner side, in front of the spermatic cord, and not adherent to the sac, a very thin-walled cystic formation suggesting a hydrocele of the cord. It was not tensely filled and seemed to contain a serous translucent fluid which did not escape during the manipulations until it was opened. When a finger was introduced it passed downward and inward into a larger mucosa-lined cavity which was evidently that of the bladder. The opened hernial sac was then closed by gauze, a part of the bladder diverticulum cut away, and the opening in the bladder closed by catgut sutures which inverted the edges without passing through the mucous membrane. The Bassini operation was completed and a small gauze drain left in the inner angle of the wound down to the bladder sutures. Slight abdominal distention followed but soon passed away and the skin sutures were removed on the eighth day, the small, serum-discharging drainage sinus soon closing.

Case II.—*Inguinal hernia with partially descended testicle and vaginal process closed only at internal ring.* Man, forty-five years, admitted to insane department of Philadelphia Hospital,

* Read before the Philadelphia Academy of Surgery, May 3, 1915.

January 3, 1910, when it was noted that he had a right inguinal hernia. Of late it has been giving him trouble. It is the size of a closed fist, reducible, direct, and the testicle on that side is a little below the external ring. Bassini operation, February 23, 1914. After opening what appeared to be the sac of the hernia it was found to be empty and the finger did not pass into the peritoneal cavity but was stopped at the internal ring. Below the testicle projected into it. Flattened out, its width was about two inches. The hernia was behind it and the hernial sac separated from it by loose areolar tissue. Its unusually large lumen was evidently caused by its being spread out gradually during the growth of the hernia underneath to which it was adherent. We had here a so-called infantile congenital hernia in which one must cut through three layers of peritoneum before reaching the contents of the hernia, the first two being those of the unobliterated vaginal process and the third being that of the hernial sac. This condition is very rare, but a congenital hernia into a completely patulous vaginal process is frequently associated with an undescended testicle. The vaginal process in this case was divided just above the testicle, the upper part removed and the lower part closed above the testicle by catgut suture. The Bassini operation was completed as usual. Recovery was uninterrupted except for some swelling of the scrotum which disappeared later.

CASE III.—*Sliding inguinal hernia.* Man, aged thirty-seven years, admitted to my service July 27, 1914, with a left inguinal hernia about the size of the closed fist, of about ten years' duration. Bassini operation July 31. The sac had a wide communication with the peritoneal cavity and contained a large mass of omentum. A considerable portion of the colon uncovered by peritoneum presented in the lower part of the hernia, a sliding hernia. The lower margin of the sac was cut away to its attachment to the colon, the protruding portion of which was turned into the abdominal cavity by suturing the upper margin of the sac to the posterior, extraperitoneal wall of the colon. Bassini operation completed and recovery uninterrupted.

CASE IV.—*Inguinal hernia with small bladder protrusion.* Man fifty-seven years old, admitted to my service July 27, 1914, with a right direct inguinal hernia, about size of a goose egg. Bassini operation August 3, 1914. The sac was surrounded by much fat. In separating this from the sac on its inner side near the neck the adhesions were firm and their separation started more than the usual bleeding which led to the recognition of a small mass firmer than the fat which covered it. From its position on the inner side of the sac and its consistency it was decided that it could only be bladder, and it was not opened. When the neck of the sac

was closed by a catgut ligature and the rest of the sac removed, the stump with the mass retracted downward and inward under the rectus muscle toward the normal position of the bladder. The chief reason for deciding it to be bladder, however, was a previous experience with Case VI, which had been previously operated on. The Bassini operation was completed, the outer edge of the rectus muscle being also sutured to Poupart's ligament. Uneventful recovery.

CASE V.—*Strangulated inguinal hernia, with early operation.* Man sixty-seven years old, a patient in the department for the insane suffering from senile dementia. Had a large, inguinal hernia on the right side, reducible until the morning of August 21, 1914, when it became painful and irreducible and vomiting set in. Operation the same afternoon. The inguinal tumor was hard, tense, tender, reddened and gave no impulse on coughing. The pulse was rapid and the skin covered by cool perspiration. The evidence seemed to show that there had been no bowel movement for two days. Bassini operation. When the constriction at the neck was relieved and the sac opened, much fluid escaped. The intestinal contents were of a dark red color which returned almost to the normal in about fifteen minutes. The Bassini operation was completed and was followed by an uneventful recovery.

CASE VI.—*Recurrent right inguinal hernia associated with an overlooked bladder protrusion and with a femoral hernia on the same side.* Man sixty-eight years old, admitted to service of Dr. A. C. Wood in the Philadelphia Hospital, March 9, 1914. Had the inguinal hernia 12 years when it was operated on in 1907. It recurred about three years ago. Has a femoral hernia on the same side. Operation March 11, 1914. Inguinal hernia first exposed and much scar tissue encountered in exposing the sac which proved to be that of a direct hernia. The spermatic cord which contained much fat was first freed from its bed with the sac, which was then isolated from the abundant surrounding fat, its neck ligated and the rest removed. The femoral hernia was then exposed after drawing the lower margin of the skin and fascial portion of the incision downward. Its sac was surrounded by and adherent to much fat which was stripped from the sac after opening the latter. After ligation of the neck and cutting the rest away the stump retracted upward under Poupart's ligament into the inguinal region. The stripping of the excessive fat from the sac of the femoral hernia and the removal of only the sac left much fat around and over the femoral vein. In clearing this fat from the pectineus fascia and muscle for the closure of the ring much difficulty was experienced in guarding against a possible wound of the femoral vein which lay under the fat. During this stage

of the operation a hemorrhage was started which proved to be coming from a small opening in the wall of the vein. This was closed by a hæmostat and a lateral ligature applied. The pectineus muscle and fascia were then exposed and approximated to Poupart's ligament by two catgut mattress sutures. Attention was then directed to the inguinal portion of the wound, in the inner part of which was much oozing from what seemed to be a mass of fat. This was ligated in mass and the hemorrhage, apparently, controlled. The Bassini operation was completed, the outer edge of the rectus being brought down with the conjoined tendon by the sutures to the lower edge of Poupart's ligament. The dressings were applied and the patient returned to the ward.

I was still in the hospital an hour later when it was reported that the patient was doing badly. Internal hemorrhage was diagnosed and the patient returned immediately to the operating room. As only the wound in the femoral vein was suspected, only the superficial part of the wound was opened, the suture in the external oblique not being removed. A free exposure of the femoral vein and of the whole wound above and below Poupart's ligament showed no signs of bleeding and the wound was again closed. Intravenous infusion, enteroclysis and other stimulation were given. At noon of the following day, twenty-four hours after operation, only two ounces of urine had been voided. At 6 P.M. of the same day a catheter withdrew only five ounces of urine, which contained a considerable percentage of blood that could not be accounted for. The breath sounds over both lungs were very rough. Forty-eight hours after operation the breathing was dyspnœic, and on auscultation harsh sounds and bubbling râles were heard. The patient died on the same day.

The autopsy showed a large collection of blood extending from the operative wound to the space of Retzius and deeper in the pelvis at the right side of the bladder, some being found in the peritoneal cavity. A ligature was found loosely encompassing a small portion of the top of the bladder on the right side. There was also a large amount of blood in both pleural sacs and blood-stained fluid in the pericardial sac, the origin of which could not be explained.

The reopening of the wound proved that the pelvic hemorrhage did not come from the operative opening in the femoral vein, which was then shown to be securely closed. The only explanation left is that the ligature which was supposed to grasp only a mass of fat encircled a small portion of the bladder which is very vascular, the veins being especially large. This ligature, probably, became loosened at the knot or by the pulling away from its grasp of the small included portion of the bladder, which has a

substantial layer of muscle. This would account, also, for the blood in the urine. At the time of operation I had not thought of the bladder being involved. It was this case which led me to seek further information on bladder hernia and to make an anatomical study of femoral hernia.

Bladder Hernia.—There is a fair probability that the bladder in this case, as well as that in Case IV, had not passed out through the hernial orifice, and, therefore, was not actually a part of the hernia, although it was adherent in both cases to the inner side of the neck of the sac. It was the starting of the hemorrhage during the separation of the firm fatty mass from the inner side of the sac in Case IV, which was operated on subsequently to Case VI, that led to the recognition of the bladder. It suggests that the bladder may frequently be found adherent to the inner side of the sac of a direct inguinal hernia.

One finds little attention given to bladder hernia, aside from the vaginal variety which is not considered here, in our books on surgery even in the large systems, and special studies do not appear frequently in the literature. Eggenberger's paper,[1] published in 1908, reports 5 new cases seen in the previous ten years in Wilm's clinic and 105 new cases reported since Brunner's report of 182 collected cases in 1896. It is a fund of information on the subject upon which I shall draw freely in view of the fact that so little information is generally accessible. In my 3 cases the bladder did not project into the hernial sac but in 2 it was closely adherent to the sac. In only 1 of Eggenberger's 110 cases did the summit of a diverticulum of the bladder entirely covered by peritoneum project into the sac, making it a true bladder hernia. Brunner found 5 in his 182 cases. In 25 of Eggenberger's cases, the hernia was said not to have an associated sac. Of the whole number there were 53 per cent. indirect inguinal, 27 per cent. femoral, 17 per cent. direct inguinal, with 2 in the linea alba and 1 in the perineum. The usual size of the portion of bladder involved is that of a cherry to that of a walnut, rarely being as large as a hen's egg or involving half of the bladder. The ureter has been observed in the hernia. In only one of my cases was the bladder abnormally thin, as far as I could determine, and in that one it was exceedingly thin. Eggenberger says that the diverticulum may have one or two muscle layers or merely the mucous membrane, and its wall be so thin as to be mistaken for the hernia sac, which would apply to my case if it were not for the fluid the diverticulum contained. Notwithstanding this retention the finger later easily passed through its communication with the bladder. In Tedenat's case the diverticulum contained pus

which was not found in the urine, although boric solution was forced into the diverticulum from the bladder. Karewski found the communication so small that after the diverticulum had been opened, fluid could not be forced into it from the bladder.

In the other 2 of my cases the bladder protrusion gave the impression of a mass of fat unusually firm. In the reported cases the herniated portion of the bladder was often surrounded by fat which had to be gone through or removed before the bladder was exposed. Frequently a real lipoma was encountered. Monod and Delageniere as well as Lotheissen considered the prevesical lipoma as a constant sign in bladder hernia. Only in exceptional cases was the absence of the fat expressly noted. The percentage of bladder hernia found in all herniæ operated on varied from 1 to 3 per cent., although Becker in 30 cases found it 26 per cent. Lotheissen said that the number observed depends upon the special attention of the operator and the method of operation, the Bassini operation being especially favorable to their exposure. In one of mine it was discovered by the escape of urine during operation, in one at autopsy, which was responsible for my finding it in the third at operation. All three were found during the Bassini operation. In only 2 of Eggenberger's 110 cases and 18 of Brunner's 182 cases, was the bladder hernia recognized before operation.

Incarceration of the bladder by the hernial orifice sometimes occurs. It does not produce the clinical picture of an intestinal incarceration, although it is similar and easily distinguishable by the colicky pains in the region of the hernia or radiating to the thigh; disturbances of micturition; long continued retention; frequent tenderness over the hernia, and occasionally blood in the urine. Reflex gastric colic and vomiting and other reflex irritative symptoms are not infrequently present. Eggenberger believes that intestinal obstruction is not likely to occur, although in one case there was said to be no stool for eight days and fecal vomiting for four days before operation, while at operation only incarceration of the bladder was found.

Of the 45 of his 110 cases in which the presence of the bladder was first recognized during the operation, and was not wounded, only one is reported to have died. In 39 cases in which the blader was first recognized after being wounded and was then sutured, 3 died. In 9 cases in which the bladder was wounded during operation and overlooked, 4 died. The recognition of the bladder during the operation, therefore, becomes important and is easy enough if its presence is suspected. The failure to separate the sac from the tissues on the

inner side as easily as usual and the presence of a more or less adherent lipoma, should excite suspicion. In palpating the mass one may get the feel of two mucous surfaces moving on each other. In most cases the end of a catheter introduced through the urethra can be made to pass into the diverticulum and can be felt through its walls. If this fails the diverticulum may be distended by boric or other solution injected into the bladder. The color and feel of the bladder, if exposed, as well as its continuation in the direction of the normal bladder, will suffice for diagnosis. The fatty accumulation here should receive attention. If the bladder is unexpectedly opened the escape of urine and even if no urine escapes the passage of a catheter will establish a communication with the bladder. If the cystocele is not wounded during an incomplete separation from the sac, it may be included in the ligature of the sac and a part of the bladder be cut away with the sac. The bladder, during a contracture, may then slip out of the ligature and the opening in the bladder may not be detected.

The diagnosis after operation may be made by the occurrence of hæmaturia or anuria soon after the operation, by a temporary urinary infiltration of the wound and fistula formation, or by the development of peritonitis from the presence of urine in the peritoneal cavity. In two of Eggenberger's cases, a second operation was done in time and the bladder wound sutured. The use of a truss is contra-indicated in all cases in which the presence of a cystocele is recognized, because the hernia is usually irreducible and the truss causes irritation, tenesmus, pain, and leads to inflammation and even gangrene. Small cystoceles found first at operation were repeatedly allowed to remain after being reduced without special treatment. If the bladder has strong adhesions to the sac, it is advisable not to attempt to separate them but to cut away the sac to the bladder, close the sac opening by sutures and reduce the cystocele with the sac. The partly changed bladder wall should restore itself to the normal later. The herniated portion of the bladder may be so thin or friable as to require its excision and closure of the opening by sutures, when a drain should be placed down to the suture line in the bladder. If a secure suture cannot be placed on account of the friability of the bladder wall, the edges of the bladder opening can be sutured to the external wound and drained. If after the operation the urine escapes into the operation wound and not into the peritoneal cavity, a fistula forms and usually closes in three to five weeks. To avoid urinary fistula after bladder suture, a permanent catheter in the urethra is serviceable. In the 39 cases in which the bladder was wounded during operation, the permanent catheter was

employed in 19, a fistula forming in 4. Of the 20 cases in which the permanent catheter was not used, 2 died in consequence of unretentive sutures and 7 developed temporary fistulæ.

Femoral Hernia.—The most essential knowledge of this as of any other hernia concerns its anatomy. But the anatomy of this hernia has been so thoroughly studied and so long established that there would seem to be little profit to be expected from studying it further. Its anatomy, however, was established in the days when operations were rare or not done at all, and was based upon theoretical considerations, chiefly. Except for the femoral ring, which I think is the only important part, the canal is made up of a very weak fascia, and in those cases in which the femoral vein is in close contact with Gimbernat's ligament, there can be no femoral canal. It is the innermost compartment of the femoral sheath and its fascial wall is so thin that it can be traced with difficulty. The only practical purpose it ever served, so far as I can learn, is to explain the peculiar course of a femoral hernia, which is first downward under Poupart's ligament, then forward through the saphenous opening, and then slightly upward. That there is a much simpler and more satisfactory explanation for this course and that the femoral ring is very important and the rest of the canal unimportant, will be one of the chief purposes of my study to show.

To study the anatomy of femoral hernia a formalin hardened body is much better than one prepared in the usual manner, because in the former the structures shown by dissection will better maintain the position they occupied in life. The structures most liable to variation are the femoral vessels, because in life they were filled by a fluid which has largely disappeared after death, especially the vein, because of its larger calibre, more flaccid walls and its adjacency to the site of the femoral hernia which is under study, and is disturbed most by the dissection. In none of the formalin hardened specimens, here illustrated, which are from the department of applied anatomy of the University of Pennsylvania, were the veins distended by injection after death, although the arteries were employed for the injection of the preserving formalin solution. Such collapse of the walls of the vein as did occur disturbed very little its relation to the femoral ring, so that we have in these specimens a fair demonstration of the actual condition of the ring in life and the formation of its boundaries, as well as of some of the variations that may be expected.

Modern illustrations made by skilful artists will best emphasize the features of an anatomical illustration, but they are not convincing when there is doubt concerning the accuracy of the anatomy illustrated. The camera would be much more effective if it did not confuse by the mass of unimportant detail and by its failure to bring all parts of the specimen into proper focus. Because of the defects of the camera it will be important to fix attention on the very small part of each illustration under study, the femoral ring or the relation of the femoral vein to the margin of Gimbernat's ligament. A preliminary general study of each illustration will help in making it serve the purpose for which it was intended.

The following reasons for the peculiar course of a femoral hernia have been taken from standard works on surgical anatomy: (1) Slight curve in femoral canal with its concavity forward; (2) narrowing below of the portion of the femoral sheath forming the femoral canal, and the unyielding nature of its adhesion to the lower margin of the saphenous opening and the cribriform fascia; (3) constant flexion of the thigh; (4) traction of the mesentery; (5) the superficial blood-vessels (chiefly veins) and lymphatics descend to the saphenous opening, the veins to join the saphenous vein and the lymphatics to the deeper lymph-nodes, the looping upward tending to suspend a femoral hernia and thus prevent its further progress downward. Let us consider these reasons, briefly, in order. (1) The canal is said to be only a half to three-quarters of an inch long, so that it cannot have much of a curve. (2) The fascial wall of the canal is so thin and weak that it can be found only with difficulty. Regardless of any adhesions it may have, it can offer little or no resistance to the progress of the hernia. (3) Flexion of the thigh should push an inguinal hernia forward and upward if it does so with a femoral. (4) Traction of the mesentery should be no greater than in an inguinal hernia which frequently descends to the bottom of the normal scrotum and sometimes much lower. (5) The blood-vessels referred to (superficial epigastrics) lie external to the course of a femoral hernia and cannot obstruct it, while the lymphatics are so small as hardly to be worth considering. The following explanation, in my opinion, is much more simple and satisfactory and will be best illustrated by the left side of the body shown in Fig. 2. The model illustrated in Fig. 3 will also be of service.

As soon as they pass through the femoral ring, with its three unyielding sides, the hernial contents immediately re-expand. This expansion takes place in all directions except backward, in which direction it cannot expand because immediately behind the hernia is the pectineus muscle resting directly on the pubic bone (see Figs. 4 and 5). Only the skin and weak fascia resist anteriorly so that the whole antero-posterior expansion is forward, and the central axis, therefore, curves

forward. I believe that this central axis does not curve upward, but that the expanding mass simply overlaps Poupart's ligament above (see Figs. 6 and 7), because the narrow neck is just below Poupart's ligament and is curving forward. The intestinal loop in Fig. 3 does curve upward, but we should bear in mind that this represents only a model made to show what some surgeon wanted it to show. Such an intestinal femoral hernia without accompanying omentum is probably uncommon. Rarely the hernia will force its way backward slightly by separating the fibres of the pectineus muscle (see Figs. 2, 4 and 5). This is known as the hernia of Cloquet. Very rarely the hernia escapes outside of the femoral vessels and then is usually also in front of them. Still more rarely it may come down behind the vessels.

The small size and infrequency of the femoral as compared with the inguinal hernia, in all probability is due to the small space through which it must escape from the abdomen and the unyielding margins of this space on three sides. It is a little difficult to understand why the femoral vein does not suffer more from the pressure of the hernial neck with swelling of that limb, as it is on the only side of the neck which can yield much to the pressure. It is likely that it is aided by the attachments of its fascial sheath to Poupart's ligament above and the pubic bone below in accommodating itself to its crowded condition. The size and character of the opening have an important bearing, also, on the nature of the hernial contents. Not infrequently, writers refer to the contents as though they were usually omentum and intestine or one was present as frequently as the other, Da Costa,[2] however, says that femoral hernia contains omentum, but rarely intestine, except in strangulated cases. My study of femoral hernia seems to support this statement, and leads me to regard it as a particularly dangerous hernia because at any time intestine may escape and cause strangulation. The ring may be unusually large, as in Fig. 4, and the intestine escape strangulation. Thomson and Miles[3] say that the hernia is often as small as a cherry or a pigeon's egg and may contain only a small tag of omentum or a portion of the circumference of the bowel—Littre's hernia. Large herniæ containing several coils of intestine are sometimes met with. In my group of cases intestine was not present when the sac was opened in any, except the two which were strangulated, and in both of these a small single loop was surrounded by a much larger mass of omentum. This suggests that both were purely omental until the escape of intestine caused the strangulation. The probability is that in most cases, as soon as the wall of the intestine gets into the ring its circulation is dangerously restricted by the pressure and that

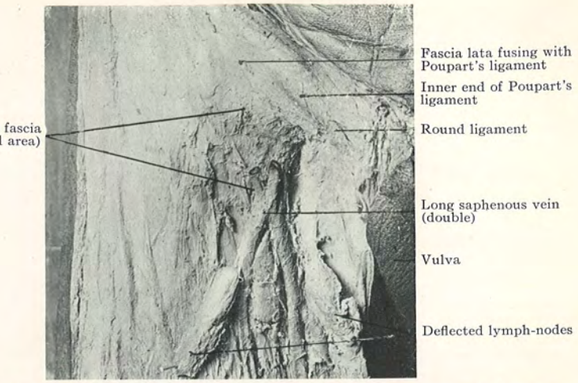

FIG. 1.—Right groin. Skin and superficial fascia removed. Fascia lata fuses with Poupart's ligament and becomes thin (cribriform fascia) where perforated by saphenous vein. Saphenous opening must be made by dissector's knife or scissors. Lymph-nodes which covered cribriform fascia have been deflected.

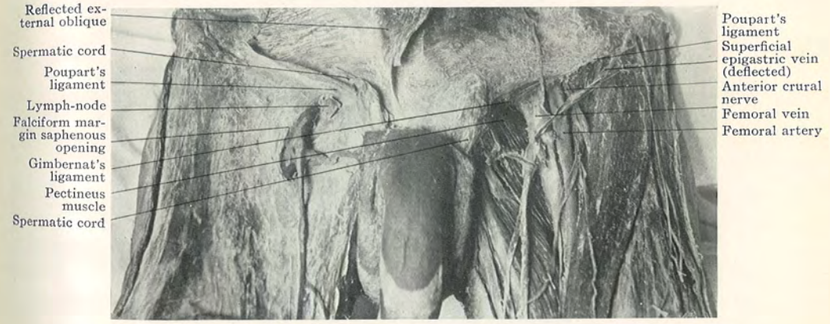

FIG. 2.—Regions of inguinal and femoral herniæ on both sides of body. On right side fascia lata exposed with removal of cribriform fascia, making saphenous opening. Lymph-node resting against femoral ring, but not passing through it as shown in Fig. 10. Portion of external oblique muscle turned inward, leaving Poupart's ligament, internal oblique and spermatic cord in normal positions. On left side fascia lata removed, exposing Scarpa's triangle with its contained structures in normal position. Only Gimbernat's ligament has been touched by paint brush to emphasize absence of any space between it and femoral vein.

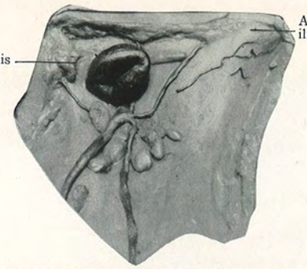

FIG. 3.—Taken from a museum model of a strangulated femoral hernia in the University of Pennsylvania. The small size of the hernia, the single loop of intestine and the turning forward of the hernia are characteristic. The turning upward is, probably, exaggerated. The color of the intestine indicates strangulation.

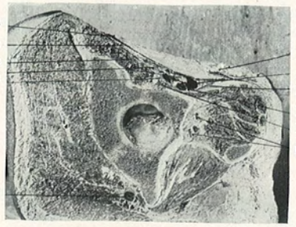

FIG. 4.—Cross-section of thigh at its junction with abdomen, a little above outer half of Poupart's ligament. Femoral ring unusually large, partly because of small femoral vein. Space between Poupart's ligament and pubic bone almost entirely filled by iliacus and psoas muscles with anterior crural nerve between the two. Boundaries of femoral ring shown clearly. Pectineus muscle seen under ring when viewed externally, but not when looked at from inside (see Fig. 8) because the pectineus ends above at the margin of the ring.

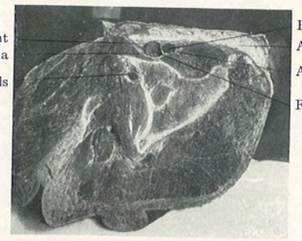

FIG. 5.—Cross-section of thigh at its junction with abdomen, as in Fig. 4. Inner portion of thigh cut longitudinally to save the penis and scrotum. Femoral vein larger than in Fig. 4 and in intimate contact with margin of Gimbernat's ligament, so that in such a patient no femoral ring exists until a hernia comes through and pushes the vein outward.

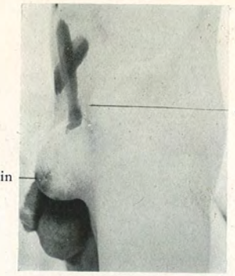

FIG. 6.—Case VII. An unusually large femoral hernia. It clearly does not turn upward, although in its upper part it overlaps Poupart's ligament. The darkened area of skin over the most prominent portion was very thin and became the apex of a conical tumor when the patient coughed.

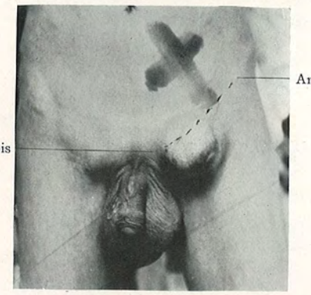

FIG. 7.—Case VII. More clearly shows that most of the hernia is below Poupart's ligament

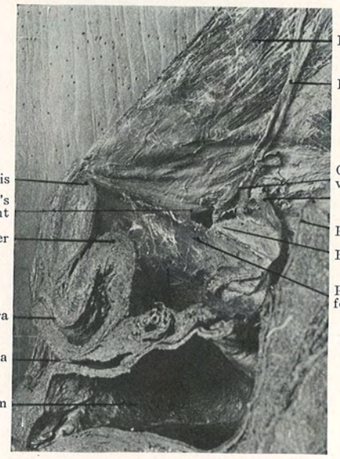

FIG. 8.—View from inside of specimen shown in Fig. 4. Lower boundary of femoral ring now seen to be the pubic bone. Wall of the small femoral vein seems to have fallen away slightly, enlarging the ring still more.

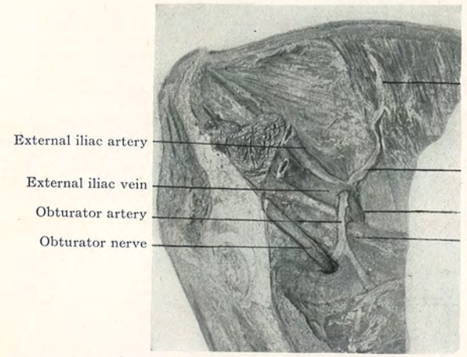

FIG. 9.—Inside view of left half of specimen shown in Fig. 2. Absence of femoral ring again shown by close contact of femoral vein with Gimbernat's ligament. It was particularly difficult to obtain a satisfactory picture of this specimen from the inside. This side has been emphasized slightly by the artist.

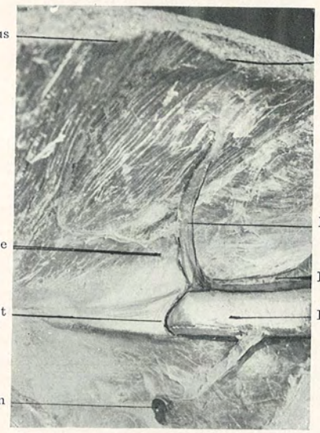

FIG. 10.—Inside view of right half of specimen shown in Fig. 2. Margins of the vessels and Gimbernat's ligament emphasized slightly by the artist. No actual femoral ring here and lymph-node seen on this side in external view (Fig. 2) not seen on inside.

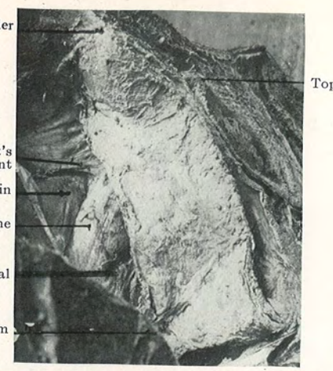

FIG. 11.—Left half of male pelvis looked at from right side and posteriorly. Rest of picture sacrificed to focus attention on femoral ring. Bladder in this specimen rises more than an inch above the top of the symphysis pubis. Normally it is at or below this level. It is also seen to extend close to the femoral ring and inguinal canal, the inner end of which is just above the femoral ring, so that the bladder might find its way into a femoral or a direct inguinal hernia.

FIG. 12.—Right half of same pelvis shown in Fig. 11. Femoral ring filled and perhaps effectively plugged by a lymph-node. Enlarged bladder again evident. Abnormal fold in abdominal wall above due to bending it forward.

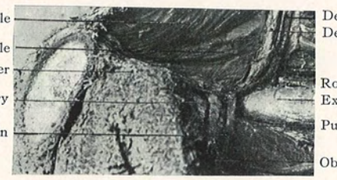

FIG. 13.—Right half of pelvis showing femoral ring covered over by the obturator artery and vein which are coming from the deep epigastrics. These might effectively prevent the development of a femoral hernia. On lifting these vessels and exposing the femoral ring, the margin of Gimbernat's ligament was found separated from the vein about a quarter of an inch. Much thickened bladder, probably due to its complete collapse.

strangulation is present either before the whole circumference of the bowel can escape or soon afterward, so that more than a single coil is rarely met with. The surgeon knows how difficult it is, frequently, to prevent the escape of very small portions of the omentum between the stitches while closing the peritoneal layer of an abdominal incision. He, therefore, knows that omentum can escape through a very small opening and may not suffer much from the constriction. But all of the omentum would not make a very large hernia, and all of it could not escape without taking with it the transverse colon. In a recent case of strangulated inguinal hernia upon which I operated, the length of the hernia was about equal to two closed fists side by side and the diameter slightly larger than that of the fist; the contents consisted of almost all of the omentum and a considerable portion of the transverse colon. The mass of extruded omentum was about the size of that of the colon. Very large herniæ are, therefore, made up chiefly of intestine, and a femoral hernia usually remains small because only omentum in varying quantity can come through or the early constriction and strangulation of the first loop of intestine prevents more from escaping. This is particularly true because the neck of the hernia is usually already filled with omentum before the intestine comes through.

Akerman,[4] in 1889, reported 235 cases of gangrenous intestinal hernia operated on in the Swedish Hospitals; and in 1913, 664 new cases, making a total of 899 cases. Of these, 214 were inguinal, 658 femoral, 13 umbilical, 7 ventral and 7 obturator. The femoral were slightly more than three times as frequent as the inguinal and the proportions of all kinds varied very little in the two groups of cases, which contributes to the reliability of the proportions since they are made up from cases operated on at different hospitals and by different surgeons. Von Bergmann and Bull [5] quote the following authorities on proportions of inguinal to femoral, in strangulated herniæ: Bryant, 50 to 44; Gosselin, 113 to 104; Maydl, 159 to 132; Henggeler, 111 to 159. Deaver and Ross [6] recently gave them as 77 to 50. The total number of cases in this group is 999, or 510 inguinal and 489 femoral. But Akerman reported only cases in which gangrenous intestine was found, while this group includes all strangulated herniæ. A pure omental femoral hernia may become strangulated but this is probably rare. One in an elderly hemiplegic woman came to autopsy at the Philadelphia Hospital recently. Many strangulated herniæ are now operated on before gangrene sets in but, owing to the smaller space and sharp, rigid margin of Gimbernat's ligament, gangrenous intestine may be expected earlier and more frequently in femoral than in inguinal hernia. Coley [7] says that of

75,535 cases of hernia admitted to the New York Hospital for Ruptured and Crippled Children, the relative frequency of femoral to inguinal was about as 1 to 17, which he says is the same proportion as that observed at the London Truss Society, according to the statistics of Macready. In 1720 operations for hernia, Sertoli [8] found 106 femoral and 1543 inguinal, or a proportion of 1 to 15. If we estimate strangulation in femoral as almost as frequent as in inguinal and the general proportion of inguinal as 15 to 17 times greater than femoral, the chances of strangulation are correspondingly greater in femoral. Intestine is very frequently present in inguinal hernia, and DaCosta's observation that it is rarely present in femoral, except in strangulated cases, is probably correct. If all inguinal herniæ are 15 to 17 times more frequent than all femoral, intestine very frequently present in inguinal and rarely in femoral, and strangulated femoral almost as common as strangulated inguinal, then intestine escaping into a femoral hernia will rarely escape strangulation.

There were said to be 116 Littre's herniæ in Akerman's second group of 664 gangrenous intestinal herniæ (154 inguinal and 487 femoral), but his report does not show their relative frequency among the different varieties of hernia. A Littre's hernia is one in which only a part of the circumference of the bowel escapes, *i.e.*, in Akerman's cases, strangulation occurred before the whole circumference of the bowel could get through the constricting ring. The presence of a small single loop is characteristic of a strangulated femoral hernia because of the small space through which it must pass and the rigid and sharp margins of the ring, as shown by the illustrations. Strangulation is more frequent, relatively, in obturator hernia because the obturator ring has still more rigid margins and is not capable of being enlarged as much as the femoral ring. These facts support the suggestion that intestine will rarely escape through the femoral ring without becoming strangulated, and that, therefore, all femoral herniæ are dangerous because intestine may escape on any severe strain. When the femoral ring is large, as in Fig. 4, there may be little danger of constriction, but such large rings are probably the exception and not the rule.

The diagnosis of a femoral from an inguinal hernia is sometimes difficult. In four of this group inguinal hernia had been diagnosed. Some years ago a group of young surgeons debated the diagnosis in the case of a boy. It was finally decided that it was probably an inguinal hernia. I had the privilege of operating on this case and it proved to be a femoral. The tendency has seemed to be to diagnose inguinal, when

in doubt, because, owing to the greater frequency of inguinal, the chances are in its favor. According to my experience, if the diagnosis is difficult the hernia is likely to prove to be a femoral. It is more easy to demonstrate that an inguinal hernia is above Poupart's ligament than that a femoral hernia is below, because the latter pushes forward immediately below the ligament and its upward expansion covers and obscures it (see Figs. 6 and 7), while an inguinal hernia makes the ligament rather more distinct than normal. In the male, the external inguinal ring can be felt by invaginating the scrotum, in the absence of a hernia, and when it has been enlarged by a hernia it is more easily recognized. Examination of this ring is a valuable aid in determining if the hernia is inguinal or not. But it is much less easy to feel the external ring in a female in whom femoral hernia is much more frequent, and it is not easy to feel the margins of the femoral ring when a hernia has been reduced through it, especially if the patient is fat, as many of them are. When there is little fat it is not difficult to recognize that the tip of the finger sinks into an abnormal depression, at the site of the femoral ring, just below Poupart's ligament and well outside of the spine of the pubis. When there is much fat, the patient a female, the hernia irreducible, and the external inguinal ring cannot be felt, it may be very difficult to positively diagnose a femoral hernia. During the past fifteen years, it has been my privilege to examine a large number of hernia, especially at the Philadelphia Hospital, and this experience has taught me that it is best, when the diagnosis is doubtful, to regard the hernia as femoral until I can prove that it is not. The best evidence in favor of its being femoral is that most of the tumor lies below the approximate line of Poupart's ligament (an inguinal is distinctly above), that it is well outside of the pubic spine (the spine can be felt outside of an inguinal hernia), and when the hernia is reduced the finger can usually be pressed into a depression just below Poupart's ligament.

The great danger to which hernia patients are exposed is that of strangulation, and the risk is greater in femoral than in any of the other common forms. Obturator hernia is comparatively more frequently strangulated than femoral but is not as common a hernia. So long as a femoral contains only omentum there is probably little danger of strangulation, but a knuckle of gut may escape at any time and bring on strangulation. Akerman discussed, chiefly, the results of operation for gangrenous intestinal hernia which were bad, v. Bergmann [9] says that there is little reason to expect a favorable result from taxis in strangulated femoral hernia and that one should advise

against it and in favor of radical operation. Since the patient is always in danger of the escape of intestine and the development of strangulation, the best treatment is to prevent gangrenous hernia by operating before strangulation occurs. Operation in this stage has a very low mortality and recurrence of the hernia is rare. Many different operations have been performed in comparatively recent years. Ochsner [10] enumerated 20 and Sprengel [11] (quoting Goebel) 50. The plastic operations for filling the canal by muscular, periosteal, osteoperiosteal and heteroplastic flaps are wrong in principle, in my opinion, and have had little support, while the simpler operations prevail. Ochsner says that removal of the sac without closure of the canal will cure all cases. While I added one or two mattress sutures to close the ring, I found much in my anatomical study to support Ochsner's radical statement. With proper regard for the femoral vein the operation becomes almost a minor one. The hernia is almost subcutaneous, no muscles are divided and the peritoneal cavity is barely opened. The placing of one or two mattress sutures to approximate Poupart's ligament to the pectineus muscle and fascia adds little or nothing to the danger of the operation, the early performance of which in practically all cases would involve much less risk than taking the chances of intestine or bladder escaping through the ring and causing strangulation.

If the sac is separated from the margins of the ring on all sides, drawn down and the ligature placed as high as possible, the stump will retract or can be pushed upward into the abdomen, when nothing will intervene between the femoral vein and the remaining margins of the ring. The anatomical illustrations show that the femoral vein must have been pushed outward by the hernia away from the curving margin of Gimbernat's ligament. When the hernia has been entirely removed the femoral vein relieved of this pressure should soon find its way back to its normal position, close to or in contact with the margin of Gimbernat's ligament. The vigorous contractions of the very active iliacus and psoas muscles should be important factors in forcing the vein against the ligament, since they almost completely fill the space between Poupart's ligament and the underlying pubic bone (see Figs. 4 and 5). The effect of sutures forcing Poupart's ligament down to the pectineus muscle would be to compress the vein and thus force it into closer contact with the remaining margins of the ring. The introduction of tissue of any kind, as bone, muscle, etc., into the ring would not close it more effectively but would only serve to permanently displace the vein from its normal position. Cicatricial adhesion of the vein to the remainder margins of the ring would be more effective in preventing a recurrence of the hernia, since it is just this relation which best prevents the first development of the hernia. A purse-string suture would accomplish the same purpose as the mattress sutures but has no advantages over them.

The usual method of exposing the sac, separating it from the surrounding fat, and after ligating its neck cutting it away, leaves the ring and the femoral vein covered by a confusing mass of fat which is retracted with some difficulty and makes the exposure of the pectineus muscle and fascia and protection of the vein rather troublesome. The normal fat of this region is considerably increased by the preperitoneal fat pushed out with the sac and left here after the sac has been removed. I have found it advantageous to remove a thick layer of fat with the sac, so that the later exposure of the margins of the ring, femoral vein and pectineus muscle becomes less troublesome. In my opinion, the vertical has advantages over the transverse incision. In its upper part the external oblique aponeurosis is quickly exposed and its lower border, Poupart's ligament, easily outlined. This is an excellent landmark. Just below it the neck of the sac with its surrounding fat can be seen, just external to which is the femoral vein. Removal of the adherent fat with the sac, high ligation of the neck with retraction upward of the stump out of the operative field, will facilitate the protection of the femoral vein and the passing of one or two mattress sutures to approximate the pectineus muscle and Poupart's ligament or the floor and roof of the ring.

Having had no experience with the method of closing the ring from the inside, through the inguinal canal, I can express an opinion based only upon my anatomical study and my experience with the ordinary closure of the ring from the outside. The illustrations showing the ring from the inside (see Figs. 8, 9, 10, 11, 12 and 13) demonstrate that its lower boundary is the pubic bone. This is covered only by loose connective tissue and peritoneum. In exposing the ring for the placing of the sutures, most of the overlying connective tissue is pushed away, leaving only the periosteum and a little connective tissue to hold the sutures. I would not trust the needle to pass under the periosteum without cutting its way out, in which case the suture could have no influence in closing the ring. On the other hand, the obturator vessels not infrequently come from the deep epigastric and pass to the obturator canal over the internal surface of the ring, as shown in Fig. 13. In most other cases pubic branches of the deep epigastric of considerable size have the same general relation to the ring as they pass to the pubic region. There are no such vessels to interfere

with the exposure and suture of the ring from the outside, where the suture can take hold of the substantial pectineus muscle and overlying fascia forming the floor of the ring. This muscle arises at the bony margin of the ring so that the suture catches it immediately below the ring. The advantage, therefore, should be with the external operation.

Case VII.—Man, forty-four years old. Admitted to tuberculous wards of Philadelphia Hospital, December 6, 1913. Diagnosis of advanced tuberculosis of lungs and tuberculosis of intestines. Now has a hernia in the left groin. Says he was operated on in this hospital for a hernia on the left side during the past summer, and this is confirmed by the presence of a linear scar over the position of the inguinal canal. It was, therefore, assumed that we were dealing with an inguinal hernia recurring after operation and no further effort was made to establish the diagnosis. Transferred to surgical service of Dr. A. C. Wood, January 10, 1914. The size and shape of the hernia are shown in Figs. 6 and 7. During standing and coughing, which is severe, the hernia assumes a conical shape and the skin over the most prominent part is bluish in color and evidently very thin. The patient desires operation because, during coughing, he has the feeling that the hernia is about to burst, and it then looks as though it might do so.

Operation (January 12).—Under spinal anæsthesia, with 10 c.c. of a ½ per cent. novocaine solution. The incision was made to expose an inguinal hernia. The skin was very thin over the most prominent portion of the hernia and was here very adherent to the sac. The external oblique and external ring appeared to be normal, no evidence of a scar of a previous operation being found in this muscle. The neck of the sac was found to be coming through the femoral ring. It afterward developed that he had been operated on for an abscess of the groin and no record of a previous operation for hernia could be found. The only contents of the sac found at operation was omentum, although my recollection of the way in which the hernia distended during coughing and its size led me to believe that it then contained intestine also. The neck of the sac was isolated as high as possible, drawn down and ligated as high as possible, and after removal of the sac the stump retracted upward. Two catgut mattress sutures were employed to approximate Poupart's ligament to the pectineus fascia and muscle in order to close the probably large ring. Silkworm-gut sutures for the skin. Dressing. Primary healing. Firm pressure was maintained over the wound by adhesive strips and a spica bandage of the groin for five weeks. Notwithstanding the continuous severe coughing no recurrence of the hernia had occurred up to the time of his death on December 9, 1914.

Case VIII.—Woman, forty-six years old, well nourished. Transferred to my service in the Philadelphia Hospital, July 4, 1914, from the nervous ward where a cervical myelitis was diagnosed. On the right side, just below Poupart's ligament, is a hernia about the size of a hen's egg, which is easily reducible and had been diagnosed as an inguinal hernia. The patient has been and is now complaining of much pain in the abdomen, particularly in the pelvic region. A dilatation and curettement of the uterus had been done for the possible relief of the pelvic pain.

Operation (July 10).—The patient requested that her abdomen be opened on account of her pain. Trendelenberg position. Pfannenstiel incision just above the pubis, and the abdomen opened and explored, but nothing abnormal found that would account for the abdominal pain. Abdominal wound then closed up to and including anterior sheath of the rectus muscle. Right end of skin and fascial portion of incision lengthened to region of hernia, the neck of which was easily outlined just below Poupart's ligament. The sac with its adherent fat was separated from the surrounding tissue, opened and found to contain some adherent omentum which was drawn down and ligated high and cut away beyond the ligature, the stump retracting upward into the abdomen. Poupart's ligament sutured to the pectineus muscle and fascia as in the preceding cases, and the skin incision closed with silkworm gut. Uneventful recovery and no recurrence of the hernia up to the present time.

Case IX.—Man, fifty years old, laborer. Admitted to my service in the Philadelphia Hospital, July 30, 1914, with a hernia in the left groin about the size a small fist, which is reducible. Femoral hernia diagnosed and operated on July 31.

Operation.—Vertical incision over hernia, exposure of external oblique first and neck of hernia just below Poupart's ligament. Sac with adherent fat isolated, ligated high and removed as in preceding cases, and Poupart's ligament sutured to pectineus muscle and fascia. Silkworm gut for skin wound. Uneventful recovery and no recurrence up to present time.

Case X.—Woman, sixty-nine years old. Emaciation and wrinkling of face make her appear ten years older. Admitted to my service, July 5, 1914, with a strangulated femoral hernia on the left side, and in a stuporous condition. From a relative it was learned that the hernia had existed about four years. For about four days before admission it had been irreducible and painful and after admission mild attempts at reduction by the

interne were unsuccessful. Operation the same day under local anæsthesia with a 2 per cent. novocaine solution.

Operation.—Sac exposed by an incision parallel to Poupart's ligament, opened and found to contain a considerable mass of omentum and a single loop of small intestine about four inches long. Both omentum and intestine were dark in color but neither was completely gangrenous, the intestine being a dark red. Gimbernat's ligament was divided on a grooved director and the loop of intestine drawn out until healthy bowel was reached. In doing this the inner limb of the loop gave way into the lumen at what was clearly the line of constriction by the sharp edge of Gimbernat's ligament and where the bowel wall was distinctly necrotic. The omentum was also driven out until a healthy portion was reached and it and the intestine were sutured to the margin of the ring. A portion of the omentum was removed, but the intestine was not resected because of the very weak condition of the patient. The bowels were freely opened, but no fæces appeared until the following day, when they escaped freely. The patient showed no signs of reaction after the operation and died two days later.

Case XI.—Woman, fifty-seven years old. Admitted to my service in the Philadelphia Hospital, August 7, 1914, with an irreducible right femoral hernia, which extended about six inches in the line of the groin and about two inches from above downward. The patient is dull and semistuporous and her statements are hardly reliable. The only apparently reliable answers she gave seemed to show that the hernia became irreducible about two weeks ago, that the bowels have not moved in that time and that she has not vomited. The overlying skin is dark red in color and the hernia tense and very tender. It is irreducible, there is no impulse on coughing and there is fluctuation in one part. Diagnosis of a strangulated femoral hernia was made. The patient is fairly well nourished, but there is a purulent discharge from both eyes and the left nostril. Heart and lungs negative, abdomen much distended, and a small umbilical hernia which is apparently giving no trouble. Operation soon after admission under local anæsthesia with a 2 per cent. novocaine solution.

Operation.—Incision in long axis of hernia. As soon as skin and subcutaneous tissue were divided, a small quantity of dark, grumous, foul-smelling material was evacuated. The sac was thick and dark in color and when opened was found to contain a considerable mass of omentum and a small single loop of small intestine, both of which were distinctly gangrenous. Gimbernat's ligament was carefully divided on a grooved director and the intestine and omentum brought out until healthy portions of both could be sutured to the margins of the ring. A portion of the protruding omentum was cut away. The line of demarcation in the intestine was distinct. On the following day the gangrenous portion of the bowel was cut away and soon afterward fæces appeared in the wound. The patient did not react from her weak and semistuporous condition, although she lived for three days after the operation.

Case XII.—Medical student, twenty-four years old. While playing foot-ball about ten years ago, developed a severe pain in the right groin. A direct inguinal hernia was diagnosed at the time and at different examinations afterwards. I saw him July 6, 1914, and diagnosed a femoral hernia which was found at operation, two days later, at St. Agnes Hospital.

Operation.—A longitudinal incision about 2½ inches long was made over the hernia, the sac exposed and opened but the neck was so small that a finger could not be passed through the ring, a grooved director being necessary for the purpose. The sac with its adherent fat was isolated, drawn down, ligated high and cut away, the stump retracting upward under Poupart's ligament. The pectineus muscle covered by its fascia was exposed and Poupart's ligament drawn down to it by one catgut mattress suture. Silkworm gut for the skin and dressing applied. Healing uneventful. He has since engaged in vigorous exercises without any sign of recurrence of the hernia.

Conclusions on Femoral Hernia.—In femoral hernia we are concerned not with a canal as in inguinal hernia, but with a ring as in umbilical hernia.

The femoral hernia turns forward immediately after passing under Poupart's ligament, because it can expand only forward, the pectineus muscle lying on the pubic bone preventing any backward expansion. The upward expansion of the hernia overlaps and conceals Poupart's ligament, but the whole hernia does not turn upward. Occasionally it separates the fibres of the pectineus, posteriorly, and is then called a hernia of Cloquet.

A femoral hernia is usually small and comparatively infrequent, for the same reason that an obturator hernia is small and infrequent, because of the small ring and its rigid margins. The femoral ring is small or does not exist until the escaping hernia pushes the femoral vein away from the margin of Poupart's ligament, which it does with difficulty and for a small distance. Omentum gets through with difficulty and intestine is usually strangulated soon after it begins to come through. Most femoral herniæ are, therefore, omental until intestine escapes and causes strangulation.

When the diagnosis between inguinal and femoral hernia is difficult, a femoral hernia will probably be present.

All femoral herniæ should be considered dangerous because intestine may escape on any severe strain and cause strangulation. For this reason it is safer to operate on all femoral herniæ before strangulation than to take the chances of strangulation.

The hernia is subcutaneous, no muscles are divided, and the peritoneal cavity is barely opened. Simple removal of the sac will probably cure in the great majority of cases, but the approximation of Poupart's ligament to the pectineal muscle and fascia by one or two catgut sutures will add to the certainty of cure.

The vertical has advantages over the transverse incision, and the removal of a thick layer of the fat adherent to the sac favors the easier exposure and suture of the ring.

The closure of the ring by the external exposure and suture is safer, easier and more effective than by the internal exposure through the inguinal canal.

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STATED MEETING, HELD OCTOBER 4, 1915

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

FRACTURE OF THE OS CALCIS

Dr. Nathaniel Ginsburg related the details of four cases of fracture of the os calcis. The first two of these were observed and treated by him through the courtesy of Dr. Edward Martin. Their histories are as follows:

Case I.—Case No. 10468. M. I., male, was admitted to the Mt. Sinai Hospital on April 4, 1915, and discharged on May 20, 1915. He had jumped out of a second-story window to escape from a fire, and landed on the heel bones of both feet. He was immediately brought to the hospital, unable to stand, with severe pain, swelling, and discoloration of the entire posterior portion of the foot and lower leg. X-ray showed present fracture of both ossa calcis. The patient remained in the hospital about six weeks and was finally discharged able to go about on a cane and crutch. He died six weeks ago of heart disease.

Case II.—Case No. 10690. A. M., male, was admitted to Mt. Sinai Hospital on April 18, 1915, and discharged May 27, 1915. He fell from a step-ladder, alighting on the heel-bone of the right foot, and sustained a fracture of the os calcis. He now walks with a cane and has pain on the outer side of the foot below the external malleolus.

Case III.—Female, aged thirty-five years, was admitted to Dr. Ginsburg's service at the Jewish Hospital, June 22, 1915, having fallen through a skylight to the floor below, landing upon both feet. She sustained a fracture of the left os calcis and a transverse fracture of the internal and external malleoli of the left tibia and fibula without separation of the latter fragments. In addition she sustained a fracture of the external tuberosity of the right tibia, the line of fracture running into the knee-joint, and a fracture of the adjacent head of the fibula with some impaction. This type of fracture of the tibia in this region is of rare occurrence. The patient was put to bed with moderate extension by traction apparatus on the right leg, not sufficient, however, to separate the fragments but merely to prevent contact of the knee-joint surfaces.

The displacement of the os calcis was regarded as one which could not be markedly improved by operation or by much manipulation, and the foot and leg were put at rest in a fracture box

and an ice-bag was applied to the seat of fracture, and after much of the swelling had subsided a light plaster case was applied enclosing the foot and leg. The fracture of the os calcis was of the comminuted type, involving the anterior extremity of the bone with some cortical tearing of the posterior plantar portion.

CASE IV.—Male, admitted to Dr. Ginsburg's service at the Jewish Hospital June 24, 1915, and discharged August 8, 1915. This patient fell down a casement and was admitted to the hospital suffering from fractures of the left humeral anatomical neck and a T-fracture of the left radius at the wrist-joint. The latter fracture showed some impaction and was apparently accompanied by a fracture of the styloid process of the ulna.

Under ether anæsthesia abduction and extension of the humerus at right angles to the body was maintained by a plaster case enclosing the thorax and the arm. The extension was maintained in bed by a traction apparatus similar to that applied in treating a fracture of the femur. A radiographic examination showed little improvement in the position of the fragments, the head of the humerus being elevated and rotated outward and the lower fragment being drawn upward and inward into a high axillary position. The plaster case was removed, the arm dressed to the side of the chest wall with a high axillary pad and a weight extension from the elbow. Good union in good position resulted, the movements of the shoulder-joint being excellent. The impaction of the lower end of the radius was broken up and a light plaster case applied, succeeding a Bond splint which was primarily employed. There is now little anatomical deformity and practically normal function of the hand.

Dr. Ginsburg remarked in connection with these cases that fracture of the os calcis is regarded by Cotton as being the commonest injury (fracture) of the tarsus. Three types of this fracture are commonly observed: (1) one being a fracture of the bone at the osseous attachment of the Achilles tendon; (2) a second type is a simple fracture of the sustentaculum tali; (3) and a third type, one which he had had the opportunity to observe in a number of patients, is a comminuted fracture of the body of the bone due to a compression force sustained by falling or jumping from a height and landing on one or both heels. This latter type is the one observed with greatest frequency. The disability resulting from fracture of the os calcis, especially of the comminuted type, is unquestionably a very severe and lasting one; in many instances the bony contour of the foot being so seriously disturbed as to permanently disable the patient. In this type of fracture of the body of the os calcis the molecular disintegration takes place approximately

near a vertical line just in front of or through the posterior articulation between the astragalus and the os calcis. The comminution of the bone may be severe enough to result in a few fragments or in almost total disintegration of the body of the bone in the region injured. The lines of fracture may have a stellate appearance running off in various directions. The displacement resulting from a comminuted fracture about the middle of the os calcis, or anterior to a vertical line drawn through the middle of this bone, is apparently the result of the dropping down of the inner border of the foot, owing to the lack of bony support at this point, and also due to some "diminution of the total depth of the bone," especially of its forward end (Cotton). Should the displacement of fragments resulting from a fracture result in an irregular contour of the plantar surface of the os calcis, a painful foot will result, simulating the condition found in exostoses of the os calcis from other causes.

A fracture of the contiguous dorso-inferior articular portion of the scaphoid bone may result, if the compression force sustained producing the fracture is partly borne by this bone.

The diagnosis of this fracture can be made in most cases by a history of the accident sustained, which is usually a fall or a jump from a height, the patient landing on the feet. Much swelling and some distortion of the normal outlines of the foot in this region promptly take place. The swelling is often so marked, and manipulation is accompanied by so much pain that it is hardly justifiable to attempt a diagnosis by examining for mobility or eliciting crepitus of the fragmented bone. The radiologic examination is the important one both for diagnostic and prognostic value.

The immediate and diffuse swelling, accompanied by much pain and tenderness, is so marked that little can be done except to put the foot at absolute rest in a fracture box with an ice-bag or sedative lotion applied to the part. From radiographic study of the injury it can be determined if improvement in the position of the fragments is possible by the employment of an anæsthetic. If, however, the bony outlines are fairly well preserved, union will take place with a resultant good position of the heel, but with some tendency toward dropping of the inner posterior aspect of the foot. If indicated, tenotomy of the Achilles tendon should be done early to assist in mobilizing the posterior fragment in order to reëstablish the morphological outline of the bone.

DR. JAMES K. YOUNG said that this fracture is more common than is usually supposed. It is apt to occur when a person falls from a height and lights on his feet. One might expect it to occur from lateral crushing, as when a horse rolls on a rider's foot. In such accidents,

however, and in automobile collisions the astragalus is more apt to be the bone fractured. He had seen a number of these cases several weeks after the injury and suggested more through treatment at the time of the injury in order to avoid the subsequent flat-foot and deformity of the ankle. Under an anæsthetic reduction should be made promptly by reimpaction of the fragments, with the hands or with a mallet and sandbag, after the method of Cotton. After the reduction, one felt pad should be placed over the dorsum, one over the os calcis and tendo Achillis, and one under the plantar arch, and, with plantar flexion of the foot and flexion of the knee, the foot and leg to the upper third of the thigh should be placed in a plaster-of-Paris cast for two weeks, after which manipulation and other remedial measures should be used.

T-FRACTURE OF THE LOWER EXTREMITY OF THE RADIUS

Dr. H. A. McKnight (by invitation) presented a man forty-six years of age, whom he had seen in Dr. Booth Miller's clinic at the Polyclinic Hospital. The man, August 18, 1915, fell eight feet from a ladder, landing on his side and left arm, and in falling jammed his left closed fist against an iron beam; on recovering from the effects of his fall he noticed soreness and slight swelling of his left wrist.

Six days later the reporter saw him; he still complained of soreness and pain on motion. Examination showed increase in the anteroposterior diameter of the wrist, although this thickening was an uncertain diagnostic sign, as he had broken the other arm twice before, so no comparison could be made. The styloid processes were in proper alignment, but wincing tenderness was elicited along the radial shaft and on extreme abduction over the ulnar styloid.

The X-ray revealed (Figs. 1 and 2) an impacted fracture of the lower end of the radius with two linear splits extending upward for about one and one-half inches and nearly parallel with each other, being separated by an interval of a quarter of an inch below and one-eighth above, thus converging from below upward, a fracture of the ulnar styloid and a slight posterior displacement of the distal radial fragment. The skiagram shows complete impaction of the radial fragments which to a casual observer would present no abnormality, but the lateral view (Fig. 2) shows the line of the radiocarpal articulation tilted backward instead of facing slightly forward as it does normally. The impacted fragments were separated under gas, and the arm splinted with a Bond and a posterior straight splint.

Skiagrams taken two days later (Figs. 3 and 4) show the arm after

Fig. 1.

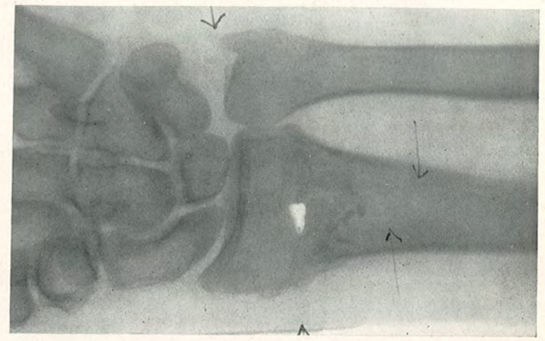
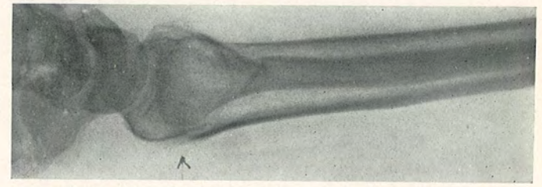


Fig. 2.



Figs. 1 and 2.—Impacted fracture of lower end of radius with linear splitting.

FIG. 3.

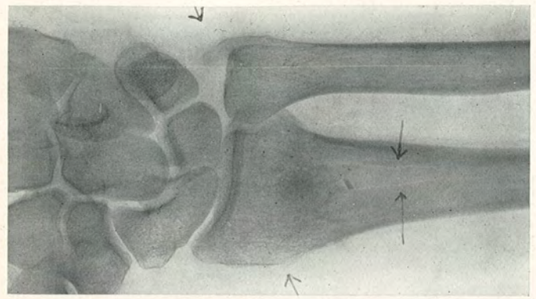
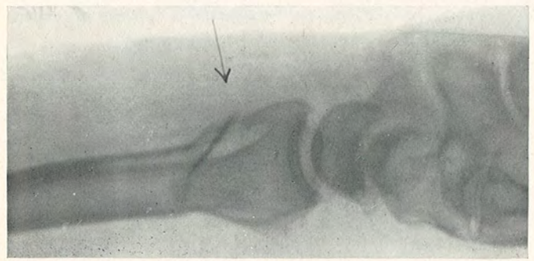


FIG. 4.



FIGS. 3 and 4.—Fracture shown in Figs. 1 and 2, after reduction.

reduction; the transverse fracture is more distinctly shown, although the linear cracks are not so easily seen. The radiocarpal joint line is now normal and faces slightly forward instead of backward.

Dr. McKnight added that uncomplicated longitudinal fractures in this position are rare, only nine cases having been reported, and he had found none in which an impacted Colles's fracture was also present.

Bigelow in 1858 reported a stellate fracture of the lower end of the radius extending along the shaft, and Cotton in 1910 stated that, "So far as we know this fracture is the result of direct violence by crushing. It is rare, three specimens constitute the total of evidence." Since then Parrish, Bendell Wilhoit and Skillern have presented fractures of the radius, and Dr. Miller has seen one case caused by the direct violence of a window falling on the wrist.

The clinical diagnosis is difficult and has only been made heretofore by means of the X-ray, although the symptoms in the cases reported present marked similarity. There is usually a history of direct violence; clinical examination reveals slight swelling and tenderness along the line of the shaft, but no deformity. Treves reports a case in which he claims he felt a vertical linear ridge but was unable to make a definite diagnosis without the X-ray which showed a longitudinal fracture extending upward for about two inches.

In cases of direct violence due to direct force in the line of splitting the mechanism is simple. The scaphoid and semilunar are driven upward and outward by the upper end of the os magnum, causing a cross strain against the lower articulating end of the radius with resulting split. The further complication of a fractured ulnar styloid is not unusual, as 66 per cent. of fractures of the radius are complicated by this added fracture.

This case is of interest due to its rarity. The diagnosis in uncomplicated cases may be suspected clinically by analysis of the history plus a vertical linear area of wincing tenderness.

DR. JOHN B. ROBERTS showed two skiagraphs of a recent fracture of the lower end of the radius. They show a splitting off of a portion of the posterior lip of the articular surface very much in the direction described by John Rhea Barton. A good many medical men confuse the various fractures at the base of the radius with that described by Colles of Dublin, which he considered to be an injury occurring about an inch and a half above the joint. It would be better to call a fracture at this point a break in the lower fifth of the shaft. The displacement is usually backward, but may be reversed so that the upper end of the lower fragment is directed forward. Almost all physicians give the

name of Colles to all fractures of the lower end of the bone, whether they be at the point described by him, or the so-called classic fracture through the base of the radius with backward displacement. The latter was considered up to the time of Dupuytren a probable posterior dislocation of the carpus. Both the classic fracture and the true Colles's fracture have usually a backward displacement of the upper end of the lower fragment, but both of them may be reversed, the lower fragment being displaced backward at its lower end.

BONE TRANSPLANTATION

That no two fractures can be treated alike is a certainty. Each fracture is treated according to the individual status of that special case. Every Colles's fracture cannot be treated on a Bond splint, a Levis splint, a Palmer splint, a posterior splint, between two splints, or in a cast. Nor can every Pott's fracture be treated in a fracture box, on Dupuytren's splint, or in a cast. The treatment of each is adapted for the individual case. The same is true of the open treatment of fractures. Lane's plates, silver wire, catgut mesh, Parkhill's clamps, bone transplants, etc., each has its own advantages or disadvantages, and no one method can be used in every case.

In two of the cases cited below it was necessary to digress from the usual method of treatment. The principle of each seems sound.

Dr. Hubley Owen related two cases of fracture in which bone transplantation was employed in their treatment.

Case I.—Miss S., aged twenty-six, fell downstairs on October 21, 1914, and sustained a dislocation of her left elbow, and a fracture of the lower third of the radius of the same arm. She was treated by her family physician and subsequently returned to her occupation, that of a stenographer, at the end of five weeks. Because of stiffness of her elbow and inability to properly supinate her left hand in order to typewrite, she was referred to reporter in January, 1915.

An X-ray was taken at that time, and showed an unreduced dislocation of the head of the radius and a fracture of the lower third of the radius, with vicious union. The lower fragment was displaced upward and inward, and was united to the upper fragment and to the ulna. Supination and pronation were impossible.

On January 24, 1915, he removed the head of the radius, and attempted to correct the deformity of the broken radius. After he had separated the two fragments, and had also separated the lower fragment from the ulna, and straightened the wrist, he found that when the fragments of the radius were in alignment

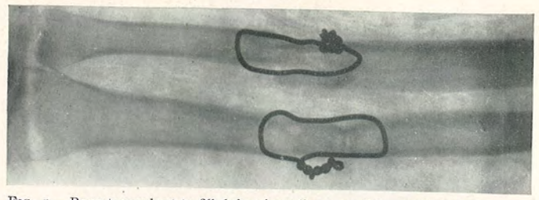


Fig. 5.—Bone transplant to fill defect in radius; condition at time of operation.

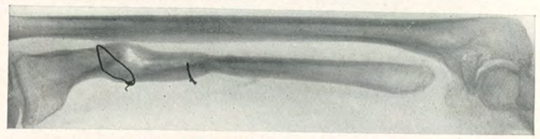


Fig. 6.—Final result of case shown in Fig. 5.

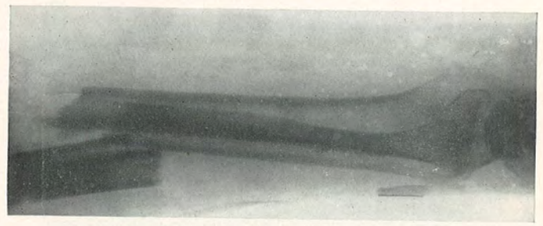


Fig. 7.—Deformity after fracture of forearm.

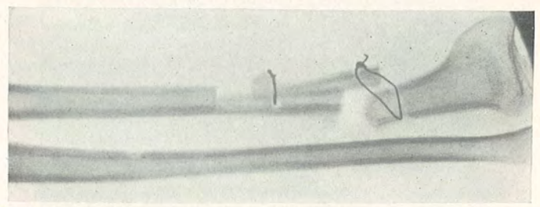


Fig. 8.—Fractured forearm, bone fragments dovetailed and secured by silver wire.

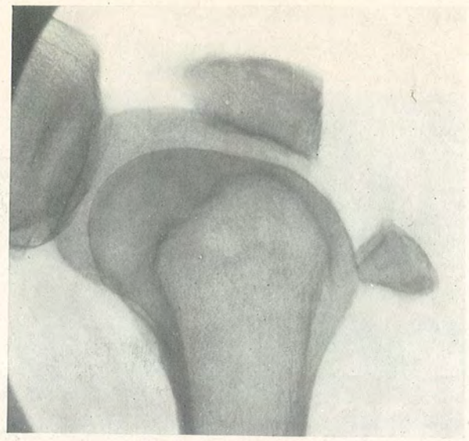


FIG. 10.—Fracture of patella.

FIG. 11.—Result of non-operative treatment.

there was a gap of about an inch between the fragments. A transplant was then taken from the upper fragment, which was one-half the diameter of the bone. He was unable to transplant this into the lower fragment, so, as shown in the X-ray (Fig. 5), the transplant was merely laid alongside the two fragments and wired thereto. The second X-ray (Fig. 6) shows union of the two fragments.

The excision of the head of the radius gave her good motion in her elbow, and she now has good pronation and supination of her forearm.

There is some eversion of the hand, which can be corrected by the excision of a small part of the shaft of the ulna.

CASE II.—J. D., aged fifty-six, tripped and fell downstairs in July, 1915, and sustained a fracture of both bones of the left fore-

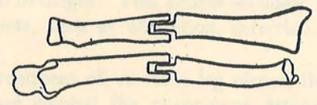


FIG. 9.—Diagram showing method of dovetailing bone fragments together.

arm. He was admitted to the Philadelphia Hospital three days after his injury, with the deformity as shown in the X-ray (Fig. 7). Two attempts were made to reduce the fracture with an anæsthetic. Both attempts were unsuccessful. Traction was then tried, but also failed.

He was operated upon August 10, 1915, and the attempt was made to hold the bones in alignment by dovetailing the ends of the fragments into each other. With a Gigli saw an oblong piece of bone was cut from the lower fragment, and, with the same implement, the upper fragment was cut so that it would fit into the groove of the lower fragment. He then supplemented this by silver wire, as shown in the X-ray (Fig. 8). The bones are uniting nicely.

Fig. 9 shows the manner in which the fragments were cut.

CASE III.—H. P., aged forty-six, fireman by occupation, fell in July, 1905, on his right knee, and sustained a fractured patella. He was treated at the Pennsylvania Hospital. He was not operated upon, but the fragments were held together by means of adhesive plaster. At the present time he has fibrous union (Fig. 11) but has absolutely good function of his knee.

In November, 1913, while working at a fire, he fell and sustained a fracture of the left patella. He was operated upon at the Jefferson Hospital, and the patella was wired.

He again fell, September 26, 1914, broke the silver wire and refractured his patella. The case was in the service of Dr. J. Chalmers DaCosta, who advised against another operation.

X-ray plate (Fig. 10) shows the wide separation of the fragments of the patella.

By treatment with a brace, which was so constructed that he was given more motion in the knee-joint each week, he now has firm fibrous union (Fig. 11) between the fragments, has discarded the brace and has perfectly good use of his knee.

TREATMENT OF VARICOSE LEG ULCERS*

By Penn G. Skillern, Jr., M.D.
of Philadelphia

Varicose leg ulcers belong to that class of maladies for the cure of which a host of therapeutic measures is recommended. The purpose of this paper is to show both the fallacy and the futility of expecting a cure of varicose leg ulcers by drug therapy alone, and to prove that the most efficient therapeutic measure is the vis medicatrix naturæ.

Varicose veins are a penalty of the upright position. Reduced to its simplest terms, the pathology is primarily that of chronic venous congestion, mechanical in origin. This simple etiologic factor underlies all the secondary effects, such as ulceration, infection, fibrosis and bone involvement.

The rational treatment of varicose leg ulcers, then, must be based upon measures that combat the phenomena attendant upon chronic venous congestion, namely, transudation of serum and migration of blood-cells into the connective-tissue interspaces, and the inevitable fibrotic thickening of the walls of the connective-tissue interspaces.

Reduced to its simplest terms, the rational treatment of varicose leg ulcers, based on their pathology, depends upon the recognition and application of the principles of, first, protection, second, drainage, and, third, support.

(1) *Protection.*—Any ulcer is cured when epithelialization of its entire surface is complete. Epithelialization of the ulcer surface will not occur in the presence of an unhealthy ulcer base. The ulcer base is made healthy by affording drainage of the matter discharged from it and by giving it proper support. With the ulcer properly drained and supported the epithelium at the margin of the ulcer begins to regenerate. Because of its delicacy of texture and superficial position, this regenerating epithelium requires protection, lest it be torn away during the change of dressings. The best protective agent is a material that has a perfectly smooth surface. Such a protective agent is rubber tissue. When the ulcer is large its epithelial edge may be efficiently protected by being covered with strips of rubber tissue cut to about one-fourth inch in width (Fig. 2). When the ulcer is small a piece of rubber tissue may be cut to the size of the ulcer and a hole made in the centre of the

* Read before the Philadelphia Academy of Surgery, October 4, 1915.

piece of tissue to afford an outlet for the discharge from the ulcer into the superposed dressing. If no outlet be provided, this discharge accumulates beneath the rubber tissue and most effectively macerates the regenerating epithelial edge. This macerating action constitutes a valid objection to the no-drainage method of smothering the ulcer with an impervious unguent dressing.

(2) *Drainage.*—As just stated, provision for the escape of the discharge from the ulcer is made by cutting a hole in the centre of the piece of protective rubber tissue. The amount of discharge will lessen as the œdema of the tissues subsides from the pressure of the bandage.

What is the best form of dressing to take up the discharge from the ulcer? The tissues are already more or less water-logged, so why apply a wet dressing? A wet dressing does not remain wet very long unless evaporation of its contained fluid be prevented by such an impervious material as paraffin paper or oiled silk. But a wet dressing covered by an impervious material merely increases the maceration of the already macerated tissues, and, furthermore, it is impracticable for the patient to keep the leg dressing moist until the time of the next visit.

Plain, dry, sterile gauze admirably meets the requirements of a dressing that will take up the discharge without increasing the water-content of the tissues. It may be objected that dry gauze placed in direct contact with a granulating surface would act as a mechanical hindrance to the granulations by their becoming adherent to it and growing into it, so that at the change of dressings the granulations would be traumatized by removal of the gauze. Practically, however, the granulations do not become adherent to the gauze owing to the slimy character of the discharge from the ulcer. The only place where the gauze could become adherent is at the epithelial edge of the ulcer, but the epithelial edge is already protected by the rubber tissue. When the dressing is removed it comes away freely without sticking at any spot.

(3) *Support.*—It is a well-known clinical fact that the very best treatment of varicose leg ulcers is by the non-ambulatory method, of rest in bed with elevation of the limb involved. The explanation of the superiority of the method of rest in bed with elevation is, of course, that the chief etiologic factor in the development of varicose veins—the attraction of gravity for the long column of blood in the saphena magna—is overcome; the œdema of the tissues subsides, and with the subsidence of the œdema the nutritional state of the tissues is improved, and improvement of the nutritional state enhances the power of tissue repair. But few patients, however, can afford to take to bed on account

of a leg ulcer. We are forced, therefore, to combine with the ambulatory treatment the advantages of the non-ambulatory.

The best substitute for rest in bed with elevation is support of the limb; the best method of supporting the limb during the active treatment of large or multiple leg ulcers is by the application of a roller bandage, not of gauze, but of muslin; and the best type of bandage to apply is the spica, or figure-of-eight of the leg.

While commonly used, yet gauze bandages do not support the tissues as firmly as muslin bandages support them, and gauze bandages have a tendency to roll up and become disarranged. The spiral reverse bandage of the leg, advocated by some, looks prettier in the text-books than upon a patient's leg. In everyday practice a spiral reverse bandage cannot be applied upon an inverted cone, such as the leg below the calf represents, and be expected to remain in place for forty-eight, or twenty-four, or even six hours, however long the patient may be up and about.

Given one or two ulcers of limited size where healing is delayed by induration at the base and periphery of the ulcer, and provided that the skin is healthy, there is no better method to effect epithelialization than that suggested so long ago as 1792, by Thomas Baynton, of Bristol, namely, firm strapping of the ulcer by imbricated lengths of adhesive plaster applied from below upward and encircling the limb for two-thirds of its circumference (Fig. 1). When treatment was begun upon these ulcers they were indolent and sluggishly inactive, and had been for several weeks. The sketch shows the improvement after a week's strapping: from being indolent and sluggishly inactive the ulcers were transformed into healthy, rapidly epithelializing and granulating wounds, the contrast between the pure blood-red and firm granulations and the broad, bluish-white band of rapidly regenerating epithelium being so striking as to merit reproduction in tints. It is my practice to fill the excavation of the ulcer flush with the skin with a powder before applying the straps of adhesive plaster, and for this purpose I have found calomel the most useful powder. The powder serves as an agent for transmitting the pressure and support of the adhesive straps to the floor of the ulcer; without powder the straps would merely bridge across the excavation of the ulcer.

The striking efficiency of the strapping method is purely in keeping with the old surgical principle that pressure upon tissues promotes absorption of fluids and, later on, atrophy of the tissues themselves. As the induration at the base and edges of the ulcer melts away under the influence of the pressure exerted by the straps, the blood-channels

are opened up, and instead of there being an excess of venous over arterial blood, the proper proportion is restored by the venous blood being permitted egress from the ulcer, and the healing arterial blood ingress into the ulcer.

For the routine treatment of the average varicose leg ulcer nothing serves better—nor is there any more economical form of support—than Unna's zinc oxide and gelatin paste enmeshed in a gauze bandage so as to form a stocking with the consistency of rubber. Upon the patient's return the Unna stocking is fenestrated at the site of the ulcer, as indicated by the area of staining from the discharge. In addition to fenestrating the stocking, it is my practice to cut the edge of the fenestration in a spoke-like manner, to prevent congestion of the ulcer from the edge of the fenestration pressing into the edge of the ulcer. I have seen many ulcers change from a livid to a rosy hue by merely making these spoke-like incisions into the edge of the fenestration. After the ulcer has been uncovered by fenestration of the stocking in this manner, it is treated by the rubber-tissue-dry-gauze-muslin bandage method described above. Unless it become loose, or very much soiled, the Unna stocking need not be changed for three weeks.

After varicose leg ulcers have been cured, it is important immediately to institute prophylactic methods against recurrence; and for this purpose a well-fitting silk-elastic stocking or a Randolph bandage should be used. Patients should be reminded that in the course of time a silk-elastic stocking wears out and loses its power of supporting the tissues, and that for this reason a new stocking must be purchased at intervals.

To prove the efficiency of the purely mechanical *vs.* the medicament treatment of varicose leg ulcers, I decided to put my method to a severe test by selecting the most extensive case of varicose leg ulcer that I could find. Accordingly, three weeks ago, I began treatment upon a patient whose legs were the seat of chronic multiple leg ulcers. This patient, a man aged seventy-five years, had had the ulcerous condition for about a quarter of a century, and during that extent of time recurrences had been numerous. He reported in the Surgical Clinic of Professor Morris Booth Miller, at the Philadelphia Polyclinic Hospital. From being indolent and sluggishly inactive (Fig. 2), now, after only three weeks of mechanical treatment, the bases of the ulcers are covered with healthy, red, vigorous granulations, while the epithelial edges are bluish-white and rapidly regenerating. When ulcers assume these healthy tints they never fail to heal. The complete epithelialization of some of the smaller ulcers indicates that there has already been established

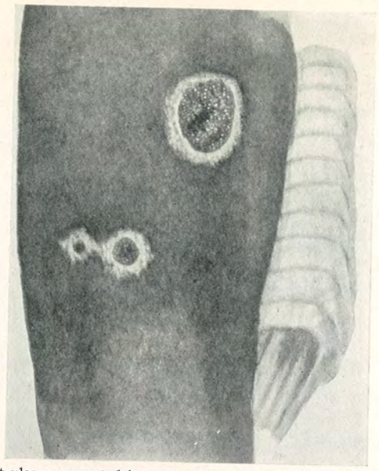


FIG. 1.—Indolent ulcers converted into the classic healing variety by the calomel-adhesive-plaster method. Note firm, bright red granulations and encircling broad band of bluish-white, rapidly regenerating epithelium. Straps curled back for sketch. Author's case (*International Clinics*, 1913, vol. iii, 23d series, p. 210).

FIG. 2.—Photograph of multiple varicose leg ulcers taken at beginning of the mechanical method of treatment. Note protection of epithelial edges by strips of rubber tissue.

a tendency to vigorous healing, and that with time and a little patience, complete epithelialization of the largest ulcer may be predicted with certainty unless the ulcer is adherent to bone.

NOTE (January 12, 1916).—Under the above-described treatment the smaller ulcers healed rapidly so that, the skin now being intact, the calomel-adhesive-plaster method was substituted, with a view to curing the two large ulcers, one on each leg. By this method the amount of discharge rapidly diminished, the ulcers quickly assumed the appearance shown in Fig. 1, and the area occupied by the ulcers became markedly decreased.

At present, owing to the adherence of their base to the bone, these two large ulcers, while healthy, seem to have reached a stationary stage in healing; all that is needed for completion of the process of epithelialization is the stimulus afforded by a few Thiersch grafts, which will be applied forthwith. Were it not for the vigorous granulations already covering the bone, the suggestion of C. H. Mayo ("The Preparation of Dry Bony Areas for Skin Grafting," ANNALS OF SURGERY, September, 1914, p. 372) could well be applied in this case.

For an exhaustive paper on other aspects of varicose leg ulcers, consult article by Williams (*British Medical Journal,* July, 1913).

CONCLUSIONS

1. The rationale of treating varicose leg ulcers is to establish a tendency to heal by combating the pathologic hindrances to healing.

2. The pathologic hindrances to healing are the sequelæ of chronic venous congestion; and chronic venous congestion, in its turn, is the result of the inability of the vena saphena magna and its tributaries to withstand the attraction of gravity upon the long column of blood contained therein.

3. Reduced to its simplest terms, the rational treatment of varicose leg ulcers depends upon the recognition and application of the principles of, first, protection of the regenerating epithelial edge, second, drainage of the discharge from the ulcer and, third, support of the venous channels from without, thus neutralizing the baneful effects of chronic venous congestion.

4. The agents employed in the rational or drugless treatment of varicose leg ulcers may be summarized by terming the method the rubber-tissue-dry-gauze-muslin bandage method. In selected cases the calomel-adhesive-plaster strapping method cures rapidly and efficiently; while for routine treatment of the average case Unna's zinc-oxide-gelatin paste stocking serves as an admirable and efficient support.

5. The tendency to healing has been established when the base of the ulcer is covered with healthy, red, vigorous granulations, and when the epithelial edge becomes broader and assumes a pale, bluish-white tint.

6. If in a case of multiple varicose leg ulcers the smallest ulcers become completely covered with epithelium under the influence of treatment, it has thereby been proven that a tendency to healing has been established, and that in time the larger ulcers will heal, if not too large, excessively fibrosed, or adherent to bone.

7. Healing of the ulcers having been brought about, it remains to prevent recurrences. Recurrences may be prevented by mechanical or operative methods: mechanically, by the use of a silk-elastic stocking, renewed when worn out, or by a Randolph bandage; and barking of the shin should be insured against by a shin-guard or wool padding of that part of the stocking that covers the shin. If an operation for excision of varicose veins augurs favorably, it should be performed after healing of the ulcer has taken place; otherwise, the operative wound might become infected from the ulcer, and septic thrombophlebitis, with all the attendant dangers of embolism, might then ensue.

8. The success of the rational, drugless, or mechanical treatment proves the fallacy, as well as the futility, of expecting cure from the application of medicaments, while overlooking the fundamental pathologic etiology of the ulcer.

9. Fads, such as scarlet red and basic fuchsin ointments, do not promote epithelialization of an ulcer without due regard for the pathologic etiology of the ulcer, and when regard for this factor has been taken into account, the use of such stimulants is unnecessary.

HÆMATOMA IN THE SHEATH OF THE RECTUS MUSCLE FROM RUPTURE OF THE DEEP EPIGASTRIC ARTERY

Dr. Speese reported the case of a woman, aged sixty-two, who was admitted to the Presbyterian Hospital with the diagnosis of intestinal obstruction. The patient stated that ten hours before her admission, she developed a sudden and severe pain in the abdomen. The pain began in a swelling, situated below the umbilicus, which had been present for one year and which had been pronounced an umbilical hernia by her family physician. The patient was in moderate shock, the pulse rapid and weak, temperature a little below normal, she complained of nausea and had vomited several times. On examination a large mass was found below the umbilicus. This was regarded as a loop of intestine, not in an umbilical, but probably in an interstitial, form of hernia, and operation advised for an apparent strangulation. An incision was made over the

tumor, and on opening the sheath of the rectus muscle, a considerable quantity of fresh and coagulated blood escaped, the slightest manipulation causing profuse hemorrhage. After packing the area from which the hemorrhage arose, and on careful exploration, it was found that the muscle was soft and pulpy, infiltrated with blood, and greatly resembled a strangulated intestine. Finally, the spurting epigastric vessel was disclosed and ligated. The muscle was so degenerated that six inches was removed. Palpation through the peritoneum did not reveal any abnormalities, so that the abdominal cavity was not opened. The sheath of the muscle was carefully sutured and overlapped, and the patient returned to the ward in good condition.

During her convalescence she was questioned more carefully concerning the development of the tumor. She was positive that it appeared suddenly about one year ago, and that there was no strain, blow, or other form of traumatism to account for its origin. On several occasions the mass enlarged slightly and became painful, but never had been so painful as during the last attack. The patient suffered from chronic nephritis and myocarditis, which complications prolonged her convalescence. The wound healed well, seemed solid and there was no tendency toward the formation of a hernia when the patient was seen last, three months after the operation.

Several years ago the author reported before the Academy a case of perirenal hæmatoma, and this case seems to belong to the same group. In perirenal hemorrhage, a definite cause may be demonstrated, such as tuberculosis, neoplasm, traumatism and hæmophilia. The spontaneous form is probably due to chronic nephritis, the only pathologic lesion which has been demonstrable. The same facts apply to the few cases on record in which spontaneous hemorrhage occurred in the rectus or other muscles. Hæmophilia has been noted in some of the cases, in others, as in the case reported, chronic nephritis has been present, and this, along with degenerative changes in the arterial system, may have acted as the etiologic factor in the production of the hemorrhage. It is noteworthy that massive hemorrhage into the perirenal or retroperitoneal space usually excites symptoms suggestive of intestinal obstruction, and that the same symptoms may be produced by hemorrhage into the sheath of the rectus or other muscles.

Dr. Floyd E. Keene said that the case reported by Dr. Speese was similar to one which came under his observation on Dr. Clark's service in the University Hospital and appeared as a post-operative complication. Hysterectomy was performed in the morning and no untoward symptoms followed the operation until late in the evening when, follow-

ing an attack of violent vomiting, there developed symptoms of internal hemorrhage. Operation was immediately done and an extraperitoneal cast of blood-clot was found, the source of hemorrhage being from the ruptured right deep epigastric vein, which was ligated. The peritoneal cavity was opened and found to be free from blood.

Dr. A. P. C. Ashhurst said that he had seen one such case at the Episcopal Hospital in the service of Dr. George W. Norris, in the case of a youth, aged seventeen years, who was admitted to the medical ward January 16, 1912. His illness had begun on January 13, with pain in the left chest, and on admission there was dulness and bronchial breathing at the base of the left lung. On January 18 the leucocyte count was 32,800. Dr. Ashhurst was asked to see him January 24. His temperature ran from 103° to 104° F., his pulse-rate was about 120, and his respirations were from 30 to 38. He was told that he had had a pneumonia at the base of the left lung, with pleural friction. There had been no abdominal symptoms except slight distention for the past several days. His bowels had been opened normally. Recently he was thought to have had pleurisy and perhaps pneumonia in the right lung. There had been no crisis. There were pneumococci in the sputum. The leucocytic count that day was 25,000.

The boy looked desperately sick; he was dyspnœic, cyanosed, flushed, but clear in mentality. He could hardly speak, being very hoarse, with constant cough, and expectorating blood-stained mucopus. The left chest was strapped, and only dry, creaking râles could be heard. The right chest was dull high in the axilla, the breath sounds were well heard, and there were numerous very loud, moist and whistling râles. The abdomen was slightly distended all over; deep respiration was impossible without pain and coughing. In the right hypogastric region a poorly-defined mass was visible. This was very tender on sudden or deep pressure, and was surrounded by tympanitic areas on all sides. There was slight œdema of the overlying skin. There was no cutaneous hyperalgesia. The abdomen elsewhere was flaccid, but slightly distended. Peristaltic sounds were normal. No mass could be felt through the rectum. The bladder was empty.

Under local anæsthesia an incision was made over the swelling. On opening the anterior sheath of the rectus there was a discharge of liquid and clotted blood. The fibres of the rectus muscle were destroyed throughout the whole width of the muscle, and for a distance of about 2 inches longitudinally. The parietal peritoneum was opened, disclosing normal contents. The peritoneum was closed and the cavity in the rectus muscle drained with gauze.

The clots removed from the rectus muscle were examined by Dr. C. Y. White, Director of the Pathological Laboratories of the Episcopal Hospital; muscle fibres were still recognizable in the clot. Cultures of the clotted blood showed "a long chain strepto-diplococcus, not the pneumococcus."

The patient died three days later, January 27, 1912. Autopsy showed no peritonitis, but pneumonia and acute parenchymatous nephritis.

This case may well be classed as one of "spontaneous hæmatoma" of the rectus muscle, presumably due to metastatic infection by hæmolytic streptococci. He objected to the use of the term "rupture" unless there is evidence of injury.

FOREIGN BODIES IN THE SMALL INTESTINE

Dr. George G. Ross reported the case of a woman, aged thirty-five years, who was admitted to the Germantown Hospital, March 2, 1915, with a history of pain in the right lower abdomen. This had been marked during the last six months and was associated with soreness. Occasionally the pains were colicky. The pain was increased by stooping or turning in bed, and by walking. Painful and frequent urination; urine was cloudy at times; there was no leucorrhœa. Her appetite was good and her bowels regular. There were no gastro-intestinal symptoms; the heart and lungs were negative.

The abdomen was flat, no masses to be felt. Pressure in the right hypochondriac region caused pain in the right iliac fossa. There was marked tenderness over the entire right lower abdomen, especially pronounced over McBurney's point and just above the symphysis. Vaginal examination showed a movable uterus, with some retroversion and prolapse. There was a distinct tender mass to the right of the uterus.

The following information was obtained after the operation and this fact accounts for the incorrect diagnosis of tubo-ovarian abscess. She had been an inmate of the State Hospital for the Insane, to the authorities of which we are indebted for the following facts: Their diagnosis was constitutional psychopathy. She had attempted abortion in all four pregnancies. During the last pregnancy, three years ago, she had made almost constant attempts to empty the uterus. Among the methods employed were three boxes of Hooper's pills; gin and celery seed of which she took three quarts; and fifty cents' worth of Epsom salts taken in one day. On the advice of a clairvoyant she took a cupful of hot claret at the same time, soaking her feet in hot water containing a pint of chopped onions. She developed suicidal tendencies,

one of her methods being the swallowing of pins, twisted bunches of hairpins, safety-pins, etc. After two years of treatment she recovered her mental balance and was discharged.

Operation.—Right rectus incision. The terminal ileum was bent on itself and the sides of the bowel were adherent to each other and the apex of the mass was adherent to the bladder. The knuckle of bowel contained a foreign body which felt like calcareous plates. This portion of the bowel was resected and lateral needle and thread anastomosis was made. The tubes and ovaries were normal. The wound was closed without drainage. The resected gut contained eighteen to twenty pieces of thin, blackened wire resembling Gem paper clips or curtain hangers. One clip had perforated the wall of the bowel and projected into the peritoneal cavity.

Dr. Addinell Hewson said that he had found in the dissecting room of the Polyclinic a cadaver in which two steel needles had been forced by the patient between the occiput and the spinal column through the foramen magnum into the medulla and which were stuck against the ventral margins of the foramen magnum. In addition the patient had two needles of the same character in the nasal cartilage in front of the nasal bones. Her stomach was of enormous size. The needles had been in the spinal cord apparently for a long time because they were rusted. The woman was an insane patient and was from the same hospital from which Dr. Ross's patient came.

TORSION OF THE OMENTUM

Dr. George G. Ross reported the following case: A woman, forty years of age, was admitted to the German Hospital, August 13, 1915. Her chief complaint was pain in the lower right abdomen. Her trouble began five days prior to admission with pain in the upper abdomen, soon becoming general. Two days later the pain had localized in the lower right quadrant. There were 6200 leucocytes, a temperature of 100° and a pulse of 108. There were no chills. Appetite, bowels, heart, lungs, and kidneys were normal. This was her first illness. Family history was negative. Husband and four children well.

Examination was negative with the exception of a point of marked tenderness at McBurney's point. An ill-defined mass could be made out in the lower right quadrant. A diagnosis of acute appendicitis with abscess was made.

Operation.—The appendix was found acutely inflamed and covered with lymph. The omentum was found twisted on its long axis for about eight inches, there being three complete twists. It was dark purplish-red, congested, but not gangrenous. The appendix and omentum were removed as was an epiploic appendix which had become adherent to the mesentery of the ileum. The recovery was uninterrupted.

GALL-STONE ILEUS

Dr. John H. Jopson reported the case of a woman, aged fifty-eight years, who had suffered for a long time with what was termed indigestion. She had been sick a week before admission to the hospital. The onset was sudden, marked by pain and diarrhœa, and following this no movement of the bowels could be obtained for six days. For the purpose of relieving the obstruction she had been given enormous doses of cathartics, including citrate of magnesia, blue mass, castor oil, calomel and rhubarb, as well as high compound enemas and opium. Vomiting was frequent and had been fecal for more than 24 hours before admission to the hospital. She was in fair condition; pulse and temperature not materially altered, abdomen flaccid, no areas of tenderness. No tumor could be felt and the rectum was empty. The stomach when washed out was found to be full of fecal matter. As soon as the abdomen was opened, the obstruction was located in a loop of the ileum, lying down in the pelvis. It was recognized to be a gall-stone and was removed by linear incision of the bowel. The opening was closed in the usual manner by two layers of sutures. The stone measured three inches in length by three-quarters of an inch in width, was smooth, oval, of an olive color and weighed 25 grammes. The bowel contracted very much at the point of suturing, evidently from muscular spasm. There were numerous adhesions in the hepatic region and no attempt was made to explore further in this direction. The first examination of the urine had been reported negative, but a second examination two days after operation revealed the presence of sugar, and in subsequent examinations as high as 3 and 4 per cent. was present; also acetone and diacetic acid. The patient's condition was poor after operation and there was marked cardiac weakness and paresis of the bowel, which responded to the exhibition of eserin, after pituitrin had been given without result. Probably as a result of an old diabetes, there was absolute failure of the wound to heal, although convalescence for the first week was almost afebrile. The wound opened up throughout its entire length and a loop of bowel protruded and the granulating process was exceedingly sluggish. At the same time, the patient's physical and mental condition were very bad. At the end of six weeks, as a result of diet and general medication, the acetone and diacetic acid had disappeared from the urine and also the sugar. The patient later

developed a phlebitis, first in the left and later in the right leg, with occasional chills and rises of temperature, and succumbed rather suddenly seventy-eight days after operation to what was apparently a pulmonary embolus.

The history of this case as regards the gall-stone ileus is very typical of obstructions of this nature. The long duration of the obstruction before it became alarming to her medical attendants, is explained by the fact that these obstructions are seldom complete in the early stages, and there is an absence of strangulation of the bowel, while spasm of the muscle fibres of the intestine is, according to Duplay and Reclus, responsible for most of the obstructive symptoms. The characteristic symptoms, according to Barnard, are the sudden onset, the absence of pain and collapse until late in the attack, the incomplete obstruction and the absence of tenderness and distention of the abdomen. Vomiting is a prominent symptom, being severe and continuous, while jaundice and true biliary colic are generally absent in the case of large stones. The mortality is high. The development of a septic phlebitis was undoubtedly responsible for the lethal termination of the case seventy-eight days after operation, and this phlebitis was probably dependent upon the toxæmia due to prolonged obstruction, the diabetic condition, and the delayed wound healing.

Dr. Alfred C. Wood said that he had had the opportunity of operating on three cases of gall-stone ileus. The first case was that of a woman about fifty-eight years of age, with no previous history of indigestion or other illness, with the exception that at eight months prior to admission to the hospital she had an attack of pain which was thought to be due to pleurisy. During the three months prior to coming into the hospital she had attacks of constipation alternating with diarrhœa. At the operation a gall-stone was found in the ileum about 6 inches from the cæcum. As this stone was faceted, other stones were looked for, and a second stone discovered in the act of passing from the gall-bladder to the duodenum.

In the second case the diagnosis was made on account of the history of an attack some months before, that strongly suggested a gall-stone attack. The stone was found in approximately the same situation as in the preceding.

In the third case, the stone was of larger size and had been arrested at about a foot from the valve. A very careful study of the patient's history will sometimes enable one to suspect the cause of the obstruction in these cases.

MULTIPLE CARTILAGINOUS EXOSTOSES (HEREDITARY DEFORMING CHONDRODYSPLASIA)*

WITH NOTES OF NINE HITHERTO UNPUBLISHED CASES

By Astley Paston Cooper Ashhurst, M.D.
of Philadelphia

The clinical entity which goes under the name of multiple cartilaginous exostoses has recently been studied by Ehrenfried, who prefers the name hereditary deforming chondrodysplasia. According to Rendu and Levy its relation to chondrodysplasia was recognized by Ollier as long ago as 1899. G. G. Davis says it was described as a clinical entity by Cæsar Hawkins, in 1837. Ehrenfried found only about twelve cases which have been reported in America, the greatest number being reported from Germany and France. Inasmuch, however, as I have myself had the opportunity to see no less than eleven such patients within the last ten years it is evident that the affection is not really rare, but merely has been ignored, because there is so little that can be done in the way of treatment.

The affection is more frequent in males than in females, is distinctly hereditary, may be transmitted by both affected males and females, but there is no good evidence that it may be transmitted by unaffected males, though it may be transmitted by unaffected females (Reinicke, 1890; Lippert, 1903). The essence of the disease is not the exostoses; these are merely incidental (Lenormant, 1905). This has received especial recognition since the more common use of X-rays, but was suggested by Ollier and others long before the advent of skiagraphy. As a matter of fact, the underlying pathological change is a chondrodysplasia, affecting especially the metaphyses of the long bones, though the bones of the pelvis, the clavicles, scapulæ and the vertebræ may be involved also. In skiagraphs the bone ends may look cystic (Fig. 2), owing to irregularly distributed areas of cartilage in the metaphyses. The epiphysis itself is small or misshapen, the intermediary cartilage is narrow, irregular, oblique, or zigzag, and sometimes prematurely ossified (Lenormant, 1905). Scattered along the ends of the shaft beneath the periosteum are to be found clumps or nests of cartilage cells persisting uncalcified where they

*Read before the Philadelphia Academy of Surgery, October 4, 1915.

were left in the process of growth. Later these groups may develop into cartilaginous exostoses or chondromas (Ehrenfried, 1915).

Certain secondary characteristics usually but not always are present, and are easily recognized (Bessel Hagen, 1891). These are a low stature, due to shortness, not of the trunk, but of the limbs; as a rule the lower limbs are more shortened than the upper. There often is a lack of growth of the ulna, resulting in relative overgrowth in length of the radius, which becomes luxated at one or both ends, especially at the elbow. Thus the condition has been mistaken for "congenital dislocation of the radius," and according to Bessel Hagen most cases so described really were cases of this dyschondroplasic affection and in no sense instances of a congenital dislocation. Pes valgus is a frequent development from lack of growth of the fibula, with relative overgrowth of the tibia.

The deformities above enumerated may come before the exostoses, and the latter may never develop. Exostoses may develop in cases of very slight or insignificant deformities; or exostoses may be present on undeformed bones while the same patient may have other bones which are deformed but without exostoses.

Occasionally a malignant osteocartilaginous tumor develops in one of the exostoses. Ehrenfried says Lenormant and Lecène collected 24 such cases, and he has himself found references to about a dozen more.

Patients usually come under observation at or about puberty, for pes valgus, for painful pressure by one or more exostoses, or for general bone pains. After skeletal maturity the disease usually ceases to progress; but in the remarkable case reported by G. G. Davis (recorded below as Case 10) a man who had had exostoses since childhood began to develop new tumors when past fifty years of age, after a quiescent period of more than 30 years. In the patient recorded below as Case 8, moreover, there is no certain knowledge of the existence of the exostoses before the age of thirty years. But if we remember that exostoses are incidental features of the affection, there is no reason, so far as I can see, to deny the possibility of their appearing for the first time in adult life.

I give below a brief abstract of the cases which have been under my own observation. Unfortunately the hereditary character of the disease is not very apparent in this series, most patients denying that any other members of their family were similarly affected. But it is very likely that closer investigation might have discovered some such cases.

Case I.—Ella C. M., aged four years, was referred to the Orthopædic Service of the Episcopal Hospital by Dr. Henry Winsor and Dr. James W. Ellis, September 20, 1915. This girl is her parents' only child; the mother has had no other pregnancies. The parents are both healthy, and the family history is otherwise negative. The child was normal at birth. From the age of 11 months to 20 months she suffered from enteritis, and had an intercurrent attack of measles at the age of one year. Since then she has been healthy, with the exception of an attack of varicella about three months before coming under observation.

About one year before seen by Dr. Ashhurst, the child fell and bruised her left knee. When her mother came to rub it for her she found a lump on the outer side above the knee. No further trouble was experienced, and it was not until about six or seven months later that the mother noticed similar bony lumps on the upper part of the left humerus and at the right elbow.

Examination at the present time shows a fairly well developed and nourished child, with no subjective symptoms. The mother thinks the lumps have not increased in size much if at all since they were first noticed. There are exostoses in the following locations: Two on the spine of the right scapula, one on the upper angle of the left scapula, one on the fifth right rib, near its cartilage; one on the upper end of each humerus, that on the right apparently arising from the lesser tuberosity, and that on the left from the greater tuberosity; one on the upper end of the right ulna, inner side; one above the external condyle of the left femur; one above the external malleolus of the left fibula.

The head of the right radius is unduly prominent, as if subluxated.

Many skiagraphs were taken, but as the child was very refractory and would not be still, none of them are sufficiently good to be reproduced as half-tone illustrations.

Case II.—Philip W., twenty years old, seen in Dr. Davis's service at the Orthopædic Hospital, April 17, 1906 (Book xviii, p. 118). Exostoses first noticed at age of three months. There are now exostoses on nearly all the bones; in both forearms the radii are longer than the ulnæ, and the hands deviate to the ulnar side. There is moderate valgus in both feet.

Case III.—Edna U., eleven years old, negress. Seen in my dispensary service at the Children's Hospital, August 13, 1907. There are four other healthy children, and so far as known no one else in family has any similar affection. No history of tuberculosis. The patient began to walk at age of nine months, and so far as family knew was perfectly normal until three years ago,

when exostoses began to appear, and have been growing larger since. She comes for pains in her bones. The photograph (Fig. 1) shows many of the exostoses. The right radius was 21 cm. in length, and the left 18.5 cm. There is some shortening of the ulnæ, and slight valgus in both feet from deformities in the leg. She was under treatment at this time for 7 months, and her pains lessened while taking the syrup of the iodide of iron. Three years later she was seen at the Orthopædic Hospital, in Dr. Davis's service, for pronounced valgus in both feet. As the condition was painful, braces were ordered including the legs.

CASE IV.—Fred R., aged seventeen years, was seen in Dr. Davis's service at the Orthopædic Hospital, November 12, 1907 (Book xx, p. 14). The family history is recorded as negative. The boy had had typhoid fever in 1897, when eight years old. About one year later he first noticed an exostosis over the upper inner end of left tibia. One year later a similar growth appeared in a corresponding situation on the right leg. Then gradually others formed all over the long bones. The left knee is markedly bowed (outward). The right lower extremity measures 88 cm., and the left 91 cm., being longer than the right in spite of the bowing of the knee.

CASE V.—Henry B., fifteen years old, was seen in Dr. Davis's service at the Orthopædic Hospital, January 21, 1908 (Book xx, p. 62). His brother, with the same affection, is recorded below as Case VI. Another brother, also said to have multiple exostoses, was not seen. Henry has had the affection for seven or eight years, and for five years had to wear leg braces on account of pain and weakness. There are exostoses on all long bones, on both clavicles, both scapulæ and on the pelvis, but none on the hands or feet.

CASE VI.—Mason B., aged thirteen years, seen in Dr. Harte's service at the Orthopædic Hospital, March 19, 1908 (Book xiii, p. 58). Two brothers have multiple exostoses. One is recorded above as Case V. Mason has noticed the present condition about two years. He comes for valgus deformity in both feet. The right leg, from knee to ankle, is 1.5 cm. shorter than the left.

CASE VII.—Herbert T., aged fourteen years, seen in Dr. Harte's service at the Orthopædic Hospital, February 11, 1909 (Book xiii, p. 215). The boy came for weakness in the left arm, which had existed for a year. There was paralysis of the left ulnar nerve, evidently due to pressure of a bony mass in the neck (Fig. 2). Over this mass there was a keloid scar from an operation performed four months previously in another hospital. So far no improvement had followed this operation. There were also exostoses of the right humerus, left femur, left tibia and

FIG. 1.—Case III. Multiple cartilaginous exostoses in a negro girl of eleven years.

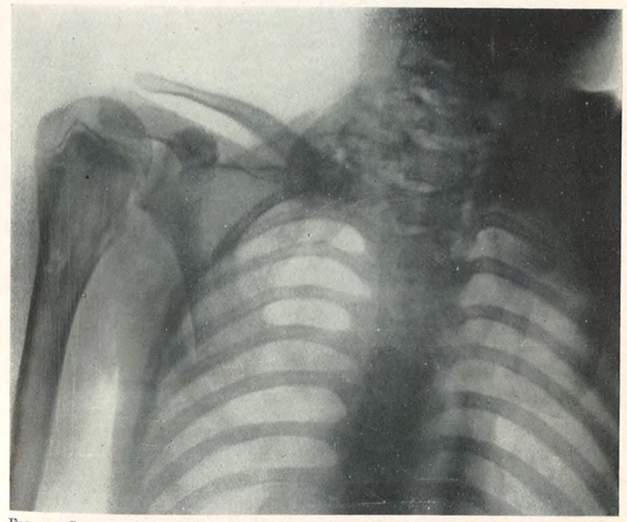


FIG. 2.—Case VII. Multiple cartilaginous exostoses. The mass in left side of neck has caused paresis of ulnar nerve. Note involvement of vertebral border of scapula, exostosis on upper metaphysis of humerus and cystic (cartilaginous) appearance of underlying bone.

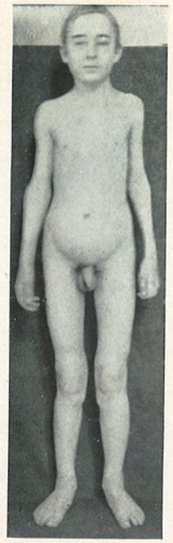


FIG. 3.—Case VII. Multiple cartilaginous exostoses.

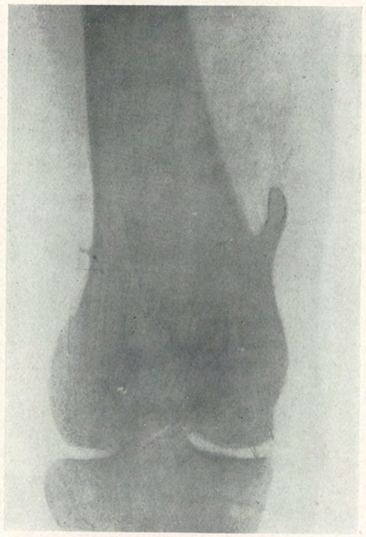


FIG. 4.—Case XIV. Exostosis above internal condyle of femur.

FIG. 5.—Case XV. Exostosis excised from humerus.

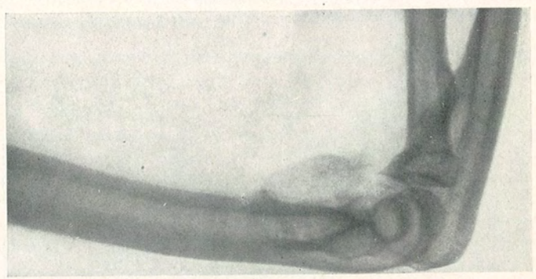


FIG. 6.—Case XVII. Traumatic hyperostosis of the humerus, four months after a fall on elbow.

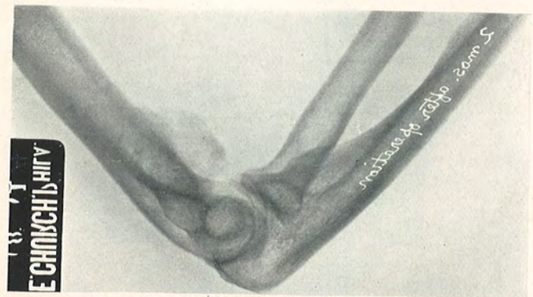


FIG. 7.—Case XVII. Recurrence of hyperostosis of humerus two months after operation.

FIG. 8.—Case XVII. Gradual absorption of new-formed bone, nine months after operation.

fibula. A photograph (Fig. 3) shows considerable valgus deformity in the feet, and moderate shortening of the upper extremities, and some of the lower extremities, as the midpoint of stature is not at the pubis, but half way between it and the umbilicus.

CASE VIII.—Alexander M., thirty years old, seen in Dr. Davis's service at the Orthopædic Hospital, June 8, 1909 (Book xxii, p. 19). The family history is negative. The patient had never been ill, and denies all venereal disease. The present complaint was noticed after what he calls an attack of "rheumatism" for which he says he was treated from December, 1908, to March, 1909. Until the latter date he did not know of the existence of any exostoses. At this time Dr. Davis removed an exostosis from the left femur, which was pressing on the sciatic nerve (possibly the cause of his "rheumatism" during the winter), and one from the left fibula.

CASE IX.—Mary R. B., aged seven years, seen in Dr. Davis's service at the Orthopædic Hospital, August 10, 1909 (Book xxii, p. 84). The exostoses were noticed before the child was one year of age. They are present on all four extremities, on the scapulæ, and one is forming on the left ribs. The child was brought for pronated feet.

I have also seen the two patients reported by Dr. Davis in the monograph already mentioned:

CASE X.—A man, aged fifty-three years, whose exostoses began to appear when he was about ten years old. After the age of fifteen or sixteen years, the disease became more or less stationary, except for gradual impairment of joint motions. At the age of fifty-two years an exostosis developed on the left ramus of the pubis; this growth subsequently grew smaller while the patient was under Dr. Davis's observation. The man suffered from considerable pain in his bones, and was incapacitated for work. A photograph published by Dr. Davis, as well as numerous skiagraphs, shows the typical deformities characteristic of the disease, namely, relative shortening of ulnæ, with ulnar deviation of the hands, and subluxation of the head of the left radius; right knock-knee, and valgus in both feet.

CASE XI.—A child (sex not recorded) aged three years, with multiple exostoses, which were first recognized by the mother before the child was one year old. The digital phalanges were involved as well as all the long bones of the limbs. The child also was rhachitic, and knock-knees were present.

There are also brief records at the Orthopædic Hospital of the following two patients, in Dr. W. J. Taylor's service. They did not come under my personal observation:

CASE XII.—Edward S., aged sixteen years, January 26, 1907 (Book xiii, p. 12). Has had knock-knee since childhood; had typhoid fever 4 years ago. Has several exostoses on or near each knee.

CASE XIII.—Hugh McN., aged thirty-four years, March 5, 1910 (Book xv, p. 31). Has presented symptoms due to exostoses for 2 years. Exostoses are present at right wrist, left elbow, and left scapula.

Owing to lack of details it is not certain that these cases (XII and XIII) are instances of hereditary deforming chondrodysplasia. But the more one looks into the matter, the more difficult does it become to draw any definite lines between well defined "typical" cases and those which are just on the verge of typical. At the other end of the scale come those patients who present one or at most two or three exostoses, which have developed without any evident cause, or have been discovered after a slight injury which may or may not have been an etiological factor. These patients present no indication of any hereditary affection, and no skeletal deformities are noticed. It is of course possible that in such cases a thorough skiagraphic examination might reveal evidences of chondrodysplasia in bones showing no other evidences of disease, or might even show other insignificant exostoses.

The following cases, for instance, are to my mind examples of chondrodysplasia of some sort:

CASE XIV.—Annie S., aged sixteen years, was seen in Dr. Harte's service at the Orthopædic Hospital, July 27, 1911. Two years previously she had struck her left thigh against the runner of a sled, and three months later a bony lump appeared. She complained of pain in the lower part of her left thigh when walking. The lump was a typical cancellous exostosis, springing from the femur above the internal condyle (Fig. 4), and I excised it with the cortex from which it sprang, September 7, 1911.

CASE XV.—Jennie F., aged thirteen years, referred to my service at the Episcopal Hospital by Dr. R. S. Hooker, in May, 1914. A bony lump had been noticed at the right shoulder for three weeks; there was no history of injury. The exostosis, springing from the humerus and presenting beneath the anterior fibres of the deltoid muscle, was excised with the underlying cortex, May 13, 1914 (Fig. 5). There has been no recurrence to date.

CASE XVI.—Grace J., aged fourteen years, came to my service at the Orthopædic Hospital, October 31, 1914. About September 1, 1914, she had fallen on the stairs, and twisted her shoulder in the banisters. About a month later she noticed a lump on the right scapula. This caused pain, and seemed to be growing larger. On December 12, 1914, I excised it. It sprang from the upper vertebral angle, and the portion of bone from which it grew was removed in one piece with it, including the entire thickness of the scapula. Recovery was uneventful. About four months later the girl returned, complaining of neuralgic pains beneath the right pectoralis minor, and shooting back to the scapula. Skiagraphs showed no bony lesion. The girl was referred to the nervous department of the hospital for an opinion, and Dr. F. W. Sinkler reported that he considered her neurasthenic. At all events she recovered from her pains without further surgical treatment.

Two utterly different types of cases, it seems to me, are those recorded by me in the remaining pages of this article—one a traumatic hyperostosis, the other an instance of osteophytes accompanying chronic hypertrophic arthritis.

CASE XVII.—*Traumatic hyperostosis of the left humerus, recurring after operation, but eventually disappearing spontaneously.*

Mary D., aged twenty-four years, was seen in the Orthopædic Service of the Episcopal Hospital, June 1, 1914. Four months previously she had fallen down ten steps, landing on her left elbow. Her physician said it was dislocated, but an X-ray showed no bone lesion. It was bandaged for some weeks, but remained painful.

When examined at the Episcopal Hospital, four months after the accident, there was marked disability, with constant pain in and above the elbow. There was full extension and normal rotation, but flexion of the elbow was stopped by bony contact at 80 degrees. A bony mass could be felt in the flexure of the elbow a little to the median side of the midline between the condyles. An X-ray showed a mass of bone in the flexure of the elbow (Fig. 6) apparently arising from the humerus, possibly from the muscle. The patient readily consented to have the excessive bone removed by operation, as she was unable to do her work (housework).

Operation (June 29, 1914).—Under Esmarch anæmia a longitudinal incision was made along the median edge of the biceps muscle, displacing the brachial vessels and median nerve to the median side. This gave ready access to the growth, which, as shown by the X-ray, sprang from the humerus, nearer its median than its lateral border. The growth extended down to the trochlear surface. It was covered by periosteum which appeared normal, and did not in any way involve the muscles. The mass with its overlying periosteum was removed by gouge and mallet, until the normal contours of the humerus were restored, and normal flexion of the elbow was possible.

The pathological report, by Dr. C. Y. White, Director of the Pathological Laboratories of the Hospital, stated that the specimen was composed of cancellous bone containing areas of granulation tissue.

July 20: Elbow flexes further than before operation. A bony mass is still felt over the lower anterior part of the humerus.

August 3: Flexion to 65 degrees and full extension.

August 31: Flexion to 60 degrees. Some pain in damp weather.

X-ray shows recurrence of bony growth in flexure of elbow (Fig. 7).

March 8, 1915. Nine months after operation. Flexion to 50 degrees, extension normal. Never any pain or disability. X-ray shows scarcely any thickening of the shaft at the site of the former hyperostosis (Fig. 8).

CASE XVIII.—*Osteophytes of humerus, accompanying chronic arthritis of the shoulder; excision with permanent relief of symptoms.*

John C., aged sixty-two years, broom-maker. Blind since age of twelve years, as the result, he says, of an attack of typhus fever. He was seen in the Orthopædic Service of the Episcopal Hospital, August 5, 1913. About 15 years previously he had fallen and injured his right shoulder, and it had given him constant discomfort since. In December, 1912, this shoulder gave a sudden crack while at his work of making brooms, and he had been unable to work at all subsequently until the present, on account of the pain in his shoulder on any motion.

Examination showed a well-preserved but thin old man, not at all robust. There was no limit to passive motion in the shoulder-joint, but very marked crackling on external rotation and very great tenderness over the tuberosities. On elevation of the arm the tender points disappeared under the acromion. A skiagraph showed no bony lesions other than some hypertrophic changes in the acromioclavicular joint, where he had no symptoms. Operation was undertaken as an exploration, in the expectation of finding some periarthritis with bursal adhesions.

Operation (August 15, 1913).—Ether. An incision from the point of the acromion downward for three inches was made, splitting the anterior fibres of the deltoid. No evidence of any subdeltoid bursa was found. Immediately beneath the deltoid the very thin capsule of the shoulder-joint was exposed, and on opening this the head of the humerus was found to be eroded and flattened. The external part of the head was much flattened, and there were two osteophytes at the margin of the articular cartilage (just at the reflection of the capsule on to the anatomical neck), which caught on the capsule during rotation outward, and caused a distinct *jump* and crackling. These two osteophytes were removed by gouge. They were about 6 or 7 mm. high. The long head of the biceps, on the inner side of the incision, seemed to be intact.

Pathological Report (Dr. C. Y. White).—Compact bone, denser than normal, covered with cartilage on its free surface. No evidence of inflammation.

The subsequent history is brief and satisfactory. The wound healed promptly, all pain was relieved, and the man returned to his work. He was last seen September 6, 1915, more than two years since operation. He has not had a pain or a twinge in that shoulder since operation, and continues his work without disability, except that he is now developing a Dupuytren's contracture in the palm of the right hand.

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DR. GWILYM G. DAVIS said that not infrequently these cases of multiple exostoses are seen in early adult life and in youth, and he did not think there is much doubt but that evidence of them exists in infancy. It is well to bear this in mind; otherwise the disease will be considered a new and active one, whereas it is a congenital trouble and of old standing. In some cases, in which only one or two exostoses are seen, if the X-ray were applied other parts would be found to be involved. This would account for some of the single exostoses supposed to be started by trauma.

DR. JOHN H. GIBBON asked Dr. Ashhurst whether syphilis plays any part in this disease of multiple exostoses. That was one of the causes assigned to the condition in a very marked case in his hospital service last year in which practically every bone in the man's body was involved. That man had had syphilis, but it is quite possible that he had the disease before he developed syphilis.

DR. ASHHURST, in closing, stated that the evidence is against syphilis being an etiological factor.

TANNERS' ULCER*

CHROME SORES—CHROME HOLES—ACID BITES

By John Chalmers DaCosta, M.D.
and
John F. X. Jones, M.D.
of Philadelphia, Pa.
with bacteriological and pathological study
By Randle C. Rosenberger, M.D.

A surgeon should know much of the nature of many callings in order that he may understand the particular dangers to which the workers in each trade are exposed. In some callings the workman is in danger of wounds and injuries more or less grave; perhaps often fatal. The stress and strain of some shatter the nervous system. In some lack of exercise and contaminated air undermine the general health. In some irritant materials produce lesions of the surface of the body. In some poisons are absorbed and produce disease or death. In statistical tables, callings in which there is definite risk are designated as *dangerous occupations.*

We might give the following instances: Structural iron workers; workers in oil refineries; subway laborers; miners; railroad men; firemen in large cities, and workers in various other strenuous vocations are exposed to violence which may cause trifling injury or perhaps frightful mutilations. Caisson workers are liable to a peculiar disease. Locomotive engineers, overharassed professional men, business men during a financial crisis, persons living on the edge of ruin or exposure to disgrace, women in men's occupations, suffer from nervous strain and its resultant maladies.

In estimating the strain of an occupation it is interesting to note that the suicide rate in any calling is a fair measure of its strain and that the suicide rate is lower among beggars than in any other class.

Certain occupations cause definite neuroses. We may mention writer's cramp, telegrapher's cramp, pianist's cramp, typewriter's cramp, sewer's cramp, hammerswinger's cramp, etc. Sweatshop workers and dwellers in sunless alleys, those who live in the rabbit warrens of the tenements, are peculiarly liable to tuberculosis.

Among dangerous callings are the following: Work in lead, antimony, arsenic, mercury, copper, yellow phosphorus, carbolic acid,

* Read before the Philadelphia Academy of Surgery, October 4, 1915.

bisulphide of carbon, picric acid, certain petroleum products, nitro-explosives, and nickel carbonyl. The absorption of poisonous materials into the tissues of one who works with poisons produces results depending upon the material and the amount absorbed and the condition of the subject.

The local effects of irritants used in industrial processes are seen among workers in many callings. There are many forms of trade eczema and industrial ulcer. Electro-platers who work in strong soda solution may develop ulcers and fissures of the hand. Electro-platers may also get cyanogen sores. Bakers' itch is from working in flour and yeast; grocers' itch from sugar. Shoemakers, bartenders, stonecutters, plasterers, bricklayers, printers, bookbinders, cigarmakers, photographers, chemists, surgeons, wood-workers and metal cleaners are prone to occupation eczema. Anthracene, a material from which alizarin dyes and a paint to preserve wood are made, is apt to cause the development of pustules on the skin and sometimes cause cancer. Workers in coal-tar and paraffin workers are liable to dry erythema, acne, pigmentations, pustules, boils, keratoses and warts; and a wart or an area of keratosis may become cancerous. In aniline and benzidine workers not only does cancer of the skin occur but also cancer of the bladder. Lampblack workers suffer from eczema of the toes, wool-sorters may get anthrax, salt grinders and salt handlers may develop ulcer of the nasal septum, and mother-of-pearl grinders may develop hypertrophy of a bone or bones and may suffer attack after attack of bone inflammation.

Among irritant materials used in certain industrial processes we must note chromic acid and its salts. This material in some form or other is used in photography, in calico printing, in bank-note printing, the ceramic industry, the manufacture of safety matches, dyeing, glass making, bleaching oils, purifying wood spirit and tanning hides.

It has long been known that the dust of chromic acid or the chromates can cause ulceration of the nasal septum and that the acid or the chromates, as dust or in solution, by acting upon the skin may cause ulcers.

Over twenty years ago one of us (DaCosta), then one of Professor Keen's assistants in the Jefferson Hospital, became interested in certain peculiar ulcers to which tanners were found to be liable, although occasionally a cloth handler or a dyer developed one. These ulcers were found to be most common on the hands, especially the fingers, but the feet were not entirely exempt. It was noticed that the ulcers tended to penetrate deeply, that few of them tended to spread much

laterally, that they were painful, resisted all treatment until the occupation was abandoned, showed no sign of tuberculosis (cultures for tubercle bacilli proving negative), were not improved by antisyphilitic treatment, and after healing left permanent scars.

Further investigation showed that none of those attacked had worked in the old tanbark methods of tanning, but all had worked in the then recently introduced chrome process, which was being actively developed for the tanning of kid by Mr. Robert Foederer, of Philadelphia.

The only workmen in the tanneries who suffered were those who actually worked with the bichromate salts. Surgeons had heard of lesions arising in workmen engaged in the manufacture of bichromate of potash in chemical works, the lesions consisting of cutaneous ulceration and perforation of the cartilaginous septum of the nose. There was no record of such lesions occurring in tanners. Previous to this time the chromic process had scarcely been used.

A study of these ulcers was undertaken and a number of cases were investigated clinically and bacteriologically. The assistant engaged in the bacteriological part of the work tired and fled, the study broke down and was not resumed until recently.

Throughout the years which followed that abortive investigation every now and then a tanner suffering from an ulcer has presented himself for treatment at the surgical dispensary. The assistant came to speak of such sores as " tanners' ulcers " or " leather workers' ulcers." We still see these cases, though far less often than formerly because in certain parts of the tanning process machines have been substituted for hands.

Recently through the kindness of the proprietors of a number of tanneries in Philadelphia, Wilmington and Camden, we have seen and gathered together for study a number of these cases and purpose report upon them.

We will first set forth the literature on " chrome sores " in general, that is to say, of chrome sores as they occur in various occupations. We will then report upon our cases which occurred among tanners and will discuss the condition.

" CHROME SORES IN GENERAL "

Chromium and the chromates were discovered by Vauquelin in 1797. The chromates have been employed in certain manufacturing establishments since before 1819. On page 156 we mention some of the industries in which they are used.

Robert Christison (*A Treatise on Poisons,* 1829) tells us that chrome sores were described to him by his late colleague, Duncan, of Glasgow. His patients were dyers who worked in vats containing bichromate of potash. Christison states that these sores spread deeply but not laterally.

D. G. Gmelin, of Tubingen, in his Treatise on the Effects of Some Metals (quoted in *Edinburgh Med. and Surg. J.*, vol. xxvi, 1826), speaks of sores developed by Glasgow dyers who immersed their hands in bichromate solutions. The sores do not extend laterally, but go deeper and deeper and may penetrate the hand or forearm.

T. J. Ducatel, of Baltimore, studied chrome sores in chemical workers (*Manual of Practical Toxicology,* 1833). He states that if one who works in chrome has an abrasion of the cuticle a painful ulcer results; but if the cuticle is unbroken, even a strong solution fails to produce ulcerations. The writer states that chrome sores are well known to Baltimore chemical workers in factories where bichromate of potash is made. He asserts that Duncan's cases among dyers were due to free chromic acid in the fluid. He describes these sores in the words of Gmelin without giving credit to the celebrated Tubingen professor. He presumes that the neutral chromate can only induce slight inflammation. The bichromate causes much more violent symptoms.

Ducatel, in a footnote, quotes Baer as having seen twenty cases of chrome ulceration. Baer describes the ulcers as painful, burrowing, persisting in spite of treatment and tending to penetrate the limb unless the victim abandons his work. Baer asserted he had seen ulcers on parts of the body which the solution did not touch, and that such ulcers could only have been caused by the vapor of chromic acid.

In 1851 Chevalier, Sr., addressed a note to the Institute calling attention to the dangers run by those who worked in chromates. Heathcote (*Lancet,* February 4, 1854) reported ulcers of the throat occurring in workmen who handled chromate of potash, and claimed that such lesions might be fatal.

M. A. Delpech (*Bulletin de l'Académie Impériale de Médecine,* vol. xxix, 1863–1864) considers certain ailments of those who make bichromate of potash. He mentions pustules and gangrenous sores of the hands and feet (especially of the sides of the fingers and toes). These ulcers he says exhibit temporary induration, tend to perforate, and leave indelible scars. He further points out that ulcerous eruptions may occur on the arms, limbs, trunk or genitals; that ulcers are due to direct contact with neutral or acid chrome; that bichromate is the more active irritant of the two; that in some subjects rhinitis arises and ends

in destruction of part of the cartilage of the nasal septum; that the perforation is usually rapid and the cartilage never reforms; that the sense of smell is seldom lost; that in some cases the perforation is insidious, without coryza; that the eyes, upper respiratory passages and stomach remain unaffected; that snuff takers seldom lose the septum from chrome perforation; that the nasal trouble is due to the vapor from the caldrons; and that both septum perforation and cutaneous ulceration are due to the escharotic action of chromic acid or a chrome salt.

In the same volume of the journal containing Delpech's paper is a paper by Hillairet on the dangers in making bichromate of potash.

In 1863, Chevalier, Sr., and Bécourt published a paper on the accidents to which chrome makers are liable (*Annales d'Hygiène,* July, 1863). The paper is founded upon an investigation conducted by Clouet and contains data obtained from Zuber and Ehrmann, of Riksheim, and Isaac Tyson, of Baltimore.

In January, 1869, and in January, 1876, Delpech and Hillairet (*Annales d'Hygiène Publique et de Médecine Légale*) published studies of the accidents which occur to chrome workers. The paper contains a review of the very scanty literature, the report of an investigation of the hygienic conditions of chrome workers, a description of the process of manufacture and a clinical study of the health impairment due to chromate. It describes chrome sores of the hands and cases of perforation of the nasal septum and mentions that nasal perforation results from inhalation of chromate dust. In the same journal in January, 1876, there is published the second part of their study. The authors mention that though bichromate is distinctly more irritating than neutral chromate, neutral chromate can cause irritation (this fact has been disputed by manufacturers). They cite instances of animals who have walked about in a slop of neutral chromate and have developed ulcers on the feet, and report cases of perforations of the nasal septum due to the neutral salt.

The authors say that the ulcers are characteristic, that they are due to escharotic action and most of them arise in excoriations. In some cases there is perforation of the cartilage of the nasal septum, in some bronchitis, headaches and loss of weight. Ulcers of the throat simulating syphilis have been reported, but it is unquestionable if chrome causes them. If the hands are free from abrasions, they can be put in vats freely, but the slightest break will lead to ulcer. If there is an excoriation, violent pain will be experienced at the moment of contact with the chrome salt. These ulcers are much worse in the cold of winter.

After an ulcer once begins it quickly indurates and in a few days a spongy, soft slough forms. These sloughs separate very slowly by peripheral ulceration. The sloughing area does not increase laterally unless more chromate is introduced, but it goes in deeper and deeper and usually reaches the bone; but once it does so, it stops. The edges of these ulcers are sharp cut and frequently show cicatrization. The core or slough is slowly separated, leaving a clear ulcer with a gray floor.

If a man stops work at once after the beginning of the ulcer, the sore quickly heals, but even then it leaves a permanent scar. The most common situations are in the articular folds on the back of the hand. He may get vesicles, pustules or eczema on various parts of the body. Sores on the body may be due to scratching with contaminated hands or may be due to dust settling through openings in the garments (it is to be remembered that the paper deals with chemical workers). The authors do not think that the systemic absorption of the chromium ever causes poisoning. Those who take snuff seldom develop perforation of the septum. Smell is seldom lost after septal perforation. After perforation has once occurred a second one never develops, because the contact of the mucous membrane of the two sides of the nasal passage has become impossible. The authors do not think that abrasions are a necessary antecedent of ulcers. If they were ulcers could not form on so many different parts of the body.

The writers then discuss at length industrial hygiene and prophylaxis.

In the quarterly publication for *Judicial Medicine,* vol. x, 2, 1895 (edited by A. Wernich), Dr. Paul Muller discusses perforating ulcer of the nasal septum. He says that the dust of many salts besides the chromates may be responsible. He mentions sodium chloride and potassium chloride.

Dr. J. William White (*University Medical Magazine,* November, 1889) reported a case in which he had used chromic acid as a cauterant for vegetations of the labia majora and nymphæ. The patient died within twenty-four hours, probably from the toxic action of the chromic acid that had been absorbed. The postmortem showed that the kidney tissue and the liver tissue contained sodium chromate. This acute case proves that absorption of toxic doses from the surface is at least possible.

Edward Curtis and R. J. E. Scott in Wood's *Reference Hand Book*

of the Medical Sciences, 3rd edition, say that general poisoning from the continued absorption of small quantities of chromium is very questionable. They state that no *chronic* condition thus caused has been found in man.

Von Lewin (*Lehrbuch der Toxikologie*) says that chromium salts can be absorbed through wounds, from the skin and from mucous membrane. He cites the case of a boy who placed a piece of potassium bichromate, the size of a coffee bean, in his nose and went to sleep. In an hour he had developed serious symptoms of poisoning.

In Sajous's *Analytical Cyclopœdia of Practical Medicine,* 1913, vol. iii, we read that potassium bichromate when applied locally to the skin may cause dangerous ulcers, and that workmen who handle cloth dyed with solution of chromates are apt to suffer from ulcers and eczema.

Imperial Medical Counsellor Dr. Wutzdorff published in February 13, 1896, a report called "Injuries to Health Observed in Chrome Factories, and Measures Required to Prevent Them." He reviews the literature on this subject and states that the report of the chemical works Committee of Inquiry in England, which was handed to Home Secretary Asquith in 1893, states that perforation of the nasal septum is frequently followed by impairment or actual loss of smell. He carefully analyzes the whole question of perforation of the septum and of all respiratory disorders. He reports many ulcers occurring in the workers of various chemical establishments. He states that the ulcers developed not only in abrasions or cracks but also in any places where chromate dust could settle and accumulate, as between the fingers and between the toes. He found no case of depressed nose. He thinks it possible that chromate may cause chronic nephritis in some cases. The diseases of the air-passages which occur seem to be secondary to the nasal affection, but perhaps they may also be directly due to the elimination of chromate salts through the air-passages. He notes a case where a 5 per cent. solution of chromic acid was used for excessive perspiration of the feet. Violent dermatitis, with symptoms of chrome poisoning, followed. Among other regions in which ulcers have been reported he notes the external ear and the eyelids. He found no ulcer that reached a tendon or a joint. It was said in one works that the bony septum of the nose had never been affected and that tobacco is no protection from attacks. Small number of ulcers of the mucous membrane of the palate and throat were noted in workers in one of the works. He discusses at length the causal relationship the work in manufactories bears to health and says that the vapor arising from hot chromate solutions contains chromates. He then sets forth the procedures

to be undertaken to prevent injuries to health, insisting particularly upon the maintenance of cleanliness among the workmen and that when any chromate affection develops, the workman must be excluded from this work while the trouble lasts.

REPORT OF CASES PERSONALLY OBSERVED

One of us (Da Costa) has seen 44 cases altogether, 19 of which are here presented. Of the previous 25 there are no detailed records. Of the 44 cases, 5 worked in dye houses, 4 handled chromium hides, 2 worked in chemical works, 1 handled dyed cloth, and the balance were tanners. We are of the opinion that now and then a man who is wearing stockings containing dye fixed by chrome develops a genuine chrome ulcer of foot or toe. We have seen ulcers on the feet presenting all the ear marks of chrome ulcer and obviously due to recent local irritation, the victim never having worked in chrome. A prolonged case resembles the trophic or perforating ulcer of locomotor ataxia.

Of the 19 reported cases only 2 were Americans; the others were chiefly Italians, Austrians and Russians. This does not show any race predisposition or immunity. It simply shows how extensive is the invasion of our protected industries by foreigners. The ages were from sixteen to fifty-five. The period during which they had worked in chromates was between two months and eighteen years. Practically all the old workmen (seven cases) showed scars of previous ulcerations. One worked in chrome thirteen years and one four and a half years before developing an ulcer. The most common situation was in the folds of the dorsal surface of the fingers over or near the knuckles (Figs. 1, 2 and 3), but in one case we found ulceration on the palmar surface just below the metacarpal phalangeal joints (Fig. 4); two on the back of the hands; two on the dorsal surface of the forearm; one in the interdigital folds; one on the side of the last digit of the finger; one on the front of the knee; one at the edge of the nail (Fig. 5); one on the outer surface of the wrist; one on the back of the forearm, etc. In the old group of cases one was on the body near the groin and one on the inner surface of the prepuce. In such situations an ulcer is probably due to scratching with contaminated hands.

In practically all cases the ulcerated part had been kept wet by chromate solution. In one case several of the finger nails were lost several times in succession. The nails reformed with fair rapidity after the loss, which was quite painless. This man has no symptom of any disease of the spinal cord or nerves. In one case a finger was lost after perforation of a joint (Fig. 3).

Duration of the cases we saw varied from a few days to seven months. The duration is indefinite. In fact, healing is not to be expected while the work is continued, unless the part is kept really covered by impervious gloves.

The chief characteristics of ulcers are induration, pain, and a tendency to deep penetration.

The longer the duration of the ulcer the greater the induration and the greater the ulceration. One of our cases reached a tendon, one entered a joint, and another reached the bone. Seven of these cases were single, twelve of them multiple. In several of the cases there were several ulcers and in one of the cases there were many ulcers. One case had nine ulcers. One of the cases of forearm involvement had a great number of small ulcers, apparently arising in hair follicles.

A number of writers have maintained that to develop an ulcer one must have first an abrasion, a fissure, a scratch, a wound, or a crack. The great majority of our cases presented some such antecedent condition but not all. In two of the cases the condition started in the hair follicles of the forearm, which part was frequently wet with the solution. In the one case ulceration began in the hair follicles of the dorsum of the hand. In the ulcer of the front of the knee (Fig. 7), the knee was constantly wet with the chrome solution but was not excoriated before ulceration. This ulcer became seriously infected and sloughed extensively. One started in an area of prickly heat and one began in an insect bite. The workman could always tell if the ulcer had started in an excoriation, because if there was such a break of continuity he felt severe sticking pain the moment the hand entered the chromate solution. While working, all ulcers will be violently painful. Most of them are very painful even when not working, particularly when exposed to cold, even slight cold. One of our cases kept his hands in his pockets, even in summer, to avoid draughts. Only one of our cases was free from continual pain. All are tortured by itching, especially at night. The patients are usually oscillating between the Scylla of pain and the Charybdis of itching. Warmth aggravates itching and cold, pain. Pain may be so severe as to seriously interfere with sleep. It is a burning pain with violent exacerbations. The ulcer will never heal while the man is working, if he does not wear rubber gloves, and it may last months or years. It usually takes weeks to heal even when work is stopped.

As previously stated, the ulcer usually begins in an excoriation, but this is not the invariable rule, as it may start in hair follicles or in an area of skin infection, for instance, eczema, acne, or in an area of

FIG. 1.—Scars of chrome ulcers.

FIG. 2.—Chrome ulcer on dorsal surface of second finger.

FIG. 3.—Amputation as the result of chrome ulcer eating into joint. Active chrome ulcer present now.

FIG. 4.—Chrome ulcer on palmar surface of ring finger, over articulation; healed ulcer on thumb.

FIG. 5.—Scar of chrome ulcer on dorsal surface of distal phalanx of second finger near nail.

FIG. 6.—Chrome ulcer of index finger over an articulation.

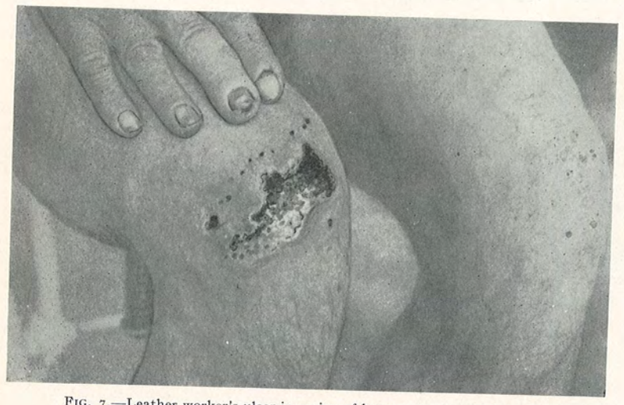

FIG. 7.—Leather worker's ulcer in region of knee area; severely infected.

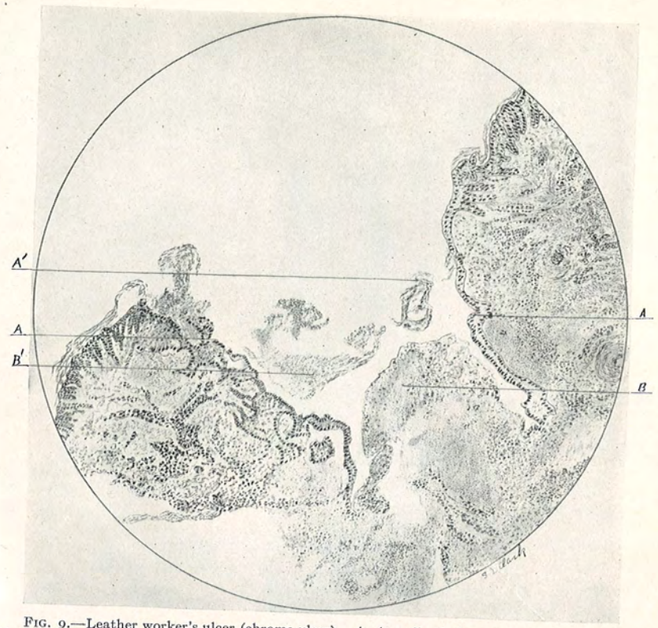

FIG. 9.—Leather worker's ulcer (chrome ulcer). *A*, *A*, walls of ulcer covered with epithelium; *A′*, island of cornified epithelium; *B*, floor of ulcer; *B′*, slough from floor of ulcer. Ulcer was 2 cm. in length, 1 cm. in width and almost 1 cm. in depth. The edges were very jagged and irregular, black in color, with induration. The floor of the ulcer was black in color, and in gross appearance contained what seemed to be masses of granulation tissue. The skin immediately adjacent to the ulcer was apparently normal, and presented areas of thickening. Sections were cut and stained with hæmatoxylin and eosin, hæmatoxylin and Van Gieson, with polychrome methylene blue; by Gram-Weigert and plain Gram technic. Histological study shows the ulcer to be clean cut and the edges lined or covered with stratified squamous epithelium. This cellular layer extends down to the floor of the ulcer and is apparently hypertrophied, as evidenced by the extensions into the connective tissue of the skin. In one area in the specimen is an isolated "island" of cornified epithelium (*A′*), evidently clipped off from a papilla of the skin. The floor of the ulcer is made up of nests of polynuclear leucocytes, areas of hemorrhage and cellular debris. Sections of sweat glands, or sebaceous glands, and of hair follicles are present, and in the immediate vicinity of these structures are accumulations of polynuclear leucocytes and some few round cells indicating a marked inflammatory condition. Irrespective of the structures above mentioned marked leucocytic infiltration is seen throughout the specimen and the blood-vessels all show marked thickening of the walls, some showing leucocytic infiltration between the coats. Recent as well as old areas of hemorrhage are present, some being immediately beneath the epithelium, while others extend down to the floor of the ulcer. When examined with the high-power objective numerous cells (leucocytes) are observed which contain pigment granules, brownish or brownish-black in color, especially in the areas of hemorrhage, while in one or two areas accumulations of these granules appear to follow minute capillary vessels. Bacteriological examination shows Gram-positive micrococci arranged in pairs and chains. No other organisms were observed. Results of inoculations from ulcers: Inoculations were made upon plain agar and into deep tubes of litmus lactose agar. These deep tubes were placed in an anaërobic condition. Of twelve cases studied, staphylococci (aureus or albus) were recovered in nine cases. Both aureus and albus were encountered in three cases. The bacillus proteus vulgaris was isolated in one case; a diphtheroid bacillus and the staphylococcus pyogenes albus in one; while the sarcina lutea and B. megatherium were observed in another. (These two latter cases were undoubtedly contaminations.) There was no difference in results obtained in the anaërobic condition. In one case no growth occurred.

FIG. 8.—Leather worker's ulcer with infected finger.

prickly heat. The ulcer is usually circular in shape, but, if it starts in a wound or fissure, has the shape of that breach in continuity. Its characteristic features are pain, induration and deep penetration. A raw, painful and tender spot is noted which enlarges little, if at all, laterally but which deepens day by day and becomes surrounded by a wide zone of induration. The ulcer may be a mere speck, may be a quarter or a half inch in diameter, or in exceptional cases, when severe pyogenic infection occurs, as large as the one shown on the knee in Fig. 7. A green or grayish core or slough forms in the centre. This becomes loose at the sides and becomes movable from side to side but long remains attached in the depths. In the deeper cases it is attached to a tendon sheath or to the periosteum. The ulcerated area with its surrounding induration moves with the skin until the ulcer reaches tendon sheath or bone and it then becomes fixed.

We had no case of perforation through a hand or forearm such as the early writers speak of as occurring in chemical works, but we have had one case of perforation into the second phalangeal joint of the ring finger of the right hand, which caused the loss of the finger (Fig. 3).

When the slough separates the discharge lessens and the healing begins from the periphery. During healing the edges seem to shrink and to reach a lower level than the ulcer or than the exuberant granulations which sometimes protrude from the sore. An ulcer may make abortive attempts to heal. It may heal on the top so that a cavity remains in the indurated area, a cavity which is roofed in and contains seropus. This may occur over and over again. The formation of a crust is usually an indication that healing is beginning. The workmen all regard it as having this significance. The edges of the ulcer are usually perpendicular and remain so unless severe pyogenic infection arises. In nearly all cases the parts about the ulcer are densely hard. This indurated area is seldom narrow. It is usually one-eighth of an inch broad or even more. If the ulcer is not very deep the indurated area moves with the skin. The more superficial the ulcer the more movable it is and the less the induration. The deeper the ulcer the less movable it is and the greater the induration. When the ulcer extends to tendon sheath or periosteum it is entirely fixed.

The floor of the ulcer is pale pink or pale gray. It shows no granulations until the slough is loose or separated. The discharge is usually thin, scanty and purulent; being commonly yellow in color, but sometimes colorless. In some ulcers there is practically no discharge observed on dressings. A little can always be found by squeezing. In one case of severe infection there was a profuse watery discharge.

The area around the ulcer is usually markedly red for a short distance and may be œdematous (Fig. 8). Some cases are bright red for a quarter of an inch about the ulcer. This means that the ulcer is not healing. The parts near about a healing ulcer are pearly white. It is not unusual to find eczema in this region. The scar which forms eventually becomes soft and loses much of its hardness as time goes on. It becomes markedly depressed, is not tender and, though first of a brownish hue, becomes pearl white. It is usually smooth but may be corrugated. In only one of our cases was there marked swelling of the hand. In this case there was cellulitis. The hand was greatly swollen and red lines of lymphangitis showed on the forearm and arm. This was the one case in which related glands were involved. In no case were there any constitutional symptoms to suggest general poisoning by chrome, and in no case were there signs of perforation of the nasal septum, ulceration of the larynx or respiratory disturbances.

Fig. 9 shows a microscopical study of a chrome ulcer and the legend contains the bacteriological report by C. Rosenberger and his description of the ulcer.

The workmen adopt various means to prevent these chrome sores when they have any excoriations upon the hands. Some wear finger tips of rubber, some apply waterproof court plaster, some apply collodion, some rub their hands with oil before putting them in the chrome salt, some wash them in a solution of carbonate of sodium on ceasing work. As a general thing the workmen use some salve for the abrasions but some workers maintain that any ointment does harm. It has been my custom to treat the cases during the progressive stage by washing them first with carbonate of sodium and then several times a day with peroxide of hydrogen and dressing them with lead water and laudanum.

Hot-water bags are used for pain. Soaking in hot lead water gives relief. Surgical removal of the slough does harm. The manufacturers maintain that the condition will seldom arise if the workman is careful to clean his hands and that he will have no severe trouble if he will stop work when he has an abrasion. Many of them dwell on the notorious carelessness of workmen. One manufacturer wrote me that oiled hands were a great protection. He also stated that similar sores occur from hydrochloric acid, from lime and from sulphide of sodium, and says that carbonate of soda has long been recommended as a wash for chrome stings.

Isaac Tyson, of Baltimore, recommended that the sore be painted once with a solution of nitrate of silver in order to form insoluble

chromate of silver. Chevalier, Sr., and Bécourt recommended dressing with weak lead acetate and dilute alcohol and have stated that soaking in dilute lead water for four or five minutes will relieve pain and enable the patient to get sleep.

We have received the following important communication as to the prevention of chrome sores among tannery workers. It was sent us by Dr. Louis Levi, Chief Chemist to the Pfister and Vogel Leather Company, Milwaukee, U. S. A. He says that chrome sores tend to become very painful and eat very deeply. He has tried all kinds of alkaline and neutral ointments for the cure of this disease and without success. He therefore determined to try and find some means of prevention. He has prepared a very efficient ointment which he has now been using for a year and the cases have dropped from four to six a week to two in six months.

He orders that the ointment be applied twice daily. Three parts of petrolatum are mixed with one part of lanolin. This mixture is melted on a water-bath or stove and when melted and thoroughly mixed, ten to fifteen drops of 90 per cent. carbolic acid are added to every 400 grammes of the mixture. This represents five drops of acid to four grammes of ointment. The material is placed into a glass or earthenware jar and allowed to solidify until ready for use. The workman cleanses his hands and arms thoroughly with soap and water, rinses with warm water and, while the parts are still moist, applies the ointment. He rubs it over the whole exposed area for about two or three minutes. He then takes a clean cloth and wipes the skin entirely dry. Doctor Levi says that the lanolin is absorbed by the skin and that the petrolatum forms a light coating on the surface. The petrolatum will keep most of the chrome away but, should this outer coating of petrolatum wear off, the lanolin in the skin will still prevent the action of the chrome. Doctor Levi published this method in the *Hide and Leather Review*, London, England.

STATED MEETING, HELD NOVEMBER 1, 1915

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

SURGICAL TUBERCULOSIS TREATED BY THE ROLLIER SUNSHINE METHOD

Dr. A. Bruce Gill presented four children who had been treated for surgical tuberculosis by the Rollier sunshine method. These children have been exposed to the sunshine in Philadelphia and at Longport, which is on the seashore below Atlantic City.

The first case is that of a child who had osteomyelitis of the femur, fibula, and bones of the foot of the right lower extremity, with numerous sinuses discharging. The child was immediately put upon the sunshine treatment. At the end of four months the sinuses are all practically healed. We not only expose the affected part, but the whole body for a short time each day, so that the skin will not blister.

The second case was one of tuberculosis of the hip-joint; winter before last the child was extremely ill. The skin and soft tissues had melted away and exposed the neck of the femur, the great trochanter and three or four inches of the shaft. There was high temperature. In February of last year treatment was begun, at which time the child weighed 41 pounds. The first of June it was sent to the seashore and there the weight came up to 48 pounds. All through last winter the child was exposed to the sunshine whenever there was any and by the end of this summer the weight came up to 61 pounds. The child is now quite well and is going to school for part of the day. Her wound is healed.

The third case is one of Pott's disease. A year ago an Albee's transplant was put in the spine. There was pus present at the time of the operation and the wound did not heal. Three or four weeks after operation there were signs of pulmonary tuberculosis. There were râles, cough and temperature. The child was put into the sunshine and after several months' time the sinuses healed up, after a small part of the transplant had come away.

A fourth child has a tuberculous hip-joint and is still kept in bed. At first the affected part itself is exposed and gradually the entire body.

It is worth while knowing that this treatment can be carried out in this climate. It is valuable in both tuberculosis and infected wounds.

Dr. William J. Taylor said that he was personally very much in favor of this method and had been advising it for some little time. In a tuberculous hip-joint where there was a sinus discharging for many months, under this form of treatment the wound has healed and the general benefit to the patient has been very great. At the Orthopædic Hospital the children are put out on the roof and kept exposed to the sun all day. The benefits are really very great.

REMARKS ON THE SURGERY OF THE EUROPEAN WAR*

WITH A DESCRIPTION OF AN IRRIGATION SYSTEM FOR PERFORATING INFECTED WOUNDS

By Edmund B. Piper, M.D.

of Philadelphia

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On the first of July, 1915, the University of Pennsylvania Unit, headed by Dr. J. William White and Dr. James P. Hutchinson, took over the University Unit of the American Ambulance in Paris from the representatives of the Harvard University.

The American Ambulance was started by the Americans in Paris, especially those connected with the American Hospital, which is situated in Neuilly just outside of the gates of Paris. This little hospital has about fifty beds and is very efficient in every respect. I believe the original idea was to construct a small temporary war hospital within its grounds. However, soon after the war began the French government turned over to the American Hospital the nearly completed school building, known as the Lycée Pasteur in Neuilly, to be used as a War Hospital, and this was where our work was done. At the time the war broke out, in August, 1914, this building was very nearly ready for occupancy. It is a structure which in America would cost from half a million to a million dollars and is built of brick with stone trimmings. There are four floors and a basement. The entire building is open to light, it being constructed in corridors with a front administration building and a central garden or court, so that all parts open within and without. The basement is used for dining halls and storage rooms. The first or ground floor has three large and seven small wards and the second and third floors each have about eighteen or twenty small wards of ten beds each. The dental department is on a wing of the second floor, the main operating room on a wing of the first floor, and the University Unit operating room on a wing of the fourth floor. The ambulance drivers and orderlies sleep on the fourth floor. The building, except for the fact that there are no elevators, is remarkably well adapted for the use of a hospital. The wards are very light, and there is plenty of air. The absence of an elevator, however, is a very great disadvantage, since one operating room is on the first floor and the other on the fourth, also that there are two X-ray plants, one adjacent to each operating room.

* Read before the Philadelphia Academy of Surgery, November 1, 1915.

When I went on duty the services were divided as follows: Dr. Du-Bouchet was Surgeon-in-Chief and had a service of his own of approximately 160 beds; Dr. Blake had a service of 150 beds; Dr. Mignot of the French Army had a service of about 80 beds; and the University Unit had a service of 180 beds, which included the entire third floor with the exception of one ward. This was given over to the treatment of the eye, and was in charge of Dr. Hunter Scarlet.

The question of infection is naturally a very important one, and I feel safe in saying that all the cases, or practically all, were infected at least in a slight degree. The slightly infected wounds were usually in those parts not covered by clothing and in which there was a slight laceration by a piece of shell or a clean puncture by a high velocity bullet. The infections were of all the usual types that we find at home with the addition of the gas bacillus. It seemed to us that the severity of the infection in many instances was increased when the patients gave a history of a great number of different dressings done in different places in the first forty-eight hours following injury. The length of time that the man had worn his clothing, both uniform and underwear, was another important factor in determining the severity of the infection. In many cases, injured in a part covered by clothing, pieces of coat, underwear, socks, etc., were recovered from the wounds for a long period of time following admission to the hospital.

As regards the treatment of these varied types of wounds, I might say that hardly any two cases could be treated alike. Of course, the same general principles applied to all and sometimes the success or failure of a type of apparatus for one case would be of value in treating succeeding similar cases.

In deciding how we should treat a given case, it was necessary first to determine whether amputation would or would not save life. (Of course, all wounds were not of the extremities, but I am speaking of them in that manner because a large proportion were, and because it was mostly in these cases where the question of judgment was of vital importance.) Our attitude was to avoid amputation when possible, not from the idea of the end-result to that particular part, but from the point of view as to whether the patient would throw off the infection and stand later amputation better.

After placing the injured part in that type of apparatus which appeared to be most comfortable, the question of the treatment by dressings came up. These were usually one of three classes: First, wet gauze dressings frequently changed; second, the steady drip of some solution; and third, irrigation.

The solutions most frequently used for wet gauze dressings were the sodium hypochlorite solution of Dr. Carrel, a normal salt solution, boric acid solution, alcohol, and sterile water. Except for the alcohol, these were always used very hot, very well wrung out, and very well covered. Our Service felt that the type of solution used in this manner was a very small determining factor as to the result. For irrigations the solutions used were again the hypochloride, salt, sterile water, and, in addition to these, sometimes weak iodine. Again, in this type of treatment we felt that the determining factor was not the chemical constituency of the solution so much as the mechanical action. Dripping of wounds was done mostly in those widely lacerated superficial wounds where there was very violent infection.

Continuous irrigation was used in some cases of through-and-through perforating wounds, also in some few punctured wounds, but these latter were done more frequently at the time of dressing once or twice a day. There were numerous types of permanent irrigations. Dr. Alexis Carrel recommended one that was apparently the most efficient. The description that was given me of this apparatus was that a tube was placed in a wound of entrance and sealed there with collodion, and a tube placed in a similar manner in the wound of exit. The solution was therefore forced into the wound and out of the wound and the external surface of the limb was kept dry. The disadvantage of this was that it was not applicable in those cases in which the wound of exit was accompanied with terrible lacerations of the skin and soft parts. There was another type of irrigation in which a fenestrated tube was carried through and through the wound which connected above with the irrigating can and below with a waste bucket. Again the disadvantage of this was that the irrigation ended by being mostly of the tube itself and not of the wound. There were many other types. My colleague, Dr. Keating, evolved a very ingenious scheme by which he could irrigate from one main irrigating can multiple wounds of the arm or leg.

There were some cases of through and through wounds in which apparently hot wet dressings did not clear up the infection and some type of continuous irrigation was essential. After seeing some of these irrigations it occurred to me that if an old fundamental principle of hydraulics were used, we could procure an actual forced irrigation of the wound under pressure. This principle which I made use of was that water always flows the easiest way and that the easiest way could not possibly be through a wound unless it was forced through by back pressure, and therefore I worked out the following simple apparatus.

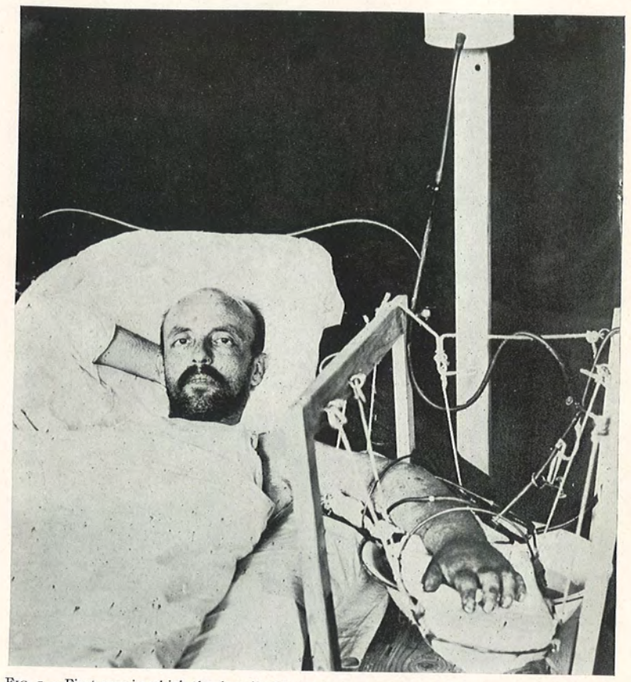

FIG. 1.—First case in which the described irrigation was used; multiple through-and-through wounds of the elbow. The result was satisfactory.

A soft rubber tube of the size necessary for a given wound was used. In the centre of this tube there was a single window cut in the shape of a gutter. This was placed in the wound, usually with the patient under anæsthesia. An irrigating can with a shut-off valve was connected with a glass T-tube. Soft rubber tubes came off of either end of the T, both of these having a shut-off valve either within them or a metal clamp. These were again connected with the tube within the wound at either end, and at the most dependent portion another T-tube was placed to which was attached another rubber tube with a shut-off valve which emptied into a bucket. In this way the water could be carried from the irrigating jar to the T-tube (Fig. 1), and by opening the valve on one side and closing it on the other the flow of the water was directed through the tube in the wound in whichever direction desired. With the valve on the dependent T-tube opened, the water flowed through the tube in the wound directly into the waste bucket, which showed us that the wound itself would not be irrigated in that manner, but when that lowest valve was closed, giving a back pressure, there was only one possible place that the water could escape, namely, through the window in the tube within the wound. In this manner the wound itself was irrigated around the tube and the pus was washed out mechanically. A slight change in the position of the window would determine which end of the wound would be flushed. In this manner we were able to keep up free drainage continuously. The solution coming from the wound was directed into the waste bucket, by rubber sheeting, and thus the bed was protected. This was tried on a number of cases with reasonably satisfactory results. *No irrigation of any type seemed to be of any value unless there was proper and sufficient drainage.*

There has been diversity of opinion in regard to the treatment of the gas bacillus infection. I believe it is generally agreed that where gangrene resulting from this infection has set in, immediate amputation is indicated. There are some men who think that amputation is indicated whenever the diagnosis "gas infection" has been made, even when there is no evidence of gangrene. The feeling of our service was that cures of gas bacillus infection could be brought about without amputation if proper and sufficient drainage were instituted. By this I mean drainage not only of the skin and superficial fascia, but wide-open drainage of the muscles around the seat of infection. It was our policy to open the infected areas freely in many places and to insert through-and-through drainage tubes.

The following case that I will give from memory is typical of gas bacillus cases that are admitted to the American Ambulance.

This man was admitted a few days after he was wounded. He had had both legs amputated below the knee at the Base Hospital. The left leg was a straight amputation without flaps, and not closed. The right leg had been amputated with apparently some post-operative hemorrhage which had been controlled by packing, and a few sutures had brought the flaps together. When this man was dressed and the packing was removed there was no difficulty in making the diagnosis of "gas infection," as the gas bubbled out in abundance. The man was immediately taken to the operating room where all the sutures were removed and the stump was laid wide open. The question of further amputation above the knee was brought up and, with the exception of our chief, Dr. Hutchinson, practically every man present was in favor of further amputation. Dr. Hutchinson decided, however, that he would give the stump very free drainage and wait. The patient was returned to the ward, where the stump was put in a sling, was extended outside of the bed and a continuous drip of a salt solution was commenced. Twice daily the stump was irrigated with peroxide of hydrogen, which was washed off with a weak solution of iodine. At the time this treatment was instituted there was practically not a particle of live tissue visible. The bone was protruding for possibly two inches, all the muscles were gray and absolutely necrotic. I had this man in my ward for two months. When I left, the left stump was entirely healed and the right stump, which at the beginning of the treatment had been at least eight inches in diameter, was healed with the exception of about three-quarters of an inch, and there was a very little bit of bone still showing, but not protruding.

Practically all amputations that came to us from the front were no-flap amputations, and these were all treated in the same manner, namely, an extension put upon the flaps.

The wounded that came to the American Ambulance during our period of service and for some time preceding that were all French or at least of the French Army. There were some Moroccans and Algerians, and some of the French negroes. The attitude of these men was nearly without exception that which made it a pleasure for anyone to work with them. They were always game, courteous, happy when not in actual pain, and full of gratitude for what little we were able to do for them. One case will always stand out in my mind as typical of the French people in this time when their very life is at stake. This case was a violent infection with fracture at about the middle third of

the femur. He was turned over to us by the Harvard Unit, and I was warned by Dr. Coller of that Unit that he was in a serious condition. He was in a plaster cast with the usual reinforced window over his point of infection. About four days after we went on duty, in the night he had a hemorrhage. When I arrived in the Ward he was bleeding rather freely, and, of course, owing to the cast we were unable to use a tourniquet and I did not feel that there was time to remove the cast. With the aid of two candles (no electric lights were allowed after nine o'clock at night on account of the danger of Zeppelin raids) I packed this man's wound of entrance and exit under ethyl chloride general anæsthesia. When the hemorrhage was controlled his first words when he came out of anæsthesia were, "*Merci, Monsieur le Docteur.*" Gentlemen, that typifies the French soldier and his innate courtesy, which supersedes everything else. Another example—during the month of August I was slightly ill for a couple of days, which I spent in the American Hospital. The first day I arrived there I received a large basket of flowers, with a letter written in French by one of my fifty wounded men, and signed by every other one. I hardly believe that any set of ward patients in a home hospital would show that kind of consideration.

There was one man who suffered tortures every time I had to dress him for several weeks. I have seen him stuff a red bandana handkerchief in his mouth so that his groans would not disturb me. I have told him after a dressing that I was very sorry to have to hurt him, and his reply was always the same, "What would you? It is necessary." This same man when he was evacuated later to a less active hospital frequently came back to see us. The last time I saw him he told me that the surgeons in his new hospital wanted to open his arm and drain it. I asked him what he did and he replied that he would not let them do it. Then I said, "But supposing we wanted to do it?" His immediate reply was that that would be all right, and that was the attitude of the French soldier to the American doctors.

In closing there is one point that struck me most forcibly, namely, *War Surgery is distinctly Ward Surgery,* and the results that are attained are much more dependent upon the treatment in the wards, than upon the operations that may be done. Of course, many operations are needed, but that is the smallest factor in determining the end-results. Any man going to serve in a War Hospital with an idea that he will procure a large operative experience I believe will be sadly disappointed, but it seemed to us that the treatment of the cases in the wards was far more interesting and valuable than any operative ex-

perience that might have been acquired, and no member of our Unit will ever regret the trip.

Dr. Charles McDonald and Dr. John F. McCloskey also gave some personal reminiscences of recent experiences with war surgery in Europe.

Dr. Ralph Bromer (of Louisville, Ky.) stated that he served as House Surgeon of the American Ambulance during the months of September and October, 1914. The mortality rate was high owing to the fact that during the retreat from Belgium the ambulance corps of the French and British armies were practically out of commission. Some of the wounded were from six to nine days without treatment. In eighteen deaths occurring on his service four were from tetanus and two from gangrene of the lung. He did not remember the exact number of amputations for gas infection. The cases too sick for operative interference were treated by administering oxygen under the skin in the good tissue around the wound. Quite a number of deaths also occurred because of secondary hemorrhage, this at times being quite sudden in its appearance. One man with a wound of the superior maxilla died quite suddenly on the fourteenth day from severe secondary hemorrhage. The point of hemorrhage could not be found at autopsy.

Dr. D. J. McCarthy (by invitation) also took part in the discussion of these papers.

STRAUS'S METHOD OF FIXING FRACTURES

Dr. John B. Roberts said that surgeons often wished for some way of fixing fractures with something less troublesome than steel or metal bodies. He called attention to a recent paper by Dr. Straus, of Chicago. Straus makes a mattress of catgut to support the line of fracture and puts a plaster-of-Paris bandage outside. It occurred to Dr. Roberts to take a piece of fascia of the subject, coapt the bone, and place the fascia which later would become absorbed. To make the part a little more rigid a drill pointed nail could be used. This method ought to be better than putting in metal flaps. His idea was to modify Straus's original plan by using a piece of fascia from the thigh of the subject.

THE ARTIFICIAL PERIOSTEUM FOR FIXATION OF SHAFT FRACTURES*

By John B. Roberts, M.D.
PROFESSOR OF SURGERY
(Note from the Surgical Laboratory of the Philadelphia Polyclinic.)

The ease with which subperiosteal fractures are cured with little callus and slight deformity is nature's hint as to treatment. Surgeons have been misled into thinking that the essential factor in treatment is absolute immobility of the jagged bone ends. Therefore, prolonged immobility by means of external splints or direct fixation by plates has successively been the vogue.

When the periosteum is little torn or only slightly stripped from the bone's shaft, reduction of the fragments and retention of the broken surfaces in apposition are easy of attainment. Successful reconstruction of the skeleton follows readily. What shall be done, however, under reverse conditions, namely, greatly lacerated periosteum, consequent wide separation of fragments, and, perhaps, entanglement of the jagged pieces of bone in muscles and fasciæ? Inspect the broken bone, repair the periosteum or provide a new periosteum, and give stability and rigidity by means of traction and contour-fitting splints.

The only way to repair the torn periosteum is to expose the broken bone by aseptic incision, adjust the ends of the fragments, and stitch the ruptured fibrous covering around the break. Often a firm repair of the periosteum in this way is not possible. Why not then substitute a graft of the fascia lata, cut from the outer surface of the patient's thigh; and, by wrapping it around the shaft of the bone at the seat of the break, prevent lateral displacement or overriding? The operative wound should then be closed without drainage and a gypsum encasement, with or without continuous traction, be adjusted to the limb.

This method I believe will be found a valuable improvement over the plating of rebellious fractures of the shafts of long bones. I have only experimented with fascial tubes or straps for this purpose on the cadaver.

The success of D. C. Straus[1] with woven catgut rugs or splints in treating experimental fractures in dogs has, however, convinced me of the value of his method of support. The autogenous fascial graft is

* Read before the Philadelphia Academy of Surgery, November 1, 1915.
[1] Surgery, Gynæcology and Obstetrics, October, 1914, p. 410.

founded on the same mechanical principle, which is that a firmly placed tube or wrapping of flexible tissue around a broken rod or bone prevents displacement.

Macewen has insisted that the periosteum does not generate bone, but merely limits its growth. If this be true, placing a new fibrous envelope, instead of the lacerated fibrous periosteum, around the ruptured osseous tissue restores in some degree the normal status of the injured bone. A long piece of fascia lata wrapped twice about the replaced fragments will, if firmly bound by sutures of fascia or of catgut or tied by strings of the same absorbable material, prevent shortening, alteration by rotation and lateral displacement. Later it will either be absorbed or converted into a sheet of fibrous tissue similar, mechanically at least, to periosteum. Normally the periosteum gives toughness and elasticity to the bone. The fascial envelope acts somewhat in a similar manner.

Thus the fascial tube is, I believe, preferable to metal plates. In comminuted fractures of the shaft it would seem to be greatly superior mechanically to plates, screws, nails, inlay grafts, or bone pegs. Straus's catgut mat was absorbed in dogs in three weeks. It is possible that stomach wall or bladder wall of the lower animals or real parchment might be used instead of the patient's own fascia lata. My experience with autoplastic grafts, however, and the ease with which a long strip of fascia lata can be taken aseptically from a patient's thigh, without real risk to him, cause me to prefer its use.

It is possible that other surgeons have suggested fascial tubes or straps for steadying or fixing fractures requiring open or blood-letting treatment. If so, I have not heard of their experiments or experience. I should be glad to hear reports from the Fellows of the Academy, if they adopt the procedure for cases to which it seems applicable.

There have been various endeavors to obtain absorbable fixation appliances instead of plates. This seems to be the simplest.

If there is too much flexibility at the seat of fracture after the fascial binding, one of my fracture drill-pointed nails, described before the British Medical Association at Edinburgh in 1898,[2] may be driven through the fascial tube into the bone ends to steady them and its shaft be allowed to protrude through the closed wound. It may be readily removed at the end of ten days or two weeks without important disturbance of the external dressings.

An artificial periosteum is adapted to fracture thus:

[2] Philadelphia Medical Journal, 1898, and Notes on the Modern Treatment of Fractures, D. Appleton Co., New York, 1899.

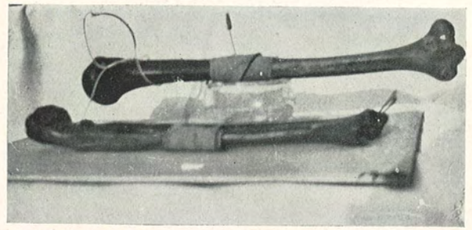

FIG. 1.—Model of fracture of humerus supported by an autogenous tubular sheath of fascia lata acting as an artificial periosteum. At the upper end of the humerus is seen the flat curved needle and catgut thread, by which the sheet of fascia has been carried around the broken bone after the fracture has been made accessible by incision of soft tissues. Bones of forearm showing fracture of ulna supported by a fascial wrapping representing an autogenous artificial periosteum.

The broken bone is exposed and freed from muscles for two or more inches. The fascial graft, cut from the outer aspect of the thigh, should be six or more inches long. One end should be pointed. To this pointed end should be tied, or sewed with catgut or fascia, a cord of thick catgut or Kangaroo tendon or a band of fascia. This cord should be threaded into a very large, flat, curved needle, like that used to carry a Gigli or chain saw around a bone. By means of the needle it is easy to draw the fascial graft around the coapted fragments so as to wrap the bone twice or thrice. The wrapped graft is then smoothed out on the surface of the bone and the cord used to fix it close to the enclosed broken shaft. One or two stitches may be made with the needle into the layers of fascia; or another absorbable thread may be used to stitch down the end and fasten the edges of the wrapping together. The muscles are then allowed to fall into place, the fascia over the muscles is sutured and the wound closed without drainage, as in Lane's method of plating. Outside is applied a gypsum-gauze encasement with or without traction, or a simple form of splint is used to give rigidity and secure protection from injurious motion.

The use of fascia may be varied somewhat. In very oblique fractures, for instance, two quite narrow splints may be wrapped about the bone at a considerable distance from each other and, if continuous traction is used, coaptation of fragments and length of bone will be preserved.

This fascial tube, or artificial periosteum, apparently solves the problem of substituting absorbable for non-absorbable support in shaft fractures. In 1911, I prepared, on invitation from the officers of the French Congress of Surgery, a paper entitled "An American Surgeon's Opinions of the Open or Operative Treatment of Closed Fractures." As I was, however, unable to attend the meeting it was published in *Archives Internationales de Chirurgie,* vol. vi, page 62. I have not since changed my opinion that the bloodless methods of dealing with fractures ought to remain the usual choice, and that they give, in the hands of those who apply them with care, good results. This view was and is the same that was taken by Robert Jones of England in his review of the Report of the Fracture Commission of the British Medical Association, and was that of the late Professor Bardenheuer in Germany, who for years insisted upon the infrequency of blood-letting operations if fractures were treated by permanent extension. Many surgeons in America hold the same opinion. When operative attack, however, is needed I believe the fascial tube or strap will often be found to answer the purpose better than the metal plate for shaft fractures.

STATED MEETING, HELD DECEMBER 6, 1915

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

OSTEOCHONDRITIS DEFORMANS JUVENILIS, OR PERTHES'S DISEASE

Dr. James K. Young presented two cases of this disease, one of these, aged five years, was suffering from Perthes's disease of one hip, and the second one, aged five years, was suffering from Perthes's disease of both hip-joints.

The first boy came under observation, July, 1913, at the Polyclinic Hospital, complaining of lameness in the left hip. There is no history of injury and his mother knew of no cause for this condition. There is no history of tuberculosis in the family. The X-ray showed a typical atrophy of the epiphysis of the femur, with some roughening of the cavity of the acetabulum. There was no limitation of motion except in abduction; and the disease, after remaining stationary for a time, has gradually recovered, there being an increased deposit of lime salts. He wore an apparatus to relieve weight bearing, and he was given calcium phosphate in large doses.

The second boy came under observation at the Polyclinic Hospital, November 22, 1914, complaining of knock-knee on the right side. He walked with his toes turned in and his mother noticed this condition for nine months, there was at this time no limitation of motion and the X-ray showed Perthes's disease of the left side. Subsequently, the same condition developed on the other side, in five months. He was treated similarly to the first case and he has now good functional use of the thigh.

Perthes's disease is characterized by atrophy of the upper epiphyses of the femur, due to a subchondral area obstruction, which eventually becomes complete; there is no temperature; there is slight limp, prominence of the great trochanter, some atrophy of the muscles and limitation of abduction, with slight pain from time to time. The patient does not respond to the tests for tuberculosis. After remaining active for a year or more there is a tendency to recovery with slight functional changes.

The X-rays in the second case are characteristic, and show a flattening and broadening of the head, with a moderate degree of coxa vara. The etiology is obscure, but Legg believes in a traumatic

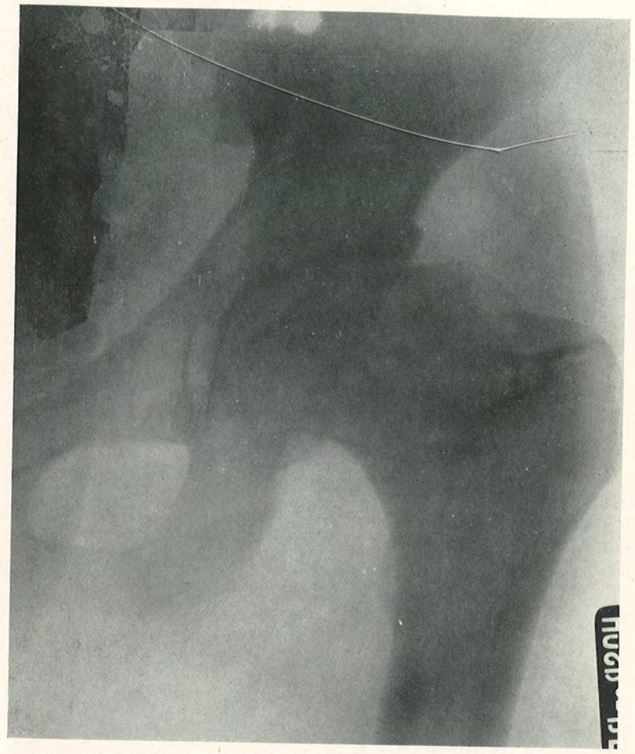

Fig. 1.—Coxa vara (flat head) in a patient aged eighteen years, following arthritis at five years of age.

etiology, with "blocking of the blood supply to the epiphysis, due to trauma of the epiphysial line."

Dr. Gwilym G. Davis said that it is easy enough to diagnose in various affections the well-advanced typical cases, but the trouble comes in atypical ones, such as when we see a child running around with perhaps just a slight or no pain and perhaps a rather marked limp who does not progress apparently beyond that stage. It is possible to conceive of there being a number of possible conditions; for instance, the symptoms may be the result of a rhachitic state, such as bone softening. In arthritis deformans we find in some cases very similar conditions. It is perfectly well known also that in the adult it is not uncommon to find cases of atrophy, especially of the neck of the femur, from injury. Without doubt, following an injury there sometimes follows disturbance of nutrition in the head and in the neck of the femur, which gives rise to local changes. One might call this an osteitis or osteochondritis, but it is hard to determine the exact pathology of the affection. In some of the reported cases changes have been observed in other joints. That would argue a rhachitic condition or one of more or less general disturbance.

Examination from a pathological stand-point shows the absence of any specific taint, the Wassermann and von Pirquet tests being negative. An X-ray plate may be made and if the disease has progressed far enough certain changes may be evident in the head of the bone. To tell, however, the exact character of these cases is very difficult because of the changes being so slight. That which is to be especially guarded against is that we do not mistake an early case of tuberculosis for this condition and permit too great activity. Many of these cases are found to have been preceded by traumatism. One marked case of his appeared almost like a separation of the epiphyses of the head of the femur. The boy presented an appearance of retarted development, almost infantilism. The question arose whether or not he had a more or less general bone softening, with lack of development, in which the local conditions were caused by an accident. If an accident is the sole cause in such a condition in a healthy individual, spontaneous recovery ought to occur; but, if the accident is only an incident in a constitutional disturbance, the case requires entirely different handling, and the proper management of these cases is by no means established, nor have we decided upon any distinct line of treatment to pursue. It would be wise to protect the joint as much as possible and then endeavor to improve the general condition.

Dr. Astley P. C. Ashhurst presented an X-ray picture (Fig. 1) of

a patient, now eighteen years of age, showing a flat head of the femur. This young man says that when five years old he had a multiple arthritis, which laid him up for about a year. When he got about he was lame in the right hip, and has been lame ever since, but has never been laid up. There is shortening of 1.5 cm., and the thigh is 5 cm. less in circumference than the left. Flexion of the hip is slightly limited, internal rotation is lost, and there is almost complete loss of abduction. The question is, is every case of flat-headed femur an example of so-called Perthes's disease?

Dr. Davis has reminded us that Perthes was not the first to describe the condition. One of the studies of this affection which caught his own attention first was by Calvé, in the *Revue de Chirurgie* for 1910; he called it a "particular form of pseudocoxalgia." A case of coxa vara at the Episcopal Hospital in 1913 was thought to be an example of this affection (Klauder: *Medical and Surgical Reports of the Episcopal Hospital,* 1914, ii, 269).

It must be remembered that for very many years all forms of hip disease were undifferentiated. Then the tuberculous nature of many of them became recognized, and for a time many surgeons considered all cases of hip disease tuberculous. It is only within a comparatively few years that it has been possible to disprove the tuberculous nature of some cases, and among these non-tuberculous cases of hip disease we must place instances of Calvé's or Perthes's disease; but of their true pathogenesis we are still in doubt.

Dr. Young, in closing, said that there has been too much confusion in regard to the nomenclature of diseases of the hip. The term hip disease should be used exclusively for tuberculosis of the hip-joint and then there would be less confusion. The term osteochondritis deformans infantilis is a good one, but the term Perthes's disease has been commonly used by orthopædic surgeons, and as his description was the first systematic and complete one, it is not improper to designate this condition as Perthes's disease.

UNUNITED FRACTURE OF THE LUMBAR VERTEBRÆ

Dr. James K. Young presented a man, aged thirty years, who sustained an injury to his lumbar region by falling from a height and striking his spine upon a track of the railroad, ten years ago, and in whom a diagnosis had only been reached one year ago. There was great difficulty in getting satisfactory X-rays on account of the large size of the patient. The symptoms during this interval resembled, somewhat, the so-called "railway spine," such as usually accompanies

ligamentous injuries. The more recent improvement in the Röntgen technic enabled Dr. Pancoast, of the University of Pennsylvania, to take a picture which shows a fracture on the right side of the transverse processes of the third and fourth lumbar vertebræ, both of which are ununited. It is possible by surgical means to remove both of these, but the condition has so greatly improved, the patient is advised not to submit at the present time to operation.

RECURRENT DISLOCATION OF THE SHOULDER-JOINT

Dr. James K. Young presented a man who had been operated upon by a new method for recurrent dislocation of the shoulder-joint. The patient was an athletic mulatto, aged twenty years. The shoulder was injured by an overhand throw while playing base-ball, at a western university, in Kansas. The dislocation was subcoracoid, and recurred frequently during the day, interfering with his occupation, which was that of a dentist's helper. The operation which was performed was suggested by Dr. Oscar H. Allis, and consists in dividing the lower half of the insertion of the tendons of the pectoralis major and the latissimus dorsi, and keeping the shoulder in an elevated position until union has occurred. The incision is made between the deltoid and the pectoralis major in front, the cephalic vein is displaced outward, and the attachment of the pectoralis major tendon is found and divided in its lower half. In thin subjects the tendon of the latissimus dorsi can be hooked up from the same incision, but in muscular subjects a second incision must be made along the posterior border of the axilla, until the tendon of the latissimus dorsi is found and its lower half divided. The shoulder is kept elevated for ten days. The patient has had no recurrence of the dislocation since the operation. He also has full strength in the muscles about the shoulder-joint.

This operation appears to be suitable in forward upward dislocations of the shoulder-joint; division of the lower half only of the tendon changes the direction of the action of these two powerful muscles, but does not apparently weaken the action of the muscles about the joint. It will be noticed that the capsule was not sutured, and that the joint was not opened, which obviates one possible source of infection.

RUPTURE OF THE SIGMOID BY INFLATION THROUGH THE RECTUM

Dr. A. D. Whiting reported the following case:

J. W., Pole, male, aged twenty-five, was admitted to the Germantown Hospital, November 11, 1915, at 2.30 P.M. While at

work, at 1.20 P.M., in a steel mill, in a stooping position, some of his fellow workmen, in a spirit of fun, placed the nozzle of a compressed air pipe within a few inches of his buttock and directed the compressed air, under eighty pounds pressure, through a three-eighths-inch nozzle toward the anus. The patient staggered and then leaned against a wall, but did not fall. With the assistance of a fellow workman, he walked to the Infirmary of the works, where the attending surgeon found the abdomen markedly distended and very tense. A rectal tube was passed, but no gas escaped through it. A small amount of blood was recovered. He was then sent to the hospital.

When first seen by Dr. Whiting, at about 3.15 P.M., his temperature was 97°, pulse 66, respirations 24. Breathing was difficult. The abdomen was distended and tense, and very tympanitic, with marked rigidity throughout but more pronounced in the upper right quadrant. Owing to the inability of the patient to understand English, a history could not be obtained until an interpreter was summoned. Then the patient denied the inflation of the colon, but stated that he had been seized with sudden upper abdominal pain. A diagnosis of rupture of the stomach or intestine was made and immediate operation advised. Before consent to operation could be obtained, the true history was given by the patient to a priest.

Operation (at 6.15 P.M.).—During the interval of five hours between the accident and operation, the patient became very much worse, the respirations were more difficult and the pulse much weaker and more rapid. Incision was made through the lower right rectus. As the peritoneum was opened, there was a gush of air, with blood and fecal matter, followed by immediate improvement in respiratory and heart action, which, however, did not last long. Inspection revealed an opening in the sigmoid, about 3.5 cm. in length, opposite the attachment of the mesosigmoid. This was closed with through-and-through catgut sutures. Further search showed that there had been a tearing of the serous coat of the sigmoid for about 15 cm. The descending colon and rectum were intact. Owing to the poor condition of the patient, it was deemed inadvisable to do a resection. A rapid closure of the rent in the peritoneum was performed, the abdominal cavity was flushed with hot saline, saline solution was administered intravenously, and the wound was closed without drainage. The patient reacted fairly well from the operation, but the improvement was not prolonged; his temperature rose, without remission, to 109°, just before his death, 28 hours after operation.

A post-mortem examination showed complete closure of all the tears of the bowels and the absence of peritonitis. A study

of the ruptured bowel shows absence of the usual rugations and irregularities of the mucosa, it being perfectly smooth from the stretching. The mucosa shows two tears, one perforating through the peritoneum, and numerous small ones longitudinal in direction. There are one longitudinal and two transverse tears of the peritoneum. There is evidence of hemorrhage between the bowel coats, and a few areas of punctate hemorrhage.

E. Wyllys Andrews (*Surg., Gyn. and Obs.*, xii, 1911, p. 63) has reported a similar case of his own and the histories of 15 others obtained through correspondence and law reports. In 13 of them the inflation of the bowel was the result of practical jokes; in three no mention is made of this feature of the accident.

In all of Andrews's collected cases, as in the present one, the nozzle of the apparatus was not introduced into the rectum, but simply directed toward the anus, the sides of the funnel formed by the buttocks directing the air into the bowel.

In all of the reported cases the intestinal injury was confined to the colon, and usually to the sigmoid, because, as suggested by Andrews, it "traps the air momentarily by its somewhat bent or kinked junction to the descending colon. It thus sustains the first shock of the pressure and, unable to pass the mass of air onward, it yields to the pressure, dilates, and bursts into the free peritoneal cavity."

The mortality of the condition is 100 per cent. without operation. Immediate cœliotomy with resection or repair of the bowel should reduce the mortality about 75 per cent. In Andrews's collected cases, seven were operated upon with a mortality of 57.2 per cent.

LUMBAR HERNIA*

By Edward H. Goodman, M.D.
and
John Speese, M.D.
of Philadelphia

Hernia in the lumbar region is one of the rare varieties and may occur as a congenital affection, as a spontaneous or acquired form, or as the result of severe local injuries or diminished local resistance following infectious processes. In reporting an instance of spontaneous or acquired hernia, we have thought it desirable to review the literature on the subject, as there is considerable uncertainty as to what constitutes a true lumbar hernia. We have studied, therefore, the instances of congenital and acquired hernia and have excluded from our statistics those hernias following direct traumatism of any type, and those the result of local inflammatory processes, both of which have been instrumental in causing a fairly large number of the cases on record. We have found reports of 33 cases of acquired lumbar hernia, 11 of congenital lumbar hernia, and about 40 cases following local injury and disease.

The entire subject of lumbar hernia is attended with much interest from the historical stand-point. We have consulted Jeannel's article freely for the descriptions of the cases reported by the first writers on this subject.

In Pierre Franco's *Traité des Hernies*, published in 1561, nothing is said of hernia other than inguinal, and it is not until a century later (1672 or 1687) that we find what seems to be the first description of lumbar hernia. Paul Barbette at this time states that, "Experience has taught me that the peritoneum may rupture in its posterior aspect toward the back, thus forming a hernia." Stephen Blancard, in 1701, states only, "Peritoneum prope spinam dorsi ruptum dat herniam"; a laconism which suggests the possibility of a lumbar hernia but does not permit of the supposition that the author had seen a case.

Dolée (1703) knew of lumbar hernia, but he, like his predecessors, took no pains to study its anatomy or its mechanism, although later writers without quoting Dolée correctly have interpreted him as describing lumbar hernia. Jeannel emphatically states that there occurs no passage in Dolée's writings to warrant this, and he reproduces verbatim the Latin text, which is without any special interest. Budgeon, in 1728,

*Read before the Philadelphia Academy of Surgery, December 6, 1915.

described a case of congenital hernia, but it is apparent that he had no idea of the true nature of the condition.

The first trustworthy observation on record is that of Garangeot (1731), who mentions a case of strangulated hernia, reducible after death, perhaps at the expense of a ruptured intestine. Although Garangeot made no autopsy, there can be little doubt about the true nature of the case. The report made by Garangeot failed to stimulate the interest of his contemporaries, for Arnaud (1749), although knowing that hernias may present themselves in the back, forbears to say more, as such hernias, "far from instructing those for whom I write, may prevent one from comprehending ordinary hernias." "*Étrange prétexte ou plutôt mauvaise excuse de l'ignorance de l'auteur,*" is the comment of Jeannel.

Ravaton, in 1750, published the first case of strangulated lumbar hernia which was cured by operation, but details are lacking as to the exact location of the tumor. A decade later Hermann (1767) described a case of strangulated hernia which was cured spontaneously by the formation of an artificial anus. In 1768, Balin writes, "Lumbar hernia may arise unexpectedly between the false ribs and the crest of the ilium, at the point where the external oblique is attached only by a cellular tissue." Although this is brief, terribly laconic, according to Jeannel, the latter claims that Petit, to whom is given the credit for describing the triangle which bears his name, has written no more fully. Jeannel discredits Petit (1774), and claims that in his article he has not described the triangle in question, has not furnished us with any anatomical data concerning his case, and Jeannel confesses he is at a loss to know why this region is called "Petit's triangle" any more than by the name of Dolée, Garangeot, Ravaton or Balin, who wrote as fully about it as did Petit. This view, it may be mentioned, is shared by Larrey also.

Since Petit's time no one until the advent of Grynfeltt attempted any serious study on the subject, and the term lumbar hernia was used so loosely that ventral hernias were continually being confused with the lumbar variety (Plenck, Chopart and Desault, Callison).

Grynfeltt (1866) was the first to give the subject deep thought, and described the space which bears his name. "The aponeurotic fibres of the transversalis in dividing form a passage for the lower intercostal artery, just as the spermatic cord enters the two pillars of the external ring. There is at this site a natural point of lessened resistance. If the lower border of the internal oblique inclines more anteriorly than normally, the last intercostal artery perforates the aponeurosis of the transversalis above the border. In other words, if the point of re-

sistance of this artery is in the lumbo-costo-abdominal triangle all the conditions favoring a hernia are realized." The space of Grynfeltt is bounded above by the twelfth rib, internally by the quadratus lumborum, externally by the external oblique and below by the internal oblique muscle.

Four years later Lesshaft (1870), without mentioning Grynfeltt's work, came to the same conclusions and the space is known in Germany as Lesshaft's triangle, but its proper name should be the Grynfeltt-Lesshaft space. Lesshaft studied 108 adult cadavers, and found Petit's triangle present in 84. In 34 cadavers of embryos or new-born the structure was present 9 times. In other words, the triangle is generally present in adults and only occasionally in embryos or the new-born. When the triangle was not present it was noted that the edge of the latissimus dorsi muscle was in direct apposition with or overlapped the margin of the external oblique. The importance of the triangle was emphasized by these studies, as it is more constantly present and is larger than the inferior triangle of Petit.

V. Baracz and Bursynski have in turn made anatomical studies with the following results: After the first layer of the back muscles is turned aside (latissimus dorsi) one sees the second layer, consisting of the posterior inferior serratus muscle and the internal oblique. Between these two may be seen the third layer, the aponeurotic portion of the transversalis. This muscle with the lower border of the serratus posticus inferior, together with the inner edge of the twelfth rib above, the erector spinalis, the internal oblique and the external oblique laterally, and the base composed of the transversalis, make up the triangle lumbo-costo-abdominal of Grynfeltt and Lesshaft.

The authors have made numerous dissections, having reference to Petit's triangle and to the triangle of Grynfeltt, and of 76 examinations, Petit's triangle was missing 12 times on both sides and 4 times on one side only. It existed, then, in 63.13 per cent. of the cases. The size of the triangle varies a great deal, often merely a slit and again having a base 5 or 6 cm. wide. The base may be muscle alone (internal oblique) or muscle and tendon where the internal oblique extends to the lateral base of the erector spinalis. To pierce this layer great force was necessary, and as there are no openings for the vessels or nerves, the authors consider it improbable that a hernia can rise through Petit's triangle.

The Grynfeltt-Lesshaft triangle was present in 93.5 per cent. of the dissections, and the authors regard it as an almost constantly occurring weakness in the lumbar region. The space is not always that of a triangle or rhombus, it may be deltoid, trapezoid or polyhedral. The

shape and size of the triangle depend on several factors: the length of the twelfth rib, whether the internal oblique with its muscle bundles reaches to the lateral border of the erector spinæ, or is in varying distance therefrom forming a tendinous aponeurosis; upon the development of the serratus posticus inferior; upon whether the fibres of the median border of the external oblique insert on the tip of the twelfth rib or above or below the rib; upon the existence of a tendinous arc in the aponeurosis of the transversalis muscle; furthermore, upon whether the median portion of the latissimus dorsi inserts in the eleventh or twelfth ribs or whether it unites with the posterior fibres of the external oblique, and finally the size and shape depend on the development of the quadratus lumborum.

The most common form is an acute angled quadrilateral, or a triangle. The thickness of the aponeurosis varies in this space but at the uppermost limit the thinnest portion of the lumbar region is seen. In this thin area vessels and nerves are found, usually the twelfth intercostal, and it is in this region that hernias most often occur.

Etiology.—In the etiology of the cases quoted in this paper, indirect traumatism alone is accepted as a cause, and all the cases are excluded in which the hernia followed direct injury, or was secondary to infectious processes, sinus formation, or visceral protrusions due to muscle paralysis. By indirect traumatism is meant conditions demanding habitual or sudden strain, lifting of heavy weights, coughing, and the strain following falls. In 14 of 33 cases, such a history is mentioned, the hernia appearing soon after the injury was sustained. Whether there has been a congenital predisposition in these cases is a matter of debate; there is little evidence to support such a view. It must be mentioned, however, that emaciation, old age, repeated pregnancies, by lowering muscle tone, predispose to the development of lumbar hernia. In those cases in which the age is given we find but 5 instances occurring before the fortieth year of life, 4 in each of the three succeeding decades, and in quite a large number of cases, the histories state that the hernia occurred in an elderly person.

There is a marked predisposition toward the development of hernia on the left side, 19 cases being noted here, 10 on the right side and 2 were bilateral. The hernias occurred 22 times in males and 9 times in females.

The hernia is generally subcutaneous but may be separated from the skin by a layer of fat or muscle. There is considerable doubt concerning the formation of a sac, for it has been distinctly noted at operation and at postmortem that a sac composed of peritoneum often is lacking. This

seems to be particularly the case in the hernias composed of fat protruding from the subperitoneal or perinephritic tissues.

The hernia is composed of fat, mesentery, large or small intestine or, in rare instances, the kidney, and as a rule the hernia is reducible without difficulty, even when symptoms of strangulation have developed. As to the site of the orifice it is impossible to determine this with accuracy in most cases unless an operation has been performed. Jeannel claims that hernias due to effort or to trophic changes in the muscles present themselves in Petit's triangle or in the Grynfeltt-Lesshaft space, while traumatic hernias and those due to disease may occur anywhere. In many cases the site of the hernia is distinctly stated, and where accurately described we have found that 6 cases occurred in the Grynfeltt-Lesshaft space and 9 in Petit's triangle. When all the cases are grouped together one triangle is involved about as frequently as the other.

The symptoms depend largely on the cause of the hernia. In our case the onset was insidious, the hernia entirely escaped the patient's notice until it was pointed out to him twenty years after the first symptom following strain. During these years he was convinced that the only inconvenience he experienced was a feeling of weariness in his back after a day of hard work. In this case as in a typical example of any type of hernia, the signs characteristic of a hernia were so well marked that there could be no question of the correct diagnosis. It should be mentioned, however, that errors in diagnosis have been made, and hernias have been incised in the belief that the condition was an abscess. In one instance the bowel was opened and a fecal fistula resulted.

Most authors speak of the serious nature of lumbar hernia because of the tendency toward strangulation. Jeannel in his analysis found strangulation in 18 per cent. of the cases; this collection including hernias due to all causes. In the 33 cases of spontaneous hernia we have collected, symptoms of intestinal obstruction or strangulation, either mild or severe, were mentioned 8 times, or 24 per cent. In many, the symptoms were mild and disappeared when the hernia was reduced. Reduction was accomplished easily, even when the symptoms indicated a severe form of strangulation, a feature probably due to the absence of a sac, removing the danger of constriction exerted at its neck.

Operative measures have been uniformly successful in the treatment of lumbar hernia, although the number of operations reported is comparatively small. Despite the fact that symptoms of strangulation are so frequently encountered, but one operative death is recorded. In

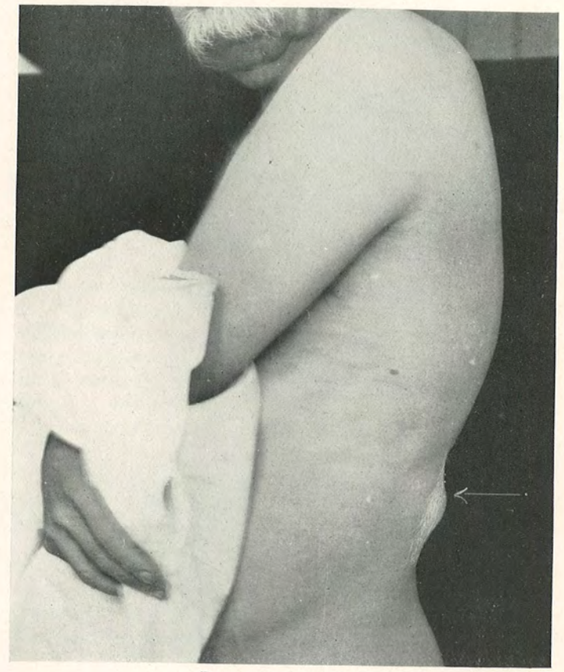

FIG. 1.—Lumbar hernia.

many instances comfort is secured by the use of a truss or belt and the hernia is thus retained within the abdominal cavity with a considerable degree of comfort. As so many of the patients are advanced in years, and in a debilitated condition, operation should be advocated with some degree of caution. Of course a radical cure should be undertaken when symptoms of strangulation arise, or when the general condition of the patient becomes a matter of concern from the pain and inconvenience of the hernia.

Patient, John C., aged fifty-eight, was admitted to the medical wards of the Presbyterian Hospital, service of Dr. James E. Talley, October, 1915, on account of nephritis. On examination of the patient, a swelling in the left lumbar region was noted. The patient said that until our discovery of this tumor he had been unaware of its existence. Just how long it had been present it is impossible to state, but the following history obtained from the patient leads us to suppose that it must have existed for many years.

The patient is a stone mason by occupation and is accustomed to very hard work. About eighteen or twenty years ago, while attempting to lift an unusually heavy piece of stone, he was seized with a sharp pain in the left side of his back, which persisted for about a week and which prevented him from working. He does not know if any swelling appeared at that time, and, as we have stated, has been unaware of any tumor existing in his side, until this autumn. This pain he was told was due to a strain, and since then he has often had attacks of "weak back," particularly when his work was unusually heavy. At times when he has attempted to lift a weight he has felt something tighten in his back, as if something were pinching him, but this sensation would pass off on assuming the upright position, and after resting a few minutes. He has never had any signs of strangulation, nor has there been any permanent interference with his work on account of his back.

Examination reveals the presence of a tumor in the left lumbar region just under the last rib. The tumor is about 3 cm. in diameter, is rounded and painless. On palpation the swelling is soft and may be easily reduced with gurgling, gives an impulse on coughing which makes the swelling more prominent as does any straining effort. On percussion the tumor is resonant and asculta-tion reveals peristaltic sounds. When the patient bends forward, the tumor becomes more prominent; when he lies on his abdomen, the tumor disappears spontaneously, and there may be felt a small opening in the dorsal muscles admitting the tip of the middle finger, against which is felt an impulse when the patient coughs. These

findings at once led to the certain diagnosis of lumbar hernia, presumably in the Grynfeltt-Lesshaft space, not in Petit's triangle.

We were interested in learning just what part of the intestine formed the hernia, and as far as we are able to decide by means of the X-ray, it is the small intestine which protrudes. Although recognizing that strangulation occurs in a larger proportion of cases than in inguinal hernia we advised against operation on account of the patient's age, the renal condition (nephritis) and on account of the benignity of the hernia, no symptoms developing during the eighteen or twenty years of its existence.

The accompanying photograph shows fairly well the site and the appearance of the hernia.

CONGENITAL LUMBAR HERNIA

Etiology.—The etiology of this form of hernia is unknown, unless it be due to congenital malformation.

For our knowledge of the anatomy we are dependent on the cases of Jeannel and of Coley, and it would seem that the sac is composed sometimes of parietal peritoneum itself, sometimes by the parietal peritoneum and large intestine, the descending colon when on the left side, the ascending colon when on the right. The sac is never adherent to the skin as far as is known.

The contents of the hernial sac may consist of any of the following—large bowel, small intestine, kidney. The site of the hernia may be either in the so-called triangle of Petit or in the space described by Grynfeltt, or in an anatomic region imperfectly described, along the external oblique at the level of the twelfth rib. As to the pathogenicity of this hernia, it may be said that the rupture falls in two categories, the one in which there has been a malformation, and the other not due to a malformation, but more in the nature of a paretic state of the muscles of the lumbar region.

From the diagnostic stand-point the recognition of a hernia should be easy, though there is a case on record in which the intestine was cut, under the impression that the swelling was an abscess (Dolbeau). It would seem that such a mistake should be impossible, as with a little care the diagnosis should be easily made.

Congenital lumbar hernia is an incurable infirmity. The course of the trouble is uncertain; there may be increasing discomfort or there may be progressive improvement with a support. There has been no record of strangulation having occurred, but one should always have before him the possibility of this accident.

Congenital lumbar hernia as well as the spontaneous type is never

cured by means of a bandage or truss, and it would seem that operative measures are to be urged.

CASES OF CONGENITAL LUMBAR HERNIA

Case I.—Budgeon, 1728. Much contested and much discussed case. Tumor at birth, ruptured at seventeen years of age. Thought by some to have been lumbar hernia, by others, spina bifida, and by Jeannel to have been hydronephrosis.

Case II.—Plenck, 1774. Hernia of kidney and not of bowel.

Case III.—Monro, 1811. Hernia of kidney.

Case IV.—Colles, 1829. Three years old. Tumor observed at time of birth. Tumor now size of a moderate-sized watch, at birth much smaller. Situated posteriorly immediately above skin of ilium, left side. Easily reducible.

Case V.—Macready: "In 1882, a youth, aged sixteen, presented himself at the Truss Society, and has often been seen since then up to the present time (1890). Soon after birth a swelling was observed on the right side, for which a belt was worn during six months. The lump then disappeared, but was again noticed when he began his apprenticeship as a plate worker, some months before his appearance at the Society. He then had a hernia of the size of half an orange; it was easily reducible, and escaped by an opening immediately below and anterior to the tip of the twelfth rib."

Case VI.—Mastin, 1890. Male. When six years of age, hernia measured eight and a half by nine inches, contents of sac were small bowel and descending colon. Apparent defect of latissimus dorsi and quadratus.

Case VII.—Wyss, 1892. Boy, nine months old. Many other congenital defects. Right sided hernia through Grynfeltt's triangle.

Cases VIII and IX.—Berger, 1895. Simply says he has seen two cases, one in a sclerotic, the other in a little child, probably due to congenital defect of the muscles in the lumbar region.

Case X.—Coley, 1895. Eleven months old child, with a hernia protrusion about the size of a goose egg in the left lumbar region. Noticed since birth and was probably due to a congenital malformation of the abdominal parietes, allowing this mass to protrude through the triangular space between the latissimus dorsi.

Case XI.—Russell, 1898. Child. Doubt whether congenital or due to congenital absence of a portion of abdominal wall. Hernia is visible except when muscles were stretched. Was inclined to treat by transplant of muscle.

Case XII.—Jeannel, 1902. Boy, four months old. Shortly after birth, tumor in right flank, size of hen's egg, situated between last rib and iliac crest. Tympanitic on percussion, reducible, increased by exertion, decreased by rest. Operation. Cure.

ABSTRACT OF CASES OF SPONTANEOUS LUMBAR HERNIA

1. Ravaton: Female, age not given, tumor of three weeks' duration, situated in the left lumbar region. Symptoms of strangulation developed. Operation. Cure.

2. Petit: Patient was an adult female, hernia on left side in Petit's triangle, size of a child's head. Strangulation relieved by taxis. Recovery.

3. Monro: Bilateral hernia in a child six months old, covered by skin only, immediately under the false rib. Each tumor contained kidney, easily reduced through an oval ring of a considerable size.

4. CLOQUET: Male, aged seventy-five, pain in lumbar region following strain; pain disappeared; recurred in two months with an attack of nausea and vomiting. Round tumor found in right lumbar region, 1 cm. from last rib. Tumor painful on palpation, gurgling, impulse on coughing. Symptoms relieved after reduction. Application of a truss gave considerable relief.

5. KINGDON: Male, aged fifty-four, for several years had asthma and cough. Eight days before he tried to lift a fire engine which he was cleaning and felt something give way in his back. At night when he undressed a swelling was felt which grew larger as he coughed. The hernia was the size of a fist and was situated between the lower ribs and the iliac crest on the left side. It was reducible, and the hole through which it came was small and above the iliac crest, about three inches from the spine at Petit's triangle. It felt crepitant, not gurgling, on reduction. The integuments over it were thin. On exhibiting the patient it was generally and unhesitatingly admitted that the swelling was a hernia through the foramen of Petit. (Quoted by Macready.)

6. BASSET: Young man with a swelling in the left lumbar region, size of an apple and ovoid in shape; had had this tumor since childhood. It was soft, elastic without fluctuation and resembled a lipoma. Coughing increased the size, gave impulse, expansible in character, reducible. There was a family predisposition to hernia in this case.

7. HARDY: Woman, thirty years old, admitted to the hospital for syphilitic paraplegia. While straining at stool noticed a tumor eight centimetres in diameter, just above the iliac bone, subcutaneous, large base, hemispherical, about the size of a fist, soft, no change in color of skin, no fluctuation, resonant on percussion. Reducible with gurgling, reappears on coughing and on effort, impulse. Patient perfectly well.

8. MARQUEZ: Old woman; while attempting to lift a heavy load of grass, felt a sudden pain in the side, becoming more and more painful and being accompanied by nausea, colic and extreme anxiety. Swelling in left flank, tender, gurgling, and spontaneously reduced. This hernia had been present five or six years.

9. TRIPONEL: In the discussion of Marquez's paper, Triponel said he was reminded of a strangulated right-sided lumbar hernia; operation. A year later another strangulation and a new reduction. Patient advised to wear a truss and to avoid violent muscular effort.

10. LEVY: Old country woman, swelling in left flank at side of Petit's triangle. Never had any serious inconvenience. Patient thought the tumor gave her lumbago on that side.

11. TURENNE: Case of elderly male with tumor in left flank of three years' standing, and arising without any apparent cause. It was the size of a nut, uneven, and rounded, and seemed to consist of a portion of the omentum. It was reduced easily, was kept in place by means of a bandage. It had never caused any inconvenience.

12. DOLBEAU: Old woman, no mention of the side. Opened for abscess. Recovery.

13. APPERSON: Female, aged sixty-three, tumor on right side, size of a teacup, now and then presented signs of strangulation but was easily reduced and retained by bandage and compress. Woman feeble and relaxed as the result of child-bearing.

14. COZE: Male, no ascribable cause. Hernia right side, toward the top of Petit's triangle, size of a hen's egg; soft, reducible. Few months later patient, a soldier, being no longer able to keep up his occupation, was brought to hospital. At this time a large hemispherical tumor 12 to 14 cm. in diameter was noted, soft, no skin changes, readily reducible with gurgling, contents probably ascending colon.

15. COZE: Soldier, right side, toward top of Petit's triangle, 6 by 4 cm. in extent; reducible small tumor; gurgling. Previously operated on for this swelling, scar of operation on skin. The following month tumor had enlarged, was reducible, impulse, no gurgling.

16. GOSSELIN: Male, aged fifty-five. When fifteen years old had lateral curvature of spine, to the right. Since five or six months some pain in left renal region, colicky in character. When he coughs or exerts himself, side pains him, obliged to stop and press it with his hand. In the left lumbar region a hernia, the size of a mandarin; reducible.

17. MACREADY: A man aged fifty-four came to the Truss Society in 1884 with a swelling over the left triangle of Petit, about the size of a walnut. It increased somewhat on coughing, but was not reducible, and therefore, as this aperture could not be examined, some doubt exists whether the tumor was a hernia or a lipoma. He had also a left inguinal hernia.

18. MACREADY: A man aged thirty came to the Truss Society in 1889, who stated that usually after a hard day's work he had pain in the right side in the position of Petit's triangle. An impulse and a bulge on cough were found there, but no complete protrusion.

19. HUTCHINSON described an autopsy on an elderly emaciated man with a hernia the size of a fist, in the left lumbar region, extending from the last rib to crest of ilium; several years in duration; diminished on pressure, resonant on percussion, impulse on coughing, gurgling; no pain, no inconvenience. Thought it was in Petit's triangle, but on dissection found an opening above and to the inner side of Petit's triangle, was outside of the quadratus lumborum, through the transversalis and the latissimus dorsi. No sac of peritoneum found, but one formed from local hypertrophy of subperitoneal fat.

20. HUME: Male, aged sixty-eight, tumor in the left lumbar region for fifteen years, size of a fist, but became larger at intervals, when it was painful and symptoms of intestinal obstruction developed. When admitted for treatment, symptoms of strangulation had been present for two days, operation disclosed gangrenous small intestine caused by pressure of two fibrous bands, and a twisted sigmoid. Hernia did not seem to be in Petit's triangle. Death in twenty-four hours.

21. RUPPANER: Male, aged forty-eight, history of strain and fall followed by pain in left lumbar region. Operation eleven days after injury disclosed a rent in lumbocostal fascia, 1 cm. in length, through which protruded a nodule of fat, size of a cherry. No sac present, tumor reduced, rent and muscles sutured. Hernia was in trigonum lumbale superior.

22. STARR: Male, age not given; eighteen years ago fell while carrying a sack of grain on shoulder, and hurt his side. He thinks lump did not appear at that time. Twelve months ago while stooping down preparing to lift a weight he was seized with pain in the side, which for a few minutes prevented him from assuming the erect position. After the severe pain had ceased, he noticed a lump in his back which has persisted ever since, always a steady pain in the side,

which sometimes becomes sharp and shoots into the backbone. The swelling is about the size of a duck's egg, its long axis being directed from above, downward and outward, and is situated in the right lumbar region, between the lower border of the ribs and the crest of the ilium. Slightly tender on pressure, elastic, reducible; crackling sensation on reduction, on straining tumor gives tympanitic note.

23. GALLOWAY: Male, after being in the army for four years, developed hernia which was the size of a partridge's egg, and has gradually grown to present dimensions, five inches in length by two inches in width, left side.

24. DUMESNIL AND BRUMON: Male, sixty-one years old, complained of shortness of breath and sometimes dyspnœa. During the examination, patient strained and immediately there appeared a tumor in left lumbar region. He says he noticed this fourteen years before. At this time it was about the size of a walnut and painless. In 1891, it was the size of a mandarin orange, but had not increased in size since then. When the patient rested, no tumor, but on exertion it became quite large. It is painless, gurgling and reducible. Never prevented patient from pursuing his occupation as collier. Since 1885 a bandage has sufficed to hold the tumor in position.

25. ZENTNER: Female, aged six years; following whooping cough, developed a walnut-sized tumor in the left lumbar region, also history of violent strain in falling, followed by pain the same day and tumor a few days later. Bandage applied but tumor enlarged in spite of constant pressure. Now tumor is size of hen's egg, is soft, tympanitic and is reduced easily, no gurgle. Situated in Lesshaft's triangle. Operation disclosed sac of peritoneum projecting through transversalis, omentum in sac, sac and muscle sutured. Cured.

26. DEMOULIN: Male, forty-seven years old, mason, who, as a result of a violent effort six months before, felt a severe pain in the lumbar region, followed by an egg-sized tumor. No serious accident has resulted from tumor. Diagnosed lipoma, not completely reducible. This was a hernia developing from the fat capsule of the kidney.

27. JONES: Male, aged forty-five; tumor present for four or five years, lately producing local pain and tenderness, constipation and dyspnœa. Hernia on right side, extended from the ribs to iliac crest; reducible with gurgle; impulse on coughing. Operation. Fat found in hernia; no sac, cure.

28. BARACZ: Male, aged thirteen. Tumor left-sided, below twelfth rib, size of a billiard ball, also small one in left flank. Straining causes prominence, tympany over hernia, reducible, in Grynfeltt's triangle.

29. GAILLAC: Soldier jumped from height; immediately felt severe pain in the lumbar region and swelling—egg-sized tumor, soft, painful, reducible.

30. LEJARS: A man sixty-five years old developed symptoms of strangulation in left lumbar region; large tumor, painful, reducible. Patient stated that he had had it twenty-five years and during this time it was the size of a walnut. In the first three weeks it had been growing in size, painful and colicky. During the last six days obstinate constipation; for past three days not even gas came from the rectum; extreme nausea, distention of abdomen, and pain, particularly in the left flank. Tumor is spherical, little flattened, 7 cm. in diameter, about 3 cm. long, extending to iliac crest, skin reddened. Operation; no peritoneal sac but large intestine found. Recovery. Believes it came out through Petit's triangle.

31. FRIEDENTHAL: Female, aged forty-five. Injury to the spine by fall, and six years later strangulation in lumbar region appeared. Patient could not give any history of hernia. Cherry-sized hernia in left side, under twelfth rib, attributed to weakening of the muscles following frequent pregnancies and the indirect traumatism of the fall.

32. SECOUSSE AND LASSERE: Male, age not given, carried heavy weight upstairs, three days later noticed a small tumor in left lumbar region about the size of a nut. Ten days later it was the size of a pigeon's egg. This was three years ago and now it has increased very much in size. Round, about the size of two closed fists, becomes larger when patient coughs, and spreads widely over the lumbar region. Reducible and gurgling, non-painful.

33. GOODMAN AND SPEESE: See above.

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DR. WALTER G. ELMER said that a case similar to this is in the University Hospital now. It is that of a little boy treated for infantile paralysis of the leg. There is paralysis of the muscles in the flank so that when he coughs there is a hernia about the size of his fist which bulges out just below his ribs on the right side. There appears to be no urgent need for treatment of this condition at present.

CONGENITAL ABSENCE OF THE FIBULA[1]

DR. ASTLEY P. C. ASHHURST reported the following case:

In May, 1912, Edgar A., a boy of seven years, came to Dr. Harte's service at the Orthopædic Hospital. He walked on his knees (Fig. 2), owing to congenital absence of the right foot and lower leg, and a congenital malformation of the left foot. The right tibia terminated as a conical stump below what should have been the middle of a normal leg. On the outer side of the right leg was a tab of tissue which could be moved voluntarily, independently of the leg. The right knee-joint was normal, but no fibula was present on this side. On the left side the knee also was normal, but there was no fibula, and the outer two toes and corresponding portions of the foot were absent. The foot was in a position of marked equinovalgus.

Operative correction of the deformities of the left foot was advised, with use of an artificial limb on the right. The parents refused operation, and the child was not seen again until the autumn of 1915, when he was ten years of age. In the meantime his father had made for him a crude artificial limb which he wore on the right leg, and with which he was able to walk moderate distances. The left foot, however, was becoming more and more deformed, and the parents were now willing for operation. The equinovalgus was now much more marked than at his first visit in 1912—the heel was very high, the inner border of the foot was convex, and the outer border was raised until the sole lay at an angle of 45 degrees with the ground. Skiagraphs (Figs. 4 and 5) showed no astragalus, a deformed calcaneum (perhaps an amalgamation of astragalus, calcis and cuboid) in marked outward displacement, and two tarsal bones, perhaps the scaphoid and one

[1] One of the most complete discussions of the interesting subject of congenital deformities of the limbs is that by G. Potel, running through the *Revue de Chirurgie* for 1914, vol. xlix. According to his classification the present case is one of hemimelia. Very evidently it is not a case of intrauterine amputation; witness the deformities of the left lower extremity, and the tab of tissue adherent to the right leg, and representing an abortive attempt to produce foot or toes.

of the cuneiforms. The three inner metatarsals with their corresponding phalanges were present. The operation planned was an arthrodesis to hold the calcis under the tibia in the midline, and a transplant from the tibia to form an external malleolus.

Operation (by Dr. Ashhurst, September 24, 1915).—Esmarch anæmia. An incision was made down the outer side of the leg, beginning 7 cm. above the ankle-joint, and continued forward parallel to the normal course of the peroneal tendons. A tendon was found inserting in the calcis and the base of the outermost metatarsal bone. This tendon was divided by Z-plasty, for subsequent reunion after lenghtening. The calcaneum was held by ligaments very tightly against the outer surface of the tibia, and a large upward projecting portion of the os calcis hindered access to the ankle-joint. A second incision was now made along the Achilles tendon, and this tendon was divided by Z-plasty for subsequent reunion with lengthening. This allowed the heel to be brought down, and made the ankle-joint more accessible. The projecting knob was then cut off the upper surface of the os calcis, and preserved to form an external malleolus; it measured about 4 by 2 by 2 cm. Its removal allowed ready access to the under surface of the tibia and upper surface of the calcis as far as the internal malleolus. The calcis was fully 5 cm. broad, and on account of an inward projection from it beneath the internal malleolus it was not possible to bring it plumb under the narrower tibia. A third incision was then made under the internal malleolus, opening the ankle-joint. After removal of the obstructing projection from the os calcis the latter bone could be brought around horizontally under the tibia in excellent position. Many small chips of bone were purposely left at the outer side of the ankle-joint to fill the slight dead space between tibia and calcaneum. Apart from this no further attempt was made to produce an arthrodesis at the ankle-joint. Next the outer surface of the tibia was removed by chisel, bearing cancellous bone, and the raw bony surface of the large mass first cut from the calcis was applied against this tibial surface, forming a very shapely external malleolus. It was fixed to the tibia by two self-boring Lambotte steel screws. This held the foot in admirable position with great stability. The new external malleolus overlapped the calcaneum, and there was not the slightest inclination to a recurrence of the valgus (Figs. 4, 6, and 7). The peroneal tendon and the tendo Achillis were reunited after suitable lengthening, the Esmarch band was removed, and the wounds closed. The foot was kept in plaster-of-Paris for about ten weeks, when a suitable ankle brace was applied. There is sufficient movement in the ankle-joint, the foot stays in perfect position, and with an artificial leg

FIG. 2.—Edgar A., seven years old (May 23, 1912). Congenital deformities.

FIG. 3.—Edgar A., ten years old (December 18, 1915). Three months after operation for congenital absence of fibula (equinovalgus).

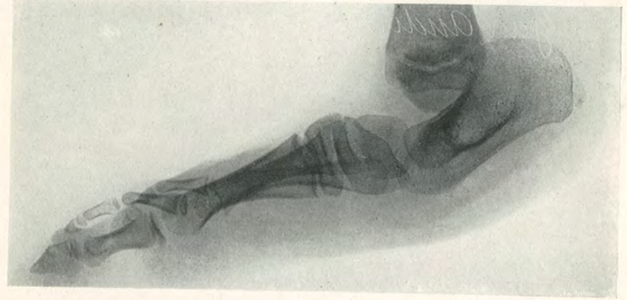

FIG. 4.—Lateral view of congenital deformity of foot, before operation.

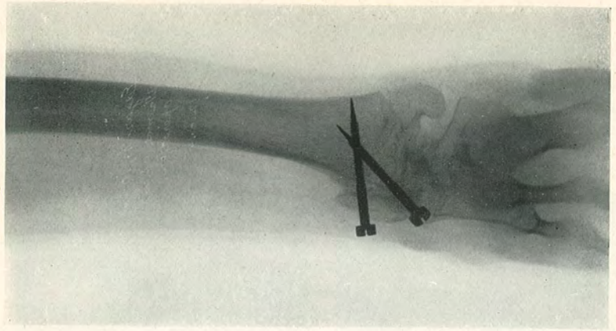

FIG. 7.—Anteroposterior view of foot after operation.

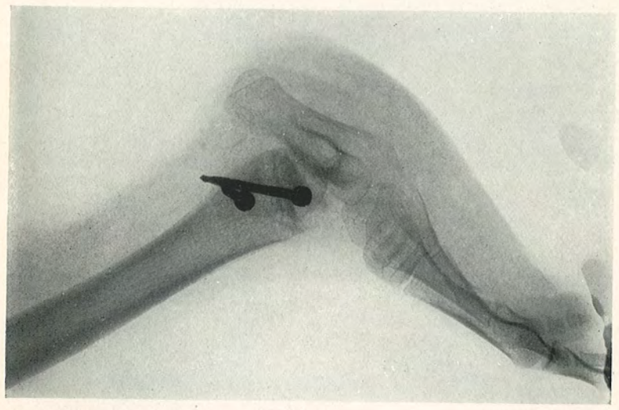

FIG. 6.—Lateral view of foot after operation.

FIG. 5.—Anteroposterior view of congenital absence of fibula and deformity of foot, before operation.

on the right side the boy is well equipped for locomotion. The ankle brace will be worn for about six months, or until the transplant from the calcaneum has become incorporated with the tibia.

DR. GWILYM G. DAVIS said that he had had a couple of cases similar to this one. In one the leg was considerably shorter than the opposite limb. In this case he bent the foot around until it came straight with the leg and resected at the ankle, putting the end up on the cut tibia so that it increased the length of the tibia and made a straight leg. By making an artificial foot the deformity was very much corrected. The other case was that of a young child and in it the tendency of the foot was to swing outward. In such a case when the child is very young, the best management is to correct the valgus by bringing the foot straight, holding it straight with braces with the foot persistently under the leg, so that the leg may accommodate itself to the foot at the ankle-joint. When the child has grown to approximately nine years of age some such operation as Dr. Ashhurst has done can be performed. Of course, the ease of the operation and its efficiency depend upon the amount of growth of bone at the time it is done. The foot can thus be held in its proper relation to the leg without the fibula, and all necessity of apparatus is dispensed with.

ENDOTHELIOMA OF LEFT FRONTAL LOBE

DR. CHARLES F. NASSAU and DR. GEORGE E. PRICE presented the following case:

Man aged thirty years, a native of Pennsylvania, white and a carpenter by occupation, who was admitted to the service of Dr. Nassau, at the Jefferson Hospital, February 12, 1915.

The family history was negative with the exception of the father's death from cancer of the thigh during the previous summer.

The patient himself gave a history of having had diphtheria, pneumonia and measles in childhood. He denied venereal infection, stated that he used but little alcohol and smoked in moderation. He had been married seven years and had two healthy children. His wife had one miscarriage. With the exception of a trivial accident affecting the left knee, there was no history of the patient having received any injury.

Twelve years ago, he had consulted an oculist because of headache, but after wearing glasses for six months the headache disappeared and he remained free from the trouble for ten years. Two years ago the headache returned, this time being unrelieved by correction of refraction.

In May of last year, he had an epileptiform attack, in which he was found unconscious and with his head turned strongly to the right. A second similar attack occurred one week later, but since this spell he has had no recurrence.

Following these attacks, the headache steadily increased in severity and would often last for days without intermission. The eye-grounds at this time were reported as being negative. Next, his eyesight failed rapidly, and, on December 11, 1914, the local surgeon removed a button of bone from the right temporal region without opening the dura. This operation, despite the failure to open the dura, was followed by rapid improvement of vision until about two weeks prior to his admission to the Jefferson Hospital, when it remained stationary. The headache had continued, but with lessened severity. There was no nausea nor vomiting at any time.

Upon examination, some tenderness was noted in the muscles of the left side of the neck near the occiput. There was no bulging at the site of the operation in the right temporal region. The lungs and heart were normal. Over the ninth and tenth dorsal vertebræ was observed a small tumor, not freely movable, but over which the skin could be readily moved.

Urine and blood examinations revealed nothing abnormal and a Wassermann test of the blood serum was reported negative.

An ophthalmological report, made by Dr. Sweet on February 13, 1915, was as follows: Pupils 3.5 mm.; reaction normal to light and convergence. Media clear, tension normal, ocular rotation unimpaired. Both optic nerves covered with exudation, extending several mm. beyond the normal edges; veins tortuous; retinal striations, particularly in R. E. No hemorrhages; swelling R. nerve about 5 D., swelling L. nerve 6 D. from a base of 2 D. Diagnosis: "Choke disk." Visual field shows slight concentric contractions of the right, but none in the left eye. There is enlargement of the blind spot in each eye.

Neurological Examination.—Gait and station normal. The pupils were slightly unequal, the right being the larger; both reacted to light and accommodation. There was no nystagmus, external ophthalmoplegia nor hemianopsia. No gross impairment of hearing. Musculature and sensation of face normal. No difficulty in articulation nor in swallowing. There was no aphasia. Grip with both hands fair and equal: no dysmetria; no diadocokinesis. The knee-jerks were normal. Upon testing for Babinski's sign, it was observed that the right great toe would sometimes flex, but at other times it would extend. Stroking under the outer malleolus on this side would usually cause extension. On the left side, there was always the normal reflex—flexion.

Sensation was everywhere normal. Astereognosis was not present. No mental symptoms were observed and the man's conduct in the ward was said to be that of the ordinary patient.

While the absence of definite symptoms prevented a positive localization, it was felt that this same paucity of localizing symptoms favored a growth in the frontal region, while the turning of the head to the right side in the epileptiform attack and the occasional Babinski on the right side pointed toward a left-sided lesion. In accord with this conclusion was the fact that the swelling of the optic disk was most marked on the left side and it was further noted that most of the headache was on the left side, beginning in the temporal region. Accordingly, at operation Dr. Nassau began by turning down a flap on the right side, where the button of bone had been removed in Erie, thinking for safety's sake a decompression could be done on the right side. When the decompression opening was made on the left side, just appearing at the edge of the hole was seen a little bluish-gray appearance of the dura, which was extremely thick. A large portion of the lower inferior angle of the parietal bone was removed with the Rongeur forceps. Bleeding was very profuse, and was controlled with hot packs and Horsley's wax. After incising the dura, a large mass bulged up into the wound anterior to the fissure of Rolando. After starting the separation with the finger, the mass peeled out very well. It left an enormous cavity. Just here he emphasized the wisdom of performing such an operation in two stages when a severe hemorrhage is encountered. If he had finished this operation in one stage, he would have lost his patient. Iodoform gauze was gently packed into the cavity and the scalp brought over the gauze with just one silkworm-gut suture. An enormous Turk's head dressing was applied, using a Halsted gauze roll. Patient was sent to the ward in deep shock. The operation was done February 17, 1915. Five days later, without anæsthesia, he removed the packing from what was then not much of a hole. The wound was closed, with the exception of two small drains. By merely laying gauze in a brain cavity, one does not make injurious pressure, and unless the bleeding is from a large vessel, it will always stop. Of course there should be no visible bleeding point. In mere oozing, one gains nothing by a hard pack on the brain. When the pack was removed, some active bleeding occurred from a vein that was easily tied. March 7, 1915, eye report at this time choked disk, right eye, 1 D, and the left eye 2½ D. He was now turned over to the Radium Department, and he was treated by Dr. Newcomet for about 8 weeks. There is now absolutely no appearance of any growth whatever. He seems to be perfectly well.

The tumor was examined by Dr. E. D. Funk, who made the following report:

Specimen is an irregular, ovoidal mass of soft, grayish-red tissue, measuring 8 by 5 by 3 cm.; weight 93 gms. One surface is convex and shows slight fissure-like markings. This surface is covered by a thin, smooth, moist membrane. The remaining surface is a torn, rough, dark-red area measuring 1 cm. square, to which a small portion of dura is attached. The mass cuts easily and the incised surfaces exhibit a grayish color.

Accompanying the larger mass is a small grayish-white piece of dura measuring 1 cm. square and 0.2 cm. thick.

Specimen was fixed in absolute alcohol, embedded in paraffin, sectioned, and sections stained with hæmatoxylin, eosin and Van Gieson's mixture.

Histology.—The sections show many islands of closely arranged cells containing prominent nuclei. These lie in irregular spaces formed by the fibrous connective-tissue stroma.

Diagnosis.—Endothelioma.

Dr. Nassau remarked further that tumors of the posterior part of the frontal lobe usually give rise to Jacksonian convulsions by involving the motor area, and on the left side, if the foot of the third frontal convolution, or Broca's area, be invaded, motor aphasia develops.

In the prefrontal region, however, diagnosis is rarely made from any direct focal symptoms. According to Starr, "A decided change in character and disposition, a mental apathy and a tendency to somnolence must be regarded as a sign of frontal lobe disease." Oppenheim states that such psychic disorders as simple dementia and a peculiar facetiousness, to which he applied the term *witelsucht*, are of frequent occurrence in tumors of the frontal region. Unfortunately, mental symptoms may result from tumors located in other portions of the cerebrum, and, when present in frontal growths, they do not indicate the particular hemisphere in which the neoplasm may be found.

Bruns and Dercum have observed a cerebellar-like ataxia in cases of frontal lesion and Stewart has noted tremor of the extremities on the homolateral side, also loss of the superficial abdominal reflex. None of these findings are constant, however.

In this case, none of the symptoms described above were present. A symptom which had some localizing value was the occurrence of convulsions with turning of the head to the right side. It is well known that irritation of one part of the cerebral cortex may spread or radiate to adjacent parts, which Starr likens to the ripple on the surface of a lake into which a stone has been thrown.

The absence of mental symptoms in this patient may have been due to the character of the growth, as the endothelioma does not actually infiltrate and destroy the brain substance, but growing from the dura it pushes aside the cortex and embeds itself, or makes a nest for itself, in the brain. Moreover, the rate of growth of this variety of tumor is slow and would, therefore, permit of considerable adaptation on the part of the brain to the changed condition.

Probably no tumor of the brain offers a more favorable outcome to the surgeon than does the endothelioma. Well defined from the surrounding tissue, it is, as a rule, readily removed, and when completely removed the liability to recur is slight. The operator must see to it, however, that the growth is not broken, or if this occurs, great care should be taken to remove all of the tumor, as, should a piece of the growth be left, recurrence is probable.

A SIMPLIFIED PRE-OPERATIVE TREATMENT OF THE HANDS AND FIELD OF OPERATION*

By A. D. Whiting, M.D.
and
Morris A. Slocum, M.D.
of Philadelphia, Pa.

A germ-free condition of the skin is not essential to the perfect healing of surgical wounds. The approach to sterility obtained by the various methods and agents that have been advocated from time to time is sufficient to afford rapid healing in a vast majority of cases. Many of the methods, however, are complicated and require considerable time for their execution; some of the agents are applicable to the field of operation alone, and only under certain conditions of the skin; some of them have deleterious effects upon the tissues.

The ideal method would be simple in application, efficient in action, free from deleterious effects, applicable to the wet or dry skin and to the hands as well as to the field of operation, and allow of rapid execution. To be efficient in action the agents used should dissolve or penetrate the débris composed of the secretions and excretions of the glands of the skin, countless broken-down cells and mechanical dirt which surround bacteria on the surface and in the most superficial layers of the skin; they should decompose and remove small particles of air that may be present in the cracks and crevices of the skin and thus penetrate more deeply; they should destroy all germ life with which they come in contact in a short space of time. To be free from deleterious effects, the methods and agents should not be harmful to the tissues, and above all should not interfere with their natural resistive and recuperative powers.

The approach to the ideal in methods or agents must be proved by both clinical and laboratory findings. The clinical results may be judged by the presence or absence of rapid and aseptic healing of the wounds, although it must be remembered that healing by first intention does not prove the absence of germ life. It simply shows that there is sufficient resistance in the tissues to overcome the activity of any bacteria that may be present. Probably the surest, the most positive prophylaxis against wound infection is conservation of the natural resistive and recuperative powers of the tissues.

*Read before the Philadelphia Academy of Surgery, December 6, 1915.

The laboratory should prove the value of the agents in destroying bacteria, preferably according to the Rideal-Walker coefficiency test, which takes carbolic acid or phenol as a standard and compares the efficiency of other agents with phenol in the ability to destroy the *B. typhosus*. The value of the agent as a germicide "can be expressed by a number called its coefficient which indicates how many times more, or in some cases less, the disinfectant can be diluted than phenol and retain an equal germicidal value." The laboratory should also show the value of the method and agents in either destroying all bacteria in the skin or in reducing them to a minimum, which may be shown, approximately, by imbedding scrapings from the skin in culture media and properly incubating them. We believe that the scraping instrument itself should be imbedded in the medium and that the method of testing which simply rinses the scraping instrument in the medium is faulty and unreliable. To obtain our scrapings both of the hands and the field of operation, we used a roughened strip of mother-of-pearl, this being used because it is readily sterilized in the autoclave, because it can be used repeatedly and because it can be imbedded in the culture medium. To avoid wrong conclusions, all chemical agents used must be neutralized or removed from the skin before the scrapings are taken, because an almost infinitesimal quantity of many antiseptics will be sufficient to prevent the development of bacteria. Scrapings should be taken thirty minutes after the supposed sterilization of the skin to prove that active bacteria have not been thrown onto the surface from the deeper layers of the epidermis. As demonstrated by Leedom-Greene and others, the skin must be moist when the scrapings are taken, because, in a dry condition, the cement substance of the epidermis holds the cells and bacteria in place to a much greater extent than it does when moist. A vigorous 24-hour culture of some easily recognized organism should be rubbed thoroughly into the skin and scrapings should be taken before and after the application of the agents being tested. Finally, a piece of the skin itself should be imbedded in culture medium and incubated for at least 48 hours.

In a former paper ("The local preparation of patients for operation," by A. D. Whiting, M.D., *J.A.M.A.*, August 8, 1914, vol. lxiii, p. 474) one of us reported several series of tests made to show the value of various methods and agents used in attempts to render the skin free from germ-life. These covered the dry method of sterilization; the wet method with the use of different chemical solutions; the combination of the wet and dry methods; and the method of freeing the skin of all bacteria by sweating. Those investigations seemed to

show that the skin could be made sterile by washing it from within outward by stimulating its natural activity, but that no other method of mechanical or chemical cleansing would render it sterile.

After studying an article by Hamilton (*American Journal of Pharmacy,* July, 1915) which grouped the various coal-tar disinfectants, and another by McDonald (*Surg. Gyn. and Obsts.,* July, 1915) which suggested the use of acetone as a solvent and alcohol as a vehicle with the incorporation into an acetone-alcohol solution of a germicide, we have experimented with several solutions in an endeavor to find one that would approach the ideal, or at least would more nearly sterilize the skin than the various methods and agents that one of us had previously investigated, be more simple in application, and allow of more rapid execution.

Hamilton states that since 1889 when the composition of creolin was made known to the scientific world, hundreds of the coal-tar disinfectants composed of creosote oil and soap and containing various proportions of the phenols have been exploited. These phenols are so called because they resemble carbolic acid or true phenol, in composition and action. They differ from carbolic, however, in being but slightly soluble in water, in being less corrosive and less poisonous, and in having greater germicidal power. They differ among themselves according to the coal-tar oil used in their manufacture and the different treatment to which they are subjected to make them soluble in water. Hamilton divides these disinfectants into three groups, according to their efficiency, the third group containing those of a high phenol coefficient. Unfortunately, many of these disinfectants, and especially those of Group 3, are proprietary preparations, the manufacturers keeping secret, for trade purposes, their method of manufacture and treatment, although making strong appeals for the use of a particular one in preference to all others. None of the preparations we have tested, according to our findings, has lived up to the reputation given to it by its proprietor. We wish to make it emphatic that we hold no brief for any manufacturer and that our sole object in mentioning any proprietary preparation is to stimulate interest in the surgical use of coal-tar disinfectants of a high coefficient in the hope that the proper authorities will provide the profession with at least one that is strictly ethical.

The following scheme of investigation was carried out at the German Hospital, service of Dr. Deaver, to whom we are indebted for the free use of surgical material.

Field of Operation.—When not contra-indicated, the field of operation was wet-shaved and the patient was given a warm tub bath the night before operation. During the day of operation, without further preparation, the field of operation was scraped with the mother-of-pearl strips, which were placed in bouillon and in liquefied agar which was plated. All culture tubes and Petri dishes were incubated at 37° C. for 48 hours.

Results.—All cultures showed a growth of staphylococci.

The field of operation was then surrounded by sterile sheets or towels and the part was rubbed for two minutes with gauze saturated with the solution being tested. The field was then washed off with sterile water or the solution was allowed to evaporate and scrapings were again taken with the pearl strips.

Result.—All cultures remained sterile.

A sterile dressing was then placed over the field and held in place by a sterile bandage. Thirty minutes later, the dressing was removed under aseptic precautions, the skin was moistened with sterile water and scrapings were again obtained with the pearl strips. These scrapings were taken to show whether or not bacteria had been brought to the surface of the skin from the deeper layers through the natural activity of the skin.

Results.—A total number of 446 of these various scrapings were obtained. With the exception of 38, all were returned sterile. Of the 38, one tube showed the presence of staphylococcus and 37 showed contamination. In the series of tests previously reported by one of us, but 2 out of 86 such scrapings remained sterile.

After the completion of an operation on a clean case, a small strip of the skin, including all layers, was removed just before the wound was closed, placed in bouillon and incubated at 37° C. for 72 hours.

Results.—Strips of skin from 117 patients cultured. Returned with no growth, 34; returned with growth, 83. Of the 83, 3 showed staphylococci, 1 streptococci, 58 large Gram positive cocci, 6 small Gram positive and negative cocci, 7 small Gram negative bacilli, 6 small positive and negative diplococci, and 2 sporulating bacteria. The laboratory reported that the majority of the growths were caused by contamination by non-pathogenic bacteria. The wounds of all but three of these cases healed aseptically. Of these three two were cases of acute appendicitis with some exudate and one was a myoma of the uterus in a patient with a very fat abdominal wall.

The Hands.—The hands and forearms were scrubbed with soap and hot running water, a bristle brush being used. The hands and forearms were then washed with the solution under consideration for

two minutes, a piece of sterile gauze being used to rub the skin. The hands were then thoroughly rinsed with sterile water and scrapings were taken with the pearl strip, the person being tested handling the strip himself, rolling it in the hands, scraping the skin, the nail-grooves and the under-surface of the free margin of the nails. The strips were imbedded in bouillon and incubated at 37° C. for hours.

Results.—All cultures were returned with no growth.

The hands were then incased in impervious, sterile rubber gloves. After the completion of an operation, the gloves were removed and similar scrapings were taken. The hands were again washed with soap and water, immersed in the solution, and again incased in rubber gloves. After each operation, scrapings were taken as before.

Results.—One hundred and forty-five scrapings were obtained, 96 were returned without growth, and 49 with growth. Of the 49, 5 showed staphylococci, in 3 and 2 successive cultures on different days. The laboratory reported that the growth in the other 44 cultures was due to contamination by non-pathogenic bacteria.

The hands were washed with soap and water for two minutes. Then 10 c.c. of a 24-hour culture of staphylococcus albus was thoroughly rubbed into the hands and allowed to dry. Scrapings were taken with the pearl strips and imbedded in bouillon and in liquefied agar which was plated.

Results.—All scrapings gave an abundant growth of the staphylococcus.

The hands were then treated with the solution under consideration, the solution was washed off with sterile water and scrapings were again taken and cultured.

Results.—Culture of sterile water before being used to remove solution, sterile. All culture of scrapings returned with no growth. Sterile water used in washing off the solution cultured and returned with no growth.

Same procedure on a different day, with immersion in the solution for 30 seconds, one minute, one and a half minutes, and two minutes. All cultures of scrapings returned with a growth of large Gram positive cocci, which the laboratory stated were positively not staphylococci.

Same tests repeated on third day, with same solution and technic throughout. All cultures returned with no growth.

Laboratory tests were made to show the germicidal properties of various agents and various solutions of them. This entailed an enormous amount of work and we wish to express our gratitude to Dr. Damon B. Pfeiffer, the Chief of the Laboratory, and to Dr. Carl

Becker, who so willingly and carefully made all of the laboratory tests for us. There were made 1174 cultures of the typhoid bacillus which had been subjected to the action of different strengths of 23 different agents or solutions for varying lengths of time. All were properly labelled and incubated at 37° C. for 48 or 72 hours.

Results.—Acetone has no germicidal power.

Alcohol in strengths varying from 40 per cent. to 95 per cent. destroyed the *B. typhosus* in less than 2½ minutes.

Acetone 40 parts and alcohol 60 parts destroyed the *B. typhosus* in less than 2½ minutes.

Acetone 40, alcohol 60, and liq. cresolis comp. 2 parts gave the same results.

Acetone 30, alcohol 65, liq. cresolis comp. 5 parts; acetone 40, alcohol 60, and crude carbolic acid 2 parts; acetone 40, alcohol 60, and pyxol 2 parts; acetone 35, alcohol 60, and creolin 5 parts; acetone 35, alcohol 63, and phenoco 2 parts, all destroyed the *B. typhosus* in less than 2½ minutes.

Liq. cresolis comp. gave a phenol coefficient of 2; creolin 1.5; pyxol, a proprietary disinfectant which the manufacturers claim to have a coefficient of 20, has a coefficient of 4, according to our laboratory reports.

Phenoco, another proprietary disinfectant with the manufacturer's claim of a coefficient of 15, has a coefficient of 9 according to our laboratory reports. Phenoco has been placed in New and Non-official Remedies, 1915, by the Council of Pharmacy of the American Medical Association.

As a result of these investigations, we would conclude that none of the various solutions used will destroy all germs of the skin in all instances, but that a solution consisting of acetone, alcohol, and one of the coal-tar disinfectants of a high phenol coefficient is more efficient than any other agent we have ever used for skin sterilization. In such a solution, the acetone (dimethylketone) acts as a solvent of the fatty or oily material of the skin and thus aids in exposing the bacteria to the germicides. The alcohol acts as a solvent; it has the power to penetrate into the cracks and crevices of the skin, as claimed by Braatz, through its ability to decompose and remove small particles of air that may be present; it is germicidal in solutions as weak as 30 per cent., according to Post and Nicoll, in solutions ranging from 40 per cent. to 95 per cent., according to our findings, with its strongest germicidal powers in solutions ranging from 60 per cent. to 70 per cent., according to Leedom-Greene; it also acts as a good vehicle. The coal-tar disin-

fectant that may be used acts simply as a powerful germicide, destroying all bacteria with which it comes in contact in a length of time varying with its coefficient and the degree of dilution.

The advantages of such a solution are many. Patients do not complain of any irritation following its use, although it causes a burning sensation when used on the scrotum. It does not stain the skin. It reduces to a minimum the time consumed in preparing the field of operation, and its method of application is the simplest. It may be used on a wet or dry skin, for emergencies or for cases where the consumption of time in preparing the patient is not of great moment. There is no exfoliation of the skin as is seen after the use of iodine, nor is there any blistering. It may replace all other solutions in sterilizing the hands, although its continuous use causes some irritation in some instances; in others, no effect is noticed; others say the application of the solution gives rise to a decided feeling of warmth. The solution may be used repeatedly, any collected detritus being removed by filtration.

To further hospital efficiency, to save time, to remove the danger of faulty technic in complicated methods, and to save expense, we would suggest that a solution consisting of 35 per cent. acetone, 1 or 2 per cent. of a coal-tar disinfectant of a high coefficient, preferably phenoco, with enough alcohol to make 100 per cent., would answer the purpose. The method of application consists in rubbing the field of operation for two minutes with a piece of gauze saturated with the solution after either a wet or dry shave. A warm, cleansing tub bath is, of course, always advisable when not contraindicated.

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